Deliverable 9.14

Second Periodic Activity and Management Report

Due date of deliverable: month 37 (October 2015)

Actual submission date: month 38 (November 2015)

Submission date revised report: month 41 (February 2016)

Grant Agreement number:	312088
Project acronym:	BENTHIS
Project title:	Benthic Ecosystem Fisheries Impact Study
Funding Scheme:	Collaborative project
Project coordination:	IMARES, IJmuiden, the Netherlands
Project website:	www.benthis.eu

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 312088

Main Contributors:

Adriaan D. Rijnsdorp & Gerda Booij , IMARES (Partner 1, Dienst Landbouwkundig Onderzoek, Netherlands)

Ole R. Eigaard, National Institute of Aquatic Research (Partner 9, DTU Aqua, Denmark)

Andrew Kenny, The Secretary of State for Environment, Food and Rural Affairs (Partner 3, CEFAS, UK)

Jan Geert Hiddink, Bangor University (Partner 4, BU, UK)

Katell G. Hamon, LEI (Partner 1, Dienst Landbouwkundig Onderzoek, Netherlands)

Gerjan Piet, IMARES (Partner 1, Dienst Landbouwkundig Onderzoek, Netherlands)

Antonello Sala, National Research Council (Partner 14, CNR, Italy)

Rasmus Nielsen, National Institute of Aquatic Research (Partner 9, DTU Aqua, Denmark)

Hans Polet, ILVO (Partner 2, Vlaams Gewest, Belgium)

Pascal Laffargue, IFREMER (Partner 7, Institut Francais de Recherche pour l'Exploration de la Mer, France)

Dave Reid, MI (Partner 8, Marine Institute, Ireland)

Lene Buhl-Mortensen, IMR (Partner 13, Havforskningsinstitutet, Norway)

Chris Smith, HCMR (Partner 15, Hellenic Centre for Marine Research, Greece)

Mustafa Zengin, Central Fisheries Research Institute (Partner 16, CFRI, Turkey)

Aysun Gumus, Ondokuz Mayıs University (Partner 33, Turkey)

Olavur Gregerson, SME01 (Partner 17, Synthesa, Faroer)

SEVENTH FRAMEWORK PROGRAMME

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 312088

DOCUMENT CHANGE RECORD

Authors	Modification	Issue	Date
Gerda Booij	Inserted tables Use of Resources & Deliverables		18/11/2015
Adriaan Rijnsdorp	Compile contributions, text IMARES activities, Dissemination, Management activities and Summary. Overall editing		30/11/2015
Adriaan Rijnsdorp	Revision following Midterm Review		22/2/2016

SUMMARY

This deliverable reports on the activities and progress made during the 2nd reporting period (month 19-36) of the FP7-project BENTHIS. The project studies the effect of fishing, in particular bottom trawling, on the sea bed and the benthic ecosystem and studies in collaboration with the fishing industry innovative fishing techniques and management measures to mitigate the impact. After an introduction on the objectives and the approach, the activities conducted for the individual tasks are reported, as well as the progress made and the results obtained so far. Deviations from the work plan in Annex 1 (DOW: Description of work) are noted. Most are relatively small and none are hampering the overall progress of the work and the flow of information across work packages. BENTHIS is well on track and all milestones and deliverables set for the 2nd reporting period have been achieved.

Main results achieved.

A framework linking the key characteristics of the fishing gears and benthos was made to provide a starting point of the analysis (WP1).

Foot print of all European bottom trawl metiers were estimated and used to quantify the spatial distribution of bottom trawling intensities by gear group in the Baltic Sea, North Sea, western waters and eastern Mediterranean Sea. The results highlighted areas and sea bed habitats with highest trawling pressure (WP2).

A biological trait based approach has been used to quantify the sensitivity of benthos for trawling disturbance. It is shown that trawling disturbance is habitat dependent. Based on stomach contents, six fisheries-related habitat classes were distinguished in the North Sea and Skagerrak. A risk assessment framework is developed that can be used to compare the pressure bottom trawling and the impact on the benthic community composition and benthic ecosystem functioning at regional and local scales. (WP3).

Experimental investigations were undertaken to evaluate experimentally the ground forces and the amount of disturbed sediment. Numerical studies were carried out to on the influence that the dimensions, the weight, the cross-sectional geometry and the soil material properties have on penetration and drag of truncated rigid cylinders towed on fully saturated muddy soils and sandy soils have been investigated. Field studies were carried out to measure the sediment mobilisation in relation to the hydrodynamic drag (WP4).

A systematic review of the literature was conducted to study (i) the initial effect of bottom fishing on the abundance of benthic invertebrates vary among species with different biological traits, (ii) the magnitude of response to fishing varies among different habitat types and fishing gears, and (iii) the temporal trajectory for recovery from bottom fishing activity varies among species with different biological traits. Bottom fishing resulted in significant negative impacts on total benthic community abundance; reductions were significantly higher following dredging (33% loss) compared to otter trawling and beam trawling (5% loss), and they were most severe for benthic communities in biogenic habitats and coarse and mixed sediment relative to sandy and muddy sediments.(WP4)

A framework was developed to estimate the amount of discards sinking to the sea bed. The framework integrates data on the spatio-temporal variation in seabird distribution, seabird attraction to fishing vessels and discard distribution. This framework was applied in a case study in the Bay of Biscay (WP4).

The effect of bottom trawling on the benthic community structure and sediment biogeochemistry across a gradient of bottom fishing pressure in muddy and sandy sediments. This work highlighted that the impacts of fishing on fauna and sediment biogeochemical parameters are influenced by the type of sediment and gear type and also by the history of exploitation of the areas studied. The biogeochemistry at the sandy site appeared to be dominated by the natural physical environment, so the impact of fishing disturbance was less evident. In contrast, fishing was an important regulatory factor in the muddy habitat. Pore-water nutrient profiles of ammonium, phosphate and silicate provided evidence of organic matter burial and/or mixing as a result of trawling at the muddy sites.

Different studies examined the effect of bottom trawling on food intake of benthivorous fish. It combines the results of empirical and modelling studies, and synthesizes the available knowledge from the literature in order to give the most comprehensive overview of the topic so far. The work shows that

there is no strong evidence to suggest that bottom trawling has substantial positive or negative effects on commercial fish populations by affecting their food supply. (WP4)

A framework for the analysis of economic performances of alternative fishing gears was developed. A model on the dynamics of effort allocation (short-term) was made available in R and has been used to study discarding decisions relevant to the implementation of the landing obligation. (WP5).

A review of possible management measures to mitigate the trawling impact on the benthic ecosystem was made. Two decision-support tools were developed: sea floor impact risk reduction tool aimed to reduce the impact of fishing on the seafloor through a change in the behaviour of the fisher; Multi-criteria Analysis for the evaluation of management strategies taking stakeholder preferences into account. (WP6).

Case studies were carried out in the Baltic Sea, North Sea, Western Waters, Mediterranean Sea and Black Sea to study the current impact of bottom trawling and study possibilities for mitigation in collaboration with the fishing industry and gear manufacturers. The case study focussed on technological innovations (semi-pelagic doors, electrical stimulation), gear substitutions (passive gears) and smart fishing (avoid vulnerable habitats) to reduce the benthic impact. Fisheries studied include: Nephrops and roundfish otter trawling; beam trawling for flatfish and brown shrimp, dredging for scallops and blue mussels. (WP7).

Successful regional stakeholder events were held during which the objectives and progress made were discussed. Around 100 stakeholders representing the fisheries sector (48%), fisheries related industry (7%), government (11%), NGO (4%) and scientist (30%), participated in one of the 5 events. Areas of harmony, conflict and opportunities for technical and sustainable management initiatives were identified and mapped. (WP8)

BENTHIS results have been disseminated in the scientific literature with 21 papers published and four papers submitted to peer reviewed journals. In total 42 oral or poster presentations were given at scientific meetings. Further, BENTHIS results have been used in national projects, and has been presented at ICES Working Groups dealing with the development of MSFD-indicators.

TABLE OF CONTENTS

INTRODUCTION

Fishing has a major impact on marine ecosystems in general and benthic ecosystems in particular (Halpern et al. 2008; Jackson et al. 2001). The main fishing gears utilised on the continental shelves are towed bottom gears such as otter and beam trawls. Because these gears are heavy when in contact with the seabed, they cause significant mortality among the animals that live on the seabed and this results in chronic alteration of the state and functioning of seabed ecosystems. There is evidence for a loss in biodiversity and shifts in the benthic community from large long-lived species to small fast growing species (Frid and Hall, 1999). There is also a major concern about the detrimental effects of fishing on bioengineering species such as cold water corals, sponge aggregates, mussel beds, and on the long lived and slow growing megafauna (e.g. burrowing crustaceans: Duineveld et al. 2007). These changes not only affect the biodiversity but also affect the benthic ecosystem functioning and production with ramifications for the provisioning of ecosystem goods and services. Trawling will influence the structure of the seabed and will bring sediments into resuspension, affecting the geo-chemical processes. Discards that are not consumed by seabirds will sink to the bottom and provide food for benthic scavengers.

In order to integrate fisheries impacts on benthic ecosystems in fisheries management, the EU needs to be informed about a number of salient questions.

1) Which benthic ecosystems and habitats are most sensitive for fishing impacts?
2) Which fishing gears have the biggest impact upon benthic systems?
3) How does the impact of fishing compare to the impact of natural disturbance?
4) What options are available to mitigate the adverse impacts of fishing, and how can these options be converted into effective management?
5) How can science and the fishing industry be brought together to collaborate on innovative technology and innovative management approaches to mitigate the impact?
6) What are the socio-economic implications of changes induced in benthic systems by fishing and of the proposed management actions to mitigate these effects?

BENTHIS aims to provide the urgently required scientific basis to integrate the benthic ecosystem into fisheries management and collaborate with the fishing industry and other stakeholders to investigate both technological innovations and alternative management scenarios to mitigate the impact of fishing on the benthic ecosystem.

PROJECT OBJECTIVES

The main objectives of this project are to

- Provide the knowledge base that allows an assessment of the status of different types of marine benthic ecosystems in European waters on a regional basis and support indicators of Good Environmental Status (GES), in particular on Seafloor Integrity;
- Develop the tools required to assess the effects of bottom trawling on the structure and functioning of these benthic ecosystems.
- Study and test, in close collaboration with the fishing industry, innovative technologies that reduce the impact of demersal fisheries on benthic ecosystem on a regional basis, encompassing the Baltic, North Sea, western waters, Mediterranean and Black Sea;
- Develop in consultation with the fishing industry and other stakeholders on a regional scale, sustainable management plans that reduce the impact of fishing and quantify its ecological and socio-economic consequences

Sub-objectives

- To assess the degradation and loss of habitats caused by different bottom trawling fleets

- To assess the impact of bottom trawling on biodiversity, nutrient recycling and benthic-pelagic coupling
- To study which factors facilitates the introduction of new technology to mitigate ecosystem impacts by fishing activities
- To demonstrate in close cooperation with SME's in the fishing industry how recent innovative technologies can contribute to reducing impact on benthic communities and other eco-system components
- To evaluate the effects of innovative management approaches such as gear substitutions and discard bans on the benthic ecosystem and the economy of the fishing sector

WORK PROGRESS AND ACHIEVEMENTS DURING THE REPORTING PERIOD

In the table below, the milestones since the start of the project are summarised and the status indicated. The deliverables are presented in the chapters on the individual Work Packages.

Milestones up to and including 2nd reporting period

#	Milestones	Work Package(s) involved	Expected date	Means of verification	Current status
					done in month
1	Kick off meeting (P1)	1, 2, 3, 4, 5, 6, 7, 8	3	Meeting completed	4
2	Project website	9	3	Website operational	3
3	Regional case study meetings (RWP1)	7	4	Meetings completed	1-6
4	Regional Stakeholder Workshops (RSE1)	7, 8	6	Workshops completed	6-8
5	Project meeting (P2) to decide on workplan case studies. Agreement on a list of fishing gears and innovations and management scenario's to be included in the case studies.	1, 2, 3, 4, 5, 6, 7, 8	9	Meeting completed	9
6	Compilation of relevant biological traits and functional literature (P2)	3	9	List available to partners	8
7	Completion of industry questionnaire surveys (P2)	2	9	Survey completed	13
8	Workplan for economic performances analysis (P2)	5	9	Workplan completed	9
9	Review of knowledge according to different types of gears from industry and research (P2)	7	9	Review completed	13
10	EU-wide Stakeholder Workshops	7, 8	9	Workshops	9

	(SH1)			completed	
11	General Assemblage meeting (GA1)	9	9	Meeting completed	9
12	Steering Committee (SC1)	9	9	Meeting completed	9
13	Stakeholder advisory board meeting (SHB1)	9	9	Meeting completed	18
14	WP3 internal workshop	3	11	Meeting completed	12
15	Regional case study meetings (RWP2)	7	16	Meetings completed	11-18
16	Steering Committee (SC2)	9	18	Meeting completed	18
17	Workshop with WP2, WP3 and WP4 to assign seabed functions to habitat types for mapping purposes (W2)	2, 3 and 4	18	Workshop completed	18
18	Development and implementation of new methodology for assessing actual seabed impact from fishing activities on a fine spatial and temporal scale (W2).	2	18	Methodology documented and available to partners	18
19	Collation of fish diet data (W2)	3	18	Data base completed	18
20	Establish biological database (W2)	3	18	Data base completed	23
21	Ranked list of fishing gear components that have most physical impact (W2)	4	18	List completed	18
22	Workshop with WP4 and WP5 (W3)	4 and 5	18	Workshop completed	18
23	Case study workshop to discuss progress (W4)	7	18	Workshops completed	18
24	ICES Symposium	8, 9	21	Oral & Poster presentations completed	24
25	Regional Stakeholder Workshops (RSE2)	7, 8	21	Workshops completed	20-27
26	WP3 internal workshop (W5)	3	23	Meeting completed	32
27	Project meeting (P3) to discuss progress in generic WPs and case studies: focus on application of the economic performance framework to case studies and fishing/seabed habitat risk model	1, 2, 3, 4, 5, 6, 7, 8	27	Meeting completed	30
28	Identification of priority areas for reducing benthic impact from	2	27	List of priority	30

	fisheries by combing habitat maps with maps of fishing activity and bottom impact (P3)			areas available	
29	List on fishing gear modification and scenarios of fleet redistributions under various management actions (P3).	4, 5, 6, 7	27	List completed	30
30	Investment model running (P3)	5	27	Model running	30
31	Fleet Dynamic State Variable model running (P3)	5	27	Model running	30
32	Sea trials Baltic Sea (P3)	7	27	Sea trials completed	Will be continued in 3rd reporting Period
33	Finalisation of prototype of a selection grid and novel trawl designs (Mediterranean) (P3)	7	27	Tested new selective gear designs at sea	36
34	Completion of beam and bottom surveys and data analysis describing benthic ecosystem and fishery impact (Black Sea) (P3)	7	27	All sea surveys, laboratory and data analysis completed	Field work completed in 2015. Analysis in 2016.
35	General Assemblage meeting (GA2)	9	27	Meeting completed	30
36	Steering Committee (SC3)	9	27	Meeting completed	30
37	Stakeholder advisory board meeting (SHB2)	9	27	Meeting completed	30
38	Regional case study meetings (RWP3)	7	36	Meetings completed	36
39	Steering Committee (SC4)	9	36	Meeting completed	36

WP1 – FRAMEWORK AND SYNTHESIS

Lead IMARES (Adriaan Rijnsdorp)

To strengthen the scientific basis for the ecosystem approach to fisheries management the EU requires knowledge on the impact of fishing on the structure, functioning and services of the benthic ecosystem as well as on the socio-economy of innovations in fisheries technology and management. BENTHIS will provide this basis. The success of this multi-disciplinary project, however, will critically depend on a clear a priori understanding of how these different topics are inter-linked and fit into the overall framework of the project. WP1 will develop a framework at the start of the project, and will provide a synthesis of the results at the end of the project. No major work is carried out during the 2nd reporting period.

Task 1.1a: Key benthic ecosystem processes

Lead: CEFAS Contributors: BU, IMR, HCMR

This task has been finished in the 1st period with the submission of Deliverable 1.1a.

Task 1.1b: Fishing impact from the perspective of the fisheries

Lead: DTU-Aqua Contributors: IMARES, BU, CEFAS

This task has been finished in the 1st period with the submission of Deliverable 1.1b.

Task 1.2: Fishing impact from the perspective of the benthic ecosystem

Lead: BU. Contributors: IMARES, CEFAS, DTU-Aqua, IFREMER, IMR, CNR, HCMR

This task is scheduled at the end of the project.

Task 1.3: Economic performances of the fisheries

Lead: LEI Contributors: IMARES, IFREMER, UCPH, CNR, SME’s

This task is scheduled at the end of the project.

Task 1.4: Mitigation of fishing impacts on the benthic ecosystem

Lead: IMARES Contributors: LEI, ILVO, CEFAS, Bangor, IFREMER, DTU-Aqua, CNR, SME’s

This task is scheduled at the end of the project.

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D1.1	Report on benthic ecosystem processes and impact of fishing gear	1	9	IMARES	yes	26/8/2013, resubmitted 7/1/2014
D1.2	Peer reviewed paper on Impact of fisheries on European benthic ecosystems by region	1	48	DTU-Aqua	no	
D1.3	Peer reviewed paper on The economics of technological innovations to mitigate ecosystem effects of fishing	1	42	LEI	no	
D1.4	Peer reviewed paper on Technological innovations that mitigate fishing impact	1	54	IMARES	no	

Deviations.

None

Failing to achieve objectives.

None

Use of resources

Participant	WP1 Budget (pm)	WP1 Realised 1st + 2nd period (pm)
SDLO	8	1.0
ILVO	0.4	0.5
CEFAS-DEFRA	3.7	2.9
BU	3.1	1.8
UNIABDN	0.5	0.2
Mar lab	0.2	0.0
IFREMER	1.9	0.6
MI	0.2	0.2

DTU-Aqua	2.6	0.5
AU-Bioscience	0.1	0.2
UCPH	0.5	0.5
SLU	0.2	0.0
IMR	0.8	0.0
CNR	1.9	1.6
HCMR	1.3	1.3
CFRI	0.4	0.3
OMU	0.3	0.2
sum	26.1	11.8
remaining personmonths		14.3

WP2 - MAPPING

Lead: DTU-Aqua (Ole Eigaard).

Project objectives for the period

The objectives of this WP are to (i) to map habitat types and sea bed impact from fishing activities in EU waters to identify where fisheries potentially compromises seafloor integrity conflicts of ecosystem services; (ii) to develop and implement new methodology, combining VMS, logbook and industry data, to assess actual seabed impact from large scale fishing activities on an appropriate spatial and temporal scale.

During the 2nd reporting period, the activities were focussed on compiling habitat information and applying the new methodology developed to assess actual seabed pressure and to sea bed habitat.

Work progress and achievements during the period are reported below.

Task 2.1 - Development and implementation of new methodology for assessing benthic pressure from fishing

Lead: DTU Aqua; Contributors: IMARES, ILVO, CEFAS, MarLab, IFREMER, MI, SLU, IMR, CNR, HCMR, CFRI)

Summary of progress

The methodology to quantify fishing pressure has been developed during the 1st reporting period and was applied during the 2nd reporting period. The footprint of the BENTHIS metiers was estimated based on a EU-wide inventory of gear characteristics and dimensions.

Clearly significant results

- Eigaard OR, Bastardie F, Breen M., Dinesen GE, Hintzen NT, Laffargue P, Nielsen JR, Nilson H, O'Neill F, Polet H, Reid D, Sala A, Sköld M, Smith C, Sørensen TK, Tully O, Zengin M, Rijnsdorp AD. 2015. Estimating seafloor pressure from trawls and dredges based on gear design and dimensions. ICES Journal of Marine Science. doi 10.1093/icesjms/fsv099

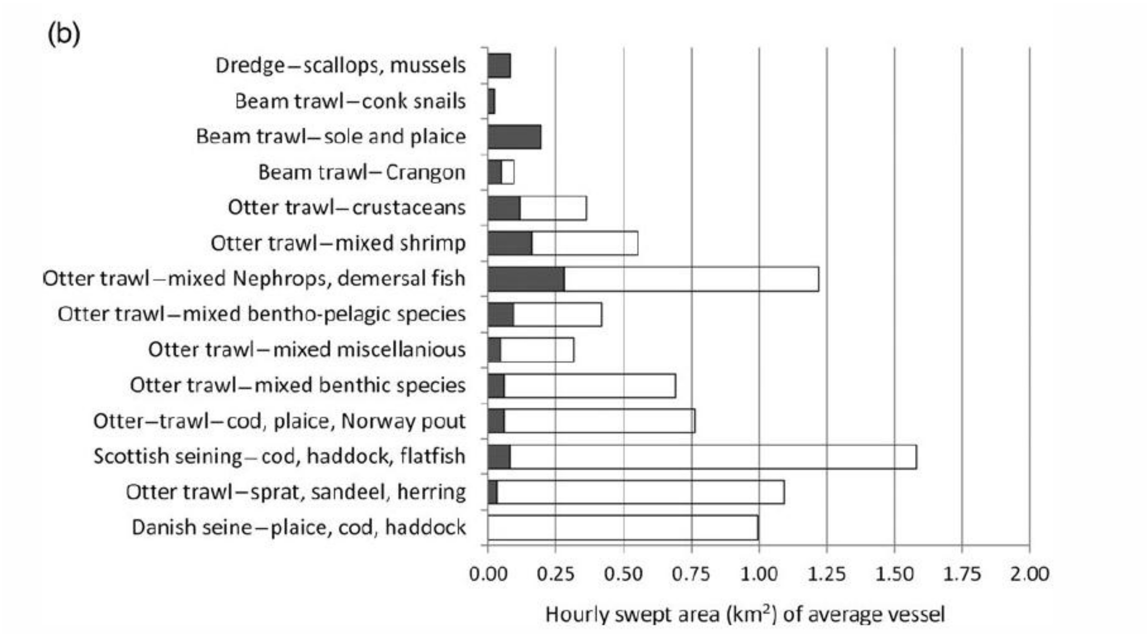


Figure 2.1. *The surface area trawled by metier per hour of fishing. The black column gives the sub-surface area, the white column gives the surface area (Eigaard et al. 2015).*

Task 2.2 - Survey of existing habitat maps of case study areas

Lead: AU-BIOSCIENCE; Contributors: DTU Aqua, CEFAS, IMR, CNR, CFRI)

Summary of progress

A survey of existing sea bed substrate and habitat classification maps was conducted with the objective to identify the most suitable templates and classification categories. This survey and choice of habitat map template was closely aligned with the habitat and functional trait classification and modelling work in WP3

EUNIS Level 3 sea bed habitat information is available for a substantial part of the European continental shelf, but do not cover all the regions where bottom trawling takes place ((http://www.emodnet-seabedhabitats.eu/default.aspx?page=1974). Therefore it was necessary to produce EUNIS-equivalent habitat maps, modelled from data of sediment and bathymetry, for the Mediterranean as well as for the Barents Sea and Norwegian Sea, which together with regional habitat maps of downloaded EUNIS data form the basis of the further analyses.

Clearly significant results

- A shapefile of EUNIS level 3 habitat has been made available.

Task 2.3.a - Selection of optimal spatial resolution for mapping European-wide fishing pressure

Lead: DTU Aqua; Contributors: IMARES, IMR, CNR

Summary of progress

This task has been completed in the 1st reporting period.

Clearly significant results

- it was agreed that the optimal spatial resolution for mapping fishing pressure (yearly frequency of area swept) of European-wide fishing activity based on VMS and logbook information is grid cells of 1 minute longitude * 1 minute latitude.

Task 2.3.b - To overlay fishing pressure data and habitat maps to identify potential ecosystem service conflicts

Lead: DTU Aqua, IMARES. Contributions CEFAS, AU-BIOSCIENCE, IMR, CNR, HCMR

Summary of progress

The lead of this task has been reallocated to DTU-Aqua and IMARES. The data set comprising trawling intensity estimates by year (2010 – 2012) by metier at the resolution of 1x1 minute has been overlaid with EUNIS level 3 habitats by management area. For the North Sea, pressure indicators have been estimated for the dominant North Sea habitats.

Clearly significant results

- The analysis shows that in all management areas bottom trawling shows a heterogeneous distribution with certain areas being trawled (very) intensely, while other parts are trawled less or not at all. In the North Sea, the muddy sediments (EUNIS A5.3) was trawled more widely than the coarser sandy sediments (EUNIS A5.2).

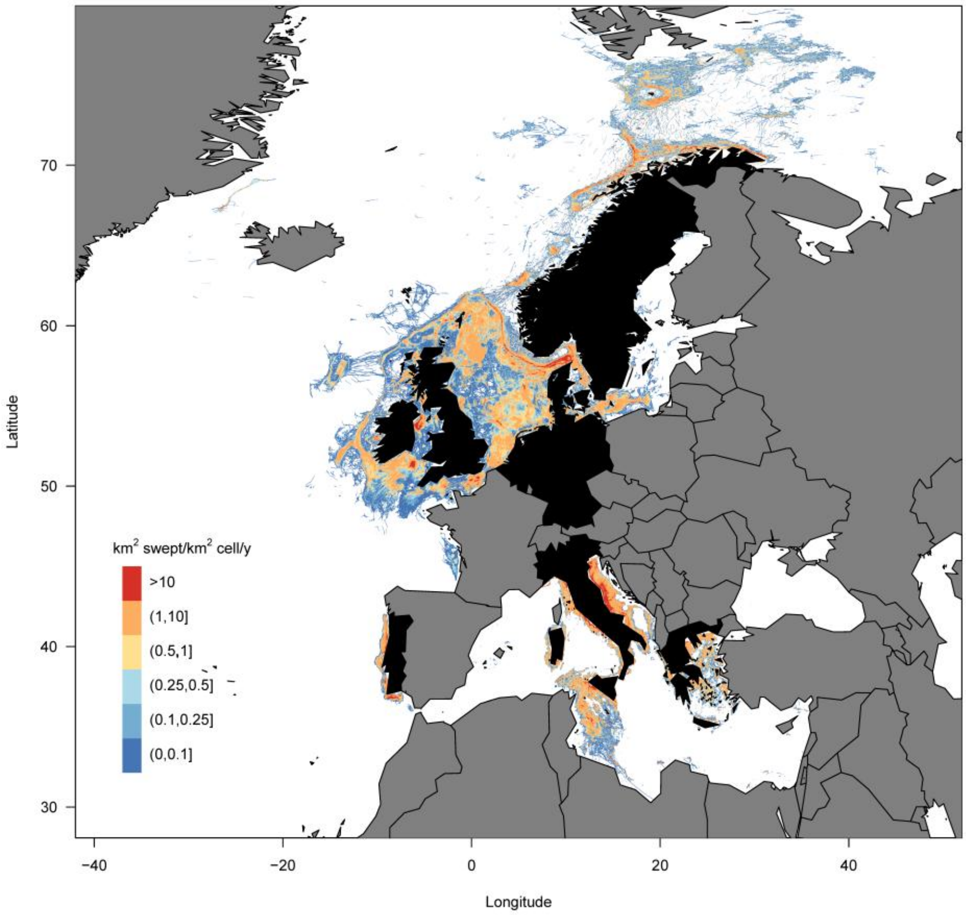


Figure 2.2. *Map of trawling intensity at the surface level of all bottom trawl metiers in European seas. The map is based on VMS and logbook information (2010-2012) made available by the countries indicated in black.*

Deliverables

Delivera ble No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D2.1	Report providing a framework for understanding gear-seabed interactions in relation to the species targeted with the gear and inventory of European common demersal gears	2	9	DTU-Aqua	yes	1/6/2013, resubmitted 1/10/2014

D2.2	Peer reviewed paper on the definition and parameterization of impact proxies based on gear and vessel data from EU wide industry surveys, and priority areas for reducing benthic impact from fishing activities	2	20	DTU-Aqua	yes	19/1/2015
D2.3	Peer reviewed paper on benthic impact of fisheries in European waters.	2	26	DTU-Aqua	yes	1/10/2015

Deviations

The data compilation of the VMS and logbook data took much longer than expected. A lot of effort has been invested in guiding colleagues that are not partner in BENTHIS in processing their national data with the BENTHIS workflow. This has been successful for Portugal and Germany, but failed due to technical problems for Spain (Atlantic).

Failing to achieve objectives

The map of trawling intensities is incomplete because we failed to get permission to add the French trawling intensity estimates as produced with the BENTHIS workflow by IFREMER (see Task 7.3.1) to the combined data set. As D2.3 will be revised before submission to a peer reviewed journal, we will continue our attempts to remedy the shortcomings in data coverage.

Use of resources

Participant	WP2 Budget (pm)	WP2 Realised 1st + 2nd period (pm)
SDLO	2.8	3.0
ILVO	1.5	2.2
CEFAS-DEFRA	1.4	3.6
Mar lab	1.5	0.9
IFREMER	1.7	2.4
MI	2.0	2.0
DTU-Aqua	10.5	10.5
AU-Bioscience	2.2	2.2
SLU	2.4	1.1
IMR	1.8	3.0
CNR	4.4	4.3
HCMR	1.0	3.4
CFRI	1.8	1.3
sum	35.0	39.8
remaining personmonths		-4.8

WP3 – BENTHIC ECOSYSTEMS

Lead: Partner 3 CEFAS (Andrew Kenny)

While the impacts of demersal fishing on the biological characteristics of the seabed have been well-studied, the approaches have tended to focus on assessing impacts on the structural (e.g. changes in species composition, diversity, etc.) characteristics of seabed biological assemblages. However, it is being increasingly appreciated that observing changes solely in the structural attributes of benthic assemblages provides only a limited capacity to inform us of the implications for, arguably far more important, ecosystem function. The present study aims to bridge this knowledge gap by analysing data regarding the biological assemblages of a large number of stations covering a range of habitats across the European continental shelf. We perform this using a biological traits analysis (BTA) in which the assemblages, and the differences between them, are quantified by their relative differences in the morphological, behavioural and life history characteristics of their individuals, as opposed to their taxonomic (i.e., based on species identity) differences. This BTA approach affords the opportunity to understand the potential differences in ecological functioning due to fishing impacts, beyond that which would otherwise be possible from structural approaches.

The relationship between benthic communities in terms of their traits and the corresponding seabed habitat characteristics is the focus for Task 3.1. Defining such relationships will allow habitats to be mapped not just in terms of their species composition but in terms of their functional properties.

The focus for Task 3.2 is to quantify and model the habitat functional relationships, particularly in relation to providing food for fish and the recycling of nutrients between the water column and the seabed.

Finally Task 3.3 aims to develop a generic risk based assessment method for the impacts of fishing on seafloor habitats.

Work progress and achievements during the period are reported below.

Task 3.1 – Links between benthic species traits, functions and habitat types

Lead CEFAS; Contributors Bangor, IMARES, IFREMER, DTU-Aqua, IMR, HCMR, CFRI, OMU, ILVO

Summary of progress

Traits data regarding the infauna (those organisms that live within the sediment) were available for 819 sampling stations, while for the epifauna (those living on the sediment), data for 1316 stations were analysed. BTA was undertaken on these two biological components independently. The infaunal stations were categorised into 13 EUNIS habitats (level 4) while the epifaunal data represented seven EUNIS (level 3) habitats. Additionally, the data for the infaunal stations were classed according to habitats that were derived following a k-means clustering approach of the environmental characteristics; this allowed an assessment (for the infauna) of the importance of using different habitat derivation methods for biological traits assessments over large spatial scales.

Using data from relatively non-fished stations, fuzzy correspondence analysis (FCA), a multivariate analysis approach particularly suitable for traits data, revealed that traits composition of infaunal and epifaunal assemblages did not vary markedly between habitats. This result was generally observed for all 10 of the infaunal, and 12 of the epifaunal, traits examined. Moreover, the proportional compositions of the various biological traits showed a high amount of within-habitat variability, even in the absence of moderate or high fishing pressure.

FCA was then used to allow an assessment of how biological trait compositions were related to total fishing pressure, both within and between habitats. The results suggested that the effects of fishing on trait compositions are complex; assemblages vary in their response both within and between habitats and, while some biological traits showed more-or-less consistent responses across habitats, others displayed varying relationships with fishing pressure across habitats. There is evidence to suggest that at least some of this habitat-specificity in response reflects differences in fishing gear, as opposed to differences in the inherent responses of the biological assemblages between habitats.

Clearly significant results

- The results show that, for the infauna, fishing generally results in reduced proportions of attached, stalked, epiphytic, non-bioturbating organisms and with increases in the proportions of free-living individuals. However, at the habitat scale, effects of fishing on trait compositions are complex; assemblages vary in their response both within and between habitats and, while some biological traits showed more-or-less consistent responses across habitats, others displayed varying relationships with fishing pressure across habitats. There is evidence to suggest that at least some of this habitat-specificity in response reflects differences in fishing gear, as opposed to differences in the inherent responses of the biological assemblages between habitats.
- Although we observe a general similarity in traits composition between habitats under no or low fishing pressure, some trait differences were discernible. A5.24 (infralittoral muddy sand), for example, contained a much lower numerical proportion of tunic (morphology) and short-lived (longevity) trait categories and a higher proportion planktonic larval recruiters (larval development mode) compared to some, but not all, habitats. Similarly, the assemblages of the deep, cold regions (Cluster 3) were numerically dominated by different trait categories (increased proportions of sessile, tube-dwelling individuals) compared to those of other habitats. The results of this task have been used to develop and validate a methodology for assessing the risk of bottom fishing impacts on seabed habitats delivered under Task 3.3 (see below).

Deliverables

The research conducted under this task was concluded in month 26 and reported in D3.4. “Biological traits as functional indicators to assess and predict (using statistical models) the status of different habitats”. A condensed version of D3.4 will be resubmitted for publication.

Bolam, S.G., Eggleton, J.D. (2014). Macrofaunal production and biological traits: Spatial relationships along the UK continental shelf. Journal of Sea Research.

Deviations: None

Failing to achieve objectives: None

Task 3.2 – Modelling benthic ecosystem processes

Lead CEFAS; Contributors Bangor, IMARES, IFREMER, DTU-Aqua, IMR, HCMR, CFRI, OMU, ILVO

Summary of progress

An important consideration in assessing the impacts of fishing on seabed habitats is to understand the functional links (as trophic interactions) between populations of demersal fish species and benthic invertebrate prey (food) which live on or in the seabed. This has been addressed in the present study through the development and application of statistical and dynamical models which have integrated the outcomes of Task 3.1 with the fish stomach contents trait analysis conducted in Task 3.2. A workshop was convened at IMARES in July 2015 to facilitate the integration of WP3 (Task 3.1 and Task 3.2) findings and to discuss the how the results support the approach to address Task 3.3 (“fishing/habitat risk assessment”).

With respect to assessing the predator (fish) and prey (benthic invertebrate) interactions the present study addresses two important questions, namely; **i.** what type of sea-bed habitats serve as important feeding areas for different species of demersal fish, and **ii.** what, if any, differences do we observe in habitat preference and diet associated with different size classes of demersal fish, both within and between different fish species.

A total of 26,400 records derived from 243 distinct research cruises, spanning the period 1990 - 2012 were used in the stomach contents analysis which involved re-classifying the contents in term of their traits composition.

Central to answering these two questions is the need to ensure that the sea-bed habitat characteristics are assessed and described at a scale appropriate to the operation of the fisheries and the assessment of demersal fish stocks and therefore this analysis was focused on the North Sea.

The benthic food web model developed in this task provides a framework that can easily be parameterized for different regions. The average size and background mortality need to be specified for a regional system based on the characteristics of the species represented in a group and if necessary also the impact of fishing on the different groups. The grouping itself into scavengers, filter feeders and deposit feeders holds for all regions studied within the BENTHIS project, including the north-east Atlantic region and the Mediterranean (BENTHIS D4.3).

Clearly significant results

- The study defined and described 6 habitat classes at a scale relevant to fisheries in the North Sea, Skagerrak and Kattegat (Table 1). It is likely that these fisheries related habitats are also present and relevant to other regions in the EU.

Table 1. *Description of each of the six fishery relevant habitat clusters located in the North Sea, Skagerrak and Kattegat*

Habitat cluster	Habitat characteristics and location
1	Mainly comprises infralittoral fine and muddy sand (A5.23/A5.24), with smaller areas of circalittoral fine and muddy sands (A5.25/A5.26), infralittoral coarse sediment (A5.13) and infralittoral fine and sandy muds (A5.33/A5.34). Located across the Dogger Bank, coastal areas of the eastern North Sea and Skagerrak and in the Kattegat
2	Heterogeneous habitat cluster comprising circalittoral and deep sands A5.25/A5.26 and A5.27, along with areas of circalittoral and deep coarse sediments (A5.14 and A5.15). Patches of rock (A4.2) and fine/muddy sands are also present. Located in the coastal waters of the western North Sea, Orkney and Shetland, in isolated areas of the North Sea and in the Skagerrak and Kattegat.
3	Mainly comprises circalittoral fine and muddy sands (A2.25/A5.26) with smaller areas of infralittoral fine and muddy sands (A5.23/A5.24), mud (A5.35/A5.36) and coarse sediment (A5.14). Located across the southern North Sea, Central North Sea and German Bight
4	Deep sea muds (A6.5) and sands (A6.3/A6.4 and A5.27). Located in the Norwegian trench off the southern coast of Norway
5	Dominated by deep sandy sediments (A2.27). Located north of the Dogger bank in the western North Sea
6	Mainly comprises deep muds (A5.37) and to a lesser extent deep sands (A5.27). Located in the Fladen Ground of the northern North Sea and two ICES rectangles in the deeper waters of the Skagerrak.

The spatial location of these habitats along with their relationship to EUNIS level 3 habitat classes is shown in Figure 3.1.

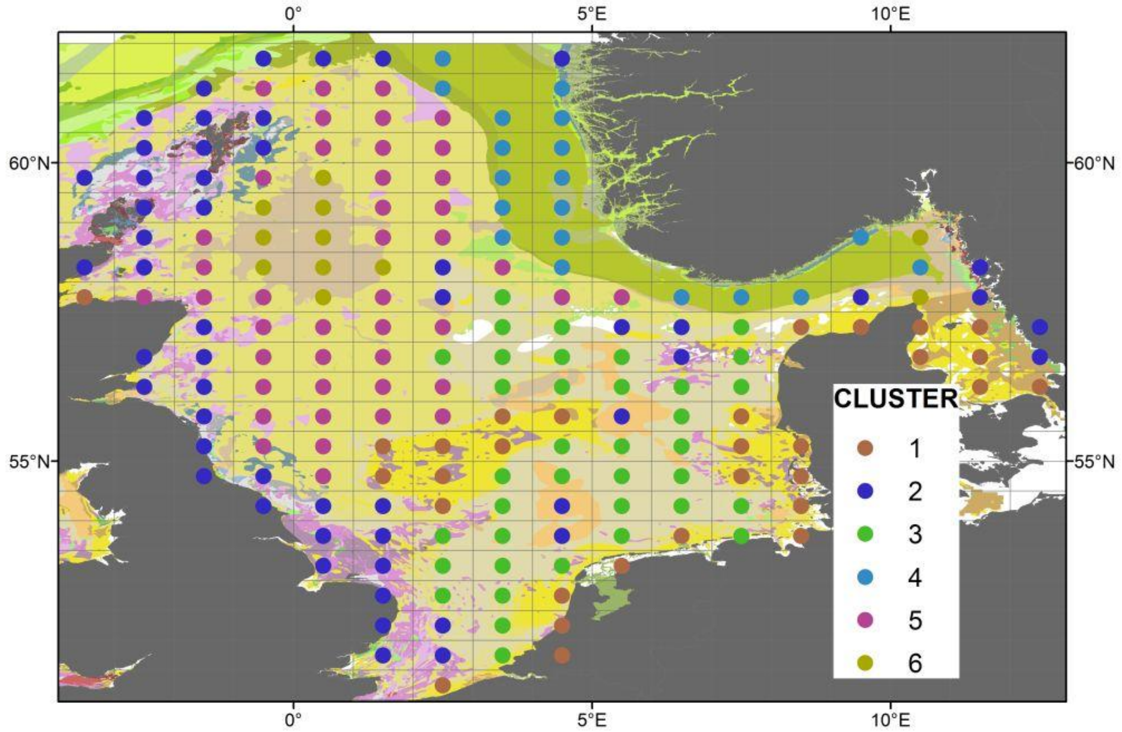


Figure 3.1. *Spatial location of the six (fishery habitat) clusters overlaid on EUSeaMap EUNIS habitat map for the North Sea.*

The study found strong associations between community trait composition and prey consumed by all fish (especially plaice) of all sizes under fished conditions for a shallow sand – muddy sand habitat located in the eastern North Sea and Dogger Bank (fishery habitat Cluster 1 – see Figure 2). This result suggests that there is some positive association between fishing and the presence of fish (especially plaice) associated with the fishery habitat cluster 1. By contrast, Long rough dab, haddock, cod and whiting did not appear to target fauna that was abundant in the environment within any one of the habitat clusters under either fished or unfished conditions. These species may therefore be less affected by changes in fishing pressure on a wide range of habitats than those species (such as sole and plaice) which favour living in closer association with the benthic environment.

Deliverables

The research conducted under this task was concluded in month 36 and reported in D3.5. "Functional links between sea-bed habitats and demersal fish stocks (A generic model of benthic productivity, diversity and natural disturbance, and a dynamic food web model of benthic ecosystem function)"

Deviations: The aim of Task 3.2 in WP3 was to statistically model the relationship between macrobenthic functions and seabed disturbance. E.g. productivity being one of those functions along with fishing pressure as a proxy for disturbance. The present report has achieved this using biological traits as proxies of functions (including productivity). The present report therefore deviates only in terms of the specific methods used and not in the aim or expected outcome. A change in method was required because of quantity and quality of data available for analysis precluded the use of the intended method, the method finally adopted was that of generating a series of ‘heat’ plots to statistically reveal the multivariate relationships between habitat type, disturbance and fish feeding. We further accept that the title for D3.5 deviates from the title given in the DoW, but actually the title of D3.5 in the DoW we feel does not accurately reflect the overall aim of Task 3.2, it simply highlights one aspect of Task 3.2 which is the assessment of the relationship between benthic productivity, diversity and disturbance – this was an oversight (on our part) at the time of drafting the titles for the list of deliverables in the DoW.

Failing to achieve objectives: None

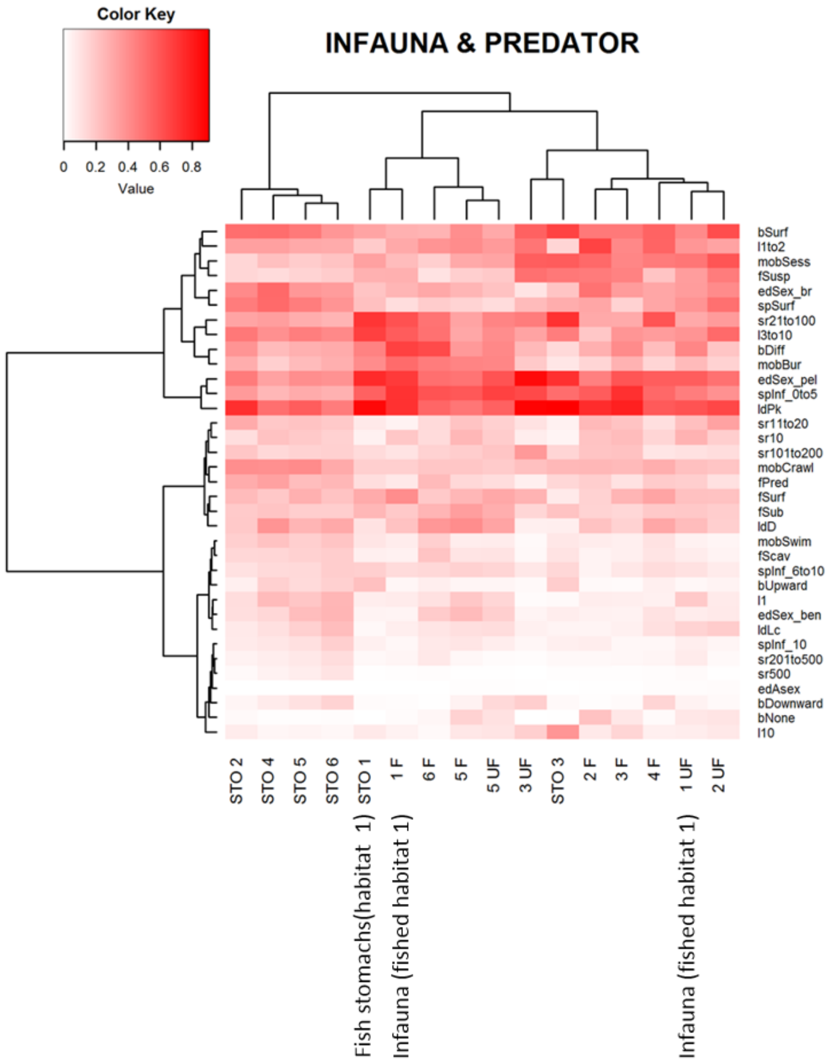


Figure 3.2. *Trait composition (weighted by abundance) of benthic prey items from stomachs (STO) of all predators combined for each habitat cluster (1-6) and trait composition of available infaunal prey in each habitat cluster under fished (F) and unfished (UF) conditions*

Task 3.3 – Integration

Lead Bangor; Contributors CEFAS, IMARES, IFREMER, DTU-Aqua, IMR, HCMR, CFRI, OMU, ILVO

Summary of progress

A workshop was convened at IMARES in July 2015 to facilitate the integration of WP3 and WP4 results and to discuss how results support the approach required to address the development of a generic fishing/habitat risk assessment framework.

The developed risk assessment framework can be used at regional and local scales. It considers the physical effects of trawl gears on the seabed, on marine taxa and the functioning of the benthic ecosystem. A reductionist approach is applied that breaks down a fishing gear in its components and distinguishes a number of biological traits that are chosen to determine the vulnerability of benthos for the impact of a gear component or to provide a proxy for their ecological role. The approach considers a wide variety of gear elements, such as otter boards, twin trawl clump and ground-rope, and, sweeps that herd the fish. The physical impact of these elements on the seabed, comprising scraping of the seabed, sediment mobilisation and penetration, are a function of the mass, size and speed of the individual component. The impact of the elements on the benthic community are quantified using a biological-trait approach, that considers the vulnerability of the benthic community to trawl impact (e.g. sediment position, morphology), the recovery rate (e.g. longevity, maturation age, reproductive characteristics) and the ecological role.

Clearly significant results

- The fishery/habitat risk assessment framework has been tested in three main seabed habitat types in the North Sea and the results of this have recently been published (Rijnsdorp et al., 2015). Preliminary results show that the sublittoral mud habitat is impacted most due to the combined effect of an intensive fishing and high proportions of long-lived taxa.
- The research conducted under this task was concluded in month 36 and reported in D3.6. “Fishing Sea-bed Habitat Risk Assessment (A framework towards the quantitative assessment of trawling impact on the sea-bed and benthic ecosystem)”
- Rijnsdorp, A., *et al.,* (2015). Towards a framework for the quantitative assessment of trawling impact on the seabed and benthic ecosystem. ICES Journal of Marine Science. (in press).

Deviations

None

Failing to achieve objectives

None

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D3.1	Minutes of workshop W1 (internal WP3 workshops)	3	11	CEFAS	yes	9/12/2013
D3.2	Minutes of workshop W2 (internal WP3 workshops)		23	CEFAS	yes	2/5/2014

D3.3	Minutes of workshop W2 on integration WP2, WP3 and WP4.	2, 3, 4	18	CEFAS	yes	2/5/2014
D3.4	Report and peer-reviewed paper on biological traits as functional indicators to assess and predict (using statistical models) the status of different habitats .	3	24	CEFAS	yes	30/9/2014
D3.5	Report describing the development and utilisation of a generic statistical model of benthic productivity, diversity and natural disturbance; and a dynamic food web model of benthic ecosystems function.	3	36	CEFAS	yes	30/09/2015
D3.6	Report and peer reviewed paper describing a generic model of fishing/habitat risk assessment	3	36	CEFAS	yes	30/09/2015

Use of resources

Participant	WP3	WP3
	Budget (pm)	Realised 1st + 2nd period (pm)
SDLO	4.2	7.6
ILVO	0.0	0.8
CEFAS-DEFRA	17.5	25.5
BU	5.5	1.8
IFREMER	4.1	3.3
DTU-Aqua	2.5	0.7
IMR	3.0	3.7
HCMR	2.7	3.0
CFRI	2.0	1.7
OMU	4.0	3.1
sum	45.5	51.3
remaining personmonths		-5.8

WP4 – EFFECT OF FISHERIES ON ECOSYSTEMS

Lead: Bangor University (Jan Geert Hiddink)

Bottom fishing affects seabed ecosystems in many ways. It directly changes the morphology of the seabed, resuspends sediment, releases nutrients, sends discards and offal to seabed ecosystems and kills and damages invertebrates. Over longer time scales, these direct effects and reductions in the abundance of benthic invertebrates result in chronic changes in the functioning of the seabed ecosystem such as changes in nutrient cycling, carbon storage and food availability to demersal fish. To ensure that seabed ecosystems are in a good state and minimize fisheries impacts, we need to be able to quantify and predict the large scale effects of fisheries on the state and functioning of these systems. WP4 will increase our understanding of the mechanisms through which fishing gears affect seabed ecosystems.

Work progress and achievements during the period are reported below.

Task 4.1 - Predicting the physical impact by towed demersal gears from fishing gear characteristics

Lead & Contributors: UNIABDN. Contributors: Mar Lab

Summary of progress:

The work undertaken for Task 4.1; there are three streams of this project where the main part is numerical modelling which is accompanied by laboratory studies and sea trials for the validation purposes.

Clearly significant results:

Laboratory study:

The experimental investigations were undertaken to evaluate experimentally the ground forces and the amount of disturbed sediment, focusing on the mount of soil formed in front of the ground fishing gear during bottom trawling when dragged along the seabed from the reduced scale modelling.

Three geometrically similar ground-gear models at different scales (λ=1, 1.5 and 2), with a value of aspect ratio (width:diameter) of 0.75, are specially designed to undertake this study. Dimensionless values for the depths (D=z/d) were set-up at 0.0625, 0.05 and 0.0375. Five different towing speeds (0.001, 0.03, 0.07, 0.11 and 0.138m/s) were tested at saturated conditions whereas a unique towing speed of 0.03m/s was tested at dried conditions. Forces evaluated from dried conditions correspond well to the fully drained situation (at a very slow towing speed or quasi-static).

The results obtained:

- forces increase linearly with the increase of the towing velocity until values up to 0.12m/s, where depending on the case a decrease or different trends are found.
- For modelling different scaled models, towing velocity was kept the same for each reduced scale model and no effect related to this parameter was found in the scaled up version of the ground forces (drag and vertical).
- Very good agreement for both forces drag and vertical is observed for most of the penetration depths and towing velocities tested. However, some disagreement is noticed for the drag force at the faster towing velocity for the reduced scale models with the respect to the full scale element.

Experimental study:

The range of gear components was chosen to simulate some of the groundgears, clump weights and doors used in demersal fisheries comprising disks, cylinders and doors of diameter/heights 200, 300 and 400mm.

The results obtained demonstrate

- that the geotechnical drag increases as the weight of the component increases;
- that, for the rolling circular disks and cylinders, the geotechnical drag tends to increase as the speed increases, and
- that, for the fixed circular disks and cylinders and the trawl doors, the geotechnical drag tends to decrease as the speed increases.

When the data were presented in terms of weight per unit area the results show that:

- the drag of the fixed elements is greater than that of the rolling ones;
- that the drag of the fixed cylinders is greater than the drag of the fixed disks; and that
- the drag of the rolling cylinders and disks are very similar.

Numerical study:

The influence that the dimensions, the weight, the cross-sectional geometry and the soil material properties have on penetration and drag of truncated rigid cylinders towed on fully saturated muddy soils and sandy soils have been investigated.

In general, over the parameter ranges examined for the muddy sediment:

- there is a non-linear increase in penetration and drag as the weight increases;
- there is a decrease in penetration and an associated reduction of drag as the Yield stress and Young's modulus increase.

We also examine the non-dimensional form of the problem and demonstrate that the penetration and drag values reduce respectively to single curves that are dependent solely, at least to a first order of approximation, on the non-dimensional weight, suggesting that the problem is essentially two-dimensional in nature and that three-dimensional effects at the edges of the clumps do not play a significant role.

Similar results were presented by Hambleton and Drescher (2008) who found that, for rigid cylinders on clays, there was no dependence on aspect ratio. On sands, however, and for rolling cylinders on drained soil, aspect ratio and three-dimensional effects have been shown to be significant (Hambleton and Drescher, 2009. These contrasting results highlight the need to ensure that our results are used appropriately. The elastic-perfectly plastic model, which we have used with a Poisson's ratio of 0.5, over a Young's modulus range of 2 – 10 MPa, relates to fully saturated soft clayey soils. Hence the formulations should apply to these types of substrates. In a fisheries context these include the highly productive muddy soils which support many important commercially exploited species such as *Nephrops norvegicus* (langoustine) and many species of demersal fish.

Deviations. None

Failing to achieve objectives. None

Task 4.2 - Predicting direct bottom trawl impacts on organisms from biological traits

Lead: BU. Contributors: CEFAS, IMR

Summary of progress

In task 4.2 we examined whether; (i) the initial effect of bottom fishing on the abundance of benthic invertebrates vary among species with different biological traits, (ii) the magnitude of response to fishing varies among different habitat types and fishing gears, and (iii) the temporal trajectory for recovery from bottom fishing activity varies among species with different biological traits. Systematic review methodology was used to conduct a comprehensive search of peer-reviewed scientific literature and grey literature and to compile a database of studies that documented and compared the biological effects of experimentally fished areas with bottom mobile fishing gear (the impacted area) to non-fished areas (the control area). The search was conducted in multiple electronic databases (e.g. Aquatic Sciences and Fisheries Abstracts, ISI Web of Science, Science Direct, Natural Environment Research Council UK, NOAA Library and information network catalog) and the internet (including organizational websites). Articles captured by the search were screened at title, abstract and full-text level. The final database consisted of 60 different experimental manipulations or observations of the effects of fishing disturbance on benthic fauna and communities. Meta-data including information on study descriptors (e.g. location, sampling design), effect modifiers (e.g. habitat type, type of fishing gear, intensity of fishing disturbance) and outcome measures (e.g. mean and variance measure for abundance, biomass and species diversity) were extracted from each study. Quantitative data synthesis involving meta-analysis was carried out by Bangor University and deliverable D4.3 was submitted to funding body on the 19th December 2014.

Clearly significant results

Bottom fishing resulted in significant negative impacts on total benthic community abundance; reductions were significantly higher following dredging (33% loss) compared to otter trawling and beam trawling (5% loss), and they were most severe for benthic communities in biogenic habitats and coarse and mixed sediment relative to sandy and muddy sediments. The effects of otter trawling on total benthic community abundance were short-lived and recovery was relatively quicker than for dredged areas, which were predicted to take about 3.5 years to recover. The damage from bottom fishing on communities in biogenic habitats may be irreversible as recovery did not appear to take place at any point after the disturbance. Recovery of total benthic community abundance in coarse and mixed sediment habitats was predicted to take up to a year after the fishing impact to occur, whereas only 5 months in sandy sediment. As for total community abundance, bottom fishing resulted in significant reductions in abundance in the fished area relative to the non-fished area for a number of modalities, and these differences were more pronounced following dredging than after otter trawling. Motility and burrowing behaviour proved to be important traits in determining vulnerability to dredging, as organisms that burrow deeper than the penetration depth of the gear may avoid fishing disturbance. Predatory species showed very little reduction in abundance in the fished area relative to the non-fished area (6% loss), whereas scavengers (35% loss), deposit feeders (37% loss) and suspension feeders (22% loss) proved vulnerable to dredging, as significantly lower densities of these organisms were recorded in the fished area. Dredging was also found to result in significant reductions of short-lived species (41% loss) and of sexually reproducing species that produce pelagic eggs (31% loss) and planktotrophic larvae (26% loss), which may have profound long-term implications for population recovery or for the recolonization of other impacted areas further afield that depend on an external source of larvae for their survivability.

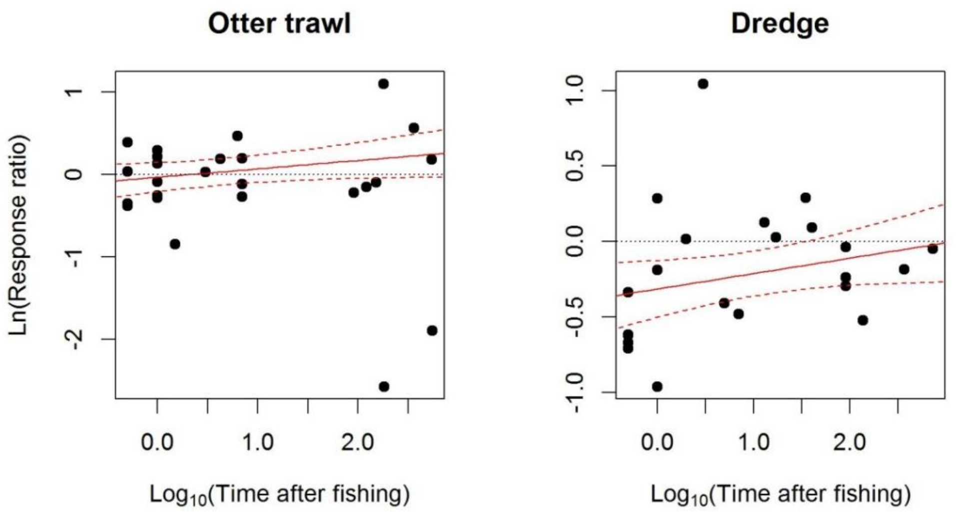


Figure 4.1. *The change in response of total benthic community abundance, estimated as the ln-transformed ratio of abundance in the fished area relative to the control area (Ln(Response ratio), through time following an otter trawling and dredging event. The vertical dotted line at (LnRR) = 0 represents equal abundance in fished and control area. The fitted model and 95% confidence intervals are plotted in red (Fitted model for otter trawling: y = -0.03 + 0.1log10time; fitted model for dredging: y = -0.31 + 0.1log10time*).

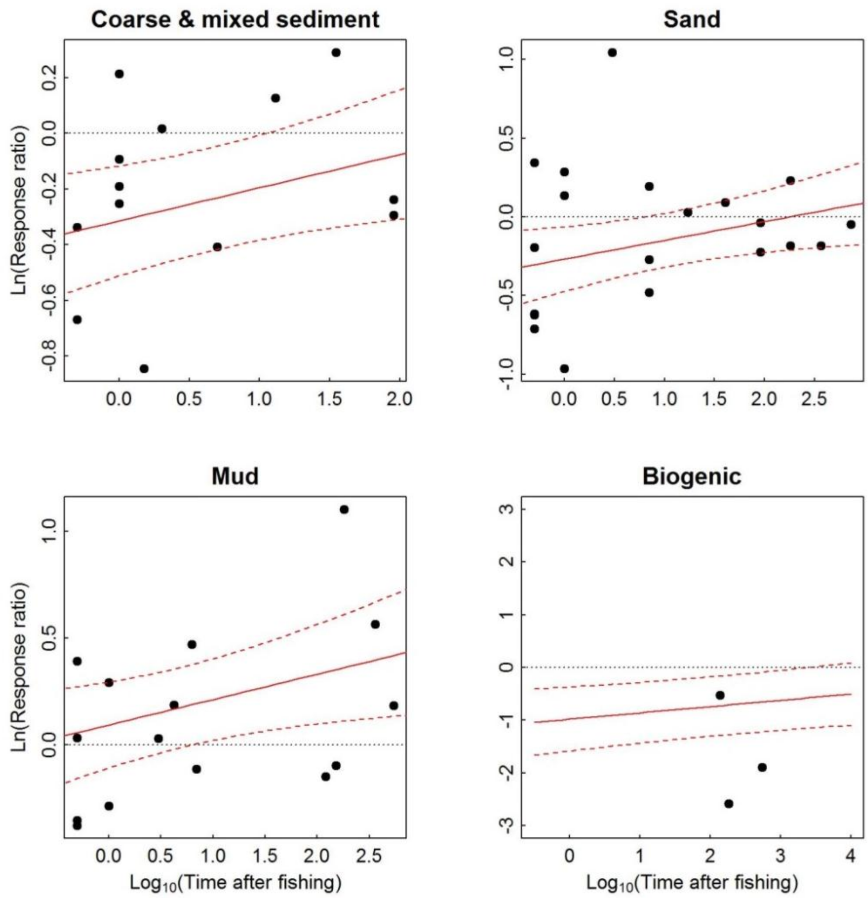


Figure 4.2. *The change in response of total benthic community abundance with time following a fishing event, for benthos occurring in coarse and mixed sediment, sand, mud and in biogenic substrata. The vertical dotted line at (LnRR) = 0 represents equal abundance in fished and control area. The fitted model and 95% confidence intervals are plotted in red (Fitted model for coarse & mixed sediment: y = -0.31 + 0.12log10time; fitted model for sandy sediment: y = -0.26 + 0.12log10time; fitted model for muddy sediment: y = 0.1 + 0.12log10time; fitted model for biogenic habitats: y = -0.98 + 0.12log10time).*

Deliverable

Deliverable 4.3: Predicting the effect of trawling based on biological traits of organisms and functional correlates of these traits to predict which functions may be disproportionally affected.

Deviations. None

Failing to achieve objectives. All objectives met

Task 4.3 - Quantifying resuspension of sediment and nutrient release by towed demersal gears

Lead: Mar Lab. Contributors: CEFAS

Summary of progress

(i) The analysis of the hydrodynamic drag and sediment mobilisation trials of the different gear components in contact with the seabed was completed.

(ii) Experimental trials to provide information on the net release of different nutrients immediately after resuspension took place in March 2015. These trials were originally planned for January 2014, but had to be called off owing to severe weather conditions for the whole of the 2 week cruise. They were also designed to investigate how nutrient release changes with time after a trawl pass i.e. longer-term changes in water chemistry following an acute disturbance. The overall aim was to provide a mechanistic approach to assess net nutrient release with respect to variable gear disturbance depth and evaluate resulting concentrations and nutrient specific, post-resuspension chemical processing within any associated plume. Experiments were run for differing depth of sediments (in relation to differing gear penetrations/disturbance horizons) and also different types of sediments (to reflect differing plume locations or concentrations and hence particle/dissolved phase interactions). By tracking differing nutrient flux behaviour, initial substrates and depths it was envisaged to develop a systematic approach to describing nutrient releases associated with gear disturbance (penetration or resuspension) for a discrete period post trawl.

(iii) A simple assessment of the significance of the nutrient flux due to direct trawling impacts was made for ammonium and nitrate. The relative impact is assessed by comparing with observed values of background benthic-pelagic nutrient fluxes. When supplemented by trawling intensity data and information on background fluxes the approach described here can form the basis for assessing the regional relevance of trawling to nutrient recycling. Because of the dependence of particle adsorption on redox conditions, calculation of the trawling flux for phosphorous was deemed to be too uncertain to estimate

Clearly significant results

The hydrodynamic drag and sediment mobilisation trials

- demonstrated the hydrodynamic nature of sediment mobilisation;
- reaffirmed the relationship between the amount of sediment put into the water column and the hydrodynamic drag;
- demonstrated that the weight (and presumably the penetration) of a component does not influence the amount of sediment mobilised.

Owing to the need to reschedule the experimental sea trails it has not been possible to analyse all of the data collected, nevertheless, it is clear that the type of data produced is novel and significant. Findings from these investigations will provide the basis for improvements in future modelling efforts. In due course this work will improve the assumptions underpinning future attempts at estimating scales of impacts and respective sensitivities of different sediment types to trawling induced resuspension.

Deliverables

Deliverable 4.4, entitled ‘Report on the model of sediment resuspension, particle size distribution and nutrient concentration behind towed demersal fishing gears’, has been delivered.

Deviations

The only deviation has been to the scheduling and subsequent data analysis due to the need to postpone the sea trials that were originally planned for January 2014 and only took place in March 2015.

Failing to achieve objectives

As explained above, some of the data analysis has been delayed, owing to the need to reschedule the sea trials that were originally planned for January 2014. This will still take place and be reported on during the next reporting period.

Task 4.4 - Quantifying food subsidies to the benthos due to discards and consequences for ecosystems

Lead: IFREMER. Contributors: IMARES, BU, DTU-Aqua, ILVO

Summary of progress

Fisheries’ discards subsidize a large community of scavenging seabirds and have significantly influenced evolutions in seabird numbers, composition and seabird ecology. Moreover, the selective extraction of discards by seabirds determines the availability of discards as a food source for non-avian marine scavengers, such as meso-pelagic and benthic fauna. In order to quantify this discard partitioning, both temporally and spatially, a framework was developed that integrates data concerning spatio-temporal variation in seabird distribution, seabird attraction to fishing vessels and discard distribution. This framework, whose end product is an estimation of discard consumption by seabirds over space and time, was applied in a case study in the Bay of Biscay. In that case study, a high variation was observed in discard consumption by seabirds across seabird foraging guilds, discard types, semesters and locations. Seabirds took off with about one quarter of the total discards in the Bay of Biscay; the remaining discards sank. These sinking discards have a limited potential to subsidize scavenging benthic communities on a large scale, but they may provide a substantial contribution to the diet of scavengers on a local scale. Hence, changes in subsidies by discard mitigation measures, such as the Landing Obligation of the European Common Fisheries Policy, are likely to have ecosystem effects, especially on scavenging seabirds but also on non-avian scavengers.

Future work planned

The region-wide contribution of discards to changes in seabird foraging ecology and populations is not likely mirrored in similar, large-scale changes in scavenging populations in the water column, on or in the seabed. On the local scale discards may, however, be substantial. Future work will focus on the main scavenging epibenthic invertebrates, because they can be assumed as the primary ecosystem component taking profit from discards besides demersal fish. Literature review will identify the main scavenging taxa and provide a state-of-the-art on our current understanding of their discard consumption rates. These discard consumption rates will be compared to the allometric metabolic requirements of the identified epibenthic invertebrates and as such, be used to estimate the potential contribution of discards to the energetic requirements of epibenthic scavengers.

Clearly significant results

D4.5 was due to month 24 (September 2014) and has been published (Report D4.5: 'Quantifying food subsidies to the benthos due to discards').

Scientific papers (in preparation):

- Depestele, J., Rochet, M.J., Dorémus, G., Laffargue, P. and Stienen, E.W.M. (under review). Favorites and leftovers in the menu of scavenging seabirds: modelling spatio-temporal variation in discard consumption. Canadian Journal of Fisheries and Aquatic Sciences. (Task 4.4)

Phd chapters:

- Depestele, J., Rochet, M.J., Dorémus, G., Laffargue, P. and Stienen, E. 2015. Chapter 8: Partitioning discards between birds and scavengers in the sea. In: Depestele, J. 2015, The fate of discards from marine fisheries. PhD thesis Ghent University. Gent, Belgium. 286pp.
- Depestele, 2015. Chapter 9: Partitioning discards between birds and scavengers in the sea. In: Depestele, J. 2015, The fate of discards from marine fisheries. PhD thesis Ghent University. Gent, Belgium. 286pp.

Deviations. See below.

Failing to achieve objectives.

D4.5 reports on the work conducted in Task 4.4. In to the Description of Work for BENTHIS, the aim of this task were defined as: (1) To produce large scale estimates of energy supplied to the seabed by discards and offal from both demersal and pelagic fisheries; (2) Quantify this energy source relative to normal energy flows. In addition, the following points were mentioned in the DoW, although it was not explicitly written that they would be part of the deliverables: (3) This task will determine if the energy flows by discards are important enough to require inclusion in ecosystem models; (4) A systematic review of literature that relates to empirical studies of scavenging by seabed biota on trawl discards will identify those species likely to be the end point recipients of energy from offal and discards; (5) Data from other sources (trawl surveys, statutory benthic surveys) will quantify the proportion of scavenging biota at a community scale and will take account of spatial variation; (6) This will lead to identification of the locations where ecosystems are likely to change as a result of a discarding ban.

Point 1, 3 and 4, and to some extend point 2, are addressed in D4.5. Point 2 has also been addressed in Deliverable D4.7, in section D4.7.2 ('Indirect effects of bottom fishing on the productivity of marine fish'), and this information is not repeated here.

Unfortunately we have not been able to address elements 5 and 6. The reason for this is that we have been we have been too ambitious in the description of work and promised too much, especially given that there were only 6 person months available to complete this task. In reality, the amount of effort that was put into the partial completion of D4.5, in particularly by ILVO, already significantly exceeds these 6 months. Completing point 5 and 6 would require a major amount of data collation and analysis, and this is not realistic at this stage.

In addition to this, the H2020 project Discardless has also started. The focus of all of WP1 in Discardless is on the effect of discards on the benthic ecosystem, including the consumption of discards by benthic scavengers, and therefore has much more resources available to address the same questions as WP4.4. This was not known at the time BENTHIS started, but means that we have been 'overtaken' Discardless, and that putting more resource into D4.5 is probably just duplicating work that is being done in more detail by Discardless. In the ideal world we would have completed this work before Discardless got started so they could build on our work, but the time-scales of the two projects did not allow this, and this means that is seems a better use of resources to concentrate our efforts on the core activities of BENTHIS. The ecosystem effects of discarding were never planned to contribute to the synthesis of understanding in WP1 and 6 of BENTHIS, and D4.5 was always planned to be a stand-alone piece of work. Because of this, the fact that D4.5 is incomplete will not affect the overall aims of BENTHIS.

Task 4.5 - Quantifying the large scale effect of chronic bottom trawling on ecosystem functioning

Lead: BU & CEFAS. Contributors: IMARES

Summary of progress

This task quantified the long-term and large-scale impact of chronic bottom fishing (by scallop dredges and otter trawls) on benthic community structure and sediment biogeochemistry across a gradient of bottom fishing pressure in muddy and sandy sediments. A research cruise on the RV Prince Madog was carried out between the 28th of June and the 6th of July 2014 to collect infaunal samples and biogeochemical measurements. Infauna and sediment samples were processed by Bangor University, whereas chlorophyll, porosity, organic carbon & nitrogen, pore-water nutrient concentration, oxygen profile and Sediment Profile-images were processed by CEFAS. Data analyses of all the datasets were carried out at Bangor University and deliverable D4.6 was submitted to funding body on the 30th September 2015.

Clearly significant results

This work highlighted that the impacts of fishing on fauna and sediment biogeochemical parameters are influenced by the type of sediment and gear type and also by the history of exploitation of the areas studied. The sandy habitat (> 90% sand) was typical of a hydrodynamic environment characterized by a diverse array of small infaunal species, low organic carbon levels and fast remineralisation of organic matter in the sediment. The muddier habitat (> 60% fines) was dominated by fewer but larger bioturbating species compared to sand, and illustrated highly diffusional solute transport, higher organic carbon content and a shallower oxygen penetration depth. The biogeochemistry at the sandy site appeared to be dominated by the natural physical environment, so the impact of fishing disturbance was less evident. In contrast, fishing was an important regulatory factor in the muddy habitat. Pore-water nutrient profiles of ammonium, phosphate and silicate provided evidence of organic matter burial and/or mixing as a result of trawling at the muddy sites.

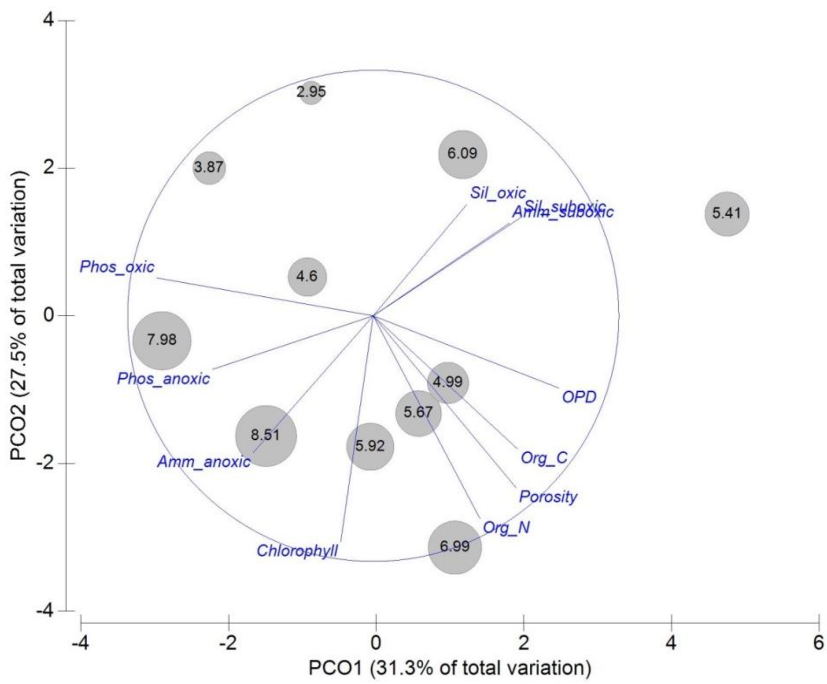


Figure 4.3. *Principle Co-ordinates analysis for the biogeochemical parameters at the muddy sites (OPD: oxygen penetration depth, Org_C: organic carbon content, Org_N: organic nitrogen content, Porosity, Chlorophyll, Amm/Phos/Sili_oxic/suboxic/anoxic: concentration of NH4+, PO43-, SiO4- at 0 – 2 cm, 2 – 5*

cm, 5 – 20 cm, respectively). The fishing frequency is shown for each station sampled. Bubble size is proportional to the fishing frequency at each station.

Deliverables

Deliverable 4.6: The effects of chronic trawling on a suite of ecosystem processes including functional GES indicators and their reference levels from empirical measurements and a benthic ecosystem model

van Denderen, P. D., S. G. Bolam, J. G. Hiddink, S. Jennings, A. Kenny, A. D. Rijnsdorp and T. van Kooten (2015). "Similar effects of bottom trawling and natural disturbance on composition and function of benthic communities across habitats." Marine Ecology Progress Series 541: 31–43.

Deviations: None

Failing to achieve objectives: All objectives met

Task 4.6 - Quantifying the indirect effect of fishing of prey availability for commercial fish species

<u>Lead & Contributors: BU, IMARES</u>

Summary of progress

Task 4.6. brings together the results of several different studies that have examined the effect of bottom trawling on the food intake, condition and population productivity of trawled demersal fish populations. It combines the results of empirical and modelling studies, and synthesizes the available knowledge from the literature in order to give the most comprehensive overview of the topic so far. All planned work and D4.7 were completed in September 2015

The large amount of work done under this WP shows that there is no strong evidence to suggest that bottom trawling has substantial positive or negative effects on commercial fish populations by affecting their food supply.

Clearly significant results

Some effects of bottom trawling, both positive and negative, on the food intake and condition of commercial fished species was evident at local scales and in models, but such effects were not detected over larger spatial scales. The detected empirical effects at local scales were quite subtle. An effect that can be hard to detect at the local scale will be even weaker when viewed at the shelf sea scale. The effect on those populations that range widely will also be rather small and diffuse. As mentioned before, the effects can be both positive and negative, but there exists only little empirical evidence for positive effects. The models predict that the effects of trawling can be substantial and both positive and negative, but only under a limited set of conditions, at low trawling for species with specific diet. It seems that the flexibility of the diet of fish helps them in overcoming effects of trawling, especially when they can shift to less sensitive prey, which lead to increases in food availability.

Deliverables

All deliverables for WP4 were submitted within the correct reporting period, and most of them were submitted before the due date. Only D4.5 and D4.3 were submitted a few months late.

Deviations: None

Failing to achieve objectives: None

Deliverables

Deliverable No	Deliverable name	WP No	Delivery month	Assigned to	submitted	subm. date
D4.1	Minutes of workshop W6 on integration WP3, WP4 and WP7	3, 4 , 7	36	BU	yes	31/8/2015
D4.2	Ranked list of components of a fishing gear that have the most physical impact and proposed measures to develop gears that are more environmentally friendly.	4	36	BU	yes	30/09/2015
D4.3	Report that predicts the effect of trawling based on biological traits of organisms and functional correlates of these traits to predict which functions may be disproportionally be affected. This analysis is then used to develop indicators of GES	4	24	BU	yes	12/1/2015
D4.4	Report on the model of sediment resuspension, particle size distribution and nutrient concentration behind towed demersal fishing gears.	4	24	MI	yes	30/09/2015
D4.5	Report on the quantification of discard flow to the seabed, relative to natural food sources.	4	24	IFREMER	yes	12/1/2015

D4.6	Report on the effect of chronic trawling on a suite of ecosystem processes including functional GES indicators and their reference levels from empirical measurements and a benthic ecosystem model.	4	36	BU	yes	30/9/2015
D4.7	Report on empirical and modelled small and large scale interactions between benthos, fish and trawl fisheries, focusing on the effect of trawling on fish condition	4	36	BU	yes	30/9/2015

Deviations

None

Failing to achieve objectives

None

Use of resources

Participant	WP4 Budget (pm)	WP4 Realised 1st + 2nd period (pm)
SDLO	5.7	6.3
ILVO	1.1	8.8
CEFAS-DEFRA	15.8	11.8
BU	18.6	14.8
UNIABDN	25.2	30.2
Mar lab	9.3	10.9
IFREMER	4.9	2.2
DTU-Aqua	3.2	2.2
IMR	0.5	0.0
sum	84.3	87.2
remaining personmonths		-2.9

WP5 - ECONOMICS

Lead: LEI-DLO

The main objective of this work package is to provide a methodological framework to all case studies to perform economic analyses of management measures and to provide tools to be applied in the Case Study Tasks. To ensure the consistency of the economic analysis and match the heterogeneity of data in the case studies, the tools provided will be generic and flexible to allow the investigation of the effect of gear substitution without or with dynamic response from the fleet.

The WP progress follows the plan (see details by tasks).

The WP5 partners have participated to one workshop focussing on the inclusion of the economic work with the other work packages in the second 18 months period. The workshop W5 was held during the general assembly meeting in Lisbon in March 2015.

Task 5.1 - Development of a framework for the analysis of economic performances of alternative fishing gears.

Task leader: IFREMER, contributors: CNR, UCPH, LEI

Summary of progress

The task 5.1 is the development of a framework for the analysis of economic performances of alternative fishing gears. This task is led by IFREMER. The model development is completed and the model was delivered in October 2014 as D 5.2.

Significant results

- The model was delivered in deliverable 5.2 and is now being applied to case studies
- Guillen, J., Macher, C., Merzéréaud, M., Fifas, S., Guyader, O., 2014. The effect of discards and survival rate on the Maximum Sustainable Yield estimation based on landings or catches maximisation: Application to the Nephrops fishery in the Bay of Biscay. Marine Policy 50 207-214.

Task 5.2 - Short-term fleet adaptations and management.

Task leader: IMARES, contributors: IFREMER

Summary of progress

The task 5.2 is the development of a short-term fleet dynamic model simulating the adaptations of the fishing fleets to management. This task is led by IMARES. The model is available as an R package and will be applied in the North Sea case study, other applications are still unclear but not expected as the data availability is key to parameterise the model and some case studies have their own models.

Significant results

- The model was delivered in deliverable 5.3
- Batsleer J, Hamon KG, van Overzee HMJ, Rijnsdorp AD, Poos JJ. 2015. High-grading and over-quota discarding in mixed fisheries. Reviews in Fish Biology and Fisheries. 10.1007/s11160-015-9403-0

- Batsleer, J., Rijnsdorp, A.D., Hamon, K.G., van Overzee, H.M.J., Poos, J.J., 2016. Mixed fisheries management: Is the ban on discarding likely to promote more selective and fuel efficient fishing in the Dutch flatfish fishery? Fisheries Research 174 118-128.

Task 5.3 - Modelling investment in innovative techniques.

Task leader: LEI, contributor: UCPH, CNR, IFREMER

Summary of progress

This task is the last on-going task of WP5. The first step was a literature review of real option theory in investment behaviour completed by CNR and circulated to other partners. We are now in the second step, formalising the real option theory with a discrete choice model to evaluate the potential investment in new gears. Additionally, interviews were made in some case study to gather information on the drivers of investment. This task is on track to deliver the Report on investment theory, its application in fisheries and the lessons on key factors influencing the investment behaviour (D5.4) in month 54.

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D5.1	Minutes of workshop W3 on integration WP5 and WP6	5, 6	18	LEI	yes	13/05/2014
D5.2	Documented framework to analyse the economic performances of alternative fishing gears	5	24	LEI	yes	1/10/2014
D5.3	Documented fleet dynamics module of spatial allocation of fishing effort	5	32	LEI	yes	31/8/2015
D5.4	Report on investment theory, its application in fisheries and the lessons on key factors influencing the investment behaviour.	5	54	LEI	no	

Deviations

None

Failing to achieve objectives

None

Use of resources

Participant	WP5 Budget (pm)	WP5 Realised 1st + 2nd period (pm)
SDLO	15.7	7.2
IFREMER	5.6	6.7
DTU-Aqua	0.4	0.1
UCPH	5.2	5.2
CNR	7	4.2
CFRI	2.9	2.5
sum	36.8	25.8
remaining personmonths		11.0

WP6 - MANAGEMENT

Lead IMARES (Gerjan Piet). Contributions LEI, ILVO, CEFAS, MarLab, IFREMER, MI, DTU-Aqua, IMR, CNR, HCMR, CFRI

This WP will develop innovative management tools and test their performance in achieving a sustainable fishery in regional case studies (WP7). Through the development of decision-support tools we intend to ascertain an optimal use of this scientific basis in the management context of the EU (Common Fisheries Policy and Marine Strategy Framework Directive as part of the Integrated Maritime Policy).

A workshop was organised to discuss integration of previous BENTHIS WPs towards management strategy evaluation (MSE) in Task 6.3. The aim of this workshop was slightly expanded so that instead of a mere integration of WPs 5, 6 and 7 it was now intended to guide the flow of information from the WPs 2-5 into WP6, and from WP6 into WP7. The focus of WP6 was primarily on the development and application of the Task 6.2 decision-support tools (DSTs), including: Multi-criteria analysis (MCA) and Footprint management.

Footprint management DST will be using information from WPs 2, 3 and 4 to parametrise the risk assessment on which this is based.

The WP5 bio-economic models that are being developed within BENTHIS WP5 are supposed to provide the socio-economic indicators for the Management strategy evaluation. The models have different use and different applications, the first model, SENSECO is a simple model that perform static comparative analysis, the second model includes fleet's short term responses to mitigation measures in terms of fishing strategy and the third model will attempt to capture the long term response of the fleets to the introduction of technological innovation and the investment behaviour in alternative gears.

Flow of information from WP6 into WP7: for each EU region case study management scenarios (primary and secondary) are identified. For the primary management scenarios it is expected that indicators (qualitative or quantitative) are provided for each of the MSE criteria and that the spending of case study resources ascertains these management scenarios are completed before the deadline. Every case study should have a minimum of two primary management scenarios. Remaining resources can be used for the secondary management scenarios for which not all MSE criteria need to be covered by indicators.

Finally, the MSE will be based on a comparison of the selected indicator values (see section 2) under the different management scenarios at different moments in time. This results in the following design for the MSE: (i) Baseline and Business as Usual (BaU): This will be some recent year (e.g. 2010) under the existing management strategies; (ii) Short term (3 years): BaU versus BaU + each new management scenarios; (iii) Long-term (20 years): BaU versus BaU + each new management scenarios.

Task 6.1 - Evaluation of possible management measures

Summary of progress

The work for this task has been done during the 1st reporting period. During the this reporting period, the draft deliverable has been completed and submitted.

Clearly significant results

The deliverable consists of a review of the existing indicators, the policy requirements and the various aspects of the benthic ecosystem and the services is provides that need to be considered when evaluating the performance of management measures aimed at mitigating fishing impact on the benthic ecosystem.

Deviations: None

Failing to achieve objectives: none

Task 6.2 - Development of decision-support tool(s)

Lead: LEI,; Contribution IMARES

Summary of progress

For the development of decision-support tools (DSTs) we distinguished different levels of decision-making for which DSTs can be developed. One is at the level of the fisher where the actual fishing activity involves a vast array of decisions that not only determine the composition and size of the catch but also the fishing impact on the seafloor. The other is at the level of the fisheries manager where the decision-making is complex and involves uncertainty, multiple objectives and multiple stakeholders. Objectives may be conflicting, and there can be disagreement between stakeholders who are involved in the decision-making process.

Two different decision-support tools were developed:

- Seafloor Impact Risk Reduction (SIRR) aimed to reduce the impact of fishing on the seafloor through a change in the behaviour of the fisher. This also has the potential to be developed into a management tool.
- Multi-Criteria Analysis (MCA) for the evaluation of management strategies taking stakeholder preferences into account.

The SIRR is based on an ecological risk assessment which, in line with the requirements of the DPSIR framework often applied for Ecosystem-Based Fisheries Management (EBFM), can cover both the pressure caused by fishing, as well as the degree to which the seafloor and its benthic community are impacted. The DST aims to achieve a reduction of the risk that the seafloor is impacted through a change in behaviour of the fishers. This change in behaviour should be accomplished by providing the fishers with a detailed spatial map showing the areas where seafloor integrity is closest to the policy goal of “Good Ecological Status”(GES) and hence the risk that the seafloor is impacted is highest, together with an incentive to avoid those areas. Various fisheries credit systems exist which have shown considerable potential for incentivizing changes towards achieving management goals that improve the environmental performance of fisheries. However, incentivizing a reduction of fishing impact on the seafloor can only be achieved if this does not reduce their catch opportunities. To that end we studied the relationship between the status of the seafloor (i.e. seafloor integrity, SI) and the fishing impact on the seafloor (i.e. uptake of Seafloor Integrity Quota, SIQ) with the catch opportunities reflected in four metrics that capture the catch opportunities of the fleet and its performance in terms of its catch efficiency in relation to swept area or seafloor impact. This showed that the highest efficiencies are achieved in the areas with the lowest SI and thus least SIQ uptake confirming the potential of the SIRR as a tool that reduces the fishing impact on the seafloor.

MCA is a quantitative tool which evaluates the impact of fisheries on the benthic ecosystem taking stakeholder input into account. Making the stakeholder preferences explicit can lead to a greater understanding of different stakeholder positions and thus increase awareness of the issues involved and the root of any conflict. It is proposed that the multi-criteria analysis is based on the Analytical Hierarchy Process. The value that stakeholders’ attach to objectives of fisheries management is calculated using pair-wise comparison. The tool is designed to be used by case-study leaders.

Clearly significant results

The tools have been developed and are about to be applied within the project. This will be reported in subsequent periodic reports.

Deliverables

Deliverable 6.3 was finished and uploaded

Deviations: none

Failing to achieve objectives: none

Task 6.3 - Management Strategy Evaluation

Lead: IMARES; Contribution: LEI, CEFAS, IFREMER, DTU-Aqua, IMR, HCMR, SME's

Summary of progress

No work has been done on this task yet

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D6.1	Minutes of workshop W7 on integration WP5, WP6 and WP7	5, 6,7	36	IMARES	yes	30/9/2015
D6.2	Report review management measures	6	18	IMARES	yes	18/08/2014
D6.3	Report development and application decision-support tool(s)	6	32		yes	30/9/2015
D6.4	Report Management Strategy Evaluation and performance test of the decision-support tool(s)	6	54	IMARES	no	

Deviations

Half year delay in submitting deliverable D6.2

Failing to achieve objectives

None

Use of resources

Participant	WP6 Budget (pm)	WP6 Realised 1st + 2nd period (pm)
SDLO	17.3	9.1
ILVO	0.4	0.7
CEFAS-DEFRA	0.9	0.2
BU	1.0	0.8
Mar lab	0.4	0.0
IFREMER	3.0	0.9
MI	0.5	0.0
DTU-Aqua	3.6	0.3
IMR	0.6	0.0
CNR	0.3	0.3
HCMR	3.3	2.5
CFRI	0.5	0.4
SME01	0.1	0.0
SME03	0.1	0.0
SME05	0.1	0.0
SME07	0.1	0.0
SME08	0.1	0.0
SME09	0.2	0.0
Tecnopesca	0.1	0.0
SME15	0.1	0.0
SME17	0.1	0.0
sum	32.8	15.1
remaining personmonths		17.7

WP7 CASE STUDIES

Lead CNR (Antonello Sala)

Introduction

The Case Study WP has the following objectives which will be studied in five regional European Seas:

- To assess the current trawling impact;
- To make an inventory of the options for mitigation;
- To collaborate with the fishing industry SMEs to study the biological and economic impact of alternative fishing gears;
- To collaborate with the fishing industry SMEs and other stakeholders to explore innovative management scenario's to mitigate effects of fishing on the benthic ecosystem and quantify the ecological and economic consequences on the fishery and related industries.

The WP is organized in five case studies each one approached with four tasks:

- Task 1: assessment of the current trawling impact
- Task 2: options for impact mitigation
- Task 3: testing alternative gears
- Task 4: Innovative management scenario's
- Task 5: local coordinating meetings

The regional approach allows us to closely collaborate with the fishing industry SMEs and other stakeholders to develop and assess the possibilities for mitigating the adverse impact of the current fisheries on the benthic ecosystem by technological and management innovations.

The activities carried out among the regional case studies focused mainly on the evaluation of possible option for impact mitigation and on the tests of alternative gears. Many feedbacks and suggestions on how to carry on the research activity came from regional case studies and stakeholder meetings held during 2013 and first months of 2014, whereby a tentative settle of possible actions were discussed and ranked.

A detailed activity report of each regional case study is below reported.

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D7.1	Minutes of the Regional Case Study Meetings (RWP1)	7	4	CNR	yes	26/6/2013
D7.2	Minutes of the Regional Case Study Meetings (RWP2)		16	CNR	yes	24/7/2014
D7.3	Minutes of the Regional Case Study Meetings (RWP3)		32	CNR	yes	30/09/2015

D7.4	Minutes of the Regional Case Study Meetings (RWP4)		44	CNR	no	
D7.5	Report of Workshop on integration Case Studies (W4)	7	18	CNR	yes	9/7/2014
D7.6	Report on trawling impact in regional seas	7	18	CNR	yes	30/09/2014
D7.7	Report on options for mitigation fishing impacts in regional seas	7	18	CNR	yes	20/10/2014
D7.8	Report on results of sea trials in regional seas	7	30	CNR	yes	30/09/2015
D7.9	Report on technological innovations and management scenario's to mitigate fishing impacts on the benthic ecosystem and their socio-economic consequences in regional seas	7	48	CNR	no	
D7.10	Peer reviewed paper on fishing impact on feeding patterns for selected species as indicator of benthic community structure and food webs compared to benthic bio-diversity to establish functional relationships between fish and benthos given fishing intensity.	7	48	DTU-Aqua	no	
D7.11	Peer reviewed paper on effect of bottom trawling on food and growth of flatfish	8	48	IMARES	no	

Deviations

The sea trials with innovative gears will be continued during the 3rd reporting period.

Failing to achieve objectives

See under case study task

Use of resources

Participant	WP7 Budget (pm)	WP7 Realised 1st + 2nd period (pm)
SDLO	27.1	19.3
ILVO	14.2	27.0
CEFAS-DEFRA	0.9	0.8
UNIABDN	9.6	4.3
Mar lab	1.5	1.9
IFREMER	38.0	39.4
MI	8.8	2.6
DTU-Aqua	20.9	11.2
AU-Bioscience	4.9	2.1
UCPH	5.3	3.9
SLU	8.9	3.4
IMR	0.9	0.0
CNR	41.4	25.7
HCMR	20.7	10.5
CFRI	20.9	18.8
SME02	0.8	9.0
SME03	1.1	2.4
SME04	0.8	1.4
SME05	1.7	7.2
SME06	2.1	1.3
SME07	1.7	2.4
SME08	2.0	1.9
SME09	4.2	6.48
SME10	2.0	2.75
Tecnopesca	14.0	4.1
SME13	7.6	2.4
SME14	7.2	2.1
SME15	6.4	2.2
SME16	6.5	2.8
SME17	2.2	0.8
OMU	15.0	15.1
sum	299.3	234.9
remaining personmonths		64.4

WP7.1 Western Baltic

Lead: DTU-Aqua (Rasmus Nielsen)

Task 7.1.1 - Assess the current trawling impact

Analyses of existing fishery data with hauled gears in the Baltic Sea with focus on evaluation of fishing impacts on the benthic environment as well as development of tools for doing this including Baltic implementation of the tools is reported under the WP2 activity reporting and in Bastardie et al. (2015), Eigaard et al. 2015 (BENTHIS D.2.2), and Eigaard et al. 2016 (BENTHIS D.2.3).

Physical and biological benthic impacts on the seabed and on benthic organisms associated with aphotic mud have further been investigated in sea trials with respect to different sweep lengths both in an area that is heavily fished and in an area closed to fishery. These surveys have used a BACI design with sediment profile imaging (SPI) and core samples (haps corer) for measures of sediment grain size composition, SPI index values, pigment profiles (HPLC), depth of H2S free zone, and species abundance, biomass and diversity and biological traits composition. Furthermore, side scan sonar & UW video were used. To the extent possible laser profiling has been carried out to evaluate the physical impact of different trawl elements. Several bilateral planning meetings according to these sea trials in the Northern Kattegat were initially conducted with SME03 (FN370 Susanne H) and the Danish Marine Home Guard to conduct this trial in late summer 2014 from the SME03 and home guard vessels. However, due to the above mentioned accident the sea trails planned for between 24/8 – 6/9 2014 in the area open to fishery (Ålbæk Bay) and the closed fishing area (the Sound, northern Øresund) were cancelled. Follow-up bilateral meetings were then conducted from autumn 2014 to summer 2015 with SME05 (SG92 GiBri) and the Danish Marine Home Guard to conduct alternative sea trials in the same areas. The final sea trials for this part of the sampling were successfully completed in two parts with the Danish Marine Home Guard Vessel “Apollo” and the DTU Aqua vessel “Havfisken” in Ålbæk Bay during 5 days ultimo March 2015, and then in the Northern Sound with SME05 (SG92) during 5 days in August-September 2015. The laboratory and data analyses of the material collected during the two latter sea trials have been initiated in April and September 2015, respectively. Initial results from the final sea trials are expected to be available primo 2016.

Biological and physical impact of demersal otter trawling in the Kattegat in relation to the closed areas and the seafloor pressure have been analysed and are now being collated and further statistically modeled and analyzed. This study follows up on the potential recovery of benthos in a permanently closed area using a BACI design and a time series of benthis grab sampling 2009, 2010, 2011 and the last sampling campaign in 2014. Data is analyzed by species abundance, biomass, diversity multimetric indices, and biological traits composition. In addition, sediment profile imaging (SPI) for SPI index values and depth of H2S free zone was sampled in 2014. The study will as well address the fishing impact using the models developed in WP2 of swept area estimates and detailed reconstruction of trawling impact from VMS and logbooks.

In relation to an previous extensive sampling program of benthic fauna and flora in the Femern Belt area there have been held meetings (both physical and phone meetings) with the Danish Hydrological Institute (DHI) and with the Femern Belt A/S Consortium to obtain these data for use in the BENTHIS Project. The benthic monitoring and data sampling program covering benthic fauna stations and associated faunistic classification has been conducted under a carefully planned survey design with intensive, standardized, and repeated grab sampling (and video monitoring) on seasonal basis (both spring and autumn) in 2009 and 2010 covering a dense grid of carefully selected sampling stations. These data are under BENTHIS compared with effort allocation of Danish and German OTB trawlers and different demersal trawl fishing intensities according to different seabed habitats (sediment types) to investigate impacts on the benthic fauna of different fishing pressures in different habitat types in those periods. The German fishery data has been obtained through contact to the national German fishery research institute (vTI institute) which have applied the BENTHIS WP2 fishing pressure software to their relevant fishery data to calculate fishing pressure during 2009-2014 in area by hauled gears. The final experimental sea trials for cod trawl fishery in the western Baltic Sea were designed and conducted in cooperation with SME05 at selected localities in

Femern Belt over 6 days in autumn (November/December) 2014 covering different types of benthic habitats (i.e. sediment types with soft bottom and hard bottom habitats) which were repeated over 6 days in spring (first half of March) 2015. This is accordingly compared with the benthic fauna at selected sampling stations from the above described benthic sampling program as well as with the fishing intensity of the full métier (OT_DMF) for Denmark and Germany which SME05 belongs to.

Clearly significant results

There has been made evaluation of fishing pressure and gear impacts on sensitive habitats relevant to the Baltic Sea trawl fisheries with respect to effort pressure and closed areas in Bastardie et al. (2014; 2015), Bastardie and Nielsen (2014), Thoya et al. (2015), and Thoya (2015) and with respect to impacts of gears in Eigaard et al. (2014; 2015; 2016), Hornborg et al. (2015; In Submission) and Rijnsdorp et al. (2015). In general the results in relation to milestone 41 (MS.41 in M36) with biodiversity analysis of selected localities and habitat mapping in the Baltic Sea region is available, and the reporting of this is well in progress in Hansen et al. (2015); Hansen et al. (in prep), Pommer et al. (submitted), Thoya et al. (2015) and Thoya (2015). The results have been also been reported in the Deliverables D7.6 (M24) and D.7.8 (M36) Reports written by Nielsen et al. 2014 and 2015.

Deviations. none

Task 7.1.2 - Options for mitigation

Summary of Progress

During the period from summer 2014 to summer 2015 there have been held a row of bilateral meetings with the involved SME's representing the catch industry stakeholders as well as other selected Stakeholders to finally plan and implement the experimental sea trials under the Baltic Case Study with 5 sub-case studies. These meetings have functioned as follow up meetings on technological developments, smart fishing, and effort reduction scenarios in relation to the trial fisheries planned and outlined during the extensive RSE1 workshop in May 2013 in Copenhagen, and also suggested by stakeholders in the sub-group meetings and in the returned questionnaires from this first RSE1 workshop with broad representation of the catch industry, the processing industry, management, environmental NGO's and scientific management advisors. On basis of the RSE1 workshop a row of pilot field studies have been conducted in the different sub-case studies to test further the recommended methods and technological developments discussed and suggested under the RSE1 in Copenhagen. This has covered fishing tests with light mussel dredges reported in Frandsen et al. (2015a), initial creel fishery compared to trawl fishery reported in Frandsen et al. (2013; 2015b) and in Hornborg et al. (2015), and fishing with pelagic trawl doors in the Western Baltic cod fishery, during 2013 to 2014. Additional SME meetings during the period from spring 2014 to spring 2015 have mainly been held on bilateral basis with the catch sector SMEs to follow up on the pilot experimental sea trials conducted in relation to each of the Baltic Sea sub-case studies. The aim of these meetings have been to modify the focus in the final sea trials performed in cooperation with the catch sector SMEs for each sub-case study. The resulting, final sea trials have accordingly been conducted during second half of 2014 and in 2015.

Clearly significant results

The task has progressed well, and despite some delay in the sea trials in the Baltic Sea all deliverables have been delivered and all milestones have been reached which were planned for the reporting period 1 and 2 (contribution to deliverables: D7.7).

Deviations. none

Task 7.1.3 - Testing alternative gears

Summary of Progress

In general the final sea trials in the Baltic Case Study has been delayed because the first extensive sea trials planned for august 2014 both in relation to WP7 and WP3-4 were cancelled in the last minute after extensive planning and communication over the spring because the owner of SME03 passed away in a tragic accident in August 2014 just a few days before the BENTHIS sweep length trials in the Kattegat Nephrops fishery should start. Consequently, the whole series of sea trials had to be re-considered and re-planned again, and we had to apply for approval of the activities and resources were transferred to another SME. Furthermore, the sea trials have also been delayed due to birth leave of two DTU scientists working on the BENTHIS project. See further details in D.7.8 & D7.3 for each of the below sub-case studies as well as under Task 7.1.1 with respect to the described sea trials conducted in relation to evaluating physical and biological benthic impacts.

Western Baltic cod trawl fishery: In the period from summer 2013 to winter 2014-15 there have been held 4 separate meetings with SME05 on board the vessel SG92 Gi-Bri to discuss methods to reduce benthic impacts and to plan final sea trials in detail. The final experimental sea trials with smart fishing to avoid hard bottom localities in the Western Baltic cod trawl fishery were designed and conducted in cooperation with SME05 at selected localities in Femern Belt over 6 days in autumn 2014 covering different types of benthic habitats (i.e. sediment types with soft bottom and hard bottom habitats) which were repeated over 6 days in spring 2015. This is accordingly compared with the benthic fauna at selected sampling stations from the Femern Belt benthic sampling program as well as with the fishing intensity of the full métier (OT_DMF) for Denmark and Germany which SME05 belongs to over a row of years. Analysis of the results is ongoing.

Mussel fishery: Smart fishing with reduction in fishing effort by using side-scan-sonar search and monitoring technology in the mussel fishery has been tested in cooperation with SME04 (Wittrup Seafood A/S) during pilot sea trials in 2015. Here side-scan sonar monitoring and test tracks have been recorded with the system bought under BENTHIS by SME04. It has taken some time to make the system function properly. Subsequently, much effort has been put into testing different software programs to evaluate the side-scan-sonar data and obtain adequate contrast in the data to enhance analysis of them. During these processes 5 bilateral meetings with SME04 has been conducted in at Wittrup Seafood A/S Horsens DK, as well as several contacts to companies producing side-scan sonar technology and software for reading and analysing such sonar data. Final sea trials are ongoing and planned for the rest of 2015 and primo 2016 with running evaluation of the sampled data on different types of mussel sea beds in cooperation with SME04.

Nephrops creel fishery: The final sea trials with Nephrops creels were conducted during 10 days survey in May 2015 in the Swedish area of Kattegat as an cooperation between DTU Aqua and SME02 (VG86 ATLAS). The final sea trials investigated the physical (and biological) seabed impact of creeling, and the fate of discard, as well as monitoring of Nephrops catch rates and behavior in relation to hagfish occurrence in the creels. This was done by use of cameras, frames with cameras, DST Tags, and GPS loggers. In relation to the final sea trials a mathematical-physical program for calculating the benthic impact of creels when they are heaved given different directions of the creel strings are produced. SME02 will continue to collect some additional data in the rest of 2015. During the reporting period several meetings between SME02 and DTU Aqua have been held in order to follow up on the pilot sea trials with creel fishery investigations in 2013 and for planning the final sea trials, e.g. discuss cruise details and agreeing on distribution of work in December 2014 and in primo March and ultimo March 2015. The data collected from the final sea trials with creels have been compiled and processed and are now in the process of being analyzed. The first results are expected primo 2016. Additionally, a number of meetings between DTU Aqua and UCPH to plan and conduct cost benefit analyses of different scenarios for substituting trawl fishing for Nephrops with creel fishing for Nephrops have been held in the reporting period. A stakeholder workshop was held in Hirtshals (DK) 12-14 November 2014 which has followed up on the additional investigations of economic efficiency in Danish creel fishery evaluated under the EU InterReg Sustainable Nephrops Fishery (OBJ Fish) (EU InterReg Project Iva, The Sound, Kattegat, Skager-rak) in cooperation with the EU-FP7-BENTHIS project with respect to the comparative economic analyses between creel and trawl fishery. The participants in the workshop were DTU Aqua (DK), IFM-AAU (DK), FOI-KU (DK), The Danish Fishery Association (DK), SLU (S) and IMR (N).

Nephrops trawl fishery: The sea trials for this sub-case in Kattegat were originally to be conducted with SME03 (FN370 Susanne H) and the Danish Marine Home Guard vessels in late summer 2014. Previous development of gear and experimental design was done in detail by DTU Aqua based on a row of meetings and close cooperation with SME03 and gear manufactures during 2013-2014. However, very sadly the owner of SME03 passed away in a tragic working accident in August 2014 just a few days before the sweep length trials in the Kattegat Nephrops fishery were supposed to start, and the sea trails planned for between 24/8 – 6/9 2014 in the area open to fishery (Ålbæk Bay) and the closed fishing area (the Sound, northern Øresund) were cancelled. Consequently, the whole series of sea trials had to be re-considered and re-planned. Follow-up meetings were then conducted from autumn 2014 to summer 2015 with SME05 (SG92 GiBri) and the Danish Marine Home Guard to conduct alternative sea trials in the same areas with SME05 replacing SME03. This change of vessel and timing of the trials was discussed and planned in detail during the RWP3-meeting in Lisbon as well as during a row of bilateral planning meetings with SME05 on board SG92 Gi-Bri during spring and summer 2015. The details of the experimental fishery (long versus short sweeps – see below) and of the benthic impact monitoring approach (BACI design – see below) were discussed and agreed upon at the meetings.

Final sea trials testing short and long sweep length catch rates have been conducted in a 7 day period ultimo August 2015 with participation of SME05, DTU Aqua and SLU. Here a number of comparative trawl hauls with short and long sweep lengths on a standard Nephrops trawl was conducted in the southern Kattegat to compare catch rates by species and size group. This covered comparable, repeated hauls with the two gear set-ups in both night and day fishery conducted in different areas where relative high catches of both Nephrops, roundfish (cod), and flatfish (plaice, sole) were likely. The experiments were completed successfully, and the data are compiled. During the coming months the catch rates and associated cost-benefit-analysis (CBA) will be analysed according to sweep length and trawl dimensions measured with sensors (among other DST tags). Initial results of the sea trials are expected to be available primo 2016.

Physical and biological benthic impacts on the seabed and on benthic organisms associated with aphotic mud have further been investigated in sea trials with respect to different sweep lengths both in an area that is heavily fished and in an area closed to fishery. These surveys have used a BACI design with sediment profile imaging (SPI) and core samples (haps corer) for measures of sediment grain size composition, SPI index values, pigment profiles (HPLC), depth of H_2S free zone, and species abundance, biomass and diversity and biological traits composition. Furthermore, side scan sonar & UW video were used. To the extent possible laser profiling has been carried out to evaluate the physical impact of different trawl elements. The final sea trials for this part of the sampling were successfully completed in two parts with the Danish Marine Home Guard Vessel “Apollo” and the DTU Aqua vessel “Havfisken” in Ålbæk Bay during 5 days ultimo March 2015, and then in the Northern Sound with SME05 during 5 days in Aug-Sep 2015. The laboratory and data analyses of the material collected during the two latter sea trials have been initiated in April and September 2015, respectively. Initial results from the sea trials are expected to be available primo 2016.

There have also been a number of bilateral meetings between DTU Aqua and UCPH to design economic cost benefit analyses of the planned sweep length experiments.

Clearly significant results

Evaluation of fishing pressure and gear impacts on benthic sensitive habitats have been conducted in relation to the experimental fisheries in the Baltic Sea as reported in Bastardie et al. (2014; 2015), Eigaard et al. (2015; 2016), Thoya et al. (2015) and in Bastardie and Nielsen (2014). Results of trial fisheries and gear comparisons have been reported in Frandsen et al. (2015a), Frandsen et al. (2015b), and Hornborg et al. (2015; In submission). Impacts in relation to the benhtic environment have been reported in Hansen et al. (2015); Hansen et al. (in prep), Pommer et al. (submitted), Thoya et al. (2015) and Thoya (2015). The task has progressed well, and despite some delay in the Baltic sea trials in the Baltic Sea all deliverables have been delivered and all milestones have been reached which were planned for the reporting period 1 and 2:

Contribution to deliverable D.7.8.

Task 7.1.4 - Innovative management scenario's

Summary of Progress

Besides evaluating innovative fishing methods and gear mitigations which can be implemented in potential management measures for reducing benthic impacts as described under Task 7.1.3 two main innovative management scenarios have been evaluated in relation to reduction of fishing impacts on the benthic community. This is mainly potential management measures promoting reallocation of fishing effort away from the most sensitive benthic habitats as evaluated in the western Baltic cod mixed fishery, as well as management measures toward promoting intelligent fishing by use of improved monitoring methods in the mussel fishery.

Evaluation of effort-reallocation scenarios: An experimental fishing design with smart fishing was set up where the final at sea trials were conducted with standard trawl gears and fishing methods respectively at soft seabed habitats and at hard seabed habitats among known fishing grounds in 4th quarter of the year, and then repeated the same stations in the following 1st quarter of the year to compare catch rates of target and by-catch species between types of localities and habitats and seasons. This final trial fishery was carried out in the Femern Belt area of the Western Baltic Sea autumn 2014 and spring 2015. Furthermore, there was conducted an extensive data analysis of effort allocation and catch rates according to seabed and habitat type for the whole OTB métier (OT_DMF) for both Denmark and Germany, which SME05 represents and belongs to, in the Femern Belt area to test the proportion of effort allocation and associated catch rates between soft and hard bottom habitats and localities on a seasonal basis. The historical data analyses included the years 2009 and 2010 where there had been extensive benthic fauna sampling in the Femern Belt area (both on Danish and German side) in the Western Baltic Sea on seasonal basis in relation to the baseline monitoring and environmental impact assessment of the fixed link planned between Den-mark and Germany in the Femern Belt Area. The above investigations are followed up by evalua¬tion of different scenarios of effort allocation and fishing intensity in the Western Baltic demersal trawl fishery (OTB métier) on different types of benthic habitats and seabed types (hard bottom and soft bottom localities) by the bio-economic DISPLACE model (Bastardie et al. 2015) with respect to evaluation of catch, profit, and energy efficiency in relation to fuel consumption in the fishery. One focus for the Baltic cod-fishery is scenario evaluation of different effort allocation schemes according to season with respect to benthic impacts and catch efficiency of Western Baltic trawl fishery evaluated through effects of potential fishing closures in relation to more sensitive habitats.

Implementing of smart fishing with use of improved monitoring of the seabed during fishery: The focus is on intelligent fishery with more efficient previous (or real time) search and monitoring of optimal fishing grounds as well as on better mapping of the mussel banks and optimal fishing areas before actual mussel fishery is conducted. In the BENTHIS project we have since autumn 2014 made pilot sea trials with tests of more efficient monitoring, search, mapping and pre-assessment methods before (or real time during) fishing which are more cost-efficient than a video sledge monitoring method. The method tested is acoustic monitoring with a side-scan sonar using acoustic transects in an optimal search survey design. The occurrence and delineation of the mussel banks are registered and mapped with the side-scan sonar to monitor location of mussel sea beds, mussel densities, as well as potentially the main size classes of the mussels. This previous and online mapping of the fishing areas, as well as surrounding low yield areas, can be done on a continuous basis also during fishing operations to make a more precise fishing plan and to monitor changes in the underlying resource abundance with respect to changes in locations and densities of the mussel banks over time. Furthermore, it is into a higher degree possible to avoid fishery on localities where there are no mussels and in areas between the mussel banks to reduce the benthic impacts in non-mussel-bank areas compared to standard mussel fishery today without or only with limited previous monitoring and pre-registration of the mussel sea beds. Furthermore, commercial trial fishing operations to test and evaluate occurrences and densities of the mussels can be reduced when using this smart fishing method. A side-scan sonar has much larger coverage surface (around 25-50 m wide bands at 4-12 m depth) and can more easily be operated, and can also be operated with higher speed and under worse weather conditions, than a video monitoring sledge.

Clearly significant results

There has been developed and implemented a robust individual vessel based model for making bio-economic evaluation of re-allocation of fishing effort as a result of different management scenarios for closures in the international western Baltic fishery. The model has in relation to BENTHIS been used to produce results on impacts on stocks and fisheries of different closures in the western Baltic Sea which is published in Bastardie et al. (2014; 2015), and Bastardie and Nielsen (2014).

A sidescan sonar has been bought and pilot experiments have been performed. Different software systems have been tested an bought to analyse the data. Preliminary results are promising and additional experimental fishery and extended data analysis is ongoing.

Deviations. none

Task 7.1.5 - Fishing impact on feeding patters of a selection of benthivorous fish

Focus will be on cod where historic collections of otolith tissue is available from the Sound long term closed area contrasted with the Kattegat open and intensively fished area, as well as the recently (short term) closed area in the southern Kattegat. Levels and variation of stable isotopes (d15N and d13C) of organic components in the aragonite is expected to indicate food chain length and complexity. New stomach samples are available from 2013 in the project from different parts of Kattegat (both in the open and short term closed areas) and will be supplemented with sampling in both the Sound long term closed area and additional sampling in the Kattegat open fishery area in fall 2014. Genetic methods will be tried out for mapping of bio-complexity of stomach content. Laboratory analyses of material will be carried out in the 3rd reporting period.

Accordingly, there is a delay in relation to Task 7.1.5. However, these analyses are only a very minor part of the case study work, and no other case study work - or any other work package work - is dependent on those analyses. Consequently, this delay will not have consequences for any other project part.

Clearly significant results

There are no results available for subtask 7.1.5 yet.

Deviations

There are no major deviations from the planned work in the Baltic case study. There has been a delay in conducting the experimental fishery in the Baltic case study because of a tragic accident, but most have been completed during the 2nd reporting period and the rest are well in progress to be completed during the 3rd reporting period. There is also a delay in relation to case study Task 7.1.5 “To evaluate fishing impact on feeding patterns of a selection of benthivorous fish.” However, these analyses are only a very minor part of the case study work, and no other case study work - or any other work package work - is dependent on those analyses. Consequently, this delay will not have consequences for any other project part. The analyses of sampled material in relation to this subtask are expected to be finalized during the 3rd reporting period.

Failing to achieve objectives

The work to achieve the planned objectives of the case study is well advanced and in progress as planned and despite some delays all milestones and deliverables have been reached during the reporting period 2. The experimental fisheries will continue into reporting period 3 as well as the analyses in relation to Task 7.1.5. We have no expectations of the objectives will not be met under the Baltic case study.

Use of resources

The use of resources has been as planned except for some delays in the experimental fisheries as well as in relation to the analyses under Task 7.1.5 as explained above. The major use of resources under the case study is in second and third reporting periods where the major bulk of experimental fisheries under the case study are carried out.

WP7.2 - NORTH SEA

Lead: ILVO (Hans Polet)

Task 7.2.1 - Assess the current trawling impact

Lead: IMARES. Contribution P03, P04,P06,P07,P08,SME's

Summary of progress

VMS and logbook data have been made available to WP2. The integrated data set from WP2 has been analysed in more detail with a specific focus on estimating habitat associations for the BENTHIS metiers. Results have been included in D7.6.

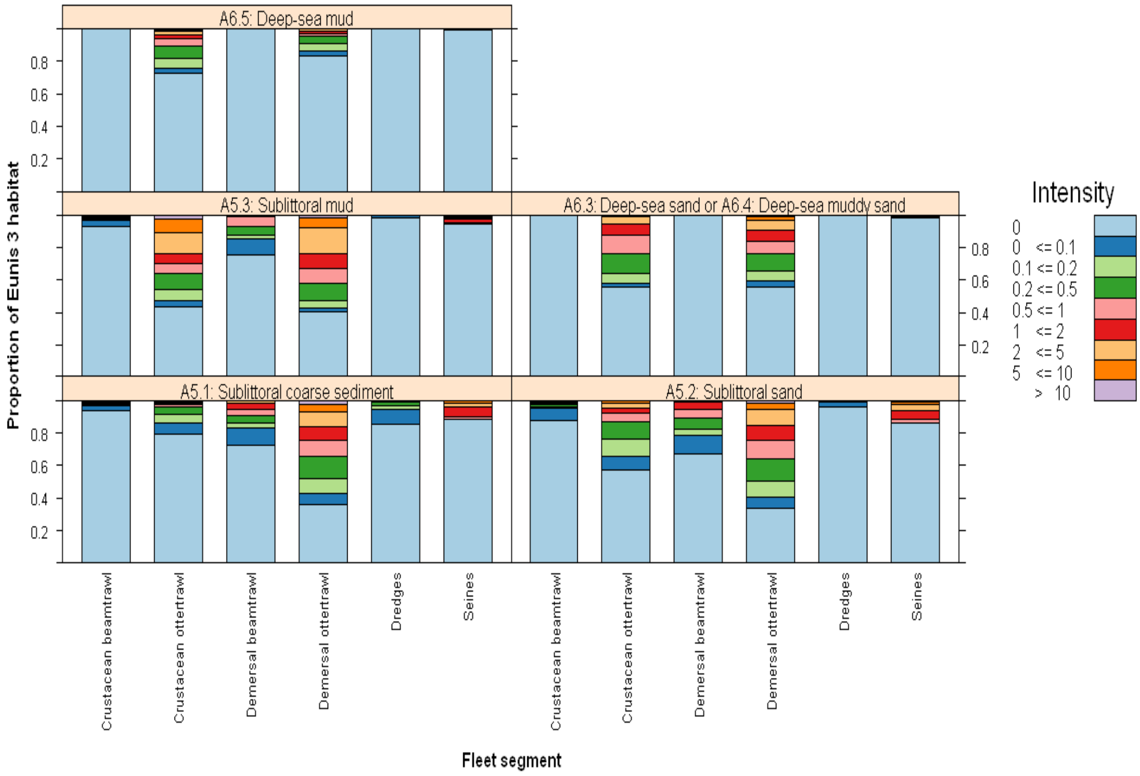


Figure 7.1. *Proportion of the surface area fished at a certain intensity (number of times the surface area of a grid cell is swept/yr) for six fleet segments and five habitats in the North Sea. Data 2010-2012.*

Clearly significant results

- The BENTHIS metiers showed a clear habitat association with one of more EUNIS level 3 habitats being used in greater proportion that their surface area, and others being used (much) less often or not at all.
- van Denderen PD, Hintzen NT, Rijnsdorp AD., Ruardij P, van Kooten T. 2014. Habitat-specific effects of fishing disturbance on benthic species richness in marine soft sediments. Ecosystems 17:1216-1226
- van Denderen PD, Hintzen NT, van Kooten T, Rijnsdorp AD. 2015. The temporal distribution of bottom trawling and its implication for the impact on the benthic ecosystem. ICES Journal of Marine Science 72: 952-961

Deviations. None

Failing to achieve objectives. None

Task 7.2.2 - Options for mitigation

Lead: E. Vanderperren (ILVO), Contributors: P01,P02,P03, SME's

Summary of progress

A review report on different options for mitigation in the region has been delivered and has been compiled into a report for all case studies combined. The options for mitigation in the North Sea, as an alternative to the present day flatfish directed fisheries, are in principle manifold but few of them are easy to implement. It is, however, very clear that electric pulse fisheries for flatfish as well as for brown shrimps have successfully been implemented into the commercial fisheries. There also are indications that these alternatives have benefits in terms of discards and seafloor impact.

Clearly significant results: Deliverable D7.7

Deviations. None

Failing to achieve objectives. None

Task 7.2.3 - Testing alternative gears

Lead: IMARES; Contributors: P02,P03,SME's

Summary of progress

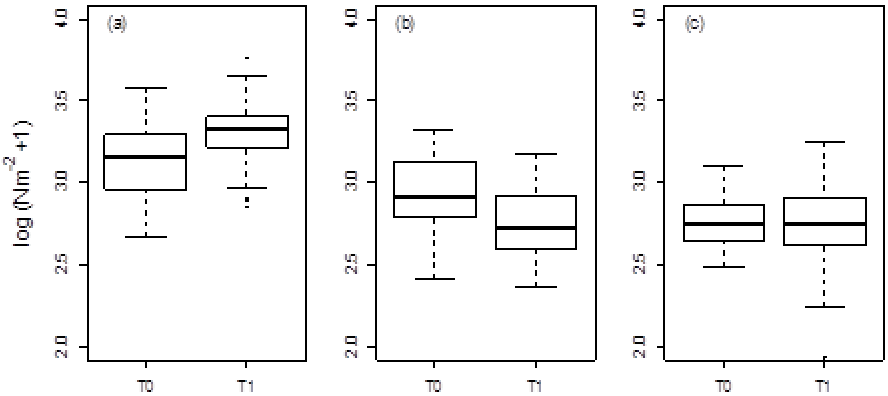
A total of 2 sea trials have been carried out in the 2nd reporting period. One sea trial was focused on the flatfish pulse in collaboration with SME17 (2014). The aim of the sea trials was to study the difference between the pulse trawl and traditional beam trawl in the flatfish fishery on the direct mortality imposed on benthic invertebrates, and to study differences in penetration depth.

The second field trial comprised of a series of experiments in the Netherlands to determine the benthic impacts of the traditional shrimp trawl and the shrimp pulse trawl in collaboration with SME08. The experiments were aimed at finding out the physical aspects of seabed disturbance, the sediment plume generated by fishing and the effects on benthos and the catches. The set-up of the experiment was BACI. The experiment conducted in 2014 in both areas in the Molenrak with the pulse rig, showed beside differences due to natural variation between sites, no relation with fishing intensity for any of the examined parameters and species groups.

Clearly significant results

- Penetration depth of the flatfish pulse trawl is less than of the traditional tickler chain beam trawl. Sediment resuspension does not differ between both gears. Catch of benthos in pulse trawls is substantially less.
- In both 1st and 2nd reporting period experiments, no significant difference in mortality of benthos could be detected in the study plots exposed to either flatfish pulse trawling, tradition tickler chain beam trawling or reference area not exposed to bottom trawling.
- The absence of significant effects of trawling may be related to the high variability encountered in the benthic samples. Benthic communities are notoriously patchy within the environment and even on a small spatial scale the variability between the samples can be high. Due to this variability sampling effort was maximised but can still be considered low. A post-hoc power

analysis was performed on the data (currently only the 2014 data) to identify the statistical power of the dataset in showing differences (Table 7.1). The power analysis revealed a higher chance of detecting an effect in the tickler chain area versus the reference area as opposed to in the pulse area versus the reference area. This is some indication that the chances of detecting significant mortality (given higher sampling effort) in the tickler area is higher than that in the pulse area. The chances of detecting differences in the intermediate sensitivity group is also higher compared to the resistant group. The probability of detecting change in the vulnerable group is low, but this can be related to the very low numbers of vulnerable species caught.



- **Figure 7.2**. *Change in density of benthic invertebrates after experimental fishing with (a) tickler chain, (b) reference and (c) pulse trawl. Boxplots (showing the median (thick line), upper and lower quantiles (edge of boxes) and the min and max, excluding the outliers (dots)) of log-transformed densities of all benthic species combined. Data from the field trial in the Frisian Front (2014) (Teal et al., in prep).*

- **Table 7.1:** *Output of power analysis on 2014 benthic sledge data. Numbers show the probability of detecting a change in abundance at the significance level 0.05, given the current experimental setup and assuming the real effect or data distribution follows the output of the statistical model applied. Teal et al (in prep).*

Response	Group	Interaction all	Tickler – ref	Pulse – Ref	Tickler - Pulse
Abundance	All	0.91	0.96	0.23	0.64
	Resistant	0.61	0.70	0.11	0.41
	Intermediate	0.95	0.98	0.37	0.67
	Sensitive	0.38	0.42	0.06	0.34

Deviations. The number of sea trials and the amount of data collected are significantly higher than anticipated in the contract thanks to additional national funding. Preliminary results are available but more sophisticated statistical analysis is ongoing.

Failing to achieve objectives. None

Use of resources: In order to fill in the existing data gaps related to seafloor disturbance for beam trawls and pulse trawls, in order to include sufficient habitat types and in order to feed the models in the generic WPs of the BENTHIS project with ample data, an extra effort was made to maximize the data collection and thus the sea trials. For this, the BENTHIS project was supported with nationally funded projects, with the addition of support by ILVO staff. As such, more labour was contributed to the BENTHIS project than anticipated. The extra cost is being covered by the individual institute, i.e. ILVO.

Task 7.2.4 - Innovative management scenario’s

Lead: Jan Jaap Poos (IMARES); Contributors: P02,P03,SME's

Summary of progress

This task is ongoing. Coordination with WP5 and WP6 has taken place during the project coordination meeting in Lisbon (February 2015) and a follow-up Skype meeting early 2015. Relevant management scenarios have been selected and are being explored.

Clearly significant results.

- The fleet dynamic model developed in WP5 has been parameterised for the Dutch flatfish fishery using the traditional tickler chain gear and the innovative pulse trawl. The model has been used to explore the effects of the landing obligation on the discarding of the flatfish fisheries.
- Batsleer J, Rijnsdorp, A.D., Hamon KG, van Overzee HMJ, Poos JJ. 2016. Mixed fisheries management: Is the ban on discarding likely to promote more selective and fuel efficient fishing in the Dutch flatfish fishery? Fisheries Research 174:118-128

Deviations. None

Failing to achieve objectives. None

Task 7.2.5 - Effect of bottom trawling on the food for flatfish.

Lead: IMARES; Contributors: P03,P04, SME's

Summary of progress

The analysis of the relationship between the trawling intensity and the condition factors of sole and plaice as recorded during the annual beam trawl surveys started during the 1st reporting period was finished. Results have been presented at the 9th International Flatfish Ecology Symposium (November 2014, Cle Elum, USA) (Rijnsdorp et al., 2014). No relationship between body condition and trawling intensity was observed in sole, but in plaice the results suggested a slight increase with trawling intensity at relative low trawling intensities. The available box core samples from the southern North Sea have been analysed in relation to trawling intensity, grain size, secondary productivity. Results have been published (van Denderen et al., 2014).

Clearly significant results

- see above
- Van Denderen PD, Hintzen NT, Rijnsdorp AD., Ruardij P, van Kooten T. 2014. Habitat-specific effects of fishing disturbance on benthic species richness in marine soft sediments. Ecosystems 17:1216-1226.

Deviations: See use of resources.

Failing to achieve objectives: none

Use of resources: The budget of the North Sea SME’s has not been fully used. Hence, the sea trials, although scheduled only for the reporting periods 1 and 2, will be continued in the 3rd reporting period. The amendment of the Grant Agreement has been adjusted accordingly.

.

WP7.3 - WESTERN WATERS

Lead: IFREMER (Pascal Laffargue)

The Western Waters case study comprises of three different components dealing with (i) the Nephrops fishery in the bay of Biscay (lead IFREMER, Pascal laffargue), (ii) the scallop and Nephrops fisheries in the Irish Sea (lead MI, Dave Read) and (iii) Shelf Slope (lead IMR, Lene Buhl-Mortensen). The progress and activities will be reported for the different components separately

Task 7.3.a - Hake & Nephrops mixed fisheries in the Bay of Biscay / "Grande Vasière"

Lead : IFREMER (P7) P.Laffargue. Contributions: SME09 (L.Treguier), SME10 (Y.Didelot)

Fisheries: Hake/NephropsOTB / OTT

Habitat: Circalittoral mudFlats, Mud-dwelling crustaceans, Hake nursery

Alternative gears and/or management strategy: enlighten gear, traps, Spatial distribution of activity

Task 7.3.1 - Current impact of fishing

Summary of progress

VMS maps have been realized according to Benthis workflow for the French EEZ of the BoB & Celtic Sea areas. Moreover, those results have been utilized to establish fishing impacts on various habitats and included into analysis and modelling framework to identify sediment and biological processes linked to trawling impacts

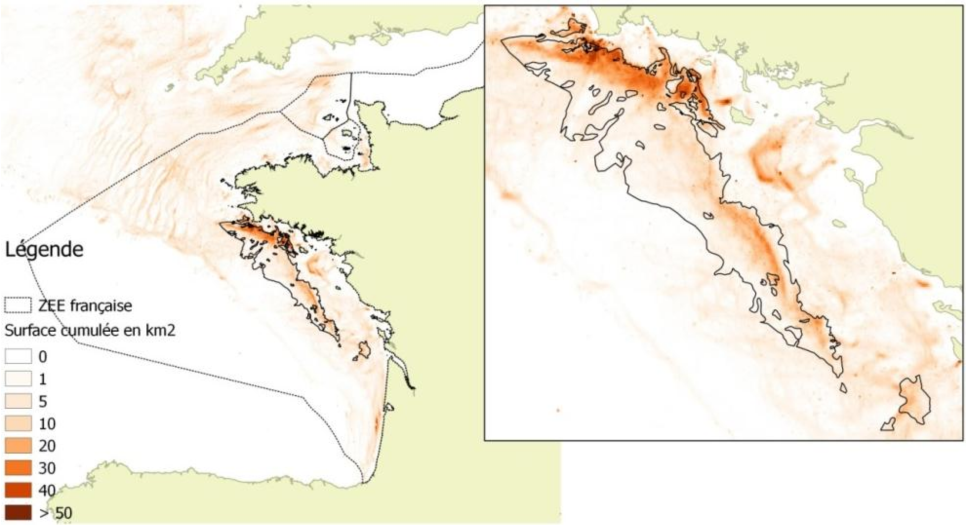


Figure 7.3. *VMS maps: Swept area (cumulated area in km^2) of bottom trawlers (OTT, OTB, PTB, DRB) operating in 2012 as computed from Benthis workflow (WP2) for the French ZEE of the Bay of Biscay and Celtic Sea areas. Map on the right proposes a zoom over the "Grande Vasière" area.*

Megafauna data derived from previously available dataset has been utilized to analyse trawling impact at european scale as reported into the deliverable D3.4 (Biological traits as functional indicators to assess and predict (using statistical models) the status of different habitats)
Discards and Birds analysis (link with WP4, deliverable D4.5): analysis of discards distribution and fate have been performed for the Bay of Biscay area linkage with the WP4. Main results of discards analysis to estimate consumption amount by the seabirds and the quantity of food potentially available to benthic fauna. Discards amount were expressed as number of items for each of the main categories of discards: roundfish & invertebrate. Estimations gave 40 to 70% of roundfish from discards are eaten by seabirds. No invertebrate eaten by seabirds and potentially come back to the benthic compartment.

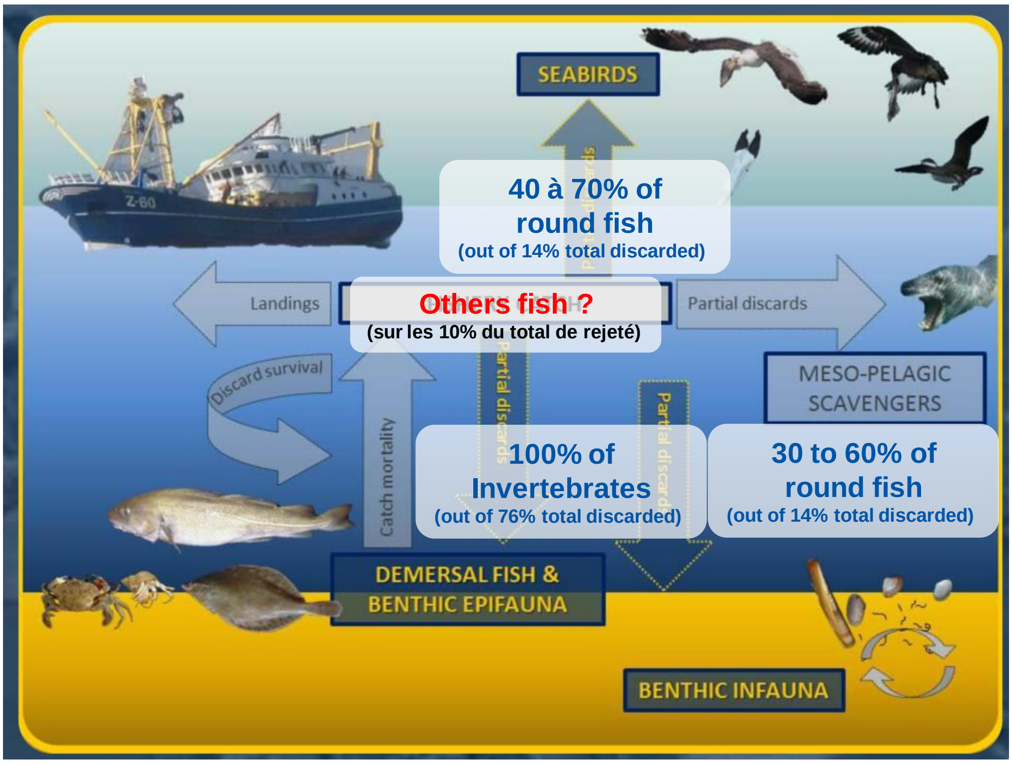


Figure 7.3. *Fate of discards (Depestele et al. submitted)*

Analysis of FEBBE 1 & 2 dataset under progress: analysis of ecosystem effect of fishing is ongoing from the data collected during the surveys FEBBE 1 & 2 (Fishing Effects on bay of Biscay Benthic Ecosystem) performed in 2013. It aimed at better evaluate effects of trawling pressure on benthic community. Expected final analysis & results are:

- to identify fishing pressure signal from macrofauna& megafauna compartments
- to evaluate species and functional (especially trophic linkages through isotopics analysis) changes under fishing pressure gradient and evaluate tresholds.
- to establish the impact of those changes to the benthic community functioning

Further work is being conducted to analyze community structure under fishing gradient considering ecosystem functions of species. Moreover, to go deeper into benthic community functioning, we will analyze data with a specific focus on the trophic structure as obtained from isotopic qualification of species. Those analyses should help us to evaluate what community responses thresholds we would expect to get under various fishing pressure levels.

Hydrodynamic model vs fishing gear impact: Mathematical models of gears behaviours and in situ observations of gears effects on sediment (resuspension process, penetration depth and reworking) have been utilized to better describe sediment processes due to bottom trawling as compared to those linked to hydro-climatic processes. The quantification of sediment fluxes (anthropogenic & natural) is realized with a numerical hydrodynamic/sediment model (MANGAE 2500). Results have been presented during INTERCOH conference held in Leuven (Belgium).

Inventory of gears utilized in the hake/nephrops fishery and collected data have been included into the deliverable 2.2 (Peer review paper on definition and parameterisation of impact proxies based on gear and vessel data from Industry surveys).

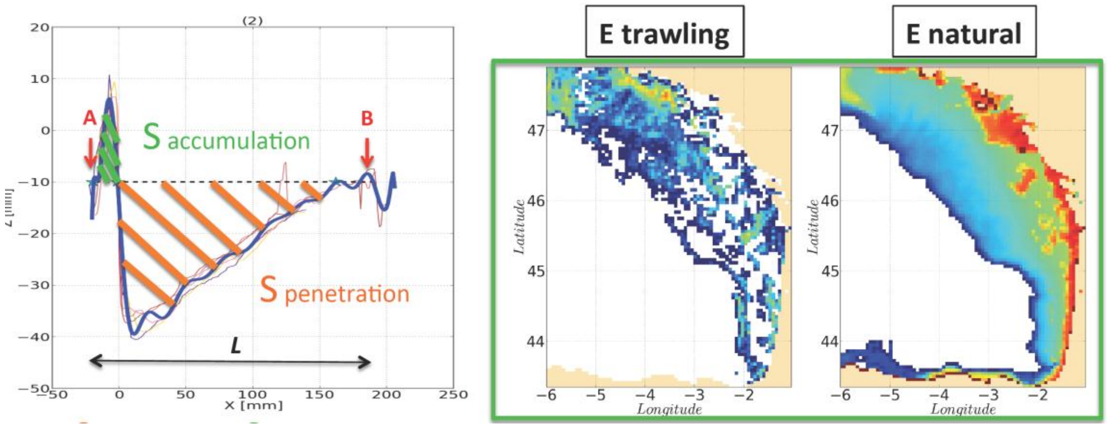


Figure 7.4. *A. Example of fishing tracks recorded from Benthis surveys 3 & 4 in order to estimate trawling erosion flux and B. global comparison of trawling vs natural erosion fluxes at the bay of Biscay scale (Mengual et al., INTERCOH 2015)*

Clearly significant results

- Under review paper on Discards and Birds in the BoB: Jochen Depestele, Marie-Joëlle Rochet, Ghislain Dorémus, Pascal Laffargue, and Eric W. M. Stienen (submitted). Are discards a substantial food source for 1 marine scavengers? Can.J.Fish.Aquat.Sci.
- Presentation of sediment processes in BoB and impact of fisheries in international symposium : Baptiste Mengual, Florence Cayocca, Pierre Le Hir, Thierry Garlan and Pascal Laffargue (2015). Physical impacts induced by bottom trawling in the “Grande-Vasière” area (Bay of Biscay, France). 13th INTERCOH, Leuven, Belgium.
- Participation to deliverables: D2.2, D3.4, D3.6, D4.5, D7.6

Task 7.3.2 - Options for mitigations

Summary of progress

The three options for mitigating trawling impact on Nephrops fishing grounds of the Bay of Biscay (two technicals and one management options) tested during Benthis project have been reported into the deliverable 7.7. The first of them will focus on replacing current trawling gear with less impacting one by reducing otter-board contact with the bottom ("jumper" boards). The second will test the viability of replacing part of the trawlers with Nephrops traps fishery. Finally, we will test for effects of spatial management strategies in order to reduce footprint of trawls while balancing with fishery viability

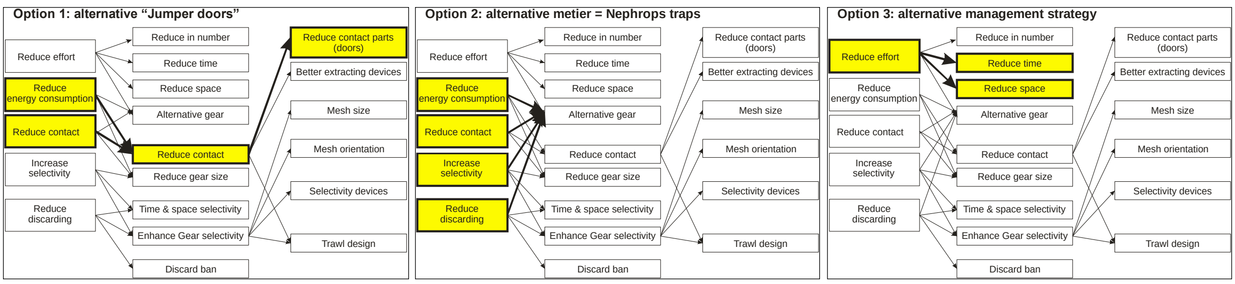


Figure 7.5. *Three options for mitigating trawling impact on Nephrops fishing grounds explored for the BoB Nephrops sub-case study as summarized into the deliverable 7.7.*

Comparisons of classic vs alternative trawling doors (BENTHIS FEBBE 3 & 4) from numerical modelling framework: a modelling process has been firstly developed in order to compare the various gears. The comparison is based on the footprint of the gear estimated by :

- the bottom surface impacted by its various parts and
- the energy transfer on the bottom by those parts

.

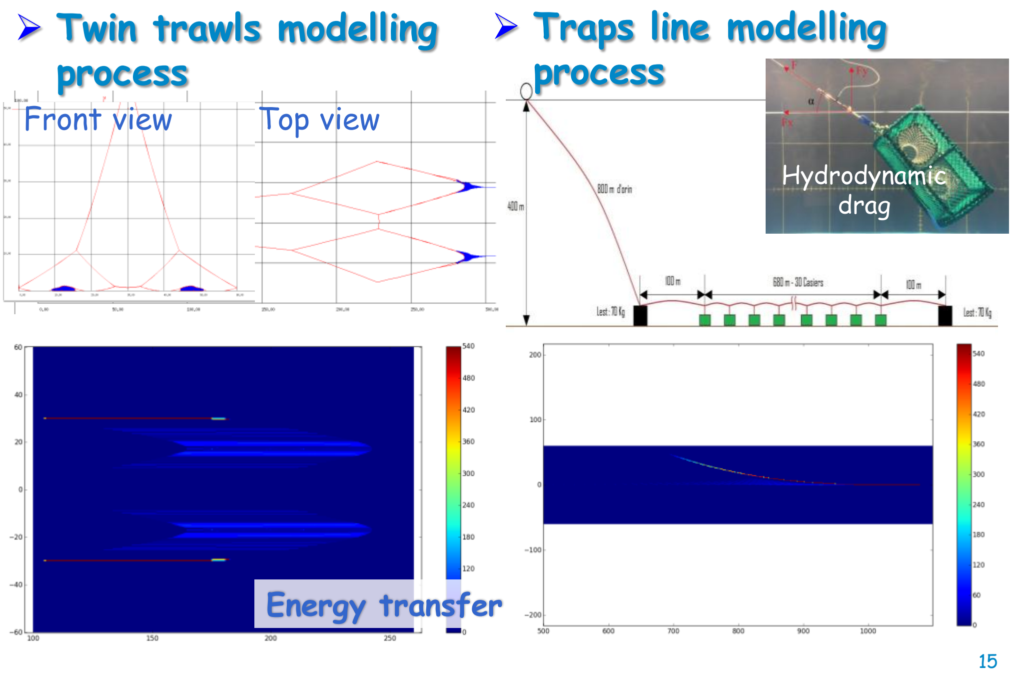


Figure 7.6 *Energy comparison should help us to compare effects of gears as different as active (trawls) and passive gears (traps)*

Clearly significant results

- Redaction/participation to deliverable: D7.5 and D7.7

Task 7.3.3 - Sea trials

Summary of progress

The surveys FEBBE 3 &FEBBE 4 (Fishing Effects on bay of Biscay Benthic Ecosystem) have been performed in May-June and October 2014 respectively with both scientific (N/O Thalia) and fishing (F/V Côte D'Ambre) vessels. Those surveys aimed at analyzing physical effects of twin Nephrops trawl equipped with current doors ("Thyboron") as compared to alternative "jumper" doors. Surveys have been performed within two muddy areas representative of the Bay of Biscay Nephrops fishing grounds. Main objectives and operations realized during both surveys were:

- to run alternative jumper doors operational tests and comparisons to current gear, and especially to test the utilization of "jumpers" with a Nephrops twin trawl
- to quantify sediment re-suspension processes behind the current and alternative gears.
- to evaluate trawls footprint and modifications of sediment bottom structures due to abrasions effects of the fishing gears

Realized observations and collected data as well as first results are reported in the deliverable 7.8.

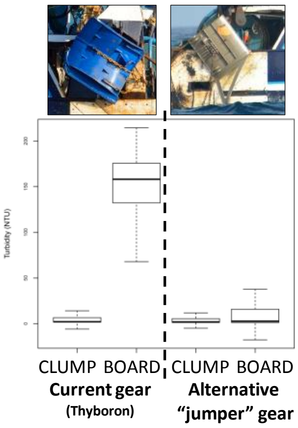


Figure 7.7. *Boxplot of overall turbidity values as recordedwith turbidity-line for twin Nephrops trawl equipped with Thyboron (graphs on left side) vs Jumper doors (graphs on the right side). Line was settled at 2 positions on the gear: the clump or the doors. (Deliverable 7.8)*

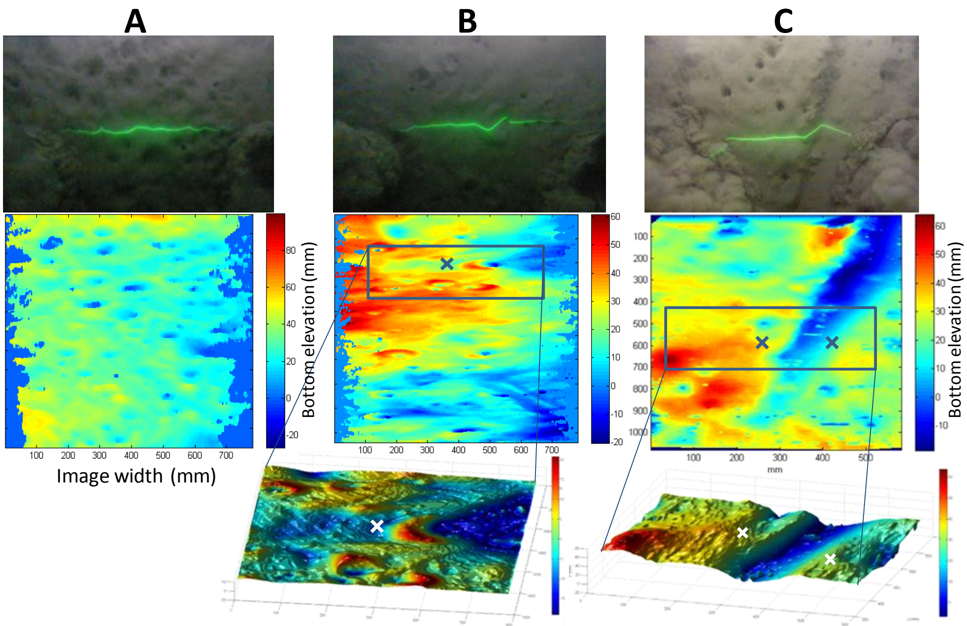


Figure 7.8. *µtopography records (bottom elevation color scale in mm) as obtained from "Pagure" sledge on muddy bottom A. biological & physical bottom structure with high rugosity at small scale(area A, FEBBE4), B. records with large biological structure like Nephrops burrow and zoom(area A, FEBBE4) and C.classical fishing board track obtained with "Thyboron" board type (area A, FEBBE3) (Deliverable 7.8)*

Those surveys have been completed by an "auto-observation" protocole designed to be utilized onboard the vessels of fishermen partners during the BENTHIS project period. The protocole has been defined and realized with a close collaboration of fishermen partners (SME09 and SME10, Côte d'Ambre & Bugal Spontuz). Those operational tests have been performed in May and June 2015: 5 days fishing trip with classical "Thyboron" doors and 14 days fishing trip with the new "Jumper" doors. It has provided data on efficiencies of the new gears in terms of captures, economic viability, fuel consumption.

Clearly significant results

- Survey FEBBE 3 and 4 achieved
- Operational sea trials of new fishing gears by fishermen partners achieved
- Redaction/participation to deliverable: D7.8

Task 7.3.4 - Management scenario evaluation

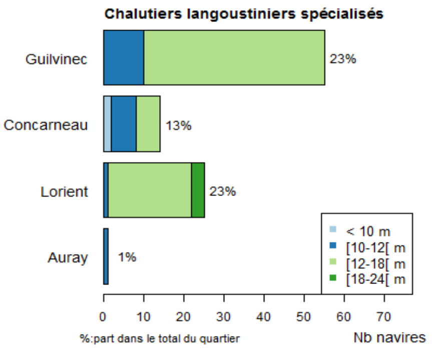
Summary of progress

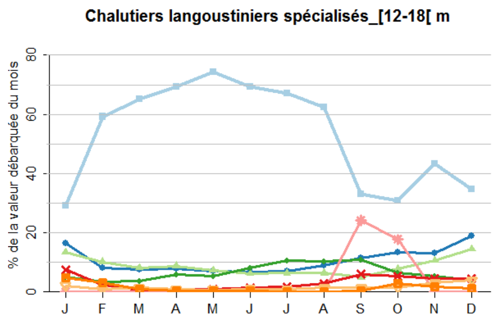
Application of SENSECO tool (link with WP5) to the Nephrops fishery in the Bay of Biscay. Static comparative analysis of the economic consequences of the adoption of alternative gears (traps, modified trawls) under different conditions and assumptions of effort reallocation using interface and capacities of the tool. Exploration of the dynamic of effort allocation by métier and incentives to adopt alternative gear or strategies.

SENSECO inputs Level 1 from the 2 partners vessels

- Data collection continuous on board sampling and surveys
- Socio-economic survey
- Data analysis: economic data, trip accountings production, FE statistics, SACROIS
- SENSECO inputs Level 2 : example-fleet level (Nephrops trawler)
- Data analysis from existing data bases
    - Revenues and costs by métier
    - Economic survey 2009 on costs per métier
    - Economic references for mono-métier fleets
    - Production and effort statistics / SACROIS
    - Economic data from other data bases

	Bay of Biscay	Nephrops Fishery in the Bay of Biscay
Nb of vessels	1629	156 (10%)
Nb of fishermen	4057	494 (12%)
Gross revenue (Millions Euros)	423	68 (16%)
Mean Vessel Length (m))		14,7
Mean Vessel age (year)		25
Nb of crew by vessel	2,5	3,2





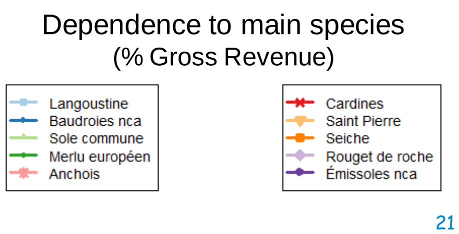


Figure 7.9. *Application SENSECO: Data analysis on the Bay of Biscay Nephrops Fishery*

Application of ISIS-Fish (link with WP6)

- Analysis of the impact of alternative spatial strategies (MPA) of effort allocation and alternative gears on the fishery dynamics (Nephrops, sole, hake/fleets/Benthos)
- Analyse impact of MPA, alternative spatial strategies of effort allocation and alternative gears on the fishery dynamics (Nephrops, sole, hake/fleets/Benthos) with ISIS-fish
- Parametrization of spatio-temporal dynamics: populations of hake, Nephrops & sole

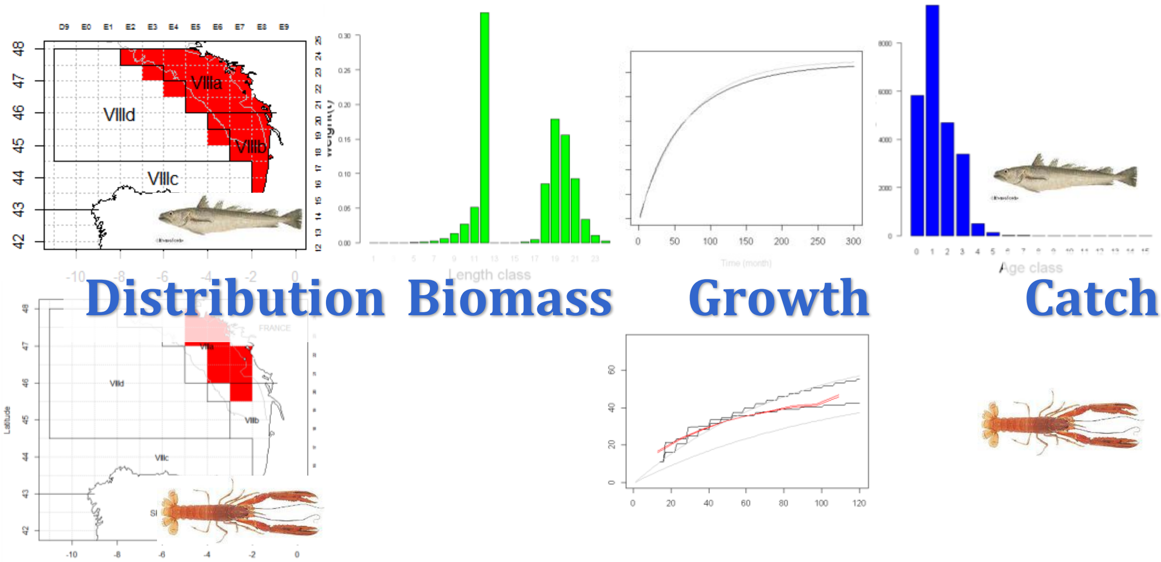
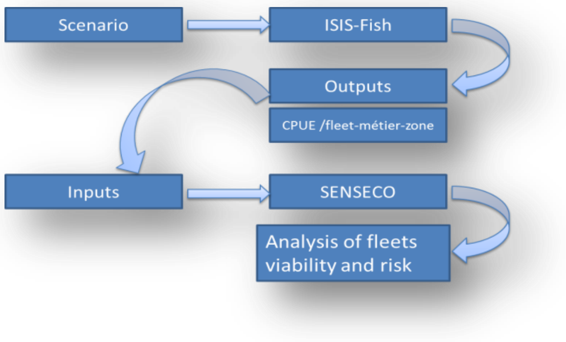


Figure 7.10. *xxxx*

Parametrization of spatio-temporal dynamics for French & Spanish fleets and validation of French fishing fleets typology

- **Offline coupling of ISIS-fish and SENSECO** (links WP5-WP6)
    - Start of explorations of the **bio-economic consequences of scenarios** and analysis of **viability and risks for fleet economic performances**



Regional case study meeting

The third regional case study meetings (RWP3) part 1 and 2 have been held in Lorient the 08/07 (with scientists and professional partners) and the 15/01 (with scientists only). Those two dates were organized to ensure the best participation both for scientists and professional fishermen involved in BENTHIS project.

For each of the WPs and dedicated tasks, we presented an overview of the regional work done since the previous meeting. We presented work to be done and proposed a workplan for the next project's period. A specific session has been organized to prepare the BENTHIS field surveys in 2015.

The second regional stakeholder event (RSE2) has been held on December 11th 2015 in Nantes (France). 15 participants from 12 different organizations were present and most of the stakeholders groups were represented: fishermen association, environmental NGO's, fishing technology industry, Seafood market process and scientists. Discussion has been organized around 8 main topics with presentations opened to questions & roundtable discussions: 1 - Introduction to the case study, 2 - Fishing footprint evaluation, 3 -

Current & alternative fishing gears, 4 - Pulse trawl, 5/6 - benthic ecosystem functioning & bottom trawl impacts, 7 - Fisheries discards and ecological effects, 8 - methods & tools to test alternative strategies.

Interesting discussion and questions arose during each presentation and roundtables such as: do habitat modifications are a real problem and how BENTHIS could improve previously estimated level of disturbance?; access to fishing footprint maps to communicate with local fishermen associations; the benthic life on the video suggested that fisheries areas are still going well; how the discards landing obligation will impact ecosystem functioning?; modelisation process to estimate footprint of fishing gears seems far from the reality; do we already have sufficient knowledge to produce such integrated models?; how do you define management strategy and especially what is a good environmental status?

RSE2 meeting presentations and discussions have been reported into deliverable D8.8.

Deviations

Delay in the publications of maps generated from VMS due to late authorization of French authorities to utilize and publish them. This implies that the data cannot be combined with those of the other countries to carry out the integrated analysis to be carried out in WP2.

Failing to achieve objectives

none

Use of resources

No exceptional deviations. Two surveys dedicated to collect data for the BENTHIS project (FEBBE3 & FEBBE4) have been performed and represented an important use of resources in 2014.

7.3.1.b - Scallop and Nephrops fisheries in the Irish Sea

Lead : MI (P8) - D.Reid

Fisheries: Nephrops trawling fishery

Habitat: Muddy habitats,35-140 m

Region: Western Irish Sea (middle)

Alternative gears and/or management strategy: "Smart fishing" (spatial and temporal fishing strategy)

Fisheries: Scallop Dredge

Habitat: Sand/gravel seabeds in shallower waters

Participant: Local scallop association

Region: SE Irish coast

Alternative gears and/or management strategy: current dredge compared to Hydrodredge

Task 7.3.1 - Current impact of fishing

Summary of progress

Trawling impact of the scallop dredging has been reviewed in the deliverable 7.6.

A number of benthic impacting gears are used in the north east Celtic Sea including bottom otter trawls (OTB), beam trawls (TBB), dredges (DRB) and pots (FPO). Scallop dredgers in the Celtic Sea target king scallop (Pecten maximus) on sand and gravel substrates. Scallop dredges are known to have significant impacts on epibenthic and inbenthic fauna. Mitigating the effects of the fishery on benthic habitats is an important objective and is driven by the requirements of the Habitats Directive and the Marine Strategy Framework Directive (MSFD). The case study examines whether dredge design can be modified to reduce inbenthic disturbance and whether high resolution information on seabed structure can be used to focus fishing effort on areas where scallop occur at high density thereby reducing dreding effort per unit of catch.

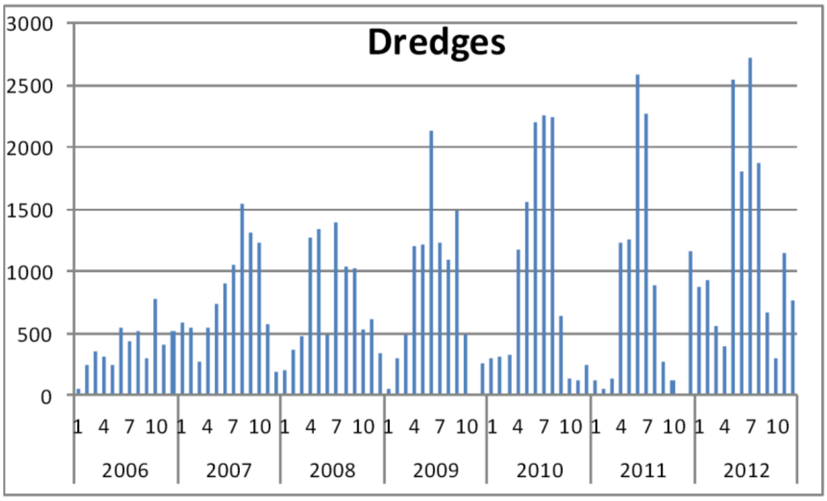


Figure 7.11. *VMS hrs of activity by vessels >15m using dredges in the north east Celtic Sea by month during the period 2006-2012 (deliverable 7.6)*

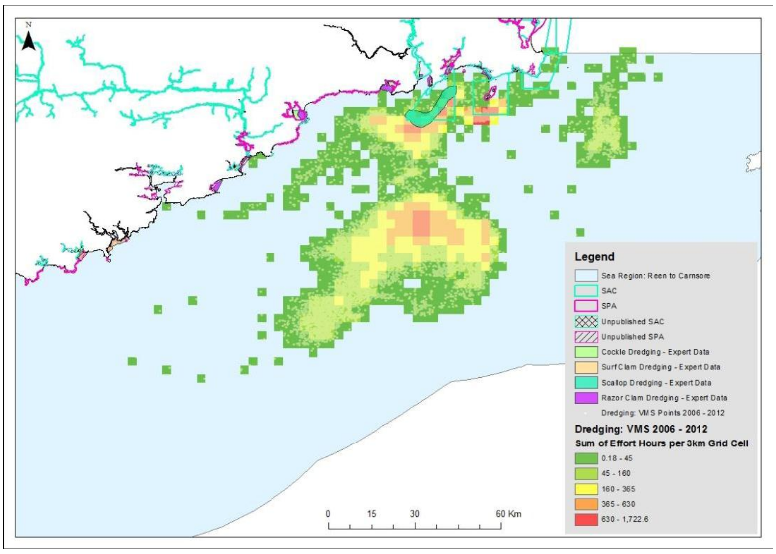


Figure 7.12. *Distribution dredge fishing (DRB) in the north east Celtic sea. The VMS data for the scallop fleet is shown in grid and point format. Other small scale dredge fisheries occur inshore. European Marine Sites (SACs, SPAs, are shown, Deliverable 7.6).*

Clearly significant results

Redaction/Participation to deliverables: D2.2, D3.4, D3.6, D4.5, D7.6

Task 7.3.2 - Options for mitigations

Summary of progress

The three options for mitigating the scallop fishing pressures in the north east Celtic Sea. and tested during Benthis project have been reported into the deliverable 7.7.

Option 1 is to provide high resolution backscatter maps to fishermen. The potential benefits of providing high resolution information on seabed substrates to scallop fishermen are increased efficiency; a higher volume of catch can potentially be caught with lower dredging effort and a lower fishing pressure footprint. If fishing effort per unit of catch is reduced fishing costs and fishing time per unit of catch is also lower. There are, therefore, potential gains from reduced environmental impact, reduced fuel consumption, lower carbon emissions per unit of catch, reduced labour costs and reduced time at sea. This of course would need to be developed in parallel with management measures that limited the total outtake. Otherwise the provision of the maps to the fleet simply represents effort creep.

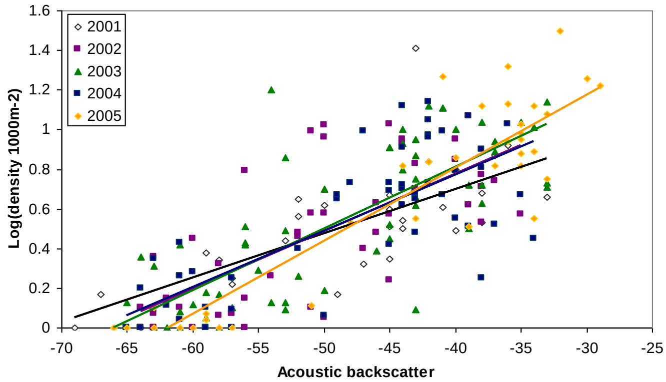


Figure 7.13. *Relationships between multibeam acoustic backscatter and catch rates of scallop in annual surveys, 2001-2005, in the Celtic Sea. Higher catches occur on harder ground (gravels).*

Option 2 is to replace of standard dredge by Envirodredges. The potential benefits, if the catching efficiency is comparable to dredges currently used in the fishery, is reduced deep disturbance of sediments and reduced impact on infauna. The fuel savings reduces costs and carbon emissions per unit of catch.

Option 3 is a combination of both options 1 and 2. There is an in-combination add on benefit to be gained by adopting both options 1 and 2 above. Option 1 reduces footprint and contact and Option 2 reduces the impact in the footprint area. Both options provide for fuel savings per unit of catch.

Clearly significant results

Redaction/participation for deliverable: D7.7

Task 7.3.3 - Sea trials

Summary of progress

Sea trials was undertaken in Clew Bay in July 2014 on the west coast of Ireland. The inner portion of Clew Bay is

designated as a Special Area of Conservation (SAC) under the EU Habitats Directive. The objective of the trial was to investigate and compare the impacts of scallop dredging with standard spring loaded Newhaven Scallop dredges and N-Viro scallop dredges on sedimentary seabed habitats in a shallow inshore bay. Specifically, the field studies had the following objectives:

- Benthic characterisation:
    - To collect sediment core samples to characterise infaunal communities in areas that are subject to regular/periodic dredging activity and areas that have not been regularly or recently dredged
    - To conduct a number of characterisation SCUBA dives on undredged grounds to establish typical background faunal composition of the associated benthic communities
- Impacts of scallop dredging
    - To collect video and photographic evidence of seabed habitat impacts and invertebrate fauna injury and mortality as a result of scallop dredging over sedimentary seabeds
    - To collect video evidence of dredge operation in order to improve understanding of the function of both spring dredges and N-Viro dredges.

Evidence of dredging related impacts recorded during the surveys include:

- moderate to severe visible physical alteration to surface sedimentary habitat structure along the path of dredge tracks
- visible impacts to cobble and boulder habitats. Coarser sediments (cobble, stones and boulders) had apparently been lifted out of the sediment and turned over or pushed or dragged along the seabed surface, frequently being are left in an inverted condition which is likely to destroy attached fauna.
- Visible dredging associated injury and direct mortality of both epi-fauna and in-fauna
- Smothering related impacts associated with re-suspension and settling out of the water column of sediments
- Visually detectable difference in the epi-fauna within dredge tracks and on adjacent areas of seabed. Overall reduction in abundance was apparent between recently dredged and undredged

areas. This could not be confirmed through in-situ enumeration of all species of epifauna due resource limitation.

There appear to be three main areas of contact between dredges and the seabed: (i) rollers at either end of the beam to which the dredges are attached; (ii) the tooth bar on the Newhaven dredge, or tines in the case of the N-Viro dredge the shoes at either side of each dredge.

In situ comparison of the physical impact of N-Viro and NewHaven spring loaded scallop dredges failed to find significant differences in the level of impact caused to seabed habitats in mixed sedimentary environments. Both dredges cause significant impact to epifauna and infauna, reduces small scale relief on the seabed and homogenises and increases the sorting of sediments. The catch and by-catch composition, scallop catch rate and selectivity of the dredges is similar.

Clearly significant results

- Detailed description of those sea trials and results have been reported into the deliverable 7.8.
- Redaction/participation for deliverable: D7.8

Deviations: none

Failing to achieve objectives: none

Task 7.3.1.c - Shelf Slope

Lead : IMR (P13) Lene Buhl Mortensen: Contribution: IFREMER (P7)

Fisheries: multispecies trawling gears (OTB, TBB) and passive gears (GNS, GTR, LLS, FPO)

Habitat: shelf to deep water areas (mainly on the continental slope) with a specific focus on Cold Water Corals habitats

Alternative gears and/or management strategy: analysis of spatial distribution of activity, gear ban

Task 7.3.1 - Current impact of fishing

Summary of progress
List of VME to be taken into account for BENTHIS project and distribution in the various covered regions.

Table 9 - List of VME's present in studied regions and taken into account for Benthis.

Sensitive habitats (modified from OSPAR' list of threatened and/or declining habitats)	Bay of Biscay		Norwegian waters	
	Presence	Taken into account for Benthis	Presence	Taken into account for Benthis
Soft and hard bottom coral gardens	YES	YES	YES	YES
Seapen and burrowing megafauna	YES	YES	YES	YES
Umbellula stands	?	NO	YES	YES
Glass sponge community	YES	NO	YES	YES

Evaluation of fishing footprint and its evolution

(1) (2)

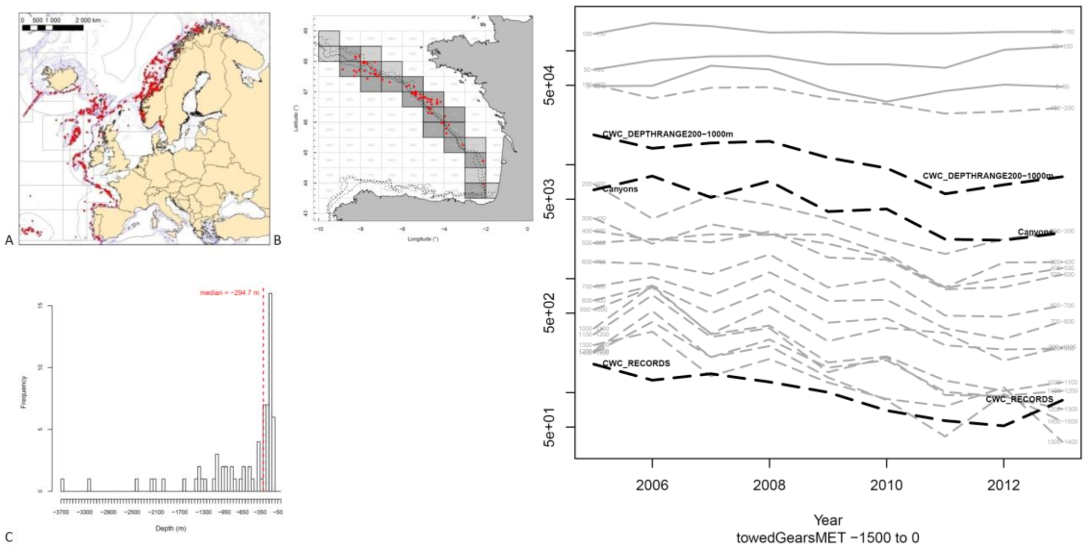


Figure 7.14. *1) Distribution of recorded cold water corals VME's in European shelf seas and the bay of Biscay and 2) cumulated fishing swept area by trawlers over depth range and for those specific habitats during the period 2005 to 2013 for the Bay of Biscay.*

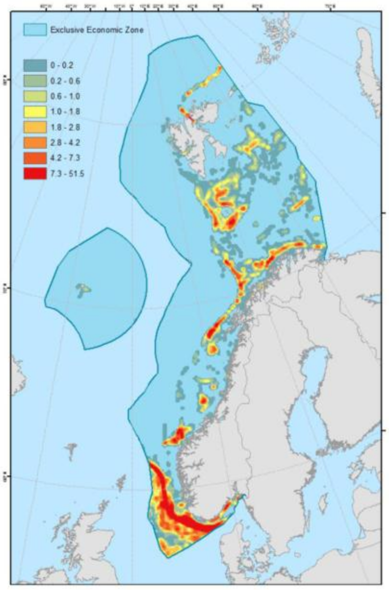


Figure 7.15 - *Trawling intensity in Norwegian waters (Norwegian and foreign vessels) in 2011, plotted on 5x5 km cells. The scale indicates the trawling intensity in towing distance by area (km/ km2), split into 8 intensity categories (quantiles). The total area trawled is 607,683 km2, with an average trawling intensity of 0.17 km2/ km2 in the affected cells. Blue represents areas not exposed to trawling.*

Clearly significant results

- Detailed results given into deliverable 7.6
- Buhl-Mortensen, L., Ellingsen, K. E., Buhl-Mortensen, P., Skaar, K. L., and Gonzalez-Mirelis, G. Trawling disturbance on megabenthos and sediment in the Barents Sea: chronic effects on density, diversity, and composition. – ICES Journal of Marine Science, doi: 10.1093/icesjms/fsv200.

Task 7.3.2 - Options for mitigations

Summary of progress

- A summary of already defined management options for CWC reefs and deep-water areas has been realized for the deliverable 7.7
- The management options for mitigating trawling impact on VMEs have been reported into the deliverable 7.7. It mainly included quantity and/or spatial reduction of fishing effort on the most sensitive areas.

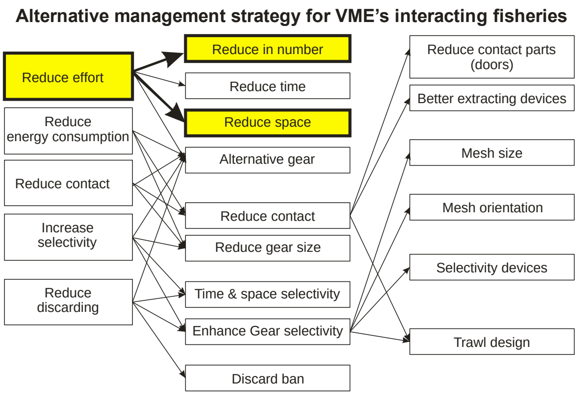


Figure 7.16. *Diagrams of the option to be tested in the sub-case study: fisheries interacting with VME's in French and Norwegian waters (Deliverable 7.7).*

Clearly significant results

- Participation to deliverable 7.7

Task 7.3.3 - Sea trials

no sea trial planned for that sub-case study

Task 7.3.4 - Management scenario evaluation

no result to date

Deviations: none

Failing to achieve objectives: none

Use of resources: no deviation

WP7.4 - MEDITERRANEAN SEA

Lead: CNR (Antonello Sala)

The focus in this region is on the demersal otter trawl fisheries. Focus for Fisheries and Alternative Strategies are on i) Reducing unwanted catches in trawl fisheries by developing commercially acceptable selective gear designs for Mediterranean demersal fisheries and formulating guidance for future designs; ii) Shifting from traditional demersal otterboards to novel and semi-pelagic otterboards; iii) Development of viable alternative fishing methods (pots and traps).

Task 7.4.1 - Assess current trawling impact

Lead HCMR, Contributors: CNR

Summary of progress

A report on the Mediterranean was compiled and submitted for completion of Deliverable D7.6 Report on trawling impact in regional seas. The report included a Mediterranean and country (Italy and Greece) review and compilation of available data on fishing gears used, vessel type numbers, importance of gears in terms of landings, days at sea and catch values, known gear impacts (trawling removal, impacts to seabed habitats, benthos, sedimentary physical properties, resuspension and sedimentation, heavy metals and pollution, sediment chemistry and fluxes), size composition of important gears, distribution of fishing effort, distribution of benthic habitats, distribution of fisheries according to habitats.

Clearly significant results

- Contribution to the deliverable *D7.6 Report on trawling impact in regional seas*.

Deviations. None.

Failing to achieve objectives..

Task 7.4.2 - Option for mitigation

Lead CNR, Contributors: HCMR

Summary of progress

A report on the Mediterranean was compiled and submitted for completion of Deliverable D7.7 Report on options for mitigation fishing impacts in regional seas. The report included a general introduction on potential input control options for mitigating fishing impacts through various options based under reduction of effort (reduction in vessel number, time, space, introduction of alternative gears), reduction in contact with the seabed (reduced contact or gear gear/part sizes), increase in selectivity (time and space selectivity, gear selectivity) and reduction of discards (discards ban). Several of these options were picked up by the different case studies. For the Mediterranean case study the work on the report included, general presentation of Mediterranean specificities (environment and fisheries), presentation of realistic options towards the tests/trials carried out in the testing phase of project (in Italy: implementation of pelagic otter boards, other modification to reduce seabed impact and fuel consumption, modification of the beach seine, introduction of fish pots; in Greece introduction of fish pots and prawn traps), discussion on the options.

Clearly significant results

- Contribution to the deliverable *D7.7 Report on options for mitigation fishing impacts in regional seas*.

Deviations. none

Failing to achieve objectives. none.

Task 7.4.3 - Testing alternative gears

lead: CNR; main contributors (HCMR, SME13, SME14).

Summary of progress

One of the aims of the Mediterranean Case Study is to shift from traditional demersal otterboards to novel and semi-pelagic otterboards. Several sea trials have been organized, which have focused on the development of novel otterboards, and to some technical modifications to a bottom trawl net design. In order to assess the physical impact reduction of novel otterboards, two traditional and two experimental otterboards, from Grilli (SME13) and Mori (SME14), have been tested. Traditional models are bottom otterboards while the experimental models have been designed as floating, semi pelagic otterboards. The performances of the otterboards have been tested in terms of geometrical and mechanical parameters as well as from the physical bottom impact through side scan sonar monitoring. During the previous reporting period wind tunnel and flume tests on the doors were described. With respect to the trawl net design, the development of novel a trawl design focused on the test of a particular device implemented in a traditional bottom otter trawl. Such modification in the design is expected to increase the adult selectivity, allowing decrease in juvenile catch. A set of sea trials has been carried out through a comparative approach, on board a twin trawl bottom commercial trawler.

Sea Trials Italy

Tests of novel otterboards

In February 2014 a first set of sea trials has been carried out on board the research vessel "G. Dallaporta" in Ancona (Italy). The aim the sea trials was to verify the stability and operability of the experimental otterboards and a preliminary performances comparison with respect to the respective traditional otterboards. All the otterboards have been tested with different door configurations and at different depths and fishing grounds. The experimental door from SME13 (**Figure 7.17**7.17) is a pelagic door with a hyper-lift device on the forward part of the vertical line of the door. The experimental door from SME14 (**Figure 7.18**7.18) is designed as a "near-bottom" floating door. The idea of the manufacturer is to increase the energy efficiency of the door by reducing bottom contact, while, remaining near the bottom, no sensors are needed. **Figure**7.19 illustrates the different rigging of the doors. In order to evaluate the effective applicability of experimental doors on a commercial fishing gear, in June 2014 another set of sea trials have been carried out on board a commercial vessel (**Figure**7.20). During this second set of sea trials, more attention was paid to the fishing gear behaviour with respect to the catch. Furthermore, the point of view of the fisherman was essential to collect information from a technical and practical point of view. Further tests have been carried out in September 2015, focusing on the evaluation and comparison of the bottom impact of the otterboards. The tests followed the methodology described by Lucchetti *et al.* (2012), by using a Side Scan Sonar from Deepvision™. In **Figure** some samples of the sonograms show a preliminary comparison of the traditional and experimental doors tested.

Figure 7.17. *Grilli Fly. On the left, the model tested in wind tunnel and flume tank; on the right the full-scale otterboard used during the sea trials.*

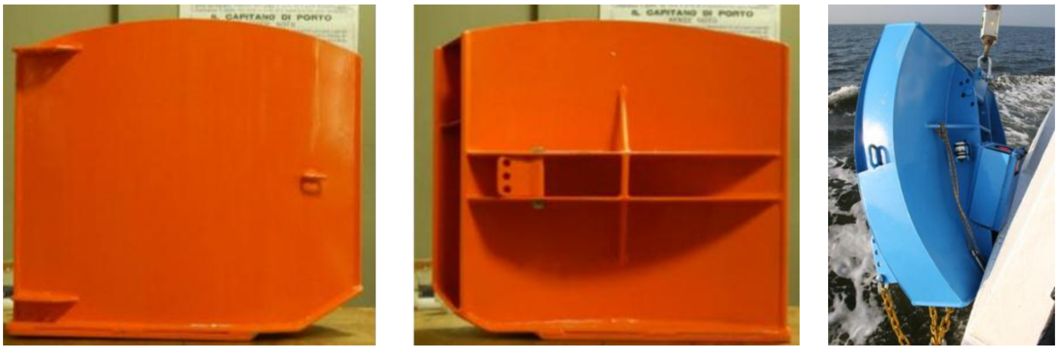


Figure 7.18. *Mori Biplan. On the left, the model tested in wind tunnel and flume tank; on the right the full-scale otterboard used during the sea trials.*

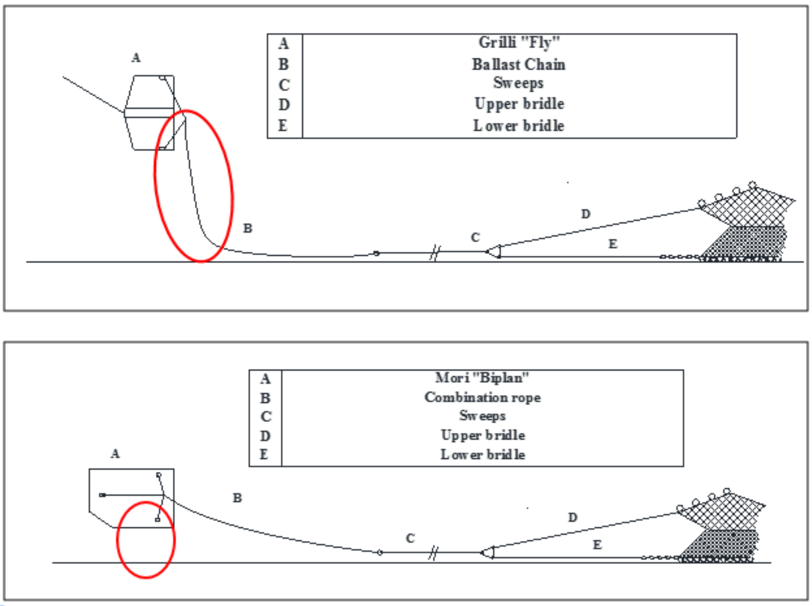


Figure 7.19. *Different configurations and working properties of the two experimental doors. The Grilly "Fly" operates as a proper pelagic door, floating in the water column. The Mori "Biplan" is conceived as a "near-bottom" floating door.*

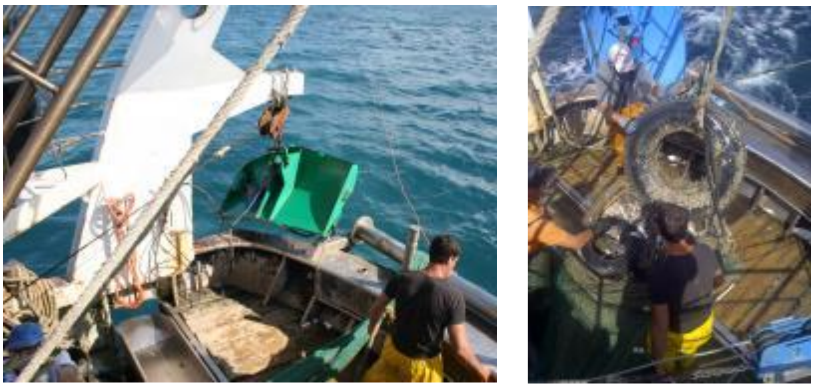


Figure 7.20. *Sea trials on board the commercial fishing vessel. On the left, the Grilli Fly, on the right the Mori Biplan.*

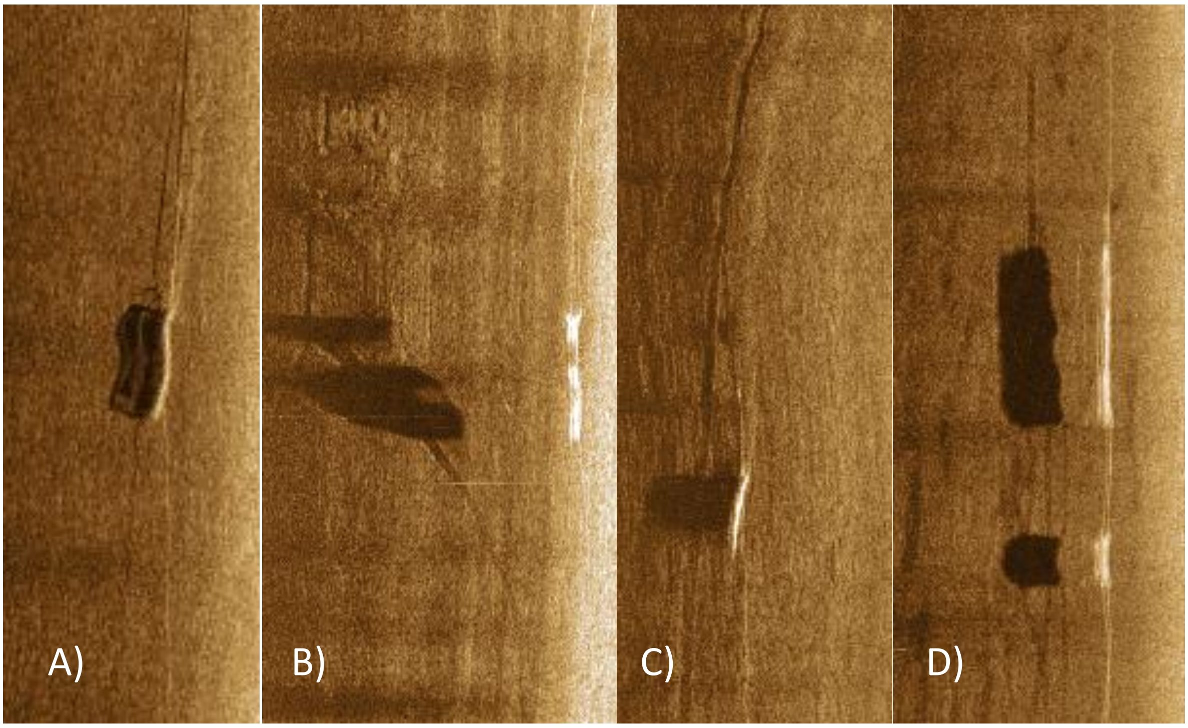


Figure 7.21. *Sonograms obtained with Side Scan Sonar, according to (Lucchetti et al., 2012) of the otterboards monitored during the sea trials carried out in September 2015. A) Grilli AR; B) Grilli Fly; C) Mori Z; D) Mori Biplan.*

Tests of new trawl net design

Novel designs for a bottom trawl net have been selected on the basis of information collection carried out in Task 7.4.1. In particular, an evolution of a selection device already tested in Spain by the Spanish company "Tecnopesca" (www.tecnopesca.com/) has been implemented on a bottom twin trawl, through an innovative implementation procedure. SME12 provided the implementation of the novel design. The experiment focused on two different tasks. One task was related to a modification in the net design, and the other related to the net material. A selection device has been implemented on one net of a twin trawl gear, while the other net represented the reference in terms of geometrical and catch performances. Furthermore, two sets of selection devices have been prepared, with the same design: one using in standard knotless netting material, the other using Dyneema, in order to evaluate the possible influence of the material in selectivity and drag resistance of the net. The same set of trawl nets has been tested with experimental doors from SME13 and SME14. A representation of the design is shown in **Figure** 7.22. One of the twin trawls (A) represents the reference in terms of catches and geometrical and mechanical characteristics such as net openings and drag resistance. The other twin trawl will be used for the implementation of the selection device (B). The selection device consists of two separator panels near the side panels of trawl net. The side panels along the separator panels will be provided with an escape window (C) with proper mesh size and configuration to guarantee the escape of juveniles and other unwanted catch species. At the end of the separator panels, through two passages (D) fishes will proceed along the net until the codend.

Both the geometrical and mechanical parameters of the fishing gear have been monitored during the sea trials (**Figure**7.23, **Figure**7.24), in particular data on the horizontal door spread, horizontal and vertical net opening of both the nets, total towing force of the fishing gear, fuel consumption and GPS data. Meanwhile, catches of the two covers have been analysed (**Figure**7.25).

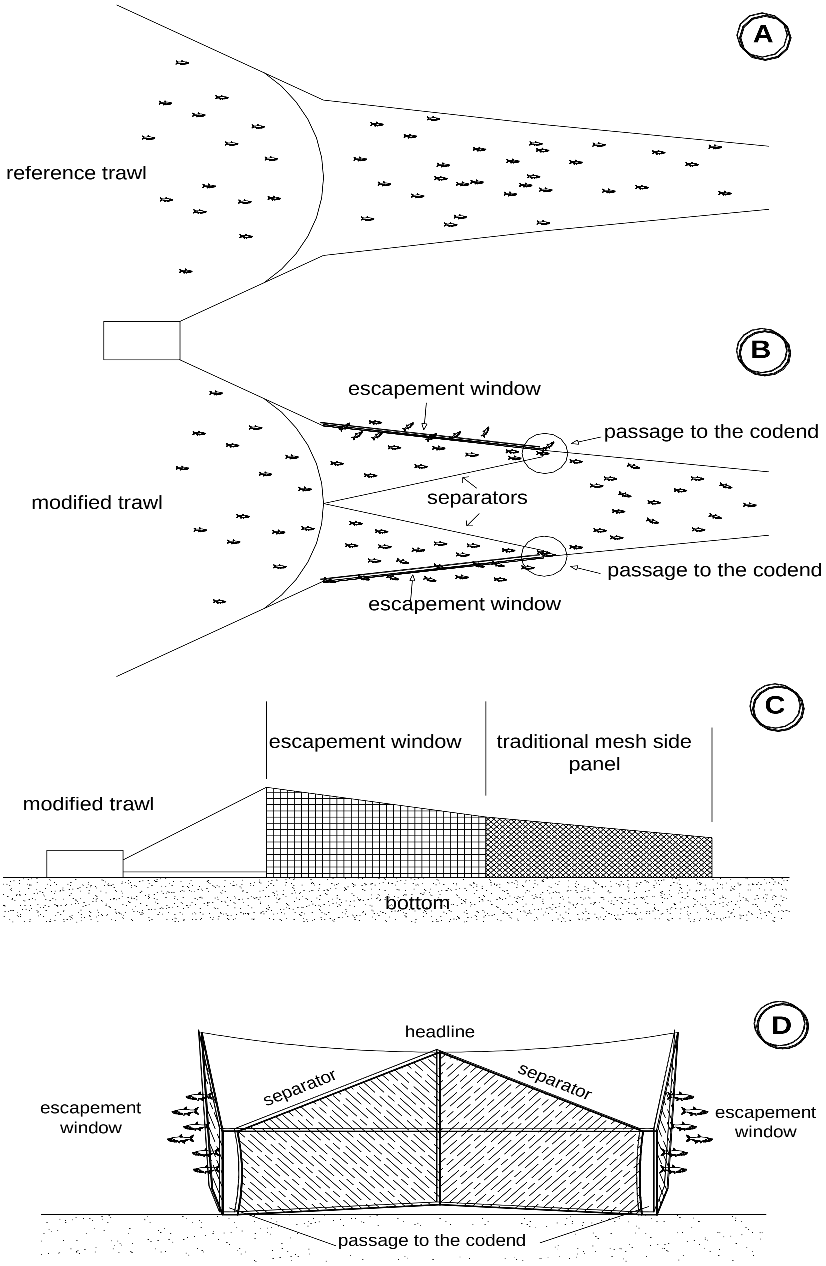


Figure 7.22. *Schematic of the test trawl. One of the twin trawls (A) represents the reference in terms of catches and geometrical and mechanical characteristics such as net openings and drag resistance. The other twin trawl will be used for the implementation of the selector device (B). The selector device consists of two separator panels, which carry the fish near the side panels of trawl net. The side panels along the separator panels will be provided with an escape window (C) proper mesh size and configuration to guarantee the escape of juveniles and other unwanted catch. At the end of the separator panels, through two passages (D) fishes will proceed along the net until the codend.*

Figure 7.23. *Fishing vessel hauling the twin nets.*

Figure 7.24. *Gear monitoring system from Simrad. The screen shows the horizontal net opening of the two nets and the vertical net opening of the net with selector.*

Figure 7.25. *Catch analysis for both codends.*

Clearly significant results

- **Table**7.2 and **Table**7.3 show the preliminary results of the tests on the otterboards. Each of the experimental doors (i.e. Grilli Fly and Mori Biplan) have been compared with a traditional type. The experimental otterboards improved geo-mechanical performances with respect to their traditional reference doors, with respect to the trawling power demand (TP), which directly affects fuel consumption. However, using the experimental doors reduced net openings.

- After the first set of tests, SMEs further developed the doors and an updated version has been tested onboard a fishing vessel. **Table**7.3 reports results the second set of tests. The door modifications increased the opening properties of the net, which were comparable among traditional and experimental doors. In particular, trawling power was reduced in both cases.
- **Table**7.4 reports preliminary resutls obtained from the test of the new bottom trawl design. The comparison between the different materials showed, as expected, a better energy performance of the Dyneema net . The overall fuel consumption and total towing force are on average less for Dyneema net. With respect to geometrical specifications, no relevant effects could be related to the selection device. Comparing catches and discards (i.e. discard is the fraction of the total catch which was considered as non-commercial), the selection device decreased the discard fraction in both of the net configurations (standard and Dyneema). While the catch is almost the same, it seemed that the lateral panels allowed the escape of most of the potential discard.

- **Table 7.2.** *Sea trials onboard R/V «G. Dallaporta» – February 2014 (HDS[m] horizontal door spread; HNO[m] horizontal net opening; VNO[m] vertical net opening; TS[kn] trawling speed; TTF[kg] total towing force; G-Ar-Poly and G-Fly: traditional and experimental doors from SME13; M-Z and M-Biplan: traditional and experimental doors from SME14).*

Benthis 14.1 - R/V "G. Dallaporta"

	HDS [m]	HNO [m]	VNO [m]	TS [kn]	TTF [kg]	TP [kW]	HDS/TTF [m/kg]	HNO/TTF [m/kg]	VNO/TTF [m/kg]
G-Ar-Poly	57.11	16.03	1.05	3.59	3108	56.25	1.84	0.52	0.03
G-Fly	53.44	13.59	1.36	3.36	2843	48.18	1.88	0.48	0.05
M-Z	61.75	17.42	1.15	3.46	3302	57.60	1.87	0.53	0.03
M-Biplan	48.60	13.35	1.33	3.36	2690	45.55	1.81	0.50	0.05

- **Table 7.3.** *Sea trials onboard fishing vessel – July, 2014. (HDS[m] horizontal door spread; HNO[m] horizontal net opening; VNO[m] vertical net opening; TS[kn] trawling speed; TTF[kg] total towing force; G-Ar-Poly and G-Fly: traditional and experimental doors from SME13; M-Z and M-Biplan: traditional and experimental doors from SME14).*

Benthis 14.2 F/V "Orizzonte"

	HDS [m]	HNO [m]	VNO [m]	TS [kn]	TTF [kg]	TP [kW]	HDS/TTF [m/kg]	HNO/TTF [m/kg]	VNO/TTF [m/kg]
G-Ar-Poly	44.06	16.48	0.78	3.71	3566	66.73	1.24	0.46	0.02
G-Fly	59.00	18.59	0.68	3.41	3316	57.04	1.78	0.56	0.02
M-Z	50.90	19.19	0.64	3.57	3455	62.22	1.47	0.56	0.02
M-Biplan	51.01	18.21	0.73	3.58	3415	61.67	1.49	0.53	0.02

- **Table 7.4.** *Results of the sea trials with the twin trawls. Data are disaggregated by net material, while are pooled by doors. Minimum, maximum, average, standard deviation and median of the most relevant parameter are reported (TS[kn] trawling speed; D[m] depth; FC[l/h] fuel consumption; TTF[kg] total towing force; MI1_TOT[kg] gear drag at the end of the bridles for the net with selector; MI2_TOT[kg] gear drag at the end of the bridles for the net without selector; HNO[m] horizontal net opening; VNO[m] vertical net opening; Catch1 total commercial fraction of the catch of the net with selector; discard1 the amount of discards from the net with the selector.*

TRX/TRA

	TS	D	FC	TTF	MI1_TOT	MI2_TOT	HNO1	HNO2	VNO1	Catch1	Discard1	Catch2	Discard2
	[kn]	[m]	[l/h]	[kgf]	[kgf]	[kgf]	[m]	[m]	[m]	[kg]	[kg]	[kg]	[kg]
min	3.45	19.00	66.80	4015	1610	1827	14.41	14.75	0.60	11.59	5.00	11.87	3.40
max	3.77	34.96	75.91	4394	2197	2486	18.85	16.55	0.70	24.21	55.00	69.48	59.00
avg	3.57	22.83	70.53	4249	1940	2172	16.16	15.41	0.65	17.16	18.39	34.26	29.32
st.dv	0.09	4.92	3.06	134	247	239	1.64	0.58	0.04	4.55	15.81	16.82	17.82
Median	3.57	21.30	69.51	4318	1978	2196	16.53	15.33	0.65	15.86	13.50	34.48	26.00

DYN/DYX

	TS	D	FC	TTF	MI1_TOT	MI2_TOT	HNO1	HNO2	VNO1	Catch1	Discard1	Catch2	Discard2
	[kn]	[m]	[l/h]	[kgf]	[kgf]	[kgf]	[m]	[m]	[m]	[kg]	[kg]	[kg]	[kg]
min	3.37	15.70	58.30	3500	1878	1763	15.78	16.38	0.60	11.49	11.50	8.56	4.50
max	3.87	47.60	70.43	4154	1962	2132	18.70	17.40	0.87	24.11	68.00	24.43	111.50
avg	3.65	29.30	67.08	3960	1914	1918	17.28	16.92	0.70	16.03	29.45	16.37	30.30
st.dv	0.15	11.68	3.49	186	31	152	0.94	0.51	0.08	4.48	15.89	4.80	29.93
Median	3.66	28.03	67.82	3977	1906	1943	17.30	16.95	0.70	14.96	28.00	16.93	24.75

Sea Trials of fish pots and fish traps (Greece)

In Greece (HCMR), two sampling cruises have been completed to trial Norwegian fish pots and Greek Prawn and Fish traps as a potential alternative to bottom trawling in the Southern Aegean Sea. The main sampling took place in August 2014 and May 2015 in Heraklion Bay Crete at 2 depth strata representing a “redfish” (red mullets and sparids) fishery at 80-90 m depth and a whitefish/shrimp fishery at 170-190 m depth. In addition the pots/traps were also tried in shallower waters (25-40 m depth). Pots/traps were fished on long-lines for 24 hours. Multiple trawls were carried out adjacent to the long-lines to investigate the background fish communities. In August, a total of 180 pots were fished with 10 comparative trawls. In May, a total of 80 pots, 160 Prawn traps and 160 Fish traps were fished with 7 comparative trawls. Cameras were deployed to make video recordings on 2 pots/traps for each daily deployment. In general pot/trap catches were very poor with low catches. From video observations the pots/traps did fish, but the attracted species were principally small and able to swim in and out of the meshes (approx. 20 x 20 mm bar). Contributions were made to *D7.8 Report on results of sea trials in regional seas*. Further trials are being planned for deeper water operations at the beginning of the next reporting period.

Clearly significant results

- From the Pot/trap results in Greece to date, the designs and rigging trialled indicated that these would not be suitable alternatives for commercial fisheries in the areas and the seasons fished.
- Three presentations with peer-reviewed extended abstracts were made based on data/results from the first sampling cruise at the Panhellenic Symposium of Oceanography and Fisheries in May 2015.
- Papadopoulou K-N et al (2015) 11th Panhellenic Symposium on Oceanography and Fisheries, “Aquatic Horizons: Challenges & Perspectives” Mytilene, Greece. Proceedings Volume: 157-160.

- Papadopoulou, K-N., et al. (2015) 11th Panhellenic Symposium on Oceanography and Fisheries, “Aquatic Horizons: Challenges & Perspectives” Mytilene, Greece. Proceedings Volume: 373-376
- Kapiris, K et al., (2015) 11th Panhellenic Symposium on Oceanography and Fisheries, “Aquatic Horizons: Challenges & Perspectives” Mytilene, Greece. Proceedings Volume: 597-600.

Deviations. none.

Failing to achieve objectives. none.

Task 7.4.4 - Innovative management scenario’s

Lead HCMR, Contributors, CNR, IRCRES (ex CERIS)

Summary of progress

The work is still in progress: here we present the first results concerning the collection of the required data and, the ways to adapt the analysis to the available data. The work has been conducted by CNR-IRCRES in cooperation with CNR-ISMAR who provided the data from the sea trials necessary to complete the economic evaluation and for consulting on the first results of the analysis. The methodology used for this study was based on the construction of a Cost Benefit Analysis (CBA), used in previous studies to evaluate various options for investment in the fishery sector (Mokua et al., 2014; Macher et al., 2008; Freese et al., 1995; Kronbak, 2009; Esteban and Crilly, 2013).

In our case, the CBA was primarily intended to be used to assess the best otterboards among various gears tested, from the fishermans point of view, so excluding all considerations related to negative (or positive) externalities generated by the fishing activities.[1]

For this type of analysis it is necessary to consider all the benefits and costs produced by an economic activity, on average in a year, with a standard equipment used as a benchmark to compare all the other tested gears.

For this gear historical data were available for costs and revenues. For the experimental gears the only available data were from the sea trials. This lack of data is the major concern for the CBA. Despite the accuracy of the measurements and the usability of data for a comparison among the performances of the gears tested, the amount of data required for a CBA is considerably greater than that available. Nevertheless, it was agreed to project the technical data collected on the trial days on the entire year, without considering all the variations that occur during the fishing year due, for example, to weather conditions, movement of fish stocks, etc., taking into account the considerable simplification of these assumptions.

Clearly significant results

- **Table** 7.5, shows the differences among the mean values obtained by each gear and the mean value of the benchmark Z otterboard. Statistically significant differences are in bold.
- Fuel consumption (FC) was significantly different only for FLY, which seems to allow a reduction in fuel consumption compared to the other otterboards. For the opening variable (HDS), the THY, FLY and POLY otterboards data were significantly different.
- The Grilli BIPLAN experimental otterboards are the best gear in terms of reduction of the strength of the nets. Favorably influencing the wear on the boat and maintenance costs.
- The Grilli FLY experimental otterboards are the best gear in terms of fuel consumption allowing a reduction of about 6.6 l/h compared to the traditional trawl doors.

[1] The possibility to introduce in the analysis *non*-marketable externalities such as reduction in sediment resuspension and impacts to the seabed.

- **Table**7.6 shows the trend of annual fuel costs and total costs of the vessel. The ratio of fuel costs to total costs is also reported. In the next months, the CBA analysis will be conducted using the data of the BIPLAN and FLY otterboards to estimate what can happen in the short term if the vessel gear is replaced and what would happen if the whole Ancona fleet would make the same decision.
- The CBA is mainly based on fuel costs as it represents the major variable cost for the fishing vessel. However, depending on the type of otterboard evaluated, also other fixed costs will be considered, such as gear monitoring systems for pelagic otterboards, which allow the behavior of the otterboards to be controlled. This monitoring system, which can have relevant investment costs, is not strongly necessary for those otterboards in contact or near the bottom.

Table7.5. *Comparison of the technical performances of the otterboards*

	TTF[kg]	Diff[kg]	FC[l/h]	Diff[l/h]	HDS[m]	Diff[m]
THY	-	-	51.29	-4.40	**69.17**	**14.93**
FLY	-	-	**49.06**	**-6.62**	**59.31**	**5.072**
POLY	**3566.30**	**111.00**	55.26	-0.43	**44.06**	**-10.12**
BIPLAN	**3414.61**	**-40.69**	54.63	-1.06	51.01	-3.23
Z	3455.30	0	55.68	0	54.24	0
C	**3537.65**	**82.35**	53.43	-2.30	55.31	1.07

Table 7.6. *Trends in annual fuel costs and total vessel costs, including the ratio of fuel costs to the total costs.*

year	Fuel cost [€[	Total cost [€]	Ratio
2003	55080.81	211530.07	26.04%
2004	62293.63	233206.65	26.71%
2005	80315.32	222737.51	36.06%
2006	91034.39	250911.49	36.28%
2007	94048.94	238594.22	39.42%
2008	100788.79	259098.31	38.90%
2009	79426.95	218266.80	36.39%
2010	97091.50	208084.86	46.66%
2011	120408.57	207222.07	58.11%
2012	128605.64	208360.28	61.72%
2013	129095.74	229501.85	56.25%
2014	118261.55	217158.29	54.46%

Deviations.

In Greece for the trials around the Development of viable alternative fishing methods, there have been some delays in completion, due to availability of vessel and disappointing results. Two trial periods have been completed, but with the disappointing results (low catches) a further trial period is being planned for the start of the next reporting period which will allow D7.8 to be updated at a later date. In Italy, a set of sea trials in September was scheduled for the evaluation of the physical impact of the otterboards using side scan sonar and a turbidity meter. Several preliminary tests have been conducted in order to set up the equipment. However, due to bad sea conditions during the trials, it has been decided to repeat the trials for a better collection of data.

Failing to achieve objectives: none

Use of resources: no deviations

WP7.5 - BLACK SEA

Lead CFRI (Mustafa Zengin)

The studies conducted by CFRI and OMU in WP7 were continued in months 19-36 within the following tasks. The goals were widely achieved in these surveys which were held for the first time for the Samsun Shelf Area (SSA).

Task 7.5.1 - Assess the current trawling impact

Lead: CFRI. Contribution OMÜ, SME15 and SME16

Summary of progress

Bottom trawl: The case study for the Black Sea in order to determine the current impact on benthic habitat was already completed in the 1st period. In this concept, the technical properties of the trawl fleet, the information about bottom trawl fishery in Samsun Shelf Area (SSA) such as biological parameters of target species, discard rates, CPUE values and bycatch compositions have been revealed.

Beam trawl: The surveys started in the 1st period to determine the impact of beam trawls on benthic habitat was continued in the 2nd period. The beam trawl operations targeting the sea snail fishery was lasted to the end of 2014 summer (August). The parameters for beam trawl fleet and the gear specifications, the landings of sea snail, CPUE values and the bycatch composition were investigated within this task.

Clearly significant results

- The studies on bottom trawls showed that there is a high fishing pressure in the region and the discard rates of target species such as red mullet and whiting is extremely high.
- The sea snail is determined as the most dominant species having a large biomass in this nearshore coastal habitat causing a high fishing pressure with beam trawls resulting in significant physical disturbance on sea bottom. The maximum landing of sea snail was obtained in summer months. Actually, fishing with beam trawls is banned in this period in order to protect the nearshore benthic and demersal macrofauna. This is one of the main contradictions in the fishery of this region. Clearly significant results

Deviations None

Failing to achieve objectives.

Use of Resources.

Task 7.5.2 - Options for mitigation

Summary of progress

The options for mitigation of the impact on benthic habitat was designed for bottom trawl and beam trawl fishery. We mainly focus on the topics of reducing the contact and increasing selectivity in order to decrease the discard rate.

Reducing the contact (Beam trawl):

Alternative Gear: The pots for sea snail fishery was suggested as an alternative gear as they are passive fishing gears and largely reduce the physical disturbance on sea bottom. A pot model used in Southern Korea for the same target species; sea snail was taken and produced locally.

Modification in the gear:

- The shoes in traditional beam trawl were replaced by sledges to reduce the dragging effect on sea bottom. Sledges were produced and attached to the beam trawls by local masters. The steel rope on the mouth of gear was mounted to the sledges without any distance from junction point.
- The steel rope removed completely to put away the dragging effect between two sledges.
- The fuel consumption was tested in modified and traditional beam trawl in two experimental design. 1. Modified gear with steel rope adjacent to sledges without any distance from junction point (muddy and sandy substratum), 2. Modified gear without steel rope (muddy and sandy substratum).

Increase selectivity (Bottom trawl):

- Mesh size: 36 mm-Square mesh and 40 mm-Square mesh were tested versus traditionally used 40 mm diamond mesh in order to reduce the discard rate.
- Mesh orientation: 40 mm-T90 mesh was tested versus traditionally used 40 mm diamond mesh.

Reduce contact (Bottom trawl):

- Test of the pelagic door model with the aid of CNR.

Clearly significant results

- The regional case study meeting was held at April 2014 in Samsun by participation of CFRI, OMU, SME16 and SME16 and the scientists from Ege University (external partners). The technical details for the gear modifications and the operations for gear trials were discussed at the meeting. All arrangements were completed between April and June 2014 to start sea trials.

Task 7.5.3 - Testing alternative gears

Summary of progress

Pot trials for sea snail fishery: The sea trials with 30 set of pots were conducted in two stations (Dereköy and Costal) remaining each pot at sea for 24h, 48h and 72h in each experimental design in July 2014. The pot trials were repeated one year later in May 2015.

Beam trawl: The modified beam trawl trials were realized by commercial beam trawl vessels along the sea snail fishery area in SSA. Totally 94 operations were done to test the gear modifications and fuel consumption rate in 15-23 June and 17-27 August 2014. The modified gear were tested with parallel and synchronous hauls using traditional model to make any comparison in terms of catch efficiency. After evaluation of the outcomes of gear trials, it is planned to repeat the fuel consumption trials in 2015 summer. The results of the 2014 trials were also shared in the 3rd General Assembly in Lisbon (Feb, 2015) and future plans were discussed.

The modified gear trials for fuel consumption were repeated in July-September 2015 using a fuel meter. Totally 50 operations were done. Both trawl types (traditional and modified) were also tested in terms of resistance of the fishing gear against the sea bottom by using a digital force gauge meter. The trials were repeated in different types of substrates such as sand, sandy mud and muddy sand. All operations were supported by underwater video camera shots (GoPro Hero 4) to observe the functionality of modified fishing gear.

Bottom trawl: The bottom trawl studies aiming to increase selectivity were realized by a commercial bottom trawl vessel in 17-27 August 2014. Totally 40 operations were done. All mesh size alternatives and one type of different mesh orientation was tested. All bottom trawl trials were completed in 2014.

The results of sea trials with modified gears both from beam and bottom trawl were presented in the meeting of the second Stakeholder meeting held in Samsun in 17 October 2014.

Clearly significant results.

- Pots: We could not succeed to find any supporting evidence to put the pots in use as an alternative fishing method to beam trawl in order to minimize the effect on benthic habitat. Because, no catch was obtained by this method except a few individuals. So, the pots could not be proposed as a fishing gear for commercial fishery of sea snail.
- Beam trawl: The difference between catch amount of traditional (with shoes) and modified (with sledges) gear is about 7% in weight. The difference in catch amount is 20% less in the modified gear without steel rope compared to traditional model. In fuel consumption trials, 4-5 % reduction was observed by the modified gear. Camera footage showed that the modified gear fished just as well as the traditional one. The results also indicated that the steel rope between the shoes does not penetrate into the sea bottom contrary to the researchers' previous assumptions.
- Bottom trawl: The highest rate of discard (18.1 %) in red mullet was determined in the conventional gear net (40 mm-diamond mesh) and also in whiting the highest rate of discard (29.5 %) was determined in the conventional gear net (40 mm-diamond mesh) still used by fishermen. 36 square and 40 square mesh size revealed less discard rates.

Deviations. None

Failing to achieve objectives. Pelagic door model of CNR could not be tested because of some technical, financial and bureaucratic formalities

Task 7.5.4 - Innovative management scenarios

The draft plan for management scenarios are:

1. The use of 36S or 40 S mesh size in bottom trawls will increase the selectivity and reduce the discard in respect to our results in experiments. What will be the economical and ecological results?

2. The use of sledges will reduce the fuel consumption. What will be the economic gain and the ecological impact if it is put in use?

3. Discussion should be made about the scenarios of fishery management (such as fishery periods, operation durations, daily quota, fleet capacity, area restrictions) for both beam and bottom trawl fishery.

WP8 – SCIENTIFIC COORDINATION, STAKEHOLDER INVOLVEMENT & DISSEMINATION

Lead: IMARES (Adriaan Rijnsdorp)

The success of BENTHIS critically depend on an open and transparent communication between scientist and the fishing sector about research objectives, scientific approach and the interpretation of the results. This WP will provide the core structure for the information exchange within the project, as well as the structure to involve the fishing industry and other stakeholders to enhance the credibility of the work and disseminate the salient results to the fishing industry and (regional) management bodies.

The main aim of WP8 is to provide the core structure for the information exchange within the project, as well as the structure to involve the fishing industry and other stakeholders to enhance the credibility of the work and disseminate the salient results to the fishing industry and (regional) management bodies.

The success of this process will critically depend on an open and transparent communication between scientist and the fishing sector about research objectives, scientific approach and the interpretation of the results.

Specific objectives of the work package are:

- Scientific coordination
- Organize the communication among WPs
- Organize stakeholder input
- Dissemination

Syntesa has been responsible for organizing the stakeholder input and the work has progressed as planned the first year. The project stakeholder groups have been identified, selected and the communication activities have brought together the parties satisfactory - both at a regional and at an EU wide level.

Task 8.1 - Project Workshops

Lead: IMARES; Contributors: all partners

Summary of progress

During the 2nd reporting period project meeting (P3) was organised in Lisbon (Portugal) from 23-26 February 2015 together with the General Assembly (GA-2) and the Stakeholder Advisory Board (SHB2), and back to back with the Scientific Steering Committee (SC-3). Monday afternoon and Tuesday morning were devoted to a presentation of the Work Packages in order to share the results among the BENTHIS scientist as well as with the members of the Stake Holder Advisory Board. The SAB had the opportunity to comment on the progress on Tuesday and discuss their view with the partners.

The meeting continued with a series of project workshops focussed at the exchange of information between Work Packages WP3, WP4 and WP7 (W6[2]) and between WP5, WP6 and WP7 (W7). These workshops, scheduled for month 36 (September), were advanced to economise on time and cost for travel. An additional workshop on the integration of WP3 and WP4 was convened at IMARES in July 2015 to finish Deliverable D3.6.

The 4th SSC was a Skype meeting aimed to review the progress with the activities related to the deliverables with a submission deadline within the 2nd reporting period. No major problems were encountered. After consultation with the Scientific Officer it was decided that the Deliverable related to the Field Trials in WP7 (D7.8) would be submitted during the 2nd reporting period even though the field

[2] The numbering of the Project Workshops deviates from the table 1.3.4 of the DOW.

trials will be continued in the 3rd reporting period. Once the new results will be available, the D7.8 will be updated and will replace the version of month 36.

Clearly significant results.

- Minutes of the workshops

Deviations

- An updated D7.8 will be submitted in month 48 after the extended sea trials will be finished.

Failing to achieve objectives: none

Task 8.2 - Stakeholder involvement and dissemination

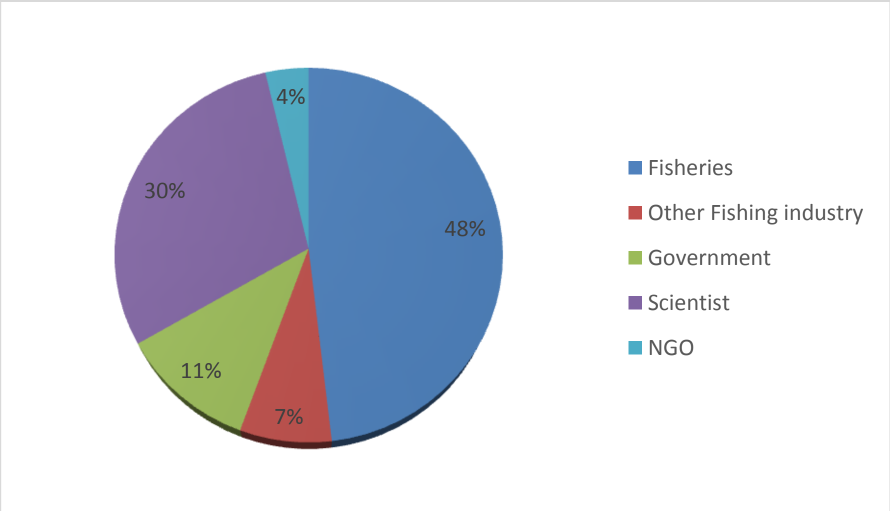
Lead: Syntesa (Olavur Gregersen).

Summary of progress

There was planned any European wide stakeholder workshop for the period, but regional stakeholder meetings and one-to-one interactions were held in all case studies. In addition the Stakeholder Advisory Board was invited to a special session on the annual meeting.

Clearly significant results

Around 100 stakeholders have participated in the 2nd Regional Stakeholder Events with the following distribution among stakeholder groups:



Almost 50% of the stakeholders have been representatives for the fishing industry, and that is very positive. Notable is that only 4% have been representatives from the NGO stakeholder group even though they have received invitations as other stakeholder groups.

Deviations. None

Failing to achieve objectives. None

Task 8.3 - Regional Stakeholder Events and dissemination

Lead: Syntesa (Olavur Gregerson); contribution other partners involved in case study

Summary of progress

The second regional stakeholder events (RSE2) were held in the five case study regions and organized as a round table discussion among the same stakeholder groups which attended the first regional stakeholder events.

Baltic Sea

During the period from summer 2013 to winter 2014-15 there have been held a row of bilateral meetings with the involved SME's representing the catch industry stakeholders as well as other selected Stakeholders to finally plan and implement the experimental sea trials under the Baltic Case Study with 5 sub-case studies. These meetings have functioned as follow up meetings on technological developments, smart fishing, and effort reduction scenarios planned and outlined during the extensive RSE1 workshop in May 2013 in Copenhagen, and also suggested by stakeholders in the sub-group meetings and in the returned questionnaires from this first RSE1 workshop with broad representation of the catch industry, the processing industry, management, environmental NGO's and scientific management advisors. On basis of the RSE1 workshop a row of pilot studies have furthermore been conducted in the different sub-case studies to test further the recommended methods and technological developments discussed and suggested under the RSE1 in Copenhagen. This has covered fishing tests with light mussel dredges, smart fishing with video monitoring and side-sonars, Nephrops creel fishery, fishing with pelagic trawl doors in the Western Baltic cod fishery, smart fishing to avoid hard bottom localities in the Western Baltic cod trawl fishery, and planning of sea trials with short sweep lengths in the Kattegat Nephrops trawl fishery. The SME meetings have mainly been held on bilateral basis to follow up on the pilot experimental sea trials conducted in relation to each of the Baltic Sea sub-case studies. Additionally, a stakeholder workshop was held in Hirtshals (DK) November 2014 which has followed up on the additional investigations of economic efficiency in Danish creel fishery evaluated under the EU InterReg Sustainable Nephrops Fishery (OBJ Fish) (EU InterReg Project Iva, The Sound, Kattegat, Skagerak) in cooperation with the EU-FP7-BENTHIS project with respect to the economic analyses.

North Sea

The North Sea meeting was held on 11 October 2014 and was attended by 27 participants. The discussions was centred around the impact of trawling on the sea bed and the benthic ecosystem. The representation of the various stakeholder was rather unbalanced with most participants representing the fishing industry and only a few representing NGO's or fisheries management authorities This unbalance likely affected the direction of the discussions. Most fisheries participants questioned the scientific basis of the view that trawling negatively affects the benthic ecosystem. As a consequence they did not see the need that the effect of bottom trawling should be reduced, although the opinions were not 'black or white' but reflected 'different tones of grey'. There was a general consensus that BENTHIS research provided a valuable contribution to the societal debate and that the meetings such as this RSE are important. It was suggested that a follow up meeting would be appreciated.

Mediterranean Sea

The Mediterranean meeting was held on 31 May 2014 and was attended by 10 participants. The research activity planned for 2014 was reported during the meeting. The focus was on the design of innovative otterboards and the assessment of a methodical approach for the comparison of otterboards performances. With respect to the wind tunnel tests, the otterboard dynamic and performances have been demonstrated. On the basis of preliminary data collected during the sea trials, the experimental doors demonstrated stability and proper operability during the tests. The discussion focused mainly on how to relate the results obtained in laboratory tests and sea trials on-board a research vessel with respect to the operability condition on-board a commercial trawler.

Black Sea

The Black Sea meeting was held on 17 October 2014 and was attended by 29 participants. The results of sea trials using modified gears were presented to stakeholders within an evaluation matrix of 3x3 to derive their attitudes. One option is held for bottom trawl modification and three other options for the algarna gears. In general, the stakeholder groups adopted the options for the gear modifications as 'Very comprehensive change- Positive, Enthusiastic'. Especially the option 1 (use of square mesh in trawl bag) and option 4 (removal of steel rope between foots) were perceived as 'very comprehensive change'. The option 2 that is resulted with fuel saving is discerned as 'some change' and the option 3 (junction of rope to the foot without distance- less impact on epifauna) is evaluated as 'poor change'. Very useful suggestions and views of stakeholders on workshop issues were put forward during the round table discussion.

Western Waters

The 2nd Benthis stakeholder meeting has been held at IFREMER Atlantic centre in Nantes the 11 December 2014. The group comprised 15 persons from 12 different organizations: 4 scientists (IFREMER and Nantes University), 9 representatives of fishermen organizations at various scale (local to national), 1 person from an environmental NGO and 1 person from seafood marketing sector. The meeting has been organized for one day and, following an introductive part, focused on 9 themes. For each theme, a presentation opened to questions was followed by a roundtable discussion. The group for Western Waters RSE2 was mainly composed of stakeholders directly linked to the fishing industry. Discussions have been mainly taken by fishermen representatives with low engagement of the lonely environmental NGO representative. A lot of questions and discussions come out from the presentations that were taken with great interest. They were as general as the question of the evaluation of the good environmental status down to very precise/technical ones for example about gears specifications. Everybody agreed that trawling had and still has effects on marine ecosystems but they need to be convinced about the specificities and level of detrimental effects and the needs to deeply modify some of the fishing practices.

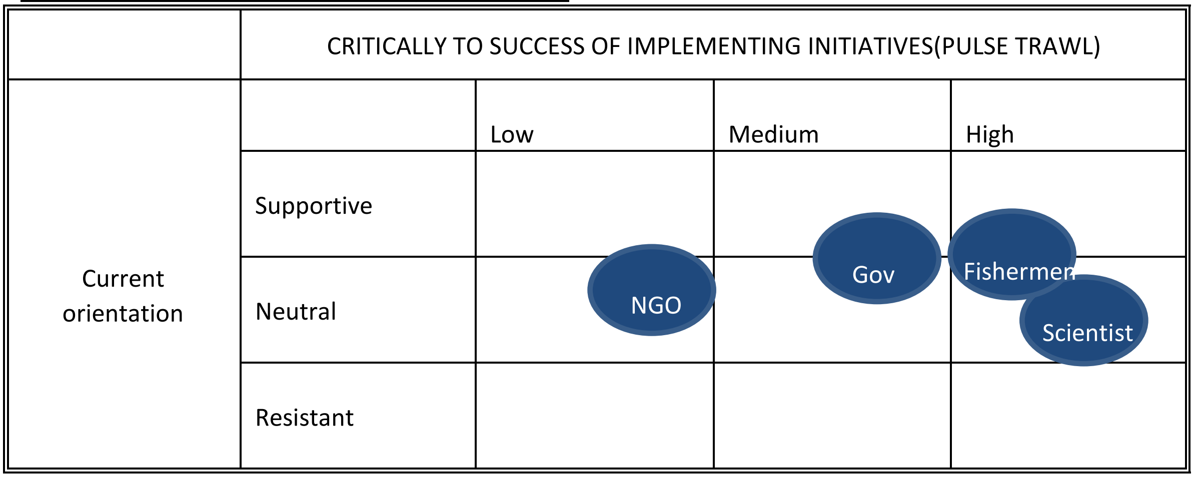
Clearly significant results.

Based on the data from first regional stakeholder events (RSE1) we have been able to work through paragraph 1 and 2. Stakeholder groups are identified and interests clarified. We identified areas of harmony, conflict and opportunities for technical and sustainable management initiatives. Until this point we are able to understand stakeholders' perspectives and interests towards the BENTHIS project issues.

Mapping the stakeholders in a Stakeholder Assessment Map (SAM) is about visualizing stakeholders' position in relation to certain objectives in this case towards the technological and managerial initiatives selected in each case study and a possible implementation of the initiatives. Based on the RSE2 meetings it was possible to analyse the stakeholders in a SAM for each case study with stakeholders' position in relation to certain objectives.

These maps were presented at the Benthis Annual General Meeting in Lisbon 2015, and reported in D8.8. An example of such a SAM is below with a generalized assessment of the North Sea and how stakeholders stand with regard to the case study work and results found during 2013 and 2014:

Stakeholder Assessment Map (example North Sea)



The mapping visualizes a presumed relationship / distance between the stakeholder groups based on the continuing discussions that have been held in the Baltic case study during 2013 and 2014. It should be noted that the Baltic Sea stakeholders have not been gathered at an RSE2 round table discussion and therefore positioning them in the SAM is challenging.

Subsequently, we focus on the stakeholder groups which stand out and propose an action plan for that specific group/sin accordance with a Stakeholder Action Plan (SAP). The case study leaders ere encouraged to review and finalize the SAM and the SAP based on their perception of the stakeholders' opinions with respect to implementing the specific technological and managerial initiatives selected for their case study.

Using the North Sea as an example again, gaining stakeholders support for the work and the technological initiatives is not straightforward for the North Sea case study. With respect to a future stakeholder action plan the following procedure was suggest at the annual meeting for the case study leader to use and complete as a tool in their continues stakeholder interaction.

Stakeholder Action Plan

Stake-holder	Issue	Why is stakeholder important?	Currrent engag-ment &attitude	What would we like them to do?	Key mess-ages	How (tactics)	When (timeplan)	Who is responsible
Fishing industry	*Negative impact of trawling – or not!?! Impact of clomate change on composition of benthos?*	*For successfull implementation of initiatives*	*Low/ Neutral - resistant*	*CS leader:*	*CS leader:*	*CS leader:*	*CS leader:*	*CS leader*
Fishing industry	*Scientists to include fisher's knowledge*	*Validate scientific informatio*	*High/ Sup-portive*					
Scientists	*Provide understandable information*	*Basis to assess impact and advise managment*	*High/ Sup-portive*					
NGO's	*Impact of other trawl gear (flyshoot and twintrawl)*	*Influence on MFSD and ecosystem approach*	*Low/ Sup-portive*					

Deviations: None

Failing to achieve objectives: None

Task 8.4 - Dissemination and External Communication

Lead: IMARES; Contributors: all partners

Summary of progress

In total, two BENTHIS newsletters were produced, each containing about 15 articles. After distributing the first newsletter (early 2014) as one message with lots of news items, we noticed that few people took effort to read the whole newsletter. Therefore we decided to produce single news items instead, distribute them weekly through Facebook and LinkedIn during a 2 month period, in order to get more attention. That strategy worked well, and will be repeated late 2015/early 2016 with a new set of news items (newsletter 3). One of the aims of the newsletter is to write a popular scientific article about each scientific article produced.

In addition to the newsletters, we decided to cover the fieldwork by joining BENTHIS research cruises. We wrote daily blogs and put a lot of effort in creating good quality photos of the fieldwork. The cruises consisted of (1) the BENTHIS North Sea fieldwork on effects of pulse trawling in the Frisian Front in June 2014, (2) the Greek experiments in which passive gear and active gear were compared (May 2015), and (3) the Belgium fieldwork on effects of shrimp pulse fisheries (July 2015). As part of the Frisian Front cruise, also two small videos were produced on how a SPI and a boxcorer operate, and these movies are published on YouTube and have been used during lectures, at open days and even in a museum in Germany. During each of these weeks, we stimulated the crew (scientists + ship crew members) actively to tag themselves in the pictures and spread the word. Some pictures were viewed 1200 times, most a few hundred times. The number of Facebook friends increased from a handful in June 2014 to over 330 people now. During the BENTHIS General Assembly in Lisbon, Feb 2015, it was decided to also put more effort in Twitter, especially during meetings. This medium still has to be explored in more detail.

BENTHIS Facebook: https://www.facebook.com/pages/Benthis/405411256222122

BENTHIS LinkedIn: https://www.linkedin.com/groups/4792096

BENTHIS results: http://www.benthis.eu/en/benthis/Results.htm

Several partners have been active in presenting BENTHIS at various scientific meetings, in publications in scientific journals and presentations in popular media.

Mike Kaiser and Jan Geert Hiddink (Bangor University) and Adriaan Rijnsdorp (IMARES) are partners in the Trawling Best Practice Project (TBP) (https://trawlingpractices.wordpress.com/). This project has rather similar objectives as BENTHIS although at the global scale. Jan Geert Hiddink & Adriaan Rijnsdorp introduced the BENTHIS project and presented results from WP2, WP3 and WP4 at TBP workshops in Bangkok (September 2014) and Boston (March 2015). Aggregated trawling intensities data from WP2 are made available to the TBP project.

Several partners have brought results of BENTHIS in ICES Working Groups dealing with the development of MSFD indicators of Sea floor integrity. The results of WP2 were presented at ICES and the ICES Working Group on Spatial Fisheries Data have adopted the BENTHIS approach of quantification of the pressure of bottom trawling on the surface and subsurface level of the sea floor. The assessment methodology developed has been presented at ICES WGECO and various MSFD workshops. A list of ICES Working Groups attended where BENTHIS results have been used is listed below.

Clearly significant results

See list of peer reviewed publications, presentations and contribution to ICES working groups and advisory process

Deviations.

None

Failing to achieve objectives.

None

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D8.1	Reports of project workshops P1	8	3	IMARES	yes	1/2/2013
D8.2	Reports of project workshops P2	8	9	IMARES	yes	26/6/2013
D8.3	Reports of project workshops P3	8	27	IMARES	yes	14/7/2015
D8.4	Reports of project workshops P4	8	48	IMARES	no	
D8.5	Report of Stake holder Workshop (SH1)	8	9	IMARES	yes	27/09/2013
D8.6	Report of Stake holder Workshop (SH2)	8	48	Synthesa	no	
D8.7	Report of Regional Stakeholder Events (RSE1)	8	6	Synthesa	yes	27/09/2013
D8.8	Report of Regional Stakeholder Events (RSE2)	8	21	Synthesa	yes	31/8/2015
D8.9	Report of Regional Stakeholder Events (RSE3)	8	45	Synthesa	no	
D8.10	Project Webpage for external and internal communication	8	3	IMARES	yes	7/3/2013
D8.11	Yearly Newsletters to be distributed throughout the European Union	8	12	IMARES	yes	26/02/2014
D8.12	Yearly Newsletters to be distributed throughout the European Union	8	24	IMARES	yes	13/10/2014

D8.13	Yearly Newsletters to be distributed throughout the European Union	8	36	IMARES	yes	19/10/2015
D8.14	Yearly Newsletters to be distributed throughout the European Union	8	40	IMARES	no	
D8.15	Yearly Newsletters to be distributed throughout the European Union	8	60	IMARES	no	
D8.16	DVD containing all reports and publications, as well as a the final project report	8	60	IMARES	no	

Use of resources

Participant	WP8 Budget (pm)	WP8 Realised 1st + 2nd period (pm)
SDLO	7.6	9.3
ILVO	2.9	2.3
CEFAS-DEFRA	2.7	0.6
BU	2.7	0.8
UNIABDN	4.9	0.0
Mar lab	1.6	0.0
IFREMER	5.2	3.4
MI	1.0	0.0
DTU-Aqua	2.9	0.8
AU-Bioscience	0.9	0.0
UCPH	1.8	0.0
SLU	2.5	1.5
IMR	0.9	0.0
CNR	6.5	4.8
HCMR	2.1	0.0
CFRI	3.0	2.3
SME01	10.9	9.0
SME02	0.2	0.0
SME03	0.3	0.0
SME04	0.2	0.0
SME05	0.3	0.0
SME06	0.3	0.0

SME07	0.2	0.0
SME08	0.3	0.0
SME09	0.8	0.1
SME10	0.5	0.2
Tecnopesca	0.5	0.0
SME13	0.5	0.0
SME14	0.5	0.0
SME15	0.5	0.0
SME16	0.5	0.0
SME17	0.3	0.0
OMU	2.1	1.9
sum	68.1	36.9
remaining personmonths		31.2

Scientific papers (peer reviewed cumulative)

2013

Brind'Amour A, Dubois SF (2013) Isotopic Diversity Indices: How Sensitive to Food Web Structure? PLoS ONE 8(31): e84198. doi:10.1371/journal.pone.0084198 (WP3)

Van Denderen PD, van Kooten T, Rijnsdorp AD (2013) When does fishing lead to more fish? Community consequences of bottom trawl fisheries in demersal food webs. Proceedings of the Royal Society. Series B. 280, 20131883 (WP4)

2014

Bolam, S. G., and J. D. Eggleton. 2014. Macrofaunal production and biological traits: spatial relationships along the UK continental shelf. Journal of Sea Research 88: 47-58

Brind'Amour A., Laffargue P., Morin J., Vaz S., Fovau, A. and Le Bris H., 2014. Taxonomic sufficiency of epibenthic macro and mega-fauna in scientific bottom trawl surveys. Continental Shelf Research 72 :1-9 (http://dx.doi.org/10.1016/j.csr.2013.10.015)

Guillen, J., Macher, C., Merzéréaud, M., Fisas, S. and Guyader, O., 2014. The effect of discards and survival rate on the Maximum Sustainable Yield estimation based on landings or catches maximisation: Application to the nephrops fishery in the Bay of Biscay. Marine Policy, 2014, 50: 207-214.

Kaykaç, M. H., Zengin, M., Özcan-Akpınar, İ., Tosunoğlu, Z., 2014. Structural characteristics of towed fishing gears used in the Samsun coast (Black Sea). Ege J Fish Aqua Sci 31(2): 87-96. doi: 10.12714/egejfas.2014.31.2.05 (in Turkish).

Lambert, G.I., Jennings, S., Kaiser, M.J., Davies, T.W., Hiddink, J.G., 2014. Quantifying recovery rates and resilience of seabed habitats impacted by bottom fishing. Journal of Applied Ecology 51: 1326–1336. doi: 10.1111/1365-2664.12277

van Denderen PD, Hintzen NT, Rijnsdorp AD., Ruardij P, van Kooten T. 2014. Habitat-specific effects of fishing disturbance on benthic species richness in marine soft sediments. Ecosystems 17:1216-1226. DOI: 10.1007/s10021-014-9789-x.

van Marlen, B., Wiegerinck, J.A.M., van Os-Koomen, E., van Barneveld, E. (2014) Catch comparison of flatfish pulse trawls and a tickler chain beam trawl. Fisheries Research 151: 57-69

2015

Bastardie, F., Nielsen, J.R., Eigaard, O.R., Fock, H.O., Jonsson, P., Bartolino, V., 2015. Competition for marine space: modelling the Baltic Sea fisheries and effort displacement under spatial restrictions. ICES J. Mar. Sci. 72, 20824–840. doi:10.1093/icesjms/fsu215

Batsleer J, Hamon KG, van Overzee HMJ, Rijnsdorp AD, Poos JJ. 2015. High-grading and over-quota discarding in mixed fisheries. Reviews in Fish Biology and Fisheries. 10.1007/s11160-015-9403-0

Buhl-Mortensen L, Ellingsen KE, Buhl-Mortensen P, Skaar KL, Gonzalez-Mirelis G. 2015. Trawling disturbance on megabenthos and sediment in the Barents Sea: chronic effects on density, diversity, and composition. ICES Journal of Marine Science. Doi 10.1093/icesjms/fsv200

Depestele J, Ivanović A, Degrendele K, Esmaeili M, Polet H, Roche M, Summerbell K, Teal LR, Vanelslander B, O'Neill FG. 2015. Measuring and assessing the physical impact of beam trawling. ICES Journal of Marine Science. doi 10.1093/icesjms/fsv056

Eigaard OR, Bastardie F, Breen M., Dinesen GE, Hintzen NT, Laffargue P, Nielsen JR, Nilson H, O'Neill FG, Polet H, Reid D, Sala A, Sköld M, Smith C, Sørensen TK, Tully O, Zengin M, Rijnsdorp AD. 2015. Estimating seafloor pressure from trawls and dredges based on gear design and dimensions. ICES Journal of Marine Science. doi 10.1093/icesjms/fsv099

Frandsen, R. P., Eigaard, O. R., Poulsen, L. K., Tørring, D., Stage, B., Lisbjerg, D., & Dolmer, P. 2015. Reducing the impact of blue mussel (Mytilus edulis) dredging on the ecosystem in shallow water soft bottom areas. Aquatic Conservation: Marine and Freshwater Ecosystems, 25(2), 162-173

Johnson, A. F., Gorelli, G., Jenkins, S. R., Hiddink, J. G., & Hinz, H. 2015. Effects of bottom trawling on fish foraging and feeding. Proceedings of the Royal Society of London B: Biological Sciences, 282(1799), 20142336.

Mellibovsky, F., Prat, J., Notti, E., and Sala, A. 2015. Testing otter board hydrodynamic performances in wind tunnel facilities. Ocean Engineering, 104: 52-62

Rijnsdorp, A.D., Bastardie, F. Bolam, S.G., Buhl-Mortensen L., Eigaard O.R., Hamon K.G., Hiddink J.G. Hintzen N.T., Ivanovic A., Kenny A., Laffargue P., Nielsen R.N., O'Neill F.G., Piet G.J., Polet H., Sala A. , Smith C. , van Denderen, P.D. , van Kooten T., Zengin M.A., 2015. Towards a framework for the quantitative assessment of trawling impacts on the sea bed and benthic ecosystem. ICES Journal of Marine Science. doi:10.1093/icesjms/fsv207

van Denderen PD, Hintzen NT, van Kooten T, Rijnsdorp AD. 2015. The temporal distribution of bottom trawling and its implication for the impact on the benthic ecosystem. ICES Journal of Marine Science, 72: 952-961

2016

Batsleer J, Rijnsdorp, A.D., Hamon KG, van Overzee HMJ, Poos JJ. 2016. Mixed fisheries management: Is the ban on discarding likely to promote more selective and fuel efficient fishing in the Dutch flatfish fishery? Fisheries Research 174:118-128

van Denderen PD, Bolam SG, Hiddink JG, Jennings S, Kenny A, Rijnsdorp AD, van Kooten T. 2016. Similar effects of bottom trawling and natural disturbance on composition and function of benthic communities across habitats. Marine Ecology Progress Series. doi: 10.3354/meps11550

Submitted

Jochen Depestele, Marie-Joëlle Rochet, Ghislain Dorémus, Pascal Laffargue, and Eric W. M. Stienen (submitted). Are discards a substantial food source for 1 marine scavengers? Can.J.Fish.Aquat.Sci

Guillen, J., Macher, C., Merzéréaud, M., Fisas, S. and Guyader, O., 2014, The effect of discards and survival rate on the Maximum Sustainable Yield estimation based on landings or catches maximisation: Application to the nephrops fishery in the Bay of Biscay. in revision Marine Policy (Task 5.3)

Hornborg, S., Ulmestrand, M., Sköld, M., Jonsson, P., Valentinsson, D., Eigaard, O.R., Feekings, J.P., Nielsen, J.R., Bastardie, F., and Lövgren, J. (In Submission). New policies may call for new approaches: the case of the Swedish Norway lobster (Nephrops norvegicus) fisheries in the Kattegat and Skagerrak. (In Submission).

Pommer, C.P., Hansen, J.L., and Olesen, M. (submitted). Impact and distribution of bottom trawl fishing on mud-bottom communities in Kattegat. (MS Submitted peer reviewed journal May 2015).

National Reports

Frandsen, R., Jensen, F., and Feekings, J.P. 2015. Vurdering af økonomien i dansk tejnefiskeri efter jomfruhummer. Report EU InterReg OBJ Fish Project (EU InterRegIVa, The Sound, Kattegat and Skagerrak) and the EU-FP7-BENTHIS Project. Report DTU Aqua.

Hansen, J.L., Dinesen, G.E., Bastardie, F., and Eigaard, O.R. 2015. Notat om effecter affiskeri med bundslæbenderedskaberpåbundfaunaen I de indredanskefarvande (memorandum on evaluation of fisheries effects on the benthic fauna in the inner Danish waters). Memorandum Contracted by the Nature Directorate, Ministry of Environment, Denmark, 5th January 2015. (In Danish).

Rijnsdorp, A.D. 2015. Flyshoot visserij in relatie met de instelling van bodem beschermende maatregelen voor het Friese Front en de Centrale Oestergronden. IMARES Rapport C065/15 (available from IMARES)

Thoya, P. 2015. Detecting ecological-economic effects of marine spatial plans from displacing the bottom fishing pressure. M.Sc. Thesis, EU ERASMUS Mundus Programme & EU-FP7-BENTHIS Project. MSc Report 61 pp. (available from DTU Aqua).

Presentations

2013

Kenny, A. (2013). The importance of seafloor integrity in assessing and managing human activities. Presentation given at 9th SETAC European Special Science Symposium, Brussels.

Mahévas, S. et Bertignac, M. 2013. Dynamique spatio-temporelle des flottilles démersales du golfe de Gascogne pour anticiper l'incidence d'une gestion spatialisée. 11ème forum de l'Association Française d'Halieutique. Bordeaux, France

Mahévas, S., S.Lehuta, M. Bertignac, Y. Vermard and P. Marchel. 2013. Modelling fishermen behaviour is firstly a question of spatial and temporal scale. C:11. ICES Annual Science Conference. Reykjavik, Islande

Pinnegar. J. et al., (2013). Ocean acidification and the possible loss of benthic invertebrates: would commercial fin-fish be affected? Poster presented at ICES ASC, 2013.

Tissière L, S. Mahévas, B. Trouillet, A. Brind'Amour and P. Petitgas. 2013. Gouvernance du golfe de Gascogne : quelle connaissance pour construire des scénarios de gestion et anticiper leurs conséquences sur la pêcherie de sole commune ? ,11ème forum de l'Association Française d'Halieutique. Bordeaux, France.

2014

Bastardie, F., Nielsen, J.R. How spatial planning constrains cross-border fisheries: the bio-economic DISPLACE evaluation on the Baltic Sea. Oral presentation at the Baltic Maritime Spatial Planning Forum (Baltic MSP Forum), 17-18 June 2014, Riga, Latvia.

Bastardie, F., Nielsen, J.R., Eigaard O.R., Fock O. H., Jonsson, P., Bartolino V. Supporting bio-economic evaluation of spatial planning constraining fishing activities: be quantitative, spatially-explicit, vessel-oriented, stochastic, and dynamically coupled to fish populations. July 7-11, Brisbane, Australia. Edited by Ann L. Shriver. International Institute of Fisheries Economics and Trade (IIFET), 2014

Bolam, S. et al., (2014). Determining the impacts of trawling on benthic function in European waters : a biological traits approach. Abstract submitted to the ICES Symposium “Effects of fishing on benthic fauna, habitat and ecosystem function” Tromsø, Norway from 16-19th June 2014.

Buhl-Mortensen, L. Trawling impact on benthos and sediment in the Barents Sea: use of satellite vessel monitoring and data from Mareano. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Depestele, J. “Physical impact of beam trawl revisited: sediment resuspension and penetration of tickler chain and pulse beam trawling presented at the ICES Symposium “Effects of fishing on benthic fauna, habitat and ecosystem function” in Tromsø (Norway), 16th - 19th June 2014 [Task 4.1]

Depestele, J., Rochet, M.J., Dorémus, G., Laffargue, P. and Stienen, E. “Spatio-temporal patterns in food subsidies provided by discards to scavenging seabirds in the Bay of Biscay” presented at the ICES Symposium “Effects of fishing on benthic fauna, habitat and ecosystem function” in Tromsø (Norway), 16th - 19th June 2014 [Task 4.4]

Eigaard OR, Francois Bastardie, Niels Hintzen, Maciej Adamowicj, Rui Catarino, Grete E. Dinesen, Heino Fock, Hans Gerritsen, Manuel M. Gonzalez, Patrik Jonsson, Stefanos Kavadas, Pascal Lafargue, Mathieu Lundy, Genoveva G. Mirelis, Jørgen Hansen, Paulette Posen, Jacopo Pulcinella, Tomasso Russo, Antonello Sala, Chris Smith, Bart Vanelslander, Mustafa Zengin, J. Rasmus Nielsen, Adriaan D. Rijnsdorp. “High-resolution mapping of European fishing pressure on the benthic habitats” presented at the ICES Symposium “Effects of fishing on benthic fauna, habitat and ecosystem function” in Tromsø (Norway), 16th - 19th June 2014 [Task 2.1]

Eigaard, O. - Europe: Patterns of fishing effort: high resolution data; analysis methods; relationship to habitat impacts. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Kenny A. Trait based analysis. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Lucchetti A, Angelini V, Pari S, Pulcinella J, Russo T, Sala A (2014) Trawl-turtle interaction: a pilot study in the Adriatic sea. Tromsø, Norway from 16-19th June 2014

Mellibovsky F, Notti E, Prat J, Antonello Sala A (2014) Assessment of hydrodynamic performance and impact of otterboards in wind tunnel trials. Tromsø, Norway from 16-19th June 2014

Piet GJ. Indicators for fisheries impact on the benthic ecosystem. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Rijnsdorp AD. Assessment of trawling impacts on benthic ecosystems with particular reference to mixed sediment bottom fauna on shelf ecosystems. ICES Symposium "Effects of fishing on benthic fauna, habitat and ecosystem functioning" Tromsø, Norway 16-19 June 2014.

Rijnsdorp AD. Electric pulse fishing: what do we know? Common Language Meeting, London, 5 November 2014.

Rijnsdorp AD. Europe: mapping trawling intensities. Workshop Trawling Best Practice. 7-12 September 2014, Bangkok, Thailand.

Rijnsdorp, A.D., et al. Integrating the benthic ecosystem in fisheries management. The FP7-project BENTHIS. Poster. 9th International Symposium on the Ecology of Flatfish. Cle Elum, USA, 9-13 November 2014.

Rijnsdorp AD, van Denderen PD, Bookelaar B, van Kooten T. The effect of bottom trawling on the food and growth of flatfish: a study of body condition in flatfish. 9th International Symposium on the Ecology of Flatfish. Cle Elum, USA, 9-13 November 2014.

Sala A, Brčić J, De Carlo F, Virgili M, Lucchetti A, (2014) Alternative fishing gears to boat seine fisheries: a performance and seabed impact perspective. Tromsø, Norway from 16-19th June 2014.

Sala A, Prat J, Mellibovsky F, Notti E (2014) A predictive tool for otterboard design and performances evaluation. OCEANS'14 MTS/IEEE St. John's, Canada, September, 15-18, 2014 (paper)

Sala A, Virgili1 M, Herrmann B, Brčić J, Lucchetti A (2014) An outlook of the sieving selection of striped venus clam (Chamelea gallina) in the Mediterranean hydraulic dredge fisheries. Tromsø, Norway from 16-19th June 2014

Sala A. Technological innovations for reducing the fisheries impact on the ecosystem. Low-Impact and Fuel Efficient (LIFE) Fishing. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Smith C., Kalogeropoulou V., Papadopoulou K.-N. (2014) The impact of trawling on the functional composition of coastal and shelf macrofaunal and megafaunal benthic assemblages in the Eastern Mediterranean. Tromsø, Norway from 16-19th June 2014.

van Denderen, PD, Rijnsdorp AD, van Kooten T. - Additive effects of trawl and natural disturbance on benthic community composition. Twinning Meeting. Tromsø, Norway 20-21 June 2014

Zengin, M, Gümüş, A., Süer, S., Van, A., Özcan Akpınar İ., Dağtekin, M., 2014. Discard trends of bottom trawl fishery along the Samsun Shelf Area of the Turkish Black Sea coast. ICES Symposium, Effects of fishing on benthic fauna, habitat and ecosystem function, June 16-19, 2014, Tromso, Norway. Abstracts Books, 69 p.

Zengin, M., Gümüş, A., Süer, S., Rüzgar, M., Van, A., Özcan Akpınar İ., Tosunoğlu, Z., Kaykaç, M. H., Başçınar, S. N., Uzmanoğlu, M. S., Çelik, T., Osma, R., Sü, U., Karadurmuş, U., 2014. The Fisheries Impact on the Benthic Ecosystem of Samsun Shelf Area in the Turkish Black Sea Coast. FABA International Symposium on Fisheries and Aquatic Sciences, 25-27 September 2014, Trabzon, Turkey, Abstracts Books, p: 580 (54-55).

2015

Depestele, J.; Rochet, M.-J.; Dorémus, G.; Laffargue, P.; Stienen, E. 2015. Hungry birds! Are there any leftover discards?, VLIZ Young Scientists' Day. Brugge, Belgium, 20 February 2015.

Mengual B., Cayocca F., Le Hir P, Garlan T. and Laffargue P (2015). Physical impacts induced by bottom trawling in the "Grande-Vasière" area (Bay of Biscay, France). 13th INTERCOH, Leuven, Belgium

Hornborg, S., Ulmestrand, M., Sköld, M., Jonsson, P., Eigaard, O.R., Feekings, J.P., Nielsen, J.R., Bastardie, F., and Lövgren, J. 2015. New policies may call for new approaches: the case of Swedish Norway lobster (*Nephrops norvegicus*) fisheries in the Kattegat and Skagerrak. Poster and Extended Abstract. ICES ASC 2015/B:29

Kapiris, K., Karachle, P.K., Papadopoulou, K-N. and Smith, C. 2015. Maja goltziana: an under-reported species from the Hellenic Seas. 11th Panhellenic Symposium on Oceanography and Fisheries, "Aquatic Horizons: Challenges & Perspectives" Mytilene, Greece. Proceedings Volume: 597-600

Kenny, A. "Integrated ecosystem assessment". Presentation at the Opening Meeting of the COFASP Case Study "Regionally-Integrated and Spatially-Explicit Fisheries and Ecosystem Management" (RISE-FEM) Two full days in Spring 2015.

Papadopoulou, K-N., Smith, C.J., Apostolidis Ch., Karachle P.K. 2015. Trawled up marine litter, first observations from Heraklion Bay. 11th Panhellenic Symposium on Oceanography and Fisheries, "Aquatic Horizons: Challenges & Perspectives" Mytilene, Greece. Proceedings Volume: 373-376

Papadopoulou K-N., Smith C.J. , Apostolidis, Ch., Karachle, V. 2015. Fish pot trials in the Aegean Sea: first experimental results. 11th Panhellenic Symposium on Oceanography and Fisheries, "Aquatic Horizons: Challenges & Perspectives" Mytilene, Greece. Proceedings Volume: 157-160

Rijnsdorp AD & Polet H. Trawling Impact European Seas with particular reference to the pulse trawl. Workshop Flemish Banks, Duinkerken, 2 April 2015.

Rijnsdorp AD. Trawling Impact European Seas Overview of main results. Workshop Trawling Best Practice. 15-18 March 2015, Rhode Island, USA.

Rijnsdorp AD, Eigaard O, Hintzen N., Engelhard G. The evolution of bottom trawling impact on demersal fish populations and the benthic ecosystem. ICES Symposium on Oceans Past V. 18-20 May 2015, Tallinn, Estonia.

Rijnsdorp AD. Pulse fishing: scientific research and Research Agenda. What do we know, and what do we not know. Pulse trawl Dialogue Meeting, 2 July 2015, Den Haag, Netherlands.

Thoya, P., Bastardie, F., Dinesen, G., Hansen, J.L.S., and Nielsen, J.R. 2015. Detecting ecological-economic effects of marine spatial plans from displacing the bottom fishing pressure. Presentation and Extended Abstract ICES ASC CM 2015/O:05.

Contributions to ICES Working Groups

2014

Eigaard, O.R. - Working Group on Spatial Fisheries Data (WGSFD). 10-13 June 2014. ICES Headquarters, Copenhagen, Denmark. Input WP2.

O'Neill, F.G. and Summerbell, K. "Recent Scottish trials on the physical impact of trawl gears" presented at the ICES Fishing Technology and Fish Behaviour (FTFB) working group, 5th – 9th May 2014 [Task 4.3]

Piet, G.J. – ICES WGECO Copenhagen, 8–15 April 2014. Input BENTHIS results relevant for MSFD indicator development

Sala, A. , Ole R. Eigaard, Francois Bastardie, Niels Hintzen, Jacopo Pulcinella, Tomasso Russo, Emilio Notti, Stefano Cataudella, Adriaan D. Rijnsdorp "Relationships among Vessel Characteristics and Gear Specifications" presented at the ICES Fishing Technology and Fish Behaviour (FTFB) working group, 5th – 9th May 2014 [Task 2.1]

2015

Bastardie F. and Hintzen, N. Hintzen - Working Group on Spatial Fisheries Data (WGSFD). 8-12 June 2015. ICES Headquarters, Copenhagen, Denmark. Input WP2.

Piet, G.J. – ICES WGECO Copenhagen, 8–15 April 2015. Input BENTHIS results relevant for MSFD indicator development

Rijnsdorp, A.D. – ICES Workshop on guidance for the review of MSFD decision descriptor 6 – seafloor integrity II (WKGMSFDD6-II), Copenhagen, Denmark, 16-19 February 2015

WP9 - PROJECT MANAGEMENT

Lead IMARES (Adriaan Rijnsdorp, Gerda Booij)

Consortium management tasks and achievements

The project manager Gerda Booij assisted several partners in filling in the Financial Statements, assisted in organising general meetings, administered the EC contribution regarding its allocation between Beneficiaries and ensured that all the appropriate payments were made to the other Beneficiaries without unjustified delay. She monitored obligations of the participants and transmitted the deliverables to the Commission. She prepared and submitted the first amendment to the Grant Agreement and monitored the progress of the project.

The project coordinator team has organised the General Assembly meetings in Rome (April 2014) in collaboration with Antonello Sala (CNR) and Lisbon (February 2015). The agenda was circulated well in advance of the meetings and the Scientific officer of the EU was invited. The coordinator chaired the meeting and was responsible for the minutes.

After having submitted the Activity and Management Report of the 1st Reporting Period, the coordinator team (Adriaan Rijnsdorp and Gerda Booij) visited the EU on the 16th of October 2014 to meet the scientific (Nila Petralli, Nikos Zampoukas) and financial (Carlo Panella) officers. The officers were happy with the progress of the project and the way we communicated with them. It was re-iterated that it is important that the deliverables specified in the DOW are delivered in time, and in case of a delay that the scientific officer is informed well in advance about any delay.

Problems which have occurred and how they were solved

During the 2nd reporting period, no major problems have been encountered.

It proved not feasible to have a full plenary meeting with all partners, including the fishery company partners. This is partly due to the language barrier but is also related to the mismatch in interest. The structure of regional stakeholder meetings, and the European Wide Stakeholder meetings provide the suitable platform to organise the interactions between the scientist and fishing industry partners. Also the meetings dedicated to the field trials in each region, facilitate this interactions.

Changes in the consortium

Amendment 2.

Danish SME03 has withdrew from BENTHIS. The Grant Agreement has been adjusted and the work planned has been transferred to SME05. The remaining budget of SME03 was also transferred to SME05.

Subcontracting was made possible for SME 07 (participant 23) and SME 17 (participant 32) for hiring ships to conduct the necessary trials.

Project planning and status

Part of the tasks have experienced a modest delay in finalising the deliverables, although all deliverables, have been submitted within their reporting period. Because the preliminary results of the research task were available before the actual submission of the deliverables, the flow of information between the Work Packages has been as planned.

No major changes in the timing of the tasks and milestones of the different Work Packages and their components as shown in the Gannt chart are expected for the forthcoming reporting period.

Impact of possible deviations from the planned milestones and deliverables

Although there have been some deviations from the initial planning, in particular a modest delay in the submission of some of the deliverables, these delays did not have ramifications for milestones and deliverables in the 2nd reporting period.

Changes in legal status

Any changes to the legal status of any of the beneficiaries, in particular non-profit public bodies secondary and higher education establishments, research organisations and SMEs;

The legal status of ILVO was changed into a third party to Participant 2 , “Vlaams Gewest”. (amendment 1, first reporting period).

Gender balance

In the table the number of individuals scientist and students (MSc, PhD) that have been engaged in BENTHIS are shown for the 2nd reporting period.

	staff		MSc / PhD students	
	female	male	female	male
DLO-IMARES	5	7		1
DLO-LEI	3	2		
ILVO	1	3	1	1
CEFAS	5	9		
BU	1	2		
UNIABDN	1			
Mar Lab	1	5		
IFREMER	9	10		1
MI		2		
DTU-Aqua	6	6		1
AU-Bioscience		2		
UCPH		1		
SLU		3		
IMR	1	1		
CNR	3	4		
HCMR	2	3		
CFRI	1	4	1	1
SME01	1	1		
OMU	2	2	3	1

Timing of the (sub-) tasks and milestones of BENTHIS[3]

	Task #	Task description / milestones	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
WP1	1	Framework (benthos - fisheries impact)	P1		P2																	
	2	Manuscript fishing impact benthic systems												W4				P4				
	3	Economic performance												W4				P4				
	4	Mitigation fisheries imapcts												W4				P4				
WP2	1	Framework gear-seabed interactions	P1		P2																	
	2	Sea bed classification	P1		P2			W2														
	3	Impact trawling sea bed habitats	P1		P2			W2			P3											
WP3	1	Traits, functions and habitat types			P2			W2			P3											
	2	Modelling benthic processes			P2			W2			P3											
	3	Integration									P3			W6								
WP4	1	Physical trawling impact model	P1		P2			W2			P3			W6								
	2	Benthic mortality model	P1		P2			W2			P3											
	3	Geo-chemical impacts	P1		P2			W2			P3											
	4	Food subsidies	P1		P2			W2			P3											
	5	Trawling impact model on structure and functioning benthos						W2			P3			W6								
	6	Report on fish, benthos, fisheries interactions						W2			P3			W6								
WP5	1	Framework economic analysis alternative fishing gears	P1		P2			W3			P3											
	2	Fleet dynamic model	P1		P2			W3			P3			W7								
	3	Investment model						W3			P3			W7				P4				
WP6	1	Review management measures	P1		P2			W3														
	2	Decision-support tool						W3			P3			W7								
	3	Management strategy evaluation									P3			W7								
WP7	1	Current impact of fishing	P1	RSE-1	P2			W4	RSE-2		P3											
	2	Options for mitigations	P1	RSE-1	P2			W4	RSE-2		P3											
	3	Sea trials						W4	RSE-2		P3			W6/W7								
	4	Management scenario evaluation							RSE-2		P3			W6/W7			RSE-3	P4				
WP8	1	Project workshops (P1 - P4)	P1		P2						P3							P4				
	2	Stakeholder involvement			SH1													SH2				
	3	Regional stakeholder events (X)		RSE-1					RSE-2								RSE-3					
WP9	1	Administrative and financial management			F-1			F-2			F-3			F-4				F-5			F-6	
	2a	General Assembly (9, 18 or 27; 48)			GA-1						GA-2							GA-3				
	2b	Steering Committee			SC-1			SC-2			SC-3			SC-4				SC-5			SC-6	
	3	Stakeholder board			SHB						SHB							SHB				
	4	Dissemination							ICES symposium										ICES theme session			

[3] project workshops codes were corrected to match the Deliverable and Milestone tables

Development of the Project website

The first activities after the start of BENTHIS was to develop the Project Website (www.benthis.eu). The website is aimed at dissemination of BENTHIS to the outside world. Website is hosted by Wageningen-UR and care has been taken that the Website will remain available for at least 5 years after the end of the project. To carry out the dissemination task effectively and efficiently, Oscar Bos (DLO-IMARES) has been made responsible for maintaining the Website. He has been actively pursuing BENTHIS colleagues for content for the Website. He attended the Rome project meeting in April 2014 and the Lisbon meeting in February 2015 to directly interact with the partners on this topic.

Co-ordination activities

The coordinator has been active to promote the collaboration with other projects, such as Biotriangle project, the Trawling Best Practice project and FP7-project DEVOTES.

Biotriangle project aims to promote the collaboration of scientist in Europe, New Zeeland, Australia and Canada on the research relevant for the Ecosystem Approach to Fisheries Management. In June 2014, a 2-day Twinning Workshop was organised by the coordinator back to back with the ICES Symposium on Trawling Impact on the Benthic Ecosystem. The logistics of the meeting was organised by Patricia Groo-Nagy (Biotriangle).

Trawling Best Practice TBP (http://trawlingpractices.wordpress.com/) Hilborn, Jennings & Kaiser are leading this project to find common ground on the scientific knowledge regarding best practices of bottom trawling. The aims of BTP overlaps with BENTHIS, in particular with regard to the mapping of the current trawling activities and the development of methods to assess the impact on benthic ecosystems. BTP however has a global coverage while BENTHIS restricts itself to the European waters. In the 2nd reporting period, BENTHIS partners have participated in two meetings of BTP (September 2014, Bangkok, Thailand; March 2015, Boston, USA). The compiled data set of trawling intensities for the major gear types have been made available to the TBP project to be included in a global analysis.

DEVOTES (http://www.devotes-project.eu/) is a FP7 project that aims at improving understanding of human activities impacts (cumulative, synergistic, antagonistic) and variations due to climate change on marine biodiversity, using long-term series (pelagic and benthic). One of the tasks in DEVOTES is focussed on the study of benthic biodiversity in relation to anthropogenic activities, such as fishing activities. Active collaboration has been achieved with the responsible scientist Olivier Beauchard

Successful initiatives were undertaken to invite research institutes that are not participating in BENTHIS to join with the mapping task of WP2.

Deliverables

Deliverable No	Deliveable name	WP No	Delivery month	Assigned to	submitted	subm. date
D9.1	Minutes of the General Assembly	8	9	IMARES	yes	26/06/2013
D9.2	Minutes of the General Assembly	8	27	IMARES	yes	14/7/2015
D9.3	Minutes of the General Assembly	8	45	IMARES	no	
D9.4	Minutes of the Steering Committee meeting	8	8	IMARES	yes	26/06/2013

D9.5	Minutes of the Steering Committee meeting	8	18	IMARES	yes	16/6/2014
D9.6	Minutes of the Steering Committee meeting	8	27	IMARES	yes	14/7/2015
D9.7	Minutes of the Steering Committee meeting	8	36	IMARES	yes	30/09/2015
D9.8	Minutes of the Steering Committee meeting	8	48	IMARES	no	
D9.9	Minutes of the Steering Committee meeting	8	60	IMARES	no	
D9.10	Minutes of the Stakeholder Board meeting	8	8	IMARES	yes	4/6/2014
D9.11	Minutes of the Stakeholder Board meeting	8	27	IMARES	yes	17/4/2015
D9.12	Minutes of the Stakeholder Board meeting	8	48	IMARES	no	
D9.13	First Periodic Activity and Management Report	8	19	IMARES	yes	4/6/2014
D9.14	Second Periodic Activity and Management Report	8	37	IMARES	no	
D9.15	Final Periodic Activity and Management Report	8	60	IMARES	no	
D9.16	Minutes of the ICES Symposium	8	21	IMARES	yes	25/8/2014
D9.17	Minutes of the concluding symposium	8	60	IMARES		

Use of resources

Participant	WP9 Budget (pm)	WP9 Realised 1st + 2nd period (pm)
SDLO	14.5	14.6
ILVO	0.5	0.5

CEFAS-DEFRA	1.0	0.2
BU	1.0	0.8
UNIABDN	0.0	0.4
IFREMER	0.5	0.0
DTU-Aqua	1.5	0.0
CNR	4.0	0.0
CFRI	0.5	0.3
sum	23.5	16.8
remaining personmonths		6.7