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Arctic Games

– Interactive development and application of a transdisciplinary framework for sustainable governance options of Arctic natural resources

A project in the research programme Mistra Arctic Futures in a Global Context, funded by the Foundation for Strategic Environmental Research

Project plan

Enveco Environmental Economics Consultancy Ltd., Sweden[1]

in cooperation with

The Centre for Economic and Financial Research (CEFIR), Russia
Northern Research Institute (NORUT), Norway
The Royal Institute of Technology (KTH), Sweden
Stockholm University, Sweden
University of Nordland, Norway

MISTRA
THE SWEDISH FOUNDATION FOR STRATEGIC ENVIRONMENTAL RESEARCH

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1. Introduction

The future development of the Arctic region is of interest for the entire world. The area is biologically connected to the rest of the world by, for example, migrating fishes, whales and birds. In the Arctic region there is also a multitude of unique non-migrating life forms, highly adapted in their life history, ecology and physiology to the extreme and seasonal conditions of their environment (Gradinger et al. 2004). Several of the habitats and plant and animal species in the area are threatened (CAFF 2010), and preserving biodiversity and assessing the resilience of present ecological systems in the area is, in effect, an important task. Further, the Arctic is the region where the environmental impacts of climate change are most strongly expressed (Gradinger et al. 2004). The Polar Regions work as cooling systems for the Earth and global warming causes ice melting and sea level rise (Chapin et al. 2006). Thus, environmental changes in the Arctic will change conditions for societies both within the area and in the world as a whole. The Arctic is also an area of strategic interest concerning issues such as extraction of natural gas and oil, fishery, tourism, shipping, etc. (AGP 2010). An increasing global scarcity of vital natural resources, advances in extraction and communication technology, and global warming, will change the stakes of nations and other actors in the area. Tradeoffs between different financial, social and ecological interests are unavoidable, and the crucial challenge is to find tradeoffs that are consistent with sustainable development and are implemented by efficient and accepted governance structures.

The Arctic marine area includes both national territories and international space, and territory claims of nations have been a problematic issue (de Roo et al. 2008). For example, the territorial borders between Norway and Russia caused a 40-year old dispute, which was finally solved last year (NMFA 2010). The environmental governance of the Arctic consists of a vast number of conventions, programmes, projects, forums and networks – in the range from binding to non-binding, governmental to non-governmental, global to local, general to specific (de Roo et al. 2008). However, in contrast to the situation in the Antarctic, which is governed by the Antarctic Treaty (1959) and the Protocol on Environmental Protection to the Antarctic Treaty (1991), there is no legally binding treaty covering the entire Arctic and its range of issues (Nowlan 2001).

The opinions of how to govern future challenges in the Arctic diverge among the scientific community. Several experts highlight the advantages with the current system, covering a range of different governance approaches, where for example many indigenous stakeholders are involved (Young 2002). Others emphasize the need for further tools to meet future challenges, and promote a common treaty, similar to the Antarctic governance (Nowlan 2001, Rayfuse 2008). It has also been argued that the future of the Arctic is dependent on a multifaceted approach that, for example, identifies the Arctic change most likely to alter human well-being within and outside the area (including externalities), explores opportunities for desirable ecological and social change, and identifies institutions poised to implement policies at appropriate scales (Chapin et al. 2006).

Areas and regions with open access, unclear property rights or diffuse governance structures are often characterized by over-exploitation (e.g. Berkes et al. 2006, Ostrom 2009). Use of game theory to analyze incentives among different stakeholders might help explaining this problem: players act rationally by e.g. maximizing their own profits, given expectations of other players' strategies. This might not result in the best common solution and outcome of the game. Tucker (1950) exemplifies this by the famous "prisoner's dilemma". Problems related to the difficulty of governing commons are often lack of coordination, information

and common rules (Ostrom 1990). Such common rules and agreements could change the conditions of the game and make stakeholders act differently. However, the real-world situation is typically much more complicated than the prisoner's dilemma example, concerning available strategies, types of payoffs and amount of players.

The research on Arctic governance has resulted in a vast number of recommendations on how to cope with future challenges (see e.g. Chapin et al. 2006, Nowlan 2001, Young 2002 or Rayfuse 2008). However, the outcomes of these suggested governance options are uncertain, and depend on the future development in the region, concerning e.g. the environmental status, the political situation, and economic incentives regarding natural resources. Hence, there is a need for a framework to analyze the outcomes of potential governance options under various scenarios. This is of importance in order to meet future challenges concerning a sustainable governance of the Arctic and its natural resources.

2. Project purposes and expected results

In order to contribute to meet the future challenges concerning a sustainable governance of the Arctic and addressing how to find tradeoffs that are consistent with sustainable development and are implemented by efficient and accepted governance structures, a transdisciplinary and international research project called *Arctic Games – Interactive development and application of a transdisciplinary framework for sustainable governance options of Arctic natural resources* was applied for within the 2010 call of the Foundation for Strategic Environmental Research (Mistra) for projects in the research program *Mistra Arctic Futures in a Global Context*. In December 2010, Mistra decided to assign SEK 6.6 million to the project for the period of 1 January 2011-31 December 2013. This implied a budget cut corresponding to 45 % of the budget for the project in the original proposal. This project plan is a revised version of the proposal based on the resources available for the project.

The focus of the revised project will be on the phase called the "framework phase" in the original proposal and trying to develop a solid framework that can be subject to in-depth application in a second Mistra call, if any. This conceptual work should be combined with empirical work, but resources do not allow the in-depth application work described in the original proposal. It is of importance for the relevance of the project to work on a local to international scale. In the original proposal, the project consisted of four work packages (WPs). In comparison to the original proposal, the change in focus affects in particular WP3, reformulated below. The communication activities of former WP4 are reduced significantly and WP4 is excluded. Communication activities are to some extent included in WP1, however they will mainly be handled on program level.

2.1 Purpose

The project will approach the following issues:

i. How to use game theory, cost-benefit analysis, economic valuation methods, and governance tools for analyzing problems involving natural resource scarcity and strategic behavior in the Arctic Region. (WP2, WP3)
ii. From a game theoretic and governance perspective illustrate the incentives, interactions and potential conflicts between different key actors in the Arctic Region. We will aim to identify key parameters that are sources to conflict as well as parameters that facilitate cooperation and solutions. (WP2)
iii. What are the economic outcomes of Arctic natural resource policy-making? What are the distributional effects? (WP3)
iv. How can the economic value of Arctic ecosystem services be assessed? (WP3)

The purpose of Arctic Games is to approach these issues by developing a transdisciplinary framework for analyzing incentives and conditions for sustainable governance options of Arctic natural resources examining actors' behavior in the Arctic under various scenarios of future development. The framework will mainly be based on game theory, governance theory, and economics. The governance analysis provides foundations for the initial conditions of the games (rules and players) as well as for changed conditions, i.e. common agreements. The economic part of the project focuses on a) development and application of a cost-benefit framework to analyze the economic outcomes (payoffs) from Arctic natural resource policy-making and b) assessment of economic valuation methods and how they can be used for valuation of Arctic ecosystem services and c) application of a non-market valuation method for valuation of Arctic ecosystem services.

Another purpose of Arctic Games is to contribute to an improved social scientific capacity in Sweden on Arctic issues and at the same time build international research cooperation. The project also wants to broaden and show the scientific and policy relevance of social science in Swedish polar research.

2.2 Expected results

The main outcomes of the project will be the following:

- An evaluation of the approach of working with a transdisciplinary framework to analyze and assess governance options for sustainable use of natural resources in the Arctic.

- An economic approach of how to assess costs and benefits resulting from Arctic policy-making. The approach includes economic effects from a changed provision of ecosystem services.

- A theoretic analysis of incentives for and interactions among actors with interest in natural resources in the Arctic region and implications for sustainable governance options.

- A substantially increased socio-economic knowledge base through scientific papers accomplished through interdisciplinary and international cooperation in the project, and also an improved research capacity in Sweden regarding the Arctic through the involvement of PhD students and researchers at different Swedish organizations.

- A provision of new knowledge to decision-makers and other involved actors regarding issues analyzed in Arctic Games, and a development of a framework that is available also after the project for further analyses regarding a sustainable use of natural resources in the Arctic.

- Arctic Games will also provide general knowledge to the scientific community on how to use game theory, cost-benefit analysis, economic valuation methods and governance tools for analyzing problems involving strategic behaviour, natural resource scarcity in regions with open access, unclear property rights or diffuse governance structures.

3. Project work

3.1 Building a framework

The analytical framework of WP2 and WP3 will be developed by using a representative case study, which in itself is general enough to be interesting and applicable in other geographical areas and for similar Arctic issues. The case study will be used for illustrating potential conflicts connected to natural resource distribution that is of general interest in the Arctic. Hence, the case study needs to be representative both in its geographical character and concerning the issue of natural resource distribution. However, the approach of using a case study for developing the framework will also facilitate the structural thinking of integrating the different methods and disciplines used in this project.

The conceptual model for the analytical framework is illustrated by figure 1. The working steps together involve all WPs, and it is important that the process is iterative and flexible, to enable adjustments and optimizing for the framework. The initial step (0) is to find a case study to analyze and formulate potential, reasonable scenarios for development of natural resource use. To form appropriate structures of games, we need to map actors, economic activities and governance structures. In step 1 we focus on the mapping of potential stakeholders, economic activities and existing governance structures. The mapping of involved stakeholders will be linked to economic activities in the area, as well as mapping of ecosystem goods and services. The governance mapping will include studies of institutions, networks, legislations and power relations. Altogether this step will generate information about potential players and strategies (rules) in a potential game situation. The strategic interaction in the Arctic region will be analyzed using game theory. Identifying the relevant game theoretic tools and parameters to model potential conflicts will be essential in addition to identifying key actors, strategies and payoffs. This step will thus give examples of and information on how to use game and governance theory to structure and analyze situations characterized by the types of resource conflicts found in the Arctic.

Step 2 implies introducing a broader, general cost-benefit analysis framework since the initial game structure can be expected to only involve a partial picture of costs and benefits to society. In particular, the value of ecosystem services is likely to be missing because of their non-market nature. In order to make the games more consistent with sustainable development, this step therefore involves developing an approach for assessing the economic value of Arctic ecosystem services by applying, for example, the framework of MEA (2005). This approach will i) map the existence of natural resources in the area, ii) describe qualitatively what these imply in terms of ecosystem goods and services to different stakeholders, and iii) assess the feasibility of different economic valuation methods (see e.g. Freeman 2003 for an overview). This is crucial information for the relevance of a minor valuation study that possibly will be carried out within the project as well as for future economic valuation studies on ecosystem services in the Arctic. The analysis in step 2 is important for the games in terms of information about pay-offs for different players in the game.

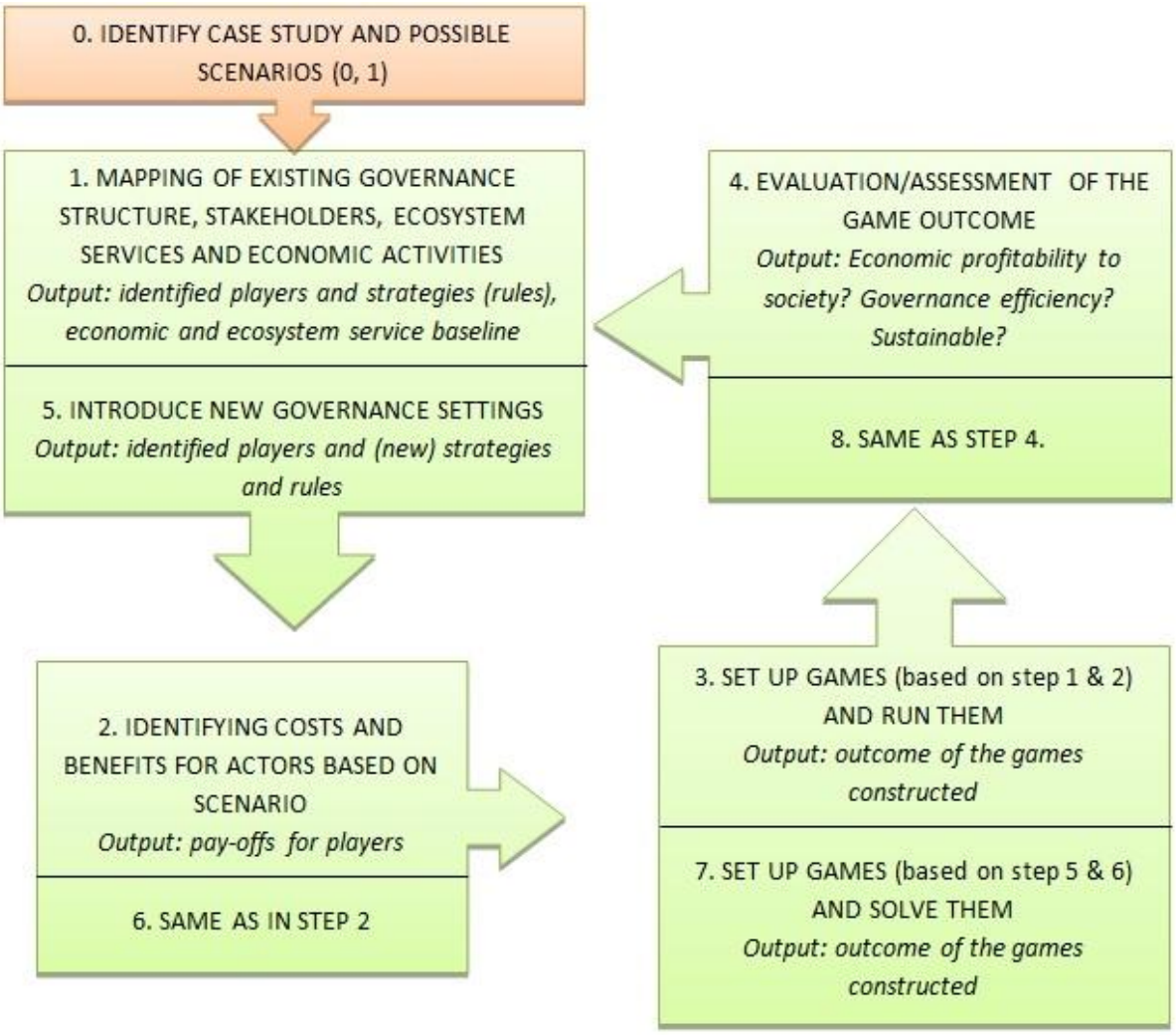

Figure 1. Conceptual model for the analytical framework of Arctic Games

The two firsts steps will give the information needed for setting up a game scenario. Thus in step 3, we use the information from steps 1 and 2 to set up games and solve them. The output of step 3 will be the result and outcome of the games constructed. Finally, in the first cycle, this outcome will be evaluated in step 4, in terms of governance efficiency and economic benefits for society regarding sustainable use.

Based on the evaluation of the game outcomes, hypothetical governance structures could be introduced in next cycle. This would create new rules in step 5, which might also change the pay-offs in step 6. Thus, the game is re-constructed in step 7 with the new information, where a new equilibrium could be identified. In step 8, the outcomes of the games are evaluated. It involves assessment of whether the added governance structures imply a more sustainable development for the case study and potentially if it could be generalized to other Arctic areas with similar characteristics.

3.2 Applications

As mentioned above, the project aims at working with a case study for illustrating the framework and work tasks for developing the framework. A relevant case study has to be characterized by the presence of a typical conflict for the Arctic region, for example, between conservation and financial interests. The case study to work with will be selected during the

first project year. Additional case studies might be selected if resources allow and if this is judged to be needed for the purpose of, for example, testing aspects of the framework.

A proposed case study to work with for developing the framework could be e.g. Lofoten in northern Norway. Lofoten hosts different potential conflicts of interest. Industries such as the shipping industry produce externalities affecting the fishing industry. There are strong financial interests driving oil extraction on one hand and interests of conservation and tourism striving towards establishment of a World heritage area (NME 2011). For the moment the Norwegian government has decided not to extract oil in the area. However for the long-term perspective the development of the area might change.

3.2.1 Data collection

For WP2, in order to construct the games essential information would be; the set of players, their strategies and their pay-offs. The data that have to be collected can mostly be gathered by literature studies and existing sources, however gathering of data through questionnaires, interviews, or focus group discussions would facilitate refining data and define important features of the governance mapping and power relations. WP2 needs to collect data on:

- Governance mapping including existing legislation such as national legislation and management plans, international legislation etc (see figure 1).
- Stakeholder mapping on important actors/players for the games (see figure 1).
- Power relations, local communities' possibility to participate and affect decisions, etc.
- Relevant tools for governance and stakeholder mapping, and game theoretical tools.

For WP3, the following data collection will be required:

- Mapping of economic activities (compile already existing information) – feeds into step 1 of the conceptual model (see figure 1) where an economic reference alternative is identified.
- Literature review of already existing costs and benefits of a changed provision of ecosystem services for a chosen case study – feeds into step 2 of the conceptual model (see figure 1). The review will identify important data and knowledge gaps.
- Carrying out a minor non-market valuation study on ecosystem services for a chosen case study in order to fill some key knowledge gaps – feeds into step 2 of the conceptual model (see figure 1).

3.2.2 Scenarios

The case specific scenarios in this application should be interpreted as the potential outcomes of the games, which is formulated in the initial step of the work cycle (see figure 1). General scenarios might also be used for forecasting the overall development of the Arctic region.

3.2.3 Stakeholder group

A stakeholder group will be connected to the work with each case study within the project. The stakeholder group will mainly serve two purposes: i) providing data for the specific case and ii) for assessing the relevance of results.

3.3 Reporting

Arctic Games will report annually on progress and development of the project work. In addition, several scientific publications are planned, see section 5 for details.

4. Organization

4.1 Project team

Six organizations participate in Arctic Games, with Enveco as a coordinator. The team is well-established through earlier collaborations and consists of both senior and young researchers with a wide span of expertise and includes Arctic competence. Furthermore, the team reflects an equal gender distribution and the number of young researchers will help securing a knowledge base of Arctic issues for the future. Enveco has experience both from coordinating international research projects such as BalticSurvey (2009-2010) (a part of the BalticSTERN research network, see http://www.stockholmresilience.org/research/balticstern) and participating in large-scale multi-disciplinary research projects involving stakeholder interaction, such as the EU FP6 integrated project SPICOSA (2007-2011) (http://www.spicosa.eu). Besides in BalticSurvey and SPICOSA, partners in the team have cooperated in the Swedish EPA project Economic Marine Information (2008-2009) and the research program PlusMinus (2007-2011), funded by the Swedish EPA (http://plusminus.slu.se). Below, the involved organizations and researchers are presented (alphabetically by organization).

The Faculty of Social Sciences at the University of Nordland is a major centre for education and research in the field of social science in Norway. The faculty has active researchers in disciplines like sociology, anthropology, history, journalism, political science, social work and psychology. Research done by the faculty takes shape also as applied and cross-disciplinary projects in resource management and northern studies. Several faculty members participate in international research networks. (http://www.uin.no)

Audun Sandberg is professor in sociology, and a senior member of the proposed research team. His research fields are e.g. institutional theory and analysis, institutions for resource governance and property rights regimes. Since the 1970´s, he has been involved in a large number of research projects, both national and international, focusing mainly on institutional aspects of governing environmental resources. 2007-2011 he participated in the project SPICOSA – Science and Policy Integration for Coastal System Assessment – together with Enveco.

The Centre for Economic and Financial Research (CEFIR) is an independent economic policy think tank established in Russia in 2000. CEFIR researchers use advanced methods of economic analysis and contribute to the formulation of Russia's economic and social policy by informing policymakers and the public about the costs and benefits of specific policy actions. CEFIR brings together 30 young Russian economists, and many researchers hold PhDs from leading Western institutions. (http://www.cefir.ru)

Sergey Izmalkov will be the senior game theorist in the project, working as a technical advisor to the project team. He is PhD in Economics (Pennsylvania State University, 2002) and MSc in Mathematics (Moscow State University, 1994), and has a position as Assistant Professor at Department of Economics at MIT since 2002. He has a profound experience in various game theory issues and has in particular studied mechanism design and auction formats. His research reflects efforts to combine theories and tools from different disciplines, e.g. example computer science and game theory in a US National Science Foundation project on cryptographic game theory. Besides game theory, his teaching at MIT has involved contract theory, econometrics and microeconomics.

Yulia Khaleeva has an experience in statistical and econometrical data analysis, preparation of proposals, reports and other documentation, organization of surveys, questionnaire preparation. She has also an experience in participating in environmental economics projects.

Enveco Environmental Economics Consultancy Ltd. was established in 2004. Enveco carries out analyses, research, education and training in environmental economics and ecological economics. Enveco's staff has qualifications in the fields of economics, political science and environmental science. One of the specialities is economic valuation of the environment, for example as part of a cost-benefit analysis. Since its establishment, Enveco has been the main coordinating body of several research projects, both nationally and internationally. (http://www.enveco.se)

Frida Franzén is analyst at Enveco since 2006 and MSc in Environmental Science. She is also a PhD student at the Department of Land and Water Resources Engineering at the Royal Institute of Technology and the School of Life Science at Södertörn University College. Her research focuses on governance and social aspects of natural resource management. She has participated in several international projects dealing with policies of relevance for aquatic systems, in particular the implementation of the Water Framework Directive.

Linus Hasselström is MSc in Economics, Stockholm University (2005). Linus is an analyst at Enveco, and his research has involved economic analyses of policy instruments against environmental pollutants and eutrophication, economic valuation of environmental change, cost-benefit analyses and the development of primary data studies. He has been involved in several national and international projects, mainly focusing on the marine environment.

Gerda Kinell is MSc in Economics and is an analyst at Enveco. Her work has involved economic analysis of environmental problems in the coastal zone, cost-benefit analysis and development of default monetary values for environmental change. Currently, she works with system approach methodology and close stakeholder involvement in the EU research program SPICOSA.

Åsa Soutukorva is environmental economist and Information Director at Enveco. She is MSc in Public Administration and Economics (1998), Umeå University. In the years of 2000-2005, she was a research assistant at the Beijer Institute of Ecological Economics. Her main focus has been on economic (non-market) valuation of ecosystem services/environmental change and cost-benefit analysis, but also other environmental economics issues such as application of multi-criteria analysis. She has also given a large number of lectures and seminars in environmental and ecological economics.

Tore Söderqvist is Research Director at Enveco and Associate Professor of Economics at the Stockholm School of Economics. In the years of 1996-2006, he was a research associate at the Beijer Institute of Ecological Economics. He has participated in numerous interdisciplinary research projects and has also coordinated several international projects. His main research topics include economic (non-market) valuation of ecosystem services and cost-benefit analysis in an interdisciplinary setting, but also institutional design of environmental policies and applications of multi-criteria analysis. His publications include two books, 29 peer-reviewed scientific articles, 36 popular science texts/government reports and 2 databases.

Northern Research Institute - NORUT is an applied research institute with offices at several places in Northern Norway, about 120 employees, and with both technological and social science departments. NORUT specializes in research on northern and Arctic issues, including marine and terrestrial environmental and natural resource management, industrial and regional development, and international cooperation and relations. (http://www.norut.no)

Eirik Mikkelsen is an economist and research director for social sciences in NORUT Tromsø. He has research experience from both Norwegian and international projects on coastal and marine management, and projects on regional development in the Norwegian North. He has practical experience from international environmental cooperation in the North, and is currently involved in a large Norwegian research-project on the Geopolitics of the high North.

The Division of Environmental Strategies Research (FMS), Department of Urban Planning and Environment, Royal Institute of Technology (KTH) aims to develop solutions for, knowledge on, and debate around environmental problems that require long-term solutions. This is primarily done through multi-disciplinary research. FMS studies interconnections between environmental issues, technological developments and societal change. The problems may be globally important or important for Sweden, a sector, a company or an agency. Today, FMS is primarily active in three areas: Future Studies, processes of change and tools for Environmental Assessment and Management. (http://www.infra.kth.se/fms)

Cecilia Håkansson obtained her PhD in Economics in 2007 at the Department of Forest Economics at the Swedish University of Agricultural Sciences (SLU)- Umeå. In 2009 she received Kungliga Skytteanska samfundets (the Royal Skytteanska Society) prize to a promising young researcher. She has work experience from cost-benefit analysis, bio-economic studies, non-market valuation, benefit transfer, distributional issues, and valuation (preference) uncertainty.

Maria Noring is a PhD student at the division. Her focus is environmental valuation and during the latest years she has been working as research engineer, with applied values in environmental assessment methods such as cost-benefit analysis and life-cycle costs. She has also investigated issues such as the usability as well as the usage of different tools for assessing the environment.

Stockholm University, Department of Economics. Stockholm University is one of the largest universities in Sweden with 50.000+ students. The Department of Economics hosts around 70 professors and PhD candidates with a wide range of research interests, such as industrial organization, public economics, economics of integration etc. (www.ne.su.se).

Eric Sjöberg is a PhD student at the department. His research interests are applied econometrics and game theory. He has worked as a teacher assistant at undergrad econometric courses and is currently also involved in a project evaluating environmental inspections in Sweden.

4.2 Project structure

The project consists of the following three work packages:

WP1: *Project management.* WP1 will lead and coordinate the project. Personnel in WP1: Tore Söderqvist (Enveco), project director; Gerda Kinell (Enveco), project manager.

WP2: *Governance and game theory.* WP2 is responsible for research on governance and game theory in the project. The main objectives are: a) identify actors with interest in or concern by activities in the Arctic (i.e. nations, organizations, populations, companies etc.) and b) identify existing governance structures (i.e. agreements, legal frameworks etc.) in the Arctic. The mapping in a) and b) will serve as a crucial input for setting up an initial game structure for analyzing strategic incentives for natural resource extraction in the Arctic. WP2 also needs to explore appropriate methodological tools for this type of issues and scientific focus. WP2 aims at locating incentives and conditions for a governance structure leading to a sustainable resource extraction in the Arctic. WP2 leader: Frida Franzén (Enveco). Other WP2 participants: Linus Hasselström (Enveco), Sergey Izmalkov (CEFIR), Gerda Kinell (Enveco), Eirik Mikkelsen (NORUT), Audun Sandberg (University of Nordland) and Eric Sjöberg (Stockholm University).

WP3: *Cost-benefit analysis and ecosystem services.* WP3 is responsible for the economic research in the project. By developing and applying a general cost-benefit analysis framework, WP3 aims to analyze the economic outcomes (payoffs) from Arctic natural resource policy-making. One important issue is to analyze how costs and benefits are distributed among different actors. Furthermore, as part of the cost-benefit analysis framework, WP3 will develop an approach for assessing the economic value of Arctic ecosystem services by applying, for example, the framework of MEA (2005). This approach will i) map the existence of natural resources in the area, ii) describe qualitatively what these imply in terms of ecosystem goods and services to different stakeholders, and iii) assess the feasibility of different economic valuation methods (see e.g. Freeman 2003 for an overview). One potential issue is to look into how valuation results are taken into consideration in Arctic policy-making. Also, a local survey on people's attitudes to the Arctic and its provision of ecosystem goods and services will be carried out. The data will be used to conduct a minor valuation study, and will also serve as a pre-study for more large-scale future valuation studies in the Arctic. The cost-benefit analysis framework developed in WP3 is intended to be generally applicable to various empirical settings in the Arctic. The usefulness of the framework will be exemplified in many ways. Important knowledge and data gaps will be identified and thereby WP3 will guide and facilitate future empirical work. WP3 leader: Åsa Soutukorva (Enveco). Other WP3 participants: Linus Hasselström (Enveco), Cecilia Håkansson (KTH), Yulia Khaleeva (CEFIR), Gerda Kinell (Enveco) and Maria Noring (KTH).

5. Communication

Well-structured communication is important for the outcome of the project, as well as for its publicity. The original proposal contained a separate WP4 for communication and described a communication strategy targeting four groups: 1) *Scientists*, 2) *Users*, 3) *the Public and 4) Media*. Due to the revised budget, WP4 has been excluded, and Arctic Games will focus on producing the deliverables listed in table 1. Other communication activities are of great importance for the project as well as for the Mistra Arctic Futures program as a whole and have to be organized at a program level. Continued communication of the results from the

project should be ensured also after the project is completed, and we suggest this to be resolved in dialogue with the program.

Most of the deliverables in table 1 are of importance to report on the scientific achievements and to provide users with readily applicable results. At least five academic paper manuscripts will be produced in the project and the scientific problems presented in table 1 are preliminary issues to address in these papers.

Table 1. Deliverables from Arctic Games.

Type of deliverable	**Responsible**	**Targeted group**	**Due (month)**
Annual project reports and the last project report (month 36) will be a final conclusive project report	WP1 with support from WP2 and WP3	Scientists and users	12, 24, 36
Academic paper manuscript 1: A general framework for cost-benefit analysis in the Arctic – how are costs and benefits of Arctic policy-making distributed? Applicability and usefulness in other Arctic settings.	WP3	Scientists	24
Academic paper manuscript 2: Game theory – what does the incentive structure look like, regarding sustainable distribution of scarce resources in the Arctic?	WP2	Scientists	24
Academic paper manuscript 3: An application of the framework in the Arctic– how well does it suit reality?	WP2, WP3	Scientists	36
Academic paper manuscript 4: A general framework for economic valuation of ecosystem services/natural resources provided in the Arctic.	WP3	Scientists	36
Academic paper manuscript 5: Governance aspects in the Arctic – existing governance and proposed changes.	WP2	Scientists	36
Doctoral dissertations, to the extent that papers are used by the involved PhD students in their theses.	WP2, WP3	Scientists	36 or later

6. Budget

The budget proposed in the application had to be revised due to the budget cut of 45%. In the redistribution of the budget was guided by two criteria: (i) to put priority on resources to PhD students within the project in order to secure the desirable capacity building on Arctic issues and (ii) to keep all partners in the project to ensure a desirable international network. In general, each partner lost manmonths corresponding to the work of at least one year in the initial budget. For several partners a significant share of the remaining resources are allocated to PhD students: Stockholm University (19.8 manmonths), KTH (12.3 manmonths) and Enveco (12 manmonths).

The budget for Arctic Games is presented in table 2. Amounts for data collection, travels etc. is to cover activities undertaken by all partners in the project.

Budgets

		Person-months (number)	Personnel (SEK)	OH-costs personnel (SEK)	Other OH-costs (SEK)	Data collection, software, equipment (SEK)	Meetings, seminars, travels (SEK)	Other costs (SEK)	*Total (SEK)*
Nordland	Year 1	0,67	55541	19439		0	0	0	74980
	Year 2	0,67	58318	20411		0	0	0	78729
	Year 3	0,67	61234	21432		0	0	0	82666
	Total for Nordland	*2,01*	*175093*	*61283*		*0*	*0*	*0*	*236376*
CEFIR	Year 1	2,00	150000	11250		0	0	0	161250
	Year 2	2,00	157500	11813		0	0	0	169313
	Year 3	2,00	165375	12403		0	0	0	177778
	Total for CEFIR	*6,00*	*472875*	*35466*		*0*	*0*	*0*	*508341*
Enveco	Year 1	12,40	679000	237650	49000	30000	85000	25000	1105650
	Year 2	12,40	712950	249533	49000	30000	85000	25000	1151483
	Year 3	12,40	748598	262009	49000	30000	85000	25000	1199607
	Total for Enveco	*37,20*	*2140548*	*749192*	*147000*	*90000*	*255000*	*75000*	*3456739*
KTH	Year 1	5,14	279000	97650		0	0	0	376650
	Year 2	5,14	292950	102533		0	0	0	395483
	Year 3	5,14	307598	107659		0	0	0	415257
	Total for KTH	*15,42*	*879548*	*307842*		*0*	*0*	*0*	*1187389*
NORUT	Year 1	0,50	42976	15041		0	0	0	58017
	Year 2	0,50	45124	15793		0	0	0	60918
	Year 3	0,50	47380	16583		0	0	0	63964
	Total for NORUT	*1,50*	*135480*	*47418*		*0*	*0*	*0*	*182898*
SU	Year 1	4,00	149033	52162		0	0	0	201195
	Year 2	6,25	244508	85578		0	0	0	330085
	Year 3	9,00	369696	129393		0	0	0	499089
	Total for SU	*19,25*	*763237*	*267133*		*0*	*0*	*0*	*1030370*
Total for all partners	Year 1	24,71	1355550	433192	49000	30000	85000	25000	1977742
	Year 2	26,96	1511350	485660	49000	30000	85000	25000	2186010
	Year 3	29,71	1699880	549480	49000	30000	85000	25000	2438360
	Total for all partners	*81,38*	*4566780*	1 468 332	*147000*	*90000*	*255000*	*75000*	*6602112*

Table 2. Budget for Arctic Games

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