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# **Review of the Role of Science in Cooperative Fisheries Management**

Version One

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## 1 Introduction to SAFMAMS

This is the draft version of a Review of Role of Science in Local Cooperative Management produced as part of the SSA project SAFMAMS<sup>1</sup> (Scientific Advice for Fisheries Management at Multiple Scales) funded through EU's 6<sup>th</sup> Framework Program.

The objective of SAFMAMS is to draw insights from existing research projects and management processes on the most useful forms of scientific advice for marine environmental management and to communicate those insights to scientists and decision makers. The product will be an outline of the various forms that such advice can take and a description of the circumstances under which these various forms are the most useful and cost effective.

The research in SAFMAMS is carried out on different levels to address the important issue of scale in scientific advice and the translation into management. SAFMAMS will investigate the use of scientific advice at: the European level; the level of the shared seas (i.e. activities around the formulation of the Regional Advisory Councils); and the sub-national level in relation to cooperative "co-management" programs.

## 2 Introduction to the Review

The review presented here serves several purposes:

First it should give an overview of present tendencies in scientific advice produced in research projects in Northern Europe. The overview is meant to inform on the kinds of scientific knowledge used to produce the advice; the scale of the research; the types of advice produced; the methods used for disseminating the results; the intended users; and the implications of these factors on sub-national fisheries co-management.

The second purpose of the review is to serve as the point of departure of conversation between project scientists in SAFMAMS and local stakeholders. The main themes of the conversation are:

- *What types of scientific advice is helpful in local co-management?*
- *What are the possibilities and problems in interfaces between scientific and experience based knowledge?*
- *How can scientific advice be improved to be of better use in local management?*

This second purpose could not be achieved without the co-operation of local stakeholders in the three selected local study areas.

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<sup>1</sup> For further information on SAFMAMS go to [www.ifm.dk/safmams](http://www.ifm.dk/safmams)

SAFMAMS needs the input of local experiences and examples to evaluate the main findings in this review, but more importantly: *to understand the implications of scientific knowledge on local management efforts.*

Therefore stakeholders involved in co-management around the Wash and North Norfolk Coast European Marine Site (UK), the Koster-Väderöfjord shrimp fishery (Sweden) and the Pärnu Bay (Estonia) were asked to offer their reactions and comments to the draft review. The stakeholders were also asked to share their experiences of the local management situation, and the use of scientific knowledge in local management. Results from the local study areas will be presented later on in this review.

The review does *not attempt to present an exhaustive list of all projects involved with different aspects of local management.* Rather it presents overall tendencies in current fisheries-related research and the scientific advice produced as a result of it.

The SAFMAMS process will culminate in workshops with representatives from all three areas to present and discuss the final review. During the workshops the stakeholders will be asked to design the forms of advice that they find the most useful for addressing their management problems.

Eventually, this will conclude in a Best Practices for Provision of Scientific Advice to Sub-national Fisheries Management.

The social-scientific theoretical and methodological implications and concerns in doing the review have been kept to an absolute minimum to make the review as accessible as possible to a great variety of stakeholders. Still the main elements of theoretical and methodological references and accountings for are presented.

### **3 Methods and theoretical framework**

#### ***3.1 Review of European research projects***

During the collation phase for this review a total of 188 research projects have been analysed for their implications on local fisheries management. Also a large number of research reports and literature have been studied to collect information on the use of scientific knowledge at a local scale.

The projects stem from a wide range of financing sources and involve many different universities and institutions in Northern Europe. The projects are funded through multinational, European, national or private sources. The projects and reports investigated were funded or produced by:

- The European Commission: 5<sup>th</sup> Framework Program and 6<sup>th</sup> Framework Program
- The Nordic Council of Ministers
- The International Council for the Exploration of the Sea, ICES (funded by 19 nations)
- The Helsinki Commission, HELCOM (funded by the member states)

- The International Baltic Sea Fishery Commission, IBSFC
- The Foundation for Strategic Environmental Research (MISTRA)
- National governmental efforts in EU countries or accessing countries.
- Regional efforts
- Non-governmental efforts (WWF etc.)
- Co-funded projects with a mix of the partners listed above.

The projects analysed in this review are/have been running between 2000 and 2008. The project descriptions were supplied by the organisations and institutions listed above on web sites, in project reports and by personal communication.

A question-sheet<sup>2</sup> to identify local co-management projects was distributed among relevant stakeholders at the initial part of the project. Sadly, the turnout of this effort was not as good as expected (only 18 examples not already included in other information with implications for local fisheries co-management was reported back<sup>3</sup>). Still, as the review is based on a large number of projects from the main funding sources, the results should be representative. The fact that not many *research projects were reported back from the local management level* is even consistent with the general findings in this review. This will be investigated further later on.

Project descriptions (containing objectives; partners; methods; type of scientific advice produced; dissemination method; and project outlines) have been sorted using a number of categories. *The categories were designed to provide insights as to what kinds of scientific advice are produced by whom, how and for what ends.* The categories were:

- **Research objective**
  - o “Basic science”
  - o “Applied science”
  - o Main objective/ focus of research.

The objectives in the research projects can be separated into two main categories: basic and applied research. Following the definitions in the Frascati Manual (OECD 2003; and Bonus Publications 2005, 13):

*“Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular aim or objective. The results of basic results are usually published in scientific journals or circulated to interested colleagues.”*

*“Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Applied research develops ideas into operational forms.”*

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<sup>2</sup> The question-sheet is presented in the appendix.

<sup>3</sup> The 18 research projects were financed through a combination of national, regional and NGO efforts. These projects were mainly concerned with technical solutions to conflicts with fish-eating species (seal, cormorant etc); restoration of coastal areas; or efforts to combine fishery with other sources of income (eco-tourism, refinement etc.). The focus of the projects was the local scale.

There is no clear-cut line between basic and applied research, most often the projects will entail some of both elements during different phases of the project, or the responsibility of the research types will be divided to different partners. Still, the category “basic research” is in this review defined as research that has *an emphasis* on producing or testing new knowledge of the underlying foundations of phenomena and observable facts, *without any defined applicability outside of the scientific community*. The category “applied research” is here defined as research that is primarily carried out with the explicit intention to be used for practical aims or objectives.

- **Type of scientific knowledge used in the project**

- o Natural science
- o Socioeconomic science
- o Scientific knowledge integration: uni-, multi- or interdisciplinary. Cooperation between which types of scientific knowledge.

Traditionally, scientific research has been separated by disciplinary boundaries, and even more so by the distinction between natural, social, art science. The modern focus on problem-oriented research has questioned these boundaries, and interdisciplinarity is often used as a key-concept in research application and project descriptions. However, the implications of “interdisciplinary” are often vague, and therefore the level of integration between the disciplines can be investigated further by using the concepts of uni-, multi-, or interdisciplinarity (Egneus 2000, Klein 1996).

- **Scale of research project**

- o European level
- o Regional level (shared seas level)
- o Local level.

The subject of scale is the key to the SAFMAMs project. It is assumed that the geographical scale of the environmental management problem is the most important variable in determining what kind of advice that will be most efficient (Degnbol, 2003). The two main reasons for this is that the larger the scale the more aggregated data must be used to create a picture of the condition of the natural systems; and that the larger the scale the more social interests and political jurisdictions are involved in decision making.

Scale in marine science:

The scales used in marine science have traditionally been based on single species perspectives. Local data collected was aggregated and generalised to give information on the general condition for the species. Even though the ecosystem approach is now lifted, there is still a tendency to focus on single species, and there is confusion on how to define the ecosystem. The knowledge produced is aggregated from the local, specific to the generalised, higher level (from local samplings to create an estimate of entire species – often shared seas level).

Scale in management:

Management, on the other hand, is based on the human structures in society. Local management is based on local socio cultural and economic structures (community-based). The knowledge needed at this level is specific: understanding changes in the local ecosystem – not entire species, but the interplay between human activity and local ecosystem factors. The advice needed at this level is highly local and should allow for quick adaptations to change (flexibility, response to change).

• **Intended user/recipient of scientific advice:**

- o Other scientists
- o Decision makers at all levels
- o Managers at all levels
- o Local stakeholder groups/users.

No further explanation needed for this category.

• **Use of experience based knowledge (EBK), (local, non-scientific knowledge) and stakeholders in research project:**

- o No use of EBK or stakeholders
- o Use of stakeholders in data collection
- o Use of stakeholders in monitoring
- o Results merely presented for the stakeholders
- o Use of EBK in evaluating the research results
- o Use of EBK as equal part of the collected information
- o Use of EBK in disseminating the results
- o Use of EBK in all phases of the process, including project partnership.

Experience based knowledge (EBK) is local, non-scientific knowledge. This kind of lay knowledge is well documented and studied within several social scientific disciplines (anthropology and rural sociology amongst many others) (Bicker et al., 2004), but very rarely studied in interaction with scientific knowledge.

Scientific research sometimes uses EBK at some stage of the process. Until now, EBK has primarily been seen as a socio cultural complement to scientific knowledge and has primarily focused on non-technical aspects. However, local stakeholders have played a role in scientific research in other ways, often by collecting data, by testing new gear or technology or by contributing to evaluations or presentations of results.

Parallels can be drawn between stakeholder involvement in co-management and in scientific research. Based on a study of a range of co-management implementations in Africa and Asia (Raakjaer Nilsen et al, 3003), various management forms could be distinguished based on the user participation.

- In ‘Modern co-management’ authorities control all levels of the management process (definition of objectives, production of knowledge, implementation and evaluation).

- In 'Instrumental co-management' stakeholders are included in the implementation process.
- And in 'Empowering co-management' stakeholders participate in all levels of the management process.

Based on the categories suggested by Raakjaer and Nilsen for co-management above, similar categories are suggested in this review to define stakeholder involvement. These categories will be used to analyse the level of stakeholder involvement in the analysed research projects. The categories are:

- 'Traditional research' does not involve stakeholders or EBK in any shape or form. If human activity is considered, it is objectified and made quantifiable.
  - 'Instrumental research' uses stakeholders or EBK as a means for collecting data (either that the stakeholders are instructed to collect information using scientific methods; or that stakeholder information is 'translated' into scientific knowledge using statistics or other quantifiable methods.
  - 'Participatory research' uses stakeholder knowledge as a separate knowledge-form. Stakeholder knowledge is used parallel to scientific knowledge.
  - 'Interwoven research' involves stakeholders in all aspects of the research as an equal partner (description of project objectives, production of knowledge, implementation, dissemination and evaluation).
- **Form of scientific advice/dissemination method:**
    - Scientific report
    - Developing and/or strengthening scientific network
    - Developing and/or strengthening overall stakeholder network
    - Database
    - Modeling methods or model
    - Identification of indicators
    - Management plan/conflict resolution plan
    - Education material/courses
    - Workshops for scientists
    - Workshops for all stakeholders
    - Management advice/recommendations
    - Stakeholder interaction (feedback from stakeholders/dialogue between science and stakeholders)
    - Integrated part of local co-management strategy.

No further explanation needed for this category.

## **3.2 Local study areas in SAFMAMS**

### **3.2.1 Identification of local study areas and stakeholder representatives**

The local study areas in the SAFMAMS project have been picked out to represent and exemplify areas where marine co-management is needed and/or used to mitigate the diverse interest in the area. The local study areas are:

- The Wash, UK
- Pärnu Bay, Estonia
- Koster-Väderö Fjord, Sweden.

Local representatives from three stakeholder groups have been selected in each area. The representatives were considered to be key-informants due to their role in the management efforts; their knowledge and experience in the area; and/or their role as representatives for a specific group of stakeholders. 8-9 stakeholders were interviewed in each area.

The three main stakeholder groups were:

- Scientists and local managers
- Fishermen
- Local nature protection representatives (governmental or NGO), i.e. “greens”.

### **3.2.2 Interview method and data analysis**

The interviews were carried out following the “practical interview guide” presented in appendix 1. The guide structures the main interview themes and was designed to shed light on the draft review findings from a local perspective. In two of the cases all interviews were taped and notes were fed into QSR6, a software program used to categorise and structure qualitative data. In the third case, notes were taken during the interviews, then compiled and finally categorised through the same QSR6 system. The interviews were carried out in the three local languages: English, Estonian and Swedish.

A table of stakeholders interviewed for the review is presented in the appendix.

## **4 Main findings**

Using the categories presented above, the 188 research projects will be analysed in the following sections for their implications on local fisheries management. For analytical purposes, some of the categories will be combined.

### **4.1 Research objectives**

#### **4.1.1 Basic research**

Using the criteria presented above for defining basic and applied research, the majority of the research projects investigated (60 %) fall into the category “basic research”. This is especially the case for projects with a natural scientific emphasis funded through EU, the Nordic Council of Ministers and the national research institutions. The most common research objectives among these projects are:

- To acquire more knowledge on species and ecosystem interaction (development of new methods)
- To develop an understanding of correlation between factors (development of modeling tools and methods)
- Synthesizing knowledge (databases used primarily by scientists)

### **4.1.2 Applied research**

The remaining projects are mainly doing applied research. This is the case for all the social scientific projects analysed here as well as for the majority of the projects co-funded by NGOs, regional efforts, HELCOM and to some extent MISTRA<sup>4</sup>.

In the projects based in new and aspiring member-states there is also a bias towards applied research in the forms of mapping, synthesis, monitoring and educational efforts that would otherwise be financed by the state.

The main research objectives among the applied research projects are:

- To develop models, indicators or systems that will help assessing the status of ecosystems and predict changes and risks (help forecasting ecological and economical consequences of different scenarios or management tools)
- To develop systems for spreading scientific results (networks, databases and educational material) to stakeholders at different levels.

It should be noted, though, that there is no analysis of the stakeholder-recipients in the majority of the natural scientific efforts to create systems for dissemination of scientific knowledge, just as there is no efforts to include non-scientific knowledge. The stakeholders mentioned are most often other scientists, decision makers (EU or national level) and managers at all levels. Local stakeholders (fishers, greens and other marine resource users) are only mentioned in a very select few of the projects – mainly projects dealing with technological gear improvement, local management efforts and some networking activities.

The main objectives found in social-scientific projects are:

- To assess economic effects of ecosystem and management changes
- To model stakeholder behavior using economic models
- To understand stakeholder interaction processes in management and/or conflicts
- To develop methods for co-management at a regional and local level.

## **4.2 Type of scientific knowledge used in the project**

### **4.2.1 Natural scientific knowledge**

The vast majority of the research projects investigated uses natural scientific knowledge exclusively. The natural scientific projects are using knowledge from a broad variety of fields such as marine biology, zoology, limnology, microbiology, system ecology and many others. Computer-science and space technology is increasingly used in creating models and using satellite observations. The increased focus on ecosystem-perspectives is evident not only in the project descriptions, but even in the efforts to bring together experts from different natural scientific areas. The level of integration between different disciplines within the natural scientific realm is relatively high.

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<sup>4</sup> Bonus 2005 indicates a 50-50 % allocation of funds for basic and applied research.

There is a social scientific element in some 20% of the natural scientific projects evaluated here. The socioeconomic research is always clearly separated from the main research, and the socioeconomic objective is mainly to assess effects of ecological or economical changes or management efforts. It seems that the term “socioeconomic” is mainly used to describe economic research and analysis. Sociology is primarily used in conflict analysis and to some extent in knowledge and management analysis, but other related social scientific disciplines are not represented. The level of integration between the natural- and social scientific knowledge in the projects can only be described as multidisciplinary with no integrative aspects between the two.

#### **4.2.2 Social scientific knowledge**

Only very few (23 of the 188 projects) can be considered to be based primarily on socioeconomic knowledge. A majority of the socio-economic projects are focusing on either economic analysis of the fishery sector or trying to develop tools to assess the economic values of marine ecosystem goods and services. The remaining are either concentrating on conflict interaction, investigating different management options or studying behavior, interaction and interests amongst stakeholders or one specific stakeholder group (for instance women in fisheries).

#### **4.3 Use of experience based knowledge (EBK) in research projects:**

Local stakeholders are not very visible in the projects analysed for this review. Stakeholders were not mentioned as anything but possible benefactors of the results in any of the natural scientific projects producing basic science<sup>5</sup>.

In the applied research, on the other hand, stakeholders are more often used in certain stages of the testing and developing of gear or technology (for instance in development of seal-safe gear, acoustic deterrents etc.). This is the one area where cooperation between science and user groups is carried out systematically and frequently. In the technological projects the interface between scientific and experience based knowledge is instrumental – no scientific effort is used to analyse the implications or socio-cultural aspects of the interface as such.

A few of the social scientific projects study stakeholder behavior and interaction in fisheries management or conflict. Here the stakeholders are the very objects of research, and EBK is used to shed light on stakeholder perspectives. It is not questioned whether or not EBK is valid or not in these projects, rather the knowledge is used to understand stakeholder perspectives and dynamics. Still, EBK is rather objectified than integrated even in these projects.

Following the categories presented above in the theoretical framework, the natural scientific projects analysed here are either doing ‘traditional research’ or ‘instrumental research’. Some of the multidisciplinary projects and most social scientific projects are doing ‘instrumental’ or ‘participatory research’.

No consequent examples of ‘interwoven research’ were found.

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<sup>5</sup> Some of these projects might actually use data collected by local fishers etc., but if so it is not mentioned in the project methods, description or objectives.

#### **4.4 Scale, form and intended users of scientific advice**

As will be discussed later on in this section, scale is intimately related to *form of advice* needed and *the method used* to produce the advice. It would seem that knowledge on local ecosystem conditions is needed to achieve local co-management – still scientific knowledge is driven by the need for methodological validity, and the use of quantifiable data has often determined scale of the research.

##### **4.4.1 Traditional scientific forms and dissemination methods**

The results produced in the basic research projects are primarily directed at a scientific audience. The results are most often presented and disseminated in one of the traditional scientific forms; as scientific reports; as scientific models; as methods for modeling; as databases for scientists; or as syntheses.

Even though some of the scientific advice presented in these forms might be helpful in local management processes, the strict scientific form and dissemination method makes local application difficult. Both form and dissemination method within the scientific realm makes the results less accessible to outside users – the stakeholders would need:

- Knowledge of the existence of the project and the results
- A basic scientific knowledge that allows penetration of the scientific results
- Ability to translate the basic scientific results into applicable forms.

Needless to say, this puts rather high strains on local stakeholder groups. Not only is the amount of results produced within these projects massive; the mere task of going through all of the results to assess their local applicability in co-management would be a very time- and knowledge-consuming task. Therefore the stakeholders will most often have to rely on applied research or contacts within the scientific community to gain access to the relevant knowledge and findings.

The natural scientific projects doing basic research focus on:

- Data collected from several local areas (for instance using research vessel surveys) that are quantifiable to allow for generalisations on a higher ecosystem level (for instance the Baltic).

##### **4.4.2 Form and dissemination method in applied research**

There are several forms and dissemination methods in applied science, spanning from the traditional scientific forms mentioned above to a varying degree of user-friendly and participatory forms and dissemination methods such as databases, management plans, workshops, networks and educational materials.

##### ***Databases and networks***

Several of the projects in the applied research category aim at creating networks and/or databases. This is even more common in projects with participants that are new or accessing the EU; and where there is a need for connecting with the European scientific community as well as integrating knowledge systems (particularly in the Baltic area).

The databases either:

- Compile same type of data from different sources (for instance bringing together national research to form an international database)
- Bring together previously unrelated data to investigate connections and correlations
- Use data from different disciplines as a common base for new research.

The majority of the databases studied in this review were either attempting to form international or European databases on same type of data; or bringing together previously unrelated data to investigate connections. The users intended were primarily scientists and managers.

The networking activities presented in the projects often brought together same-field scientists on an international, European or shared seas level. Networks involving scientists and stakeholders from relevant marine industries were even represented; as were broader networks bringing together scientists and higher-level managers (EU and national). Networking on sub-national levels are mostly funded through national or regional efforts.

### ***Indicators, models and methods for assessing ecological and economical change***

The software and technical methods for modeling are developing rapidly. It is evident from the research project studied that there is a high interest for developing new methods for assessing effects of change within ecosystem and economy using models.

There are several types of models that bring together multi species data with ecological, economical or managerial factors to investigate impacts (on a single species or on interrelated factors and species within the ecosystem):

- **Models that identify precautionary thresholds.** This type of model is the most commonly used in natural-scientific projects dealing with risk assessment.
- **Trend assessment methods.** This type of method is increasingly used to assess ecosystem change within one or several species. Projects that use these methods argue that they are more cost-efficient than precautionary threshold models and that they leave better margins for adapting to ecosystem change, thereby making them a better choice in risk-assessment as well.
- **Models that predict specific risks or phenomena.** This type of modeling will for instance use fuzzy logic to identify critical locations and periods that are susceptible to harmful algal bloom.
- **Models that assess economic and ecologic consequences of different management options and ecosystem changes.** This type of model is mostly used in research on economical impacts of different management option (for instance to study the economic incentives for different management schemes among fishermen). It is even investigated to evaluate economic impact of ecosystem change on the fishery industry.
- **Methods to identify ecological indicators** that can be used at local and regional levels to assess the ecosystem status (for instance to assess chemical contamination and oil pollution). Methods of this type are not as common as the methods mentioned above, but there are attempts within a few projects to use indicators or key factors to assess local and regional stock or to predict ecosystem alternation at a local ecosystem level.

Looking at the models and methods above from a local management perspective leaves us with the problem of scale. The models rely on data that is quantifiable (aggravated and generalised) – this is one of the main principles in traditional natural scientific theory and method. Ecosystems fluctuate and change and are interconnected to other ecosystem levels, climate and anthropogenic impacts. The main difficulty is to balance generalisations with local specifics to enable assessment or prediction that is of use at a local level. The traditional quantifiable predictability models and methods relate to other scales than the local knowledge – local management is specific, whereas the quantifiable research is general (Degnbol, 2003). The risk of conflict in interfaces between scientific research and local management needs is increasing if research methods are not adapted to the management level.

The increased focus on ecosystem perspective and regional management will call for methods that can be used cost-efficiently at a local and regional level; the use of indicators and key-factors are examples of efforts to work in this direction. Most often the definition of indicators for local use will be part of an international attempt (involving countries on a shared sea level as the Baltic).

Research results are primarily directed toward scientists, decision makers or managers at European, national and regional levels; while only two of the projects mention use of research results in these forms at a local level. The models and modeling tools are commonly presented at workshops or network activities for a selected number of scientists, decision-makers and managers. In projects that have practical technical objectives (development of new modeling methods; new gear-types; methods for restoring coral reefs etc.) the results are commonly presented to members of the relevant industries or stakeholders.

Result presentation and project evaluation will often be combined in a workshop or networking activity, pulling together scientists and intended users. The absolute majority of projects studied here (with the exception of about 40-50 projects that use a varying degree of more intensive stakeholder participation methods) only meet the user-groups in these final stages of the project, and then often in the form of advisory boards, regional representatives etc. There is a risk that the same representatives are used in many projects; making the representatives “professional stakeholder experts” and that the advice is not trickled down to the local stakeholders at a practical level (Piriz, 2004).

### ***Management plans, advice and conflict resolution***

Research projects producing management advice (in the form of results to be used as a basis for decision makers; or as management plans and conflict resolution schemes) are well represented in the evaluated projects. Government agencies (Board of Fisheries, Environmental Protection Agency etc.) are often funding such efforts that can be fed into the development of management plans or resource evaluations at a national and regional level. This type of management advice is often presented in forms that can easily be fed into the political and bureaucratic systems – reports are relatively brief and concise. There is clear over-representation of natural scientific research in this area; only in the areas “integrated coastal zone management” (ICZM), fisheries co-management, and conflict management are social-scientific research used in this form.

The management advice that is formulated from a natural scientific perspective is often based on singular species territory, ecosystem perspectives or shared seas level. Still, management is indeed determined by human infrastructure: international, European, regional, national and sub-national levels of organisation, policies and commitments.

Social-scientific advice, on the other hand, will often be based on human infrastructure and institutions – making this kind of advice easier to feed into the management system. Problems often arise in interfaces between natural scientific and social scientific knowledge forms, as the pre-conceived scales are not the same.

### ***Development of new technology and gear***

Concrete research that focus on development of gear and technology that is useful in specific settings to solve technical problems (for instance development of seal-safe gear; pingers that repel porpoise; or probe systems that allow for measuring change in shallow waters).

The techniques are responding to local or regional needs – the focus is more on adapting technology to fishery method or ecosystem characteristics than on generalising data. Here the research is often very local, and the gear is tested by local user-groups. The results are presented in stakeholder workshops or by the national or regional fishery administrations. It seems that the technical aspect of the research leaves more room for local stakeholder participation as well as for local adaptation of technology.

## 5 Experiences from local study areas

### ***Introduction to study area 1: the Wash, UK***

#### Management structure

The Eastern Sea Fisheries Joint Committee (ESFJC) ([www.esfjc.co.uk](http://www.esfjc.co.uk)) is one of 12 Sea Fisheries Committees, which have inshore fisheries and environmental management responsibilities within the 6-mile limit around the coasts of England and Wales. The main offices of the Committee are in King's Lynn, Norfolk.

The Committee was formed in 1894 to protect inshore fish stocks along the East Anglian coast for the benefit of local fishing communities that relied on those fish stocks for their livelihoods. The Committee is now recognized as a leader in the field for its commitment to protecting the local fish stocks and the marine environment that they are dependent upon and for its approach to conservation for the benefit of the fishing industry generally.

The Committee is composed of 20 members, consisting of four County Councilors from Norfolk and three each from Lincolnshire and Suffolk. Nine members are appointed by the Fisheries Minister, as being persons acquainted with the needs and opinions of the fishing interests, or having knowledge of, or expertise in, marine environmental matters of the district. The Environment Agency appoints the final member.

The Joint Committee is an autonomous Local Authority in its own right, but does not receive any funding from central government. Funding of the Committee is totally provided by a direct levy upon its three Constituent County Councils, Lincolnshire, Norfolk and Suffolk, with their contribution being in proportion to their membership, i.e. Norfolk 40%, Lincolnshire and Suffolk 30% each. The annual budget is approximately £1.3 million.

The Committee appoints Officers to undertake its duties. In 2005 there were 21 members of staff and 2 patrol vessels and 1 research vessel. Further information on the organizations aims and objectives can be found on their website.

As a result of the increased export of shrimp, mussel and cockles for the continental market, pressure has increased on the stocks, especially the sedentary mussels and cockles. Both these species are managed through the provisions of the Wash Fishery Order that came into force on 4th January 1993.

Under the terms of this Order the Committee, working in close co-operation with the industry itself, can close shellfish beds, allocate areas of intertidal flats to individual fishermen for the cultivation of shellfish, impose quotas and limit the number of vessels licensed to work the beds. Therefore the Committee must be considered to be the primary tool for co-management in the area.

Main marine resources in the area

Fishermen within the Wash devote most of their time to fishing for cockles, mussels and shrimps (brown and pink) although the large double-beam trawl shrimp vessels range throughout the District as stocks dictate. Demand for all three species, mainly for Continental markets, has increased rapidly in recent years leading to heavy investment in vessels and sophisticated equipment both afloat and ashore.

The Wash & North Norfolk Coast are rich and varied wildlife areas, accommodating national and internationally important assemblages or migratory, breeding and non breeding bird species e.g. 163,000 waders and 51,000 wildfowl use the Wash including dark-bellied brent geese, knot, dunlin, bar-tailed godwit, sanderling, oystercatcher, wigeon, curlews, scoter, etc.

The North Norfolk Coast supports 4,500 pairs of Sandwich Tern (c. 33% of the British population) 400 breeding pairs of Little Tern, 1000 pairs of Common Tern, c. 30% of the British population of Marsh Harrier, as well as Ringed and Grey Plover, Avocet, Shelduck, Pintail, Oystercatcher etc. A breeding colony of common seals, which accounts for c. 9% of the total UK population, is resident within the Wash.

Marine communities that are of international importance (e.g. Peacock and Ross Worms, dense Brittle Star and extensive Razor beds, Lug and Sand Mason Worms etc.) are also found here.

In addition, the North Norfolk Coast offers the only classic British example of a barrier beach system; extensive areas of saltmarsh and creek patterns that have developed behind sand and shingle bars and with clean mobile sand in exposed areas. Here, habitats range from the estuarine to those more suited to exposed coastal areas salt meadow and saltmarsh scrub.

On account of the unique environmental traits, the area carries several environmental designations:

3 Sites of Special Scientific Interest (SSSI), 6 National Nature Reserves (NNR), a Special Area of Conservation (SAC) and three Special Protection Areas (SPA) for its wild birds. The SPA sites are also Ramsar sites.

## ***Introduction to study area 2: Pärnu Bay, Estonia***

### Management structure

Fish resources in Estonian waters belong to the Estonian state and the management of the resource is the responsibility of the Ministry of Environment. The Department of Fish Resources manages and co-ordinates research, assessment, exploitation, stockings and protection of fish resources. Its main objective is to create a competitive sustainable field of economy that meets the requirements of the EU's Common Fisheries Policy. The role of Environmental Inspectorate is to control performance of fishery legal acts, inspect fishing harbors and fishing vessels in Estonian waters and make proposals to the minister on fishing restrictions and closures if fish resources are endangered.

Estonian Marine Institute is the main academic R&D institution on interdisciplinary marine science in Estonia, established in 1992. The main goals of the fundamental scientific activities of the institute are: (1) exchange of matter and energy between the ecological subsystems of the Baltic Sea; (2) structure, dynamics and functioning of the Baltic ecological subsystems and their internal exchange of matter and energy; (3) changes in the ecosystems caused by natural and human impacts and (4) development of the ecosystem and prognostic models and their verification. The main efforts in applied science are: (1) stock assessment of fish and macroalgae of the Baltic Sea, composition of forecasts of possible catches and management advice; (2) marine monitoring (3) Expert evaluations and contracts (e.g., environmental impact assessments).

### Main marine resources in the area

Pärnu Bay fishery is mixed fisheries with different fishing gears (e.g., gillnets, fykenets, pound nets) and various species exploited. Both commercial and recreational fishermen exploit fishery resources. The number of fishers (without recreational fishermen) has been fluctuating during the last decade from 600 to over 700.

The most important commercial fish is herring *Clupea harengus membras*. Herring catches in Pärnu Bay have varied during the past decade between 7000 and 10000 tons; the number of pound-net licenses issued in 2005 was 175. Important coastal fish are perch *Perca fluviatilis* (catches around 300-400 tons); vimba *Vimba vimba* (catches around 100 tons); roach *Rutilus rutilus*; and whitebream *Blicca bjoerkna* (catches around 100-200 tons). Formerly, pikeperch *Sander lucioperca* (catches over 400 tons) and smelt *Osmerus eperlanus* (catches over 1000 tons) stocks were also abundant.

Recreational winter fishing on ice is one of the most important features of the Pärnu Bay fisheries. The estimated mean number of recreational fishermen actually fishing on ice for the winter 2001/2002 was 800-1200 per day; the same number for 2000/2001 winter was 400-600. This activity put the highest pressure on perch: it has been estimated that the mean catch during the 2001/2002 winter was 4.5 kg per fisher day. Thus, the estimated total perch catch by recreational fishers is about the same as from commercial catches. The main reason for the perch winter fisheries by recreational fishermen is lack of alternative employment sources in rural regions: at least part (if not all) of the catch was usually not consumed by fishers but sold.

### ***Introduction to study area 3: Koster-Väderö Fjorden, Sweden***

The Koster-Väderö area is situated in the northern part the Swedish West-coast. The islands in the area host some 300 people during the winter and some 3000-4000 persons during the tourist summer-season.

#### Management structure

Since the 1970s there has been a controversial discussion locally and between Koster residents and municipal- and higher level authorities. A restrictive land-use plan favouring conservation triggered one of the more complex coastal planning conflicts about local control over resources, sustainable development, and the use of management instruments.

In 2000, a conflict between conservation and fisheries was Strömstad's most controversial coastal management issue (Piriz 2004, Morf 2006). National authorities had proposed a Marine Protected Area in the Koster-Väderö Trench. The Trench is rich in shrimp, but also in deepwater species unusual for the rest of Skagerrak. Researchers and conservationists opposed trawling in the Trench. Coastal fishermen were afraid, that the proposal for marine reserves meant more or less exclusive rights for conservationists and marine research interests in an area important for them.

A number of planning processes and projects were carried out to address the conflict, ranging from municipal and regional administrative initiatives to local informal initiatives. Since the 1960ties, the initiatives to solve the conflict have gone from top-down formalised processes to locally rooted, informal processes (Morf 2006). Much can be said of this process, and all the steps in it cannot be accounted for in this review; an in-depth analysis can be found in Piriz 2004 and Morf 2006.

Local participation has played a central role for finding solutions adapted to the local context, and the local process has now been formalised to be applied during the next steps of negotiation towards establishing a marine reserve in the Koster trench.

The main local initiative to solve the conflicts between marine resource use and nature conservation has been the development of the Koster Board. The board represents Koster's most important opinions and organisations towards the municipality. It should integrate the diverging local opinions for municipal purposes and give the opinion from Koster more strength and a broader base of legitimisation. The Koster Board is an innovation by the municipality initiated after 2000 (elected by permanent residents with right to vote). It has a consultative function for the municipality, but without political mandate or budget.

(continued on next page)

The most recent step toward marine co-management is the Swedish Fisheries Co-management Initiative (SFCI). The SFCI is an experimental program, which started in January 2005. The Swedish Board of fisheries has been commissioned by the Government to investigate the possibilities for institutionalizing local- and regional fisheries co-management structures in Sweden. Six pilot areas have been defined, and Koster-Väderö fjord is one of them. Groups of stakeholders (commercial and recreational fishers; local and regional authorities; researchers; water owners; and other local groups from the area) discuss methods and solutions to local co-management. Eventually management plans are created and implemented. The project can be seen as a local equivalent to the EU process with Regional Advisory councils (RAC), and guidelines for Integrated Coastal Zone Management (ICZM).

In the Koster-Väderö area, the Co-management Initiative builds heavily on the already existing local management structures mentioned above.

#### Main marine resources in the area

The Koster Fjord area hosts a unique combination of Swedish saltwater-species; in fact it is the richest Swedish sea-area from a biodiversity perspective. Due to its depth, saline water and low temperatures, the fjord hosts species that would otherwise only be found in the Atlantic. Deep-sea coral reefs are one example of the unique species found in the area. About 200 species of animals and 9 algae species are unique to the Koster area. The total number is estimated to be some 4000 species.

The Koster fjord is within the trawl-boundaries and all trawling is forbidden. Still, local trawling for north sea-shrimp has been excluded from this rule – as long as it is carried out within specific limits.

As a result of the longstanding conflicts between local marine use and nature protection, the fishery has been adapting to environmental restrictions since the early 1990ties. This has resulted in an agreement between fishers and local authorities on gear development, education, designation of sensitive areas, and that fishery is limited in time (only three fishing-days a week) and in space (sensitive reefs are excluded).

This is underlined by the fact that the Koster shrimp fishery is indeed the only fishery in Sweden that is certified by Swedish KRAV (an organic certification). NGO organisations such as Swedish WWF and Swedish Nature Protection Association are highlighting the Koster fishery as a good example of sustainable small-scale fishery.

Koster is presently under protection by conservation-ordinances: seals, birds, flora, and the Koster Trench by a NATURA 2000. Since 2005, a new process is under way to deal with the new planned marine national park and its effects from a local perspective.

## **5.1 Use of scientific knowledge in study areas**

### **5.1.1 Scientific knowledge at the local level**

The scientific knowledge produced in research projects of the type presented in the first part of this review is very rarely used in the everyday management in the study areas. Instead, science officers closer to home supply the main sources of scientific information and advice.

In the Wash, management information is provided by the staff at ESFJC (yearly stock and catch assessments; information on general ecosystem changes; as well as landing information). English Nature carry out own research in the area to monitor ecosystem changes; map wetland species; and provide risk estimations for management purposes. English Nature will use scientific advice from the national level or from other regions if it is needed. This is possible due to the resources and structure of English Nature. No other stakeholders will supply their own scientific advice.

Research from national or international levels is very rarely used in ESFJC management. There are two main reasons for this

- **Relevance.** The information needed to manage fisheries in the area is *specific and local* – the scientific advice presented in most of the reviewed projects has no direct bearing on the local level. To use them at the local level, they need to be translated or interpreted into the local context. The ESFJC has no resources to carry out this extensive work while at the same time producing the specific local information.
- **Access.** The scientific advice produced in research projects that could be relevant for the local management of the Wash is rarely easily accessible. As noted above in the first part of this review, scientific advice is often presented in forms that are directed toward scientific audiences. It is time and resource consuming to keep up-to date with all new scientific results, and often they will only be known within their own scientific realm. There is a risk that the information is not trickled down to the right persons (everyday users), should the information indeed be presented in stakeholder workshops or in other public fora.

In Pärnu Bay, management information is provided by the Estonian Marine Institute (EMI) (stock assessment; environmental impact assessment; and catch forecasts and management advice). No stakeholders provide their own scientific information.

EMI even supplies information for the Department of Fish Resources (DFR) at the Ministry of Environment. The department bases its management decisions on this information. The Estonian Marine Institute is the main Estonian academic authority on fishery and marine ecology. As opposed to the Eastern Sea Fisheries Joint Committee in the Wash, EMI has the scientific competence to put local research into an international scientific context. However, financial resources do not suffice to carry out such a task consequently.

In Koster-Väderö Fjorden, management information is mainly provided by the Laboratory for Coastal Fishery (Kustfiskelaboratoriet); the Laboratory for Offshore Fisheries (Havsfiskelaboratoriet); or the Tjärnö Marine Biological Laboratory. The Laboratories for Offshore Fisheries and Coastal Fisheries are both research sections under the Swedish Board of

Fisheries; whereas Tjärnö Marine Biological Laboratory is run in cooperation between the universities in Göteborg and Stockholm. Due to the close cooperation with universities and the national Board of Fisheries, relevant information from national and international research projects might be integrated into the local management advice, or dispersed to relevant local stakeholders. Still the same problems as mentioned in the Wash can be identified (relevance and access). The research is either commissioned by the Board of fisheries or financed through national and international research projects. The regional administration in the area monitors the general marine ecosystem changes, but has no budget or competence for more in-depth research.

## **5.2 General experiences from the study areas**

### **5.2.1 Scientific advice in local co-management**

Several similarities between the three study areas were found regarding the use of scientific advice in local co-management. The Wash and Koster-Väderö are similar as to the fact that there are protected sites within the areas; and that there has been serious conflicts between resource users (fishermen) and nature conservationists (nature protection agencies and NGO's). Nature protection interests are mainly channeled through local divisions of national nature conservation agencies as well as through NGO's. As fisheries are separated from nature protection in the administration, nature protection interests are indeed able to fund their own research to contrast the fisheries perspective. In Pärnu Bay, on the other hand, there are almost no stakeholders representing the nature conservation side. It is thought that the Ministry of Environment, Department of Fish Resources, should incorporate nature protection into the management decisions; and that EMI is integrating nature protection in the fisheries data and management advice. The conflicts in Pärnu have been evolving more around human competition over resources; the most infected conflict recently solved was between recreational and professional fishermen.

Generally, following similar theme-patterns were found in the three study areas:

- **Perceptions of scientific advice.** Scientific knowledge is generally met with skepticism from the fishermen's side. The information is considered to be biased by default. Traditionally, scientific knowledge has been the tool of central states and the authorities, and this has rubbed off on the fishers' perception of science. Lately, fishers have discovered that scientific advice can even benefit their own causes and perspectives, see examples below. The fishers in the Wash and Koster-Väderö ask for more influence on the scientific advice produced for the area. They would like to be part of all aspects of the process, from research objectives to data collection and presentation. The Pärnu fishers seem less interested in being part of the process.
- **Increased stakeholder involvement in management.** To deal with the skepticism and unwillingness to cooperate, the managers in the Wash (ESFJC) and Koster-Väderö (CMI) have chosen to open up the process to local stakeholders. Clear examples of this can be found in examples II, VI and VII below. In these areas, it has been the conflicts between fishery and nature protection that has developed the management system along the process. To solve the conflicts, the management structure has been forced to open up for the local stakeholders to find acceptance for the management strategies.

- **Cleavage between fisheries management and nature protection.** In all three areas there is a cleavage between fisheries management and nature protection. The management initiatives in the Wash and Koster-Väderö are attempts to deal with this cleavage. Still, nature protection interests are seen as separate entities by many of the stakeholders. The main reasons for this could be that research is often either directed towards fisheries sector or towards nature protection. The fact that local sections of the nature protection agencies are able to carry out own research to support their views is stressing the gap between the perspectives.
- **Experience based knowledge and social science.** Experience based knowledge (EBK) is rarely used directly in research at the local level. The scientists have a tendency to distrust the information from the local stakeholders, as they are afraid that stakeholders' interests color the information. Still, the management authorities in the Wash and Koster-Väderö seem interested in finding methods to incorporate local knowledge while at the same time keeping the scientific quality. The management authorities lack methods or examples of how the knowledge forms can be integrated. The fact that social scientific knowledge is very rarely applied at the local level could explain the lack of knowledge in this area. Only in the Koster-Väderö case were the stakeholders able to give examples of social scientific knowledge used at the local level for improving co-management. In the other study areas, social science was very absent.

When asked, all stakeholders agreed that social science could be useful in mitigating the management process. On the other hand, several of the stakeholders indicated that the social scientific knowledge needed was to be found within "common sense" and that no scientific experts are needed in that area.

- **Spreading of scientific advice to local stakeholders.** In all three study areas the main form of scientific advice comes in scientific reports. The reports are most often presented in two versions: one scientific and one public version. In the Wash and Koster-Väderö some of the information can even be found on the web sites. In the Wash, the ESFJC sends out data and reports to all individual fishermen and not through the fishers associations. This is done to avoid the political factions that exist within the fishers associations, and because experiences in the area show that there is a discrepancy between perceptions brought forward by the associations and by the individual fishermen. The research results are even presented at open meetings with the industry in the Wash and Koster-Väderö.
- **Local needs and interests.** The fishers in the local areas ask for more information on the local ecosystem functions and changes. In example I below, one of these needs is expressed. Generally, the fishers would like information that would allow for quick response to ecosystem changes. To do this, continued monitoring is needed, and specific research objectives should focus on specific ecosystem functions.

Local managers and nature conservation representatives, on the other hand, understand the fishers' need for quick responses. In example IV an example of scientific advice

sought by the nature conservation side is presented. The managers in the Wash and Koster-Väderö seem open to a more pragmatic and responsive management method. The nature conservationists are more reluctant to accept more responsive methods, as this would threaten the principle of caution. From the nature conservation side, it is stressed that ecosystem changes needs to be evaluated over time, and that international responsibilities (to protect endangered species etc.) are sometimes more important than local needs.

In Pärnu, further socioeconomic research is asked for, as it is needed to understand and solve the conflicts over human resource use in the area. Here, it is even more an issue that can be connected to rural development than in the other two study areas.

The management efforts and methods in the three study areas differ from each other. The management efforts in the Wash seem to be more open to local participatory efforts than in Koster-Väderö and Pärnu. The board has an open structure and the fishermen are invited to question and challenge the scientific results. The Swedish efforts to create structures for local co-management are indeed striving for the same effect: to open up the local management process to a variety of stakeholders to create fast and grounded responses to local ecosystem changes and stakeholder interactions. Still, the initiative seems to be at a more basic stage and further work is needed.

The Estonian case exemplifies a situation where the centralised state structure is affecting the local management process. As a consequence of the financial and political situation in the Eastern European countries, resources for co-management are scarce at the local and regional level. Nature protection agencies and NGOs are still relatively weak in these countries, and the Estonian example from Pärnu Bay demonstrates this.

### ***Main management conflicts in the areas***

Several conflict themes have been identified during stakeholder interviews in the Wash, Pärnu Bay and Koster-Väderö Fjord. The first main conflict theme is *marine resource use*.

The conflict types range from:

- Differences in opinion regarding choice of protected areas and restrictions used.
- Conflicts between principles of precaution (nature protection) and need for quick response (fishers' perspective).
- Conflicts between different human resource users in the area (commercial fishery versus recreational; fishery versus shipping or windmills; tourist activities versus industrial etc.).

The other main conflict theme is one of *knowledge production and power*. Here conflict types refer to a notion of hidden agenda in scientific knowledge production, a perceived nature protection bias in science:

- Differences in opinion regarding stock estimates and condition.
- Conflicts between local primary producers (fishermen) and national and international political and legislative structures.
- Conflicts over lack of influence on management plans.

## 5.2.2 Examples from the local study areas

### ***I. Example of scientific advice sought by fishers and industry***

The fishers in the Wash are generally very content with the scientific knowledge and advice produced by the ESFJC. Still, there are areas that they would like to be researched more thoroughly.

For instance the fishers' wish for scientific monitoring of the mussel and cockle spawn. Their own lay knowledge tells them that the mussel and cockle spawn when the water seems milky and unclear; but they would like more scientific evidence of the processes, which would even give a hint of the state of the stocks in the area. Fishers say that the Dutch authorities provide this type of information to the Dutch fishers, and that the information is important for forecasting local stocks and evaluating ecosystem changes. Other examples of scientific advice sought by the fishers include information (and methods) that allow for quick response to ecosystem changes (see example II below).

### ***II. Example of gap between scientific knowledge and need for quick response***

All stakeholders often referred to the recent increase in Duck-duck population in the Wash as a source of conflict. All stakeholders agree that there has been an increase in Eider-duck population in the Wash during the last 3 years. The ducks feed on the mussel beds, and fishermen worry that the ducks are threatening the resource. The fishers and industry would like a quick response to the situation. From their perspective, a large eider-duck population is not a natural part of the local ecosystem, and the population should be controlled to protect the mussel beds.

The nature protection perspective, represented by English Nature, stress that the increase in ducks-ducks should be evaluated based on the principle of caution. Ducks-ducks may very well be a key-species in the Wash, and the effects of the eiders should be investigated further before actions can be taken. ESFJC are asked to take on the responsibility to evaluate the effects of the duck-duck predation on mussel beds, but the ESFJC feel that they have no resources to carry out such an extensive task.

The local stakeholders ask for methods to evaluate ecosystem changes that will allow for quick response, and claim that a more pragmatic management system is needed to integrate scientific knowledge with practical decisions at the local level. Still, the need for caution and responsibility for national and international agreements on nature protection should be taken very seriously. Methods to balance the need for specific local knowledge with management practice are needed.

### **III. Examples when scientific advice benefit fishers and industry**

The fishers in the Wash have benefited from the scientific advice produced at the ESFJC in several cases.

The yearly survey of the mussel and cockle beds is popular amongst the fishers as it maps the mussel beds that are ready to be harvested, while at the same time closing off others that are not. The fishers seem to follow the information provided by the ESFJC, but there is some concern among the scientific officers that the scientific information might in fact damage the local knowledge of the area.

Also in the Wash, a project of lobster tagging was started in 2004. In the project, lobster catches are measured, and a number of lobsters are tagged and put back. The project is planned to run for a five-year period and should give insights to the condition of the local lobster stock and the migration of the stock. The research has already proven that the stock is smaller than expected, and that it may be a genetically separate species in the area. If so, the results could benefit the local fishers, as it would allow for closing off the area for fishers outside the area.

In Pärnu Bay, scientific advice has proved useful in several cases where stocks have been declining due to significant decrease of spawning stock, or where length-frequency distribution of fish stock has continuously shifted towards smaller fish.

Based on research, the scientific advice suggested establishment of a minimum size (based on maturity investigations) for perch *Perca fluviatilis*, pikeperch, bream *Abramis brama*, pike *Esox lucius*, etc.

Other advice included total fishing ban during the main reproduction period of the most valuable fish in Pärnu Bay (pikeperch) for years 2000-2002, as well as fishing ban for pikeperch during its main reproduction period for several years before and after.

Specific spatio-temporal restrictions for gillnet fishery included restrictions for the mesh size net dimensions, but also total ban in some areas/periods. A general fishing ban for smelt *Osmerus eperlanus* in spawning areas was even recommended.

Stakeholders in the area agree that the scientific advice provided in the Pärnu Bay has improved the stocks. From a stakeholder perspective, the main problem in the area is that of a lacking and weak control of the landings. Judging by stakeholder experiences in this area, an improved control system with better resources would help build the foundation for further co-management schemes.

#### ***IV. Example of scientific advice sought by nature protection interests***

In Pärnu Bay, fishers seem content with the information provided by the EMI. For them, problems are identified within the control system.

From a nature protection perspective, on the other hand, more scientific advice is requested. The scientific information should help map the activities in the area, and provide for planning the resource use in a spatio-temporal way. This would imply that nature protection interests (such as hauling-out sites for seals or nesting places for birds) should be mapped; as well as human activities such as fishery (professional and recreational), transport routes, tourist areas etc. The mapping should include both time and space.

#### ***V. Example of the use of experience based knowledge (EBK) in scientific advice***

Fishers' knowledge is used in both the Wash and Koster-Väderö. Fishers are letting scientific officers collect data from the boats, and sometimes even engage in the data collection themselves (by filling in formalized tables on specific species etc.). However much of the information spilled over from the local fishers is communicated on a more personal level. As mentioned earlier, fishers are never engaging in creating the research projects or defining the objectives.

In the Wash, shrimp fishers inform the ESFJC whenever they come across mussel or cockle beds. The ESFJC will then be able to evaluate the beds and eventually open them up to fishery. Fishers will even inform the ESFJC if they come across Saballeria reefs, which are considered to be an important marine feature that supports many other species.

In much the same way, fishers in the Koster-Väderö area have been cooperating with scientists to locate the deep-sea coral reefs specific for the area (see example VII). In the local co-management initiative (Samförvaltningsinitiativet), local stakeholders such as fishers play an important role in negotiating management plans and strategies. Here EBK is put into a political context; stakeholders are formulating the plan as a joint effort, and all experiences and knowledge forms are brought together in that process. Still, scientific knowledge is setting the standard; local knowledge is not considered to be valid outside its own political sphere without being tested within the scientific frame (see example VII).

### **VI. Example of research challenged by fishers**

Even though fishers are often skeptical toward scientific results, they rarely challenge it by using other scientific information.

In the Wash, fishers did not agree with the results presented by ESFJC in a mussel survey. Instead they demanded that a Dutch scientist should be contracted to do a second survey. Eventually the results from the consultant showed trends that were even more negative than the ones provided by the ESFJC. The fishers then accepted the result and the management strategy that followed of it. By accepting that “a second opinion” should be heard, the conflict could be settled and a management plan followed.

### **VII. Example of knowledge-exchange at the local level**

The local co-management initiative in the Koster-Väderö area is one of six pilot projects in Sweden (see introduction to the Koster-Väderö area above). The co-management initiative in Koster-Väderö is built as a project, with the objective of developing methods to manage the local resource, and to create long-term sustainable coastal fisheries in the region. This should be achieved through the cooperation between stakeholders in the region and should be formulated in a management plan. The processes and networks formed during the project should then be permanented to enable continuous work with local co-management.

One of the main strategies in the first part of the co-management initiative is focused on knowledge exchange. It is acknowledged that there is a gap between scientific knowledge production and the local fishers. Trust and understanding has to be built between these two important groups for future work to succeed. Therefore a special course in marine biology for coastal fishermen is taught at Tjärnö Marine Biological Institute as part of the co-management initiative. Here fishers are introduced to the theoretical framework and practical methods used by marine biologists. The introduction focuses on presenting practical methodology while at the same time shedding light on some of the more recent methods for forecasting ecosystem changes such as modeling.

Scientists see this as an opportunity to communicate their knowledge to the fishers while at the same time building trust. It is implied that the fishers will be more informed in the decision-process after the course and that they will not perceive the scientific results to be biased by default. The fishers are very positive to the course and so far the participants have been very content with the structure of the course. Until now, two courses have been held, and two more will be held during autumn 2006. The goal is that 60 local fishers will have attended the course by the end of 2007.

## 6 Conclusions

In the first part of this review 188 marine research projects funded by the main funding institutions were analysed for their implications on local co-management. It was concluded that the majority of the projects were natural scientific, and that the objective in these was roughly 50-50% basic and applied science. There was a tendency for the projects to follow in traditional footsteps and base the scientific advice on generalised data at an ecosystem level (or shared seas level) that is not as specific as the local management areas. A broad variety of projects were represented, ranging from databases, models, stock estimates, and ecosystem studies to gear development. The scientific advice was primarily addressed to the scientific community in scientific reports or as methodological tools (for modelling etc.), and to the national and regional stakeholders presented in workshops and popular versions of the scientific report.

The scientific knowledge integration between disciplines was high within the natural scientific realm, where disciplines complement each other. There was a social scientific aspect to some 20% of the natural scientific projects, but in this respect social science was most often only represented by economics. It seems that social scientific disciplines that use qualitative methods, (such as sociology, anthropology, psychology or human ecology) are rarely used in combination with natural science in the fisheries research. When natural science and one of the social scientific disciplines mentioned above are combined, the disciplines are rather doing parallel research (multi-disciplinarily) than attempting deeper knowledge integration.

In the second part of the review, results from interviews with stakeholders from three local study areas were brought together. Similar management conflicts were reported back from all three areas. There are protected areas within both of the areas the Wash and Koster-Väderö and the conflict situations mainly evolve around nature protection versus fishery. In Pärnu Bay, on the other hand, conflicts concentrate on anthropogenic resource use and the need for more efficient system for fishery control.

A central subject in the review has been the subject of scale. The scales used in marine science have traditionally been based on single species perspectives. Local data collected have been aggregated and generalised to give information on the general condition for the species. Even though the ecosystem approach is now lifted, there is still a tendency to focus on single species, and there is confusion on how to define the ecosystem. The knowledge produced is aggregated from the local, specific to the generalised higher level (from local samplings to create an estimate of entire species – often shared seas level). Management, on the other hand, is based on the human structures in society. Local management is based on local socio cultural and economic structures (community-based). The knowledge needed at this level is specific; there is a need to understand changes in the local ecosystem – not entire species but the interplay between human activity and local ecosystem factors.

There is a general problem with translating scientific advice produced in research projects to the local management level. In all three study areas, stakeholders report that it is difficult to

- Find scientific advice that is relevant to the local management situation. There are no resources at the local level to monitor and sort all scientific advice produced in international research projects for relevant knowledge to be used in local co-management.

- Translate scientific advice produced within research projects at a higher level (shared seas or larger ecosystem levels) to the local ecosystem. To take on such translation and adaptation of scientific advice, scientific resources are needed at the local level. The scientific officers working at the local level are not able to take on such tasks, as they are busy collecting and interpreting data from the local area.
- Compare experiences from other local management areas. Though there might be important lessons to be learned from other local management projects, it is difficult to find the time and resources to extract knowledge that can be transferred from one area to another. More cooperation between local-level management groups and institutions is wanted by the stakeholders. Research projects that entail such knowledge (by comparing local cases or developing tools for knowledge transferral) are in high demand.

The majority of the stakeholders interviewed for the review have a natural scientific background. This reflects the traditional natural scientific focus in fisheries research, with marine biology as the central discipline. There is a tendency amongst the interviewed stakeholders to chalk down social scientific knowledge to “common sense”. It seems that the lack of social scientific human resources at a local level is even hindering adaptation of social scientific advice in co-management. Obviously, natural science is needed to understand the ecosystem status and change. But the ecosystem is met by human action based in society – therefore there is even a need for social scientific knowledge to account for human behaviour and guide towards successful co-management. Increased cooperation between natural and social science would be very fruitful at all levels to understand the interfaces between human society and marine resources.

In Pärnu Bay, the Ministry of Environment, Fishery Department, carries out management of the area from the national level. The scientific advice is provided by the Estonian Marine Institute. In the two cases where local co-management was carried out more directly by local stakeholders (the Wash and Koster-Väderö Fjord); scientific knowledge is provided by scientific officers (the Wash) and the coastal fishery laboratory (Koster-Väderö). Scientific advice produced in projects on national and international levels are rarely used in local co-management in the three areas. This is mainly due to the fact that much of the scientific advice needs to be interpreted from a larger scale to the local level; or that the advice is unknown or not easily accessible to the local stakeholders. The scientific and financial resources at the local level do not suffice for such knowledge transfers. Due to the different management structures, the obstacles to successful fisheries co-management vary between the three areas.

The fishers and managers in the three study areas prefer scientific advice and management methods that allow for quick adaptation to ecosystem changes; and they are particularly interested in forecasting, monitoring and understanding the local ecosystem and its changes.

The fishers and industry are rarely involved in planning the scientific research (examples VI and VII are exceptions from this general trend). The fishers would like that their experiences could be integrated more in scientific research and that they could be more involved in data collection etc. The Eastern Sea Fisheries Joint Committee has succeeded in building trust from the fishermen during the last decade (see example III, V and VI). The Co-management initiative in Koster builds on an organization of stakeholders that has developed out of conflicts in the area.

As part of the Co-management initiative courses are held for fishers in marine biology. The goal is to build trust between fishers and scientists, and to inform fishers of the methods used in research dealing with fisheries.

Nature conservation representatives, on the other hand, prefer scientific advice that has a precautionary quality. In their perspectives, ecosystem changes need to be monitored and evaluated over a longer time-period to be sure that it is valid. Here the need for pragmatic management and precaution collide – there is clearly a need for scientific and managerial methods for producing scientific knowledge at the local level for management purposes. This need is not met by the research reviewed in the first part of this review.

The central question for future fisheries research should be: *How do we create scientific advice that is scientifically valid, has a precautionary perspective and allows for adaptation to ecosystem changes?*

Based on the review, it can be concluded that funding resources should be directed towards efforts that will support and develop local management initiatives. This includes

- Developing methods and systems to evaluate ecosystem change at the local management level. This entails research that will support quick response to local ecosystem changes (indicators or other ecosystem evaluators) while at the same time taking into account precautionary aspects.
- Developing methods for local co-management. (This includes pilot-projects as well as evaluation of existing projects as well as comparison of different methods.)
- Research that evaluates local management efforts. How are natural protection interests balanced with marine resource use? What can be done to improve local co-management?
- Developing methods and forum for knowledge exchange on local co-management. What lessons can be transferred from one local management situation to another?
- Developing methods for local stakeholders to gain access to scientific advice produced in research projects. Funding authorities should encourage local application of scientific advice by adding applicability at the local level as a priority. Further resources can be directed to help translate scientific results to the local management level.
- Finally, the subject of scale should be highlighted in all research projects, and further research is needed to analyse and support knowledge integration.
- Developing methods to analyse experience based knowledge as well as ways to incorporate this local knowledge in scientific advice.

The review presented here is intended to serve as the starting point of a conversation between local stakeholders in the three study areas. No change toward sustainable marine resource use can be carried out without the direct and open cooperation with stakeholders at all levels.

Local stakeholders are the most important partners in this future work. Researchers should open up their understanding of ecosystems to include human influence and resource use. The understanding of human behavior in marine resource use includes bringing together natural scientific and social scientific perspectives; while at the same time incorporating experience based knowledge in scientific advice.

The challenges facing science and funding authorities are indeed demanding. The marine resources are at stake. Still stakeholders at all levels, particularly at the local level, direct their efforts to find new methods for sustainable marine co-management. The scientific task is to

monitor and support such sustainable development. The partners in SAFMAMS look forward to continuing this process at workshops in the local study areas during fall 2006.

**Table 1: Overview of research objectives, types of research and research level of the 188 projects analysed**

	Research objectives		Main type of research	
	Basic research	Applied research	Natural science	Socio. science
Percent of 188 projects	58.5%	41.5%	87% <sup>6</sup>	13%
Scale: main level of research	Large ecosystem level	Regional and local ecosystems	Ecosystem level	Institutional levels
Projects that use stakeholder participation	8%	16.5%	14% (of 165 natural scientific projects)	100% (of 23 socioeconomic. projects)

<sup>6</sup> 20% of the natural scientific projects use socio-economic research in some form in the projects.

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## **Appendix 1: Interview guide**

<b>Interview guide, wp4</b>	Scientific advice in local marine co-management
<b>Themes</b>	<b>Practical questions: Ask for examples/ experiences!</b>
<b>Informants perception of local situation</b>	Describe the local management situation? Describe the main local management projects? Who are the main stakeholders? What are the main issues at hand? Special conflicts?
<b>Draft review</b> Informants general comments	General comments to the review? What can be improved? How does the review reflect (or not) local experiences?
<b>Local examples and experiences</b> Basic and applied science Project examples	What are the main sources of scientific information in local management now? Who provides it? How is it used? Describe situations where scientific advice has benefited the management process? How and why? How was the situation initiated? / Who provided the scientific advice? What were the main problems? Lessons learned?
<b>Knowledge integration</b>	What kinds of knowledge are being used? What other types of knowledge could be useful? How and why? Did you ever experience difficulties getting specific scientific advice? How and what? Do other stakeholders look for other types of knowledge? Describe what kinds and why?

**Experience based knowledge**

Is local knowledge and experiences (non-scientific) being used in management?  
How? (Stages of management: data collection, monitoring, implementation, evaluation etc.)

Can it be useful to local management or not?  
Have you experienced advantages or problems with using local knowledge/experiences? How?  
How do you think that the scientific community perceives local knowledge?

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**Forms of scientific advice**

In what form does the scientific advice usually come?  
Who provides it?  
Is the advice accessible to user groups and stakeholders?  
Have you experienced particularly accessible forms of scientific advice?  
Or scientific advice that was inaccessible (time-consuming etc) to user groups?

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**Best practice for local management**

Ideal local management project:

Describe your ideal management project?  
What kind of research would be needed?  
What role would local knowledge and experiences play?  
In what form should the advice be delivered and spread?  
Funding

**Conclusion**

Concluding comments

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**Appendix 2: Table of stakeholders interviewed.**

<b>Type of stakeholder</b>	<b>The Wash</b>	<b>Pärnu Bay</b>	<b>Koster-Väderö Fjord</b>	<b>Total Review</b>
Scientific officers	2 (local level)	3 (national level)	3 (local, regional and national level)	<b>8</b>
Management project representatives.	2 (local level)		1 (local level)	<b>3</b>
Fishers and industry	3 (fishers and owner of fishery industry)	3 (fishers)	2 (fishers)	<b>8</b>
Nature protection representatives.	1 (local level)	3 (national level)	2 (regional level)	<b>6</b>
<b>Total sub-area</b>	<b>8</b>	<b>9</b>	<b>8</b>	<b>25</b>

### **Appendix 3: Management plan for the Wash**

The management plan was launched in January 2002

<http://www.esfjc.co.uk/ems/pages/scheme.htm>.

The plan is in two parts. The first part describes the background to the Habitats Directive, why the Wash and North Norfolk Coast are so important from a nature conservation perspective, the conservation objectives, the activities that takes place within or adjacent to the site, and the management structure and process. The second part describes the agreed actions that each relevant authority will undertake to ensure that the conservation objectives are achieved. This may be described as the “living part” of the document as it will evolve and be updated annually and presented to the Full Management board (see below).

Since the launch of the management plan three annual reports have been produced

<http://www.esfjc.co.uk/ems/pages/ANREP3rd.doc> .

The management framework includes three, tiered management bodies described below and, three stakeholder groups which provide support, advice and opinion to the management bodies. The 3 stakeholder groups represent users from 3 geographic areas around the Wash.

The Full Management Board (FMB) is large (100+ participants<sup>7</sup>), the Full Management Group is also potentially large, but in reality has proven to be less than half the size of the FMB. The Core Management Group (CMG) has tended to be made up of 10-15 participants.

The advisory groups have fluctuated between 6-20 participants.

An outcome from the development, launching and initial implementation of the management plan has been the recognition by almost all the relevant authorities that a Project Officer needs to be maintained and work on behalf of the FMB. English Nature’s initial commitment was to provide a Project Officer to draft the management plan and, once this was complete, funds would be reduced. As a result almost all of the relevant authorities (including English Nature) agreed to contribute equal funding to support a full-time Project Managers post.

The Project Manager was appointed and has been based in the offices of the ESFJC. Line management has been undertaken by the ESFJC’s Clerk and Chief Fishery Officer, on behalf of the FMB.

The main roles of the post have been to liaise and coordinate with the relevant authorities and advisory groups, encourage and report on progress with respect to agreed management actions,

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<sup>7</sup> Internal Drainage Boards, King's Lynn Conservancy Board, King's Lynn & West Norfolk Borough Council, Lincolnshire County Council, Ministry of Defence, Norfolk Coast Partnership Project Manager, Norfolk County Council, North Norfolk District Council, South Holland District Council, Wells Harbour Commissioners, Wash Estuary Strategy Group Project Officer, Advisory Group Chairpersons, Boston Borough Council, Boston Port, Common Rights Holders, Crown Estates, DEFRA, East Lindsey District Council, ESFJC, English Nature, Environment Agency, Fenland District Council, Fosdyke Port.

take forward agreed joint initiatives (e.g. development of a Good Practice Guide, website) and produce an annual report.

#### **Full Management Board (FMB)**

**Composition:** Officers, elected members, representatives of user groups & other partner organisations, plus project manager. Chaired by the lead authority (or other elected body.) Meets twice a year.

**Role:** Accountable under legislation & protocols.

Agrees policy and direction.

Bids for project support within relevant authority/other partner organisations.

Represents project within same.

Responsible for management scheme & its progress.

Delegates executive function to Full Management Group.

#### **Full Management Group (FMG)**

**Composition:** As for FMB, less elected members (members welcome at their own discretion). Chair as for FMB. Meets as FMB, or as required.

**Role:** Acts in an executive capacity for Board, individually/collectively taking forward agreed policy & programme as required.

Liaises with & briefs elected members, principals/colleagues/groups & other relevant committees/groupings.

Reports to & advises FMG/FMB on behalf of those they represent.

Delegates corporate elements of executive function to Core Management Group.

**Core Management Group (CMG)**

**Composition:** A subgroup of the relevant authorities within FMB/FMG, plus the project manager. Chair as for FMB/FMG. Meets 4/5 times a year, or as required.

**Role:** A working group taking forward functions delegated from FMG.

Sets programme & manages project manager.

Reports to & advises Full Management Group.