SIXTH FRAMEWORK PROGRAMME
PRIORITY 8.1
Policy-orientated research: Modernisation and sustainability of fisheries

Contract for:

COORDINATION ACTION

Annex I - "Description of Work"

Project acronym:	INDECO
Project full title:	Development of Indicators of Environmental Performance of the Common Fisheries Policy
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1 Project Summary

Indicators can be valuable tools for tracking change, identifying problems and monitoring implementation of policies and results. They are increasingly used to assess the efficacy of EU policies, including the extent to which environmental concerns are integrated into sectoral policies. A robust set of informative indicators will help policy- and decision-makers to evaluate the performance of management measures, as well as ensure accountability to the public through regular information.

The aim of the co-ordination action is to achieve a more coherent approach to indicator use in the implementation of the Common Fisheries Policy, by synthesising existing research and analysis from national, EU and international sources. A set of indicators to measure the effectiveness of fisheries management, particularly environmental aspects, is to be identified. Operational models establishing the relationship between fishing activities and changes in the marine environment will be used to underpin some of the ecological indicators.

In addition, the project will identify data gaps and ways of addressing these, taking account of the need for cost-effectiveness. The project will also seek ways of ensuring that agreed indicators are subsequently used in the policy process. The results will be targeted at fisheries managers and other stakeholders. Overall, the action is firmly embedded in, and will respond directly to, EU policy calling for the development of fisheries/environment indicators.

A number of work packages will examine existing efforts to develop indicators. Since a considerable amount of work has been done already, networking will here be of particular importance. In order to bring expertise in different countries together, several meetings and two conferences will be held. As the combined scientific and policy expertise of the participants covers both fisheries and environmental issues, the CA will be a vital contribution to developing indicators of environmental performance of fisheries management in the EU

2 Project objectives and state of the art

2.1 Project Objectives

Fish stocks around the world have been declining for years. Currently, around 75 per cent of the global fish stocks offer no possibility of increased catches. Many of these are overfished and yields are far below optimal levels. In the EU, as many as 50 per cent of the commercial fish stocks are overfished. The situation is particularly serious for many demersal stocks, such as cod, hake and whiting. Fishing also affects the wider marine ecosystem, including habitats and non-target species. So far, fisheries policies have been unsuccessful in preventing the decline in stocks and the associated damage to marine ecosystems.

The achievement of sustainable development and the integration of environmental requirements into sector policies are now established and legally binding objectives of the EU. Building on these objectives, and recognising the deteriorating state of the marine environment, including fish stocks, the Community agreed on a new framework for managing fishing and aquaculture activities under the Common Fisheries Policy (CFP) in December 2002. The aim of the resulting Regulation 2371/2002 is 'to ensure the long-term viability of the fisheries sector through sustainable exploitation of living aquatic resources based on sound scientific advice and on the precautionary approach'. More concretely, the stated objectives of the CFP now include exploitation that provides for, *inter alia*, sustainable environmental conditions. Moreover, 'The CFP shall aim at a progressive implementation of an ecosystem approach to fisheries management.' (Article 2)

The result is that the introduction of ecosystem considerations in the management process is now a requirement in the EU. Together with other developments at an international level, this is creating increasing pressure first to understand and then to manage the relationships between fishing activities and ecosystems, as well as finding ways to measure the effectiveness of different management approaches. This, in turn, will allow management strategies to be adapted accordingly. Well-designed indicators are a recognised tool to help assess progress towards policy objectives, as well as to provide a basis for adjusting policies and communicating with stakeholders. Ultimately, the use of indicators should promote action to improve management systems in pursuit of policy goals and objectives.

The purpose of this Co-ordination Action is to ensure a coherent approach to the development of indicators at EU level, in support of environmental integration within the CFP and in the context of international work on indicators. The principal objectives of INDECO are:

1. **To identify quantitative indicators for the impact of fishing on the ecosystem state, functioning and dynamics, as well as indicators for socio-economic factors and for the effectiveness of different management measures.**
2. **To assess the applicability of such indicators.**
3. **To develop operational models with a view to establishing the relationship between environmental conditions and fishing activities.**

Priority will be given to the impact of fishing on (i) benthic communities, (ii) sensitive species and (iii) trophic structure, but indicators for measuring the success of a number of other management objectives will be looked at as well. All of this will be done within a clear policy framework, using current CFP management objectives as a starting point.

The existing methods developed to evaluate changes in marine ecosystems from environmental and fisheries perspectives will be reviewed. Generic indicators (including 'headline' indicators) will be identified to analyse ecosystem-wide effects of fishing and to distinguish these from changes in marine ecosystems due to other factors, such as eutrophication, where possible. Particular attention will be given to link up with other related and ongoing efforts such as the BECAUSE project[1] which analyses the quantitative role of species interaction as a first step towards an ecosystem approach to fisheries management.

The Co-ordination Action will aim to identify robust and operational indicators making efficient use of available data. The work will be designed and co-ordinated to ensure general applicability across a range of fishery zones, including the Mediterranean, and major habitat types, including sea regions prone to eutrophication.

Policy makers, managers, researchers and other stakeholders not part of the consortium will be closely involved throughout the project, in order to contribute practical knowledge of fisheries management and needs, to identify relevant objectives and also to increase the eventual take-up of indicators once a final set is agreed upon.

In summary, this Co-ordination Action aims to undertake a review of existing research, synthesise and present the state of the art on fisheries/environment indicators, identify gaps in the current research, data collection and statistical work, and examine necessary policy and institutional changes needed to fill these gaps. This will be achieved by bringing together key scientific and policy experts, as well as end-users and relevant stakeholders in the EU and other regions of the European Research Area, including those currently less focused on using indicators as a management tool.

2.2 State of the Art

Substantial efforts have already been made internationally, as well as in regional and national fora, to develop fisheries/environment indicators. Many different indicators have been proposed, but few have been tested systematically and even fewer have been put to use. To identify a set of indicators that can be applied at the EU level to measure and monitor progress under the CFP, a more co-ordinated approach is needed, drawing on the knowledge and experience of different organisations and individuals.

In the area of fisheries management, for example, substantial contributions have been made by the OSPAR Convention process, the International Council for Exploration of

[1] Linking up will be greatly facilitated by the fact that INDECO and BECAUSE have several participants in common. These are AZTI, DIFRES, FGFRI, IFREMER, HCMR, SFI and UR.

the Seas (ICES), the European Environment Agency (EEA) and the UN FAO, as well as by a number of national ministries and agencies. On an international level, the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC) have set up a working group (WG 119) on Quantitative Ecosystem Indicators for Fisheries Management to develop theory to evaluate changes in marine ecosystems from environmental, ecological and fisheries perspectives. The above work has focused on the environmental and ecological aspects of fishing, in particular. Less attention has been paid to the socio-economic aspects of fisheries policy, and to the aquaculture sector. In addition, most of the work in the EU has been carried out in the northern Member States, while efforts to find indicators suitable for the Mediterranean region have been more limited.

A framework that aims at integrating fisheries and environmental issues through the development of an 'ecosystem approach' to management has been developed for the North Sea. A number of workshops under the auspices of the North Sea Task Force and the OSPAR Convention have resulted in a general methodology for describing Ecological Quality (EcoQ) and setting Ecological Quality Objectives (EcoQOs). As a result of this work, ten issues have been proposed that cover the structural and/or functional aspects of the ecosystem within the different hierarchical levels: ecosystem, communities and habitats and species (Table 1).

Table 1. Proposed set of issues and hierarchical levels for EcoQOs in the North Sea.

	Proposed Issues	**Hierarchical level**
1	Reference points for commercial species	Species
2	Threatened or declining species	
3	Sea mammals	
4	Sea birds	
5	Fish communities	Communities and habitats
6	Benthic communities	
7	Plankton communities	
8	Habitats	
9	Nutrient budget and production	Ecosystem
10	Oxygen consumption	

The following sections describe the state of the art relating to different components of INDECO, with work packages 2 to 4 covering the three hierarchical levels identified in the above table. State of the art in relation to modelling methods (WP 5) is also outlined.

2.2.1 Institutional framework and the usefulness of possible indicators

Various projects or institutions have sought to identify criteria for developing indicators. The FAO guidelines for developing indicators on sustainable development set out five sequential steps that need to be addressed in order to develop a meaningful set of indicators out of thousands of actual and potential indicators (FAO, 1999). These are:

1. Specifying the scope of the indicator framework (e.g. its purpose, which human activities to cover, the issues to be addressed and the boundaries of the system under consideration, i.e. fishery, area, region, ecosystem);
2. developing a framework to agree on components within the system;
3. specifying the criteria, objectives, potential indicators and reference values (targets, thresholds or standards);
4. choosing a set of indicators and reference values; and
5. specifying the method of aggregation and visualisation.

According to ICES (2001), indicators should be:

- Relatively easy to understand by non-scientists and those who will decide on their use;
- Sensitive to a manageable human activity;
- Relatively tightly linked to that activity;
- Easily and accurately measured with a low error rate;
- Responsive primarily to a human activity (i.e. fisheries), with low responsiveness to other causes of change;
- Measurable over a large proportion of the area to which the indicator is to apply (i.e. EU policy area);
- Based on an existing body or time series of data to allow a realistic setting of objectives.

For ecosystem indicators, many different matrices exist, each considering different components or sets of components, and each providing information aimed at answering very specific questions. Several classifications of these matrices have been developed, based on different sets of criteria, ranging from organisation level, along the gradient of single-species to ecosystem considerations (Link, 2002; Rochet & Trenkel, 2002), to those based on their properties (Rice, 2000) or nature (Link *et al.*, 2002). Another classification involves environmental, ecological, fisheries and socio-economic indicators (SCOR-IOC WG 119).

A common mistake in efforts to identify suitable indicators is to list all possibilities without carefully considering the policy framework and the objectives that one wants to measure progress against. In its first phase, INDECO will therefore review the current management framework, identifying the relevant objectives for sustainable development and environmental performance of the CFP. To evaluate the usefulness of indicators suggested by the other work packages, a set of criteria to will be compiled from earlier work in this area. The FAO, for example, suggests that the choice of indicators should be based on the following criteria:

- policy priorities and objectives;
- practicality/feasibility;
- data availability;
- cost-effectiveness;
- understandability;
- accuracy and precision;
- robustness to uncertainty;
- scientific validity;
- acceptability to users/stakeholders (consensus among parties);
- ability to communicate information;

- timeliness;
- formal (legal) foundation; and
- adequate documentation.

2.2.2 Indicators on Population Level, including Sensitive Species

When considering the effects of fishing on the marine ecosystem at a single-species or population level, we need to distinguish between two groups of species that are fundamentally (and by definition) different in terms of their relationship with fishing: target species and non-target species. When the objective is to identify indicators to monitor and conserve species, there are two other important differences: the availability of data and the existence of a reliable advisory framework.

As regards reference points for commercial (target) species, the scientific advice is primarily based on evaluating the necessary and sufficient conditions for conservation and sustainable exploitation. While there are significant imperfections in the data sets and models used, considerable research effort is being directed at the development of this framework. Hence it will not be over-emphasised in this co-ordination action. This type of advisory framework and data do not exist for most non-target species, making management more difficult and further work urgent.

Improperly managed, fisheries can place populations of both target and non-target species at risk by causing unsustainable mortality over time periods long enough to have an impact on abundance. Prolonged high mortality rates can affect a population directly by reducing the spawning biomass to a level at which productivity is impaired. Spawning stock biomass, fishing mortality and their respective reference points are the criteria currently used by ICES to decide if a stock is inside or outside safe biological limits.

Among non-target species, several sub-groups can be distinguished, based on their relationship with fishing and/or different properties in terms of monitoring and general attention from the public and policy makers. In the EcoQO framework (above), three issues were proposed for the non-target species:

- threatened and declining (or sensitive) species;
- sea mammals; and
- seabirds.

For example, many sharks, skates and rays can be considered sensitive species and their populations have been dramatically depleted as a result of fishing activities. The decreases in range and abundance of many species have led to concerns about the viability of their populations, and several species have recently been listed as threatened and declining by the OSPAR Biodiversity Committee 2001, as well as by the World Conservation Union (IUCN). In the case of the North Sea skates and rays, four of the largest species are currently caught in fisheries at levels that may lead to their extinction.

The EU Birds and Habitats Directives also list a number of fish, mammals and seabirds that should benefit from various forms of protection, in order to ensure favourable conservation status. This is supposed to be backed up by surveillance systems and in some cases, more specific monitoring requirements, notably to monitor

the incidental capture and killing of cetaceans. In practice, Member States have made little progress in defining favourable conservation status, or in developing comprehensive surveillance and/or monitoring systems.

A comparative assessment of the abundance, distribution and vulnerability of rare and declining species requires efforts to:

- identify or develop appropriate methods for assessing vulnerability;
- identify appropriate indicator metrics for reporting vulnerability and changes in abundance and distribution to policy makers;
- determine effective methods of monitoring changes in abundance and distribution; and
- determine how fishery management actions (catch controls, effort controls and technical measures, including closed areas) will affect the abundance and distribution of rare and declining species, and the indicator metrics used to describe their status.

A problem that almost by definition applies to threatened and declining species is that several of these species are now so scarce that existing surveys do not monitor their status effectively. For effective monitoring, it is important to determine:

- how the statistical power of surveys can be increased; and
- how data from existing surveys can be analysed to maximise the statistical probability of detecting trends in abundance.

2.2.3 Community and habitat indicators

The removal of fish and shellfish from the ecosystem not only affects the target species but may also affect non-target species, directly as well as indirectly (e.g. through changes in the foodweb or disruption of the habitat). Higher-order indicators (e.g. at community level rather than population level) may reveal changes caused by fishing that would otherwise have remained unnoticed. Because of the nature of fisheries, effects can be expected in the fish and benthic invertebrate communities as well as in their habitat.

The structure and ecological functioning of a community is determined by its components. It consists of different species, many of which may change markedly throughout their life in terms of behaviour, food preferences and other characteristics. A community can therefore be characterised by distinguishing several aspects of both structure and functionality, such as:

- size-structure;
- species composition (including species diversity);
- composition based on traits (e.g. life-history, habitat preference, etc.); and
- trophic structure.

These various aspects may be reflected in the choice of indicators. Because of data limitations, indicators for the above aspects are currently better developed for the fish community than for the benthic community. The experience gained from developing indicators for the fish community, however, is likely to be useful in the identification of indicators for the benthic community.

There is currently a need to develop suitable indicators that reflect the effects of fishing on both benthic and fish communities, especially in the Mediterranean. Several studies (Gaertner *et al.*, 1999; Colloca *et al.*, 2003) have shown that there are close relationships between macrobenthos and demersal fish assemblages, indicating that negative effects of fishing on the benthic community may be mirrored in the distribution and abundance of fish species. A holistic approach, considering the use of indicators for the benthos-fish community, would therefore be preferable.

Marine habitats are generally distinguished by the physical nature of the environment; for example, silty-mud is distinct from muddy-sand. Habitats can also include biologically produced features such as reefs. The development of indicators for marine habitats is currently hampered by the fact that no agreed framework for habitat classification exists. For this, the marine habitat portion of the European Nature Information System (EUNIS) provided by the EEA needs to be further advanced.

There are limited data on the impacts of fishing on habitats within EU waters. The effects of bottom trawling are widely recognised, and there are data that suggests serious impacts of deep-sea fisheries on cold-water corals, such as *Lophelia* or *Sabellaria* reefs. In the north-west Mediterranean, fisheries-induced changes in the size and species composition of the fish community may have led to large changes in the benthic communities as a result of increased abundance of sea urchins. This is an example of how direct effects of fisheries may cause habitat modification through changes in the fish community and the foodweb. A hierarchical approach to the development of ecosystem indicators, as we have chosen here, illustrates the need for close collaboration between the relevant work packages (WPs 2, 3 and 4). It also shows that the protection of habitats is a prerequisite for protecting the species and communities dependent upon them.

Although a broad range of indicators has already been developed for the community/habitat level, the theoretical framework underpinning these indicators (e.g. what they are actually showing and their relationship to fishing) is often non-existent or at least poorly understood. If these indicators are to be used in a management context, there is a need for validated models that help to predict the impacts of fishing and changes in fishery management practices on the marine ecosystem. Therefore, close collaboration between WPs 2, 3, 4 and 5 will be ensured throughout the CA.

2.2.4 Indicators on ecosystem state and function

As highlighted in the previous sections, fishing activities affect the marine environment and its biological communities directly as well as indirectly and have a definite impact on the structure and function of ecosystems. Detecting these effects at the ecosystem level is, however, not an easy task.

We know that living organisms may shape their ecosystem and that species dynamics (and hence biotic diversity) may be more sensitive to ecosystem stress than are ecosystem processes; an ecosystem under stress apparently keeps many of its functions even if its species composition changes (Holling *et al.*, 1995). But, as suggested by Thompson *et al.* (2001), we also need to know how evolutionary responses at the species level produce the collective morphology (physiognomy) and

behaviour (ecosystem function) of ecosystems. A key question is whether first principles of physics, chemistry and evolution by natural selection can successfully predict the composition, structure and functioning of ecosystems.

Most ecosystems are very complex. A fundamental cause of ecosystem complexity is indirect effects, effects of one species on another, that only arise in the presence of other species (Wotton, 2002). Consequently, understanding and predicting the behaviour of ecosystems depends on our ability to effectively identify and deal with indirect effects, which can have important implications in ecological studies.

Within this framework, how can the implementation of ecosystem considerations into fisheries management be improved? ***First***, it is necessary to clearly define fishery goals in an ecosystem context and develop protocols that resolve competing goals for any given ecosystem. This will be an iterative process and will require that all stakeholders be provided with an opportunity for input. ***Second***, a suite of ecosystem metrics and possible indicators merit exploration to determine if there are ecosystem analogues to single species reference points, standards and similar control rules. According to Link (2002), three main groups need to be explored:

1. Systems Analysis (Cybernetic) Metrics: exergy, emergy, total production, total biomass, energy flux, resilience, persistence, resistance, stability, free energy and information content;
2. Aggregate Metrics: mass flux, ascendancy, redundancy, developmental capacity, guild composition, trophic transfer efficiency, production and biomass of a trophic level or group;
3. Food Web Metrics: connectivity, trophic links, modal chain length, % omnivory, % cannibalism, linkage density, allocation of species across trophic levels, interaction strength, cycles and predator/prey ratios.

These metrics need to be sensitive to change, directional, general enough to be useful, feasible to measure and able to incorporate uncertainty. ***Third***, more appropriate theory, models and methods at the aggregate and system levels need to be developed and applied. ***Fourth***, monitoring should be maintained and expanded. By maintaining current monitoring, many of the system-level emergent properties can be calculated from existent resource survey data.

2.2.5 Modelling methods that incorporate ecosystem indicators for management advice

A wide variety of modelling methods and approaches has been established to model the impact of fishing on fish species complexes and marine ecosystems, and to predict how measurable aspects of the populations and ecosystem will change as a result of fishing and environmental changes (Sainsbury 1988; Francis et al. 1989; Hill and Wassenberg 1990; Auster and Langton 1999; Punt et al. 1999; Gilbert et al. 2000; Moran and Stephenson 2000; O'Brien et al. 2000; Pitcher et al. 2000; Jennings et al. 2001; Shin and Cury 2001; Boyd 2002; Furness 2002). These include methods that model the interactions among fish species, interactions between fish species and their habitats, impacts of fishing on marine mammals, seabirds and benthic habitat, and suggest experimental management approaches that can help to distinguish alternative hypotheses about fish population dynamics and associated ecological hypotheses

(Sainsbury, 1988; Punt *et al.*, 1999). In addition, approaches that model the impact of environmental (e.g. oceanographic) perturbations on fish population dynamics, and in some instances suggest how fisheries management should be modified to account for these perturbations (Francis *et al.*, 1989; Jokobsson *et al.*, 1994; Cardinale and Arrhenius, 2000; O'Brien *et al.*, 2000) have also been tried.

A number of different attempts to model the technical interactions between fishing fleets and groups of interacting fish stocks, and provide a simulation platform with which to evaluate the potential consequences of alternative hypotheses for fish population dynamics and changes in fisheries management regulations, for example, on fishing gear selectivity (e.g. BORMICON) has also been made. Other approaches apply mass balance equations to marine ecosystem complexes and permit evaluation of the potential effects of fishery-related removals on the structure and functioning of the food web (Pitcher *et al.*, 2000), or explore fish community dynamics through size-dependent trophic interactions using spatialised individual-based models (Shin and Curry, 2000). Yet others have aimed to provide strategic management advice based on coherent and plausible hypotheses for fisheries management and ecosystem dynamics, and to formulate and identify management methods that are robust to key uncertainties (Kuikka *et al.*, 1996; 1999).

The different modelling approaches vary considerably in their data and research requirements, and this has to be taken into careful consideration in the development of tools for better fisheries management. Due to the relatively short time period of the proposed project, and the relatively small amount of resources available for new research and modelling efforts, the proposed work will not promise to extend in any significant way the sophistication of the existing modelling methods and approaches. Instead, it will consider reformulating some relatively simple and generic analytical models that integrate and analyse the indicators developed in other WPs for the purpose of monitoring and evaluating the environmental performance of the CFP. This methodology will incorporate baseline reference points, where they have already been established or proposed within the project, designed to prescribe modifications to current management actions.

To facilitate the uptake and application of indicators in fisheries and marine environmental management, frameworks for evaluation will be reviewed and reformulated, if necessary, to identify improved monitoring protocols that may utilize some of the proposed indicators and in some instances variations in harvest control rules (e.g. gear regulations, TACs and fishing effort controls) for some key fisheries (Kell *et al.*, 1999) that make efficient use of the new indicator metrics and prescribe adaptation or restorative measures as appropriate. This work will be focused on sensitive species (e.g., marine mammals and seabirds) where data, modelling work, and expertise have already accumulated but urgently require further work to incorporate it into operational management.

2.2.6 Socio-economic indicators

The CA will also cover other aspects of the management framework affecting the sustainability of the fisheries sector, by identifying key indicators for critical socio-economic issues and evaluate their usefulness, feasibility and costing from a management perspective. So far, attempts to identify and select relevant socio-

economic indicators have been rather modest. However, the FAO has made an important effort to establish the relationship between the principles of sustainability, the provisions of the Code of Conduct for Responsible Fisheries, and criteria and indicators (including socio-economic) for sustainable fisheries (Garcia, 2000). Other efforts include OECD-initiated work on identifying (sector-specific) indicators to measure decoupling of environmental pressures from economic growth (OECD, 2001) and the EU Concerted Action "Economic Assessment of European Fisheries" (Salz, 2003).

Work to develop socio-economic indicators, and to integrate these with ecological indicators, for the related area of coastal zone management has also been done (Unesco, 2002). Experiences from these initiatives, as well as from others sectors such as forestry, will be drawn upon. Organisations involved in work on indicators for fisheries and aquaculture, such as the OECD, the General Fisheries Commission for the Mediterranean and the FAO, will be encouraged to participate in the work and pool their resources with the project. In addition, international experts from countries and institutions already using socio-economic indicators, for example Australia, will be invited to share their knowledge. Close links will also need to be established with DG Fish and DG Environment, where relevant staff will be invited to meetings.

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3 Participants list

The coordination action will have 20 participants covering 11 countries.

Partic. Role[2]	Partic. No.	Participant name	Participant short name	Country	Date enter project	Date exit project
CO	1	Institute for European Environmental Policy	IEEP	UK	1	24
CR	2	Netherlands Institute for Fisheries Research	RIVO	NL	1	24
CR	3	Department of Environmental Sciences, University of Venice	DSA-UNIVE	Italy	1	24
CR	4	Renewable Resources Assessment Group, Imperial College	RRAG	UK	1	24
CR	5	Institute for Fisheries Management and Coastal Community Development	IFM	Denmark	1	24
CR	6	Sea Fisheries Institute, Poland	SFI	Poland	1	24
CR	7	Hellenic Centre for Marine Research	HCMR	Greece	1	24
CR	8	Fundación AZTI – AZTI Fundazioa	AZTI	Spain	1	24
CR	9	Fishery Research Service Marine Laboratory Aberdeen	FRSMLA	UK	1	24
CR	10	Centre for Environment, Fisheries and Aquaculture Science - Lowestoft Laboratory	CEFAS	UK	1	24
CR	11	Institut Français de Recherches pour l'Exploration de la MER	IFREMER	France	1	24
CR	12	Institut du Développement Durable et des Ressources Aquatiques	IDDRA	France	1	24

[2] Co: Coordinator; CR: Contractor

Partic. Role[2]	Partic. No.	Participant name	Participant short name	Country	Date enter project	Date exit project
CR	13	University of Rome La Sapienza – Department of Animal and Human Biology	UR	Italy	1	24
CR	14	Danish Institute for Fisheries Research	DIFRES	Denmark	1	24
CR	15	Institute of Coastal Research, Sweden	ICR	Sweden	1	24
CR	16	Finnish Game and Fisheries Research Institute	FGFRI	Finland	1	24
CR	17	Central Institute for Marine Research, Italy	ICRAM	Italy	1	24
CR	18	Joint Nature Conservation Committee	JNCC	UK	1	24
CR	19	Consiglio Nazionale delleRicerche	IAMC-CNR	Italy	1	24
CR	20	Estonian Marine Institute, Tartu University	EMI	Estonia	1	24

4 Relevance to the objectives of the programme

The overall objective of the SSP Priority 8.1 on Policy-oriented research is to support the formulation and implementation of Community policies, by providing scientific contributions 'on demand' that are coherent with other Community policies and sensitive to policy change.

The specific principles listed are:

- timely and effective scientific inputs, covering a wider field of policies than in the past, and with the prospect of improved information, exploitation and uptake of results, at national and EU level;
- a coherent research base that reflects the increasing integration of Community policies and of the science that underpins them;
- systematic improvements in the relationship between research and policy at all levels in the EU; and
- development of the European Research Area, by encouraging a single 'playing field' in relation to policy-related research.

In this proposal, we have interpreted the area priority 'Sustainable management of Europe's natural resource' and instrument *8.1.B.1.3. Modernisation and sustainability of fisheries, including aquaculture-based productions systems* as a need for sustainable use of the marine fishing resources by a competitive fishing industry, while taking the necessary actions to protect the marine environment. In order to achieve this, an ecosystem-based approach to the management of fishing activities needs to be adopted. Since the beginning of 2003, a gradual implementation of such an approach is embedded in the EC Common Fisheries Policy, together with the precautionary approach. To make these approaches operational, the use of indicators and reference points to judge ecosystem status is central.

The objectives of this Co-ordination Action are to develop indicators of the ecological effects of fishing, and models that help to predict the impacts of fishing and of changes in the fishery management system on the marine ecosystem, as well as indicators for other aspects (e.g. socio-economic factors). The applicability of these indicators within the EU management framework will also be assessed.

The indicators identified should be suitable for tracking fishery-induced changes in diversity, productivity, trophic structure and functional processes in marine ecosystems, and will be validated using historic and experimental data, as well as measuring the effectiveness of key management measures to meet general objectives on sustainability and environmental protection.

The contents of the project closely mirror the objectives of this priority area, by supporting the evaluation of EU fisheries policies, from an environmental perspective, including their content and implementation. The proposed workplan and deliverables will provide the scientific contributions needed in order to ensure that the Common Fisheries Policy is more coherent with EU environmental policy, and will highlight necessary adjustments.

The project team brings together researchers from a number of different disciplines and networks, supporting joint activities between natural scientists (fisheries and ecologists) and policy researchers. It will, furthermore, ensure close co-operation between researchers from different parts of the EU and Candidate Countries, as well as collaboration not just between researchers but also agencies, scientific institutes and fisheries managers or end-users. From an early stage, relevant international expertise will be drawn in where possible. We believe that this co-ordination action is firmly embedded in and will respond directly to EU policy documents calling for the development of fisheries/environment indicators, and that the proposed workplan is highly relevant to the call.

5 Potential Impact

Indicators have an important role to play both in support of management decisions and in communication. To date, large numbers of quantitative indicators of the status of ecosystems have been proposed by ecologists around the world. Less effort has been spent on indicators of fisheries economics or social aspects in the sector, and on headline indicators addressing the effectiveness of management actions. Very few indicators of any kind have been properly tested and used in management. Efforts so far have also been mostly regional or limited in scope. For indicators to become an effective tool in EU fisheries management, a coherent co-ordinated effort is needed to bring the scientific expertise together. Moreover, the application of scientific expertise needs to be firmly lodged in the policy-making context.

One of the main challenges is to find indicators corresponding to different elements of the management framework. For this, a clear articulation of the management objectives is necessary, as well as collaboration with the potential users of the indicators at an early stage to identify their needs. This will be addressed in WP1, through a review of the management objectives in EU fisheries and environmental policy, and the establishment of an advisory User Group to ensure that the indicators developed are indeed corresponding to the needs of managers and other stakeholders.

This project will, among other things, try to identify indicators that can help quantify the impact of fishing on the ecosystem state, functioning and dynamics. Several work packages (WP 2, 3 and 4) will focus on the development of a minimum number of indicators that reflect the main properties of the marine ecosystem and can be monitored on a range of scales in space and time. To facilitate the uptake and application of indicators in fisheries and marine environmental management within Europe, simulation modelling will be applied to address the inter-linkages and relationships between environmental conditions and fishing activities (WP5).

The CA will also aim to rectify the lack of indicators for the other two basic principles of sustainable development: social and economic factors (WP6). So far, this area has largely been neglected in efforts to find indicators to measure the effects of fisheries management. Many countries do, however, collect the necessary data for the use of indicators as an effective communications tool.

What is feasible in the short and medium term depends to a large extent on data availability, which will also be taken into consideration. Some data gaps are likely to be identified and the project will therefore also consider ways to address these (e.g. which data will need to be collected in the future and by whom). In addition, the set of indicators should be expected to change over time as data availability improves and/or policy objectives and priorities change.

Building on previous efforts, on a national and international level, to develop fisheries and environment indicators relevant to the EU Common Fisheries Policy, the project will develop a common and multi-disciplinary knowledge-base needed to support the development of effective and coherent policies, taking full account of environmental concerns. It will be executed in such a way as to promote and support the networking and co-ordination of research and innovation activities, in what are all too often separate or discrete scientific or policy domains. Through a series of joint working,

twinning or peer review efforts, as well as the organisation of open conferences and meetings, the project will ensure strong collaboration and maximum use of the scientific and policy knowledge in the EU and related fisheries regions/fora.

5.1 Contribution to EU Policies

Efforts to improve environmental integration within the Common Fisheries Policy have been driven by numerous factors, including increasing awareness of the environmental implications of the fishing sector as well as firm objectives on sustainable development and integration now contained in the EU Treaties. The environmental integration requirements has led to activities in various fora, even at the Summit level where Heads of State have called for the development of sectoral integration strategies under the so-called Cardiff Integration Process. A key component of this process is to monitor progress on integration, with the help of indicators.

Environmental integration in general, and the specific need for indicators to monitor progress, have subsequently been expressed in several Commission documents, including the Biodiversity Action Plan on Fisheries (COM(2001)162) and the Communication on Elements for an integration strategy (COM(2001)143). The use of indicators has also been explicitly supported by the Council in its 2001 report on environmental integration, submitted to the June 2001 Göteborg Summit.

The 2002 Commission Action Plan to integrate environmental protection requirements into the Common Fisheries Policy (COM(2002)186) provides the clearest statement as to future developments in this area, noting that progress should be monitored by means of a system of indicators, initially based on a preliminary set. In 2003, a case study was conducted on behalf of DG Fisheries. On the basis of this experimental work, the Commission is to submit a report, by 2006, on the environmental performance of the CFP. Additional improvements are to be stimulated by research under the 6th Framework Programme, with a view to developing a more comprehensive monitoring system, including benchmarks and indicators of driving forces, pressure, state, impact and response. This Co-ordination Action is likely to underpin this process and help the Commission find a suitable set of indicators supported and tested by researchers in many of the Member States.

While this preparatory work continues, the implementation of the so-called Lisbon Strategy to make the EU the most sustainable, competitive and knowledge-based society has resulted in one headline indicator on fisheries already being included at a strategic level. The indicator focuses on the percentage of catch taken from commercial stocks below "safe biological limits" in the EU.

This co-ordination action is clearly driven by and will respond to the EU policy framework and policy needs. The project brings together both scientific and EU policy expertise, to ensure a scientifically robust contribution that is also of maximum relevance to EU policy makers and other end-users. The result should be to improve the management system overall through the use of indicators as an assessment tool to judge the effectiveness of the Common Fisheries Policy. Drawing on existing efforts covering diverse geographical areas and aspects of the fisheries sector, the project will

provide the most up-to-date and coherent approach to the subject of fisheries/environment indicators at EU level, based on the involvement of participants from a large number of Member States, many of whom are actively involved in either fisheries science or fisheries management activities.

5.2 The PIP (Policy Implementation Plan)

Contractors shall, through the co-ordinator, submit at, or before the end of the project, a Policy Implementation Plan (PIP) detailing how the research group proposes the application of the results at the fishery policy management level.

The specific content of the PIP shall detail the initially expected policy related results from the project to be measured against the obtained results. It shall describe the potential application of the results within EU and national policy frameworks (e.g. legislation, control, economic impacts) on short-, mid- and long-term time scales, and provide overall policy guidance conclusions. The format of the PIP shall be a free-style text document written as an executive summary of maximum 3 A4 pages.

The targeted readers of this deliverable would be policymakers, stakeholders and officials concerned with policy management issues. The document could be designated as confidential, if the consortium requests that this part of the final report is not to be published.

6 Project management and exploitation/dissemination plans

6.1 Project management

The project will be managed by five institutions under the overall leadership of the co-ordinator (IEEP). This will entail regular communication between the five institutes, via email and in person. The proposed timetable allows for **five co-ordination meetings** between the leading institutions to discuss preparations for **Sub-group Meetings** and **Conferences** and to co-ordinate the progress on different tasks. In addition, the co-ordinating institutions expect to engage in research activities together that will strengthen their ability to co-ordinate the Actions. The **Sub-group Meetings** will be organised by the Work Package leaders. These meetings will, in part, serve as **review mechanisms** but also as preparation meetings for the conferences. Sub-group Meetings, where appropriate, will include external experts. In particular, this will include where possible project participants/leaders of related ongoing projects, such as the BECAUSE project.

The two annual **conferences** will be organised by the Sea Fisheries Institute in Poland and the Hellenic Centre for Marine Research in Greece, in co-ordination with IEEP. This will give the meetings an appropriate geographical span and permit easier access to research communities in all parts of the ERA. The conferences will be open to parties outside the INDECO consortium as well. Communication to **outside Parties** relating to each conference will flow through IEEP. IEEP will also maintain contact details of outside Parties for dissemination of the results. The Sea Fisheries Institute is responsible for the organisation of the first conference in Month 9 of the project and the Hellenic Centre for Marine Research for the second in Month 16.

The meetings shall be organised in such a way that travel and subsistence costs are kept to a minimum. Project coordination meetings will be held with participation of all contractors and members of the Commission in conjunction with the conferences. The European Commission shall be informed about the meetings at least eight weeks in advance.

The Institute for European Environmental Policy, as co-ordinator and leader of WP 1, will be responsible for:

- Leading and conducting research and other activities under WP1.
- Ensuring and facilitating communication between members of INDECO.
- Organisation of the co-ordination meetings.
- Organisation of annual conferences: programme, invitations, participants lists and reports.
- Communications with the advisory User Group.
- Communications with the EU and the delivery of timely progress reports.
- Communications with parties outside the INDECO membership.
- Dissemination of results throughout the course of the co-ordinated action.
- Writing of annual literature reviews and state of the art reports, jointly with participants 2, 3, 4 and 5.

- Conducting all Consortium management activities, including managing the external travel budget.

The **Netherlands Institute for Fisheries Research (RIVO),** as leader of WP 2 and WP 3, will be responsible for:

- Participation in the co-ordination meetings.
- Leading and conducting research under WP2 & WP3.
- Ensuring that its twinning partners, AZTI and FRSMLA, meet their responsibilities in relation to WP2 and WP3 respectively.
- Organisation of two of the joint subgroup meetings of WP2, WP3 and WP4.
- Timely delivery of the results of WP2 & WP3 to IEEP.
- Presentation of the results of WP2 & WP3 at the annual conferences.
- Preparing relevant sections of the annual literature reviews and state of the art reports.

The Department of Environmental Science (DSA-UNIVE), as leader of WP 4, will be responsible for:

- Participation in the co-ordination meetings.
- Leading and conducting research under WP4.
- Ensuring that its twinning partner, CEFAS, meets its responsibilities in relation to WP4.
- Organisation of one of the joint subgroup meetings of WP2, WP3 and WP4.
- Timely delivery of the results of WP4 to IEEP.
- Presentation of the results of WP4 at the annual conferences.
- Preparing relevant sections of the annual literature reviews and state of the art reports.

The **Renewable Resources Assessment Group, Imperial College**, as leader of WP5, will be responsible for:

- Participation in the co-ordination meetings.
- Leading and conducting research under WP5.
- Ensuring that its twinning partner, IFREMER, meets its responsibilities in relation to WP5.
- Co-ordination with and participation in the joint subgroup meetings of WP2, WP3 and WP4.
- Organisation of the subgroup meetings of WP5.
- Timely delivery of the results of WP5 to IEEP.
- Presentation of the results of WP5 at the annual conferences.
- Preparing relevant sections of the annual literature reviews and state of the art reports.

The **Institute for Fisheries Management & Coastal Community Development (IFM)**, as leader of WP6, will be responsible for:

- Participation in the co-ordination meetings.
- Leading and conducting research under WP6.
- Ensuring that its twinning partner, IDDRA, meets its responsibilities in relation to WP6.
- Organisation of the subgroup meetings of WP6.
- Timely delivery of the results of WP6 to IEEP.
- Presentation of the results of WP6 at the annual conferences.
- Participation in WP1.
- Preparing relevant sections of the annual literature reviews and state of the art reports.

The **Sea Fisheries Institute (SFI)**, as leader of WP7, will be responsible for:

- Organisation of the 1st Annual Conference in co-ordination with IEEP.
- Participation in the 2nd co-ordination meeting (ahead of the Conference).
- Participation at relevant subgroup meetings and the two annual conferences.
- Presentation of research results at the annual conferences.
- Contributions to the studies and state of the art reports as required.
- Review of the literature reviews and studies produced by the relevant WPs and the corresponding sections of the state of the art reports.

The **Hellenic Centre for Marine Research (HCMR)**, as a leader of WP8, will be responsible for:

- Organisation of the 2nd Annual Conference in co-ordination with IEEP.
- Participation in the 4th co-ordination meeting (ahead of the Conference).
- Participation at relevant subgroup meetings and the two annual conferences.
- Presentation of research results at the annual conferences.
- Contributions to the studies and state of the art reports as required.
- Review of the literature reviews and studies produced by the relevant WPs and the corresponding sections of the state of the art reports.

Twinning partners will be responsible for**:**

- Participating in and reviewing research under the relevant WP (see above) according to their twinning agreement.
- Participation in the subgroup meetings of the relevant WP (see above).
- Contributions to the state of the art reports as required.
- Participation in the two annual conferences.
- Presentation of research results at the annual conferences.

Other participants will be responsible for**:**

- Contributions to the studies and state of the art reports as required.
- Review of the literature reviews and studies produced by the relevant WPs and the corresponding sections of the state of the art reports.
- Participation at relevant subgroup meetings and the two annual conferences.

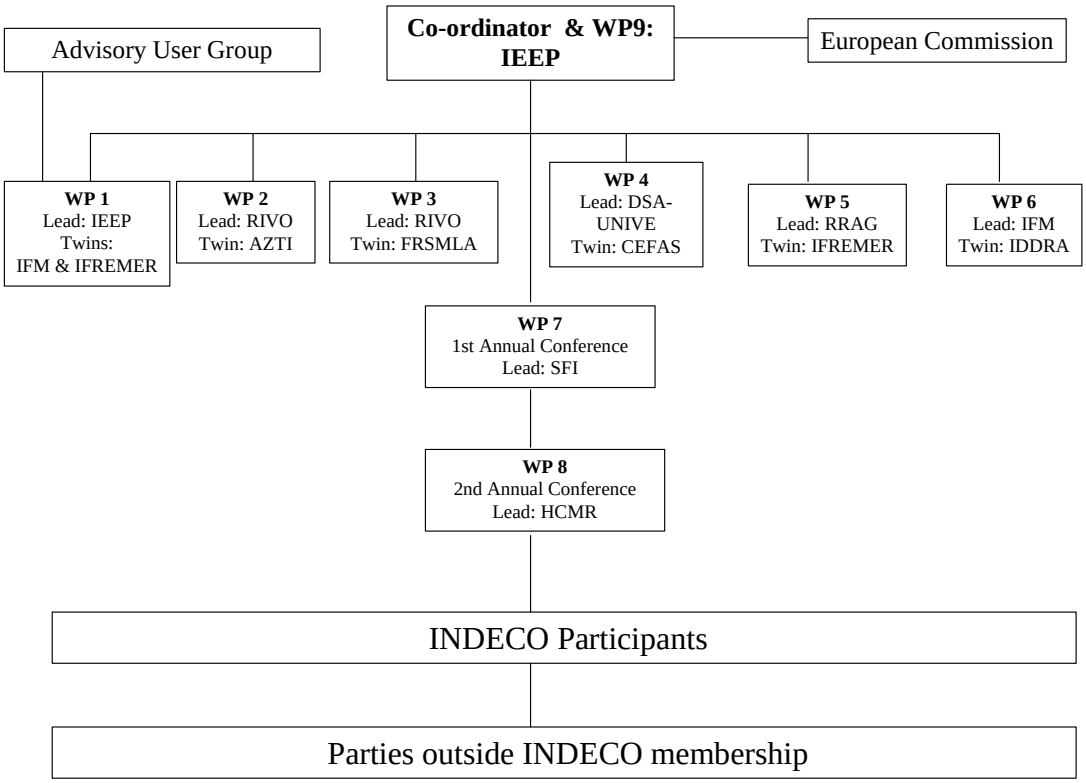
- Presentation of research results at the annual conferences.

An advisory **User Group** of approximately ten representatives from National and EU fisheries and environment authorities that might be expected to use the indicators in their work will be formed to provide a link between the researchers in INDECO, policy makers and managers. The Advisory User Group is to ensure that **policy priorities and needs** are adequately reflected in the work of the Co-ordinated Action and to provide **guidance** and **quality assurance**. This will ensure that the results will be pertinent and not a mere list of suggestions difficult to implement.

The User Group is to be composed of representatives from fisheries and environment authorities. Advisory group meetings will be organised in conjunction with the relevant subgroup meetings and held in Brussels if possible. Efforts will be made to co-ordinate dates with events that are likely to bring Advisory User Group members to Brussels anyhow.

The organisation of a Co-ordination Action requires expertise and resources for communication and organisation of events. These are available at all the leading institutions, which have undertaken numerous research projects in the relevant fields and have organised meetings and conferences as envisaged in this proposal. The capacity of the WP leaders is sufficient to manage a co-ordinated action of this size. The IEEP has two members of staff that support the co-ordination of such efforts. IEEP also maintains a website, which will be used to house the INDECO materials.

GRAPHICAL REPRESENTATION OF MANAGEMENT STRUCTURE



6.2 Plan for using and disseminating knowledge

The concepts and conclusions from our efforts will be actively disseminated and promoted across the EU in a number of ways.

Direct contacts will be sought with different potential user groups, such as policy- and decision-makers, government agencies, fishermen's organisations and environmental NGOs. The project's advisory User Group itself is to be composed of representatives from fisheries and environment authorities. IEEP has excellent contacts within the EU policy community, including a database of over 1,000 electronic and a further 600 hard copy subscribers to its fisheries/environment newsletter, El Anzuelo, which it has produced for over six years. National and EU press will also be used to disseminate the outcomes, drawing on IEEP's good relationship with fishing industry press.

Other mechanism include the publication of peer reviewed papers, the continuous posting of reports at the project website; and the production of a CD-ROM containing all the materials at the end of the project.

The involvement of the European Commission in this project will be demonstrated by including the following sentence in each publication:

> 'This study (report, paper, workshop…) has been carried out with the financial support of the Commission of the European Communities, under the specific RTD programme "Specific Support to Policies, SSP-2004-513754 INDECO. It does not necessarily reflect its views and in no way anticipates the Commission's future policy in this area.

A 2-4 page newsletter, glossy leaflet or flyer will be made by the co-ordinator. This will contain: e.g. general information about the work programme, participants, published results, and exploitation strategy. This leaflet is scheduled to appear e.g. 1-3 times, and will be broadly distributed (EU, participants, industry, scientific meetings, etc*).*

A web-site for the project shall be established to ensure that the appropriate information regarding the project will be widely accessible to facilitate the dialogue with society within Europe.

7 Detailed implementation plan

7.1 Introduction

The project workplan reflects two basic factors:

1. The Co-ordination Action will include a large number of participants; this requires opportunities to ensure that all participants are fully involved.

2. Despite the number of members involved, a number of researchers in the EU and internationally who are or will be working on these issues are not members of the Consortium. At the beginning of the project, opportunities will be created to involve some of these researchers in the Co-ordination Action. A budget facility, managed by IEEP, is foreseen to allow the attendance of additional researchers and policy makers from both the ERA countries and the international community.

The CA is aiming to cover all relevant areas and aspects of indicators of the environmental performance of the CFP. It therefore contains two work packages covering issues not specified in the Task description. We believe that these aspects are essential to finding a comprehensive set of indicators that truly measure environmental performance of the CFP and that will meet the overall objectives of the SSP Priority 8.1 as well as the instrument 8.1.B.1.3. (see B.2. Relevance to the Objectives of the SSP Priority).

7.2 Work planning and timetable

The work has been organised in nine different work packages, some of more limited scope than others. While the first WP focuses on the policy interface and evaluation of indicators emerging from the project, the following five WPs will aim to produce suggestions of indicators, as well as models to underpin some of them. The annual conferences have been set aside as two separate WPs, and finally the co-ordination of the project forms WP 9. WPs 2-6 can almost be considered mini-coordination actions, bringing together expertise in particular areas, and the work will take place parallel in time. The overall co-ordination and the efforts to link this work to the policy framework will therefore be essential for the project to fulfil its objectives. In short:

WP 1 will be focusing on the policy framework/-s where the indicators will be used, the usefulness of indicators as a tool, constraints and possibilities. Throughout the project, it will also evaluate the usefulness of indicators suggested by the other WPs through consultation with the advisory User Group. Relevance in relation to management objectives, data constraints and costs involved will be among the factors considered in the evaluation process.

WP 2 will be exploring potential indicators on population level, focusing on sensitive species such as marine mammals and seabirds.

WP 3 will be focusing on community indicators, including trophic interactions.

WP 4 will be looking at indicators on ecosystem state and function.

WP 5 will review existing models available, and in the later phases look at specific indicators proposed by WP 2 to 4.

WP 6 will develop socio-economic indicators to provide feed-back on management objectives in those areas.

WP 7: 1st Annual Conference

WP 8: 2nd Annual Conference

WP 9: Consortium management activities, co-ordination of the work and dissemination of results.

In general terms, the work under WPs 2, 3, 4 and 6 will be organised as follows:

1. A review of each area, identifying possibilities and constraints will be carried out by the leading institute/organisation.
2. Each 'twinning partner' has a shared responsibility for the research and is expected to peer-review, give feedback, and co-operate more closely with the WP leader.
3. Three subgroup meetings will be organised during the course of the project to discuss results, as well as constraints, with the wider group. Joint meetings are planned for work packages 2 to 4 to facilitate exchange between them. The lead of WP 5 will also be participating in these meetings to ensure proper links with the modelling work.
4. Results of all work will be presented and discussed at the annual conferences, Month 9 & 16.
5. After the first conference, the work will focus more on modelling, data availability and data collection issues.

The WP reviews should each lead to the production of at least one peer reviewed paper covering each area. The results will be discussed during the conferences, and disseminated on a sub-section of the IEEP website, in the annual reports and in a final report, which will also be available on CD-ROM.

A number of mechanisms will be used to achieve the purpose of the CA:

1) **Co-ordination meetings** for the WP leaders will be held throughout the CA to ensure that the work is progressing as planned and facilitate discussions related to the state of the art reports and other publications.

2) **Sub-group Meetings** are designed to permit the participating institutions under each work package to meet and engage in discussion and exchange experiences and ideas. These meetings will also provide peer review of the studies and the state of the art reports. Based on the comments received during the meetings, the papers/reports will be adjusted for later presentation at one of the annual conferences, after which they will be finalised and posted on the

website, and if possible published in a scientific journal. The Sub-group Meetings will be prepared and hosted by the Work Package leaders.

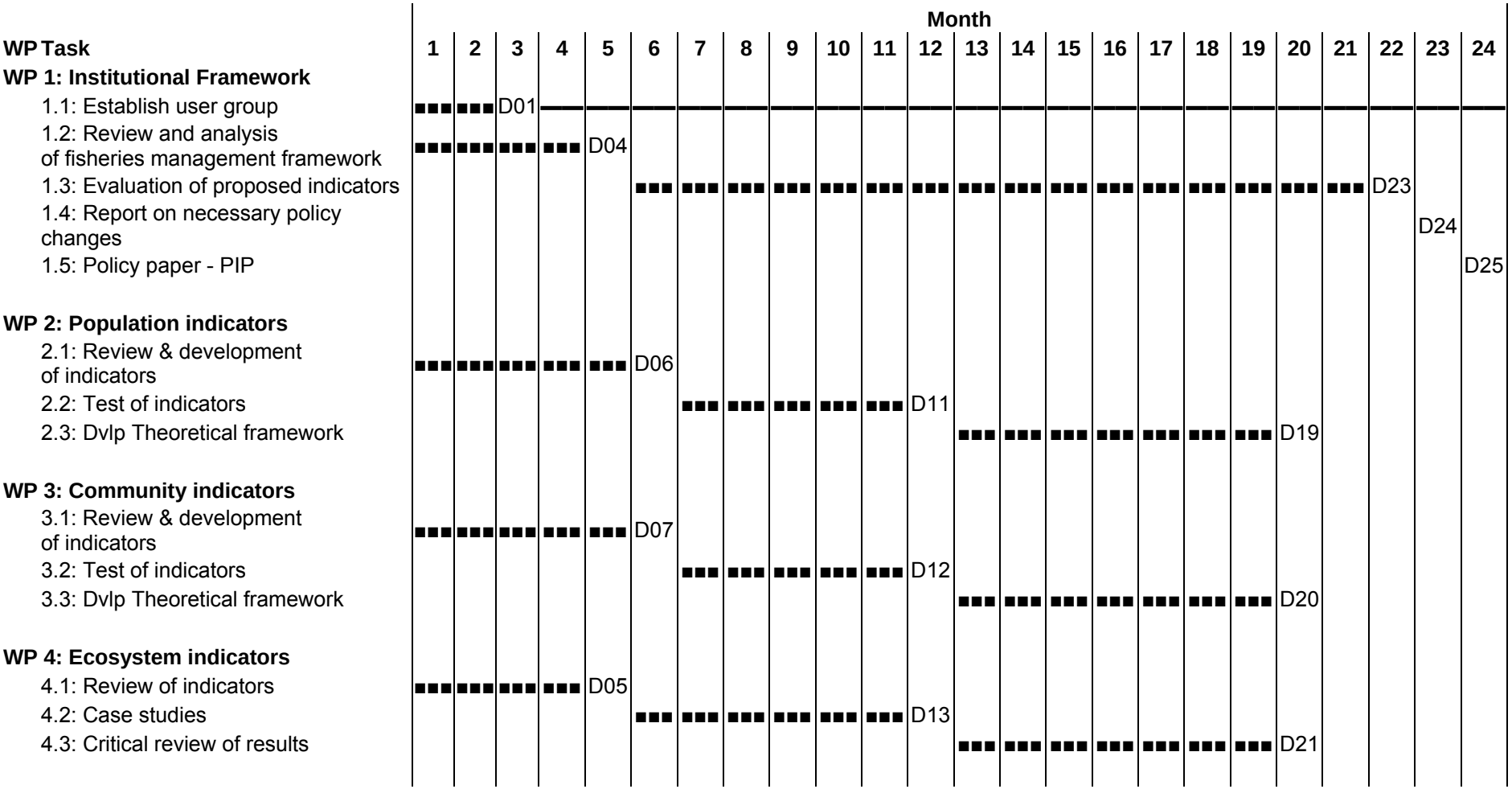
3) Two **annual conferences** are designed to permit state of the art presentations, including the most recent research results, as well as to discuss the results and provide guidance for further work. In addition to CA members presenting results of relevant studies and work carried out in the WPs, policy makers and other stakeholders will be invited to make presentations. A small budget is requested to fund participation of outside parties who would otherwise be prevented from participation for financial reasons. Apart from stakeholders from Eastern and Central European countries, we also plan to invite external experts from countries outside the ERA that have made important achievements in this area. The focal topics of the conferences reflect the objectives of the co-ordination action, but may be changed in response to developments during the course of the project.

4) Regular **meetings with the advisory User Group** will ensure policy relevance and help identify constraints and problems related to the use of different indicators.

5) **Annual state of the art reports** will summarise the results of the Concerted Action in a fashion that is useful to both researchers and policy makers. Drafting of the report will be undertaken by the WP leaders jointly, reflecting assignments for literature reviews and studies, with overall responsibility vested in the co-ordinating institute, IEEP.

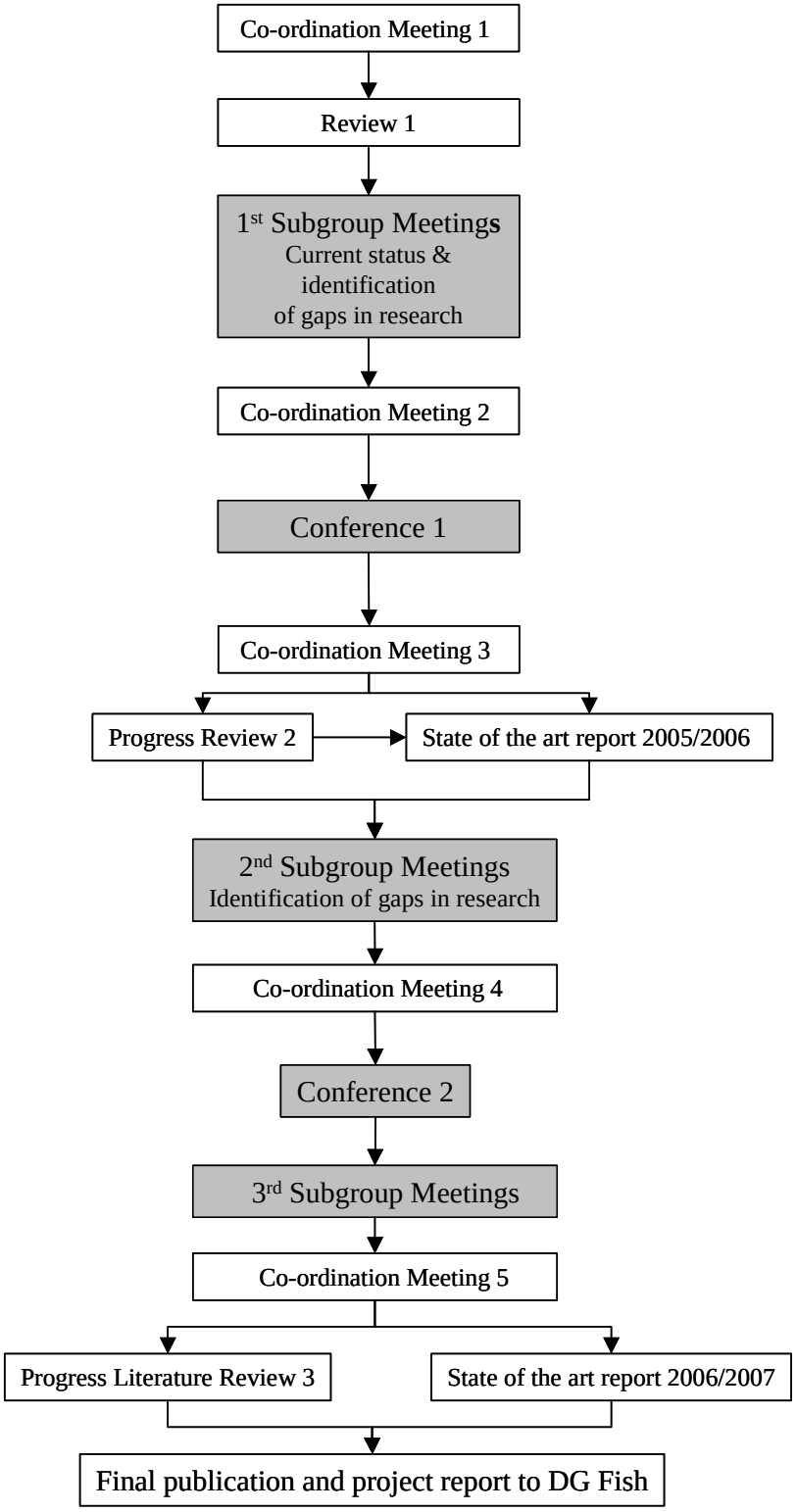
6) The materials generated will be made **publicly available**, initially by posting on the **website** and subsequently through a **formal publication** (CD-ROM) that has been subjected to peer review. The co-ordinating institute, IEEP, will appoint a staff person responsible for publications and distribution of materials.

7) At the end of the project a short **overview paper** is to be prepared and presented to relevant policy makers at a **briefing in Brussels**. The co-ordinator is responsible for this activity. This overview paper will contain the PIP (Policy Implementation Plan) detailing how the consortium proposes the application of the results at the fishery policy management level.


Month
WP Task
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
WP 1: Institutional Framework
1.1: Establish user group
D01
1.2: Review and analysis of fisheries management framework
D04
1.3: Evaluation of proposed indicators
D23
1.4: Report on necessary policy changes
D24
1.5: Policy paper - PIP
D25
WP 2: Population indicators
2.1: Review & development of indicators
D06
2.2: Test of indicators
D11
2.3: Dvlp Theoretical framework
D19
WP 3: Community indicators
3.1: Review & development of indicators
D07
3.2: Test of indicators
D12
3.3: Dvlp Theoretical framework
D20
WP 4: Ecosystem indicators
4.1: Review of indicators
D05
4.2: Case studies
D13
4.3: Critical review of results
D21

WP	Task	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP 5:	**Modelling**																								
	5.1: Review modelling methods	▬	▬	▬	▬	▬	▬	▬	D09																
	5.2: Evaluate utility									▬	▬	▬	▬	▬	▬	▬	▬	▬	D17						
	5.3: Synthesis																			▬	▬	D22			
WP 6:	**Socio-economic indicators**																								
	6.1: Review of existing socio-economic indicators	▬	▬	▬	▬	▬	D08																		
	6.2: Two comparative case studies							▬	▬	▬	▬	▬	D14												
	6.3: Identification of gaps and recommendations													▬	▬	▬	▬	▬	D18						
WP 7:	**1st annual conference**								▬	D10															
WP 8:	**2nd annual conference**														▬	▬	D16								
WP 9:	**Co-ordination**																								
	Project Leaflet	▬	▬	D02																					
	Design and maintain CA website	▬	▬	D03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Produce CD-ROM																								D26
	Coordination meetings				X				X			X				X				X					
	Sub-group meetings							X						X							X				
	Progress reports													D15											D27

7.3 Graphical presentation of the work packages



7.4 Work package list

Work package No	Work package title	**Lead contractor No**	**Person months**	**Start month**	**End month**	**Deliverable No**
WP1	Institutional framework – linking indicators to management and policy objectives	1	7.95	1	24	D01; D04; D23; D24; D25
WP2	Population indicators	2	12.3	1	23	D06; D11; D19
WP3	Community & habitat indicators	2	13.8	1	23	D07; D12; D20
WP4	Ecosystem indicators	3	13	1	23	D05; D13; D22
WP5	Applying modelling methods to identify information rich ecosystem indicators and demonstrate how to use them	4	10.6	1	22	D09; D13; D21
WP6	Social & economic indicators	5	6.25	1	23	D08; D14; D18
WP7	1st Annual Conference	6	1.25	7	9	D10
WP8	2nd Annual Conference	7	1.25	14	16	D16
WP9	Management of the CA	1	6.75	1	24	D02; D03; D15; D26; D27
	TOTAL		73.15			

7.5 Deliverable list

Deliverable No	Deliverable name	WP no.	Estimated person-months	Nature	Dissemination level	Deliverable date
D01	Advisory User Group established.	1	0.45	O	PU	Month 3
D02	Project flyer containing general information about the work programme, participants and exploitation strategy	9	0.25	R	PU	Month 3
D03	Website. Section established in month 3 and updated throughout the course of the project.	9	0.25	O	PU	Month 3
D04	A review of the current management framework, identifying the policy objectives for which indicators are needed.	1	2.5	R	PU	Month 5
D05	A report reviewing potentially useful indicators methods that can be used to identify the ecosystem status	4	4.5	R	PU	Month 5
D06	A review of existing population indicators	2	4.3	R	PU	Month 6
D07	A review of existing community and habitats indicators	3	4.6	R	PU	Month 6
D08	Review of the usage of socio-economic indicators on the environmental impact of fishing activities	6	2.25	R	PU	Month 6
D09	A document reviewing potentially useful modelling methods that can be used to identify the ecosystem indicators having the highest information value.	5	3.8	R	PU	Month 8
D10	1st Annual Conference	7	1.25	O	RE	Month 9
D11	A document presenting the most suitable population indicators including time-series, performance tests and suggestions on reference/target levels based on data sets of as many European waters as possible.	2	4	R	PU	Month 12

Deliverable No	Deliverable name	WP no.	Estimated person-months	Nature	Dissemination level	Deliverable date
D12	A document presenting the most suitable community and habitat indicators including time-series, performance tests and suggestions on reference/target levels based on data sets of as many European waters as possible	3	4.6	R	PU	Month 12
D13	A report that details a Venice Lagoon (Northern Adriatic Sea) ecosystem case study application that explores the use of some of these indicators (both modelling and time series analyses)	4	4.5	O	PU	Month 12
D14	A comparative North Sea and Mediterranean Sea study of the utility and possibilities for the usage of socio-economic indicators on the environmental impact of fishing on ecosystem	6	2	R	PU	Month 12
D15	1st year activity report	9	2.75	R	PU	Month 13
D16	2nd Annual Conference	8	1.25	O	RE	Month 16
D17	A document that explores the use of some potentially useful operational modelling methods that incorporate ecosystem indicators with regards to a few different well-studied European marine fisheries ecosystems.	5	3.8	O	PU	Month 18
D18	The usage of socio-economic indicators - recommendations on how to improve their utility	6	2	R	PU	Month 18
D19	A document on the relationship between one or more population indicators and fishing including the theoretical background and illustrated with the output from a quantitative model	2	4	R	PU	Month 20

Deliverable No	Deliverable name	WP no.	Estimated person-months	Nature	Dissemination level	Deliverable date
D20	A document on the relationship between one or more community and habitat indicators and fishing including the theoretical background and illustrated with the output from a quantitative model	3	4.6	R	PU	Month 20
D21	A report that synthesises the findings of the review and case study application to provide conclusions about potentially useful operational modelling methods and generic indicators of marine ecosystem status	4	4	R	PU	Month 20
D22	A document that synthesizes the findings of the review and case study application to provide conclusions about potentially useful operational modelling methods and generic indicators of marine ecosystem status.	5	3	R	PU	Month 21
D23	An evaluation of the usefulness of proposed indicators, together with a costing exercise to identify possibilities and constraints in relation to operationalising indicators as a tool in management.	1	3	R	PU	Month 22
D24	A report setting out the policy changes needed to facilitate the use of indicators in the EU.	1	1	R	PU	Month 23
D25	A policy paper making the results of the other tasks directly accessible to policy-makers and other stakeholders and including the PIP	1	1	R	PU	Month 24
D26	CD-ROM containing the publications of the CA (month 24)	9	0.5	O	PU	Month 24
D27	Final activity report	9	3	R	PU	Month 24

7.6 Work package descriptions

7.6.1 WP 1- Institutional framework - linking indicators to management and policy objectives

WP Leader: IEEP (Participant 1)

WP Number	1	**Start date**:		Month 1
Activity type	Coordination			
Participant id.	1	5	11	18	Total
Person/month per participant	5.95	0.5	0.5	1	7.95

Objectives

- To ensure that the indicators identified in the project are suitable for measuring the effectiveness of the management framework and particularly operational management measures;
- To involve the final users: policy makers, managers and the public to identify their needs and concerns in relation to indicators to assess the performance of the CFP;
- To identify and evaluate policy changes needed to implement the use of indicators, including data collection procedures, costs, etc;
- To identify gaps and weaknesses in the policy framework in relation to the use of indicators.

Description of work

This WP provides the policy framework within which indicators of environmental performance of the CFP identified under WPs 2 to 5 will be reviewed. Apart from setting the framework for subsequent work, a key output of WP 1 will also be identification of any policy changes needed to support future indicator work, and policy/structural changes needed to ensure indicators are used in management. An advisory user group will be set up to aid this work. The WP will thus provide the linkage between the policy framework and the more technical examination and testing of indicators. The four principal tasks under WP 1 consist of:

Task 1.1

Establishing an advisory User Group for the duration of the project, involving policy- and decision-makers, government agencies, NGOs, fishermen's organisations and other stakeholders.

Task 1.2

An initial review and analysis of the EU fisheries management framework, identifying the policy objectives for which indicators are needed as a tool to measure effectiveness. The review will cover both environment and the wider issue of sustainability in the sector (social and economic). It will consider relevant objectives under the Common Fisheries Policy, including the new framework Regulation 2371/2002, and under EU environmental policy such as the Sixth Environmental Action Programme, the EU Sustainable Development Strategy, the Biodiversity

Action Plan for Fisheries and the Council integration strategy adopted under the Cardiff Process. Consideration will also be given, as appropriate, to objectives set out under global fisheries conventions and associated instruments. The review will be discussed with the advisory User Group, consisting of policy makers, managers, government advisors and NGO representatives. It will also be discussed with and agreed by the core members for consideration in WPs 2-6 involved in identifying and testing indicators. The review will subsequently be revised to reflect these discussions.

Task 1.3
Following conclusion of the work under WPs 2-6, and discussion at the first annual conference (WP7), Task 1.2 will focus on analysis and evaluation of the selected indicators, notably usefulness and practicability, and the extent to which they address the policy needs identified under Task 1.1. In the process of evaluating the indicators, account will be taken of efficacy, costs, administrative and institutional feasibility, and other relevant factors. Cost issues, in particular, will be examined and discussed with the advisory User Group. Data needs and constraints will also be considered as part of the practicability and costing exercise.

Task 1.4
An examination of changes required in the policy and institutional frameworks in order to secure appropriate data collection. This task will also involve examining ways of ensuring indicators are actively used in the management system. The examination will be discussed among members of the project team and in the User Group, before the report is finalised.

Task 1.5
Production of a policy paper, presenting the results of Tasks 1.2, 1.3 and 1.4, in a form that is directly accessible to and relevant for policy makers and other Users. The paper will be drafted in close consultation with the User Group and the other WP leaders

Deliverables
- D01: Advisory User Group established.
- D04: A review of the current management framework, identifying the policy objectives for which indicators are needed.
- D23: An evaluation of the usefulness of proposed indicators, together with a costing exercise to identify possibilities and constraints in relation to operationalising indicators as a tool in management.
- D24: A report setting out the policy changes needed to facilitate the use of indicators in the EU.
- D25: A policy paper making the results of the other tasks directly accessible to policy-makers and other stakeholders and including the PIP.

Milestones and expected results
- Establishment of advisory User Group in Month 3.
- Completion of policy review report in Month 5.
- Completion of evaluation of proposed indicators in Month 22.
- Completion of report on necessary policy changes in Month 23.
- Completion of policy paper in Month 24.

7.6.2 WP2 - Population indicators

WP leader: RIVO (Participant 2)

WP Number	2	**Start date**:							Month1
Activity type	Coordination								
Participant id.	2	7	8	14	15	16	18	19	Total
Person/month per participant	2.3	1	1.5	2	1.5	1	1	2	12.30

Objectives

- Review of existing indicators
- Development of new indicators
- Implementation of indicators on data sets covering all major European waters
- Identify reference levels and/or target levels for the indicators
- Develop theoretical framework

Description of work

To structure the work as much as possible this work package is divided into four issues: commercial species, sensitive species, marine mammals and seabirds. The work consists of three components:

Task 2.1

The first component is the review and development of indicators. In the review, we will collate information on all the indicators that have been developed so far for each of the issues. We will screen these indicators against criteria for good indicators arrived at in collaboration with WP 1. This should result in an overview of the most suitable indicators and gaps for each issue and identify where relevant aspects of the population issues (notably in relation to effects of fishing) are not covered by existing indicators. Following up on this review we will attempt to develop new indicators for those aspects. These new indicators will also be screened.

Task 2.2

The second component is the implementation of these indicators on data sets from monitoring programs that encompass several of the major European waters. For this all project participants are encouraged to bring forward as many useful data sets as possible. Time series of the indicators will be created for each of the data sets and performance tests will be carried out. Based on these time series and other existing information we will attempt to identify reference levels and/or target levels for each of the indicators necessary to deliver advice on the state of this indicator in relation to a specific goal. Ideally these reference levels should represent a “pristine” state of the ecosystem. Since all European waters were affected by fishing long before the current monitoring programs started it will probably not be possible to determine this in practice. Therefore alternative approaches that may guide the setting of target levels of the indicators for management purposes will be pursued. Because the sampling of sensitive (and therefore usually rare) species is often difficult emphasis will be put on

the suitability of monitoring programmes to deliver data.

Task 2.3
For many of the indicators the relationship with fishing is not clearly understood. Therefore a (further) development of the theoretical framework underpinning the indicators is necessary. This is the third component and should be done in close collaboration with (feed into) the model development in WP5.

Deliverables
- D06: A document reviewing the existing indicators
- D11: A document presenting the most suitable indicators including time-series, performance tests and suggestions on reference/target levels based on data sets of as many European waters as possible
- D19: A document on the relationship between one or more indicators and fishing including the theoretical background and illustrated with the output from a quantitative model

Milestones and expected results
- Review of existing indicators (month 6).
- First subgroup meeting to discuss review findings and identify gaps (month 7).
- Identification of a set of potentially useful indicators and exploration of the relationship with fishing (month 12).
- Second subgroup meeting to discuss the suggested indicators, implementation into data sets, performance tests to be used and potential for modelling (month 13).
- Third subgroup meeting to discuss the applicability of indicators based on the results of the implementation of the indicators and to discuss the first results of the modelling approaches (month 20).
- Formulation of conclusions on the applicability of indicators not only to describe the state of the ecosystem but also as a tool for ecosystem-based fisheries management (month 23)

7.6.3 WP3 - Community and habitat indicators

Work package leader: RIVO (participant 2)

WP Number	3	**Start date**:								Month 1
Activity type	Coordination									
Participant id.	2	3	7	8	9	13	14	15	16	19	Total
Person/month per participant	2.3	0.5	1	1.5	1.5	2	2	1.5	1	0.5	13.80

Objectives
- Review of existing indicators
- Development of new indicators
- Identify reference levels and/or target levels for the indicators
- Develop theoretical framework

Description of work

To structure the work as much as possible we divided this work package into three issues: fish community, benthic community and marine habitats. Focus will be on the benthic community, as more work has been done on fish communities to date. We intend to make use of that experience in our efforts to develop benthic community indicators. The work consists of three components.

Task 3.1

The first component is the review and development of indicators. In the review of existing indicators we will collate information on all the indicators that have been developed so far for each of the issues. We will screen these indicators against existing criteria for good indicators which should result in an overview of the most suitable indicators for each issue and gaps and identify where relevant aspects of the population issues (notably in relation to effects of fishing) are not covered by existing indicators. Following up on this review we will attempt to develop new indicators where needed for those aspects. In addition we will collate information (e.g. life history, trophic level, habitat classification etc.) into databases that may be used to improve existing indicators or develop new ones. These new indicators will also be screened.

Task 3.2

The second component is the implementation of these indicators on data sets from monitoring programs that encompass the major European waters. For this all project participants are encouraged to bring forward as many useful data sets as possible. Time series of the indicators will be created for each of the data sets and performance tests will be carried out. Based on these time series and other existing information we will attempt to identify reference levels and/or target levels for each the indicators necessary to deliver advice on the state of this indicator in relation to a specific goal. Ideally these reference levels should represent a “pristine” state of the ecosystem. Since all European waters were affected by fishing long before the current monitoring programs started it will probably not be possible to determine this in practice. Therefore alternative approaches that may guide the setting of target levels of the indicators for management purposes will be pursued.

Task 3.3

For many of the indicators the relationship with fishing is not clearly understood. Therefore a (further) development of the theoretical framework underpinning the indicators is necessary. This is the third component and should be done in close collaboration with (feed into) the model development in WP5. As there is a strong link between the occurrence of benthic communities and habitats, the matter benthic community conservation versus habitat protection will also be addressed in this component

Deliverables

- D07: A review of existing community and habitats indicators
- D12: A document presenting the most suitable indicators including time-series, performance tests and suggestions on reference/target levels based on data sets of as many European waters as possible
- D20: A document on the relationship between one or more indicators and fishing

including the theoretical background and illustrated with the output from a quantitative model

Milestones and expected results

- Document on the review of existing indicators (month 6).
- First subgroup meeting to discuss review findings and identify gaps (month 7).
- Identification of a potentially useful indicators and exploration of the relationship with fishing (month 12).
- Second subgroup meeting to discuss the suggested indicators, implementation into data sets, performance tests to be used and potential for modelling (month 13).
- Third subgroup meeting to discuss the applicability of indicators based on the results of the implementation of the indicators and to discuss the first results of the modelling approaches (month 20).
- Formulation of conclusions on the applicability of indicators not only to describe the state of the ecosystem but also as a tool for ecosystem-based fisheries management (month 23)

7.6.4 WP4 - Ecosystem indicators

WP leader: DSA-UNIVE (Participant 3)

WP Number	4	**Start date**:				Month 1
Activity type	Coordination					
Participant id.	3	6	7	9	10	17	Total
Person/month per participant	9	1	0.5	0.5	1	1	13

Objectives

Fishing activity directly affect biodiversity of marine systems as the fishing impacts propagate through all the different levels of complexity from genetics to ecosystem, involving physiology, species, population, community and ecosystem levels. So ecosystem state and functioning could summarise, on a wide scale, all changes at the lower complexity levels.

Changes of population, community and habitat are extended to the farthest component of the ecosystem through the trophic cascade effects, which consequently lead to changes in production and usage of the energy within the ecosystem. The fishing discards and the increase of mortality of non-target species enhance the importance of detritivorous fauna and scavengers, thus changing the efficiency of the use of the system energy. Moreover, fishing could produce changes on abiotic factors, through resuspension of bottom sediments and oxygenation: more generally fishing (especially bottom trawling) could be a source of bioturbations of bottom sediments, with physic-chemical implications, surely affecting the biotic compartments.

All these changes affect ecosystem structure, functioning and the interactions between its components, interactions that are non-linear, chaotic or behavioural. The high

complexity of the system and the effects of fishing lead to the development of "ecosystem based management" concept, which considers the effects of fishing at an ecosystem scale, and aims to preserve ecosystem stability and its capacity to re-organise and to allow the persistence of its species.

There is a need to capture this complexity of direct and indirect effects, both on short- and long-term scale: the time-series analyses and the modelling approach could provide a general description (including the anthropogenic disturbances) of ecosystem functioning and structure by means of its properties: diversity, dynamics and food web properties.

In this framework, starting from a review of existing information, the following indicators will be taken into account:

- indicators of the impact of fishery, including discards (fish and megafauna), on the ecosystem structure (*e.g*. fishing down the food web)
- indicators of the impact of fishery on ecosystem dynamics: thermodynamic functions and system orientors (*e.g*. exergy, emergy)
- indicators of the impact of fishery on the food web properties (*e.g*. transfer efficiency, mixed trophic impact)
- other general ecosystem issues (*e.g*. analysis of shift in the time series of the type of control (top-down, bottom-up, wasp-waist), successional stages in relation to forcing forces)

Description of work

In order to achieve the selection of ecosystem indicators that could be used to assess the effects of fishing on marine ecosystems, we'll consider the two main approaches at present adopted: time series based approach and modelling. These approaches, rather being opposite, should be considered complementary and in this light they'll be studied. The work will be organised developing three different steps.

Task 4.1

The first step will provide a description of the present knowledge and application of ecosystem-based indicators. This review will consider ecosystem-based indicators (structural, functional, and informational) and their application through modelling simulations, and long-term time series analyses.

Task 4.2

This background will give the basis for the second step, the application of both approaches to two different case studies: the Venice Lagoon and the Northern Adriatic Sea. These areas can be considered as representative (on a small-medium scale) of lagoons and semi-enclosed basin of the Mediterranean Sea, being characterised by semi-industrial fishery (quite different from the industrial one of the North Europe), which is multi-target and multi-gear with strong seasonal variation of fishing grounds, targets and gear; furthermore, these areas are subjected to eutrophic process which can alter by itself the ecosystem structure and functioning.

Task 4.3

The results will provide the basis for the third step, which is meant to be the critical discussion of the case studies results. This step will be conducted in the light of

literature background comparing the results provided by the application of the two approaches (ecosystem descriptors obtained by means of modelling and the time series analysis).

Two main questions will be addressed: which indicators are more suitable to describe the effects of fishing at an ecosystem level? Which are the most informative? At first these questions will be considered only in the comparison within the two sites, then the analysis will be extended to other referenced case studies, in order to re-evaluate the scientific background.

Deliverables

- D05: A report reviewing potentially useful indicators that can be used to identify the ecosystem status.
- D13: A report concerning the Venice Lagoon (Northern Adriatic Sea) ecosystem case study application that explores the use of some of these indicators.
- D21: A report that synthesises the findings of the review and case study application to provide conclusions about potentially useful operational modelling methods and generic indicators of marine ecosystem status.

Milestones and expected result

1. Completion of review of potentially useful indicators that can be applied to evaluate fishing effects on the ecosystem state and functioning (month 5).
2. First subgroup meeting, discussion about the review findings and identification of some potentially useful indicators and their application to different case studies (month 7).
3. Second subgroup meeting to discuss the conference and case studies findings and co-ordinate further contribution to the application of ecosystem indicators on the case studies (month 12).
4. Third subgroup meeting to formulate the conclusions in order to address the two main questions: which indicators are more suitable to describe the effects of fishing at an ecosystem level? Which are the most informative? These questions will be considered in the comparison within the two sites and to the light of the scientific background (month 19).
5. General conclusions about the application of indicators on ecosystem state and functions (month 21).

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7.6.5 WP5 - Applying modelling methods to identify information-rich ecosystem indicators and demonstrating how to use them

WP leader: Imperial College (Participant 4)

WP Number	5	**Start date**:				Month 1
Activity type	Coordination					
Participant id.	3	4	9	11	20	Total
Person/month per participant	0.5	6.2	0.5	2.4	1	10.6

Objectives

The objective of WP5 is to review and identify conceptual and quantitative modelling methods that can incorporate the most informative indicators of the status of ecosystems that are impacted by fishing activities. A variety of modelling methods have already been established to model the impact of fishing on marine ecosystems and determine how measurable aspects of ecosystems may change as a result of fishing and environmental changes (e.g., Sainsbury 1988; Francis et al. 1989; Hill and Wassenberg 1990; Auster and Langton 1999; Punt et al. 1999; Gilbert et al. 2000; Moran and Stephenson 2000; O'Brien et al. 2000; Pitcher et al. 2000; Jennings et al. 2001; Shin and Cury 2001; Boyd 2002; Furness 2002). These include multi-species

fisheries models as well as models of the impacts of fishing on benthic communities, seabirds and mammals. The utility of indicators proposed in WPs 2-4 used in concert with these various approaches to establishing the inter-relationships between environmental conditions, fishing activities and marine ecosystem state will be reviewed. Based on this review, quantitative and conceptual models that can account for plausible hypotheses about these inter-relationships will be developed in a few case studies of European fisheries impacted ecosystems. In the case studies, models that can utilize of measurable indicators will be identified and evaluated for their usefulness in helping analyse ecosystem effects of fishing on fish assemblages, seabirds, mammals and benthic communities and distinguishing these effects from other changes in marine ecosystems due to other factors such as eutrophication and anoxia.

Description of work

There are three main components to this work.

Task 5.1

The first component is to review existing modelling methods that have been developed to model the impact of fishing on marine ecosystems for their utility in helping to identify the most informative generic indicators of marine ecosystem status with a view to providing timely advice on required changes in fishing practices and restoration measures, as appropriate. We will review the key purposes for which the models were constructed, the key sets of assumptions of the models, the types of results that the models are designed to produce, and the usefulness of the models in producing indicators. Models reviewed will include multi-species fisheries models, and models of the impacts of fishing on benthic communities and species, seabirds and mammals. Overall, the goal will be to evaluate the potential utility of a variety of fisheries-ecosystem and marine-ecosystem modelling methods within the European CFP context. We will review the capability of the models to

(1) estimate, evaluate the usefulness, or interpret proposed indicators,

(2) improve the knowledge of the functioning of marine ecosystems,

(3) facilitate evaluation of the performance of management measures that utilize particular indicators for the monitoring of the CFP,

(4) facilitate monitoring of the quality of an ecosystem (aspects pertaining to benthic communities and species, seabirds and mammals), quantification of the impact of fisheries on benthic communities and species, and seabirds and mammals, and maintenance of fishing at levels that do not damage the ecosystem,

(5) depict the overall environmental performance of the existing policy and help to specify adaptation of restoration measures as appropriate, and

(6) promote the analysis of wide ranging ecosystem effects of fishing such as impacts on fish, seabird, benthic and mammal biodiversity.

Task 5.2

The second component is to evaluate the utility of some of the modelling methods and indicators in a few different marine ecosystems. One or two appropriate case studies will be decided as a result of work in the other WPs, together with the core team and

twinning partners and potential candidates are the North Sea and Bay of Biscay marine ecosystems. The indicators will be evaluated for their information value in monitoring the impacts of fishing on ecosystem state (with focus given to benthic communities and species, seabirds and mammals; NB in the Bay of Biscay we will not have data for seabirds and mammals and no time-series for benthic communities). The indicators chosen for study will be evaluated for their potential to be utilized within modelling methods that will be designed to provide timely advice on required changes in fishing practices and restoration measures, when the status of some key parts of the ecosystem are assessed to approach or drop below predefined limit reference points. Based on existing research findings and modelling tools already developed (e.g., from other EC projects) we will review the potential usefulness of these various modelling tools, e.g., that model fish population dynamics, and interactions of fisheries with benthic species, seabirds and mammals to utilize a variety of indicators proposed within the case studies. The idea would be to identify the most useful and informative indicators given the modelling tools available and with regard to monitoring CFP performance. Operational models that could provide management advice based on a subset of the available indicators will be identified that utilize and interpret the indices and based on their analysis prescribe management control actions to facilitate the implementation of the CFP for the marine ecosystem of interest. The work would seek to make recommendations to take into account a subset of ecosystem indicators that are currently ignored but yet contain signals about ecosystem state and CFP policy performance.

Task 5.3

The third component is to formulate from the review and case study evaluations conclusions about potentially useful operational indicators of marine ecosystem status, within the CFP context.

Deliverables

1) D09: A document reviewing potentially useful modelling methods that can be used to identify the ecosystem indicators having the highest information value.
2) D17: A document that explores the use of some of these potentially useful operational modelling methods that evaluate or estimate ecosystem indicators with regards to a few representative European marine fisheries ecosystems.
3) D22: A document that synthesizes the findings of the review and case study application to provide conclusions about potentially useful operational modelling methods and generic indicators of marine ecosystem status.

Milestones and expected result

1) Initial draft of review of potentially useful modelling methods that can be applied to formulate ecosystem indicators that will have the highest information value in the CFP context (month 6).
2) First subgroup meeting to discuss review and agree on ecosystems for modelling applications (month 7).
3) Identification of a variety of potentially useful operational modelling approaches, indicators that could be used within them for application under the

CFP (month 8).

4) Second subgroup meeting after first conference to discuss the potential application of a variety of modelling methods for use in European fisheries and ecosystem management and initial development of the modelling applications (month 15).

5) Initial results from the development and evaluation of the potential utility of the various modelling methods and proposed indicators for the fisheries ecosystem case studies (month 18).

6) Third subgroup meeting to discuss results from evaluation of modelling methods and proposed indicators in the fisheries ecosystem case studies (month 20).

7) Formulation of conclusions regarding the use of modelling methods to identify useful ecosystem indicators and how they should be applied for ecosystem-based fisheries management based on the review and case study evaluation (month 21).

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7.6.6 WP6 - Social and economic indicators

WP leader: IFM (Participant 5)

WP Number	6	**Start date**:	
Activity type	Coordination		
Participant id.	5	12	20	Total
Person/month per participant	3	2.25	1	6.25

Objective

The objective of WP 6 is to review and analyse the utility of socio-economic indicators in fisheries management, with reference to the impact of fishing on the environment. On the basis of a strategic review and comparative case-studies (North Sea and Mediterranean Sea), it is intended to understand the existing usage of socio-economic indicators, to identify critical gaps and to make recommendations for future development of appropriate methods and their application. A key aspect of the work will be to broaden the perspective on socio-economic analysis into the key domains of policy development and institutional change (with reference to fisheries management systems), and how appropriate stakeholder participation and feedback might bring this about.

Description of the work

There are three main components to this work.

Task 6.1
The first component will review the existing use of socio-economic indicators that have been used to understand the impact of fishing on marine ecosystems. The initial focus will be to clarify the conceptualisation of the relationship between natural and social science views of fisheries, and to understand the ways in which natural and social science information has been used and integrated in the past. The choice and purpose of socio-economic indicators (however defined) in general within the context of fisheries will be reviewed.

Task 6.2
The second component of the work will involve two comparative case studies to evaluate the existing utility and future possibilities for the use of socio-economic indicators in the study of the impact of fishing on ecosystem state. The first case study will be in the North Sea and the second in the western basin of Mediterranean Sea. The two comparative case-studies have been selected to provide a basis for valuable insights into the utility of socio-economic information for a number of reasons: the political and institutional structure of the fisheries show important similarities/differences, and the nature of fishing impacts in the different ecosystem types also show important similarities/differences. It is anticipated that the case-studies will adopt the following 3-phased approach to investigate and evaluate: (a) the use of socio-economic indicators to understand the linkages between 'driving forces' for increased fishing effort (e.g. consumption per capita and fishing capacity of fleets); (b) the use of socio-economic indicators to document and understand the casual chain between such factors as investment in fishing and new technology, and the state of the environment; (c) the use of socio-economic indicators to document and understand the nature of policy responses to environmental impact from fisheries (particular attention will be given to the extent to which socio-economic indicator information can facilitate stakeholder participation in decision-making and institutional change).

Task 6.3
The third component of the work will draw upon the previous review and the comparative case studies to identify and analyse important gaps in the usage of socio-economic information for the study of fishing on ecosystems. The outcome of this analysis will be a series of recommendations to increase the utility of socio-economic information through appropriate and innovative methods and their applications. Once again, particular attention will be given to the need to broaden the perspective on socio-economic analysis into the key domains of policy development and institutional change (with reference to fisheries management systems), and how this might be brought about by appropriate stakeholder participation and feedback.

Deliverables

1. D08: A document which provides 'A review of the current usage of socio-economic indicators in relation to the impact of fishing on the environment';
2. D14: A document which provides 'A comparative evaluation of the existing utility and future possibilities for the usage of socio-economic indicators in the study of the impact of fishing on ecosystem state (North Sea and Mediterranean Sea)';
3. D18: A document which identifies 'Important gaps in the usage of socio-economic indicators for the study of fishing on ecosystems and recommendations to increase the utility of socio-economic indicators through appropriate and innovative methods and their applications'.

Milestones and expected results

1. Completion of review of current usage of socio-economic indicators in relation to the impact of fishing on the environment (month 6);
2. Identification of existing utility and future possibilities for socio-economic indicator usage on the basis of North Sea and Mediterranean Sea comparative study (month 12);
3. Identification of important gaps and recommendations for future usage of socio-economic indicators, with particular reference to policy analysis, institutional change and the role of different stakeholders in the fisheries (month 18).

7.6.7 WP7 – 1st Annual Conference

WP lead: SFI (Participant 6)

WP Number	7	**Start date**:	Month 7
Activity type	Coordination		
Participant id.	1	6	Total
Person/month per participant	0.25	1	1.25

Objectives

Organisation of the 1st Annual Conference in co-operation with IEEP

Description of the work

The work involves planning, providing facilities and necessary equipment for the Annual Conference, including help with accommodation and travel arrangements.

Deliverables

1. D10: A successful first Annual Conference

Milestones and expected results

The first Annual Conference will be held in Gdansk in month 9 of the CA.

7.6.8 WP8 – 2nd Annual Conference

WP leader: HCMR (Participant 7)

WP Number	8	**Start date**:	Month 14
Activity type	Coordination		
Participant id.	1	7	Total
Person/month per participant	0.25	1	1.25

Objectives Organisation of the 2nd Annual Conference in co-operation with IEEP
Description of the work The work involves planning, providing facilities and necessary equipment for the Annual Conference, including help with accommodation and travel arrangements.

Deliverables 1. D16: A successful second Annual Conference

Milestones and expected results The first Annual Conference will be held at HCMR in month 16 of the CA.

7.6.9 WP 9 - Management activities

WP leader: IEEP (participant 1)

WP Number	9	**Start date**:	Month 1
Activity type	Management		
Participant id.	1	Total	
Person/month per participant	6.75	6.75	

Objectives

- Management of the project, provision of progress reports.
- Liaison with other projects.
- Organisation of the co-ordination meetings.
- Provision of information to the participants and facilitation of communication between participants
- Dissemination of results, conference papers and “state of the art” reports to the wider audience, overview paper
- Communication with advisory User Group.

Description of the work

The work involves financial management, project management, dissemination of results (publications and website) and reporting as well as establishing and

maintaining links with other projects in particular the BECAUSE project.

Deliverables

1. D02: Project leaflet.
2. D03: Website established in month 3 and updated throughout the course of the project
3. D15: First year activity report to the EU
4. D26: CD-ROM containing the publications of the CA
5. D27: Final report to the EU

Milestones and expected results

To manage the consortium in such a way that we deliver the different products and milestones set out in this application.

8 Project resources and budget overview

8.1 Effort for the duration of the project

The implementation of the coordination action is estimated to require a total of 73.15 person months of which 6.750 are for management activities (WP9). An overview table of the effort in person months by each of the participants is given in the table below.

CA Project Effort Form Full duration of project

	1 IEEP	2 RIVO	3 DSA-UNIVE	4 RRAG	5 IFM	6 SFI	7 HCMR	8 AZTI	9 FRSMLA	10 CEFAS	11 IFREMER	12 IDDRA	13 UR	14 DIFRES	15 NBF-ICR	16 FGFRI	17 ICRAM	18 JNCC	19 IAMC-CNR	20 EMI	TOTAL
Coordination activities																					
WP1	5.95				0.50						0.50							1.00			**7.95**
WP2		2.30					1.00	1.50						2.00	1.50	1.00		1	2.00		**12.30**
WP3		2.30	0.50				1.00	1.50	1.50				2.00	2.00	1.50	1.00			0.50		**13.80**
WP4			9.00			1.00	0.50		0.50	1.00							1.00				**13.00**
WP5			0.50	6.20					0.50		2.40									1.00	**10.60**
WP6					3.00							2.25								1.00	**6.25**
WP7	0.25					1.00															**1.25**
WP8	0.25						1.00														**1.25**
Total	6.45	4.60	10.00	6.20	3.50	2.00	3.50	3.00	2.50	1.00	2.90	2.25	2.00	4.00	3.00	2.00	1.00	2.00	2.50	2.00	**66.40**
Management activities																					
WP9	6.75																				**6.75**
Total	6.75																				**6.75**
TOTAL	13.20	4.60	10.00	6.20	3.50	2.00	3.50	3.00	2.50	1.00	2.90	2.25	2.00	4.00	3.00	2.00	1.00	2.00	2.50	2.00	**73.15**

8.2 Overall budget

Financial information – whole duration of the project (CPF form A3.1)

Estimated breakdown of the EC contribution per reporting period (CPF form A3.2)

Based on the above the payment schedule will be:

- Advance: 85% of (299,000.00 + 119,000.00) = 355,000.00 EUR
- Interim payment (12 months): 85% of the last 6 months up to a max of 80% of the EU contribution or 45,000.00 EUR
- Balance: payment (24 months): 20% of the grant or 100,000. 00EUR

8.3 Management level description of resources and budget

This Co-ordination Action involves 20 institutes and organisations from the European Research Area. Because of the limited funding available for the CA, we have agreed on a three-levelled structure with decreasing involvement in research efforts and report writing specifically for the project. This enables us to draw on the wide expertise and knowledge present in the ERA, and reflect the ongoing efforts in this field. More importantly, it also involves and informs a large part of the scientific community as well as the relevant management institutions in the work - something that will facilitate the efforts to find a small set of suitable indicators to be used in all Member States. Bringing the people and the expertise together to enable more co-ordinated efforts in this area in the future is indeed the purpose of the CA.

All of the participants have been or are currently involved in efforts to develop or evaluate indicators in their respective countries, and/or in other international fora (see detailed descriptions in Appendix A below).

An indicative breakdown of the budget is given in the table below. The major resources needed will be staff time, travel and subsistence to attend meetings and the conferences. The estimated cost of conference logistics is also indicated.

Participant		Type of input	Staff time	Travel	Conference logistics	Total
1	**IEEP**	Coordinator & WP leader	79,965	35,000[3]		114,965
2	**RIVO**	WP leader	65,000	5,000		70,000
3	**DSA-UNIVE**	WP leader	35,000	5,000		40,000
4	**RRAG**	WP leader	30,000	5,000		35,000
5	**IFM**	WP leader	38,500	5,000		43,500
6	**SFI**	WP leader	4,980	5,000	9,180	19,160
7	**HCMR**	WP leader	6,750	5,000	6,625	18,375
8	**AZTI**	Twinning partner	10,000	5,000		15,000
9	**FRSMLA**	Twinning partner	10,000	5,000		15,000
10	**CEFAS**	Twinning partner	10,000	5,000		15,000
11	**IFREMER**	Twinning partner	18,000	5,000		23,000
12	**IDDRA**	Twinning partner	19,500	4,500		24,000
13	**UR**	Other participant	3,000	5,000		8,000
14	**DIFRES**	Other participant	3,000	5,000		8,000
15	**ICR**	Other participant	3,000	5,000		8,000
16	**FGFRI**	Other participant	3,000	5,000		8,000
17	**ICRAM**	Other participant	3,000	5,000		8,000
18	**JNCC**	Other participant	3,000	5,000		8,000

[3] Includes a provision to finance the participation of external experts.

Participant		Type of input	Staff time	Travel	Conference logistics	Total
19	**CNR**	Other participant	3,000	5,000		8,000
20	**EMI**	Other participant	6,000	5,000		11,000
	Total		354,695	129,500	15,805	500,000

APPENDIX A – CONSORTIUM DESCRIPTION

Participant 1. The Institute for European Environmental Policy (IEEP)

The IEEP is one of Europe's leading environmental policy 'think-tanks'. Based in London and Brussels, the Institute's major focus is the development, implementation and evaluation of EU environmental policy. Its work also encompasses other EU policies of environmental significance, including agriculture, fisheries, regional development and transport. The Institute's inter-disciplinary staff has developed considerable expertise in relevant aspects of governance at EU level, particularly as regards new institutional mechanisms, *ex ante* impact assessment procedures, and methodologies for *ex post* evaluation of impact and effectiveness.

The Institute is a registered charity and was founded in 1976 by the European Cultural Foundation. Sponsors include the EU institutions, international organisations, national and regional government departments, and NGOs.

IEEP team includes:

Clare Coffey, Senior Fellow, is from a legal background and her work over the past nine years has covered EU/EC and international legal and institutional issues. She has contributed significantly to the Institute's work on environmental integration within sectoral policies, notably in relation to the Common Fisheries Policy (CFP). She has also participated in studies concerning the implementation and effectiveness of EU law, including national implementation and the EC's role in international conventions. Recent projects include an analysis of the relationship between aspects of the UN Fish Stocks Regime and the CFP. Clare Coffey is currently visiting Professor at the College of Europe, Bruges.

Dirk Reyntjens, Senior Fellow (IEEP lead on fisheries policy), has nearly 20 years experience in fisheries and aquaculture management projects. He has worked as a consultant to several bilateral and multilateral donors organizations in Asia, Africa, Latin America and the Mediterranean.

Saskia Richartz, Research Assistant, is an ecologist with a background in conservation, environmental management and environmental economics. She specialises in habitat protection and ecological networks. Past projects have included research on the marine health of the North-East Atlantic, the habitats and birds Directives and their application in the marine environment, and other work for the Commission, government agencies and non-governmental organisations.

IEEP (Co-coordinator/Participant 1)

Staff category	Expertise	WP1	WP2	WP3	…	WP7	WP8	WP9	Total months
Senior Fellows	CFP, environmental integration, EC funding mechanisms and institutional arrangements	4.20				0.25	0.25	3.00	7.70
Research Assistant	Nature Conservation/Information Officer	1.75						2.75	4.40
Admin staff	Consortium management activities, website & conference organisation							1.00	1.00
Total		**5.95**				**0.25**	**0.25**	**6.75**	**13.20**

Relevant publications:

Coffey, C and Baldock, D (2000) *Towards a Fisheries Council integration strategy.* English Nature and Institute for European Environmental Policy.

Fergusson, M; Skinner, I (2003) *EFIEA Workshop on Integrated Environmental Assessment of the Trans-European Transport Networks: Workshop proceedings* for European Forum on Integrated Environmental Assessment (EFIEA), January 2003

Fergusson, M; Wilkinson, D (1995) *Indicators for Local Agenda 21 - A summary*, Local Government Management Board, November 1995

Grieve, C., Sporrong, N et al. (2002) *Review and gap analysis of environmental indicators for fisheries and aquaculture.* IEEP London.

Guedes Vaz, S, Martin, J, Wilkinson, D and Newcombe, J (2001) Reporting on environmental measures: are we being effective? *Environmental Issue Report* no 25. European Environment Agency, Copenhagen.

Haq, G; Bailey, P; Gough, C; Skinner, I; Fergusson, M. *contributions to 'A Methodology for appraising the Sustainability Implications of EC Initiatives: The Integration of Economic, Societal and Environmental Aspects'* for the Joint Research Centre of the European Commission, May 2001

Sporrong, N (2001) *Political strategy for CFP reform.* Internal WWF document outlining the political process and strategy to greening the CFP through the WWF European Fisheries Campaign.

Sporrong, N (2001) *Put environment at the heart of European fisheries policy - WWF Manifesto for the review of the EU Common Fisheries Policy.* WWF European Fisheries Working Group, Brussels, Belgium.

Participant 2. Netherlands Institute for Fisheries Research (RIVO)

RIVO undertakes fundamental and applied research on the sustainable harvesting of natural populations using an ecosystem perspective, and on the quality control of the products harvested. This involves fish stock assessment and environmental monitoring in marine, estuarine and freshwater ecosystems. The aim is to find the right balance between economic considerations of the fishing industry and social

responsibility towards the environment. A responsible utilisation of the ecosystem ensures an ecologically sustainable and competitive fishing industry.

RIVO is part of Wageningen University and Research Centre (Wageningen UR) and has a staff of some 130 persons. It has modern land-based research facilities and is supported by a fleet of seagoing research vessels. International research is carried out in co-operation with corresponding institutes in Europe and around the Atlantic, including combined monitoring programmes involving research vessels, data collection and exchange, as well as model developments and scientific output through publications. RIVO can draw on the knowledge and expertise of several other institutes within Wageningen UR, e.g. on fishery economics, aquaculture, ecological research and food technology.

Dr G.J. Piet has been working for more than 10 years on the ecosystem effects of fishing, and the planning and analysis of various programme-based monitoring data sets. He is a member of several ICES working groups, among them the 'working group on the ecosystem effects of fishing' and chair of the 'working group on beam trawl surveys'. He has also been involved in the development and evaluation of single species and community indicators for fish and benthos within national and international frameworks (EcoQOs).

Dr N. Daan has over 40 years experience in (multi-species) fish stock assessment and ecosystem effects of fishing, and has participated in and chaired numerous ICES working groups on stock assessment or ecosystem effects of fishing

RIVO (Participant 2)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Scientists	Stock assessments, threatened and declining species Fish and benthic communities		2.3	2.3					4.6
Total			2.3	2.3					4.6

Relevant publications:

Piet, G. J., and Rijnsdorp, A. D. (1998). Changes in the demersal fish assemblage in the south-eastern North Sea following the establishment of a protected area ('plaice box'). *ICES Journal of Marine Science* 55(3): 420-429.

Piet, G. J., Rijnsdorp, A. D., Bergman, M. J. N., van Santbrink, J. W., Craeymeersch, J., and Buijs, J. (2000). A quantitative evaluation of the impact of beam trawling on benthic fauna in the southern North Sea. *ICES Journal of Marine Science*, 57(5): 1332-1339.

Piet, G.J. and Rice, J. C. (2003) Performance of management advice of North Sea fish stocks using a precautionary approach. *ICES CM 2003/Y*:11

Daan, N. (2001). A spatial and temporal diversity index taking into account species rarity, with an application to the North sea fish community. *ICES CM 2001/T*:04

Participant 3. Department of Environmental Science (DSA-UNIVE)

The DSA-UNIVE is an academic department belonging to the University of Venice, providing postgraduate Diplomas, Master's degrees and Research degrees. One of its strengths is the interdisciplinary approach to the investigation of marine and terrestrial habitats in order to implement environmental management policies.
Among other things, our group is developing research activities with an ecosystem approach aimed at assessing the impact of fisheries on coastal ecosystems. Particular attention is paid to non-target species and their role in ecosystem functioning, using a food web analysis.

DSA-UNIVE team includes:

Dr Fabio Pranovi is a lecturer in Fishery Ecology at the University of Venice. His particular research interest is in the field of disturbance ecology and ecosystem model approach. Since 1995, he has worked on the assessment of direct and indirect effects of demersal fishing activities on benthic communities, and the analysis of recolonisation processes after disturbance both in marine and lagoon environments. Other areas of research are the analysis of trophic structures with regards to the proliferation of fishing disturbances throughout the entire trophic web.

Dr Simone Libralato, junior researcher, has experience in the modelling of biological systems, especially mathematical modelling applied to the marine environment analysing growth in fish, time series of biological data, trophic web interactions, and sensitivity.

Dr Saša Raicevich, junior researcher, focuses on the effects of fishing activity on marine and lagoon ecosystems. He has worked on the evaluation of the effects of demersal fishing on *Liocarcinus depurator*, integrating physiological, morphometric and population approaches; the quantitative assessment of the direct impact of fishing on non-target species by using different damage scales.

DSA-UNIVE (Participant 3)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Researcher	Fishery ecology, Disturbance ecology			0.5	2.5				3.0
Assistant researcher	Fishery ecology, food web analysis				6.5	0.5			7.0
Total				0.5	9.0	0.5			10.0

Relevant publications:

Pranovi F., Giovanardi O. & Franceschini G. (1998). Recolonization dynamics in areas disturbed by bottom fishing-gears. *Hydrobiologia*, 375/376: 125-135.

Sorokin Y., Giovanardi O., Pranovi F., & Sorokin P. (1999). Restrictions needed in the farming of bivalve culture in the southern basin of the Lagoon of Venice. *Hydrobiologia* 400: 141-148.

Pranovi F., Raicevich S., Franceschini G., Farrace M.G. & Giovanardi O. (2000). "Rapido" trawling in the Northern Adriatic Sea: effects on benthic communities in an experimental area. *ICES Journal of Marine Science*, 57: 517-524.

Pranovi F., Curiel D., Rismondo A., Marzocchi M. & Scattolin M. (2000). Variations of the macrobenthic community in a seagrass transplanted area of the Venice lagoon. *Scientia Marina* 64(3): 303-310.

Pranovi F., Raicevich S., Franceschini G., Torricelli P. & Giovanardi O. (2001). Discard analysis and damage to non-target species in the "Rapido" trawl fishery. *Marine Biology*, 139: 863-875.

Libralato S., Pastres R., Pranovi F., Raicevich S., Granzotto A., Giovanardi O. & Torricelli P. (2002). Comparison between the energy flow networks of two habitats in the Venice Lagoon. *Marine Ecology PSZN*, 23: 228-236.

Pranovi F., Libralato S., Raicevich S., Granzotto A., Pastres R. & Giovanardi O. (2003). Mechanical clam dredging in Venice Lagoon: effects on ecosystem stability evaluated with a trophic mass-balance model. *Marine Biology* 143: 393-403.

Granzotto A., Libralato S., Pranovi F., Raicevich S. & Giovanardi O. Comparison between artisanal and industrial fisheries by using ecosystem indicators. *Chemistry and Ecology*, in press.

Pranovi F., Da Ponte F., Raicevich S. & Giovanardi O. A synoptic-multidisciplinary study of the immediate effects of mechanical clam-harvesting in the Venice Lagoon. *ICES Journal of Marine Science*, in press.

Participant 4. Renewable Resources Assessment Group (RRAG), Imperial College

The RRAG is an interdisciplinary research group, bringing together expertise in the biological, mathematical, statistical, information and social sciences, including resource economics. In advancing scientifically sound and practical methods for sustainable use of renewable resources, RRAG undertakes both strategic and applied research in marine and freshwater fisheries, forestry pest management and the conservation of wild mammals. Major areas of focus include statistical modelling and fisheries management strategy evaluation. Topics of specific contribution include Bayesian and geo-statistical tools for fisheries research survey design and data analysis, complex multi-stock, multi-area, age structured operating models of fish population dynamics, Bayesian stock assessment methodologies, statistical methods to analyse mark-recapture data, statistical decision analysis methodologies for fisheries stock assessment, and bio-economic and game-theoretic models for fisheries management policy advice. The Group has expertise in the provision of Management Advice through ICES, the EU commission, IOTC, CCAMLR, ICCAT, US National Marine Fisheries Service, IWC, and Falkland Islands Government.

RRAG team includes:

Dr G. P. Kirkwood is a Senior Lecturer and Head of the Renewable Resources Assessment Group in the Department of Environmental Science and Technology. Education: PhD 1974, Mathematical Statistics, University of NSW, Australia. Key qualifications: Since 1974, he has worked on fish population dynamics and assessment, fishery bioeconomics, and fishery management strategy evaluation. Employment: CSIRO Division of Marine Research (1974–1990), Imperial College, London (1991– date). He has participated in or co-ordinated a number of EU-funded study projects. He is past Chairman of the IWC Scientific Committee, current chairman of the IOTC Scientific Committee and member of the CCAMLR Scientific Committee.

Dr Murdoch McAllister is Senior Lecturer in Statistical Risk Assessment at Imperial College. Education: PhD Fisheries Science, University of Washington, Seattle, MSc. in Natural Resource Management, Simon Fraser University, Burnaby, B.C., Canada, BSc in Behavioural Ecology, SFU. Key qualifications: Since 1987 he has worked on (1) spatial-temporal fish population dynamics modelling, (2) developing new statistical methods for fish stock assessment, (3) statistical analysis for fisheries research surveys and survey design, (4) quantitative fisheries management strategy evaluation. He has been principal investigator on several international projects, participated in several EU-funded projects and is a member of the ICES WG on Baltic salmon and sea trout, the ICCAT stock assessment methods working group, US Atlantic coastal shark stock assessment, and ICCAT stock assessments of Atlantic bluefin tuna and Atlantic swordfish.

RRAG (Participant 4)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Scientist	Stock assessments, fisheries and population dynamics modelling					2.1			2.1 (staff time not counted for AC partner)
Junior Scientist	Fisheries and ecosystem modelling					4.1			4.1
Total						6.2			6.2

Participant 5. The Institute for Fisheries Management & Coastal Community Development (IFM)

IFM is a non-profit research foundation specialising in social and economic research and the provision of advisory services in fisheries management and coastal community development. IFM is associated with Aalborg University and is subject to university staff structure rules. IFM's research focuses on governance and development issues in relation to fisheries and coastal communities. IFM staff have extensive experience in fisheries management, sector and master planning, policy formulation and institutional analysis encompassing issues concerning economics, political science, sociology and economic and development geography, and project administration.

IFM is co-ordinating two 5th FP projects on how fisheries management decisions are informed by knowledge: i) the 'Policy and Knowledge in Fisheries Management' which investigates the interaction between various sources of knowledge and policy decisions in Europe; and ii) the 'Knowledge in Fisheries Management' investigating the potentials for identification of indicators as a basis for fisheries management in seven case studies in Africa and Asia. Other research projects include co-management arrangements in Asia and Africa, objectives in fisheries management, fleet behaviour and technical measures, delegation of responsibilities in fisheries management and the social implications of interactions between fisheries and other biota.

IFM team includes:

Sten Sverdrup-Jensen, Senior researcher, M.Sc. (Economics). His qualifications are within institutional analysis related to management of natural resources and coastal zones; organisational development and capacity building; socio-economic analysis. Founding director of IFM 1994-1999.

Jesper Raakjær Nielsen, Research professor, PhD (Institutional economics). He has been involved in several international research projects focussing on institutional aspects of fisheries management including user-participation, legitimacy and compliance both in a developed and developing country context.

Poul Degnbol, Director, M.Sc. (Fisheries biology/ecology). He has worked with responsibilities for fisheries surveys, stock assessments and management advice. He is presently chair of the ICES Advisory Committee on Fisheries Management (ACFM).

Douglas C. Wilson, Senior Researcher, PhD (Sociology). He is an environmental and natural resource sociologist with extensive experience in fisheries management in both Africa and North America. He serves as Editor-in-Chief of the Common Property Resource Digest.

IFM (Participant 5)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Researchers	Fisheries economics, sociology, governance						3.0		3.0
Director	Fisheries ecology, fisheries management	0.5							0.5
Total		0.5					3.0		3.5

Relevant publications:

Wilson, D.C., J. Raakjær Nielsen and P. Degnbol (eds). The Fisheries Co-management Experience. Accomplishments, Challenges and Prospects. Kluwer Academic Publishers, Dordrecht. July 2003. 348 pp.

Degnbol, P. (Ed), A. Carlberg, H. Ellingsen, M. Tonder, R. Varjopuro and D. Wilson (2003). Integrating Fisheries and Environmental Policies: the Nordic Experience and the CFP. 115 pp. TemaNORD

Degnbol, P. (2002). The ecosystem approach and fisheries management institutions: the noble art of addressing complexity and uncertainty with all onboard and on a budget. Paper no 171. Proceedings IIFET 2002. Wellington, New Zealand, 2002.

Degnbol, P. and C. Symon (2000). The Status of Fisheries and Related Environment of Northern Seas, Nord 2000:10, Nordic Council of Ministers.

Sverdrup-Jensen, S. (1999). Policy issues deriving from the impact of fisheries on food security and the environment in developing countries, p.73-91. *In* M. Ahmed, C. Delgado, S. Sverdrup-Jensen and R.A.V. Santos (eds.) Fisheries

Policy Research in Developing Countries: issues, priorities and needs. ICLARM Conf. Proc. 60, 112 p.

Wilson, D.C. (2003) Three Complementary approaches to Understanding the Use of Scientific Claims in Environmental Debates. Annex 7 in Varjopuro, Riku (Ed) Conflicts between Protected Species and Fisheries. Social science research and policy approaches. Nordic Council of Ministers. TemaNord 2003:525, 76-95.

Participant 6. Sea Fisheries Institute (SFI)

SFI is the Polish Governmental Fisheries Research Institution. SFI has long-standing, world-wide experience and expertise in fishery research, but recently its activities have been limited mostly to the Baltic Sea and the Polish Exclusive Economic Zone (EEZ). The Institute celebrated its 80th anniversary in 2001, making it the oldest marine research institution in Poland. The mission of the Institute is to develop and provide scientific foundations for the rational use and exploitation of living marine resources. Research carried out by the Institute forms the basis for establishing catch limits and developing technical measures aimed at conservation and the sustainable exploitation of fish stocks. The principal areas of research conducted at the Institute include fishery biology and oceanography, marine ecology, fish processing technologies and fishery economics.

SFI (Participant 6)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Scientist	Ecosystem-based approach to marine policy & marine chemistry				1.0			1.0	2.0
Total					1.0			1.0	2.0

Participant 7. The Hellenic Centre for Marine Research (HCMR)

HCMR is a governmental research institution, the result of a recent merge of the National Centre for Marine Research and the Institute of Marine Biology of Crete. It is supervised by the General Secretariat of Research and Technology, Ministry of Development. The main purpose of the HCMR is to be engaged in research activities in all fields of the aquatic environment. The HCMR is divided into five main research institutes, of which the Institute of Marine Biological Resources is taking part in this proposal.

The ***Institute of Marine Biological Resources (IMBR)***, and particularly its Fisheries Department, has participated in many European projects aimed at: studying the biology, ecology and dynamics of the marine biological resources, evaluating and monitoring the effects of fisheries on these resources, investigating the impact of environmental changes on marine stocks, understanding the interaction between environmental parameters and fisheries, and finally contributing to the management of the Greek fisheries and to international policy.

HCMR (Participant 7)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	…	WP8	Total months

Senior researcher	Environmental conservation, benthic communities research		1.0		0.5	1.5
Senior research scientist	Fisheries biology & ecology, fisheries discards, CFP	1.0		0.5	0.5	2.0
Total		1.0	1.0	0.5	1.0	3.5

Participant 8. Fundación AZTI – AZTI Fundazioa (AZTI)

AZTI Foundation is a non-profit foundation, funded by the Department of Agriculture and Fisheries of the Autonomous Basque Government (Spain). It has two centres, with more than 125 people in three research departments: i) Fisheries Resources, ii) Oceanography and iii) Environment and Food Technology. The Department of Fisheries Resources is involved in fish stock assessment, and fishing gear technology.

AZTI has co-ordinated European research projects and participated in various EU-funded projects relevant to this project. Studies include species such as anchovy and hake, and particularly in the implementation of egg surveys for the direct assessment of anchovy by the DEPM, mackerel and other species, as well as methodological improvements for surveys such as DEPM application on anchovy (DG XIV Contract No. MA-1-151, 96/034, 99/011, 00/013), triennial egg surveys and associated indices (Study Contracts No. 00/038 & 97/017), improvements in direct surveys (DG XIV Contracts MA-2.495 EF, 99/010 (PELASSES), juveniles (JUVESU- FAIR CT97/3374), implementation of GAMs (99/080), estimations of F and M from direct surveys (95/C 76/15), and tagging on mackerel (DG XIV Contract No. 96/035).

The Department of Oceanography is also involved in studies relating fisheries and environment, in environmental impact studies and monitoring networks (including water, sediment, biota, benthos, fishes, and plankton). One of the most important recent research areas involves the implementation of EU Directives, such as the Water Framework Directive. The Department's staff has broad experience in developing biological indicator indices based on benthic and other communities.

AZTI team includes:

Dr Ángel Borja has a very broad experience in managing both research and advice projects, in national and European frameworks. In the last 22 years, he has worked on benthic ecology, fisheries-environment relationships, marine resources exploitation, environmental impact, and marine monitoring. He has published more than 100 papers, and has developed a benthic index for the assessment of the community health.

Iñigo Muxika is a Ph.D student, working on the development of biological indicators.

AZTI (Participant 8)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Head of Project	Indicators on population (benthos, seabirds), community (benthos, plankton, fishes), ecosystem and function, European Policy		1.0	1.0					2.0
Junior Scientist	Indicators on population and community levels (benthos)		0.5	0.5					1.0
Total			1.5	1.5					3.0

Relevant publications:

Borja, A. and Collins, M. (Eds.) *Oceanography and Marine Environment of the Basque Country*. Elsevier Oceanography Series, Elsevier, Amsterdam, 636 pp, in press.

Borja, A., J. Franco, V. Valencia, J. Bald, I. Muxika, M.J. Belzunce and O. Solaun. The implementation of the European Water Framework Directive: a methodological approach for the assessment of the marine ecological status, from the Basque Country (northern Spain). *Marine Pollution Bulletin*, in press.

Borja, Á., I. Muxika and J. Franco (2003). The application of a Marine Biotic Index to different impact sources affecting soft-bottom benthic communities along European coasts. *Marine Pollution Bulletin*, 46: 835-845.

Borja, Á., Franco, J. and Muxika, I. (2003). Classification tools for marine ecological quality assessment: the usefulness of macrobenthic communities in an area affected by a submarine outfall. *ICES CM 2003/Session J-02, Tallinn (Estonia), 24-28 September, 2003.*

Muxika, I., Borja, Á. and Franco, J. (2003). The use of a biotic index (AMBI) to identify spatial and temporal impact gradients on benthic communities in an estuarine area. *ICES CM 2003/Session J-01, Tallinn (Estonia), 24*-28 September, 2003.

Borja, A., J. Franco and I. Muxika (2003). The Biotic Indices and the Water Framework Directive: the required consensus in the new benthic monitoring tools. *Marine Pollution Bulletin.*

Borja, Á., J. Franco and V. Pérez (2000). A Marine Biotic Index to establish the Ecological Quality of soft-bottom benthos within European estuarine and coastal environments. *Marine Pollution Bulletin*, 40 (12): 1100-1114.

Participant 9. Fishery Research Service (FRSMLA)

The Marine Laboratory, Aberdeen, has a well-established reputation in fisheries research and has been active in the field of fish stock assessment. It has a long history of carrying out ground fish surveys and has in the past been heavily involved in North Sea benthos surveys. More recently the laboratory has carried out research into the effects of fishing on the marine ecosystem of the North Sea, particularly concerning the impact of industrial fishing on top predators, the effects of fishing on the demersal fish community and the impact of fishing on the benthic community. The marine laboratory has played an active role in several ICES working and study groups concerned with the protection, conservation and management of the marine ecosystem.

FRSMLA team includes:

Dr Simon Greenstreet whose research interests include the interactions between pelagic fish prey and their marine mammal, seabird, and fish predators. He has considerable experience in the examination of groundfish survey data to determine trends in groundfish assemblage species composition and diversity, as well as other indices of community health. Dr Greenstreet is group leader of the Multi-Species Interactions Group in the marine Ecosystems Programme. His role is the assessment of the ecosystem effects of fishing and provision of advice to management.

FRSMLA (Participant 9)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Scientist	Community Ecology,			1.5	0.5	0.5			2.5
Total				1.5	0.5	0.5			2.5

Relevant publications:

Greenstreet, S.P.R. & Hall, S.J. (1996). Fishing and the ground-fish assemblage structure in the north-western North Sea: an analysis of long-term and spatial trends. *Journal of Animal Ecology*, 65, 577-598.

Hall, S.J. & Greenstreet, S.P.R. (1996). Diversity, abundance and body size: relationships in the North Sea fish fauna. *Nature*, 383, 133.

Hall, S.J. & Greenstreet, S.P.R. (1998) Taxonomic distinctness and diversity measures: responses in marine fish communities. *Marine Ecology Progress Series*, 166, 227-229.

Greenstreet, S.P.R., Spence, F.E., Shanks, A.M. & McMillan, J.A. (1999) Fishing effects in northeast Atlantic shelf seas: patterns in fishing effort, diversity and community structure. II. Trends in fishing effort in the North Sea by U.K. registered vessels landing in Scotland. *Fisheries Research*, 40, 107-124.

Greenstreet, S.P.R., Spence, F.E. & McMillan, J.A. (1999) Fishing effects in northeast Atlantic shelf seas: patterns in fishing effort, diversity and community structure. V. Changes in structure of the North Sea groundfish assemblage between 1925 and 1996. *Fisheries Research*, 40, 153-183.

Jennings, S., Alvsvåg, J., Cotter, A.J., Ehrich, S., Greenstreet, S.P.R. Jarre-Teichmann, A., Mergardt, N., Rijnsdorp A.D., & Smedstad, O. (1999). Fishing effects in northeast Atlantic shelf seas: patterns in fishing effort, diversity and

community structure. III. International fishing effort in the North Sea: an analysis of spatial and temporal trends. *Fisheries Research*, 40, 125-134.

Jennnings, S., Greenstreet, S.P.R. & Reynolds, J. (1999) Structural change in an exploited fish community: a consequence of differential fishing effects on species with contrasting life histories. *Journal of Animal Ecology*, 68, 617-627.

Greenstreet, S.P.R. & Rogers, S.I. (2000) Effects of fishing on non-target fish species. In *Effects of Fishing on Non-Target Species and Habitats: Biological, Conservation and Socio-economic Issues.* (Eds. M.J. Kaiser & B. de Groot), Blackwell Science, Oxford. Pp 217-234.

Jennings, S., Warr, K.J., Greenstreet, S.P.R. & Cotter, A.J.R. (2000) Spatial and temporal patterns in North Sea fishing effort. In *Effects of Fishing on Non-Target Species and Habitats: Biological, Conservation and Socio-economic Issues.* (Eds. M.J. Kaiser & B. de Groot), Blackwell Science, Oxford. Pp 3-14.

Jennings, S., Greenstreet, S.P.R., Hill, L., Piet, G.J., Pinnegar & Warr, K.J. (2002) Long-term trends in the trophic structure of the North Sea fish community: evidence from stable isotope analysis, size-spectra and community metrics. *Marine Biology*, 141, 1085-1097.

Jennings, S., Warr, K.J., Greenstreet, S.P.R. & Cotter, A.J.R. (in press) Spatial and temporal patterns in North Sea fishing effort. In *Effects of Fishing on Non-Target Species and Habitats: Biological, Conservation and Socio-economic Issues*. Blackwell Science, Oxford.

Participant 10. Centre for Environment, Fisheries and Aquaculture Science (CEFAS)

CEFAS is a multidisciplinary scientific research and consultancy centre specialising in fisheries science and management, as well as marine, coastal, estuarine and ports and harbour environmental monitoring and assessment. CEFAS is an Executive Agency of the Department for Environment, Food and Rural Affairs (Defra). The organisation employs over 550 staff at three well-equipped laboratories, and provides its services to a large number of UK and international public and private sector clients, including Defra, the Environment Agency, and the European Commission. We are presently managing over 300 projects for these customers.

CEFAS scientific and management expertise includes technical stock assessment, fish reproductive physiology, fish tracking and telemetry, population modelling, the design, collection and storage of data for fisheries management, biological sampling of commercial catches, fishery-independent resource surveys, provision of stock data, assessment software and archiving systems, and advice on biological sustainability. One of our strengths is advising on approaches to licensing and enforcement elements of fisheries monitoring, control and surveillance (MCS) systems in both marine and freshwater environments. This includes managing shared and straddling stocks, managing highly migratory stocks, added value in MCS operations, best international practice in fisheries management and MCS training. CEFAS also has expertise in researching, and advising on, mitigating the impacts of a wide range of coastal zone activities upon commercial fisheries and the marine ecosystem.

CEFAS scientists are leading participants in the International Council for the Exploration of the Seas (ICES). CEFAS has an international standing. We are well placed to advise policy makers and governments throughout the world on the

development of regulations and the implementation of control measures to manage new and expanding fisheries. For collaborative projects we have long-standing and well-established relationships with key organisations involved in fisheries management and research worldwide.

CEFAS (Participant 10)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Principal Scientist	Food web ecology, size-based indicators				1				1
Total					1				1

Participant 11. Institut Français de Recherches pour l'Exploitation de la MER (IFREMER)

IFREMER is a public body of industrial and commercial nature. Created by decree of June 1984, it is the only French organisation with an entirely maritime purpose.

IFREMER in figures:

- has an annual budget of € 150 millions;
- employs 1.700 executives, researchers, engineers, sailors, technicians and administrative staff;
- comprises 72 laboratories or research departments, located in 24 stations or centres along the mainland coast and in the French overseas departments and territories;
- maintains 7 research vessels, 2 manned submersibles, one 6000-metre ROV (Remotely Operated Vehicle), and a full set of test facilities.

Being involved in all areas of marine science and technology, IFREMER has the capability of solving different problems with an integrated approach. IFREMER's scope of actions can be divided into four main areas: i) understanding, assessing, developing and managing the ocean resources; ii) improving knowledge, protection and restoration methods for marine environment; iii) production and management of equipment of national interest; and iv) helping the socio-economic development of the maritime world.

IFREMER (Participant 11)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Scientist	Effects of fishing on population and community dynamics Indicators for fisheries management	0.5				2.4			2.9
Total		0.5				2.4			2.9

Relevant publications:

Benoît, E., Rochet, M. J. 2003. A continuous model of biomass size spectra governed by predation, and the effects of fishing on them. J. Theor. Biol. 226, 9-21.

Rochet, M. J. 2000. May life history traits be used as indices of population viability? Journal of Sea Research 44, 145-157.
Rochet, M. J., Trenkel, V. M. 2003. Which community indicators can measure the impact of fishing? a review and proposals. Can. J. Fish. Aquat. Sci. 60, 86-99.
Rochet, M.-J., Péronnet, I., Trenkel, V. M. 2002. An analysis of discards from the French trawler fleet in the Celtic Sea. ICES J. mar. Sci. 59, 538-552.
Trenkel, V. M., Rochet, M. J. 2003. Performance of indicators derived from abundance estimates for detecting the impact of fishing on a fish community. Can. J. Fish. Aquat. Sci. 60, 67-85.

Participant 12. Institut du Développement Durable et des Ressources Aquatiques (IDDRA)

IDDRA is an independent French research institute, established in 1999, with headquarters in Montpellier. It also has an office in the Institut Océanographique in Paris. IDDRA staff comes from the world of research and higher education. They have developed a series of research programmes at the international and European levels involving agencies such as the World Bank, FAO, EU, OECD and bilateral co-operation agencies.

IDDRA works mainly in economics, with a focus on the management of aquatic (especially fish) resources and coastal area management. IDDRA also contributes regularly to research evaluation.

IDDRA's team will be led by:

Stephen Cunningham PhD Economics has a long experience of fisheries management both academically and practically. From 1991 to 1996 he was Director of the Centre for the Economics and Management of Aquatic Resources (CEMARE) at the University of Portsmouth, and from 1997 to 1998 was Chief Technical Adviser on an FAO project based in the Moroccan Fisheries Ministry. Since 1999 he has been Co-Director of IDDRA.

IDDRA (Participant 12)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Scientist	Fisheries economics, fisheries management						2.25		2.25
Total							2.25		2.25

Relevant publications:

Cunningham, S., Ba, B. & Sidi el Moctar ould Iyaye (2003). Factors of unsustainability and overexploitation in relation to major international fisheries instruments: West African coastal and small-scale demersal fisheries. Paper presented to FAO conference in Mauritius, February 2003 (in press).
Cunningham, S. & D. Greboval (2001) Management of Fishing Capacity: a review of policy and technical issues *FAO Fisheries Technical Paper* 409: 60 pp.

Participant 13. Department of Animal and Human Biology (UR), University of Rome

The Department of Animal and Human Biology (UR) of the University of Rome "La Sapienza" offers 61 courses within 12 main research areas. It has a scientific staff of 48 full-time researchers and over 40 contract researchers and PhD students, and an administrative and technical staff of 30 people.

Research is mainly focused on investigating ecological and evolutionary processes operating at the level of populations, species, and communities. Major work is devoted to understanding the processes, such as the distribution and abundance of organisms, behavioural adaptations to the environment, the processes and patterns of evolutionary change, and the application of all of these areas to the conservation of biodiversity. Studies in the fields of marine ecology and fisheries sciences include the biology, population dynamics and spatial distribution of demersal organisms; structure of demersal communities; artificial reef communities; taxonomy and ecology of benthic organisms; structure and spatial distribution of benthic communities; and impact of trawling gear on benthic communities.

During the last 5 years, the Department has been involved in the following research projects: MEDITS – Mediterranean trawl surveys – Ligurian Sea, northern and central Tyrrhenian Sea. (Regulation EC 1543/2000); GRUND – Evaluation of demersal resources in the Italian seas. (Regulation EC 1543/2000); DISCARDS - Discards of trawl fishery in the Italian seas; CAMPBIOL – Collection and analysis of landing and biological data on demersal fish stocks in the Italian seas (Reg. EC 1543/2000, 1639/2001); SAMED – Stock assessment in the Mediterranean (EU project 99/047); Trophic structure of fish assemblages on the Tyrrhenian shelf break; Study on the mixed-species catches of the "RAPIDO" trawl fishery along the Italian coasts (EU Study Contract 99/051); Analysis of catches and fishing effort for stock assessment of *Merluccius merluccius* in the central Tyrrhenian Sea (EU Study Contract 95/79); Monitoring of the trawl and gillnet landings in the central and northern Tyrrhenian Sea (EU Study Contract. 97/0068); Cartography of Italian fish demersal resources (1/MED/91-013; Ministero per le Politiche Agricole); Bivalve molluscs biology and fishery along the Latium coasts; Key species recruitment pattern on artificial reefs.; Impact of dredge and beach restoring on coastal demersal resources of central Tyrrhenian Sea coasts; and Impact of trawl fishery on *Posidonia oceanica* meadows in the Central Tyrrhenian Sea.

The UR team includes:

Dr Francesco Colloca is currently a contract researcher at the Department of Animal and Human Biology in Rome, Italy. His main fields of expertise are trophic ecology of demersal fishes, trophic interaction modelling, ageing and growth, and population dynamics.

Prof. G.D. Ardizzone is an expert in ecology and population dynamics of Mediterranean fish species. He is also the Vice-President of the Italian Society of Marine Biology and a member of the Scientific, Technologic and Economic Committee on Fishery (STECF) of EC. In this framework, he was chairman of the EC workshop "Shared stocks in the Mediterranean Sea" (Brussels, September 2002). He

has participated in many EC research projects and in particular, has been responsible for the project “Cartography of the Italian demersal fishes”.

UR (Participant 13)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior fellow	Ecology and population dynamic of Mediterranean fish species			1					1
Research fellow	Structure of fish assemblages, trophic interactions in fish assemblages.			1					1
Total				2					2

Participant 14. Danish Institute for Fisheries Research (DIFRES)

DIFRES is a research institute that carries out research, investigations and provides advice concerning sustainable exploitation of live marine and fresh water resources. DIFRES deals with chain considerations from water to table. This includes interaction between the water environment and productivity and variation of the fish stocks, methods for assessment of the sizes of fish stocks, development of methods for sustainable fisheries management, and stock enhancement. Moreover, processing and improvement of fish products as well as quality assurance in the fish industry are important parts of the research areas of the Institute.

DIFRES also acts as advisor to the Ministry of Food, Agriculture and Fisheries, other authorities, international commissions, the fishing industry and fishery organisations. Four research departments are responsible for research and advisory work carried out by DIFRES. The Institute has approximately 270 employees and a budget of 170 million DKK, of which 80 million DKK is governmental funding and 90 million DKK is external funding. DIFRES is managed by a director with reference to a Governing Board, with representation from the fishing industry, professional and industrial bodies, national research councils and members of the staff.

DIFRES team includes:

Prof. Henrik Gislason is a research professor at the Department of Marine Fisheries. His main areas of research are multi-species models of interacting fish stocks, and the impact of marine fisheries on the marine environment. He was the first chairman of the ICES WG on Ecosystem Effects of Fishing, member of the drafting panel for the 1991 Quality Status Report on the North Sea, co-convener of the ICES/SCOR Symposium on Ecosystem Effects of Fishing in Montpellier and participated in the drafting of the FAO guidelines for Ecosystem-based Fisheries Management. He has published a range of papers on multi-species modelling of marine fish stock and on the impacts of fishing on the size composition of fish communities.

Dr. Astrid Jarre is a senior scientist at the Department of Marine Fisheries. She is a member of the ICES Working Groups on the "Ecosystem Effects of Fishing" and on

"Fisheries Systems", as well as the joint SCOR - IOC Working Group 119 on "Quantitative Ecosystem Indicators for Fisheries Management. Additionally, Dr. Jarre is familiar in detail with the procedures of generating scientific advice in ICES through her membership of both the Advisory Committee for Fisheries Management and the Advisory Committee on the Marine Ecosystem (then responsible for ecosystem issues) during her Chairmanship of the ICES Marine Habitat Committee 1997-2000, this work included i.a. the review of parts of the OSPAR Status 2000 Assessment. She has published extensively on trophic interactions in marine ecosystems and the role of fisheries. Her current research focuses on indicators for an Ecosystem Approach for Fisheries Management, including both situations with adequate data coverage and highly data-sparse situations.

Anna Rindorf is a junior scientist at the Department of Marine Fisheries. Her main areas of research are predation interactions between piscivores and their prey, in particular gadoids, sandeel and seabirds in the North Sea. She has participated in the ICES Study Group on the effects of sandeel fishing and in the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. She has published a number of papers on feeding of gadoids, sandeel sampling and the interaction between sandeels and seabirds.

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Prof.	Multispecies modelling		0.5	0.5					1.0
Senior Scientist	Ecosystems effects of fishing		0.5	0.5					1.0
Junior Scientist	Fish species interaction		1.0	1.0					2.0
Total			2.0	2.0					4.0

Participant 15. National Board of Fisheries (NBF-ICR)

The Swedish NBF's Department of Research and Development is a governmental research organisation dealing with fisheries science, fish stock assessment and management of marine, coastal and freshwater fisheries. Research areas of focus are fish ecology, fisheries and environmental research. Monitoring of fish and fisheries encompasses the Baltic Sea and Kattegat and Skagerrak areas. NBF is participating in a number of European projects, both related to fish ecology and fisheries management. With a staff of about 200 employees, NBF is divided into three main institutes: i) the Institute of Marine Research, ii) the Institute of Coastal Research, and iii) the Institute of Freshwater Research.

The Institute of Coastal Research has expertise in monitoring coastal fish and fisheries, environmental monitoring, genetics, biodiversity, modelling and fishery management. Ongoing research projects are related to marine protected areas, recruitment collapse of coastal fish fauna, environmental issues, genetics and biodiversity, by catch of mammals as well as stock assessment of coastal species. The institute is involved in the development of sustainable coastal zone and adaptive fishery management.

NBF-ICR (Participant 15)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Fellow	Fisheries, environmental integration, population and community indicators,		0.5	0.5					1.0
Research Fellow	Fisheries, biodiversity and reference points		1.0	1.0					2.0
Total			1.5	1.5					3.0

Participant 16. Finnish Game and Fisheries Research Institute (FGFRI)

FGFRI is a governmental research organisation and the principal research centre on fisheries research in Finland. FGFRI produces high-quality scientific information for sustainable use of exploitable natural resources. The Institute's budget is EUR 22 million and it has a staff of 330 persons.

The Fisheries Research Unit has a staff of 90 persons, 45 % of them scientists. The Unit has scientific expertise in all major fields of traditional fisheries research. It assesses major commercial fish stocks in the Baltic Sea and main inland watercourses, studies the impacts of fishery and environmental changes on them, and develops fisheries management methods and harvesting technology. A large body of data is available on stocks, distribution, growth, spawning and nursery grounds, and migration patterns. Extensive research projects are under way for developing improved stock monitoring methods and fisheries management procedures. The research on the applicability and efficiency of technical fisheries management methods has a high priority.

Increasing attention has been paid to the reproduction problems of coastal fishes, as well as to the status and distribution of reproduction and nursery areas of fish. The responses of fish communities to eutrophication in coastal waters have been another recent focus of the Institute's work.

Another important component of our research programme is the improvement of the selectivity of trawl and gillnet fisheries, and the assessment of survival of fish that escape fishing gears. Recently, development of gear modifications and operational procedures to mitigate the seal-fishery conflict in the Baltic Sea has also had a high priority. The co-operation with other research institutes and industry has greatly expanded during the last decade.

The contact person for the FGFRI will be Dr Antti Lappalainen. Dr Lappalaine has an M. Sc. in Hydrobiology and limnology (1989, University of Jyväskylä). He obtained his Ph.D from the University of Helsinki in 2002. He is currently involved in two research projects on the effects of eutrophication on coastal fish communities in the Gulf of Finland, Baltic Sea and on shallow coastal bays as fish reproduction areas.

FGFRI (Participant 16)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Researcher	Environmental effects on fish populations and communities		1	1					2
Total			1	1					2

Participant 17. The Central Institute for Research Applied to the Sea (ICRAM)

ICRAM is an Italian non-profit public entity included in category VI, "Scientific Institutes for Research and Experimentation", instituted by Law no.41 in 1982. It provides support to policies implemented by the competent public administrations, makes recommendations, and supports local authorities in co-ordinating their activities in marine protected areas, port dredging, fishing and aquaculture.

ICRAM's mission is "to contribute to the care and protection of the sea and its resources by means of management, conservation and awareness-building support activities grounded on solid scientific bases and on the principle of precaution. To ensure enjoyment of a healthy sea environment, that is sound in terms of biodiversity and living resources, self-sustaining over time and capable of coexisting with man and his needs."

The aim is to support the administration in the defence and protection of the sea, in three main domains: i) Protection of the quality of the water and of sea, coastal and lagoon environments; ii) Conservation of marine biological diversity, with special reference to the safeguarding of the habitat and of protected marine species; and iii) Sustainable and responsible use of the marine environment and its resources. To this end, ICRAM carries out research activities providing technical support for the sustainable use of marine biological resources, as well as to ensure the compatible management of fishing and aquaculture.

ICRAM is organised in four departments: 1) Monitoring of environmental quality; 2) Prevention and mitigation of impacts; 3) Protection of habitats and biodiversity; 4) Sustainable use of resources**.**

ICRAM (Participant 17)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior scientist	Fishery Ecology				1				1
Total					1				1

Participant 18. The Joint Nature Conservation Committee (JNCC)

JNCC was established under UK statute in 1990 and commenced its work in April 1991. It is a forum through which the three UK country nature conservation agencies – the Countryside Council for Wales (CCW), English Nature and Scottish Natural Heritage (SNH) – deliver their statutory responsibilities for Great Britain as a whole

and internationally. These responsibilities, known as the special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems. The special functions are principally:

- to advise ministers on the development of policies for, or affecting, nature conservation in Great Britain and internationally;
- to provide advice and knowledge to anyone on nature conservation issues affecting Great Britain and internationally;
- to establish common standards throughout Great Britain for the monitoring of nature conservation and for research into nature conservation and the analysis of results;
- to commission or support research which the Committee deems relevant to the special functions.

JNCC (Participant 18)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Senior Advisor	Marine conservation, esp. mammals and seabirds, and policy development	0.5	0.5						1.0
Advisor	Marine conservation and human use issues	0.5	0.5						1.0
Total		1.0	1.0						2.0

Participant 19. Consiglio Nazionale Delle Ricerche (IAMC-CNR)

Since the mid-1980s, the IAMC-CNR (IRMA Department) is actively involved in assessment of the demersal resources and in preparing scenarios and simulations of various fishing regimes, using both direct techniques such as trawl-surveys (i.e. statistically programmed sea investigations with a trawler as sampler) for periodical collection of data (and computers and population dynamics models for processing) and indirect techniques, such as sample statistics of landings and trawl catch and effort in the base ports of southern Sicily of the fleets operating in the Straits area.

The Institute has been the inspirational nucleus, in Italy and in the Mediterranean, in the development of widely used techniques and methods, and is still a focal point for analysis and development. It frequently hosts conferences on particularly important aspects and problems, in order to move towards the aim of rational management of the biological resources of the sea (i.e. achieve the maximum economic benefit for the community in line with maintaining the exploited populations in time), and is the node of national and international research networks. Work is carried out to extend the area of research to cover the whole Straits of Sicily.

IAMC-CNR team includes:

Dr Michele Gristina (Researcher) has been working on the benthic component of artificial reef communities and on MPAs. She is also involved in researching the

effects of trawl surveys on the demersal communities of the Straits of Sicily (South-Central Mediterranean).

Dr Fabio Fiorentino (Researcher) is a fishery biologist working on demersal resources in the Mediterranean, within the framework of Italian and international programs. His main expertise is in stock assessment in the Ligurian Sea (North-Western Mediterranean) and the Strait of Sicily (South-Central Mediterranean).

Dr Germana Garofalo is a research scientist at the IRMA-CNR. Her main research interests include methods of spatial analyses and the use of geographic information systems (GIS) for stock assessment purposes, use of artificial neural networks for data mining and temporal series prediction. She is currently involved in a number of national and EU-funded research projects on demersal resources assessment.

IAMC-CNR (Participant 19)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	Total months
Research. 1	Fishery Ecology		0.5	0.5			1
Research. 2 &3	Fishery biology Spatial analyses		1.5				1.5
Total			2.0	0.5			2.5

Relevant publications:

Fiorentino F., G. Garofalo, M. Gristina & D. Levi (2003). The ratio between "benthic" and overall fish biomass (BOI) as an indicator of trawling impact on demersal assemblages. *Biol. Mar. Medit*., 10, (in press).

Gristina M., Garofalo G., Bono G. & Levi D. (2000) Effects of commercial trawl fishing in the Strait of Sicily on the diversity of demersal resources. ICES CM 2000: Marine Habitat – Mini 13.

Garofalo G., M. Gristina, F. Fiorentino, F.Cigala Fulgosi, G. Norrito & G. Sinacori (2003). Distribution pattern of rays in the Strait of Sicily in relation to fishing pressure. Presented at "37th EMBS Symposium" 5-9 August, 2002, Reykjavik, Island. *Hydrobiologia*, (in press).

Garofalo G., Gristina M., Toccaceli M., Giusto G.B., Rizzo P. & G. Sinacori (2002). Geostatistical modelling of biocenosis distribution in the Strait of Sicily. Second International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences, 3-6 September 2002, University of Sussex, Brighton, UK.

Fortunati L., Garofalo G. & R. Demontis (2002). TSDV: a GIS tool for inspecting trawl survey data. ICES Journal of Marine Science, 59, 168-178.

Participant 20. Estonian Marine Institute, University of Tartu (EMI)

EMI is a multidisciplinary scientific research institution involved in ICES work related to fish stock assessments and management advice, as well as in marine systems modelling. The model with horizontal grid step approximately 3 nm is already in operational use for the Baltic Sea. The Finnish-Russian-Estonian-Swedish Co-operation (FRESCO) modelling suite is operational to simulate marine ecosystem dynamics and matter transport in the coastal Baltic (horizontal grid step of 1/4 nm). Risk analysis and hazard mitigation advice is based on the statistical analysis of measurements at sea and the results of simulations.

The concept of a coupled economic and ecological system cycle is developed as a tool to evaluate the strategic and operational management objectives. Statistical modelling and the game theory elements are used to study the possible solution for allocation of the Baltic shared fishery resources.

EMI team includes:

Dr Robert Aps (EMI, Deputy Director) has twenty-eight years of experience in fish stock assessment and management. In 1972-1991 he worked as a fishery scientist/senior scientist/leading scientist at the Baltic Fisheries Research Institute/Estonian Marine Institute, where his main research interests were the ageing of fish and the microstructure of fish otoliths, fish stock modelling, assessment and management. Robert has a BSc in Zoology, University of Tartu 1972, and a PhD in Ecology, University of Tartu 1981. For the period 1992-2000, he was Head of Section/Deputy Director General at the National Fisheries Board/Fisheries Department of the Ministry of Environment of Estonia. In 2000, Robert Aps was invited to work at the Estonian Marine Institute, University of Tartu, to contribute to the scientific and institutional strengthening of marine science in Estonia through his experience in development and management of research programs, fiscal management, institutional development and the strategic planning. He is the Estonian delegate to ICES, member of the ICES Advisory Committee on Ecosystems, and has published more than 100 papers.

Dr Rein Tamsalu (EMI, Head of Marine Systems Modelling Department) received his PhD in Physics and Mathematics in 1969, and DSc in Physics and Mathematics in 1986. In 1967, he started as senior engineer at Tallinn Technical University. In 1968, he chaired the marine modelling group in the Computing Centre Siberian Dept of SU Academy of Science (Novosibirsk). R. Tamsalu continued, in 1971, as senior scientist at the Institute of Electrophysics and Thermophysics (Tallinn), in 1975, as Head of Department at the Baltic Fisheries Research Institute (Tallinn), in 1980, as Head of Laboratory at the Institute of Applied Geophysics (Tallinn), in 1988, as Head of Department at the Institute of Electrophysics and Thermophysics (Tallinn), in 1990, as Head of Department, Estonian Institute of Ecology (Tallinn). In 1992-1999, R. Tamsalu was active as a guest scientist at the Finnish Institute of Marine Research (Helsinki). Since 1992, R. Tamsalu is Head of the Marine Systems Modelling Department at the Estonian Marine Institute, University of Tartu (Tallinn). He has published more than 100 publications and 3 monographs on numerical modelling of marine hydrodynamics and ecosystems.

EMI (Participant 20)

Staff category	Expertise	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total months
Deputy Director	Stock assessment and management advice, socio-economics						1		1
Senior Scientist	Marine modelling systems					1			1
Total						1	1		2

Relevant publications:

Aps, R. (2004). Management of shared Baltic fishery resources. In: *Management of Shared Fish Stocks.* Payne, A.I.L., O'Brien, C.M. and Rogers, S.I. (Eds.), Oxford, Blackwell; pp.190-201, (in press).

Aps, R., Rice, J.C., Tamsalu, R., Zalesny, V. (2003). Theory of optimal control based adaptive fishery management. *ICES CM 2003/Y*:14 (CD-rom)

Aps, R., Lassen, H., Andrejeva, K. (2003). Allocation of Baltic herring shared fishery resources. Baltic Fisheries Cooperation (BAFICO) Seminar, St. Petersburg 21-23 October 2003. The Nordic Council of Ministers, *TemaNord 2004* (in press).

Aps, R. (2002). The Estonian fisheries industry. *Eurofish Magazine, 4/2002*, 50-53.

Aps, R. (2001). The International Baltic Sea Fishery Commission: Current Situation and Future Challenges. Proceedings of the Fourth Conference on the Environmental Conventions and the Baltic States. Tallinn, 2001, pp. 114-116.

Aps, R, Vaarja L. and Lillipuu T. (1997). The Fishery Industry in Estonia. Eastfish Fishery Industry vol. 5, 83 pp.

Aps, R. (1996). The Fishery Industries in Estonia. Globefish Research Programme, vol. 42, 72 pp.

Ennet, P., Kuosa, H., Tamsalu, R. (2000). The influence of upwelling and entrainment on algal bloom in the Baltic Sea. *Journal of Marine Systems* 25. 359-367.

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Hamza, W., Ennet, P., Tamsalu, R., Zalesny, V. (2003). The 3D physical-biological model study in the Egyptian Mediterranean coastal sea. *Aquatic Ecology*, 37, 307-324.

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Suursaar, Ü., Otsmann, M., Kullas, T., Tamsalu, R., Ennet, P. (2000). Ecological risks of the hydrodynamical buildings in the regio of straits of Estonia, the Baltic Sea: two case studies. In *Risk analysis II*, Wit Press, Southampton, Boston, pp 487-498.

Tamsalu, R. (ed.) (1998). The coupled 3D hydrodynamic and ecosystem model FINEST. *Meri - Report Series of the FIMR*, No.35, 166 pp.

Tamsalu, R., Mälkki, P., Myrberg, K. **(**1997). Self-similarity concept in marine systems modelling. *Geophysica*, 33 (2), 51-68.

Tamsalu, R., Ennet, P. (1995). The ecosystem modelling in the Gulf of Finland Part The aquatic ecosystem model FINEST. *Estuarine, Coastal and Shelf Science*, 41: 429-458.

Vetemaa, M., Eschbaum, R., Aps, R. and Saat, T. (2000). Collapse of political and economical system as a cause for instability in fisheries sector: An Estonian case. Proceedings of IIFET 10th Congress, 2000, 9 pp.

Zalesny, V., Tamsalu, R. (2002). Mathematical Models in Water Science. In *The Encyclopedia of Life Support Systems*. EOLSS Publishers Co. Ltd, 56 pp (accepted).

Zalesny, V.,Tamsalu, R. (2000). Numerical analysis of the marine dynamics. Proceedings of the international conference on Numerical Mathematics and Mathematical Modelling, INM, Moscow, pp 110-124.

Relevant projects

6th Framework Programme, Priority 8.1 Policy Orientated Research, COMMIT, Creation Of Multiannual Management Plans for Commitment, Proposal/Contract no.: 502289. Sub-contract with CEFAS, UK (2004-2007) R. Aps

Sustainable Management of Freshwater Fisheries and Nature Conservation in Central and Eastern European Countries, Phase II. IUCN Central Europe Office, Warsaw (2004) R. Aps

Freshwater Fisheries in CEE countries, IUCN Project No 76150-102/202/1. IUCN Central Europe Office, Warsaw (2003) R. Aps

5th Framework Programme "Multi-Annual TACs Evaluation Study for Roundfish Stocks" Studies and support services related to the Common fisheries policy, Contract No: MATES FISH/2001/02 2002 (Baltic Cod stocks - R. Aps) (2002) R. Aps

Academy of Finland project FAN-AS (2003-2005) R. Tamsalu

Nordic Council of Ministers, project NOCOMMENTS (2000-2003) R. Tamsalu