BONUS call 2014: Sustainable ecosystem services

Project acronym: GOHERR

Project full title: Integrated governance of Baltic herring and salmon stocks involving stakeholders

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Key theme addressed: 4. Improving the capabilities of the society to respond to the current and future challenges directed to the Baltic Sea region

Subthemes: 4.1 Governance structures, policy performance and policy instruments; 4.2 Linking ecosystem goods and services to human lifestyles and well-being; 3.1 Enhanced, holistic cross-sector maritime risk analysis and management, including effects of new technologies, human factor, climate change effects in open water and in ice, and interaction with onshore activities

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A. Scientific and/or technological excellence

2. Concept, objectives and expected outcome of the project

Following the principles of the Marine Strategy Framework Directive (MSFD) of the EU, the HELCOM Baltic Sea Action Plan (BSAP) is explicitly based on the Ecosystem based management (Backer and Leppänen 2007; Backer et al. 2010). Implementing the approach requires holistic thinking and comprehensive representations of the ecosystem, incorporating the biotic and abiotic components, human activities and institutional components, as well as connections with the global market, climate, other ecosystems, public policies, societal values, and so forth (Connolly 2008; Garcia and Charles 2008). Adaptive management and integrated management (CEC 2008) are seen as tools for responding to the challenges of ecosystem approach (Connolly 2008). Thus, applying ecosystem based approaches implies acknowledging the dynamic causal relationships and variability within the ecosystem, the wide-scale impact of management actions, iterative processes of learning from management outcomes, and coordinating interrelated issues across stakeholder groups, sectors and levels of governance (Connolly 2008). A move from a “use perspective” to a regional “system perspective” is therefore required (Ounanian et al. 2012).

The aim of GOHERR is to develop a novel integrated governance framework and a related decision support tool that combines the health of the Baltic Sea with the health of humans, and the dynamics of the ecosystem with human values and behaviour. By integrating the governance of two fish species and the sectoral, regional, national and sub-national as well as marine, coastal and river basin perspectives, the project aims at systematically identifying synergies or inefficiencies in the management of the social-ecological system. The project will involve all stakeholders-in-chain for improving the capability of society to respond to the challenges of the Baltic Sea, from policy makers to fishermen and from scientists to consumers. The framework targets at successful implementation of ecosystem based management in the Baltic Sea, by applying and improving the tools of adaptive management and integrated management in order to enhance the coherency and efficiency of policy making and to improve the acceptability and resiliency of decisions (CEC 2008).

The project focuses on the governance of two interrelated keystone fisheries of the Baltic Sea: salmon and herring. Both of these provide a rich source of Omega3 fatty acids and vitamin D for humans and could be attractive for people favoring locally produced healthy and natural food. A problem in common for Baltic salmon and herring is, however, that they contain high concentrations of dioxins and dioxin-like PCBs (HELCOM 2004). Frequently the dioxin levels in these fish exceed the limit set by the EU for food and feed (EP 2011). Owing to the dioxin, the value of these fish species for human consumption is low, and the authorities recommend restricting their intake. For instance in 2010, adults in Sweden, on average, consumed Baltic herring only two times per year, and the average consumption of wild-caught Baltic salmon was less than one portion per year (Livsmedelsverket 2011). The dioxin content in salmon and herring, both of which are among the most important catches of the Baltic Sea, makes the prerequisites for fishing livelihood unstable and the use of the catches contradictory, and can also affect management decisions. The high dioxin concentration in fish may even impact negatively on the image of the whole Baltic Sea. For fish market, dioxin poses a risk due to sales bans targeted to fish containing dioxin.

Baltic salmon is one of the most charismatic species in the Baltic Sea, associated with strong cultural and emotional values (Kulmala et al. 2012). In the coastal and offshore areas salmon is a desired catch for commercial fisheries while inhabitants of the river areas today see salmon as an essential element in developing tourism around recreational fishing. Different expectations to benefit from the limited salmon resource have caused conflicts between user groups over centuries, and unanimity in the management of Baltic salmon stocks has long been poor. Currently there are 30-40 stocks around the Baltic Sea, each of which has a different ecological status. Still, one single TAC (total allowable catch) is defined every year for ensuring the sustainable use of the stocks, which is not assumed to protect the weak stocks. The reproduction of the salmon stocks suffers from high post smolt mortality, the reason for which is largely unknown. Based on time series analyses, Mäntyniemi et al. (2012) suggested that the post smolt mortality may be connected to predation by grey seals, and that interannual variation in post-smolt mortality relates to availability of their key prey, juvenile herring.

Herring is one of the key species of the Baltic ecosystem because of its high abundance and its role in the pelagic food web (Sparholt 1994; Kornilovs et al. 2001). The value of herring seems to be mostly economic, although its value in different countries varies. For instance in Finland, Baltic herring is the most important catch in economic terms (Finnish Game and Fisheries Research Institute 2013). Usage of catches is driven by the market conditions and varies among countries. Besides human consumption, catches go to fish oil and meal, and animal feed (CEC 2010; EP 2011). Human consumption of herring is low in Finland, Denmark and especially in Sweden, but has a more important role e.g. in Estonia, Latvia, and Lithuania.

Although salmon and herring have a predator-prey relationship in relation to each other, and management measures targeted to one of them potentially also affect the other, these species are managed separately. Mäntyniemi (2012) found out that herring is important food for salmon especially during its first year. In GOHERR, the predator-prey interactions and the impact of this on bioaccumulation of dioxins will be explicitly accounted for. Also, we will analyze how size-selective fishing mortality could impact both production of salmon and herring stocks and bioaccumulation of dioxin in these food resources. As fishing is assumed to reduce dioxin from the sea, the impacts of different types of management measures on the dioxin concentration will be estimated. Since the dioxin content in fish is dampened by biological dilution (many organisms per dioxin concentration unit in a eutrophicated system), it is essential that nutrient and eutrophication abatement is accompanied by extensive dioxin abatement. Otherwise, nutrient abatement alone can lead to increased dioxin concentrations in fish (Håkanson et al., 2010).

A Bayesian decision support model will be built for assessing if integrated management could increase the likelihood to achieve management aims, and to reduce dioxin in these fishes. Based on future scenarios for the consumption of fish in different Baltic Sea countries, and exposures to harmful and healthy compounds in Baltic fish, the future health impacts of the Baltic fish on humans will be analysed. In addition, it will be specified how the overall fishing effort affects dioxin concentration in salmon and herring. Further, the consequences of management aims specified by stakeholders, and of future scenarios for euthophication, dioxin release, and the utilization of Baltic salmon and herring for the salmon and herring stocks will be analysed.

The project will study the prerequisites and potential benefits of integrated governance. It will be analyzed how socio-cultural traditions and values related to salmon and herring in different Baltic Sea countries have modified the governance and policy performance. In addition, the project will analyse how the socio-cultural context of those countries has shaped the recommendations for salmon and herring consumption, and the attitudes and behaviour of consumers in relation to these fish species. Is, for instance, the low consumption of Baltic salmon and herring in Sweden caused by the dioxin, or by other reasons? It will be studied if integrated governance of salmon and herring can generate decisions for reducing the bioaccumulation of dioxin and for minimising the dioxin content in catch. The impact of decision options designed in a participatory context will be tested by using a Bayesian decision support model. Moreover, the Bayesian model will be used to analyse the implementation success and consequences of different types of governance structures to management. The focus will be on the potential of regional, national and sub-national policy dynamics and stakeholder/consumer interests. Finally, it will be analysed if reduced dioxin concentration in catch can enhance the value of Baltic salmon and herring as source of food.

Using the Bayesian decision support model, a value-of-Information (VOI) analysis will be conducted to propose priorities of research for policy, i.e. what kind of new information is the most beneficial for the integrated governance. The central idea of VOI is to measure the sensitivity of optimal decisions to new information. If a new piece of information can be envisaged to change the behaviour, then gathering this new information has some value. VOI analysis aims at quantifying this value, which then helps to prioritize research efforts (Mäntyniemi et al. 2009). Value-of-control (VOC) analysis will be carried out to find out if new ways to control the system would be worth investing.

GOHERR aims in a nutshell:

- Involving stakeholders in building a novel integrated governance framework for Baltic salmon and herring that responds to the challenges of the ecosystem approach
- Analyse the consequences of the biological dependence between Baltic salmon and herring, and their consequences for bioaccumulation of dioxins
- Building a decision support model for an integrated risk analysis and governance of Baltic salmon and herring with the aim of reducing dioxin concentration in these fish species
- Mapping future scenarios for the use of Baltic herring and salmon
- Improving the quality of salmon and herring management through searching for synergies and coherence across sectors
- Proposing a governance structure for the integrated maritime policy in the Baltic Sea including relevant interrelated elements

Expected outcomes:

- Suggestions of new policy instruments for multi-level/nested integrated governance of Baltic salmon and herring stocks
- Increased understanding of integrated governance and suggestions of ways and tools for bridging policy sectors, governance levels, and stakeholder perspectives in ecosystem based governance
- A decision support tool to facilitate the implementation of integrated governance
- Increased understanding on the interrelationship between Baltic salmon and herring, and the impact of this on dioxin concentration

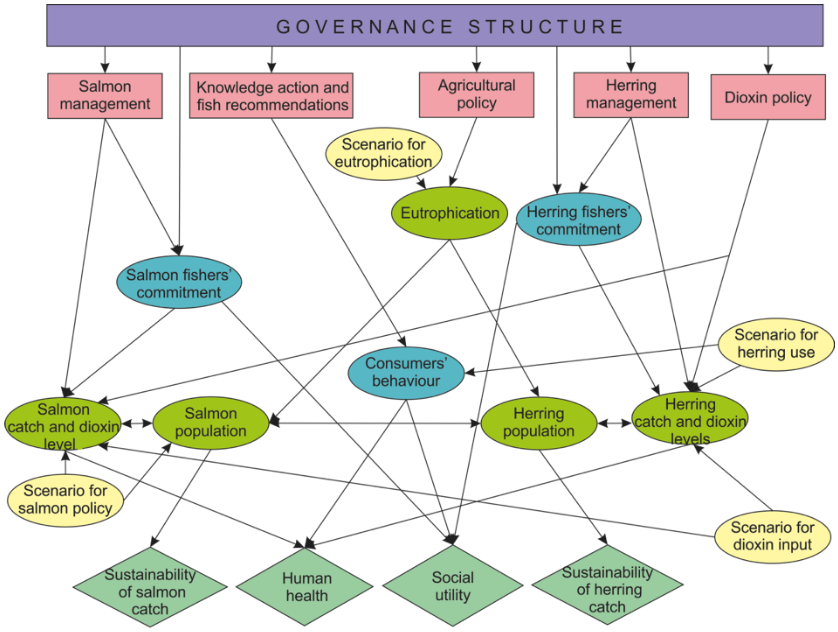

Figure 1. The basic idea of GOHERR decision support model. The pink rectangles represent management actions and policies affected by governance structure, ellipses variables that are uncertain and therefore modelled as random variables, and green diamonds illustrate the utilities related to the ecological status of

fish stocks, health of humans, and social aspects. The biological part describes the dynamics of salmon and herring populations (interacting with each other), the accumulation of dioxins in fish as well as the effect of eutrophication and fishing on stocks (green ellipses), whereas the social science part concentrates on people's

behaviour and attitudes (blue ellipses). Scenarios for future (yellow ellipses) are defined in expert workshops. Note that the figure is a simplification, i.e. in the final model the number variables and interactions is higher.

3. State of the art, theory and methods

In fisheries, the ecosystem approach suggests, *inter alia*, moving from single species to multi species management, i.e. managing the target species while maintaining the sustainability of interrelated species, and controlling other components of the ecosystem (Link 2002; Morishita 2007). Although the importance of an ecosystem approach is increasingly emphasized and the theory well developed, single-species approaches still dominate fisheries management whereas the wider ecosystem context is ignored (Möllmann et al. 2013). The International Council for the Exploration of the Sea (ICES) initiated a dialogue between ICES and managers to foster the development of a multispecies management system for the Baltic Sea, by including multispecies considerations for the central Baltic cod, herring, and sprat in the scientific advice of year 2013 (ICES 2013).

A major reason for the slow adoption of ecosystem-based approaches is the difficulties of elucidating complex ecosystem dynamics and adopting the required interdisciplinary approach (Link 2002). In addition, practical guidelines for implementing the ecosystem approach are missing (Morishita 2007; Mollmann et al. 2012). In a recent paper, Raakjaer et al. (accepted) highlighted the key role of governance in the success of the ecosystem approach, pointing to a lack of coordination between different organizations, governance levels, and maritime sectors. Lack of collaboration and coordination structures between actors and the lengthy process of adopting integrated thinking have also been referred to as difficulties in implementing integrated approaches (CEC 2008).

Morishita (2007) has highlighted the importance of good scientific basis; well defined management goals and tools for achieving the goals; integration of human aspect and; participation of stakeholders for adopting the ecosystem approach. Raakjaer et al. (accepted) suggested mobilising institutional networking, interaction and policy coordination in order to build a governance system in which institutions, policies, laws and sectors are nested into a tiered planning and decision making system, while ensuring that governance structures are context dependent and a "one size fits all" approach is avoided.

The management of Baltic salmon stocks is challenging, under high uncertainties and high stakes. Still, mostly biological research contributes to solving the management problems, whereas social scientific research focusing on salmon fisheries and the related governance is less common. Salmi and Salmi (2010) analyzed fisheries governance in the River Tornionjoki, and recommended establishomg a forum for a dialogue between stakeholders, to reduce tensions between the commercial fishery and the tourism industry. Haapasaari et al. (2007) focused on fishers' commitment to management measures targeting at the restoration of Baltic salmon stocks, and the impact of commitment on catches. Haapasaari and Karjalainen (2010) studied stakeholders' preferences on long term management options, and Levontin et al. (2011) integrated biological, economic and sociological knowledge to evaluate potential management plans for Baltic salmon. Levontin et al. (2011) demonstrated the difficulty of optimization in fisheries management due to human-induced uncertainty. A synthesizing analysis of different types of governance structures and their impact on the management of the Baltic salmon stocks is missing.

Burns and Stöhr (2011) studied the governance of Baltic fisheries in general, as a case study in a research related to power, knowledge and conflict in the shaping of commons governance. They outlined that the top-down regulatory system has not succeeded in achieving compliance by fishermen, and predicted a shift towards more participation.

Sociological studies focusing on Baltic herring are even fewer. Ulrich et al. (2010) involved stakeholders in developing a Long Term Management Plan for Western Baltic herring stocks, in order to facilitate the complex governance scheme. Haapasaari et al. (2012a) involved stakeholders in framing the problem of the long term management of Central Baltic herring fishery, and concluded that the current fisheries management procedures based on biological fisheries analyses do not cover the interests and views of stakeholders. The study highlighted the importance of putting more emphasis on social and economic issues, and supported the ecosystem approach to herring fishery management. The study showed that involving stakeholders in problem framing can facilitate the understanding of the broader context of fisheries. The importance of decreasing dioxin content in herring was stressed in the stakeholder workshops, as well as the importance of using herring for human consumption only.

However, the dynamics of herring as well as the bioaccumulation of dioxin in herring cannot be understood in isolation from the food-web herring is embedded in. Similarly, the production and dioxin content of salmon depends on its interactions with other species in the ecosystem. In particular, the interactions between salmon and herring are of key interest for understanding the dynamics of Baltic salmon.

Small herring is a key prey for Baltic salmon, and annual variation in the survival of post-smolt salmon coincides with the amount of juvenile herring available (Mäntyniemi et al. 2012). In contrast, the abundance of large herring does not explain the variation in salmon post-smolt survival, which highlights the importance of addressing the changes in size-structure and body growth dynamics in herring for resolving its effects on salmon production. Recent advances in theory of size-structured communities shows the importance of accounting for the feedbacks from size-dependent interactions and resource dependent body growth for understanding the dynamics of interacting fish species (Van Leuween et al. 2013, Huss et al. 2012, 2013). Moreover, as bioaccumulation of many contaminants are directly linked to the fat content of individuals, understanding how management affects bioaccumulation of dioxin in herring and salmon requires resolving body growth responses to fishing and species interactions.

Kiljunen et al (2007) studied the extent to which Finnish human dietary intake of organochlorines (PCDD/Fs and PCBs) originating from Northern Baltic herring can be influenced by fisheries management. This was investigated by estimation of human intake using versatile modeling tools (e.g., a herring population model and a bioenergetics model). A probabilistic Bayesian approach was used to account for the variation in human intake of organochlorines originating from the variation among herring individuals. Their estimates were compared with contemporary precautionary limits and recommendation for use. According to the results, the consumption levels and frequencies of herring give a high probability of exceeding recommended intake limits of PCDD/Fs and PCBs. Health impact assessments have been performed about herring and salmon consumption (Tuomisto et al. 2004; Leino 2014). Usually, the benefits of healthy fish oils have been found larger than the harmful effects of dioxins or other pollutants.

Adaptive ecosystem based management requires tools for the analysis of interrelated issues and ability to predict the effects of management actions. We find the Bayesian networks (BNs) a flexible tool for environmental risk and decision analysis, as they enable the linking of several risk factors and their management options in one model, and the examination of their impact on each other both in qualitative and quantitative terms. The main idea is to update existing (a priori) information by newly acquired knowledge, by using probabilities as a measure of uncertainty. Problems are structured into cause-effect relationships which allow examining how an information change in one variable affects the other variables. The strength of the links is expressed by conditional probability distributions. The approach is based on subjective knowledge, which can originate from new experimental data, the literature, pre-existing simulation models, or statistics, or it can be elicited from experts. The probability is expressed as a degree of belief, i.e. a private assessment on the likelihood of an event, based on available evidence. A BBN can consist solely of random variables, but it can be extended to an influence diagram that can assist in decision making under uncertainty, by adding variables that can be controlled (managerial decisions) and variables related to utility, loss, or preference of the decision outcomes (Shachter 1986; Pearl 1988; Spiegelhalter et al. 1993).

We have applied BBNs to fish stock assessments and other environmental problems, also involving decision analyses (Varis and Kuikka 1999; Kuikka et al. 1999; Kuikka et al. 2011). In addition, we have found the approach useful in examining the human perspective to fisheries problems (Haapasaari et al. 2007; Haapasaari and Karjalainen 2010; Levontin et al. 2011). We have built BBN models based on expert knowledge (Kuikka and Varis 1997), and on participatory processes involving diverse stakeholder groups (Haapasaari et. al 2012a; 2013).

Recently, Rahikainen et al. (2014) used the Bayesian approach for the integrative management of water quality, oil spills and herring fishery. The outcome of the integrative model was a set of probability distributions for future nutrient concentrations, herring stock biomass, and for achieving the water quality targets by HELCOM BSAP. The model can be used to derive the probability of reaching the management targets for each alternative combination of management actions. GOHERR will further develop this model by taking spatial aspects into account.

4. Progress beyond the state of art and interdisciplinary

GOHERR will improve the understanding of ecosystem based management, and analyse how governance structures could respond to the challenges related to the approach. The project highlights the importance of a collective view over the fisheries sector that goes beyond activities taking place in the sea, towards taking all factors that influence salmon and herring stocks into account. The aim is to build a coherent holistic view over the exploitation of herring and salmon stocks, that integrates influencing factors and their governance both horizontally (interrelated policy areas) and vertically (scenarios for the future). The project examines how synergies and an increased coherence of governance involving networks of stakeholders can improve the management of salmon and herring.

A strategy for the integrated governance of holistic multi-species fisheries management will be developed. The project will analyse the current governance levels, organisations, policies and sectors related to Baltic salmon and herring, and the potential of a nested governance structure in multi-species management. An interesting question is, for instance, the possibilities of river-based/stock specific governance of the Baltic salmon stocks, to facilitate the protection of the weak stocks (CEC 2009). It will be analysed what kind of institutional network and interaction would ensure collaboration and policy coordination in the case of Baltic salmon and herring in an optimal way, and a "tailor-made" governance structure will be suggested. We will apply the theory of new institutionalism, that aims at developing a view of institutions the way they interact with each other and the society. The approach analyses institutions as parts of an institutional environment, as influenced by other institutions. Thus it addresses all levels of governance, and facilitates analyses of multi-level, complex governance systems (Powell 2007). We will analyze how the theory of new institutionalism lends itself to the requirements of ecosystem based management.

GOHERR will make good use of *Open policy practice,* which is a recently developed set of guidance, practices, web workspaces and tools, for managing information flows and storage in complex policy problems with multiple stakeholder groups, sectors, and governance levels (Pohjola et al., 2012; Tuomisto et al., 2014a,b). The tool facilitates open participation and the development of a shared understanding among the participants about the problem and its solution, the inclusion of scientific knowledge, and updating research questions according to stakeholders' feedback. Shared understanding entails that all participants commonly identify relevant scientific and value-based issues, agree on what the agreements and disagreements are, and what are the reasons for disagreements, but do not necessarily agree on the topic itself. Therefore, it is not the same as consensus. A key part of the framework is *Opasnet* web workspace (http://en.opasnet.org), which offers functionalities for dissemination, public discussion, questionnaires, online modeling, and for data storage and visualization. So far, *Opasnet* has been used in assessments related to the impact of dioxin on human health, and in analyses of the effects of climate change and energy production on humans. Until now, the tool has neither been used in wide-scaled international settings, nor combined with Bayesian models. In GOHERR, the tool will be launched to the use of participatory approaches in environmental and natural resource management. Opasnet allows structuring information for both scientific scrutiny and for policy use at the same time, and we will examine how the tool can benefit ecosystem based fisheries management.

We will use *Open policy practice* to combine fishery models, the Bayesian decision support model, stakeholder participation, and expert work in a unique way. *Opasnet* will be used to facilitate 1) collecting, sharing, and using data (even "Big Data", i.e large and complex data sets), 2) organizing stakeholder participation, 3) structuring the output of stakeholder meetings and workshops and enhancing the use of the output, 4) collecting feedback from people that cannot participate in the workshops or would otherwise not be reached at all, 5) the modeling of health impacts of dioxin, Omega3, and vitamin D (WP5), 6) analyzing the results of the decision support model built in WP6. Moreover, we will apply Opasnet for online publishing of input data, models, and estimates about the current situation and the future. This makes it possible for external experts to check details of the models, or interested users to create and compare policy options by adjusting the variables in the models and rerunning the models with the new scenarios. Overall, the processes and output of the different WPs in GOHERR are planned to feed new aspects and input to each other, and Opasnet will function as an important tool in this.

The project will produce new knowledge related to the dioxin accumulation in Baltic herring and salmon, and propose management actions to reduce the dioxin concentrations. The potential and consequences of, for instance, Individual Transferable Quotas (ITQ) in reducing dioxin in fish will be analysed. The ITQ system is based on the idea that shares of a total quota can be sold and bought on the ITQ market. In addition, the project will update knowledge related to the health impacts of Baltic Sea fish in humans, and further develop the analysis of Rahikainen et al. (2014) on the effect of eutrophication on herring reproduction.

GOHERR will further develop integrated Bayesian analyses by modelling the interactions of Baltic salmon and herring and the most important ecosystem and social components affecting these fisheries, including the behaviour of fishers and consumers, and governance. For interdisciplinary Bayesian analyses, the VOI and VOC analyses will be a novelty. The model will be used to analyze if and how integrated governance could benefit the society in terms of reduced dioxin in fish while at the same time ensuring sustainable catches for both species. The interactive and integrated decision analytic approach developed by the project team will form a new basis for science-policy interface in a nested multi-level governance framework of natural resources. The project will strengthen the role of social sciences in policy related fisheries research.

The project is based on interdisciplinary collaboration between social scientists, biologists, and medical scientists. The combination of disciplines is ideal for investigating how optimal governance can link the health of the Baltic Sea with the health of humans in terms of reduced dioxin in fish. Integration of disciplines will be achieved through an intensive learning process that takes place between individual scientists, between disciplines and between types of knowledge. The learning process will be facilitated by agreeing to common methods (Open policy practice, Bayesian networks) and common research questions at the outset of the project (Haapasaari et al. 2012b). These will be agreed in the kick off meeting. All disciplines will produce information that will be integrated in the Bayesian decision support model (WP6), using probabilities as the common language. The *Open policy practice* and the *Opasnet* web framework will be used as a common discussion, data sharing, and modelling forum. In addition, all researchers will participate in the International Workshops No 1 and 2, both of which also involve representatives of the key stakeholder groups (fishermen, authorities, decision makers, eNGOs, scientists, consumers, etc.). We expect that a small consortium will facilitate making truly interdisciplinary research. Interdisciplinarity requires getting to know each other, and in a small consortium this is easier. The project will also have transdisciplinary features, as the role of stakeholders in the project will be considerable (Klein et al. 2001).

5. Relevance to the thematic content of the call

The project focuses on theme 4.1. (Governance structures, policy performance and policy instruments). It is also linked to themes 4.2. (Linking ecosystem goods and services to human lifestyles and well-being), and 3.1. (Enhanced, holistic cross-sector maritime risk analysis and management, including effects of human factor). The proposal will produce outcomes accordingly:

Theme 4.1

GOHERR will analyse how the socio-cultural context of different Baltic Sea countries (Denmark, Sweden, Finland, Estonia[1]), and current governance structure (member states, EU, eNGOs) have shaped 1) management, policy instrument choice, and policy performance of Baltic salmon and herring; 2) attitudes and behaviour of consumers in relation to salmon and herring, both of which contain dioxin; and 3) recommendations for salmon and herring consumption. A novel governance structure and a decision support tool for the integrated management of Baltic salmon and herring will be proposed. A new framework and tools for information flows between policy makers, experts and stakeholders will be developed. The models, data, and guidance produced in the project will be published online for further use.
Theme 4.2

The ecosystem approach requires that governance should ensure both human and ecosystem wellbeing and integrity (Connolly 2008). By focusing on dioxin content in Baltic salmon and herring, GOHERR builds a bridge between the health of the Baltic Sea and the health of humans.
Theme 3.1
GOHERR will produce a holistic risk analysis- and decision support tool for the integrated management of Baltic salmon and herring. The tool incorporates uncertainties related to interaction between Baltic salmon

and herring, euthrophication, dioxin bioaccumulation, fisherman behavior, the use of salmon and herring catches, and related policy options. The tool enables evaluating the potential of different measures to reduce dioxin while ensuring sustainable use of the fish stocks. The implementation success of management measures will be assessed through the analysis of fishermen's commitment to them. The project will also assess, if higher involvement of fishermen and other stakeholders in policy making can improve their overall commitment to policy decisions, and at which governance level (sub-national, national, regional) their involvement is optimal. In addition, the potential of advisory tools for influencing human consumption will be examined.

6. List of work packages

Work package No	Work package title	Type of activity	Lead participant No	Lead participant abbrev.	Person months	Start month	End month
1	Project management	MGT	1	UH/UOULU	10	1	36
2	Comparative study of the socio-cultural traditions and values related to salmon and herring, their use, and their governance	RTD	1	UH	58	1	36
3	Scenarios and management objectives	RTD	5	UOULU	33	1	28
4	Linking fish physiology to food production and bioaccumulation of dioxin	RTD	4	SLU	42	1	34
5	Linking the health of the Baltic Sea with the health of humans: Dioxin	RTD	2	THL	39	1	36

[1] Estonia is one of our case studies even though we do not have an Estonian partner. We find Estonia an interesting case because of its different socio-cultural (historical) context. The fieldwork will be conducted by IFM-AAU.

6	Building a decision support model for integrated governance	RTD	1	UH	39	1	36
7	Dissemination of results	OTHER	1	UH	28	1	36

7. Description of work packages and tasks

Work package number	1	Start date: M1			End date: M36	
Work package title	WP1 Management					
Activity type	MGT					
Participant number	1	2	3	4	5		
Participant abbreviation	UH	THL	IFM-AAU	SLU	UOULU		
Person months per participant:	0	0	0	0	10		

Objectives

1) The overall objective of the management of consortium activities is to ensure project implementation according to the description of work
2) To carry out coordinator's administrative obligations to participants and the BONUS EEIG, and to act as the intermediary between these parties

Description of work

Professor Sakari Kuikka will act as the WP1 leader. He has wide experience in both participating and acting as the Scientific Coordinator in EU funded projects, including the coordination of the BONUS+ project IBAM. A full list of his (and Hoviniemi's) past and ongoing projects can be found at http://www.helsinki.fi/science/fem/projects.html. Project Coordinator Kirsi-Maaria Hoviniemi will carry the responsibility over the administrative coordination of the project. She will deal with all administrative and financial issues between participants and the BONUS EEIG. In addition to being experienced in administration of EU funded projects, she has substance knowledge on the field of this proposal and will support the timely planning, provision and content of project deliverables.

Task 1.1 Consortium's communications plan (Month 2 /36)

Drafting and implementing an efficient communications action plan for the consortium. Besides project meetings, this will include regular Skype-meetings and the establishment of a Wiki platform that will serve as the common forum for all participants to transfer knowledge, ideas, results and all sorts of material facilitating the implementation of the project. The plan will be discussed and jointly agreed upon by the consortium at project Kick-off. This Task also includes setting up efficient communications with the BONUS programme.

Task 1.2 Consortium management (M36)

The most important aspect of the management of the consortium activities is to see that the project is implemented according to the project description of work. This will be achieved by ensuring that the work plan is clear and jointly agreed upon, so that each participant is well aware and understands her/his role and obligations, both in the project tasks directly assigned to her/him as well as towards other participants and tasks where input is expected. The project management will ensure that all participants are motivated to carry out their tasks and will produce high quality well-disseminated project deliverables. The coordination of the scientific work will be done in respective work packages where the appointed work package and task leaders have the responsibility over managing the associated tasks and deliverables. The progress of work will be monitored in each project meeting and the management will ensure that corrective actions are taken where needed.

Task 1.3 Scientific and financial reporting (M36)

Coordinating, preparing and compiling the periodic and final reports, and obtaining associated certificates. **Management includes:** A) Administrative coordination between the BONUS EEIG and participants; B) Cooperating with key stakeholder groups, e.g. Baltic Sea Regional Advisory Council (BSRAC) C) Managing of legal, contractual, ethical, financial and administrative aspects of the project. Here, the extensive experience of UH/UOULUin administration is in a key role; D) Preparing, updating, and managing the Consortium agreements between the participants; E) Coordinating of gender and other issues; F) Ensuring the required communication with relevant advisory and management bodies; G) Obtaining audit certificates from partners whose BONUS funding is equal or more than 750 000, to be submitted with periodic reports; H) Writing and communicating requests for possible amendments to BONUS EEIG; I) Reporting to BONUS EEIG in compliance with the obligations. In the description of work, each work package, task and deliverable has its named responsible participant. This ensures that the scientist will be motivated to produce work of high quality, while acknowledging the usage of EU scientific funding to develop worldwide sustainability criteria. The planned project meetings are: **Kick-off Meeting 1:** Month 1, A three day meeting hosted by UH in Finland. The meeting will enable participants to get to know one another and make detailed plans for the implementation of the project work. Participants will be advised on administrative issues. **Main Meeting 2:** Month 10, A three-day meeting in Denmark, will be organized in collaboration with International Stakeholder Workshop No1. Exchanging first project experiences, updating detailed work plans and schedules, monitoring work progress and preparations for the first periodic reporting. **Main Meeting 3:** Month 16, three-day meeting in Finland. **Main Meeting 4:** Month 24, three-day meeting in Sweden. Preparations for the second periodic reporting. **Main Meeting 5:** Month 29, three-day meeting in Finland, in collaboration with International Stakeholder Workshop No2. **Final Meeting:** Month 36, in Finland. Preparations for the third periodic reporting.
Deliverables (brief description and month of delivery) **D1.**1 Periodic report after 12 months (incl. summary, journal manuscripts, meeting minutes, UOULU) **M14.** **D1.2** Periodic report after 24 months (incl. summary, journal manuscripts, meeting minutes,UOULU) **M26.** **D1.3** Periodic report after 36 months (incl. summary, journal manuscripts, meeting minutes,UOULU) **M38.** **D1.4** Final report (includes a summary and individual journal manuscript versions,UOULU). **M38.**

Work package nr.	**2**	Start date: M1		End date: M36	
Work package title	**Sociocultural use, value, and governance of Baltic salmon and herring**				
Activity type	RTD				
Participant number	3	1	5	2	4
Participant abbreviation	IFM-AAU	UH	UOULU	THL	SLU
Person months per participant:	16	26	10	6	0

Objectives and rationale WP2 will carry out a comparative study of the socio-cultural traditions and values related to salmon and herring, their use, and their governance. Anthropological research has long shown the importance and value of particular foods and environmental resources such as fish on society and culture (Counihan and Van Esterik 2013). Such importance and values are informed and reified by culture, as is the use of these fish in society (see e.g., Hamada 2011). Furthermore, the governance structures and institutions in place that inform the management and use of such resources will be investigated with suggestions on how they could be redesigned with input provided to WP 3 (Scenarios and management objectives) and WP6 (Building a decision support model for integrated governance). The objectives are: 1. To understand the socio-cultural importance, value, and use of Baltic salmon and herring;

2. To apply these understandings to suggestions for the socio-cultural and political prerequisites for successful integrated fisheries governance; and
3. To understand what kind of institutional, organisational, structural and attitudinal flexibility is needed for integrated governance.

Description of work, tasks, and role of participants
Dr. Päivi Haapasaari (expert in human-induced uncertainties in fisheries management; experience of Baltic salmon and herring) will lead the WP and take the main responsibility of Tasks 2.1a,b; d, 2.2b,e,d, and Task 2.3. Associate professor Alyne Delaney (expert in cultural and governance related research, IFM-AAU) will lead Tasks 2.1c, 2.1e, 2.2.a, and 2.2.c. Professor Jesper Raakjaer (IFM-AAU) will provide input into the governance sub-tasks given his significant intellectual theorizing and publications on EU marine governance.
Description of work
Baltic salmon has great cultural importance in the Baltic Sea region and is associated with strong emotional values. This is shown e.g. by estimates of public spending for habitat restoration, results of studies regarding willingness to pay (WTP) by anglers, and the constant political debate revolving around salmon, related to who should be allowed to fish salmon, where, and to what extent (Kulmala et al. 2012). Baltic herring does not seem to have such a high cultural value. Rather, its most obvious value is economic. For instance, in Finland, Baltic herring is the most important catch in economic terms. The catches are used for human consumption, fish oil and meal, and animal feed (CEC 2010; EP 2011). Usage is driven by the market conditions, and varies among countries.
In WP2, GOHERR first investigates, qualitatively, the importance and value of Baltic salmon and herring in selected case studies in four Baltic Sea MSs: Denmark, Sweden, Finland, and Estonia. For the sociocultural work, the following tasks will be undertaken:
Task 2.1. Socio-cultural importance and use of Baltic salmon and herring (IFM-AAU, UH, UOUL)
a) Undertake a literature review on the socio-cultural importance and use of Baltic salmon (M12); UH ; **b)** Undertake a literature review on the socio-cultural importance and use of Baltic herring (M12);UH; **c)** Conduct a minimum of 10 qualitative semi-structured interviews with key Stakeholder groups on the socio-cultural importance and use of Baltic salmon and herring in the selected case studies (M26); IFM-AAU (lead), UH; **d)** Conduct a socio-cultural valuation study of the ecosystem services and goods provided by salmon and herring, using Q-sorts or other suitable method (M36); UH (lead), IFM-AAU, UOUL; **e)** Selected interviews filmed and edited, feeding into public dissemination and outreach tasks (M32); IFM-AAU.
Task 2.2. Socio-cultural and political prerequisites for successful integrated fisheries governance (IFM-AAU, UH, UOUL, THL)
a) Undertake a literature review focusing on multi-level/nested governance, and on integrated governance overall and in the Baltic Sea; IFM-AAU (lead), UH, UOUL; (M12) **b)** Undertake a literature review of the legal and policy frameworks related to management of the Baltic salmon and herring, with the aim of assessing constraints and opportunities for changing the present institutional structures towards more integrated ecosystem-based and multi-level decision-making procedures; UH (lead), UOUL; (M12) **c)** Integrate Task 2.1 results to analyse how Baltic Sea governance structures and management are related to salmon and herring values (M30); IFM-AAU (lead), UH; **d)** Initiate a stakeholder consultation process (International workshop No1, M10) together with WP3, WP4, WP5 and WP6 on the need for scientific information on dioxin with eNGOs, consumers, and scientists, about their use of information, the sources of scientific information they use and the differences they perceive in the credibility and legitimacy of information sources for national and international marine science. The workshop will identify specific data needs for supporting ecosystem-based management, and how to produce research and expertise that could be easily transformed to policy advice. As output of the stakeholder consultation, management objectives for salmon and herring will be formulated in collaboration with WP3. IFM-AAU, UH (lead), UOUL, THL; **e)** Feed results into the Decision Support Model (WP6) in order to develop scenarios for nested and regionalised governance systems for Baltic Salmon and Herring management (M32), UH (lead), IFM-AAU, UOUL, THL.

Task 2.3. Elaborating draft scenarios at the pan-Baltic scale for changing governance structures based on inputs from Task 2.1, 2.2, WP3, WP4, WP5, and WP6. (IFM-AAU, UH, UOULU)
a) Expert workshop where drafts of the scenarios developed in WP2.2 (d) are presented and discussed with management experts (International workshop No2, M32); with participants from each Baltic EU MS; UH (lead), IFM-AAU, UOULU; **b)** Finalise scenarios for nested and regionalised governance systems for Baltic herring and salmon, based on feedback from the expert workshop and follow-up key informant interviews covering administrators in Baltic Sea countries, and fishing sector and eNGO representatives (M34); UH(lead), IFM-AAU. **c)** Provide options for delivering integrated scientific advice on a regional basis, particular emphasis is given to potential measures to reduce dioxin in Baltic salmon and herring. Building on close interaction with other WPs; UH (lead), IFM-AAU (M36).

Deliverables (brief description and month of delivery)
D2.1. Edited film short: Sociocultural traditions and values of Baltic salmon/herring (Month 26). Responsible partner: IFM-AAU.
D2. 2. Journal publication (submitted): The potential for changing the present institutional structures towards nested and integrated structures required by ecosystem based management, based upon current governance structures, management policies and policy performance (Month 30). Responsible partner: IFM-AAU.
D2.3. Journal publication (submitted): Comparative analysis of differing socio-cultural traditions and values of Baltic herring and salmon among Baltic Sea countries (Month 30). Responsible partner: UH.
D2.4. Report/MS: Governance structures related to ecosystem approach in the Baltic Sea: integrated management of Baltic salmon and herring at the regional, national and subnational level (Month 30). Responsible partner: UH.
D2.5. Report/MS: Scenarios for nested and regionalised governance systems of Baltic salmon and herring management and their evaluation by experts (Month 35). Responsible partner: UH.
D2.6. Report/MS: Sociocultural Valuation of Ecosystem Goods provided by Baltic salmon and herring (Month 36). Responsible partner: UH.

Work package nr	**3**	Start date: M1	End date: M28	
Work package title	**Scenarios and management objectives**			
Activity type	RTD			
Participant number	5	1	2	3	4
Participant abbrev.	UOULU	UH	THL	IFM-AAU	SLU
Person months per participant:	15	16	2	0	0

Objectives
1. Define objectives for integrated salmon and herring policy
2. Define pathways for reaching the objectives
3. Build exploratory future scenarios for eutrophication and dioxin input in the Baltic Sea, and for the use of Baltic herring and salmon

Description of work, tasks, and role of participants
The leader of WP3 will be Dr. Timo P. Karjalainen (expert in stakeholder involvement, UOULU) who will also be in charge of Task 3.1. Dr. Simo Sarkki (expert in scenario building, UOULU) will be responsible for Tasks 3.2 and 3.3. Dr Päivi Haapasaari (UH) will participate in each task.
The Common Fisheries Policy (CFP) aims at ensuring that marine resources are exploited in a sustainable environmental, economic, and social manner (CEC 2002). However, the Green Paper (CEC 2009) related to the reform of the CFP highlights that the economic and social objectives are neither clearly defined nor prioritized in relation to ecological objectives. In WP3, different stakeholder groups will be involved in defining and prioritizing management objectives for Baltic salmon and herring. Emphasis will be given to stakeholders' views and objectives related to the impacts of Baltic fish on human health. Tasks 2.1, 5.3 and

5.4 will form an informative context for the objective setting. The method of value-focused thinking (Keeney 1992) will be applied. The method is regarded fruitful in leading to thoughtful and innovative management options (Arvai et al., 2001; Gregory and Keeney, 1994).

Achieving the objectives in the long term is influenced by a myriad of factors, most of which relate to different political, economic, social, technical, climate change-related, etc. conditions in the future. For addressing these factors, a scenario analysis is needed. We will organize workshops for eliciting expert knowledge for building scenarios for 1) eutrophication, 2) dioxin input, 3) salmon policy, and 4) the use of herring catches, in the Baltic Sea up to year 2040. Scenarios are plausible and relevant stories about how the future might unfold, and the related uncertainties. Scenario building means a process of analyzing possible future events by considering alternative outcomes, and trends of drivers and factors (Carpenter et al. 2005; Kok et al. 2007). Scenarios for eutrophication are, in many respects, bound to changes in agriculture, whereas the outlook for the dioxin input is related e.g. to the development of and within the chemical, paper and metal industries. Human values (Task 2.1) are in a considerable role in the scenarios for salmon policy (allocation of salmon resource in the future), and herring use (human consumption, fur production, fish oil, other). An interesting question is whether reduced dioxin in catch could change the scenarios.

The aim in the participatory tasks is to create shared understanding among the participants in identifying relevant scientific, societal, and value-based issues. The functionalities of Opasnet will be utilized in these tasks, and the output of the workshops will work as input in WP2, WP5 and WP6.

Task 3.1. Defining desired future state and objectives for integrated salmon and herring policy (UOULU, UH, THL) (Month 12)

Representatives from different stakeholder groups (fishers, consumers, eNGOs, authorities, scientists) will be involved in defining and prioritizing biological, social, economic, and human health related objectives for integrated salmon and herring policy. First, a questionnaire study using internet based survey tool Webropol (www.webropol.fi) will be carried out targeted to stakeholder groups. The results of the questionnaire will be evaluated with stakeholders in the International Workshop No1 (month 10), and based on that, objectives and targets will be defined both in qualitative and quantitative terms (e.g. target % to decrease dioxin level in fish), in collaboration with WP2 (Task2.2). The method of value-focused thinking will be used. It is a systematic procedure for identifying and structuring values and objectives by dividing the objectives into a) fundamental - b) means - c) process-, and d) organizational objectives (Keeney, 1992). The method is expected to lead to thoughtful and innovative management options (Arvai et al., 2001; Gregory and Keeney, 1994).

Task 3.2. Identifying desirable future paths to reach the objectives (UOULU, UH, THL) (Month 20)

In the International Workshop No1 (month 10), defining the management objectives and targets for salmon and herring will be followed by identifying pathways to reach the desired management outcomes (e.g. what changes are needed, who should change and what, when). The proposed changes will be analysed backwards from the objective to the current situation, and a timeline for changes required to meet the future targets will be created. We apply the backcasting methodology (e.g. Robinson 2003), by not only focusing on desired outcomes, but also elaborating the processes needed to achieve the outcomes.

Task.3.3. Building scenarios (UOULU, UH) (Month 28)

An exploratory approach will be used in scenario building, based on existing large scale environmental scenarios (e.g. the Global Environmental Outlook), literature reviews (WP2), stakeholder interviews (WP2), the work on dioxin (WP5), and expert workshops (scientists, authorities, industry representatives). The aim is to: a) Build and explore four integrative scenarios for the future of Baltic salmon and herring regarding threats, state, impacts and governance responses, and; b) Build scenarios up to year 2040 for the needs of the Decision Support Tool (WP6) related to 1) eutrophication and 2) dioxin releases, 3) the use of Baltic herring, and 4) salmon policy, by taking into account different political, economic, social, technical, climate change-related etc. circumstances. For the Decision Support Tool (WP6) the probability of materialization of each identified scenario will be estimated by probabilities. Experts' views will also be interviewed in relation to potential management measures to decrease eutrophication and dioxin input in the Baltic.

Deliverables (brief description and month of delivery)

D3.1 Report/MS: Concretizing fundamental values to normative future targets: What are the objectives and outcomes of Baltic salmon and herring governance processes (Month 14). Responsible partner: UOULU.
D3.2. Online description of the scenarios developed, applicable in the dioxin model (Task 5.1) and decision support model of WP6 (Month 16). Responsible partner: UOULU.
D3.3. Report/MS: Exploring futures of Baltic salmon and herring by assessing potential impacts of ecosystem approach (Month 20). Responsible partner: UOULU.
D3.4 Report/MS: From context specifics to robust recommendations: targeted future proposals to make Baltic salmon and herring governance more sustainable (Month 24). Responsible partner: UOULU.
D3.5. Journal publication (submitted): Developing the scenario methodology in the context of complex multi-level fisheries governance (Month 26). Responsible partner: UOULU.

Work package nr	**4**	Start date: M1		End date: M34
Work package title	**Linking fish physiology to food production and bioaccumulation of dioxin**			
Activity type	RTD			
Participant number	4	1	2	5
Participant abbrev.	SLU	UH	THL	UOULU
Person months per participant:	32	5	2	3

Objectives

To resolve consequences of different management scenarios for herring and salmon growth, stock development and bioaccumulation of dioxins, explicitly taking size-dependent species interactions into account.

Description of work, tasks, and role of participants

Dr Anna Gårdmark (SLU) will lead WP4. She is expert on modelling marine species and food-web dynamics. Traditional approaches to model fish stock dynamics and management commonly ignore species interactions, as well as size- and food-dependent processes. This work package is based on the perspective that to understand population-level responses we need to base our understanding on energy utilization by individual organisms and interactions among individuals. To integrate over life histories we will use a model framework referred to as physiologically structured population models (PSPMs; Metz & Diekmann 1986). This framework is characterized by an explicit account of individual organisms and incorporates mechanistic representations of how individuals assimilate energy from food for maintenance, reproduction and development and how they engage in ecological interactions (competition for food and predation) depending on body size and condition. This will allow us to explicitly consider linkages between individual energy budgets, growth rates and bioaccumulation of dioxin, which is important as bioaccumulation depends on the attributes of organisms, such as body size and lipid content. This approach will be used in both WP4 and WP5, to analyze the consequences of management for herring and salmon growth (WP4) and bioaccumulation of dioxins (WP5). Specifically, the questions addressed are (i) How do size-dependent predator-prey interactions between salmon and herring modify herring and salmon population size structure and dynamics? (WP4) and (ii) How do herring population size-structure and individual body condition impact bioaccumulation of dioxins in salmon? (WP4 & 5). The combined results will be integrated into the decision support model for integrated governance (WP6). Results of the studies will also be presented in the International Stakeholder Workshops 1 and 2 (tied to WP2,3,5,6).
The results of the herring-salmon model will be used for scenario analyses of impacts of consumption patterns and fisheries management on bioaccumulation of dioxin in WP5. As sampling schemes of commercial fish stocks commonly include key information concerning both individual- and population-level characteristics (e.g. growth rates, body condition, biomass distributions), we will also contrast model predictions on size-at-age, body condition and population biomass distributions with monitoring data using time-series analysis. The biological input we provide based on our analyses of herring-salmon models will also contribute to Bayesian Belief Network modeling of integrated governance addressing the management questions at hand, to be developed in WP6.

Tasks
4.1 Derive size-dependent life history parameters for salmon to be used in model parameterization and analyses, **SLU** (Month 12)
4.2 Develop an existing PSPM parameterized for Baltic Sea herring (Huss et al. 2012) to also include salmon, based on above parameterization, **SLU** (Month 24).
4.3 Analyze the model over a productivity gradient to evaluate consequences of size-dependent salmon-herring interactions for community structure (biomass distribution between species), population structure (biomass distribution within species over body sizes), dynamics (population cycle length and amplitude) and individual life history (growth rate, fecundity and mortality), **SLU** (Month 28).
4.4 Manipulate herring population size-structure and body condition (set by food availability) to study how bioaccumulation (set to be proportional to lipid content) affect the transfer of dioxins from herring to salmon, **SLU** (Month 34).
4.5 Compile monitoring data on herring and salmon, including individual-level data such as size-specific body growth, to analyze the interdependence of herring and salmon populations using time-series statistics, **SLU,** (Month 24).
4.6 Compile output from model analyses (i.e. biomass, size-structure, size-at-age, dioxin levels etc) to feed into the integrated governance modeling (Decision Support Tool in WP6) aiming to evaluate potential management plans for Baltic herring fisheries (**SLU, UH, THL, UOULU**) (Month 28-34, following tasks 4.3 and 4.4).

Deliverables (brief description and month of delivery)
D4.1. Journal publication(submitted): Effects of size dependent interactions between herring and salmon on community structure and individual performance. (Based on analyses of monitoring data.) (Month 24). Responsible partner: SLU.
D4.2. Report/MS: Size dependent predator-prey interactions and the dynamics of herring and salmon in the Baltic Sea. (Based on model analyses.) (Month 30). Responsible partner: SLU.
D4.3. Report (model description for D5.3): Novel physiologically structured population model for herring and salmon to analyse bioaccumulation of dioxin in Baltic Sea fish (Month 34). Responsible partner: SLU.

Work package number	**5**	Start date: M1		End date: M36	
Work package title	**Linking the health of the Baltic Sea with the health of humans: Dioxin**				
Activity type	RTD				
Participant number	2	4	3	5	1
Participant abbreviation	THL	SLU	IFM-AAU	UOULU	UH
Person months per participant:	16	13	0	2	8

Objectives To resolve consequences of different scenarios of human consumption and fisheries management for bioaccumulation of dioxins in fish and consequences for human health.

Description of work, tasks, and role of participants
The leader of WP5 will be Dr Jouni Tuomisto, who has long experience in benefit-risk assessments related to dioxin containing foods. He represents THL, which has extensively studied dioxins for more than 25 years. SLU will lead Tasks 5.1 and 5.2.
Herring and salmon as fatty fish are healthy food, but they also contain harmful dioxins. Therefore, estimates of fish consumption and health benefits and risks are crucial in making rational policy about fish stocks and food recommendations. Dioxins enter the Sea as air fallout from land-based sources and via

waterways, and are spread all over the sea area. Dioxins are persistent and bio-accumulative, which means that the concentrations increase toward the top of the food chain (HELCOM 2004). Emissions have decreased, but dioxin levels in salmon and Baltic herring are still high (EP 2011).
The level of bioaccumulation in fish depends on food-web processes, as well as individual body growth of fish as dioxins are stored in fat tissue. Thus, bioaccumulation depends on the attributes of organisms, such as body size and lipid content. We will therefore analyze how alternative consumption demands and fisheries management scenarios affect bioaccumulation of dioxin in fish by explicitly accounting for linkages between individual energy budgets, growth rates and bioaccumulation, using the models and results from WP4.
The recommendation of the Finnish Food Safety Authority EVIRA for children, the young and young women for eating big herring (over 17 cm) or Baltic salmon is 1-2 times per month (Evira 2013). In Sweden, the current recommended maximum consumption of Baltic Sea herring and salmon for children up to 18 years and for young women is 2-3 times per year. For other groups the recommendation is once a week (Livsmedelsverket 2013).

Tasks

5.1 Effects of fishing on bioaccumulation of dioxins in herring (SLU) (M36)

Use the herring-salmon-dioxin model from WP4 to analyze the effect of different fisheries, parameterized to mimic current Baltic Sea herring fisheries aimed for food consumption or industrial use, leading to positively, negatively and neutrally size-selective fishing mortality, respectively, and study their differential impact on bioaccumulation, individual life history, population and community structure.

5.2 Herring fishing to reduce dioxin in salmon and herring (SLU) (M36)

Investigate alternative management schemes aiming to minimize bioaccumulation of dioxins in herring and salmon by systematically varying the level and size-selectivity of fishing mortality on herring in the novel herring-salmon-dioxin model from WP4.

5.3 Determinants of fish eating habits (THL, UH, UOULU) (M22)

The impact of different eating habits (demand of different sizes of herring) on the state of the fish stocks and finally the Baltic Sea will be examined. Also, determinants (such as age and knowledge about dioxins or recommendations) and trends in people's eating habits will be studied by using a questionnaire targeted to a large sample of consumers in selected case studies (different Baltic Sea countries). The results will be used in the scenario modelling related to the use of herring and salmon in WP3, and finally in the Decision Support Model of WP6. The analyses will help to understand how improved information for consumers may impact the consumption, and health benefits and risks related to the consumption.

5.4 Benefit-risk assessment of previous, current and future fish intake (THL) (Month 34)

THL has recently collected data about previous and current fish consumption in Finland, especially about Baltic herring. These data will be used to update the estimates about fish intake and also exposures to harmful (dioxin and other persistent pollutants) and healthy (omega-3 fatty acids, vitamin D) compounds in Baltic fish. A probabilistic benefit-risk assessment will be performed to inform policy makers about the health impacts of fish. Further, this assessment will be combined with the results of the other WPs to produce estimates of future health impacts of Baltic fish related to different policy options. These estimates will be used as input in the decision support model built in WP6.
A similar assessment will be produced for Sweden using their respective national data about fish consumption.

Deliverables (brief description and month of delivery)

D5.1 An open online model about dioxins in fish; human consumption; and health benefits and risks (Month 24). Responsible partner: THL.

D5.2 Journal publication (submitted): The health benefit-risk model results (Month 34). Responsible partner: THL.

D5.3 Report/MS: The role of size-selective fisheries on bioaccumulation of dioxins (Month 36). Responsible partner: SLU.

Work package number	**6**	Start date: M1	End date: M36	
Work package title	**Building a decision support model for integrated governance**			
Activity type	RTD			
Participant number	1	4	2	3	5
Participant abbreviation	UH	SLU	THL	IFM-AAU	UOULU
Person months per participant:	18	2	5	0	14

Objectives

Holistic decision analysis of Baltic salmon and herring fisheries and management measures aiming at social, biological, and health-related utilities

Description of work, tasks, and role of participants

Based on 1) the analysis of integrated ecosystem-based governance (WP2), 2) biological dynamics between salmon and herring stocks and the link of this to dioxin concentration (WP4), 3) Benefit-risk assessment of previous, current and future fish intake (WP5), 4) Definitions of management aims (WP3), and 5) Future scenarios for the use of Baltic herring and salmon, dioxin input, and eutrophication (WP3), a holistic Bayesian decision support model will be built for the integrated governance of Baltic salmon and herring. The model will be used to analyze the impact of salmon and herring and their management on each other, on the dioxin concentration and on human health under different scenarios, and the impact of the different management options on these. The management options that will be incorporated in the model relate to a) reducing dioxin in salmon and herring, b) sustainable use of salmon and herring, c) reducing eutrophication, d) guiding the consumption of salmon and herring, could benefit the society in terms of reduced dioxin in fish while at the same time ensuring sustainable catches for both species. Importantly, the model will be used to analyse fishers' commitment to the decision options that relate to fishing.

Moreover, as the core question of the whole project, the decision support tool will be used to analyse the success of different types of governance structures in implementing ecosystem based management, and the consequences of them from the perspective of decisions. Alternatives for the governance structures will be developed in WP2, focusing on policy dynamics and networking between sectoral, regional, national and subnational levels, and stakeholder/consumer interests. It will also be analysed which is the most beneficial governance level to involve stakeholders, if the aim is to enhance fishers' commitment to management decisions.

The tool enables an integrated risk analysis for examining biological, cultural, and governance-related uncertainties in relation to biological, social and governance-related utilities. A value-of-Information (VOI) analysis will be realized to propose priorities of research for policy, and a value-of-control (VOC) analysis to find out the most beneficial ways to control the system.

Task 6.1 Building the structure of the decision support model (UH, THL, UOULU, SLU) (Month16)

The preliminary model structure for the integrated Bayesian influence diagram will be specified will be built as a scientific desk work, in collaboration with other WPs. It will be presented in the International Workshop No 1, discussed, and modified according to stakeholders' feedback. Thereby, building the model structure means a problem framing for the whole project, as the stakeholders/experts may highlight issues that in project planning were not taken into account. The model will include 1) uncertain factors related to: salmon and herring dynamics and the use of these fishes in the future, dioxin, eutrophication, fishers' commitment, consumer values, and governance; 2) social, biological, and human health related aims, and 3) management alternatives to achieve the aims. The structure of the model will be checked and redefined during the research process as needed.

Task 6.2. Populating the conditional probability tables (UH, THL, UOULU, SLU) (Month 34)

The conditional probability tables will be populated using experimental data from the other WPs. In addition, literature, pre-existing simulation models, statistics, and expert knowledge will be used as needed to provide prior probabilities for the variables.

Task 6.3. Analysis of the decision support model (UH) (Month 36)
As one of the final tasks of the project, the decision support tool will be analysed, and the management consequences as well as consequences for future research elaborated. The analysis will inform the governance about the optimal decision combinations, as well as about the optimal type and structure of governance. The completed model including quantitative information will be presented in the International Workshop No2. The analysis will include a Value of Information (VOI) and Value-of-Control (VOC) analysis.

Deliverables (brief description and month of delivery)
D6.1. Integrated decision support model for Baltic herring and salmon (M36). Responsible partner: UH.
D6.2. Report/MS: Integrated multi-species decision support tool to reduce dioxin in Baltic salmon and herring in sustainable fisheries (M36). Responsible partner: UH.
D6.3. Report/MS: Analysis of the utility of different types of governance structures for ecosystem-based management of Baltic salmon and herring (M36). Responsible partner: UH.

Work package number	**7**	Start date: M1		End date: M36	
Work package title	Dissemination				
Activity type	OTHER				
Participant number	1	2	3	4	5
Participant abbreviation	UH	THL	IFM-AAU	SLU	UOULU
Person months per participant:	10	5	2	2	9

Objectives Disseminate results to stakeholders and authorities.

Description of work, and role of participants
Task 7.1 Preparing www-pages and flyers
At the outset of the project, www-pages and flyers presenting the project will be made.
Task 7.2 Developing and updating detailed communications plan
The aim of Task 7.2 is to organize different types of communication with stakeholders for the needs of WP2, WP3, WP4, WP5, and WP6. The communications plan will be updated periodically.

a) At the beginning of the project, interest groups / stakeholders related to the topic of the project (fisher organisations, authorities, decision makers, eNGOs, scientists) will be mapped, and informed about the project through 1) email and 2) in a meeting of the Baltic Sea Regional Advisory Council (BSRAC). All interest groups will be encouraged to follow the GOHERR www-pages, and communication will be active through the whole project.
b) The project will carry out total 40 interviews in four Baltic Sea countries (Finland, Sweden, Denmark, Estonia). The interviews cover all stakeholder groups (WP2).
c) Two questionnaire studies will be conducted: 1) A questionnaire study focusing on stakeholders' preferences about objectives for Baltic salmon and herring management will be targeted to a selected group of people representing relevant stakeholder organisations (WP3, by UOULU, UH), and 2) A questionnaire study focusing on consumers' eating habits related to Baltic salmon and herring, will be targeted to a wide sample of people from different Baltic Sea countries, month 18 (WP5, by THL, UH, and UOUL).
d) Two international workshops will be organized: 1) International Stakeholder Workshop No 1 (Month 10, Jan-Feb 2016), 2) International Stakeholder Workshop No 2 (Month 32, Nov 2017). The workshops will serve 1) data needs of WPs 2,3,5,6; 2) in establishing and maintaining interaction between the project and stakeholders, and 3) in presenting the aims, processes and results of the project (WP2, 3,4,5,6). The plan and program for the workshops will be defined in the Kick off meeting.
e) A Film short will be included on the website as a part of outreach (Month 20).

f) Two courses will be given for PhD students and PostDocs: 1) A course in marine governance in Aalborg University by IFM-AAU; 2) A course in decision analysis in the University of Helsinki by UH.

Task 7.3 Open linked data and models (UH, THL, IFM-AAU, SLU, UOULU)

The project will do its share in open linked data movement by opening up data and models that are collected or produced. The task will start from WP5 human data, month 6. Typically, the data will be opened when representative publications are published. Opasnet web workspace will be used as the main data repository. Others will pay special attention to the format of the data and models so that they will be easily reusable.

Deliverables timetable

D7.1 Project web-pages and electronic flyer (Month **2).** Responsible partner: UH.

D7.2a,b Report of student training in Task 7.2f (courses on marine governance (IFM-AAU and decision analysis (UH) (M34). Responsible partners: IFM-AAU and UH.

D7.3 Developing and updating stakeholder communication plan (Month 36, start M2). Responsible partner: UH.

D7.4 Online material in Opasnet (report) (M36). Responsible partner: UH.

D7.5 Open linked data and models (M36). Responsible partner: UH.

D7.6 Report of stakeholder communication and involvement in the project (M36). Responsible partner: UH.

8. Gantt chart to show the timing of different work packages and tasks

Work package	Task and Task Leader abbreviation	Months 1-12						Months 13-24						Months 25-36						M 37-38	Deliverables
WP1	1.1 Consortium's communications plan, UOULU	x																			
	1.2 Consortium management, UH	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
	1.3 Scientific and financial reporting, UOULU						x	x					x	x				x	x	x	D1.1.-1.4 –
WP 2	2.1a,b Undertake literature reviews on the socio-cultural use, value, and…, UH	x	x	x	x	x	x														D2.3, D2.6
	2.1c Conduct qualitative stakeholder interviews, IFM				x	x	x	x	x	x	x	x	x	x							D2.3, D2.6 D2.1
	2.1d Conduct a sociocultural valuation study of the ecosystem goods and…, UH							x	x	x	x	x	x	x	x	x	x	x	x		D2.6
	2.2 a-d Integrate results of tasks 2.1 into governance and policy structure work, IFM									x	x	x	x	x	x	x					D2.2, 2.4, 2.5
	2.1e Film selected stakeholder interviews and interactions, IFM				x	x	x	x	x	x	x	x	x	x	x	x	x				D2.1
	2.3 Finalize nested and regional governance scenarios, UH							x	x	x	x	x	x	x	x	x	x	x			D6.1 -6.2 D2.5
	2.2e Feed results for Decision Support Model, UH									x	x	x	x	x	x	x	x				D6.1 -6.2 D2.5
WP 3	3.1 Defining desired future state and objectives, UOULU	x	x	x	x	x	x														D3.1, 3.3
	3.2 Identifying desirable future paths to reach the objectives, UOULU						x	x	x	x	x										D3.4
	3.3 Scenario building, UOULU									x	x	x	x	x	x						D3.2, 3.5
WP 4	4.1 Derive size-dependent life history parameters for salmon to be…, SLU	x	x	x	x	x	x														D4.2 – 4.3
	4.2 Develop the PSPM parameterized for Baltic Sea herring to also include salmon, SLU				x	x	x	x	x	x	x	x	x								D4.2, 4.3
	4.3 Evaluate consequences of size-dependent salmon-herring interactions for…, SLU									x	x	x	x	x	x						D4.2
	4.4 Manipulate herring population size-structure and body condition to analyze its…, SLU									x	x	x	x	x	x	x	x	x			D4.3, D5.1

	4.5 Analyze the interdependence of herring and salmon populations from time series…, SLU	x	x	x	x	x	x	x	x	x	x	x	x								D4.1
	4.6 Compile output from herring-salmon model analyses to feed into the integrated…, SLU															x	x	x			D6.1
WP 5	5.1 Analyzing effects of fishing on bioaccumulation of dioxins in herring, SLU												x	x x	x	x	x	x	x		D5.3
	5.2 Analyze alternative herring fishing strategies to reduce dioxin in salmon and herring, SLU												x	x	x	x	x	x	x		D5.3
	5.3 Determinants of fish eating habits, THL						x	x	x	x	x	x									D5.1
	5.4. Benefit risk assessment of previous, current and future fish intake, THL	x	x	x	x	x								x	x	x	x	x			D5.2
WP 6	6.1 Building of the structure of the decision support model, UH	x	x	x	x	x	x	x	x												D6.1
	6.2. Populating the conditional probability tables, UH							x	x	x	x	x	x	x	x	x	x	x			D6.1
	6.3 Analysis of the decision support model, UH													x	x	x	x	x	x		D6.2 – 6.3
WP 7	7.1 Electronic flyer and project web pages, UH	x	x																		D7.1
	7.2 Developing and updating stakeholder communication plan, UH	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		D7.2a,b, 7.3, 7.6
	7.3 Open linked data and models, THL			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		D7.5, 7.4

9. Schedule of deliverables

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Est. pers months / instit.	Delivery date
D1.1	Periodic reports (12 months)	1	RE	RE	UOULU:2	Month 14.
D1.2	Periodic reports (24 months)	1	RE	RE	UOULU:1	Month 26
D1.3	Periodic reports (36 months)	1	RE	RE	UOULU:1	Month 38.
D1.4	Final report	1	RE	RE	UOULU:2	Month 38.
D2.1	Edited film short: sociocultural traditions and values of Baltic salmon/herring	2	PP	PU	IFM:3	Month 26
D2. 2.	The potential for changing the present institutional structures towards nested and integrated structures required by ecosystem based management, based upon current governance structures, management policies and policy performance	2	SP	(RE)PU	IFM:4 UH:2 THL:4	Month 30
D2.3	Comparative analysis of differing socio-cultural traditions and values of Baltic herring and salmon among Baltic Sea countries	2	SP	(RE)PU	UH:6 IFM:3	Month 30
D2.4.	Governance structures related to ecosystem approach in the Baltic Sea: integrated management of Baltic salmon and herring at the regional, national and subnational level.	2	RE(SP)	RE	UH:6 IFM:2 UOUL:2	Month 30

D2.5	Scenarios for nested and regionalised governance systems of Baltic salmon and herring management and their evaluation by experts	2	RE(SP)	RE	UH:6 IFM:2 UOUL:2	Month 35
D2.6.	Sociocultural Valuation of Ecosystem Goods provided by Baltic salmon and herring	2	RE(SP)	RE	UH:6 IFM:2 UOUL:6 THL:2	Month 36
D3.1.	Concretizing fundamental values to normative future targets: What are the objectives and outcomes of Baltic salmon and herring governance processes	3	RE(SP)	RE	UOUL:3 UH:3	Month 14
D3.2	Online description of the scenarios developed, applicable in the dioxin model (Task 5.1) and decision support model of WP6	3	PP	PU	UOUL:1 UH:1 THL:2	Month 16
D3.3	Exploring futures of Baltic salmon and herring by assessing potential impacts of ecosystem approach	3	RE(SP)	RE	UOUL:3 UH:4	Month 20
D3.4	From context specifics to robust recommendations: targeted future proposals to make Baltic salmon and herring governance more sustainable	3	RE(SP)	RE	UOUL:4 UH:4	Month 24
D3.5	Developing the scenario methodology in context of complex multi-level fisheries governance	3	SP	(RE)PU	UOUL:4 UH:4	Month 26
D4.1.	Effects of size dependent interactions between herring and salmon on community structure and individual performance. (Based on analyses of monitoring data).	4	SP	(RE)PU	SLU:11 UH:6	Month 24
D4.2.	Size dependent predator-prey interactions and the dynamics of herring and salmon in the Baltic Sea, model-based analyses	4	RE(SP)	RE	SLU:11 UH:1	Month 30
D4.3.	Novel physiologically structured population model for herring and salmon to analyse bioaccumulation of dioxin in Baltic Sea fish	4	RE	RE	SLU:10 UH:1 THL:2	Month 34
D5.1.	An open online model about dioxins in fish; human consumption; and health benefits and risks.	5	MO	PU	THL:8 UH:3 UOUL:2	M24
D5.2.	Health benefit-risk model results	5	SP	(RE)PU	THL:8 UH:2	M34
D5.3	The role of size-selective fisheries for bioaccumulation of dioxins	5	RE(SP)	RE	SLU:13 UH:3	M36
D6.1	Integrated decision support model for Baltic salmon and herring	6	MO	PU	UH:11,5 THL:4 UOUL:10	M36

					SLU:1,5	
D6.2	Integrated multi-species decision support tool to reduce dioxin in Baltic salmon and herring in sustainable fisheries	6	RE(SP)	RE	UH:3 UOULU:2	M36
D6.3	Analysis of the utility of different types of governance structures for ecosystem-based management of Baltic salmon and herring	6	RE(SP)	RE	UH:3,5 THL:1 SLU:0,5 UOUL:2	M36
D7.1	Project web-pages and electronic flyer (report)	7	RE/PP	PU	UH:3	M2
D7.2a,b	Student training reports	7	RE	PU	UH:1 IFM:1	M34
D7.3	Stakeholder communication plan	7	RE	PU	UH:1 UOUL:1	M36 (start M2)
D7.4	Online material in Opasnet (report)	7	RE	PU	UH:4 THL:3	M36
D7.5	Open linked data and models	7	RE	PU	UH:4 THL:2 SLU:2 UOUL:3	M36
D7.6	Report of stakeholder communication and involvement	7	RE	RE/PU	UH:1 UOUL:1 IFM:1	M36

10. Milestones

Milestone number	Milestone name	Work packages involved	Expected date	Means of verification
MS 1	First Stakeholder meeting	WP 2, 3, 6 and 7	Month 10	Number of attendants, report
MS 2	Management objectives	WP 3, 2 and 6	Month 12	MS Written (first draft version)
MS 4	Scenarios for salmon, herring, dioxin and eutrophication	WP 3, 2, 4, 5 and 6	Month 16	MS Written (first draft version)
MS 3	First version of statistical model for decision analysis	WP 6	Month 18	Draft version of decision support model
MS 5	Trends and impacts of eating habits	WP 5	Month 22	MS Written
MS 6	Output from salmon-herring model for the Decision Support Model	WP 4	Month 33	MS Written
MS 7	Second Stakeholder meeting	WP 7, 6, 3 and 7	Month 32	Number of attendants, report
MS 8	Final integrated Bayesian model	WP 6	Month 33	Completed decision support model

B. Quality of the consortium and efficiency of implementation

11. Participants and management of the project

The project will be coordinated (WP1) by UH. Professor **Sakari Kuikka (fisheries science),** will be the project manager. He has been a member of the Scientific, Technical and Economic Committee for Fisheries (STECF) (European Commission) for 12 years, and has wide perspective to fisheries management research. He has coordinated 2 EU framework projects, 1 BONUS project (IBAM), and several other projects. Prof. Kuikka leads the Fisheries and Environmental Management Group (FEM-group) of UH, which was evaluated among 10 best research groups (of 130 evaluated) in UH and as third in the category 5: societal impact (http://www.helsinki.fi/science/fem/evaluations.html; UH 2012). The FEM group focuses on the interaction between ecosystems and human society. The group is advanced in interdisciplinary risk and decision analysis using the Bayesian methodology and has developed applications in several projects (ECOKNOWS, PRONE, JAKFISH, IBAM, POORFISH, EVAHER, EVAGULF, MIMIC, OILECO, OILRISK, PROBAPS, PROMOS, SAFGOF).
Dr. **Päivi Haapasaari (cultural anthropology, fisheries management, UH, FEM-group)** will lead WP2 and WP6. She has a considerable role in WP3 and participates also WP4 and WP5. She is experienced in risk and decision analysis using Bayesian networks, risk governance, and human-induced uncertainties. She has worked both with Baltic salmon and herring. Professor **Samu Mäntyniemi** (multidisciplinary risk analysis of Baltic Sea, FEM-group, UH) will provide expertise in probabilistic model developments, as in-kind work.

Chief researcher **Jouni Tuomisto** (Dr Med Sci, adjunct professor) from THL will lead WP5. Tuomisto has 20 years of expertise in environmental health, toxicology, risk assessment, decision analysis, and decision support. He is a key person in the development of the *Opasnet* and *Open Policy Practice*, and he is expert in benefit-risk assessment of dioxin-containing foods. THL has studied dioxins for more than 25 years.

Associate Professor **Alyne Delaney** (Dr, **Cultural Anthropology**) (IFM-AAU) will be the Primary Investigator for IFM-AAU. Dr. Delaney has extensive experience serving in EU 5,6, and 7 Framework projects, as workpackage and task leader (e.g. VECTORS, PKFM, UNCOVER, etc.) for cultural as well as governance related research. Professor **Jesper Raakjaer** (Dr; Fisheries and marine governance, IFM-AAU) will provide input into the governance sub-tasks given his significant intellectual theorizing and publications on EU marine governance. Drs. Raakjær and Delaney and IFM-AAU staff have extensive experience in conducting interdisciplinary research with biologists, ecologists, economists, political scientists, historians, and sociologists. Their work centres on bringing social science research perspectives and data into policy and research.

Associate Professor **Anna Gårdmark** (SLU) will lead WP4. Dr Gårdmark and **Dr Magnus Huss** (SLU) are leading scientists on size-structured dynamics of interacting fish species in the Baltic Sea, and **Dr Johan Östergren** (SLU) and his group are experts on Baltic Sea salmon dynamics and responses to human pressures. Assoc Prof Anna Gårdmark (SLU) is also contributing to the development of novel forms of ecosystem-based advice for multi-species fisheries management in the Baltic Sea and the group of Johan Östergren (SLU) are directly involved in the assessment of Baltic Sea salmon and fisheries advice.

Senior research fellow **Timo P. Karjalainen** (Dr, Adjunct Professor in Environmental Sociology) will be the Principal investigator for UOULU (Thule Institute), and will lead WP3. Dr **Simo Sarkki** (Adjunct Professor in Environmental Anthropology) will take the responsibility of Task 3.3. Drs. Karjalainen and Sarkki have worked in several interdisciplinary EU projects and worked extensively on the citizen and stakeholder involvement in complex policy decisions, and have designed and led successful stakeholder processes involving scientists, agency representatives and civil society groups. They have also published on transdisciplinary knowledge integration and scenarios as well as on decision analysis methods and ecosystem services.

Each partner institute (except IFM-AAU due to the budget cut) will employ a PhD student or a PostDoc for the project.
The consortium consists of social scientists (majority), fisheries scientists, and medical scientists, and is ideal for responding to Themes 4.1 and 4.2 of the Strategic Objective 4 of the BONUS Call. All partners have actively been involved in planning the proposal. The skills of the team cover the needs of the project: governance, scenario building, stakeholder involvement, objective setting, decision support tools, predator-prey interactions, impacts of dioxin, etc. We prefer a small consortium because it provides a more efficient framework for getting to know each other, for interaction between researchers, for learning, and for managing and committing to the

whole project by each participant. Haapasaari et al. 2012b showed that a small team is more capable of interdisciplinary work.

The work package leaders will monitor the progress of the work and identify problems, and report to the project manager. The project coordinator and manager put together the periodic and final reports to the funding organization. The work package leaders will also report on how data is managed, and ensure that data will be loaded to the open Opasnet web space. The coordinator will prepare issues of decisions, in collaboration with project manager, to be discussed and decided in project meetings, or in urgent issues, via Skype. In GOHERR, division between women and men is about half-half.

12. Overall budget

WP	Task	Personnel	Other direct costs					Sub-contracting	Total
			Travel and meetings	Support activities	Equip-ment	Disse mi-nation	Other direct costs		
	1.1 Consortium's communications plan	5700							5700
	1.2 Consortium management	17100							17100
	1.3 Scientific and financial reporting	34200						10000	44200
WP2	2.1a,b Undertake literature reviews on the sociocultural use, value…	22800	3134						25934
	2.1c Conduct qualitative stakeholder interviews	35526	17630		250				53406
	2.1d Conduct sociocultural valuation study of the…	95084	3134						98218
	2.2 Integrate results of tasks 2.1 through 2.3 into governance…	129332	1587						130919
	2.1e Film selected stakeholder…	24126	1587						25713
	2.3 Finalize nested and regional governance scenarios	55408	3134						58542
	2.2e Feed results for DSM	5700	2263						7963
WP3	3.1 Defining desired future state and objectives	72372	1999						74371
	3.2 Identifying desirable future paths to reach the objectives	44448	1999						46447
	3.3 Scenario building	67888	2454	4501					74843
WP4	4.1 Derive size-dependent life…	26300	1361		868				28529
	4.2 Develop the PSPM …	31560	1361		868				33789
	4.3 Evaluate consequences of…	26740	1361		868				28969
	4.4 Manipulate herring population size-structure and body…	49588	1361		868				51817
	4.5 Analyze the interdependence of herring and salmon…	48660	1361						50021
	4.6 Compile output from herring-salmon model analyses…	43400	2856		868				47124

WP5	5.1 Analyzing effects of fishing on bioaccumulation of…	40110	2569		868				43547
	5.2 Analyze alternative herring…	45370	2569		868				48807
	5.3 Determinants of fish eating…	77236	2473	7000					86709
	5.4. Benefit risk assessment of…	60712	911						61623
WP6	6.1 Building of the structure of the decision support model	68676	2560						71236
	6.2. Populating the conditional…	85412	2560						87972
	6.3 Analysis of the decision support model	68500	1213						69713
WP7	7.1 Electronic flyer and project web pages	17100	607			2000			19707
	7.2 Stakeholder communications plan	44008	2778	45000					91786
	7.3 Open linked data and models	103176	12778			15000			130954
Total without overheads		1446234	79600	56501	6326	17000		10000	1615661
Indirect costs		289253	15920	11300	1265	3400			321138
Total		1735487	95520	67801	7591	20400		10000	1936799

Table 6g Budget breakdowns by WPs and partners

Partner	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total	Total incl indirect costs
UH	10000	153580	95557	31258	46640	111965	90610	539610	645533
THL		38353	12784	12784	109268	31959	36959	242106	290528
IFM-AAU		152033					44973	197006	236409
SLU				180823	73432	11030	16030	281316	337581
UOULU	57000	56731	87321	15382	11346	73967	53876	355622	426748
SUM	67000	400695	195661	240247	240687	228922	242448	1621660	1936799

13. Summary of staff effort

Participant no./abbreviation	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total person months
UH		26	16	5	8	**18**	**10**	83
THL		6	2	2	**16**	5	5	36
IFM-AAU		**16**	0		0	0	2	18
SLU				**32**	13	2	2	49

UOULU	10	10	**15**	3	2	14	9	63
Total	10	58	33	42	39	39	28	249

14. Description of the significant facilities and large equipment available for the project: Not relevant

15. Support activities

The project will include active interaction with stakeholders and experts (other scientists, authorities). Email, project www-pages, and Opasnet www-space will facilitate this. The project will be introduced in meetings of BSRAC, and in the context of the interviews (tot 40) (WP2) in four BS countries (FI, SWE, DE, EST). Two international workshops will be organized: 1) International Stakeholder Workshop No 1 (Month 10, Jan-Feb 2016), 2) International Stakeholder Workshop No 2 (Month 32, Nov 2017). The workshops will support the project in establishing and maintaining active interaction with stakeholders, and in making the project familiar. Expert workshops (WP3) will make the project known for other scientists, authorities and other potential experts. A publicly available film short will be included on the website/Opasnet webspace of the project, and it may initiate new contacts. The Opasnet web space will facilitate sharing data, knowledge, models etc. among and beyond the project researchers. For instance, the scenarios (WP3) and the decision support model (WP6) will be openly published there. This provides a possibility for external researchers/stakeholders to comment on the contents and the quality of the project material.

16. Training plan

The project provides an interdisciplinary and transdisciplinary learning environment for PhD students and post docs. An important aim of the project is to enhance expertise in environmental and fisheries social sciences. UH will employ a PhD student (MA, MSosSci) with the aim of training in Bayesian networks, to be supervised by P. Haapasaari. Research institute THL will employ a PostDoc researcher (or a PhD student) under supervision by J. Tuomisto. In SLU, part of the work will be done by a PhD-student that will be hired for the project, supervised by A. Gårdmark, M. Huss, and/or J. Östergren. In UOulu, part of the work (participatory and interdisciplinary scenario work and transdisciplinary research) will be done by a PhD-student that will be hired for the project. Two university courses will be given for PhD students and PostDocs: 1) A course in marine governance, in Aalborg University by IFM-AAU; 2) A course in decision analysis, in the University of Helsinki by UH (Task 7.2).

17. Subcontracting

Project subcontracting consists of costs for certificates for financial reports for participants UH.

18. Addressing state aid obligations

The consortium does not include enterprises or commercial related activities.

19. Possible risks and their management

We do not see major risks in the implementation of the project. The consortium is small, and therefore each research institute and researcher has a significant role in the project. Thus, a small risk would be that some of the key persons left her/his institute. This would require replanning the distribution of work, and familiarizing new persons with the tasks. Another risk is the cutting of BONUS funding, but we could adapt to that by decreasing the tasks. The aim of recruiting PhD students or post-docs may include a risk of not finding persons that commit to the project and to completing the GOHERR research. Thorough job interviews will help in selecting the best available researchers for the project. The PhD theses must not be completed within the time horizon of GOHERR project, as they will be partly funded by other projects/partner institutes. Senior researchers will lead and contribute to the work of GOHERR in each partner institute and will advise the work of the PhD students/PostDocs. Thus, involving PhD students in the work will not cause major risks for the completion of GOHERR deliverables.

C. Potential impact

20. Policy relevance and results' end users

GOHERR responds to the main objective of the **Baltic Sea Action Plan** and **EU Marine Strategy Framework Directive** to restore a good environmental status in the Baltic Sea by 2021. In particular, the objectives related to viable populations of species, and the safety of fish for consumption will be addressed. The project acknowledges that one of the qualitative descriptors for determining good environmental status referred in the MSFD is that contaminant concentrations in fish do not exceed levels established by the EU legislation or other standards. The project will also elaborate the impact of eutrophication on herring and salmon. GOHERR will increase understanding of the complexity of the ecosystem structure and its functioning by addressing the knowledge gaps regarding the interaction between Baltic salmon and herring, and bioaccumulation of dioxin in these fishes. GOHERR will build scenarios for the use of Baltic salmon and herring and consequent dioxin intake by humans for the future, and examine the impact of potential measures to reduce dioxin in catch, and to influence consumers' behaviour. The implementation success of the management measures targeted at fishermen will be assessed through the analysis of fishermen's commitment to the measures. The project will provide new information on the levels of contaminants in the seafood, in the current situation and for the future. Thus the project will create an analytical bridge between the health of the Baltic Sea and the health of humans.

Both BSAP and MSFD explicitly call for the implementation of the ecosystem approach to management in responding to the environmental challenges of the marine ecosystems. By developing a multi-species governance framework for Baltic salmon and herring, GOHERR improves the understanding of what ecosystem based management means in practice. GOHERR will focus on interaction between salmon and herring, and interaction between these fish stocks and human society. GOHERR will analyse how integrated governance and compatible management measures of salmon and herring, could ensure the sustainable use of both species, while taking into account the interaction between these species.

The project will analyse how changes in size-structure and body growth dynamics of herring affect the salmon stocks, and what is the impact of this on the high post smolt mortality of salmon. Thus the project responds to the **EU 2020 Biodiversity Strategy** which aims at reversing biodiversity loss by ensuring sustainability of fisheries.

The **BSAP** acknowledges the importance of public engagement and stakeholder involvement in activities promoting a healthy Baltic Sea. This is also written in the **MSFD,** and in the **Common Fisheries Policy (CFP).** GOHERR will analyse how the socio-cultural context and values have shaped the governance, policies, and policy performance of Baltic salmon and herring, and involves stakeholders in designing and evaluating tailor made integrated governance structures for the multi-species management of salmon and herring. Thus, GOHERR brings new value-based aspects to bridging science and policy. The aim is to examine the potential of nested multi-level (local/subnational, national, regional /international) governance structures involving stakeholders, to improve fisheries management and the overall ecological status of the Baltic Sea.

GOHERR will apply a novel stakeholder approach with continuously evolving shared information objects. In practice, this means that we will open a separate web page in Opasnet for each important policy-relevant question within the domain of GOHERR, and produce data and conclusions on those pages on a continuous basis. Thus, these pages will act as the up-to-date information storage for the work done. A critical part of this work is to invite stakeholders to participate in the discussions about these topics in such a way that the feedback obtained also affects the subsequent work done. In this way, we will improve the policy relevance of the scientific work done within the project, shorten the delays from research to practical implementations, and improve active communication between all parties.

Responding to the aims of **Integrated Maritime Policy** (IMP), GOHERR contributes to enhancing the sustainable use of the Baltic Sea and to building a knowledge base for the use of maritime policy. GOHERR will produce new biological, human health related, and social knowledge related to Baltic salmon and herring stocks and develop coherent policy measures and governance strategies to ensure sustainable use of the fish stocks by taking into account local cultural and social factors. By elaborating the question of bioaccumulation of dioxin in fish and the impact of dioxin in humans, and the possibilities to minimize these, the project will contribute to enhancing the quality of life in the coastal regions. GOHERR focuses on integrated management of salmon and herring. Thus it contributes to developing integrated ecosystem approaches and coherent decision-making tools for maritime policy. GOHERR analyses potential of multi-level governance in enhancing commitment of fishermen to management decisions, current and future use of salmon and herring, and the impact of this on fishing livelihood. Thus it explores the opportunities for marine and maritime sustainable growth, and contributes to the aims of Blue Growth.

GOHERR provides output for the calls of **Marine Knowledge 2020** initiative by providing new inter-operable knowledge regarding salmon and herring: 1) interaction between salmon and herring; 2) social and cultural values in different Baltic Sea countries; 3) governance structures for ecosystem based management; in an open format (web workspace Opasnet) that is freely accessible for industry, public authorities, researchers and society. In addition, the project will provide state of the art Bayesian stock assessment methodology for both species.

GOHERR will produce new information and tools for the whole society for the consideration how the consumption of local sustainable fish could replace imported fish and other less sustainable or less ethical food resources. This would increase the value of Baltic herring and salmon for consumers. Baltic salmon and herring could even become desired fish for people favoring sushi or other ethnic or local food trends. An image of Baltic Sea as a source of healthy fish could increase the value of the whole Sea. This would also build a stabile basis for viable fishing industry, providing employment and opportunities for coastal communties, as stated in the **CFP.** Thereby GOHERR can strengthen the link between the Baltic Sea and the people living in the Baltic Sea countries.

The whole society will be end users of GOHERR project results that will improve knowledge on the health impacts of Baltic salmon and herring on humans. Fisheries and environmental managers in the EU and in the Baltic Sea countries can use the output of the project in their overall designing work related to ecosystem based, multi-species - , and integrated governance. For managers focusing on Baltic salmon and herring the project provides new knowledge for planning policies and measures both for the long and short term. For authorities responsible for human health and nutrition the results are useful for revising the recommendations for Baltic fish intake. Fishers can benefit from decreasing uncertainty related to the dynamics of salmon and herring stocks, and of the potential of reduced dioxin levels in salmon and herring, especially if this can improve the value of catch. For scientists, GOHERR will produce useful new data, knowledge, future scenarios for the Baltic Sea, and a holistic risk analysis and decision support model, all of which will be freely available in the internet. Finally, consumers will benefit of GOHERR, especially if increased understanding on the bioaccumulation of dioxin in fish will lead to management measures that can reduce dioxin content in catch. The project integrates also scientific disciplines, as emphasised in the Strategic research agenda 2011-2017 of BONUS programme.

The project team involves members of 1)The Scientific, Technical and Economic Committee for Fisheries (STECF) (prof. Kuikka, associate prof. Alyne Delaney), 2) Working Group for Baltic Salmon and Trout (WGBAST) of the International Council for the Exploration of the Sea (ICES) (prof. Mäntyniemi), and Working Group on Comparative Analyses between European Atlantic and Mediterranean Marine Ecosystems to move towards and Ecosystem-based Approach to Fisheries (WGCOMEDA) (Dr Gårdmark). This will facilitate the inclusion of the biological and governance results to the assessment and management of stocks. The project results will be published both in scientific journals, in popular publications and in fishermen’s journals, and in the public web workspace Opasnet.

21. Plan of submitting project data to a common database and handling of intellectual property rights

GOHERR commits to the principles of free and open exchange of data, knowledge, and open-access publishing of the Council of Europe, related to scientific results of publicly funded research. However, data collected through questionnaires and/or interviews of stakeholders cannot be published as such, because of confidentiality issues. The contents of the data collected from stakeholders will be analysed, and published in the form of journal articles or separate analyses, without referring to individual informants. In special cases, such as the edited film short related to sociocultural traditions and values of Baltic salmon/herring (Task 2.5), the permission for publishing will be asked from the interviewed person(s).

The project will do its share in open linked data movement by opening up data and models that are collected or produced. The task will start from WP5 human data, month 6. Typically, the data will be opened when representative publications are published. Opasnet web workspace will be used as the main data repository. Special attention will be paid to the format of the data and models so that they will be easily reusable by others. D7.5 will report what kind of data and models has been produced and published, and their availability.

22. Communication and dissemination plan

After the Kick off meeting which is expected to build a good basis for efficient communication between project partners, periodical project meetings will maintain active relationships within the small consortium. The participants will be in close contact throughout the project via e-mail, SKYPE and video conferences whenever necessary. Communication will serve the sharing of information, participation in decision-making, sharing scientific results, informal discussions, administrative tasks, reporting and, building and achieving efficient interdisciplinary teamwork. Project website, Opasnet web space, and flyers will ensure that not only project participants, but also stakeholders, authorities, scientists and other end-users will be continuously informed, and that they will gain availability to the outputs of the project. Active contact with the BSRAC is regarded important. Two International Stakeholder workshops and several expert workshops will be organized to serve communication with stakeholders. GOHERR has strong policy implications and thus active and timely contact with end users is essential.

Research findings will be published in international peer-reviewed journals, and at the minimum, five manuscripts will be submitted for publication during the project. We prefer publishing in open access journals. Opening up data and models for interested users in the Opasnet is part of the project plan. Opasnet web workspace will be used as the main data repository. Special attention will be paid to the format of the data and models so that they will be easily reusable by others. In addition, popular articles will be published in national level newspapers, professional journals or other relevant journals/magazines. This is the main media to disseminate results to general public.

Dissemination of know-how implies training of PhD students and PostDocs. Each partner (except IFM-AAU due to budget cut) will employ and supervise the work of at least one PhD student or post-doc, related to GOHERR.

Administrative coordination between the BONUS EEIG and participants will be the responsibility of project coordinator and project manager (UH). The consortium communications plan will be updated as need arises, at least once a year. The coordinating participant UH will act as the intermediary between all parties.

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LIST OF POTENTIAL ETHICAL ISSUES:

(Note: Research involving activities marked with an asterisk * in the left column in the table below will be referred to Ethics Review automatically)

	Research on Human Embryo/ Foetus	YES	Page
*	Does the proposed research involve human embryos?		
*	Does the proposed research involve human foetal tissues/ cells?		
*	Does the proposed research involve human embryonic stem cells (hESCs)?		
*	Does the proposed research on human embryonic stem cells involve cells in culture?		
*	Does the proposed research on human embryonic stem cells involve the derivation of cells from embryos?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	x	

	Research on Humans	YES	Page
*	Does the proposed research involve children?		
*	Does the proposed research involve patients?		
*	Does the proposed research involve persons not able to give consent?		
*	Does the proposed research involve adult healthy volunteers?		
	Does the proposed research involve Human genetic material?		
	Does the proposed research involve Human biological samples?		
	Does the proposed research involve Human data collection?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	x	

	Privacy	YES	Page
	Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?		
	Does the proposed research involve tracking the location or observation of people?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	x	

	Research on Animals	YES	Page

	Does the proposed research involve research on animals?		
	Are those animals transgenic small laboratory animals?		
	Are those animals transgenic farm animals?		
*	Are those animals non-human primates?		
	Are those animals cloned farm animals? I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	x	