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Final Report

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**Project Full Name:** Management and monitoring of deep-sea fisheries and stocks

## Final Report

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# Final Report

## PROJECT FINAL REPORT

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# Final Report

Please note that the contents of the Final Report can be found in the attachment.

## 4.1 Final publishable summary report

### Executive Summary

The strengths and weaknesses of the management and monitoring of deep-water stocks, fisheries and ecosystems in DEEPFISHMAN case studies and a number of other areas of the world were reviewed. The main conclusion of the overall review was that most of the monitoring and management regimes, including those in the north-east Atlantic, had four major weaknesses: (i) there is lack of an agreed definition of deep-water species and deep-water fishing activity; (ii) only rarely are regulations in place to collect socio-economic data (although such regulation exists in EU waters as part of the DCF); (iii) most have no mechanisms in place to monitor parasites, contaminants and pathogens in deep-water fish; and (iv) there is little monitoring of ecosystem composition, health and productivity. These gaps were addressed by the project.

The socio-economics of the nine studied fisheries were reviewed. These are managed primarily by TACs, licenses, effort restrictions, technical restrictions and spatial and temporal closures. The Greek blackspot seabream fishery is though in effect an open access fishery. The only cases of market-based management are found in Norway and Iceland. Three kinds of bio-economic models were constructed: a basic theoretical model that was not applied to any fishery, but intended to throw light on the general development of deep-water fisheries, and two applied models for the French fishery to the West of the British Isles and the Icelandic fishery for deep-water beaked redfish.

A global review identified the assessment and management approaches currently being implemented for deepwater fisheries and highlighted the need for the development of techniques that allowed a more sustainable exploitation of vulnerable deepwater stocks. New and alternative stock assessment methods were developed, including, e.g. standardisation of Landings Per Unit of Effort (LPUE), a Bayesian state-space model, a Multi-year catch curve (MYCC), a catch-at-age model and a continuous state-space model. The GADGET modelling toolbox was applied in two cases and simulation testing of a number of assessment methods in varied situations of data limitation was carried out. The data used for stock assessment came from data-mining carried out in the project and recent data collected e.g. under the DCF in EU waters. Considerable progress in the assessment of deep-water stocks was made. In particular, a range of suitable assessment models were tested, new assessment methods were developed and some are already in use by ICES.

A comprehensive review of candidate indicators, reference points (RPs) and harvest control rules (HCRs) used for deep-water/data poor species revealed very few instances where RPs or HCRs had been applied to deep-water fisheries, even in a global context. Appropriate indicators, RPs and HCRs for each of the case studies were defined including precautionary reference points based on alternative sources of information such as life history theory and spatial information. Simulations were used to develop and test RPs and HCRs.

Analyses of trends in biodiversity and the identification of biodiversity indicators were carried out based upon fishery dependent data including haul-by-haul data provided by stakeholders, on-board observations and surveys in several areas and case studies including: Irish waters, Eastern Ionian Sea, West of Portugal and Icelandic waters. These studies have also given rise to work in connection with the project CoralFISH.

In order to define management strategies, the management options and monitoring data were reviewed, existing and new options for management strategies were identified, including by stakeholder consultation. The management options were tested by Management Strategy Evaluation (MSE) using FLR ([flr-project.org/](http://flr-project.org/)), the spatially explicit simulation platform ISIS-fish (<http://www.isis-fish.org/en/index.html>) and qualitative modelling.

Using data and knowledge collated by project and results of project analyses, guidelines towards management and monitoring framework for deep-water fisheries/stocks in the NE Atlantic were presented.

There was an active dissemination during the project and dissemination has continued after the end of the contract. The scientific output of the project was highlighted in a joint conference of DEEPFISHMAN and CoralFISH, 28-30th August, 2012, Galway. Report, documents and publications are available on the project's WIKI ([deepfishman.hafro.is/doku.php](http://deepfishman.hafro.is/doku.php)).

## Summary description of project context and objectives

### Concept of the project

The deep-water is generally considered to be the area of the world's oceans beyond the continental shelf; that is, greater than 200 meters depth. Fisheries targeting deep-water species generally take place in depths below 400 meters. This project addressed the deep-water species listed in Annex I and II of the EC Deep-water Licensing Regulation (Council regulation (CE) No 2347/2002). It also included benthopelagic species such as Greenland halibut (*Rheinhardtius hippoglossoides*) and beaked redfish (*Sebastes mentella*), that are in effect deep-water, at least some populations but excluded the mesopelagic blue whiting (*Micromesistius poutassou*) commercially exploited by pelagic fisheries. An addition reason to consider Greenland halibut and beaked redfish was that these species provided comparatively data-rich case studies and, for Greenland halibut, allowed assimilation of the characteristics, strengths and weaknesses of the NAFO management and monitoring regime.

Using information and data currently available, new information from other ongoing projects, knowledge of the management and monitoring of deep-water fisheries/stocks in other parts of the world and outputs from the project, DEEPFISHMAN aimed to develop a range of strategy options for the exploitation of deep-water species in the NE Atlantic.

The project relied upon a range of case studies selected to reflect the diverse characteristics of the different types of deep-water fishery found in the NE Atlantic. In addition two case studies outside the NE Atlantic and Mediterranean Sea were selected to give a wider perception of the management and monitoring of deep-water fisheries elsewhere in the world. The project included an ICPC country: Namibia. Fisheries data (including all bycatch data) from case studies were used to examine historical catch data for changes in biodiversity and to identify protocols for monitoring biodiversity (of both vertebrates and invertebrates) in the deep-water ecosystem. The project aimed to evaluate the socio-economic profile and projected socio-economic impact of the management strategy options, as applied both through a short- and long-term framework, for selected fisheries. In this way the project aimed to provide robust guidelines for deep-water fisheries management suitable for adoption within the Common fisheries policy (CFP).

A key involvement of stakeholders was considered to be key to the success of the project, since they offer a source of unique information to undertake proposed approaches. The project included plans to request the fishing industry to contribute to specific work packages, largely through their participation in workshops arranged through the relevant RACs or by the use of questionnaires and other tools. In particular, an initial start-up workshop to formulate the views of stakeholders on the present and possible future management regimes for deep-water stocks/fisheries in the NE Atlantic was part of the concept. It was anticipated that outputs to stakeholders, policy makers and NGOs would be through a dedicated Stakeholder outreach and dissemination work package.

### Objectives of the project

The objectives of DEEPFISHMAN were :

- To review (i) salient characteristics of the deep-water environment in the NE Atlantic, (ii) the major features of selected fisheries (this require input from the Industry and the collation and analysis of socio-economic data), (iii) the life history characteristics and vulnerability to fishing of the stocks/species targeted in these fisheries, (iv) the current availability of fisheries, ecosystem and biological data, (v) the current methods used for monitoring, assessing and managing the state of stocks, (vi) the current state of deep-water stocks in the NE Atlantic and (vii) the outcomes and guidelines from the Commission of the European Communities, specific RTD programme "Specific Support to Policies", SSP-2004-22745 "Probabilistic assessment, management and advice model for fishery management in the case of poor data availability" (POORFISH) of relevance to deep-water stocks.
- To draw lessons from the current management and monitoring frameworks for deep-water species used internationally, to identify strengths and weaknesses. These includes e.g. approaches employed by (i) EU and NEAFC in the NE Atlantic, taking into account the recent Review of the Management

of Deep-water Stocks carried out by the Commission (ECCOM, 2007), the outcomes of a recent European Parliament Workshop on Deep-water Stock Management (EP, 2007) and the views of fishers as expressed through the relevant RACs; (ii) deep-water fisheries New Zealand, (iii) by NAFO for Greenland halibut fishery in the NAFO Regulatory Area, (iv) orange roughy fishery in Namibia and (vi) the effort-based management framework for deep-water and other species in the Mediterranean and (vii) the experience of CCLAMR in assessing and managing stocks of Patagonian toothfish and finally, and importantly, the views of stakeholders.

- To examine and trial stock assessment methods not previously used or not fully developed for use on deep-water stocks in the NE Atlantic, with the primary aim of evaluating the state of stocks.
- To examine appropriate biological reference points (BRPs, e.g. MSY for stocks prosecuted by selected fisheries) and harvest control rules (HCRs) for deep-water fisheries/stocks in the NE Atlantic, and to explore the feasibility of simple approaches (e.g. the use of biological parameters such as trends in mean length and proportion immature : mature in catches) as indicators of the status of stocks.
- To explore catch data from appropriate case study fisheries for trends in biodiversity, to identify protocols for monitoring biodiversity (of both vertebrates and invertebrates) in the deep-water ecosystem and to integrate issues of by catch species and biodiversity in the management of deep-water fisheries.
- To develop a range of strategic options for the exploitation of deep-water stocks, fisheries and ecosystems in the NE Atlantic with the overall aim of developing a short- and long-term ecosystem based management framework with the aim of reversing any negative trends in abundance and reducing impacts of fisheries on biodiversity and, where feasible, vulnerable marine ecosystems (VMEs). Management frameworks will take into account (i) the outcomes of the objectives above, (ii) the FAO International Guidelines on the Management of Deep-water Fisheries in the High Seas (FAO, 2007), (iii) a risk assessment approach and (iv) the requirement that EU member States commit themselves to maintaining or restoring fish stocks to levels that would produce MSY by no later than 2015.
- To develop a socio-economic profile of selected fisheries and to evaluate projected socio-economic impacts of management strategy options as applied both through a short- and long-term management framework.
- To disseminate outputs/results to stakeholders, policy makers and NGOs.

## **Description of main S & T results/foregrounds**

### **WP1 Coordination and management**

The coordinator (Ifremer) followed the research activities of the consortium partners in collaboration with the work package (WP) and the case study (CS) leaders, setting up deadlines for each research activity and ensuring that all partners fulfilled their project duties and that task time tables and deliverables were met in due time. The coordinator was responsible for putting together research results and prepared periodic management and technical reports for the EC. All contact between the project consortium and the EC were undertaken by the coordinator.

The coordination activity fell into three tasks

Task 1.1 Project co-ordination

Task 1.2 Administrative management and project office

Task 1.3 Exploitation and implementation plan

The project co-ordination (task 1.1) and the administrative management (task 1.2) of the project was carried out smoothly. The coordinator and projects partners were in frequent email contact. Project meetings were organised and held in several locations. During the second reporting period, a WP4-WP5 workshop was held at Imperial College (Ascott, UK, 17619 May 2011) a WP7 workshop was held in Bilbao (15-17 November 2012). Steering and governing board meetings were organised during these workshops and at the final project symposium (28-30 August 2012, Galway, Ireland).

Further some decisions, e.g. the date and location of the final symposium were agreed by the steering committee members by email.

In task 1.3 links with related projects within the EU and internationally (sub-task 1.3.1) were developed primarily with the EU-project CoralFISH (grant number 213144). A common working meeting was held with this project (with two CoralFISH partners Ifremer and NUIG and two DEEPFISHMAN partners Ifremer and Cefas) and the two projects organised jointly their final symposium. The final stakeholder workshop scheduled in DEEPFISHMAN was also organised jointly, in the same week as the final symposium. In recent months, both projects have presented their outcomes in a number of events mentioned below in WP 8. Some participant scientists have contributed to studies in both projects. The results, publications, tools from several previous FP6 projects including FISHBOAT, POORFISH, TECTAC were used in DEEPFISHMAN approaches. The use and dissemination of the foreground (task 1.3.2) was carried out as scheduled including through input from the project into ICES, STECF, NAFO and other international experts groups. It is worth mentioning here that some DEEPFISHMAN methodologies are already integrated into regular stock assessment made by ICES. The project results were further presented in RACs meetings and RACs representatives have also taken part in stakeholder workshops organised by the project. In addition to the project WIKI, project publications and reports are available from institutional archives of some partners (e.g. <http://archimer.ifremer.fr/> and <http://www.cefas.co.uk/publications/miscellaneous-publications.aspx>). The use and dissemination of the foreground will continue well after the end of the project through continued input into organisations such as ICES, NAFO, OSPAR and publication of project results. In particular, a special issue is underway and will disseminate project results to the scientific community.

## WP2 Review of existing management and monitoring approaches

This work package was led by Cefas with contribution from all other partners except Imperial College. The work came under two tasks (Cefas leading both):

Task 2.1 – Review of international management approaches

Task 2.2 – collation of data and information

The work was mostly carried out during the first reporting period with the compilation of 9 case study reports. This work package was the major link between case studies, i.e. regional data and expertise and work packages (i.e. research carried out in the project). During the second reporting period some work was published and the collaboration between all partners remained high as case study scientists were strongly involved in the use of their data in the bio-economic modelling (WP3), in stock assessment (WP4), biological reference points and HCRs (WP5), biodiversity analyses (WP6) and Management Strategy Evaluation (WP7). For example, the analyses of patterns of fish biodiversity carried out in WP6 were based upon data assembled and formatted in WP2. These analyses involved several case studies and several of the final publications, already submitted or to be submitted in the DEEPFISHMAN special issue, were led at case study level.

A global review of the strengths and weaknesses of the management and monitoring of deep-water stocks, fisheries and ecosystems in DEEPFISHMAN case-studies and a number of other areas of the world was finalised (D2.3) and is now accepted for publication in *Reviews in Fisheries Science*. The main conclusion of the review is that most of the monitoring and management regimes, including those in the north-east Atlantic, have four major weaknesses: (i) there is lack of an agreed definition of deep-water species and deep-water fishing activity; (ii) only rarely are regulations in place to collect socio-economic data (such regulation exists in EU waters as part of the DCF); (iii) most have no mechanisms in place to monitor parasites, pollutants, contaminants, as well as viral, bacteriological, fungal and protistan pathogens in deep-water fish, shellfish and other marine organisms; and (iv) there is little monitoring of ecosystem composition, health and productivity. In the north-east Atlantic, this mostly stems from the paucity of extensive internationally coordinated fisheries-independent surveys which can be used as a platform for ecosystem monitoring. The work carried in other DEEPFISHMAN work packages addressed the definition of deep-water species and deep-water fishing activity (see below WP7) and fish community indicators and modelling were addressed in WP6 and WP4 respectively. Further, an analysis of contaminants, pathogens and parasites in deep-water fish is in preparation for submission to the DEEPFISHMAN special issue. In other words, WP2 provided data and assembled the knowledge from which other WPs could start scientific work but it also identified issues that were addressed by other WPs.

Overall the work, mainly reviews, carried out in WP2 allowed to feed data and background to other WPs and was also a major support of the management and monitoring framework proposed in WP7.

### WP3 Socio-economic study

Work package 3 was lead by the Institute of Economic Studies (IoES) of University of Iceland, with contributions from partners UpO/CEMARE, AZTI; Cefas, MI, HCMR, IEO, MRI IPIMAR.

WP3 analysed the socio-economics of deep-water fisheries, and the work was organized around the analysis of the economic performance of fleets, the effectiveness of management measures and the functioning of markets. These analyses provided information for formulating policy options from the economic point of view. The work package was divided in three main tasks:

T3.1. Economic framework (led by IoES)

T3.2. Management (led by UoP/Cemare)

T3.3. Bio-economic modelling (lead by IoES)

The overview carried out in task 3.1 showed that DEEPFISHMAN case-study fisheries are managed primarily by TACs, licenses, effort restrictions, technical restrictions and spatial and temporal closures. The Greek blackspot seabream (DEEPFISHMAN case study 3b) fishery is though in effect an open access fishery. The only cases of market based management are found in Norway and Iceland. Norwegian vessels taking part in beaked redfish fishery in the Barents Sea and Norwegian Sea are subject to individual vessel quota regime, and although the quotas as such may be non-transferable, it is possible to transfer quotas between vessels owned by the same entity. Furthermore, vessels with quotas can be bought and sold on the market. In Iceland, an ITQ system has been in effect in almost all fisheries since 1990. There are two kinds of quotas, permanent and annual catch entitlements. No restrictions apply to transfers of permanent quotas, but transfers of annual catch entitlements are subject to considerable restrictions. Further details on this overview can be found in D3.1.

Case studies included in DEEPFISHMAN can be classified in a number of ways. The most striking examples are given below focussing on the fleets involved, as the fleets vary considerably in size and scope. In essence, the fleets can be categorised as artisanal fleets, industrial fleets, consisting of only a handful of vessels, and large industrial fleets, primarily the Spanish, Icelandic and Portuguese fleets

#### Fleet size (subs-task 3.1.1 and task 3.2)

The Greek artisanal fleet is the most numerous, comprising close to 1,800 vessels, ranging from 10 meter long gillnetters and trammel netters to 23 meter long trawlers. The fleet has numerous home ports and catches are landed in more than 1,200 ports. The socio-economic effects of the blackspot seabream fisheries are therefore not limited to a few communities, but are felt in a considerable part of the country. Reliable information on total catches is though scant.

The blackspot seabream fishery in the Strait of Gibraltar and the black scabbardfish fishery off Portugal are by contrast very local. In Spain, most of the catches are landed in the port of Tarifa and in Portugal in the port of Sesimbra. The Spanish voracera fleet numbers 100 boats, whereas the Portuguese fleet counts 17 vessels in 2009. The local effects of the fishery are quite profound. In France, Ireland, the UK and Spanish Basque country there are only a handful of vessels, mostly trawlers, taking part in the deep-water fisheries in the waters around the British Isles and west of Ireland. Catches of the fleets have fallen drastically in the last decade; the orange roughy stock and deep-water shark stocks have been depleted, and although the blue ling is less vulnerable, catches in most ICES areas have declined since the 1970-1980s, in recent year the decline has been mainly driven by the regulation.

The orange roughy stock in Namibian waters has been depleted and a moratorium on fishing has been in effect the last few years. Most of the industrial fleets engaged in the deep-water fisheries have in recent years only contained few vessels.

As a consequence of stocks decline and /or regulations, deep-water fleets have declined since the early 2007. For example, catches of the shallow pelagic beaked redfish in the Irminger Sea and adjacent waters have fallen from 55,700 tonnes in 2003 to 2,000 tonnes in 2008, and catches of deepsea redfish from 100,300 tonnes to 30,100 tonnes over the same period. The number of Icelandic vessels taking part in the fishery has dropped from 26-27 to 12 in less than a decade. Norwegian

catches in the redfish fishery in the Barents Sea and the Norwegian Sea have remained fairly stable in recent years, hovering between 4,500 and 9,000 tonnes, but only a handful of Norwegian vessels have taken part in the fishery. The Greenland halibut NAFO fishery has also declined. In 2008, only 14 Spanish trawlers took part in the fishery, whereas in 2005 the fleet counted 35 ships. In 2007, there were 13 Portuguese trawlers taking part in the fishery.

#### Employment (sub-task 3.1.3)

The total employment of the artisanal fleets of the Mediterranean countries can be estimated at 1,150-1,200. The Greek fleet is estimated to have engaged around 550 individuals in recent years, the voracera fleet 350-400 and the Sesimbra fleet 230.

The Irish longliners and trawlers had on average a crew of 8-10, and the fleet in 2005 probably only employed around 50 seamen. The largest French trawlers usually command a crew of 14-15, while smaller vessels employ 7-9. The seven vessels active in the deepwater fisheries in recent years have thus probably employed around 100 individuals. The UK fleet employed 93 workers in 2007 and the Spanish Basque country fleet around 50 in 2005.

Employment in the Icelandic fleet engaged in the redfish fishery probably totalled around 350 seamen in 2007, while the Norwegian fleet probably employed a third of that. The combined crew of the large Portuguese and Spanish off-shore fleets can be estimated at 500 and 650 members respectively. Taken together all the industrial fleets can thus be estimated to have directly employed around 2,000 individuals in recent years, all males.

Some kind of a share system is the most common remuneration method in all fisheries. In boom times when catches are good and/or prices high, wages will therefore be high and the fishery an attractive way of living. In other times, when catches and/or prices are low the fishery may find it difficult to man the vessels taking part in the fishery.

#### Processing and markets (sub-task 3.2.2)

Catches of the artisanal fleets are usually sold in open auctions in the port of landing for direct consumption or further processing. The black scabbardfish is though sold fresh or frozen, with most of the catches bought by large distribution stores, while only a small portion is sold in the local market.

As France is the most important European market for deep-water fish products, catches of the Irish, UK and France deep-water fleets are usually transported to France and sold there in auctions or at auction prices. Limited processing takes place in Ireland and the UK, but transport and logistic facilities have been developed in British Isles for swift transport to the continent. In 2006, there were 324 companies active in the French fish processing and marketing sector, and the sector employed a total of 18,500 individuals and a turnover of 1,703 million euros. Most of the firms are located in coastal areas.

Trawlers in the large Icelandic, Portuguese and Spanish industrial fleets usually freeze their catches on-board and the products are then usually exported. Norwegian catches of redfish are either exported frozen or fresh, with exports of the latter having increased in recent years.

#### Economic performance (tasks 3.1 and 3.2)

The financial performance of the deep-water fleets, or segments to which these vessels belong, varies considerably, both between fisheries, as well as between years.

The Irish orange roughly enjoyed huge profits at first, but their performance deteriorated thereafter. In 2005-2007 the fleet was though operated with profits. The French fleets were run with losses in 2005-2008, except the smaller vessels (24-40 meters) in 2007. The UK fleet has generally experienced profits in recent years, whereas the Spanish Basque country fleet has most often in the last few years been operated with losses. The Spanish NAFO fleet and Norwegian fleet have both enjoyed decent profits, but the Icelandic deep-water fleet appears to have constantly outperformed the other industrial fleets.

Information on the artisanal fleets is limited. The trawl vessel segment of the Greek fleet though appears to have been doing quite well, and the Portuguese black scabbardfish fishery has also enjoyed profits in recent years.

#### Modelling (task 3.3)

Most of the NE-Atlantic and Namibian deep-water fisheries tell a similar story of good harvests in the beginning of the fishery and then a fairly steep decline, resulting in small or even zero TACs. To analyse this development three kinds of models were constructed: a basic theoretical model that was not applied to any fishery, but intended to throw light on the general development of deep-water fisheries, and two bio-economic models that were applied to specific fisheries in two of the case studies of DEEPFISHMAN.

### Theoretical model

In order to set the stage, a generic model was developed that may be used to analyse deep-water fisheries in general. The model is a standard aggregate bio-economic fisheries model. In a competitive setting, the results indicate that the higher the price of landings and the lower the harvesting and fixed costs of the fishery, the more likely that the competitive fishery will exhaust the biomass. In general, for any fishery including deep-sea ones, there is a certain biomass level (possibly zero) at which point profits from fishing will be zero. It follows from this that the higher the minimum viable biomass of the stock the more likely it is that the competitive fishery will exhaust the biomass. The model also reveals that although an equilibrium may be reached, the equilibrium will be unstable if the associated biomass is less than or equal to a certain critical biomass level.

Further, it was shown that if the marginal biomass growth of the stock in question is low enough and/or the rate of interest high enough, no sustainable equilibrium will be optimal. In that case, the optimal policy is simply to exploit the fishery until it is no longer profitable. Unlike mines and non-renewable resources, which may be exhausted, the optimal policy for deep-sea fish resources would in general not be to completely exhaust the stocks. Instead, it might for instance be optimal to introduce rotational fishing, where the biomass is fished down to a certain level and then allowed time to recover without any fishing taking place.

The model indicates that when there is no management both aggregate harvests and profitability are likely to evolve in a cyclical fashion. Aggregate harvests reach a maximum soon after the beginning of the fishery and then evolve cyclically, and profits are highest at the very outset and then evolve cyclically averaging zero over time. These theoretical predictions seem to be largely confirmed by the experience of the deep-sea fisheries in DEEPFISHMAN case studies (see deliverable D3.2 for further details).

### Applied models

In order to analyse the deep-water fisheries further, two models were developed for the French and Icelandic fisheries (task 3.3, see D3.3 for further details). The model of the French fishery is a spatially- and seasonally-explicit bioeconomic model with three fleet dynamics processes built in endogenously, i.e. fleet capacity changes, fishing effort allocation shifts and fishing efficiency creeping. For the purpose of investigation, the model was then applied to the complex French deep-sea fishery to west of the British Isles. This comprised a medium depth demersal stock, i.e. North Sea saithe (*Pollachius virens*), and a mix of deepwater species. The model was run over a ten-year period (1999-2008), where the biological, harvest and economic data were available and then contrasted with a forecast.

The best overall fit was achieved where effort allocation was determined 80% by traditions and 20% by economic opportunism, and where fishing efficiency creeping was set at around 8% a year. With this fleet dynamics parameterisation, annual trends in fishing effort and profit were well reproduced by the model over the whole time period. Time series of the observed fishing effort by métier were generally well fitted by the model over the period 1999-2003, but less so over 2004-2008. The model also reasonably reproduced the catches by species over most of the time series, except for black scabbardfish.

Not many studies have attempted to validate comprehensively the simulated outcomes of fisheries bio-economic models at a fine spatial and seasonal scale. In that respect, it is perhaps comforting that the catch and effort forecast were reasonably close to observations over the first five years of the simulated period. It is also important to stress that while the results obtained are likely specific to the case study, the framework developed here could in principle be applied to any mixed fishery, for which sufficient biological and economic information is available to parameterise the underlying model. A key step forward will then be to use this model within a management strategy evaluation

framework. That would require to integrating in the model those processes that have been here treated as endogenous, either by making the process explicit (e.g., stock-recruitment relationship, harvest control rule, stock assessment, price elasticity function, competition between fishing fleets), or through sensitivity analyses when information is insufficient, and also to build in uncertainty adequately.

A different model was assembled to analyse the Icelandic pelagic redfish fishery in the Irminger Sea and adjacent waters. Icelandic freezer trawlers have exploited the shallow pelagic redfish stock in the Irminger Sea since 1989, and the deep stock since 1991. Catches from the shallow stock have rarely exceeded 10 thousand tonnes per year, but the deep stock fishery yielded harvests of 40-50 thousand tonnes in the 1990s. Harvests in recent years have though only been a quarter of that. The shallow stock has seriously declined and most of the nations previously engaged in the fishery are party to a ban on fishing from that stock. The deeper stock is in far better shape although recent TACs are much smaller than those set a decade earlier.

For this fishery, a simple bioeconomic model was developed which made it possible to compare results obtained in a wholly deterministic model to those obtained when allowance was made for uncertainty and/or stochasticity. Uncertainty here referred to cases where parameters, such as carrying capacity and harvesting costs, are fixed but unknown, while stochasticity refers to event that are truly stochastic in time, such as stock biomass and output price. For each scenario, the model was run under the assumption of optimal sustainable yield (OSY), maximum sustainable yield (MSY) and maximum economic yield (MEY). OSY was assessed by determining the paths of harvests and biomass that led, using a simple feedback rule, to the highest present value from the fishery.

In the case of the shallow stock, the results indicate that the present value of profits is very similar in a completely deterministic setting to profits in the scenarios where allowance is made for incomplete knowledge of the carrying capacity and harvesting costs, but lower than when either biomass growth or prices are assumed to follow a stochastic process. These results do, however, not carry over to the deep pelagic stock. Here, the present value of profits is smallest in the deterministic model under OSY, but not when the management strategy is based on either MEY or MSY. The results for the deep stock appear to be much more sensitive to the model specification.

Comparison of actual harvest to simulated harvests for the years for which good estimates of stock size exists shows that in the case of the shallow pelagic redfish fishery it would have been more profitable to harvest more in the early years and less – or nothing – in more recent times. This would have allowed the Icelandic fleet to exploit the shallow stock more heavily while the stock was still large. Because stock assessments of the deep stock have not been carried out as frequently as surveys of the shallow stock, there are far fewer data points for similar comparisons. However, model simulations indicate that actual harvests have always exceeded optimal harvests.

The decline of the shallow stock has to a large extent been blamed on changes in the ocean environment. These changes have, however, not been fully understood. The model abstracts from environmental changes, but rather assumes that the development of the size of stock only depends on harvests, natural mortality and growth. The results from the model reflect these imperfections.

Incorporating these environmental factors in the model is a daunting task, but would of course make the model much more realistic and make it possible to trace out the effects that such shocks would have on stock size and harvests.

Overall in work package 3 all the intended work was achieved, the economic framework was studied under task 3.1. The overview the economic management measures (Deliverable 3.1) was carried for all case studies, while it was only schedule to do for a subset of selected case-studies. The manuscripts scheduled in Deliverables 3.2 and 3.3 were delivered. At least two scientific papers are being submitted to the DEEPFISHMAN special issue to be published in 2013 and the model for the French fishery is submitted to the Canadian Journal of Fisheries and Aquatic Science.

#### WP4 Development of appropriate assessment methodologies

The objectives of this work-package were to review and evaluate the appropriateness of a range of assessment methods currently in use for deep-water fish stocks and to develop novel tools for assessment. Importantly, the research looked beyond the boundaries of traditional single-species stock assessments and encompassed more holistic ecosystem-based approaches.

The tasks of this work package were to:

T4.1 Review alternative assessment method available for deep-water stocks

T4.2 Identify strengths and weaknesses of assessment methods currently used in case study stocks

T4.3 Identify and develop suitable and novel assessments for EU deep-water species

T4.4 FLR suite of assessment methods for use in data poor situations

Since the aim of stock assessment is to evaluate the abundance of the population and current level of exploitation status, WP4 was closely linked with the development of reference points/directions and harvest control rules (WP5). The work was also closely integrated with WP6 and WP7.

A global review (task 4.1) identified the assessment and management approaches currently being implemented for deepwater fisheries and highlighted the need for the development of techniques that allowed a more sustainable exploitation of vulnerable deepwater stocks. The main problems associated with existing assessment approaches were due to: i) data limitations, ii) the use of methods that failed to take advantage of other useful sources of data, iii) violations of the underlying model assumptions and/or iv) high uncertainty associated with the assessment (due to poor knowledge of the biology and/or fishery). The main outcomes of the review work were published in combination with reviews of biological reference points and Harvest Control rules (HCRs) carried out in WP5 (Edwards et al. 2012).

Much more effort than scheduled was focussed on the development of new and alternative methods (Task 4.3 and 4.4) in relation to both obvious needs and availability of data following the work carried out in WP2, the natural lengthening of time-series and new data collected e.g. under the DCF in EU waters. These new methods were specifically formulated to accommodate the issues common to deep-water fisheries with the result that they provide several promising approaches to improving the robustness and reliability of the assessments of data-poor stocks and are given particular emphasis below. The assessment method developed are mostly coded in R. A stock reduction Analysis (SRA) was coded in FLR and was used for assessment purpose of the blue ling stock to the West of the British Isles in 2012. Lastly an FLR training course was provided by DEEPFISHMAN (Task 4.4) in the framework of ICES training courses on 26-27 March 2012 at ICES headquarters. Overall all the tasks in WP4 were achieved. Considerable progress in the assessment of deep-water stocks was made. In particular, a range of suitable assessment models were tested, new assessment methods were developed and some are already in use by ICES. The work carried out includes innovative spatially explicit statistical modelling and the development of a realistic spatial simulation framework.

Main assessment methodologies developed within WP4.

Effect of accounting for discards in the assessment of the roundnose grenadier stock

The effect of including discards in the catch at age of roundnose grenadier (*Coryphaenoides rupestris*) in the Northeast Atlantic fishery, was investigated using a separable virtual population analysis (SVPA). However, because of the lack of discard data for many of the years covered by the study (1990-2008), the catch data used as input to the assessment model had to be reconstructed from the available information (landings, discards, fishing effort and bathymetric distribution of the stock) using two methods. The first method relied on the assumption that the recent length distributions of discards were applicable to the earlier years (1990-1997) and resulted in unrealistic bimodal length distributions, suggesting a change in discarding practices through time, with larger individuals being discarded in the early days. The second method, based on the fishing effort and length distribution by depth strata, produced unimodal distributions for the whole period and confirmed that the average length of discarded fish was higher in the early days of the fishery. Although, this study acknowledged that SVPA will not be the most appropriate assessment model for roundnose grenadier in the future owing to short time series, changing fishing strategies such as changing fishing depth over time and uncertainties in age estimations, it demonstrated that including the discards in the data used for assessment may not change much the estimated stock trends (Pawlowski and Lorange, 2009).

Standardisation of LPUE using fishers tally-book data (discrete time)

Logbooks (tallybooks), from the French deep-water fishery to the west of the British Isles, were used to calculate standardized blue ling (*Molva dypterygia*) landings per unit effort (LPUE) for the period 2000–2008 (Lorange et al. 2010). To investigate how to track stock trends reliably, LPUE values

were estimated in five areas for different subsets of the data. The subsets consisted of hauls during the spawning season (when blue ling aggregate), outside the spawning season, and hauls in which blue ling was only a bycatch. The results suggest that blue ling LPUE values have been stable over the period 2000–2008, and that the declining trend previously observed for the stock has been halted. This finding is consistent with stable mean lengths in the landings during the same period and is even more confirmed by an increase in subsequent years.

The same approach was applied to roundnose grenadier and black scabbardfish (*Aphanopus carbo*) and the calculation of biomass indices at stock level were developed by Lorance et al. (2011). For all three species, the depth and area effect were significant. These studies demonstrate the greater suitability of haul-by-haul data than EC logbook data for deriving abundance indices for deep-water stocks. These time-series of LPUE are considered to be the most reliable indices of relative abundance for the three studied species.

#### Standardisation of LPUE using fishers tally-book data (continuous time)

The continuous space-time distribution of blue ling to the West of the British Isles was modelled using catches per haul from commercial fishing vessels. Generalised additive mixed models (GAMM) were used to separate fishing strategy effects (haul duration, fishing power, fishing location) and species biology (depth preferences, spawning season) from population dynamics. The results confirmed that blue ling in the study area increased slightly over the period 2000-2008 and suggested that no local depletion occurred (Augustin et al. in press).

#### Testing Assessment Methods for Data Poor Deepwater Stocks

A data simulator in FLR was used to create simulated stocks with plausible life history characteristics for four deepwater species blue ling, blackspot seabream (*Pagellus bogaraveo*), black scabbardfish and roundnose grenadier. An operating model was used to project these stocks forwards through time under a range of different fishing scenarios and observations with noise. Five different assessment models: Surplus production, Bayesian surplus production, stock reduction analysis (SRA), XSA and Multi-year catch curves (MYCC) were tested as the operating model of which the Bayesian model performed best in terms of providing estimates of stock biomass that best approximated the simulated data.

#### Multi-Year Catch Curve model (MYCC)

A Multi-Year Catch Curve model was developed for the simulation of annual values of total mortality ( $Z$ ) and recruitment from proportions-at-age and total catches for the stocks of roundnose grenadier and blue ling to the West of the British Isles (Trenkel et al., 2012). Following the presentation of the model at ICES, this method is now used for regular assessment of the stock of blue ling.

#### State-space spatial life-stage model for black scabbardfish

A state-space model was developed to describe the dynamics of the subpopulation of black Scabbardfish in ICES Division IXa. The main objective was to evaluate the plausibility of the underlying hypothesis proposed for the dynamics of the species in the NE Atlantic area.

#### GADGET modelling

GADGET (Globally applicable Area-Disaggregated General Ecosystem Toolbox) was used to investigate the dynamics of beaked redfish (*Sebastes mentella*) in the Norwegian and Barents Seas and blue ling in Icelandic waters (DEEPFISHMAN case study 4).

#### Beaked redfish

An artificial dataset developed in DEEPFISHMAN will be included in FLR in order to provide a range of data for use in testing assessment models in the JRC research initiative “a4a” initiative (Assessment for All, <https://fishreg.jrc.ec.europa.eu/projects>). The suite will include a range of life histories, from forage fish through to long-lived species where the redfish case from DEEPFISHMAN will form the long-lived part of this suite. The DEEPFISHMAN redfish model is also used within the "balanced fishing" paper presented at the ICES/PICES Symposium on “Forage fish interactions: Creating the tools for ecosystem based management of marine resources”, Nantes, France, 12-14 November 2012 ICES/PICES. The model is used in the analysis of the impacts of non-selective fishing on a range of different life histories within the Barents Sea. This work will be submitted to the ICES/PICES special issue.

#### Blue ling

GADGET was used for the assessment of blue ling in Icelandic waters. The model was able to follow trends in survey indices reasonably but failed in fitting to the limited age structured data. This model was used for regular ICES assessment in 2012 to estimated relative, rather than absolute, trends in biomass and fishing mortality.

#### Modelling of in-season variations of abundance

A model taking account of seasonal events in abundance was developed for greater forkbeard (*Phycis blennoides*) to the west of the British Isles. This work was presented in an ICES benchmark. The approach did not reveal appropriate for this stock but it was further developed for a shelf species (Roa-Ureta, 2012). This suggest that ideas and approaches developed for deep-water stock may be of interest in a wider context and contradicts the traditional approach which tends to start from models used in the best documented and data-rich situations and apply them to data limited situations.

#### Pseudo-cohort Analysis and surplus production model: exploratory stock assessment of blackspot seabream in Eastern Mediterranean

The fishery for blackspot seabream, in the East Ionian Sea was no assessed prior to DEEPFISHMAN. Pseudo-cohort analysis and surplus production model were used to generate estimates of fishing mortality and stock numbers. The results indicated that the immature individuals were not subject to the same intensive fishing pressure exerted on older age-groups. The models suggested that the level of exploitation in 2008 was within the sustainable limit but the stock was over-exploited between 2005-2007 (to be submitted to the DEEPFISHMAN special issue).

#### Spatial Assessment Testing Framework

This investigation explored the benefits of protecting older fish and how spatial management can be used to adjust the age structure and improve the sustainability of the catch (productivity). A non-spatial equilibrium model accounting for biomass growth, mortality and recruitment was used to describe the relationship between mean age of the population and productivity for the South African deepwater hake *Merluccius paradoxus* trawl fishery (Edwards et al. 2011). Results indicated that management measures capable of increasing the mean age at which fish are caught may be of benefit. Furthermore, although the contribution of older fish to recruitment was important, the biomass growth of individuals before they are caught is responsible for the most significant productivity benefit of an older population age structure.

#### Testing community-level Indicators for future Integrated Ecosystem Assessments

A novel size-structured multi-species community model was constructed for 49 deep-sea fish species from the Northeast Atlantic continental slope off the West of Scotland (Blanchard et al., 2012). The model was used to establish reference-levels of several community indicators in the absence of fishing. The modelled overall community size spectrum slope and % of elasmobranchs were consistent with empirical indicators sampled prior to the period of intensive fisheries exploitation in the same region. By testing a range of fishing scenarios that correspond to recent ideas about sustainable fisheries and balanced harvesting, it was possible to demonstrate trade-offs in conservation and fisheries management objectives in deep-sea fisheries. The results provided the first steps towards reducing the uncertainty about the ecosystem-effects of multi-species fisheries on deep sea fish communities.

#### Other methodologies

The Stock Reduction Analysis (SRA) was recoded in FLR and applied to blue ling, this assessment model was used in addition to the MYCC for stock assessment in 2012. Spatial indicators for multi-species commercial catch were developed for the multi-species case study of the project (DEEPFISHMAN case study 2, demersal deep-water mixed fishery to the West of the British Isles, Trenkel et al. 2012). A statistical catch at age model was use to reconstruct the time-series of redfish recruitment in the Norwegian and Barents Sea and was further developed to allow a quantitative assessment of the total stock in 2012 (Planque et al., 2012).

#### WP5 Reference points and HCRs

The objectives of this work-package were to examine and develop appropriate reference points and harvest control rules for deep-water fisheries in the Northeast Atlantic, including indicator-based

approaches for evaluating stock status. This work was fully integrated with WP4 on the development of assessment methods and closely connected with the development of indicators to support an ecosystem approach (WP6) and management strategy evaluation (WP7).

Work package 5 included the following tasks:

- task 5.1 Global review of candidate biological and economic reference points
- task 5.2 Reference points and harvest control rules for case study fisheries/stocks
- task 5.3 The design of harvest control rules for case study deep-water species and systems

A comprehensive review (task 5.1) of candidate indicators, reference points (RPs) and harvest control rules (HCRs) used for deep-water/data poor species revealed very few instances where RPs or HCRs had been applied to deep-water fisheries, even in a global context (Edwards et al. 2012). In task 5.2, indicators, RPs and HCRs for each of the case studies were reviewed and appropriate ones were defined (deliverable D5.2). Areas for further development were identified. Testing of HCRs was carried in out in relation to WP7 (e.g. Marchal and Vermard, in prep. see D5.3; Garcia et al., 2012). Taks 5.3 focused on the development of empirical trend-based HCRs, precautionary reference points based on alternative sources of information such as life history theory and spatial information, combined with the use of simulation methods to develop and test reference points, harvest control rules and overall management strategies in order to improve monitoring and management of deep-sea fish and fisheries in the future.

Global review of common approached to fisheries assessment and management of deepwater and data-poor stocks.

The review identified current assessment and management approaches for deepwater fisheries and data-poor stocks and proposed some new approaches that might be suitable in the future. The review included a critical analysis of the use of:

- Simple Indicators of Stock Status - Indicators of Relative Abundance and Indicators based on Catch Size Structure
- Aggregated Biomass Models - Depletion Methods and Biomass Production Models.
- Structured Population Models - Catch Curve Analysis, Cohort Disaggregated Models, Virtual Population Analysis (VPA) and Integrated Assessment Methods

Given the limitations in the data, the review highlighted the importance of adequately representing uncertainty in assessment results and emphasised the need for management decision mechanisms that were robust to an incomplete picture of resource dynamics. This required the construction and testing of harvest control rules within a simulation framework. For deepwater stocks where only relative changes in biomass could be discerned from the data, the review recommended that a simple empirical approach with uncomplicated harvest control rules was adequate for management.

Review of the strength and weaknesses of current Biological Reference Points, Harvest Control Rules and indicators for case studies

New and revised BRPs and HCRs were developed (where required) for each of the DEEPFISHMAN case studies. The results are best summarised in table 1 supplied as attached document.

Table 1 Review of the strength and weaknesses of current Biological Reference Points, Harvest Control Rules and indicators in DEEPFISHMAN case studies

Suitable Harvest Control Rules for EU fisheries and Biological Reference Points for Management Strategy Evaluation in WP7

A series of Harvest Control Rules and Biological Reference Points for selected case studies were identified for further testing using Management Strategy Evaluation in WP7. The proposed Operating Models, Assessment Models, HCRs and BRPs for each case study are summarised in table 2 supplied as attached document. Saithe, *Pollachius virens*, was included here because of the technical interaction between fishing for saithe and deep-water species, see Marchal and Vermard in D5.3).

Table 2. Suitable Biological Reference Points (BRPs and Harvest Control Rules (HCRs) for EU fisheries for introduction in Management Strategy Evaluation in WP7

## WP6 Trends in biodiversity

This work package was lead by Ifremer with a significant contribution from MRI, Cefas, HCMR and IPIMAR. Reviews of knowledge and data on biodiversity were made in each case study in work package 2 and further data analyses were carried out in this work package 6.

The work package included five tasks:

Task 6.1: Review of the impacts of deep-water fishing on biodiversity

Task 6.2: Explore trends in biodiversity in time-series catch data from fisheries on the continental slope.

Task 6.3: Explore trends in biodiversity in deep-water survey data

Task 6.4: Trends in invertebrate diversity

Task 6.5: Identify biodiversity indicators from catch data, on-board observations and survey data

The five tasks were completed. Reviews of the impacts of deep-water fishing on diversity (task 6.1) were made in conjunction with work package 2. Four review documents are available on the DEEPFISHMAN wiki. Trends in biodiversity in time-series catch data from fisheries on the continental slope (task 6.2) were carried out based upon haul-by-haul and on-board observations data. Trends in deepwater survey data (task 6.3) were investigated in several areas and case studies (CS): Irish waters (CS1b), Eastern Ionian Sea (CS3b), West of Portugal (CS3c), Icelandic waters (CS5) additional analyses were carried out in the Bay of Biscay (CS3a). These analyses have been finalised and articles are submitted or in preparation for the DEEPFISHMAN special issue. Trends in invertebrate diversity (task 6.4) have been analysed as part of deliverable D6.2. These studies have also given rise to work in connection with the project CoralFISH and have been passed to WP7 and used in the proposal for the monitoring and management framework. The identification of biodiversity indicators from catch data, on-board observations and survey data (task 6.5) was addressed for several studies, as reported in deliverable D6.1 and D6.3. Additional studies have been carried out, including an analysis of trade-offs in the management of the blue ling fishery to the West of the British Isles. This analysis showed that management measures taken to protect blue ling from overexploitation may have negative impact on other ecosystem components including the seafloor and deep-water sharks (Lorance, P., Figueiredo, I., Laffargue, P., and Moura, T. 2012. Continental slope fisheries and conservation of vulnerable fish species and deep-water benthic communities: Implications for management. . 7th.- 11th May 2012. World Fisheries Conference 2012, Edinburgh, Scotland).

In this section a few examples of the biodiversity studies carried out in WP6 are given. The relevance of indicators defined in the Data Collection Framework (DCF) and in the Marine Strategy framework Directive (MSFD) was investigated in the case of the Irish Deep-water survey (Dransfeld et al., 2012). The Irish deepwater survey has been conducted between 2006 and 2009 and covers ICES Divisions VIa and VIIc. Three areas (Figure 1, see attached PDF) and four depths (500, 1000, 1500 and 1800 m) were studied. The survey was coordinated with the Scottish deepwater survey which covers the slope further North in Division VIa. The DCF indicators Conservation Status of Fish (CSF) and Proportion of large fish (PLF) were calculated as well as total abundance, total biomass and Shannon species diversity (H'). The abundance and biomass of some species and groups such as sharks were also calculated. The results for sharks are taken here as an example of a result that has some significance for fishery management. Twenty one species of sharks were caught in the survey, two of which *Somniosus rostratus* and *Oxynotus paradoxus* as a single specimen. For all sharks taken together, there was a highly significant depth effect in the catch in number and weight (Figure 2). This effect varied slightly but significantly by areas for the weight caught but not for numbers. Lastly, there was not year effect also the number and biomass of sharks in the last year of the survey.

Figure 1. Areas studied in the Irish deep-water survey.

Figure 2. Box-plots of log-numbers (top) and log-weight (bottom) of sharks caught in the Irish deep-water survey by area (left), depth (middle) and year (right).

This study provided several other important results, in terms of distribution of species diversity, abundance and biomass as well as significance of standard indicators.

New results in terms of distribution patterns of fish diversity were obtained from the time-series of the Icelandic deep-water survey and the MEDITS bottom trawl survey in the eastern Ionian Sea (Greek waters). Using the Icelandic survey data, correlative modelling of fish diversity against abiotic variables was used to address two main questions: how do fish communities respond to environmental gradients; and area there generalised responses in fish diversity that would be sufficiently predictive for use in fisheries management in data-poor regions of the deep-sea? Significant responses of diversity to temperature, bottom depth, slope, near bottom current speed and surface primary production were found. However the direction and shape of the response depended on the diversity index used, i.e. comparing Species Richness, Shannon diversity and Taxonomic Diversity (Figure 3). The finding of significant effects of the other variables than depth and temperature on the deep-water fish community is novel. Two elements may have allowed to identify effects previously unnoticed (1) the availability of a time-series with a high number of haul carried out in standardised protocols since 1996 and (2) the use of global marine environment data repositories to extract environmental variables.

Figure 3. Generalised Additive Model (GAM) partial plots for the Southwest Iceland slope fish community (top, species richness; middle Shannon Diversity and bottom taxonomic distinctness diversity index).

In the Mediterranean Sea, the analysis of the patterns of fish diversity showed that depth and location were the main factors of the observed fish diversity. However, for some diversity metrics, including length metrics temporal (year) and/or fishing effort effects were found. In this area, the fishing effort is estimated to have decreased over the study period (1998-2008) and this may have allowed for an increase in biomass, abundance, species richness and maximum size at sampling station (haul) scale.

Figure 4. Estimated smooth terms of the parameters contributing to the selected GAMs for metrics of the total fish community in the eastern Ionian Sea.  $\ln(B_i)$ : natural logarithm of biomass;  $\ln(N)$ : natural logarithm of abundance; for definition of the remaining metrics see text. Diagonal dashed lines indicate alternative models. Grey areas are 95% confidence intervals. Temperature: natural log transformed values of temperature. Rug plots indicate the distribution of the observed values.

These results from Irish, Icelandic and Greek waters are part of studies presented at the joint CoralFISH-DEEPFISHMAN Symposium "The scientific basis for ecosystem based resource management and monitoring in the deep-waters of the Mediterranean & North Atlantic", Galway, 28- to 31 of August.

#### WP7 management strategy framework

This work package was led by AZTI-Tecnalia with a significant contribution from Cefas and UoI, Imperial college of London and UoP/CEMARE, a workshop was organised in Bilbao, from 15 to 17 November 2011, in order to assure the consistency between the definition of the Management Strategy framework and the assessment methods developed in WP3, WP4 and WP6 and to optimise the integration of all the work carried out in DEEPFISHMAN into the WP7. In addition IFREMER had a larger than scheduled contribution to WP7 with the development of two Management Strategy Approaches (see below).

The two objectives of WP7 were:

- to define case study management strategies, both in the short and long term, in order to evaluate the biological, bioeconomic and ecosystem implications of these strategies and to perform management strategy evaluation (MSE) for selected case studies.
- to develop a prototype short and long-term management and monitoring framework for deep-water fisheries/stocks.

Work package 7 included three tasks:

Task 7.1. Definition of management strategies

Task 7.2 Management Strategy Evaluation (MSE)

### Task 7.3 Prototype short- and long-term management and monitoring framework for deep-water fisheries and stocks in the NE Atlantic

All three tasks were lead by AZTI-Tecnalia

For the first objective, the management options and monitoring data were reviewed, existing and new options for management strategies were identified, including by stakeholder consultation (task 7.1). The strategy management options have been tested by MSE using FLR, the spatially explicit simulation platform ISIS-fish and qualitative modeling (task 7.2). The tool FLBEIA developed as an R package was tested in three selected case studies with different characteristics:

- Blackspot seabream in the strait of Gibraltar as an artisanal mono-specific and single fleet fishery;
- Blue ling mixed and multifleet French fishery in VIa, VII and XIIb,
- Redfish in I and II as an example of data rich stock.

The multi-fleet and multi-stock characteristics of the FLBEIA Tool has allowed in each case study to define (as a preliminary approach) the management strategies in the short and long term for these stocks. To do this, for each case study several scenarios were defined combining the specific Harvest Control Rules, fleet dynamics, observation and assessment models and management advice in order to evaluate the biological, bioeconomic and ecosystem implications of the management plans.

A spatially-explicit bioeconomic modeling framework to evaluate management strategies, building in both data-rich and data-limited harvest control rules, for DEEPFISHMAN case study 2. Trends in catch per unit effort were used as a surrogate for stock abundance variations, either to tune stock assessments, or to trigger directly management action. This approach differs from that developed using FLBEIA in that it is spatially structured, using The ISIS-Fish simulation platform.

Lastly a framework for qualitatively evaluating fisheries management plans, both rebuilding plans and others, which allows a first rapid appraisal before any quantitative analysis was developed. The framework includes three steps: 1) assessment of the sustainability of the objectives of the plan, 2) assessment the theoretical chance of success using qualitative analysis of a bio-economic model, and 3) assessment of the expected operational success using empirical rules derived from the literature. The framework has been demonstrated for evaluating the management measures currently in place for the roundnose grenadier stock exploited to the west of the British Isles (DEEPFISHMAN case study 2). The results of these development were presented in the joint CoralFISH-DEEPFISHMAN Symposium The scientific basis for ecosystem based resource management and monitoring in the deep-waters of the Mediterranean & North Atlantic, Galway, 28-31 August, they are included in Deliverable D7.5 and scientific papers are submitted to journals.

Further details of the MSE carried out under FLBEIA are given in the section "Development and test of FLBEIA" below. Details of the ISIS-FISH and the qualitative modelling approaches can be found in deliverable D7.5, which includes 3 manuscripts to be submitted to the DEEPFISHMAN special issue in Aquatic Living Resources (MSE using FLBEIA from Garcia et al.); to Canadian Journal of Fisheries and Aquatic Sciences (MSE using ISIS-Fish from Marchal & Vermard) and Fish & Fisheries (Qualitative Modelling from Trenkel et al.).

The second objective was achieved in task 7.3 by the preparation of an extensive document presented in the Deliverable 7.4 that describes the Guidelines towards a prototype management and monitoring framework for deep-water fisheries/stocks in the NE Atlantic. This document was constructed from several sources outputs and knowledge gained from (i) deliverables from the various DEEPFISHMAN Work Packages, (ii) feedback from a European Commission review (EC, 2009a) of the current EU Deep-sea Access Regime (EC, 2002), (iii) the requirements of EU Regulations and developing policy, (iv) a DEEPFISHMAN review (D2.3) of the management and monitoring regimes applying in the north-west Atlantic, the south-east Atlantic, off Brazil, in the Antarctic, off Australia and New Zealand and in the Mediterranean, (v) outcomes from consultations with stakeholders in the deep-water fishing industry in the NE Atlantic (vi) information on the strengths and weaknesses identified in the existing management and monitoring of DEEPFISHMAN case study stocks/fisheries and (vii) relevant information from other DEEPFISHMAN Deliverables (a brief account of the guidelines are given in the section "Guidelines towards a prototype management and monitoring framework" below).

#### Development and test of FLBEIA.

FLBEIA is an R package build on top of FLR libraries. The purpose of the library is to provide a flexible and generic tool to conduct Bio-Economic Impact Assessments of harvest control rule based

management strategies under a Management Strategy Evaluation Approach (Punt and Donovan, 2007; Rademeyer et al., 2007; De la Mare, 1998). This approach is widely used in fisheries modeling and management to evaluate the performance of management strategies taking into account the main sources of uncertainty present in the fishery system. It consists in simulating the real fishery system together with the management process. The simulation is divided in two big blocks, the Operating Model (dotted area in figures 5) and the Management Procedure (solid grey area in figures 5). The Operating Model (OM) represents the real fishery system formed by the stocks, the fleets and the covariables in FLBEIA. The Management Procedure Model (MPM) simulates the whole management process starting with data collection, followed by the assessment model and ending with the management advice. In this way, when a management strategy is tested, the management advice is not given based on the population simulated in the operating model (the real population as referred in MSE literature) but on the population estimated by the assessment model in the management procedure (the observed population as referred in MSE literature). Thus when the goodness of a management strategy is evaluated, not only the strategy itself is evaluated but also its performance in combination with the data collection and the assessment model.

The model is multi-stock, multi-fleet and seasonal and uncertainty is introduced by means of montecarlo simulation. The covariables component allows introducing variables of interest not present in biological and fleets components. For example it could be used to introduce relevant ecosystem components in a simple way.

The uncertainties in fishery systems were described and categorized in 6 groups, three of them relate to the dynamics of the real fishery system process, implementation and institutional uncertainty and the other three to the accuracy in the management process, observation, model and estimation uncertainty.

The algorithm has been developed in a modular way to ease checking and debugging but principally to allow its extension. It has been used a top-down approach as shown in Figure 5. The rectangles represent models and the ellipses particular blocks within a model component.

The rectangles in grey indicate that the corresponding function is fixed within the algorithm and the ones in white are chosen by the user. The user can choose among existing functions or develop new ones. The Covariables of the Operating Model is thought to accommodate variables relevant to fishery system that are not included in the biological and fleet data containers. It is expected for these variables to be dependent on specific problems and/or case studies. The Management Procedure runs annually and it mimics the management process as it is done in reality. It has three components, the observation model, the assessment procedure and the management advice. The observation model simulates the data stock by stock and it simulates two kind of data, on the one hand it simulates catch and biological data and on the other hand abundance indices. All the simulated data is generated annually despite of OM's seasonal dimension and it is done stock by stock independently. The Assessment models are applied independently stock by stock in order to obtain estimates of abundance and/or exploitation level of the stock. Any assessment model coded in R and which input data can be generated based on the data simulated in the OM can be used. FLBEIA does not include any assessment model. The management advice is generated by means of the harvest control rule (HCR). The advice in the HCR could be given in terms of catch or effort but at the moment only catch based HCRs are implemented.

Figure 5. Scheme showing the top-down (left-right in the diagram) structure followed in the algorithm. Rectangles represent functions/models and ellipses particular blocks within model components. Grey rectangles represent fixed models and white ones represent models that need to be specified by the user.

Guidelines towards a prototype management and monitoring framework for deep-water fisheries/stocks in the NE Atlantic

A step-wise approach has been used in the DEEPFISHMAN Consortium to address of several topics for (i) EU vessels and (ii) vessels of all nationalities fishing in the Northeast Atlantic Fisheries Commission (NEAFC) Regulatory Area (RA). A summary of the DEEPFISHMAN recommendations is given below:

Management in the NE Atlantic at the macro-level, (TACs, effort, rights#based management, etc) DEEPFISHMAN recommends that EU vessels fishing for deep-water species in EU waters and in

international waters of the NEAFC RA continue to be managed by TACs and effort/licensing. Notwithstanding, DEEPFISHMAN recommends that the TAC and effort regimes currently incorporated in the EU Access Regime should be revised in content and scope and this is addressed deliverable 7.4.

Consistent with proposed CFP reforms (EC COM, 2011), DEEPFISHMAN recommends the introduction of a system of transferable fishing rights (preferably ITQs) for EU vessels having deep-water licences. Distributed by Member States, the concessions will grant their owner an entitlement to a share of the national fishing opportunity for each year. Operators will be able to lease or trade their shares. This will give the fishing industry a long-term perspective, more flexibility and greater accountability, while at the same time reducing overcapacity. In making this recommendation the project assumes that ITQs will be tradable between fishers in different Member States, subject to the principle of overall relative stability (which we assume will remain in the reformed CFP). The project consortium acknowledges that stakeholders consulted during the project strongly opposed to an ITQ approach to management of deep-water fisheries.

DEEPFISHMAN recommends that TACs be evaluated using management strategy evaluation (MSE) where possible. MSE developments made in WP7 provide a number of options for analytical (FLBEIA) spatially explicit (ISIS-FISH) and qualitative MSE.

DEEPFISHMAN recommends that vessels of all nationalities fishing for deep-water species in international waters of the NEAFC RA should continue to be managed by TACs and effort control. However, these regimes should be revised and considerably strengthened as described later in Deliverable 7.4.

#### Definition of deep water and deep-water species

DEEPFISHMAN recommends that in the NE Atlantic deep water be defined as waters where the depth is >200 m; this is consistent with the FAO definition applied globally in all of the world's oceans.

- DEEPFISHMAN recommends that in the NE Atlantic deep-water species be defined as those which spend a significant part of their life-cycle at depths >200 m. More practically, this can be defined by >50% of adult biomass located at depths >200 m, or by >50% of expected lifetime spent at depths >200 m. Information on the depth distribution of species biomass should, where possible, be sourced from available fisheries independent survey data and, in the absence of these, time series abundance and landings data from commercial vessels and available information on the maximum and minimum depth range of species distribution. In areas of narrow shelf, this rule may need some adjustment.
- DEEPFISHMAN recommends that for EU deepsea fishing licensing purposes the species listed in Annex I and II be combined, that conger eel and Norway redfish be deleted and Greenland halibut, tusk and beaked redfish be included.
- DEEPFISHMAN recommends that tusk and Greenland halibut continue to be included in species treated as deep-sea by NEAFC, that beaked redfish is added, and that ling, conger eel and Norway redfish be removed.

#### Total Allowable Catch (TAC) management: review of the current list of species and the periodicity of TAC reviews

DEEPFISHMAN recommends that EU TACs be introduced for the following:

- o Common Mora (*Mora moro*) and the Moridae
- o Rabbitfish (*Chimaera monstrosa* and *Hydrolagus* spp.)
- o Baird's smoothhead (*Alepocephalus bairdii*)
- o Wreckfish (*Polyprion americanus*)
- o Blackbelly rosefish (*Helicolenus dactylopterus*)
- o Silver scabbardfish (*Lepidopus caudatus*)
- o Black (deep-water) cardinal fish (*Epigonus telescopus*)
- o Deep-water red crab (*Chaceon* (*Geryon*) spp.)

- DEEPFISHMAN recommends that consideration be given to allocating a specific EU TAC to beaked redfish (*Sebastes mentella*).
- DEEPFISHMAN recommends that the historical landings data for the NEAFC RA be evaluated to determine the scale and extent of landings of the species proposed for EU TAC regulation.
- DEEPFISHMAN recommends that the deep-water species managed by TACs in the NEAFC RA be revised as appropriate.
- DEEPFISHMAN recommends that EU TACs for orange roughy and deep-water sharks be

reviewed every five years.

- DEEPFISHMAN recommends that EU TACs for roundnose grenadier and beaked redfish these species be reviewed on a triennial basis.
- For all other existing and proposed deep-water species, DEEPFISHMAN recommends that EU TACs be reviewed biennially, except where long-term management plans are in place.
- DEEPFISHMAN recommends that if the range of deep-water species managed by TAC in the NEAFC RA is expanded, consideration should be given to reviewing these TACs with the same frequency as recommended above for EU TACs.

Review of TAC management units taking into account known information on stock structure  
The project reviewed the current management areas and the state of knowledge of the stock structure. Based upon this a number of recommendations for adjustment of management areas were made. Table 3, supplied as attached PDF provides examples for two species (see deliverable 7.4 for similar results for all deep-water species currently managed by EU-TAC).

Table 3. Recommendations for changes in EC management units and assessment units for roundnose grenadier and black scabbardfish.

#### Definition of deep-water fishing effort and capacity ceilings

Some VMS data were analyzed in DEEPFISHMAN. In particular UK VMS data became available by the end of the project, Irish VMS data were available for studies of the trends and distribution of fishing grounds to the West of Ireland, French VMS data were available aggregated for the French deep-water fleet by depth strata of 100 m and a spatial resolution of 10' x 10'. The data from these three countries (including data for vessels of all flags) all appeared very useful for fisheries assessment and were used in for scientific work presented at the joint CoralFISH-DEEPFISHMAN symposium. All data showed strong decreased in deep-water fishing effort since 2003, and this was interpreted as an effect of the EU-management.

The main recommendation that can be drawn is that deep-water fishing effort is estimated from VMS data as this allows an accurate tracking on fishing effort by depth. Effort management may not be required if an effective catch management is in place. In EU waters in recent years, the management of landings through TACs and quotas has probably been effective and allowed effort was not all used. However, even if it is not a management tool, an accurate monitoring of effort is essential, as accurate effort data are essential to both stock and ecosystem assessment

Management and monitoring of bycatches, discards and protected, endangered and threatened (PET) species.

Mobile PET species to consider for deep-sea fisheries are primarily deep-water sharks. There is no known significant impact of deep-sea fisheries in the North-East Atlantic to marine mammals, seabirds and marine turtles.

Fixed species are be addressed primarily in terms of VMEs and spatial management. These aspects are mainly in the remit of the CoralFISH project.

Further work is needed on deep-sea shark assessment. The ban of fisheries have reduce available data. Trends-based assessment from survey and on-board observation indicators, have been investigated in DEEPFISHMAN and are the main current way forward for assessing the status of deep-sea sharks. These have the potential to provide relative quantitative trends but no absolute assessment. A bayesian assessment model of sharks was developed in DEEPFISHMAN and will be presented in the relevant expert groups.

#### Spatial and temporal closures and technical measures

DEEPFISHMAN recommends priority should be given to fully quantitative and high resolution (spatial and temporal) assessments of both seabed habitat features and fishing pressure (effort), and research should be allocated to increasing knowledge to fulfilling an analysis of the following key elements essential for undertaking an appropriate seabed spatial risk assessment:

- Mapping of actual and predicted VME habitat and VME indicator species distributions and densities
- Mapping of actual fishing effort distribution and intensity in order to define the fishing footprint. VMS data are readily available for the deep-water where mostly large vessels operate, so it is a matter of all flag countries to be obliged to provide data
- Assessment of actual and predicted sensitivity/vulnerability of habitats and species to fishing

pressure to determine risk

- Assigning the calculated risk to a defined risk category (as outlined above)
- An evaluation of uncertainty in the risk

These aspects are mainly in the remit of the CoralFISH project, innovative habitat modelling and management approaches, including the use of stakeholder knowledge, have been shown by CoralFISH scientists in the CoralFISH-DEEPFISHMAN final symposium.

EU Data Collection Framework (DCF) and observer sampling plans

Deep-sea fishery independent surveys and monitoring regimes

For most deep-water stocks there is no adequate survey coverage. Nationally funded surveys are carried out by Norway, Faroes, Iceland, Ireland, Scotland, Portugal and Spain. Target species are Greenland halibut and deep-water redfish in the Faroe Islands, Norway and Iceland, although data for other species are also collected. The main commercial targets of the Scottish and Irish surveys are roundnose grenadier and black scabbardfish, these surveys also provide indicators for deep-water sharks and all species caught are sampled.

Only few surveys funded by DCF may give adequate coverage in space, depth or in time, the implementation of WGNEACS ICES expert group proposals for deep-water survey has the potential to produce stock-indicators for several stocks, it is depending on DCF funding.

Management of mixed-fisheries: species/fishery level

This topic summarizes several of approaches to address mixed fisheries management problems that have been developed seeking to maximize yield from a complex of species without overexploiting any one species whilst calculating foregone yields

Data-poor stock assessment methods and biological reference points (BRPs)

This topic provides a review of stock assessment methods and BRPs for deep-water stocks. It shows that stock assessment advice has greatly improved for a number of stocks in recent years and that some stocks are showing sign of recovery following the management that has been implemented since 2003.

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## Potential impact and main dissemination activities and exploitation results

### 4.8. WP8 Dissemination and outreach

This work package was led by MRI, 5 tasks were identified:

T8.1. Establishment and maintenance of public web site

T8.2. Publications

T8.3. Conferences, workshops and stakeholder for a

T8.4. Policy delivery approaches

All tasks were achieved. In task 8.1 a web site and a WIKI were developed, the WIKI was an active communication media between DEEPFISHMAN partners and with stakeholders. In task 8.2, some scientific publications are already published, a larger number are in press or will be submitted to a DEEPFISHMAN special issue of a journal. In task 8.3, in addition to the two planned stakeholder workshops at the start and at the end of the project (task 8.3), two additional workshops were held. This close collaboration to stakeholders from the beginning of the project proved fruitful for the project, in addition to the publication mentioned above, stakeholder data and knowledge were used in several project studies, in particular in WP3 socio-economic studies. Results from the project were presented in a number of conferences (see list of dissemination activities) and a final symposium was organised jointly with the project CoralFISH. In task 8.4

#### 4.8.1 Website and WIKI (task 8.1)

A website (<http://www.ifremer.fr/deepfishman>) and a WIKI ([deepfishman.hafro.is/doku.php](http://deepfishman.hafro.is/doku.php)) were launched at the start of the project. The usage of the WIKI proved to be successful to the project as an active communication and collaboration interface for external stakeholders and for project partners. The site served as a gateway for the web-based survey and questionnaire directed toward stakeholders. A section of the site was closed to public view but served as a working platform for partners (exchange of working documents, data exchange, final documents, announcements, guidelines etc.) and was actively used as such by partners throughout the project lifetime. Project documents and publications have been accessible through the WIKI. New documents, including publication will continue to be made accessible after the end of the contract.

#### 4.8.2 Publications (task 8.2)

Some scientific publications are already published in the following journals: *ICES Journal of Marine Science*, *Canadian Journal of Fisheries and Aquatic Sciences*, *Aquatic Living Resources*, *Journal of applied ecology*, *Reviews in Fisheries Science*. Open access is or will be available for the majority of these. A larger number of articles are in press or will be submitted. In particular, most of the

DEEPFISHMAN studies presented in the symposium in Galway are being submitted to a DEEPFISHMAN special issue of the Journal Aquatic Living Resources (<http://www.alr-journal.org/>).

#### 4.8.3 Stakeholders' workshops and surveys (task 8.3)

Following two stakeholder workshops and numerous informal contacts and two surveys (both web-based and face-to-face) organised during the first reporting period, an article on the use of stakeholder knowledge and data was published in 2011 (Lorance et al., 2011).

During the second reporting period, a third workshop was held in Lisbon 4th July 2011 with the aim of collecting stakeholders' contribution to a model development of a Bayesian state-space model for the assessment of black scabbardfish population. Stakeholders from the fishing sector for this species from Portugal (mainland and Madeira) and France contributed to this workshop with DEEPFISHMAN partners IFREMER and IPIMAR.

The fourth and final stakeholder workshop was held on 31st August 2012 in Galway, Ireland. This was a joint workshop with the EU-project CoralFISH with two goals: firstly to introduce DEEPFISHMAN proposed options for management of deep-water fishery and secondly to collect views and comments of stakeholders on the management framework output of the project. This workshop was attended by 39 persons. Attendees included DEEPFISHMAN participants (13) and CoralFISH participants (9), scientists outside of the projects (3), FAO (1), ICES (1), fishing catching sector (4), seafood sector (1), RAC representative (1), National Administration (1) Government Agency (1) and NGOs (4). Four government public bodies were represented:

- AAMP (Agence des Aires Marine Protégées) France
- BIM (Bord Iascaigh Mhara, Irish Sea Fisheries Board) Ireland
- DPMA (Fisheries directorate), France
- JNCC (Joint nature and Conservation Committee), UK

The NGOs represented were Oceana (<http://oceana.org>), Seas at Risk ([www.seas-at-risk.org/](http://www.seas-at-risk.org/)) and Pew Environment group (<http://www.pewtrusts.org>).

During the workshop, questionnaires were distributed with all topics listed where stakeholders could document their views on each issue presented. They could either return the questionnaire at the end of the workshop or by email after consulting with their organization. Completed questionnaires were appended to the stakeholder workshop report.

#### 4.8.4 Conferences (task 8.3)

Dissemination within the scientific community was achieved by the participation of project partners in scientific conferences and workshops. A final conference entitled "The scientific basis for ecosystem based resource management and monitoring in the deep-waters of the Mediterranean & North Atlantic" was held as a joint symposium with the project EC FP7 project CoralFISH 28-30th August in Galway Ireland. The conference offered an excellent opportunity from confronting the mostly fishery-based approach from DEEPFISHMAN to the conservation approach for CoralFISH. The focus of CoralFISH was Vulnerable Marine Ecosystems, (VMEs) mostly cold-water coral and sponge beds but also some vulnerable species such as sea pens. The topics addressed by CoralFISH presentations and posters in the symposium included:

- Underwater observations
- Distribution factors, habitat suitability and ecological modeling of VMEs
- Impact of human activities, primarily fishing
- Ecological relationships between VMEs and fish
- Genetics of cold-water corals

Valuation and management of the biodiversity associated with cold water corals

Overall, 18 oral communications from DEEPFISHMAN and 35 from CoralFISH as well as 5 posters from DEEPFISHMAN and 10 from CoralFISH were presented. Communications from DEEPFISHMAN are being submitted to a special issue of the journal Aquatic Living Resources (<http://www.alr-journal.org/>).

#### 4.8.5 Policy delivery (task 8.4)

DEEPFISHMAN methods, analyses and other material have been introduced since 2010 into the fish stock and ecosystem assessment and advice process by DEEPFISHMAN scientists participating to fisheries and ecosystem management advice. This has primarily taken place through ICES experts groups, in particular on the biology and assessment of deepsea fisheries resources (WGDEEP), on Deep-water Ecology (WGDEC), on Elasmobranch Fishes (WGEF), on arctic fisheries (AFWG) as well as through benchmark workshops on Deep-water Species (WKDEEP 2010) and on redfish (WKRED 2012). Through this process, DEEPFISHMAN methods and results have fed into fisheries advice from ICES. This utilization of DEEPFISHMAN methods and results will continue in the same

ICES expert groups and in relevant benchmark workshops.

The project has been in email contact with the European Commission DG-MARE, in particular about the monitoring and Management framework. Comments from the commission have been addressed in the final version. Members of DG-MARE participated in some project meetings in particular the meeting of WP7 "management Strategy framework", 15-17 November 2011, Bilbao, Spain. Contacts with DG-MARE also occur in external meeting such as ICES experts groups.

The policy advice and guidelines are based on the various output of the project and views and comments from stakeholders from the last stakeholders' workshop have been integrated.

The project results and monitoring and management framework were presented at the Science Policy Panel (SPP) of the FP7 HERMIONE project (contract number 226354) on 19 September 2012 and to EC policy makers in a "Conference de Midi" on 26 October 2012. This latter event was attended by an audience of about 50 people from diverse services of the European Commission. The results of the project were further presented in a joint RAC focus group on deep-sea habitats and species, in CNPMEM, Paris, 21 November 2012.

These two latter event occurred after the end of the contract and further dissemination of DEEPFISHMAN results and foreground will be pursued with the EC, Regional Advisory Councils (RACs), national administrations/governments and other foras.

#### **Address of project public website and relevant contact details**

## 4.2 Use and dissemination of foreground

### Section A (public)

#### Publications (peer reviewed)

LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

No.	DOI	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Permanent identifiers (if applicable)	Is open access provided to this publication ?
1	10.1051/alr/200 9040	Effect of discards on roundnose grenadier stock assessment in the Northeast Atlantic	Pawlowski, Lionel	Aquatic Living Resources	22, 4		EDP science	02/01/2010	573-582		Yes
2	10.1093/icesjms /fsq048	Standardizing blue ling landings per unit effort from industry haul-by-haul data using generalized additive models	Lorance, Pascal	ICES Journal of Marine Science	67, 8	Oxford University Press		04/06/2010	1650-1658		Yes
3	10.1093/icesjms /fsq072	History and dynamics of the overexploitation of the blackspot sea bream (Pagellus bogaraveo) in the Bay of Biscay.	Lorance, Pascal	ICES Journal of Marine Science	68, 2	Oxford University Press		17/06/2010	290-301		Yes
4	10.1111/j.1365-2664.2011.01961 .x	Protecting old fish through spatial management: is there a benefit for sustainable exploitation?	Edwards, Charles T. T.	Journal of applied ecology	48, 4	WILEY-BLACKWELL		07/07/2011	853-863		No
5	10.1093/icesjms /fsr076	Using qualitative and quantitative stakeholder knowledge: examples from European deep-water fisheries	Lorance, Pascal	ICES Journal of Marine Science	68, 8	Oxford University Press		17/07/2011	1815-1824		Yes

6	10.1080/1064126 2.2012.683210	Fisheries Assessment and Management: A Synthesis of Common Approaches with Special Reference to Deepwater and Data-Poor Stocks	Edwards, C. T. T.	Reviews in Fisheries Science	20	Taylor & Francis		18/06/2012	136-153		No
7	10.1093/icesjms /fss014	Historical variations in the year-class strength of beaked redfish ( <i>Sebastes mentella</i> ) in the Barents Sea	Planque, B.	ICES Journal of Marine Science	69			11/01/2012	547-552		No
8	10.1093/icesjms /fss110	Modelling in-season pulses of recruitment and hyperstability-hyperdepletion in the <i>Loligo gahi</i> fishery around the Falkland Islands with generalized depletion models	Roa-Ureta, R.H.	ICES Journal of Marine Science	69(8)				1403-1415		No
9		Atlas of Irish Groundfish Trawl Surveys: Supporting fish stock assessment and new ecosystem advice	Marine Institute	Monitoring	May 2012	Marine Institute	Oranmore, Galway, Ireland	31/05/2012	1-3,7-18, 44-50	ISBN: 9781902895 536	Yes
10	10.1139/f2012-1 03	A random effects population dynamics model based on proportion-at-age and removal data for estimating total mortality	Trenkel, V. M.	Canadian Journal of Fisheries and Aquatic Sciences	69			07/11/2012	1881-1893		Yes

LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Conference	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Improved Fisheries and Science Partnerships as Policy Drivers	09/11/2010	Ostende, Belgium	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	70	EU
2	Workshops	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	INDISEAS workshop	29/11/2010	Paris, France	Scientific community (higher education, Research)		EU countries
3	Presentations	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	Understanding deep sea Vulnerable Marine Ecosystems and Fisheries in the NW Atlantic: links between	03/02/2011	Zoological Society of London (ZSL)	Scientific community (higher education, Research)		UK
4	Conference	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	Marine Protected Areas on the high seas	03/02/2011	Zoological Society of London (ZSL)	Scientific community (higher education, Research)		UK
5	Publication	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Using qualitative and quantitative stakeholder knowledge: examples from European deep-water fisherie	17/07/2011	ICES journal of marine science	Scientific community (higher education, Research)		Journal readership
6	Thesis	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	Establishing abundance – occupancy relationships for deep-?#sea fish populations and assemblages	01/09/2011	Univ London Imperial Coll Sci Technol & Med, Div Biol, Ascot SL5 7PY, Berks, England	Scientific community (higher education, Research)		UK
7	Workshops	THE SECRETARY	Workshop on	15/09/2011	United Nations,	Scientific	150	Several from all

		OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	implementation of UN resolution 61/105 and 64/72		New-York, USA	community (higher education, Research) - Industry - Civil society - Policy makers		continents, including USA, Canada, EU, Australia New-Zeland
8	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Workshop on implementation of UN resolution 61/105 and 64/72	15/09/2011	United Nations, New-York, USA	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	Several from all continents, including USA, Canada, EU, Australia New-Zeland
9	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Data and research programmes: Examples from Europe	16/09/2011	United Nations New-York	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	Several from all continents, including USA, Canada, EU, Australia New-Zeland
10	Presentations	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	Deep-sea macroecology ?& fisheries	28/09/2011	Aberdeen, Scotland	Scientific community (higher education, Research)		Worldwide
11	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Advanced environmental studies in the North	08/11/2011	Tromsø	Scientific community (higher education, Research)	20	Norway
12	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	The future of EBM advice in European marine ecosystems: Challenges for science	09/11/2011	Tromsø	Scientific community (higher education, Research)	15	Norway
13	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Workshop for the development of a database for vulnerable marine ecosystems (VMEs)	07/12/2011	FAO Headquarters, Rome, Italy,	Scientific community (higher education, Research) - Policy makers	29	Australia, Canda, France, Italy, Japan, Korea, New Zeland, Norway, Spain, UK, USA

14	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Data from the industry in the North-East Atlantic	07/12/2011	FAO Headquarters, Rome, Italy,	Scientific community (higher education, Research) - Policy makers	29	Australia, Canda, France, Italy, Japan, Korea, New Zeland, Norway, Spain, UK, USA
15	Workshops	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Workshop on the Development of Assessments based on LIFE history traits (WKLIFE)	13/02/2012	Ipimar, Lisbon, Portugal	Scientific community (higher education, Research) - Industry - Policy makers	30	EU fishing countries
16	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Workshop on the Development of Assessments based on LIFE history traits (WKLIFE)	13/02/2012	Ipimar, Lisbon, Portugal	Scientific community (higher education, Research) - Industry - Policy makers	30	EU fishing countries
17	Workshops	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	DEEPPISHMAN FLR Course on the 26th and 27th March, ICES (Baltic Room)	26/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	10	DK FR FO IE IS PT SP UK
18	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
19	Workshops	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
20	Workshops	FUNDACION AZTI/AZTI FUNDAZIOA	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
21	Workshops	INSTITUTO NACIONAL DE	working group on biology and	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher	17	DK FR FO IE IS NO PT SP UK

		RECURSOS BIOLOGICOS I.P. INRB	assessment of deep-sea fisheries resources (WGDEEP)			education, Research)		
22	Workshops	MARINE INSTITUTE	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
23	Workshops	HAFRANNSOKNASTOFNUNINN	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
24	Workshops	INSTITUTO ESPANOL DE OCEANOGRAFIA	working group on biology and assessment of deep-sea fisheries resources (WGDEEP)	28/03/2012	ICES, Copenhagen, DK	Scientific community (higher education, Research)	17	DK FR FO IE IS NO PT SP UK
25	Presentations	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	Environmental Structuring Of Deep Water Fish Communities In Icelandic Waters: Abundance And Diversit	08/05/2012	6th World Fisheries Congress, EICC, Edinburgh, Scotland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	65 countries
26	Presentations	HAFRANNSOKNASTOFNUNINN	Temporal trends in deep-water fish community off W-Iceland	08/05/2012	6th World Fisheries Congress, EICC, Edinburgh, Scotland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	65 countries
27	Publication	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Continental slope fisheries and conservation of vulnerable fish species and deepwater benthic commun	08/05/2012	6th World Fisheries Congress, EICC, Edinburgh, Scotland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	65 countries

28	Presentations	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	Finding efficient harvest control rules for data limited management	09/05/2012	6th World Fisheries Congress, EICC, Edinburgh, Scotland	Scientific community (higher education, Research)		65 countries
29	Presentations	HELLENIC CENTRE FOR MARINE RESEARCH	Effect Of Spatial And Environmental Factors On Community Metrics Of The Ionian Sea (Eastern Mediterr	08/05/2012	6th World Fisheries Congress, EICC, Edinburgh, Scotland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	65 countries
30	Presentations	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	Estimating uncertainty in deriving spatial distribution of blue ling landings from VMS	10/07/2012	10th International Symposium on Spatial Accuracy Assessment in Natural Resources and Env. Sciences	Scientific community (higher education, Research)	45	Wordwide
31	Conference	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Ecosystem based management and monitoring in the deep Med. & N. Atlantic	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
32	Presentations	INSTITUTO ESPANOL DE OCEANOGRAFIA	All about my growth: Highlights from the Red seabream population of the Strait of Gibraltar	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	69	D DK FR GR IE IS IT NL NO PTSP UK USA
33	Presentations	HELLENIC CENTRE FOR MARINE RESEARCH	Effect of spatial and environmental factors on community metrics and diversity indices of the Ionia	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
34	Presentations	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	Testing Assessment Methods for Data Poor Deepwater Stocks	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
35	Presentations	INSTITUTO NACIONAL DE	Spatial segregation of three	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher	68	D DK FR GR IE IS IT NL NO PTSP

		RECURSOS BIOLÓGICOS I.P. INRB	cosmopolitan species of deep-water sharks			education, Research)		UK USA
36	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Analytical assessment of roundnose grenadier in Vb, VI, VII	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
37	Presentations	HASKOLI ISLANDS	Temporal trends in deep-water fish community off W-Iceland	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
38	Presentations	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Modeling the dynamics of Black Scabbardfish at ICES IXa	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
39	Posters	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Analysis of species associations in deep-sea fisheries off the British Isles from an industry haul b	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
40	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Preliminary stock assessment of black-spot red seabream, Pagellus bogaraveo, in the Ionian Sea (East	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
41	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	Feeding Habits of rabbit fish Chimaera monstrosa (Linnaeus, 1758) in deep waters of the Gulf of Cadi	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
42	Posters	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Otolith geochemical signatures as a new tool to identify Aphanopus carbo and Aphanopus intermedius i	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA

43	Posters	MARINE INSTITUTE	Trophic ecology of black scabbardfish, <i>Aphanopus carbo</i> in NE Atlantic - Assessment through stomach c	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	6	D DK FR GR IE IS IT NL NO PTSP UK USA
44	Presentations	HASKOLI ISLANDS	Effective management of deep-sea species: The Icelandic redfish fishery in the Irminger Sea	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
45	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	DEEPFISHMAN stakeholder consultation process	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
46	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	A spatialised Management Strategy Evaluation for deepwater mixed fisheries off the British Isles	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
47	Presentations	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	Using vessel monitoring system (VMS) data to assess the impact of marine protection boundaries on bl	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
48	Media briefings	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Continental slope fisheries and conservation of vulnerable fish species and deep-water benthic commu	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
49	Presentations	FUNDACION AZTI/AZTI FUNDAZIOA	FLBEIA: A toolbox for Bio-Economic Impact Assessment of fisheries management strategies	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA

50	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	New methodological developments for stock assessment and management strategy evaluation without surv	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
51	Presentations	MARINE INSTITUTE	Adapting ecosystem indicators to evaluate good environmental status to deepwater fish communities	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
52	Posters	MARINE INSTITUTE	Managing the risk of vulnerable species exposure to deepwater trawl fisheries- The case of Orange Ro	28/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
53	Presentations	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS	DEEPFISHMAN: A prototype deep-sea fishery management plan for the NE Atlantic	30/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research)	68	D DK FR GR IE IS IT NL NO PTSP UK USA
54	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Stakeholder workshop	31/08/2012	NUIG, Galway, Ireland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	39	BE D FR GR IE IS IT NL NO PT SP UK USA
55	Presentations	HAVFORSKNINGSINSTITUTT	Monitoring beaked redfish in the North Atlantic, current challenges and future prospects	20/09/2011	Gdansk, Poland	Scientific community (higher education, Research) - Policy makers	800	EU, Norway, Iceland, Faroe Islands, Canada, USA, Japan
56	Workshops	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	Deep-sea ecosystems policy and research in Europe: past, present and future	19/09/2012	Koning Albert II-Iaan, B 1210 Brussels	Scientific community (higher education, Research) - Policy makers	29	EU, USA
57	Presentations	INSTITUT FRANCAIS DE	Spatial indicators for multi-species	18/09/2012	ICES ASC, Bergen	Scientific community (higher	700	EU, NO, Canada, USA, Australia

		RECHERCHE POUR L'EXPLOITATION DE LA MER	commercial catch based management			education, Research) - Policy makers		
58	Presentations	HAVFORSKNINGSINSTITUTT	Unfenced fishing, a fisheries analysis for the Barents Sea	14/11/2012	Nantes, France	Scientific community (higher education, Research)	70	CA, DE, DK, ES, FI, FR, GR, IS, JP, NL, NO, UK, US, SE, SP
59	Presentations	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	DEEPFISHMAN - Management and monitoring of deep-sea fisheries and stocks	21/11/2012	RAC focus group meeting, CNPMEM, Paris	Industry - Civil society - Policy makers	25	EU
60	Conference	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	DEEPFISHMAN - Management and monitoring of deep-sea fisheries and stocks	12/11/2011	CNPMEN, Paris, France	Industry - Policy makers	25	FR

## Section B (Confidential or public: confidential information marked clearly)

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)

**OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND**

Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved
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**ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND**

Description of Exploitable Foreground	Explain of the Exploitable Foreground
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## 4.3 Report on societal implications

### B. Ethics

<b>1. Did your project undergo an Ethics Review (and/or Screening)?</b>	
<b>If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final reports?</b>	
<b>2. Please indicate whether your project involved any of the following issues :</b>	
<b>RESEARCH ON HUMANS</b>	
<b>Did the project involve children?</b>	
<b>Did the project involve patients?</b>	
<b>Did the project involve persons not able to consent?</b>	
<b>Did the project involve adult healthy volunteers?</b>	
<b>Did the project involve Human genetic material?</b>	
<b>Did the project involve Human biological samples?</b>	
<b>Did the project involve Human data collection?</b>	
<b>RESEARCH ON HUMAN EMBRYO/FOETUS</b>	
<b>Did the project involve Human Embryos?</b>	
<b>Did the project involve Human Foetal Tissue / Cells?</b>	
<b>Did the project involve Human Embryonic Stem Cells (hESCs)?</b>	
<b>Did the project on human Embryonic Stem Cells involve cells in culture?</b>	
<b>Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?</b>	
<b>PRIVACY</b>	
<b>Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?</b>	
<b>Did the project involve tracking the location or observation of people?</b>	
<b>RESEARCH ON ANIMALS</b>	

<b>Did the project involve research on animals?</b>	
<b>Were those animals transgenic small laboratory animals?</b>	
<b>Were those animals transgenic farm animals?</b>	
<b>Were those animals cloned farm animals?</b>	
<b>Were those animals non-human primates?</b>	
<b>RESEARCH INVOLVING DEVELOPING COUNTRIES</b>	
<b>Did the project involve the use of local resources (genetic, animal, plant etc)?</b>	
<b>Was the project of benefit to local community (capacity building, access to healthcare, education etc)?</b>	
<b>DUAL USE</b>	
<b>Research having direct military use</b>	
<b>Research having potential for terrorist abuse</b>	

## C. Workforce Statistics

**3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).**

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	0
Work package leaders	0	0
Experienced researchers (i.e. PhD holders)	0	0
PhD student	0	0
Other	0	0

<b>4. How many additional researchers (in companies and universities) were recruited specifically for this project?</b>	0
<b>Of which, indicate the number of men:</b>	0

## D. Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project ?

6. Which of the following actions did you carry out and how effective were they?

Design and implement an equal opportunity policy

Set targets to achieve a gender balance in the workforce

Organise conferences and workshops on gender

Actions to improve work-life balance

Other:

7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

If yes, please specify:

## E. Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

If yes, please specify:

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

## F. Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

Main discipline:

Associated discipline:

Associated discipline:

## G. Engaging with Civil society and policy makers

11a. Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14)

**11b. If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?**

**11c. In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?**

**12. Did you engage with government / public bodies or policy makers (including international organisations)**

**13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?**

## **H. Use and dissemination**

**14. How many Articles were published/accepted for publication in peer-reviewed journals?**

10

**To how many of these is open access provided?**

6

**How many of these are published in open access journals?**

0

**How many of these are published in open repositories?**

0

**To how many of these is open access not provided?**

4

**Please check all applicable reasons for not providing open access:**

**publisher's licensing agreement would not permit publishing in a repository**

No

**no suitable repository available**

No

**no suitable open access journal available**

No

**no funds available to publish in an open access journal**

No

**lack of time and resources**

No

**lack of information on open access**

No

**If other - please specify**

**15. How many new patent applications ('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).**

0

**16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).**

<b>Trademark</b>	0
<b>Registered design</b>	0
<b>Other</b>	0
<b>17. How many spin-off companies were created / are planned as a direct result of the project?</b>	0
<b>Indicate the approximate number of additional jobs in these companies:</b>	0
<b>18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:</b>	,
<b>19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:</b>	0

## I. Media and Communication to the general public

<b>20. As part of the project, were any of the beneficiaries professionals in communication or media relations?</b>	
<b>21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?</b>	
<b>22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?</b>	
<b>Press Release</b>	No
<b>Media briefing</b>	No
<b>TV coverage / report</b>	No
<b>Radio coverage / report</b>	No
<b>Brochures /posters / flyers</b>	No
<b>DVD /Film /Multimedia</b>	No
<b>Coverage in specialist press</b>	No
<b>Coverage in general (non-specialist) press</b>	No
<b>Coverage in national press</b>	No
<b>Coverage in international press</b>	No
<b>Website for the general public / internet</b>	No
<b>Event targeting general public (festival, conference, exhibition, science café)</b>	No

**23. In which languages are the information products for the general public produced?**

<b>Language of the coordinator</b>	No
<b>Other language(s)</b>	No
<b>English</b>	No

<b>Attachments</b>	
<b>Grant Agreement number:</b>	227390
<b>Project acronym:</b>	DEEPFISHMAN
<b>Project title:</b>	Management and monitoring of deep-sea fisheries and stocks
<b>Funding Scheme:</b>	CP
<b>Project starting date:</b>	01/04/2009
<b>Project end date:</b>	30/09/2012
<b>Name of the scientific representative of the project's coordinator and organisation:</b>	Dr. Pascal LORANCE INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER
<b>Name</b>	
<b>Date</b>	

This declaration was visaed electronically by pascal LORANCE (ECAS user name nloranpa) on