Title:

Spatial PREdiction of benthic HABitats in the Baltic Sea: incorporating anthropogenic pressures and economic evaluation

Acronym:

PREHAB

REVISED PROJECT PLAN 080926

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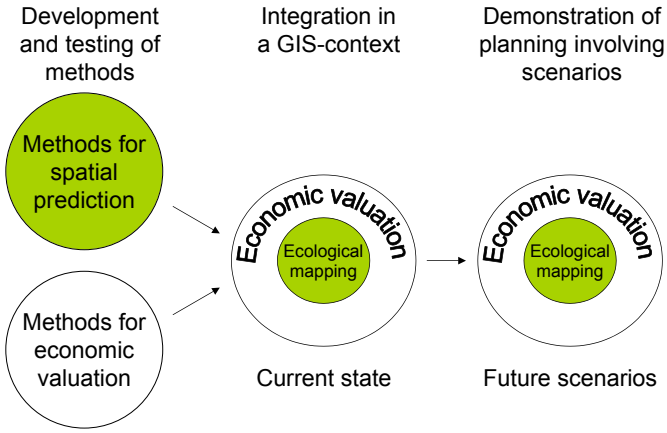

Figure. 1. Conceptual figure of the objectives of PREHAB.

1. Concept objectives and expected outcome of the project

Spatially explicit planning is an important component of future ecosystem-based approach to management of the Baltic environment (HELCOM 2007). While the need for spatial planning may be necessary at multiple administrative levels (from global to local), planning at levels corresponding to counties or municipalities is often most important in terms of legislation and community acceptance. To offer reliable options for management, planning at these scales need to be based on solid information about the spatial distribution of relevant biological properties of the system, quantitative knowledge about the effects of human pressures on these properties and estimates of the socioeconomic costs and benefits associated with different ecological values. The conceptual idea behind PREHAB is therefore to develop and integrate methods for ecological mapping and economic valuation and to apply these to a selection of Baltic coastal areas. Using a GIS-approach and information on responses of habitats, PREHAB will develop a framework for integrated regional planning and apply these to a set of scenarios for future options for management (Fig. 1).

In order to achieve these objectives and to deliver scientifically sound and user-friendly tools for regional planning in marine environments along the Baltic coastline, we propose a program structured in four scientific and workpackages (WP's), each corresponding to the conceptual components in figure 1, and one WP devoted to management and communication. Each WP will deliver specific outcomes, which are useful for future work within PREHAB or directly for stakeholders involved in regional planning in the Baltic. The overall objectives and outcomes of individual WP's are:

WP1: DATA- coordination, sampling and requirements *(WP-leader: ÅA)*
This WP will coordinate and deliver internal and external guidelines for how to optimise collection and compilation of data based on scientific and managerial criteria. This process involves identifying and reducing gaps in knowledge by collecting additional data in the field and from other sources.

WP2: Developing methods for spatial prediction *(WP-leader: KU)*
This WP will develop and deliver (a) recommendations for spatial prediction, (b) assessments of how human pressures can be used as quantitative or qualitative predictors and (c) maps of relevant biological properties. The guidelines will be based on criteria such as explanatory power, costs and predictive performance. Maps and knowledge about effects of human pressures will be used to define current ecological settings and scenarios to be used in subsequent WP's.

WP3: Developing tools for evaluation of goods & services *(WP-leader: HU)*
This WP will develop, test and apply practical and conceptual methods for valuation of ecosystem goods & services in a context of geographic information systems (GIS).

WP4 - Demonstrating methodologies for integrated assessment of regional scenarios *(WP-leader: GU)*
This WP will deliver routines for integrated assessment of planning scenarios. These will be based on methods and data developed in WP's 1, 2 and 3 and delivered as user-friendly tools accessible on the internet.

WP0 - Management and communication *(WP-leader: GU)*
This WP will coordinate and communicate internal work within the program, but also deliver solutions for communicating user input to and scientific output from PREHAB. The main tools for this will be meetings with the defined user-group, the interactive web-page and a stakeholder conference.

2. State of the art, theory and methods

The major scientific challenges of PREHAB centre around (1) developing methods for empirical modelling of benthic habitats, (2) developing methods for GIS-based valuation of ecosystem goods & services and (3) integration of ecological and economic predictions into realistic scenarios for planning. In order to meet these challenges and thereby to deliver useful knowledge and practices for the benefit of a sustainable use of the Baltic ecosystem, a range of sources information and approaches are necessary.

Modelling of benthic habitats. The benthic environment, with its high diversity of species and habitats, its productivity and its intensity of biogeochemical activity, is of fundamental ecological, economic and social importance. In the Baltic Sea Region and elsewhere the distributions of benthic species and habitats are typically variable at multiple spatial and temporal scales (e.g. Urban et al. 1987, Davey & Stockwell 1991, Holling 1992, Falandysz et al. 2000, Kautsky & Kautsky 2000, Mackey & Lindenmayer 2001). In a Baltic-wide perspective, i.e. from the Bothnian Bay in the north, to the Kattegat in the south-west, certain patterns and characteristics are particularly well documented and understood. For example, species diversity changes along horizontal and vertical gradients (e.g. Bonsdorff and Pearson 1999, Bonsdorff 2006). One important consequence of this is a horizontal gradient in the number fuctionally important species (Elmgren & Hill 1997, Laine 2003).

Models explaining these large-scale patterns in the open sea usually involve environmental factors such as salinity and substrate (e.g. Elmgren 1978, Bonsdorff & Pearson 1999, Laine 2003). In contrast, mechanistic explanations for small-scale benthic variability in coastal areas are less well understood. Because of large differences in coastal morphology among region, i.e. rocky and moraine coasts in Swedish and Finnish parts of the parts of the Bothnian Bay and Baltic proper vs. coasts dominated by sand on the south and eastern shores in Lithuania, Poland, Germany, Denmark and southern Sweden, small-scale diversity of habitats differ strongly among regions (Al-Hamdani & Reker 2007). Nevertheless, several studies indicate that environmental factors, such as substrate and exposure, are important mechanisms causing small-scale patterns in coastal benthic communities in the Baltic (e.g. Bonsdorff et al. 2003, Perus et al. 2007).

Thus, there are substantial evidence of qualitative and quantitative relationships between environmental factors and the structure and function of benthic assemblages in the Baltic and elsewhere. Because data on some environmental factors (e.g. bathymetry and exposures) can be estimated at high resolution and over large areas at low costs, a fundamental idea behind PREHAB is to formalise these relationships into quantitative, empirical models and to use these for spatial prediction and projection into the future. The wealth of emerging examples (e.g. Eastwood et al. 2006, Hewitt et al. 2004, Bryan & Metaxas 2007) suggests that such models do indeed provide a feasible alternative in marine habitats around the world (but see also some recent examples from the Baltic e.g. Bergström et al. 2007, Florin et al. 2008, Sandman et al. 2008). More importantly, because of the large costs associated with sampling benthic assemblages, it is clear that predictive models provide the only realistic approach for obtaining information at sufficient grain and cover necessary for marine spatial planning, let alone the task of estimating cover in future.

PREHAB will review and incorporate existing conceptual knowledge about ecological processes and effects of human pressures, into empirical models to predict the spatial distribution of benthic habitats in a set of case-study areas. The existing information involves data on environmental factors such as bathymetry (e.g. depth, slope and topographic complexity), wave-exposure, turbidity and biological variables such as vegetation cover, species composition of rocky and sediment assemblages and recruitment of fish. The resolution and completeness of existing data varies among case-study areas and variables. Available data will be assessed in an initial gap analysis and supplemented by new data in order to allow for the explicit comparisons outlined in section 11.

Evaluation of variables and techniques for predictive modelling in a Baltic-wide perspective is a central and substantial part of PREHAB (WP2 and more than 40% of the budget is devoted to this). A wide array of statistical techniques, with different purposes and data requirements, is available for fitting data and predictive modelling (Guisan & Zimmermann 2000). When data is available on the presence of a potential target variable (but not absences), methods such as geographic and climatic envelopes utilise multivariate methodology (e.g. ENFA) and machine learning (GARP) to predict the presences

and absences. These methods generally perform poorer than models based on data on presences and absences (Yamada et al. 2003). Nevertheles, modern methods based on data of presences only, (e.g. the maximum entropy principle, MAXENT) are able to fit more complex functions between the response and predictor variables, and generally outperform the other presence only methods (Leathwick et al 2006). When data is available on both presences and the absences of a target variable, a multitude of methods can be applied, including, generalized linear models (e.g. GLM, GAM, MARS), tree based methods (CART), machine learning methods (e.g. ANN), and Bayesian methods (Guisan & Zimmermann 2000, Leathwick et at. 2006). Based on the analyses in WP1, which will indicate: (1) the limitations of existing data, (2) the ecological and logical basis for using certain data and (3) the managerial usefulness of different target variables, a selection of these types of statistical approaches will be used to evaluate the specific tasks in WP2, to produce maps of present ecological distributions to be used in economic valuation in WP3 and those resulting from future scenarios in WP4.

One all-embracing theme in WP2 is to compare the performance of models in order to arrive at recommendations for cost-efficient and precise modelling practices to be used in spatial planning in the marine environment. The performance of an empirical model can be measured on the basis of several different methods and criteria. These involve the per cent correct classification of observations, its capacity to correctly identify presences or absences and the precision of quantitative predictions of continuous variables such as per cent cover, species diversity or abundance. In operational terms these aspects are compared and contrasted using the area under the curve (AUC) of a receiver operating characteristic (ROC) plot. Kappa statistics, the Boyce index or other measures derived from a confusion matrix (Fielding & Bell 1997, Hirzel et al. 2006). Predictions of abundance will be evaluated using the root mean squared error of predictions. Irrespective of which measure of performance that is used, there is an important philosophical distinction between using procedures for validation (or rather testing) of models based on internal vs. external data (Noren 2007). In many instances, internal validation provides the best available option, but critical tests of the performance of a predictive model, which incorporates errors due to sampling as well as temporal and spatial variability in the strength of predictive relationships, can only be achieved using independently sampled data. Comparisons of the performance of models for spatial prediction in WP2 will thus involve assessing models using independent data. This will ensure that the best models are used for mapping of goods & services in WP3 and future projections in WP4.

Ecosystem valuation. The marine environment provides a wide range of benefits for humans through ecosystem services, such as production of food and raw materials, regulation of gas, climate, and disturbances, along with cultural services (heritage, recreation, education, research, non-use) and overarching support services such as resilience and resistance and nutrient recycling. Moreover, there might be future unknown and speculative benefits (Nunes and van den Bergh 2001, Beaumont et al 2007, MEA 2008).

The conceptual definition of the economic value is the net present value of goods & services that flow from uses and non-uses of the resources and the environment. The total economic value consists of direct use value, indirect use value, and non-use value (Turner 2000). The interconnections between goods & services and inability to value all goods & services (e.g. the primary life support functions), however, make the estimation of the total value difficult (Spash and Vatn 2006) Two approaches have been used: to estimate either a single aggregated value of the environment (e.g. Costanza et al. 1997, Troy and Wilson 2006) or the values for each or as many services as possible without aggregating them (e.g. Wilson et al. 2005, Beaumont et al. 2008).

The value of ecosystem goods & services can be assessed through a range of environmental valuation methods. The revealed preference methods utilize market data directly or indirectly, while stated preference methods elicit the preferences through hypothetical market scenarios. These methods exploit the neo-classical economic framework according to which the utility-maximising individuals are willing to pay a certain amount of money for the environmental improvement, or, alternatively, to avoid the deterioration of the environment (Champ et al. 2003). In addition to the methods that assess the individual-level values to be aggregated to the population, a discourse-based group valuation method can be used to estimate the social value of ecosystem services (de Groot et al. 2002). The applicability

of method depends on the type of ecosystem service in question. For instance, for production and regulation services and some cultural services that are traded at certain market prices, direct market valuation may serve well along with indirect valuation methods: factor income, avoided cost and replacement cost methods, hedonic pricing, and travel cost method. For services not traded in the markets or holding non-use values, stated preference methods (contingent valuation and stated choice methods) are the only ones applicable (de Groot et al. 2002*,* Ledoux and Turner 2002).

Recently, the interest towards the use of value transfer methods (single value transfer, marginal value transfer, value function transfer, meta-analysis) has been growing (Ecological Economics 2006) The value estimates from existing 'source' studies are transferred to the target study area. The value transfer, however, might be subject to errors due to different contexts of the source and target locations. The scale of environmental change and the population affected by it, characteristics of population, policy context, and biological setting may be different (van Bueren and Bennett 2004, Spash and Vatn 2006*)* Also the lack of relevant studies available in valuation databases (e.g. EVRI, ENVALUE) may limit the use of value transfer methods. More research is needed about the transferability of values and the context-specific factors affecting the validity of transfer.

The collection of primary valuation with the most appropriate set of valuation methods data produces economic values for goods & services that are theoretically sound (Spash and Vatn 2006). By utilizing the general framework and typology of the ecosystem goods & services (de Groot et al. 2002, Beaumont et al. 2007), following good valuation practice, and producing the estimates that are adjustable for differences in characteristics of ecosystem, location and population, the estimates may well serve also as an input for future value transfers (Champ et al. 2003, Morrison and Bergland 2006, Loomis and Rosenberger 2006). The set of regional-specific valuation data collected from different locations in the Baltic Sea would serve as basis for exploring the context-specific factors affecting valuation, and the potential and the success of value transfer across the Baltic locations. Also the comparison of the estimates based on the primary data with estimates from the existing data, especially the studies conducted within the Baltic Sea (e.g. Söderqvist et al. 2005, Beaumont et al. 2007), tests the transferability of values.

Scenario planning in Baltic regions. The ecosystem goods & services concept integrates the social, economic and environmental pressures as required by the Ecosystem Approach (MEA 2008). The integrated assessment considers interactions of ecological aspects and human pressures, translated into monetary terms through the concept of ecosystem goods & services (Wilson et al. 2005).

The scenarios summarise the changes in economic and social pressures and ecological impacts on habitats and the associated goods & services resulting from alternative management options. For the assessment of impacts of changes in pressures the potential future trends are specified. The scenarios fall in categories, such as the business-as-usual (a projection of the current rate of development), the policy target (the full implementation of management policies), and the domination of conservation interests (Eurocat 2008)

The mapping of ecosystem goods & services and the associated economic values to habitats (Rönnbäck et al. 2007, Wilson et al. 2005) in GIS context allows for scenario assessment that accounts for spatial distribution of habitats (Costanza et al. 1997, Troy and Wilson 2006, Snickars and Pitkänen 2007). The incorporation of GIS and economic valuation into the framework of integrated assessment assists the decision makers in planning the management of marine environment such that the delivery of value to the society is maximised (Troy and Wilson 2006)

3. Innovation and new approaches

A systematic approach to spatial prediction in Baltic environments. Empirical models for spatial prediction provides the only conceivable method to obtain biological information with sufficient resolution at scales relevant for regional planning. This conclusion is founded on logical and economic arguments and on the observation that there is currently a large number of individual modelling efforts going on in the Baltic and other coastal regions. The PREHAB initiative is the first attempt to systematically assess the scope and limitations of predictive habitat modelling in the Baltic environment. Clearly, such a systematic approach has the potential to contribute to a more efficient use of sampling

and modelling resources and, in particular, achieve more reliable routines for spatial planning in the Baltic region (HELCOM 2007).

Combining the concepts of habitat modelling and scenarios planning by incorporating human pressures. The use of scenarios is a powerful way of assessing the response of complex systems to a range of options for management. Ideally, such scenarios summarise the ecological impacts on habitats of the changes in economic and social pressure indicators providing easily comprehensible models, which are accessible to a wide range of stakeholders. The use of idealised maps is a particularly powerful tool in the development and communication for such scenarios. By developing routines for mapping and economic valuation approaches in a GIS-context, and by using these models to construct empirically based scenarios, PREHAB will make important contributions to the planning process. One component, which is critical for the success of this scheme, is the incorporation of knowledge about the impacts of potential human pressures, which include physical construction and habitat modification, recreation, changes in land-use and shipping among others. By quantifying the ecological impacts of these pressures and incorporating them into models for spatial prediction, effects of future changes to that pressure may be modelled and incorporated into scenarios. Using this strategy, PREHAB will be able to make predictions about effects of future development and demonstrate how scenarios can be used in the planning process.

Monetary evaluation of goods & services in a GIS-perspective. Tools for evaluation of economic and societal effects of different options for management are very valuable in any planning process. Even though there are examples from regional planning, estimates of the value of goods & services are mostly available at national or global scales. One important innovation of PREHAB is to provide theoretically sound value estimates for ecosystem goods & services at the regional scale. Combining modern methods for economic valuation with the best available practices for ecological mapping in GIS is extremely useful in order to achieve quantitative estimates for potential management plans and scenarios, and it will expand the use of economic valuation in the regional planning process. Previously, GIS framework has been applied in terrestrial environment, and PREHAB will apply it in the marine environment. PREHAB will apply a conceptual model and produce a few specific case-studies from the marine environment as examples of how multi-disciplinary planning may be achieved. In particular, the combination with the scenarios, this work has the potential to provide scientifically rigorous and user-friendly tools for stakeholders involved in decision- and policy-making in the Baltic region.

4. Themes and key research issues of the BONUS-169 Science Plan. Relevance for management of the Baltic

In order to optimise economic and ecological benefits and to promote sustainable use of regional resources in the Baltic region, decisions about managerial actions need to be based on the best available scientific information. Marine spatial planning in combination with scenario planning have fundamental roles for implementing the ecosystem based approach to management, and for incorporating scientific knowledge about the distribution of biological resources and their associated goods & services into the decision process. In particular, the use of GIS and the combination of layers representing the geographic distribution of different ecological properties, socioeconomic values, human pressures etc. is a powerful tool for identifying conflicts of interest, negotiating solutions and promoting participation among various types of stakeholders.

The process of spatial planning can, however, only deliver solutions, which are optimal with respect to ecological and socioeconomic criteria, if they are based on robust scientific knowledge about the spatial distribution of biological properties and their economic values. Today, such knowledge is rarely available. Information on ecological properties is usually very incomplete and spatially and temporally scattered and socioeconomic values are seldom assessed at relevant landscape scales. Therefore, the main tasks of PREHAB are: (1) to develop methods for empirical, spatial modelling, which can be used to integrate information and reliably predict biological properties in the geographic context necessary for spatial planning; (2) to develop methods for economic evaluation of marine landscapes and (3) to use these tools to evaluate consequences of future changes using different scenarios of human pressures. We believe that the development of such methods are essential for achieving the central aims of

the BONUS+ call, in particular themes focussing on "Links between science and Policy" and "Integrating Ecosystem and Society".

Theme 1: Linking Science and policy. The ecosystem approach is an emerging and important success factor for managing the Baltic. This requires knowledge about the spatial distribution, relative importance of and links among different components of the system as well as ecosystem-level assessments of human impacts on the Baltic Sea biological systems. Predictive modelling and subsequent implementation in maps using GIS, provides the only economically feasible alternative for obtaining comprehensive data with sufficient detail for such purposes. Importantly, such maps are invaluable tools for communicating data to managers, political levels and the general public. By developing methods for scientifically credible, cost-effective and easily communicated models, and by invoking human pressures and estimates of economic benefits, PREHAB will make important contributions to linking science and policy under the development of an ecosystem based management.

Theme 2: Climate change. PREHAB will contribute to this theme through several key research issues. Using aspects of coastal bathymetry, geology, hydrography and human pressures for predictive purposes will deepen the understanding of regional and sub-regional geophysical forcing on biological properties of habitats. Furthermore, climate change is usually perceived as acting on large spatial scales, but nevertheless its effects may also be manifested at local and regional scales. Therefore, methods for spatial modelling and mapping of habitats may potentially provide important tools for designing cost-efficient strategies for monitoring of environmental change and evaluating overall ecological and socioeconomic consequences under different scenarios of climate change.

Theme 3: Combating eutrophication. PREHAB will contribute to this theme by providing frameworks for improving strategies for regional-scale surveillance, assessment and management of marine habitats. Reliable predictive tools will be useful in evaluating and pinpointing potentially vulnerable areas and how effects of increased or decreased eutrophication will change the distribution and quality of specific benthic habitats.

Theme 4: Achieving sustainable fisheries. PREHAB will contribute to improving the scientific basis for implementing the ecosystem approach to fisheries management by developing tools for efficient mapping of essential fish habitats, such as spawning and nursery areas. The essential fish habitat maps produced within PREHAB will be directly fed into fisheries management, to be used in work towards protection of essential habitats and reduction of bycatches. Another tool for an ecosystem based management, aiding in quantifying the ecological consequences of human activities, will be developed by combining predictive modelling with models describing the relationship between habitat quantity/quality and fish stock size. Using this method it is possible to translate the effects of habitat degradation, for example through physical exploitation and eutrophication, to economic terms.

Theme 5: Protecting biodiversity. Maintaining the diversity of species, habitats and ecological functions, are fundamental aims for strategies and policies promoting sustainable use of coastal areas. Lack of spatially explicit and comprehensive information about biodiversity is a major obstacle for regional scale planning, and complete inventories is not economically feasible. The methods developed within PREHAB will not only provide scientifically based routines for how to synthesise and use available and new data, they will also provide tools for evaluating socioeconomic costs and benefits following certain managerial decisions and environmental impacts. In particular the tight link from spatial predictions to GIS-based mapping will ensure that the tools developed within PREHAB are readily applied in the practical management of resources and risks. Last but not least, the communicational and educational power of using maps in interactions among the stakeholders including the general public, cannot be overrated. The maps provide an invaluable tool for establishing a common description of ecological features and known pressures (se also theme 7).

Theme 6: Preventing pollution. The methods developed within PREHAB will improve the knowledge about the geographic distributions of ecological and socioeconomic values. Such information is instrumental for managing risks and preventing damages in the event of accidents, such as oil spills.

Theme 7: Integrating ecosystem and society. PREHAB will contribute to this theme through several key research issues, which are directly related to the two main tasks. The methods developed for predictive modelling will be directly helpful in developing the scientific basis for improving governance of the

Baltic Sea ecosystem. As described before, maps of biological and socioeconomic values developed from predictive models, is an extremely efficient platform for exchange of information and participation in the planning process. In particular, the integration of economic valuation into the planning process will be useful for demonstrating socioeconomic costs and benefits of various managerial options, including conserving, protecting and restoring the Baltic ecosystem.

5. Contribution to deliverables of the BONUS-169 Science Plan.

The work planned within PREHAB directly addresses most of the deliverables under "Linking science and policy" and "Large scale ecosystem threats and changes including responses and mitigation". Spatial modeling methods will be developed and best practice recommendations for habitat modeling produced. Tools will be developed that are designed to predict the effects of human-induced changes of the environment on habitat distribution. By coupling these tools to economic valuations of ecosystem goods & services, the relative costs and benefits of different management scenarios relating to eutrophication, climate change and direct physical exploitation of benthic habitats can be explored. The outputs of these tools are maps and simple economic cost-benefit analyses, both of which are very straight-forward ways of condensing and communicating scientific results to managers and policy makers. Some of the end-products of PREHAB can directly be adopted as decision support tools in marine management, while others will lay the groundwork for development of future management tools.

Habitat maps constitute one of the corner stones for integrating biological information with socioeconomics in marine spatial management. Therefore PREHAB will directly contribute to the promotion of the related concepts of "Ecosystem Approach to Management", "Integrated Coastal Zone Management" and "Marine Spatial Planning". The program is truly cross-sectorial as the tools to be constructed integrate methods from several disciplines, as for example geological, hydrographical and socio-geographical information is integrated in the biological models, which in turn are coupled to socio-economic models. There is also potential for bridging gaps between currently conflicting marine interests. For example, by quantitatively studying the importance of habitat availability for fish production, shared interests between the nature conservation and fisheries sectors may potentially be found. The PREHAB work includes partners from three different countries, with access to data from a diverse set of Baltic areas (from Swedish parts of the Kattegat, via Lithuanian parts of the southern Baltic Proper, to the Finnish-Swedish archipelago region of the northern Baltic Proper). Thereby the partners will be able to evaluate the Baltic-wide generality of any recommendations regarding spatial modeling (e.g. scales, predictor variables, predictive power of human pressures and modeling approaches) and economic evaluation (e.g. effects of different scenarios). Conversely, any features that are specific to particular regions and habitats will also be identified and incorporated to achieve robust recommendations.

The regional approach adopted in the project plan and the appointment of the group of end-users ensures that general recommendations can be extended to other countries than those directly involved as partners in the project. Besides scientific publication, the results from PREHAB will also be fed into the work of marine management authorities as well as into the advisory work of relevant ICES and HELCOM working groups, both through the group of end-users or through the appointments of the project partners. The planned outputs of PREHAB are well in line with the prioritized research themes identified both in the HELCOM action plan and in the draft ICES science plan.

The project will contribute to "Strengthening collaboration and use of common resources" by building competence networks in the area of spatial predictive modeling and environmental scenario analysis. Data and results from the project will be openly accessible and actively communicated towards end-users within management and policy making. This will ensure efficient use of research funding and will hopefully accelerate the work towards developing tools for implementing a sustainable, regionally integrated, management of the Baltic Sea.

6. Dissemination plan

The fundamental drivers behind PREHAB are to develop methods and knowledge for predictive capacity in a scientific context and to develop tools, which make these developments accessible to users in need. The dissemination of the results of this work to the scientific community is fairly straightfor-

ward and involves traditional procedures, such as publication in peer-reviewed journals and presentations at scientific conferences. The dissemination of results to prospective users and other stakeholders is more demanding and requires (1) that particular care is taken to meet the needs of the users and (2) that a clear strategy is adopted for communicating the results.

In order to meet these requirements, PREHAB will devote special effort into developing tools, which are user-friendly, cost-efficient, accessible and Baltic-wide in scope. This will be achieved primarily by three different mechanisms. First, the organisation of the program contains a specially assembled group of users representing important planning authorities in the Baltic region (Fig. 2). In this group, nations which are not regular partners within PREHAB, international organisations and NGO's will also be represented. Throughout the course of the program, this group will have the specific task to promote the user perspective and to ensure that tools developed within PREHAB are not to narrow geographically. The user-group also provides a direct pathway into relevant planning authorities and is therefore a potentially important mechanism for dissemination.

Second, to ensure full accessibility to all potential users, PREHAB will deliver a web-based resource, which will be used to communicate important recommendations, tools and findings in a user-friendly way. Previous experiences with similar resources, e.g. www.marbipp.se and www.mare.su.se, provide excellent examples of the usefulness of such initiatives for various types of stakeholders. The web-site will be constructed and initiated at the start of the program by a professional, subcontracted web-designer using state-of-the art database approaches which allows continuous updating and possibilities for internal and external interactions. The database will be completed and presented at the end of the program. The main purposes of the web-site will be to:

A. *Present the program to the general public.* Considering the increased use of predictive models, economic valuation and environmental scenarios, combined with the need for increased public participation in future planning processes, the general understanding of these activities will be increasingly important.
B. *Present recommendations and tools to professional users.* Scientific outcomes, their practical implications and applications will be presented. These presentations will designed as practical, interactive manuals and demonstrations using case-studies from PREHAB.
C. Provide a *platform for internal communication* and reporting within the program.

After completion, the web-site will be located at any server that the BONUS-organisations finds suitable. There will be no additional costs for maintenance after the program period. Finally, results from PREHAB will also be disseminated directly to various types of users. This will be achieved by direct, electronic communication to relevant stakeholders identified by the consortium and the user-group.

7. Participants and management of the project.

In order to achieve effective management of the program, PREHAB has a number of specific functions and structures dedicated to this task (Fig. 2).

- The steering group consists of the principal scientists from all partners. This group will make strategic decisions about scientific and managerial priorities for PREHAB. The group will be chaired by the coordinator (GU) and will meet at least twice a year.
- WP0 is specifically constructed to manage internal and external communication, organise meetings, coordinate efforts among scientific WP's and make sure check the completion of scientific tasks and that deliverables are fulfilled. This WP is also responsible for communication with and specifying tasks to be delivered by the sub-contracted web-designer. WP0 consists of the coordinator and a part-time (20%) research secretary.
- The coordinator associate professor Mats Lindegarth (GU) has currently a part-time position as environmental coordinator at GU, he has extensive and up-to-date insights in coastal zone management, planning and the "end-users' perspective". Although, this would be the first time he coordinates an international program of this size, he has extensive experience in project-management and as a work-package leader in the EU FP6 programme, FLOWMART and the Swedish national programme on marine biodiversity, MARBIPP. The hosting institute, Department of Marine Ecology,

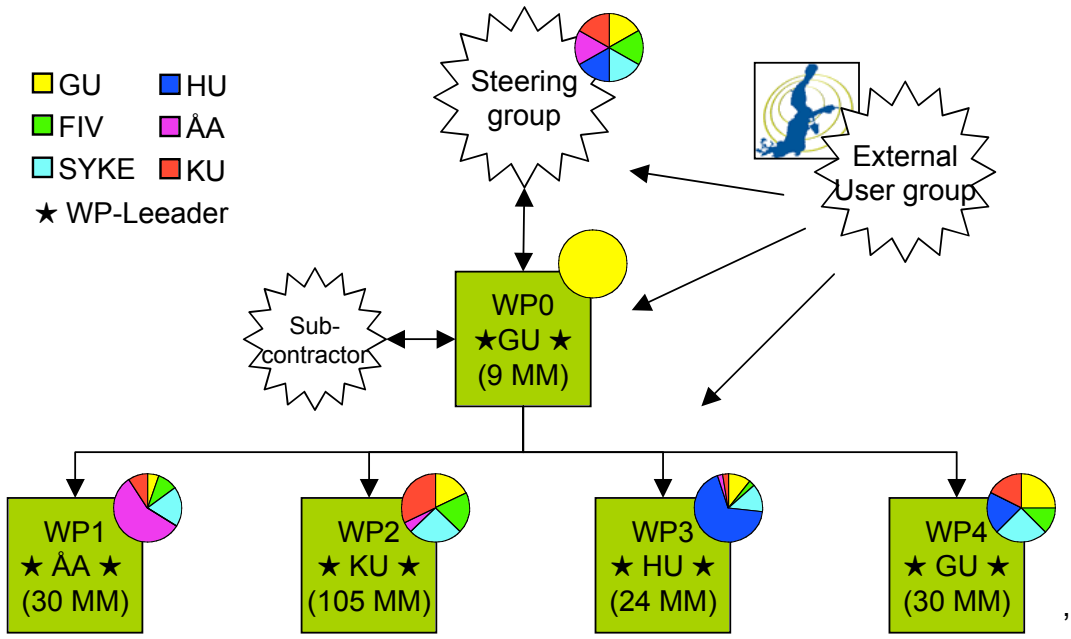

Figure. 2. Management structure, allocation of resources to WP's, responsibilities and proportional contributions of partners within PREHAB (see section 11 for responsibilities and resources individual tasks).

and the University of Gothenburg has a well-functioning system of support for project management and extensive experience in coordinating national and international programs in research and development.

- WP-leaders are assigned to all WP's. The leaders coordinate the work within WP's and the communication to WP0 and steering committee.
- Task leaders are assigned to all tasks. The task leaders have a particular role in coordinating Baltic-wide comparisons and syntheses of specific scientific tasks.

PREHAB attempts to bridge the gap between ecological science, environmental economics and practical coastal zone management. In order to ensure that the program is on par with the needs and priorities of practical management we have also assembled an external group of users. The exact composition of all participants of this group is not yet determined. Members that currently have accepted participation are Cecilia Lindblad of the Swedish EPA and Johnny Reker of The Danish Spatial and Environmental Planning Agency. The size of this group will be 3 people.

To solve the scientific tasks we have assembled a consortium of four universities with a solid expertise in marine ecology, fishery science, statistical modelling, GIS, environmental and resource economics coupled with two national authorities involved in practical management of marine resources at national and international levels: University of Gothenburg (GU), Åbo Akademi University (ÅA), The Swedish Board f Fisheries (FIV), Klaipeda University (KU), Finnish Environment institute (SYKE) and University of Helsinki (HU). Three partners (FIV, KU and SYKE) have previously collaborated successfully on predictive modelling in the Baltic (BALANCE). With the addition of new partners to the constellation PREHAB can now take further steps ahead by invoking economic evaluation, human pressures and an explicit Baltic-wide perspective. The scientific fields of competence and excellence of the individual partners and principal scientists have previously been described in preproposal and their academic excellence are evident from the individual Forms B. These are not elaborated further here.

8. Overall budget

The distribution of costs and in kind contributions are summarised in Table 1 (for details see individual budgets of in the partners' FORM B). Travels are calculated to cover participation in two BONUS+-meetings per year for the Principal Scientist, and one PREHAB-project meeting per year for two representatives from each organisation. The allocation of costs and manmonths (MM's, including in kind contributions) are shown in figure 2.

Table 1. Allocation of costs and in kind contributions of individual partners of PREHAB.

Type	GU	FIV	SYKE	HU	ÅA	KU
Personnel costs (€)	156234.42	112046	98800	114000	77500	69500
Manmonths (months)	24	25	28	26	20	46
Consumables (€)	1000	3000	10000	20000	3000	9140
Travel costs (€)	30000	9000	5200	14000	7650	15000
Equipment (€)	3000	0	0	0	5000	21500
Other costs (€)	0	0	0	0	0	12000
Subtotal (€)	190234.42	124046	136800	114000	93150	127140
Overhead (€)	66582.047	18607	17100	14250	11645	11980
Subcontracting (€)	6815	0	0	0	0	0
Total costs (€)	263631	142653	153900	128250	104795	139120
In kind contributions						
Manmonths (months)	10	0	11	2	9	0
Personnel costs (€)	83927.581	0	47666.667	7600	34818.75	0

The proportional allocation of MM's is 5, 15, 53, 12 and 15% respectively for WP's 0-4. Allocation of MM's to individual tasks is presented in section 11. Note that the relative increase in allocation to WP2 from WP1 is caused by moving and merging one task.

9. Significant facilities and large equipment

The members of the PREHAB-consortium are all part of major organisations involved in marine research and management within their respective countries. Therefore, the infrastructural facilities necessary to achieve the objectives of PREHAB are all available to the consortium. This includes research vessels and possibilities to host a possible multidisciplinary training course (see section 10). Equipment included in the application cover computer soft- and hardware necessary for spatial prediction, mapping and video-processing.

10. Research exchange and training

The integrated structure of PREHAB, where all partners are involved in practically all scientific WP's and in the steering committee, necessitates continuous exchange of scientific expertise, ideas and data within the program (Fig. 2). In particular, the shared responsibilities of WP's which is built in by the assignment of task-leadership ensures that collaboration is continuous and not just happens during the yearly workshops. In summary, mechanisms of scientific exchange are primarily integrated coordinated efforts on scientific and applied tasks and presentations and discussions at yearly workshops.

Furthermore, the composition of the PREHAB consortium ensures that this exchange will be multinational and multidisciplinary. In particular, the multidisciplinary dimension opens interesting prospects for fruitful collaboration and integration among disciplines. We believe that this aspect is a fundamental requirement for sustainable management in line with government declarations and international agreements. To this end we are willing and able to organize an international course for PhD-students. The major elements of the course would highlight the following themes:

- National and international policy-documents relevant for the Baltic region.
- Tools for spatial planning
- An introduction to spatial modeling and mapping involving GIS
- Economic valuation
- Scenario planning

The diversity of topics in such a course obviously means that the treatment will be introductory. Nevertheless, we believe that the demand for this kind of multidisciplinary competence is great both in research and society. Note, however, that the resources necessary for such a course is not covered by the present application but have to be added to the funding.

11. Detailed work plan

The overall objectives and expected outcomes of the program and the individual WP's are described in section 1. Here we describe specific objectives, deliverables, resources and responsibilities of individual tasks.

WP1: DATA- coordination, sampling and requirements

Task 1.1: Review, compilation and gap-analysis of existing biological and environmental data	
Description	Available biological and environmental data at from all case-studies will be reviewed and summarised.
Importance	In order to fulfil scientific and applied aims of the project (e.g. allow comparison among types of predictors and methods) it is necessary that data are comparable among case-studies. For the same reason, important gaps in knowledge need to be identified so that additional data can be collected (see also task 1.5). This includes identifying needs for independent data for validation.
Deliverables	Matrices of metadata from all case-study areas which will form the basis for decisions about complementary sampling and detailed decisions about the scope for modelling tasks in WP2.
Resources	5 MM
Task-leader	ÅA

Task 1.2: Identify and evaluate criteria for selection of predictor and response variables in empirical modelling of Baltic benthic habitats	
Description	Analyses of existing evidence for mechanistic and / or correlative relationships between biological features and environmental factors. Analyses will take into account management needs and constraints and be based on interaction with end-users.
Importance	The precision and accuracy of predictive models depend on the explanatory power of empirical relationships (fit) and the precision of estimates (standard errors). Clearly these properties differ among variables and therefore the success of predictive models will differ among combinations of predictors and responses. In particular, the selection of variables needs to incorporate the best available qualitative and quantitative knowledge about mechanistic and empirical relationships among response and predictor variables. This will ensure that methods for spatial prediction developed within PREHAB are scientifically sound, cost-efficient and useful tools for management.
Deliverables	Review of literature on the importance of different types of predictors and predictability of different biological aspects of keynote or focal species in the Baltic region. Predictors and response variables will be classified with respect to usefulness and feasibility in a management perspective. Matrices of metadata from all case-study areas which will form the basis for decisions about complementary sampling and detailed decisions about the scope for modelling tasks in WP2.
Resources	15 MM
Task-leader	ÅA

Task 1.3: Complementary sampling of biological and environmental data for modelling for development and validation of the models	
Description	Collection of new biological and environmental data as revealed from the gap-analyses in Task 1.1. Data will be used for development and validation of selected models.
Importance	In order to achieve reliable models for spatial predictions it is important that models are based on representative data sampled at appropriate scales and that the predictive power of models are tested (validated) using independent (external) data. In order to test particular, the need for validation means that new data need to be collected.
Deliverables	Complementary data for modelling and validation. To be used in WP2.
Resources	10 MM

Task-leader	ÅA

WP2: Developing methods for spatial prediction

Task 2.1: Theoretical and empirical analyses of scale-dependent performance of predictive habitat models using success criteria, such as explanatory power, costs and precision	
Description	Theoretical analyses using simulated (MATLAB) sampling efforts on a range of realistic patterns of distribution and empirical analyses of existing multi-scale data.
Importance	Explanatory power, precision and costs of predictive models are dependent on the spatial resolution (grain) and scope (extent) of the model. This is a direct, logical consequence of the scale-dependence of ecological processes and patterns. Therefore, knowledge about the performance of predictive models at varying resolution and scope is fundamental for optimising future modelling and sampling. Simulation of different combinations of resolution and scope based on observed patterns of distribution for different types of predictor- and response-variables, in different parts of the Baltic region is a realistic way to obtain such knowledge and produce necessary recommendations on this issue.
Deliverables	Analyses of and recommendations for efficient scales for sampling and predictive modelling in the Baltic region. To be used as a basis for modelling in tasks 2.2. – 2.5. and as direct recommendations for users and to the scientific community.
Resources	10 MM
Task-leader	GU

Task 2.2: Comparison and Baltic-wide synthesis of the performance of different techniques for modelling of benthic habitats	
Description	Empirical comparisons of different statistical techniques for spatial prediction. Comparisons will focus on a few classes of methodologies and apply these to existing data from all case-study areas. Analyses need to emphasize general as well as site-specific properties.
Importance	The number of methods for spatial prediction is large and increasing. These developments involve invention of new statistical approaches for fitting response- to predictor variables, methods for model selection, methods for internal and external validation and indices of model performance. The diversity in approaches and variants of methods is a sign of the great difficulties and need for predictive capacity both from a scientific and applied perspective. Nevertheless, one interesting challenge is to evaluate the robustness and generality of different families of approaches in a Baltic-wide perspective. This involves opening for the possibility that different methods are more suitable than others for some types of variables. Such a comprehensive analysis will be an important tool for formulating the sampling modelling approaches in future mapping efforts in the Baltic.
Deliverables	General and specific recommendations for statistical approaches to habitat modelling in the Baltic region. Deliverables to be disseminated to users and to the scientific community.
Resources	25 MM
Task-leader	KU

Task 2.3: Comparison and Baltic-wide synthesis of the performance of different kinds of environmental predictors for modelling of benthic habitats	
Description	Empirical comparisons of the performance different types of predictors using existing and new data from all case-study areas. Analyses need to emphasize general as well as site-specific properties and involve criteria accounting for

	scientific and managerial aspects (see also tasks 1.2 and 1.3).
Importance	Because the effects of different ecological processes on spatial and temporal patterns of benthic habitat vary, environmental variables directly or indirectly associated with these processes will have varying efficiency and predictive power. The choices made *a priori* about which environmental variables to measure and to use for modelling sets limits to the success and the practical usefulness of any predictive model. This also includes decisions about the quality of data (e.g. resolution of bathymetric data). In combination with the scientific review of existing evidence for qualitative and quantitative relationships between patterns and processes, this task will provide an important empirical evaluation of the efficiency of these variables in a practical, quantitative context.
Deliverables	General and specific recommendations about the merits of certain types and qualities of predictor variables. These will be based on mechanistic information from task 1.2 and empirical results from this task.
Resources	25 MM
Task-leader	KU

Task 2.4: Comparison and Baltic-wide synthesis of predictability of different types of response variables	
Description	Empirical comparisons of the predictability of different types of response variables using existing and new data from all case-study areas. Analyses will involve criteria accounting for scientific and managerial aspects (see also tasks 1.2 and 1.3).
Importance	While tasks 1.2 and 1.3 identifies candidate targets for spatial prediction and mapping from scientific criteria, this task will provide a quantitative analysis of which biological aspects actually lend themselves to practical mapping in an empirical context. The overall objective is to coordinate and compare modelling efforts going on in the different case-study areas. This will result in a comprehensive synthesis where existing general patterns and inconsistencies in predictability among areas can be identified.
Deliverables	General and specific recommendations about the predictability of biological aspects, such as presence and cover of vegetation, abundace and occurrence of keynote or focal species, diversity, EUNIS-habitats etc.. Deliverables to be disseminated to users and to the scientific community.
Resources	25 MM
Task-leader	SYKE

Task 2.5: Quantitative assessment of selected human pressures and their capacity as predictors of benthic habitats	
Description	Information on the past and present intensity of selected human pressures will be collected from one example area. Effects of these pressures on benthic habitats will be assessed from empirical models and other available sources of information. Selected models will be used for mapping the distribution of habitats in subsequent formulation of scenarios.
Importance	One important success factor for management and conservation is the ability to predict the impacts of recent and projected human pressures. By quantifying and assessing human pressures as predictors in empirical models, PREHAB introduces a possibility to (1) quantify and test the responses to human pressures and (2) model ecological and economic effects of future management of coastal habitats. Using this strategy, impacts are assessed in a quantitative manner and accounting for effects of and interactions with other environmental factors. Such empirical, statistical modelling can also serve as a framework for assessing the statistical power and uncertainty of conclusions

	about the effects of these pressures. In combination with estimated impacts from the literature, this provides a possibility to project responses to future pressures in a regional GIS-context, using a precautionary approach even in the absence of a strong response in the PREHAB case-studies. Whichever the result will be, these possibilities provide an essential foundation for construction and evaluation of scenarios in WP4. This involves mapping of certain scenarios in agreement with decisions made in task 4.1.
Deliverables	Estimates of responses of habitats to human pressures. Production of maps to be used in WP4.
Resources	20 MM
Task-leader	FIV and SYKE

WP3: Developing tools for evaluation of goods & services

Task 3.1: Review and compilation of existing data on values of benthic habitats and associated goods & services	
Description	Available value estimates for ecosystem goods & services from the existing studies will be reviewed
Importance	Compilation of existing information on values of ecosystem goods & services forms the basis for region-specific valuation in Task 3.3. Identification of which goods & services have been valued in which contexts and of potential shortages in availability of existing value estimates, and the assessment of validity of the use of values transferred from studies that are conducted in different contexts are necessary for reasonable collection of new data.
Deliverables	Database of estimated values of ecosystem goods & services, recommendations for collection of region-specific valuation data in Task 3.3.
Resources	4 MM
Task-leader	HU

Task 3.2: Mapping of goods & services provided by the current state of habitats using existing and new data	
Description	Mapping of goods & services to habitats in study areas
Importance	Existing and new data of habitat distribution in study areas are used to map goods & services to habitats in the study areas. This forms the basis for region-specific valuation data collection in Task 3.3 and evaluation of scenarios in WP4.
Deliverables	List and map of goods & services provided by habitats and their distribution in study areas
Resources	5 MM
Task-leader	FIV and SYKE

Task 3.3: Collection and analysis of new valuation data for 2 case-study areas and test for transferability of values between Baltic Sea regions	
Description	Using the most appropriate valuation method(s) new valuation data from selected study areas will be collected and analysed. Test for transferability of values between Baltic Sea regions.
Importance	Based on recommendations from literature review in Task 3.1, knowledge on goods & services produced in study areas based on mapping in Task 3.2, and effect of potential future scenarios on distribution of habitats as specified in Task 4.1, new valuation data will be collected from selected study areas. This new data collected on the regional scale will be free from errors that value transfer may involve and enables the examination of transferability of values between the study areas. The test of transferability and the comparison of regional-specific values from this task with value estimates from existing studies reviewed in Task 3.1 will reveal the context-specific aspects affecting the value

	of goods & services. This information is useful for the future use of values for goods & services.
Deliverables	Value estimates for goods & services, assessment of transferability of ecosystem values between Baltic Sea regions
Resources	15 MM
Task-leader	HU

WP4: Demonstrating methodologies for integrated assessment of regional scenarios

Task 4.1: Specification and integrated assessment of scenarios in a selected case-study area	
Description	Ecological and economic consequences of scenarios will be defined and evaluated in one case-study area.
Importance	The use of scenarios is an important tool in integrated assessment of ecological, social and economic aspects of management options. The change in human pressures results in the change in habitat distribution that in turn affects value of goods & services provided by habitats. The definition of scenarios will be based on information on levels and rates of change in human pressures and on estimates of responses of benthic habitats to human pressures from task 2.5, and face the real policy context. The scenarios will fall in a few categories, such as projections using current rates of development, perfect implementation of management policies and full dominance of conservation interests and precautionary principles. By combining the produced valuation estimates with the predicted changes in habitats and ecosystems services, the chosen scenarios are analyzed at length. The integrated analysis provides a characterization of the extent and value of changes in ecosystem services. It demonstrates how human pressures on ecosystem show up in ecological and economic terms and helps to relate these ecological values to economic costs of changing relaxing pressures.
Deliverables	Integrated ecological-economic assessment of changes in ecosystem services due to human pressures. To be used as a basis for production of user-friendly tools and recommendations in task 4.2.
Resources	20 MM
Task-leader	GU and HU

Task 4.2: Developing a framework for integrated assessment	
Description	Development of a framework for integrated assessment, which will be made accessible on the PREHAB web-site.
Importance	A key task of the project is to provide an intuitive and user friendly framework that can be applied in regional planning. The approaches chosen and results obtained in the project will be critically evaluated from the viewpoint of planning. Drawing on this, a stylized and simple approach and framework is suggested for potential users in the Baltic Sea. The framework will be based on experiences from different parts of the Baltic and will be made accessible on the to stakeholders in the whole Baltic region.
Deliverables	A generic framework for integrated planning in Baltic coastal regions.
Resources	10 MM
Task-leader	FIV and GU

WP0: Management and communication

Task 0.1: Check on deliverables and milestones, and report to the steering committee 0.2: Organise internal communication and meetings within PREHAB 0.3: Organise outreach activities and communication with end-users 0.4: Produce and maintain web-site for internal and external use	
Description and	Detailed accounts of management structure and communication (dis-

importance	semination) are given in sections 6 and 7, and are not further elaborated here.
Resources	9 MM
Task-leader	GU

12. Time table

Detailed timing of WP's, tasks and events planned within PREHAB are shown in figure 3.

13. Data management

Important parts of the work within PREHAB consist of comparing and synthesing results based on analyses of existing and new data from four Baltic areas. Thus one important objective of WP1 is to summarise meta-databases on predictor and response variables available in the different areas. In this process harmonisation and intercalibration of datasets collected using different standards will constitute an important part of the data management (Bergström et al. 2007). This work will be coordinated by the WP- and task-leaders involved in WP1, but individual partners will be responsible for the quality of the data.

The objectives of PREHAB is to develop and integrate methods for spatial prediction, economic valuation and scenario planning. The primary aim is not to produce data. Nevertheless, in order to describe the necessary components of these methods, a metadatabase will be constructed for all data used in the modelling as well as for the map predictions produced. This metadatabase will be made publicly available via the PREHAB we-page. At the website, the map and results from the economic valuations on ecosystem goods & services will also be posted.

14. Ethical issues

The work within PREHAB does not involve any experimentation or sampling with higher animals. Ethical concerns to do with animal welfare are therefore not relevant for PREHAB.

15. References

Al-Hamdani Z, Reker J, (eds.) (2007) Towards marine landscapes in the Baltic Sea. BALANCE interim report #10. Available at http://www.balance-eu.org

Beaumont NJ, Austen MC, Atkins JP, Burdon, D, Degraer S, Dentinho TP, Derous S, Holm P, Horton T, van Ierland E, Marboe AH, Starkey DJ, Townsend M, Zarzycki T (2007) Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach. Mar. Poll. Bull. 54: 253-263

Beaumont NJ, Austen MC, Mangi SC, Townsend M (2008) Economic valuation for the conservation of marine biodiversity. Mar. Poll. Bull. 56: 386-396

Bergström U, Sandström A, Sundblad G (2007) Fish habitat modelling in the Baltic Sea archipelago region. BALANCE Interim report 11. http://www.balance-eu.org/.

Bergström U, Isæus M, Kotta J, Möllmann C, Sandström A, Sparrevohn C, Tomkiewicz J, Vestergaard O (2007) Guidelines for harmonisation of marine data. BALANCE Interim

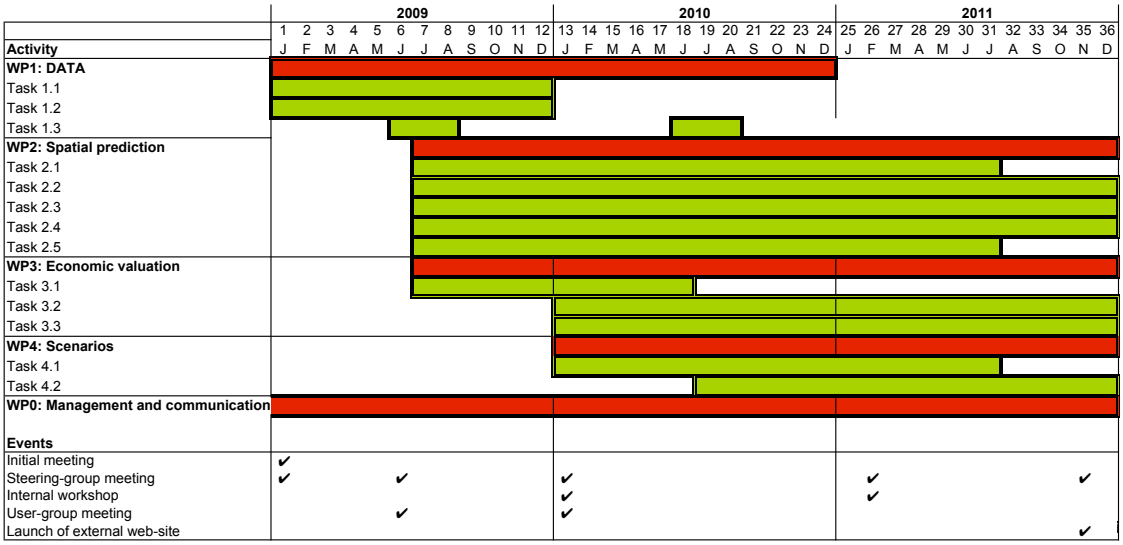

Fig. 3. Time table of WP's, tasks and events planned within PREHAB. Also indicated are the number of MM's to each task.

report No 32. http://www.balance-eu.org/.
Bonsdorff E. (2006) Zoobenthic diversity-gradients in the Baltic Sea: Continuous post-glacial succession in a stressed ecosystem. J. Exp. Mar. Biol. Ecol. 330: 383-391.
Bonsdorff E, Pearson TH (1999) Variation in the sublittoral macrozoobenthos of the Baltic Sea along environmental gradients; a functional-group approach. Aust. J. Ecol. 24: 312-326.
Bonsdorff E, Laine AO, Hanninen JH, Vuorinen I, Norkko A. (2003) Zoobenthos of the outer archipelago waters (N. Baltic Sea) - the importance of local conditions for spatial distribution patterns. Bor. Environ. Res. 8:135-145.
Bryan TL, Metaxas A (2007) Predicting suitable habitat for deep-water gorgonian corals on the Atlantic and Pacific continental margins of North America. Mar. Ecol. Progr. Ser. 330:113-126
Costanza R, d'Arge R, de Groot R, Farberk S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P, van den Belt M (1997) The value of the world's ecosystem services and natural capital. Nature 387: 253-260
de Groot RS, Wilson MA, Boumans RM (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. 41: 393-408
Eastwood PD, Souissi S, Rogers SI, Coggan RA, Brown CJ. (2006) Mapping seabed assemblages using comparative top-down and bottom-up classification approaches. Can. J. Fish. Aquat. Sci. 63:1536-1548.
Elmgren R (1978) Structure and dynamics of Baltic benthos communities, with particular reference to the relationship between macro- and meiofauna. Kieler Meeres. 4: 1-22.
Elmgren R, Hill C. (1997) Ecosystem Function at Low Biodiversity - The Baltic Example. Pp. 319-336 in Ormond RFG, Gage J, Angel M. (eds), Marine Biodiversity: Patterns and Processes. Cambridge University Press Cambridge
Ecol. Econ. (2006) Special issue on Environmental Benefits Transfer: Methods, Applications and New Directions - Benefits Transfer. Ecol. Econ. 60
EUROCAT (2004) European Catchments: Catchment changes and their impact on the coast, Summary Report. http://www.cs.iia.cnr.it/EUROCAT/project.htm
Falandysz J, Trzosinska A, Szefer P, Warzocha J, Draganik B. (2000) The Baltic Sea, especially southern and eastern regions. In: Seas at the millennium, Vol. I, Regional chapters: Europe, the Americas and West Africa. Sheppard C. (ed). Elsevier Science Ltd, pp. 99-120.
Fielding AH, Bell JF (1997) A review of methods for the assessment of pediction errors in conservation presence / absence models. Env. Cons. 24:38-49.
Florin A-B, Sundblad G, Bergström U. (submitted) Characterisation of juvenile flatfish habitat in the Baltic Sea. J. Sea Res.
Guisan A, Zimmermann NE (2000) Predictive habitat distribution models in ecology. Ecol. Model. 135:147-186.
HELCOM (2007) Baltic Sea Action Plan. http://www.helcom.fi/
Hewitt JE, Thrush SE, Legendre P, Funnell GA, Ellis J, Morrison M. (2004) Mapping of marine soft-sediment communities: Integrated sampling for ecological interpretation. Ecol. Appl. 14:1203-1216.
Hirzel AH, Le Lay G, Helfer V, Randin C, Guisan A (2006). Evaluating the ability of habitat suitability models to predict species presences. Ecol. Model. 199:142-152.
Holling CS. (1992) Cross-scale morphology, geometry, and dynamics of ecosystems. Ecol. Monogr. 62: 447-502
Kautsky L, Kautsky N. (2000) The Baltic Sea, including Bothnian Sea and Bothnian bay. In: Seas at the millennium, Vol. I, Regional chapters: Europe, the Americas and West Africa. Sheppard C. (ed). Elsevier Science Ltd, pp.121-133.
Laine, A. O. 2003. Distribution of soft-bottom macrofauna in the deep open Baltic Sea in relation to environmental variability. Estuarine Coastal and Shelf Science 57: 87-97.
Leathwick JR, Elith J, Hastie T. (2006) Comparative performance of generalized additive models and multivariate adaptive regression splines for statistical modelling of species distributions. Ecol. Model. 199: 188-196.
Ledoux L, Turner RK (2002) Valuing ocean and coastal resources: a review of practical examples and issues for further action. Ocean & Coast. Manag. 45: 583-616
Loomis JB, Rosenberger RS (2006) Reducing barriers in future benefit transfers: Needed improvements in primary study design and reporting. Ecol. Econ. 60: 343-350
Mackey BG, Lindenmayer DB. (2001)Towards a hierarchical framework for modelling the spatial distribution of animals. J. Biogeogr. 28: 1147-1166
Millennium Ecosystem Assessment (2003) Ecosystems and Human Well-being - A Framework for Assessment. Chapter 2, Ecosystems and their services.
http://www.millenniumassessment.org/
Morrison M, Bergland O (2006) Prospects for the use of choice modelling for benefit transfer. Ecol. Econ. 60:420-428
Noren K 2006. Predicting spatially and temporally variable infaunal assemblage structure. Thesis for PhD. Göteborg University.
Nunes PA, van den Bergh, JC (2001) Economic valuation of biodiversity: sense or nonsense? Ecol. Econ. 39: 203-222
Perus J, Bonsdorff E, Bäck S, Lax HG, Villnas A, Westberg V. (2007) Zoobenthos as indicators of ecological status in coastal brackish waters: A comparative study from the Baltic Sea. Ambio 36: 250-256.
Potts JM, Elith J. (2006) Comparing species abundance models. Ecol. Model. 199: 153-163.
Rönnbäck P, Kautsky N, Pihl L, Troell M, Söderqvist T, Wennhage H (2007) Ecosystem Goods and Services from Swedish Coastal Habitats: Identification, Valuation, and Implications of Ecosystem Shifts. Ambio 36: 534-544
Sandman A, Isaeus M, Bergström U, Kautsky H. (in press) Spatial predictions of Baltic phytobenthic communities: Measuring robustness of Generalized Additive Models based on transect data. J. Mar. Syst.
Snickars M, Pitkänen T (2007) BALANCE Interim Report: GIS tools for marine spatial planning and management. http://balance-eu.org
Spash CL, Vatn A (2006) Transferring environmental value estimates: Issues and alternatives. Ecol. Econ. 60: 279-388
Troy A, Wilson MA (2006) Mapping ecosystem services: Practical challenges and opportunities in linking GIS and value transfer. Ecol. Econ. 60: 435-449
Turner RK (2000) Integrating natural and socio-economic science in coastal management. Journal of Marine Systems 25(3-4) 447-460
Urban DL, O'Neill RV, Shugart Jr HH. (1987) Landscape ecology. Bioscience. 37: 119-127
van Bueren M, Bennett ,J (2004) Towards the development of a transferable set of value estimates for environmental attributes. Aus. J. Agr. Res. Econ. 48: 1-32

Wilson MA, Costanza R, Boumans R, Liu S. (2005) Integrated assessment and valuation of ecosystem goods and services provided by coastal systems. In "The Intertidal Ecosystem", Wilson JG (ed), Royal Irish Academy Press, Dublin, Ireland

Yamada K, Elith J, McCarthy M, Zerger A. (2003) Eliciting and integrating expert knowledge for wildlife habitat modelling. Ecol. Model. 165: 251-264.

16. Comments to project revision 080926

PREHAB was subjected to a cut by 19.5% to be done in one week. While this has led to some substantial changes to the program, we have tried to maintain the main focus and quality of the project. Needless to say, however, PREHAB will be a less advanced project after the cuts. The main cuts have been in personnel costs but as much as possible we have tried to cut down on travels and outreach. The main changes to the projects are outlined below:

- Total MM's have decreased from 241 to 201.
- The list of tasks and deliverables have been changed so that some tasks and deliverables have been merged (Tasks 1.2 and 1.3 have been merged into a new 1.2, Tasks 1.4 and 2.5 have been merged into a new 2.5, Tasks 4.1 and 4.2 have been merged into a new 4.1). Because many tasks build on previous ones, completely cutting out tasks proved difficult. It is, however, clear that the extent, quality and usefulness of the new deliverable will not live up to the ones originally intended. Nevertheless, we believe that the present list of deliverables can make useful contributions to planning in the Baltic region. Furthermore, the PREHAB consortium will continue to look for additional funds that might add value to the project. We also hope that we can maintain a dialogue with the BONUS+ organisation, in case opportunities for additional funding arises.
- Stakeholder conference at the end of project has been omitted. Specific activities for dissemination to stakeholders of PREHAB deliverables will be made electronically. Therefore some additional funds have been allocated to a web-consultant.
- User-group decreased from 5 to 3 people.
- Physical meetings are kept to a minimum.