



## Deliverable 2.1

# Report of framework for estimation of EU wide fishing pressure on the benthic habitats, including the minutes of WP2 workshop

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### **SUMMARY**

#### Deliverable 2.1

This report presents the minutes and outcome of the WP2 workshop (and preceding work) held on the 7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> of October 2013 in Copenhagen, Denmark. The main purpose of the workshop was to conclude and summarize all the WP2 efforts to establish a framework for understanding gear-seabed interactions and for assessing fishing pressure on the benthic habitats for the most common demersal gears in Europe. Two central parts of this framework is 1) the collation of a trans-European vessel-gear inventory based on industry interviews and 2) the development of a methodology to integrate this industry information with logbook and VMS data of the European fishing fleet. These two parts are described in a report below (Deliverable 2.1).

#### Coordination of BENTHIS-WP2 with best trawling practice project

During the workshop the participants also discussed and agreed on the need for the BENTHIS WP2 work to be concerted closely with the efforts in the Best Trawling Practice Project developed by Hilborn, Jennings and Kaiser (<u>http://trawlingpractices.wordpress.com/</u>) that runs from 2013-2014 and has similar objectives but aims to map this at the global scale. This issue is detailed further below

#### Coordination of BENTHIS-WP2 with ICES-WGFSD

It was recognized that the coming WP2-work, in particular the collation of logbook and VMS data from all of Europe (partners and non-partners), should be conducted in close collaboration with ICES Working Group on Spatial Fisheries data (WGSFD; <u>http://www.ices.dk/community/groups/Pages/WGSFD.aspx</u>) and related ICES data call requested from HELCOM. Chair of WGSFD is Josefine Egekvist <u>isv@aqua.dtu.dk</u>). An important issue to address for the coming data collection work in both BENTHIS-WP2 and ICES-WGSFD is the technical difficulties of processing and aggregating logbook data and VMS data into the correct formats required to run the developed VMStools procedures of both initiatives, which produce compatible aggregated national outputs. This technical challenge highlights the need for coordination between BENTHIS and ICES-WGSFD.

#### Plan of work for BENTHIS WP2

During the workshop the group discussed and identified the steps and deadlines required to meet the next milestones and deliverables of WP2. This included outlining the contents of two manuscripts for submission to peer-reviewed journals (D2.2 and D2.3) and assigning specific tasks to the workshop participants.

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### DELIVERABLE **2.1:** *REPORT ON FRAMEWORK FOR UNDERSTANDING GEAR-SEABED INTERACTIONS AND ASSESSING FISHING PRESSURE ON THE BENTHIC HABITATS BASED ON A TRANS-EUROPEAN INVENTORY OF VESSEL AND GEARS*

#### 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. Fishing can affect benthic ecosystems in many ways, by modifying the sedimentary habitats, increasing or decreasing nutrient fluxes, killing benthic invertebrates and through the redirection of energy from discards to the seabed. These changes in turn lead to changes in the functioning of the benthic ecosystem and the availability of food for commercial fish species. The origin of these many impact mechanisms is the actual fish capture process using demersal gears with direct physical impact on the benthic habitats and organisms, and in the following description of the BENTHIS framework for estimating fishing pressure the fishing operation itself is the starting point.

Commercial fisheries utilise a wide variety of fishing gears ranging from passive gears such as pots and trammel nets, to bottom trawl that are towed over the sea bed. Passive gears may damage benthos, for instance when a long line deployed on a reef may tear off branches of the reef, but it is generally assumed that bottom trawls will have a much larger impact on benthic ecosystems than passive gear because a) they cause higher mortality rates of benthos and higher habitat modification rates and b) because the footprint of towed gears will be many orders of magnitudes larger than those of passive gears (Jennings and Kaiser 1998). In the following framework description only towed demersal gears, i.e. otter trawls, beam trawls, dredges and demersal seines are dealt with.

The impact of a bottom trawl will depend on the size of the gear components, their penetration depth as well as the speed and distance over which the gear is towed. For example, in an otter trawl, the sweeps only touch the surface of the sea bed, whereas the otter boards dig a furrow into the sediment. In a beam trawl the tickler chains, that are mounted between the shoes, penetrate into the sediment and disturb the upper layer as well the benthic organisms that live in the sediment. The most noticeable physical effect of beam trawling and scallop dredging is a flattening of irregular bottom topography by eliminating natural features such as ripples, bioturbation mounds and faunal tubes. The penetration depth of the tickler chain of beam trawls and the teeth or sheer of scallop dredges range from a few centimetres to at least 8 cm (FAO, 2005). The penetration depth for beam trawls depends on the number of tickler chains and the sediment type (Ivanovic et al. 2011).

#### Framework for assessing fishing pressure

In order to classify and map European fishing activities according to sea bed pressure it is necessary to go into detail with the gear types and sizes deployed and the catch processes (target species) that govern the

design and use of particular gears (i.e. the degree of bottom contact of the gear), as well as the appropriate spatial and temporal scale of measuring fishing activity.

The gear specifications available in the official EU fisheries statistics, the logbooks, are limited and not well suited for estimating the bottom contact of the gears. Consequently, a true and fair large scale mapping and classification of sea bed impact from EU fishing activities requires additional gear data, such as trawl door type and ground gear length, to be included. As collection of such data is not feasible on a single trip or vessel basis other approaches have to be developed to overcome the gear specification deficiencies of the official statistics.

In the Benthis project the solution for incorporating quantitative information of gear-sea bed interactions into the logbooks is to first classify the logbook observations in functional gear groups (e.g. DCF metiers) on a trip basis, secondly identify appropriate proxies for gear size by functional group (e.g. through parameterizing the relationship between engine power and wingend spread for different otter trawl fisheries) using questionnaire data from industry surveys, and thirdly to assign quantitative information of bottom contact to each logbook trip by converting proxy values into measures of gear size.

Having extended the logbook observations with quantitative information of gear composition (e.g. door spread) it is possible to estimate the frequency and severity at which the sea bed is impacted in a given area. For logbook trips where VMS data are obtainable, the trawling intensity and benthic impact can be expressed at a fine spatial scale and where VMS data are not available the impact can be expressed on a more crude scale (e.g. the ICES rectangle scale). The BENTHIS framework for estimating fishing fishing pressure on the benthic habitats is visualized below (Figure 1).



Figure 1. Diagram of BENTHIS framework for estimating fishing pressure from logbooks, VMS data and vessel-gear size information from industry survey.

#### **Gear-seabed interactions**

In order to assess the direct physical impact on the seabed when fishing with different types of bottom gears, it is necessary to distinguish between the bottom impacts of the individual gear components. For a traditional single otter trawl there are three main types of sea bed impact during a trawl haul: 1) from the otter boards, 2) from the sweeps and 3) from the trawl itself (the trawl ground gear). Of these three impacts the one from the otter boards is the most severe but also the impact with the narrowest track/path of impact (Figure 2).



Figure 2. Conceptual footprint from standard otter trawls with three types of sea bed impacts: 1) the track affected by the otter boards ("Dørbane"), 2) the track influenced by the sweeps ("Sveipbane") and 3) the track affected by the trawl itself ("Bunngearbane"). Illustration from Buhl-Mortensen et al. 2013.

For a beam trawl the footprint is more homogenous than for otter trawls and can be separated in two types of paths/tracks: one type of track being affected by the shoes of the beam and the second type being affected by the ground gear of the beam trawl and before that, by the tickler chains of the trawl if such chains are deployed (Figure 3).



Figure 3. Drawing of beam trawl with warp, beam, shoes, tickler chains and ground gear (illustration from FAO Fisheries Technical Paper 472)

Dredges used for catching molluscs such as scallops, mussels and oysters, can be expected to have an even more uniform gear footprint than beam trawls in that the ground gear does not vary in structure across the entire width of the dredge (Figure 4). In contrast the variations in dredge towing methods and numbers can be quite large.



Figure 4. Two different dredge types, with and without with shearing edge, and towed in different ways and numbers (drawing from FAO Fisheries Technical Paper No. 419)

#### **Demersal seiners**

When fishing with Danish (or anchored) seine the gear is laid out in roughly a triangular area on the seabed using very long ropes that are hauled by an anchored vessel (Figure 5). As the two ropes are hauled in the net gradually closes, and towards the end of the haul it moves forwards in the same way as a trawl. The largest track/path of impact is that from the ropes, when they are pulled together in the first phase of the operation (Figure 5). The sea bed impact is likely smaller than for demersal otter trawling, since there are no trawl doors and the ground gear is typically lighter. However, the ropes may have a physical impact similar to that of the sweeps of a trawl. Scottish seining (or flyshooting) is a more engine power demanding variation of Danish seining where the vessel moves forward while at the same time hauling in the ropes – Flyshooting can be considered a hybrid between anchored seining and demersal otter trawling.



Figure 5. Left: Illustration of three steps in an individual anchored seine haul, Right: the combined gear footprint of a series of four seine hauls (illustration from <u>http://www.fao.org/fishery/geartype/203/en)</u>

The direct sea bed impact from demersal otter trawls and the other major towed gears can be assessed from two parameters for each of the major gear components described above: a) the width of the track/path of seabed affected by the passage of the component (see figure 2), and b) the severity of this impact. Both of these parameters vary strongly with the target species, vessel size and bottom type.

The variation in impact parameters with target species is particularly true for otter trawl and therefore an understanding and categorization of the main catch principles (target species types) of otter trawls is key to predicting the track width and impact severity of the individual gear components this gear type, which is by far the most widespread towed gear type in European waters.

#### Catch principles of otter trawls

Trawl design has evolved to exploit the specific distribution of behaviour of the species being targeted. As such, the fishing power exerted by a trawl gear is not only related to trawl size but also to trawl geometry. Number of meshes and mesh size in the fishing circle of a trawl is typically used to describe trawl size (e.g. Rahikainen and Kuikka, 2002; Eigaard and Munch-Petersen, 2010) but the size of the fishing circle can be transferred differently into geometrical components such as vertical or horizontal opening of the trawl mouth. Based on personal communications with net makers and fishermen as well as knowledge of how trawl geometry, ground gear and mesh sizes are best matched to the behaviour and size of target species, four conceptual trawl typologies were defined by Eigaard et al 2001 (Figure 6).



Figure 6. The four trawl types defined, (a) herded volume, (b) non-herded volume, (c) herded area, and (d) non-herded area.

- 1) HV (herded volume) trawls are designed to catch shoaling pelagic or semi-demersal fish that are off the bottom such as herring (Clupea harengus), blue whiting (Micromesistius poutassou) and sand eel (Ammodytes marinus). HV-trawls are generally large trawls constructed with very big meshes (>8m) or ropes in the forward part of the trawl that herd fish towards the centre of the body of the trawl constructed in much smaller mesh size (Fig. 1a).
- 2) NHV (non-herded volume) trawls are designed to catch crustaceans such as northern shrimp (Pandalus borealis) which are generally close to the seabed but exhibit an upward migration, particularly at night where they form "swarms" several metres from the seabed. All shrimp species like Pandalus borealis are predominantly captured by a process of filtration. Therefore, the volume swept by the small meshes (<50mm) is what determine the capture efficiency and NHV-trawls are typically constructed with small meshes in their wings and body of the trawl (Fig. 1b).
- 3) HA (herded area) trawls are generally used to target demersal species that are herded by doors and sweeps such as cod (Gadus morhua) and haddock (Melanogrammus aeglefinus). These trawls are characterised by having relatively short fishing lines and the meshes in the fishing circle are typically designed to "balloon" out to increase the vertical opening. HA-trawls generally have heavy rock hopper or bobbin footropes for targeting demersal species over rough ground although they can be constructed with lighter rubber disc ground gears for use on cleaner grounds of sand and mud (Fig. 1c).
- 4) NHA (non-herded area) trawls tend to have long ground gears with large wingend spread and low vertical opening. They are used to target demersal species, which are not herded by doors and sweeps, such as Nephrops (Nephrops norvegicus) and monkfish (Lophius spp.)(Fig. 1d).

#### Trawling modes

In addition to trawl type the current logbook format also informs the mode in which bottom trawls are operated. Three different modes of towing bottom trawls are distinguished; one vessel towing a single bottom otter trawl (OTB); one vessel towing multi-rig otter trawl (OTT); and a pair of vessels towing a single bottom trawl (PTB). The single trawl technique is commonly used to target demersal species, which are herded by the doors and the sweeps and bridles. The main benefit from using the twin trawl technique is the ability to increase the horizontal opening at the wing ends of the trawl deployed without proportionally enlarging the main body of the trawl, in which case the drag resistance would become inconveniently large. This is done by deploying two juxtaposed smaller trawls rather than a larger single trawl with increased horizontal opening. In other words twin trawls enable you to increase wingend spread (by approximately one third) without also increasing vertical opening and towing resistance (Sainsbury, 1996). This exercise is most useful in trawl fisheries targeting species closely associated to the bottom, which are not necessarily herded by the sweeps and due to their sedentary behaviour are not liable to escape over the headline of the trawl. Species such as Nephrops and monkfish fall into this category (Sangster and Breen, 1989) and shrimp trawls are also often fished as twin rigs by Danish, Norwegian, Icelandic and Canadian fishermen (Sainsbury, 1996; Eigaard and Munch-Petersen, 2010). The pair trawling technique is used primarily to increase swept area and, by design, catchability compared to single trawling under certain conditions. This is the case when targeting demersal species that can be herded (e.g. flatfish or roundfish species such as haddock and cod). In demersal pair trawling it is possible to increase the swept area by deploying very long sweeps and herding the catch, more akin to the operation of a Danish seine. In some cases the trawl deployed during pair trawling is up scaled to match the combined engine power of the two vessels (Sainsbury, 1996). This is particularly attractive for smaller vessels.

#### Mitigating Logbook shortcomings of gear size variables

Ideally the mandatory logbooks of all European vessels above 10 meter would hold information of the gear size used for each logbook observation of effort and catch, which could be merged with VMS data to provide swept area estimates at a high resolution spatial scale. Unfortunately only gear type (OTB, DRB and TBB) is currently informed in the logbooks and no details at all are given on gear size. This is a major shortcoming when using logbook information of effort to estimate and map fishing pressure from demersal towed gears.

In BENTHIS this logbook deficiency of gear size information is mitigated by a stepwise solution for incorporating quantitative information of gear-sea bed interactions into the logbooks. The first step is to classify the logbook observations in functional gear groups (e.g. DCF metiers) on a trip basis; the second step is to identify and appropriate proxies for gear size by functional group (e.g. the relationship between vessel engine power and door spread for each of the otter trawl typologies described above) using questionnaire data from industry surveys; and the third step is to assign quantitative information of bottom contact to each logbook trip by converting proxy values into measures of gear size.

Based on the above considerations of catch principles and corresponding gear design focus in combination with the EU-DCF standardised metier categorisation the following gear/fisheries groupings were identified for further analysis:

- 1. Otter trawling for demersal fish: OT\_DMF (plaice, cod, haddock, hake, saithe, etc.)
- 2. Otter trawling for crustaceans: OT\_CRU (Nephrops, Pandalus)
- 3. Otter trawling for small pelagic fish: OT\_SPF (sandeel, sprat)
- 4. Otter trawling for mixed demersal species: OT\_MIX (any mixture of the above)
- 5. Beam trawling for demersal fish: TBB\_DMF (plaice, sole, cod, etc)
- 6. Beam trawling for crustaceans: TBB\_CRU (Crangon)
- 7. Dermesal seining for demersal fish: DS\_DMF (Plaice, cod, etc.)
- 8. Dredging for molluscs: DRB\_MOL (mussels, scallops, oysters, etc.)

For the otter trawls it is possible to distinguish between towing modes (single, twin, pair) in the logbooks and potentially the four otter trawl groupings above could be further divided into trawling modes to gain precision in the proxies for gear width. Whether such a further segregation of gear groups is useful will be easier to decide once the statistical analyses of the industry data have been completed. In this decision it needs to be acknowledged that a number of experts attending the WP2 workshop put forward that in their national logbook data the assignment of individual observations to any of the three categories (OTB, OTT, and PTB) is considered highly uncertain.

#### Inventory of European vessel-gear specifications

The questionnaire developed to collect the industry information needed to parameterize the relationship between vessel size and gear size by metiers is presented in Appendix 5A to 5D. Over the summer and early autumn of 2013, this questionnaire has been presented to a selection of fishers and net makers in all regions covered in BENTHIS. Table 1 shows the response up to date.

|            | Observations collected |     |    | d   | Inventory format |     |    |     |  |
|------------|------------------------|-----|----|-----|------------------|-----|----|-----|--|
|            | OT                     | ТВВ | DS | DRB | ОТ               | TBB | DS | DRB |  |
| DTU Aqua   | 60                     | 2   | 15 |     | 60               |     |    |     |  |
| IMARES     | 5                      | 17  | 1  |     | 5                |     |    |     |  |
| ILVO       |                        | 29  |    |     |                  |     |    |     |  |
| CFRI       | 21                     | 22  |    |     |                  |     |    |     |  |
| CNR        | 508                    |     |    |     |                  |     |    |     |  |
| IMR        |                        |     |    |     |                  |     |    |     |  |
| MI         | 27                     |     |    |     |                  |     |    |     |  |
| CEFAS      |                        |     |    |     |                  |     |    |     |  |
| SLU        | 120                    |     |    |     |                  |     |    |     |  |
| IFREMER    | 55                     |     |    |     |                  |     |    |     |  |
| Marine Lab | 270                    |     |    |     |                  |     |    |     |  |
| HCMR       |                        |     |    |     |                  |     |    |     |  |

Table 1. Number of vessel-gear observations obtained from industry sources before WP2 workshop (columns 2-5) and number of observations forming the basis of the preliminary analyses described below (column 6-8).

#### Danish and Dutch sub-sample results

Although all the above data (Table 1) has been collected through interviews with the industry, not all vessel-gear observations were in the standard format at the start of the WP2 workshop in Copenhagen. Exploratory analyses of vessel-gear-target species relationships were therefore performed on a sub sample of 65 Danish and Dutch otter trawl observations, which had been entered in the joint inventory in the standard format. The observations were grouped according to the agreed target species assemblages (closely mimicking DCF level 5 metiers) and a number of relationships between vessel size and gear size were plotted (Figures 7 to 11).



Figure 7. Door Spread against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, SPF=small pelagic fish and MIX=mixed crustaceans and demersal fish).



Figure 8. Sweep length against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).



Figure 9. Twin trawl clump weight against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).



Figure 10. Otterboard (door) weight against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).



Figure 11. Ground gear length against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, SPF=small pelagic fish and MIX=mixed crustaceans and demersal fish).

The preliminary plots above revealed a number of potential proxies for the size of the different gear components. Engine power appeared to be strongly correlated to door spread, sweep length, door weight, clump-weight, and ground gear length for primarily the single species fisheries.

When the inventory of vessel-gear observations is complete, more thorough statistical analyses of these relationships will be conducted to deliver parameter values, which can be used to assign quantitative information of gear size to the logbook observations for otter trawl trips.

In a similar approach proxies for gear size will be established for the other major groups of towed demersal gears identified above.

#### Linking logbook and VMS data

Once each EU logbook trip is extended with quantitative information of the contact between the fishing gear and the bottom it is possible to estimate the frequency and severity at which the sea bed is impacted in given area at the ICES rectangle scale (the finest resolution of the spatial information held in the logbooks).

#### VMStools

For logbook trips where VMS data are obtainable, the trawling intensity will be expressed at a much finer spatial scale by using and expanding the methodologies available in VMStools. VMStools is a package of open-source software, build using the freeware environment R, specifically developed for the processing, analysis and visualisation of landings (logbooks) and vessel location data (VMS) from commercial fisheries. Analyses start with standardized data formats for logbook (EFLALO) and VMS (TACSAT), enabling users to conduct a variety of analyses using generic algorithms. Embedded functionality handles erroneous data point detection and removals, métier identification through the use of clustering techniques, linking logbook and VMS data together in order to distinguish fishing from other activities, provide high-resolution maps of both fishing effort and -landings, interpolate vessel tracks, and calculate indicators of fishing impact as listed under the Data Collection Framework at different spatiotemporal scales (Hintzen et al. 2010).

#### Mapping of fishing intensity at a fine-scale spatial resolution

For some purposes, even scaling up from the 'low' spatial resolution of logbooks (ICES rectangles) to the more detailed VMS resolution with vessel positions informed with two hour intervals is not enough. In this case you may want to interpolate the fishing tracks between your VMS data points to create a number of 'intermediate' points. These are called 'interpolated tracks'.

Two types of interpolation are available in VMStools, linear interpolation and Cubic Hermite Spline (CHS) interpolation (Hintzen et al. 2010). Other methodologies to resolve the two hour ping distance is nested gridding (Gerritsen et al. 2013) where the grid cell size is dynamic and increases resolution (decreases in size) with increasing ping information. In the BENTHIS WP2 workflow the cubic hermite spline methodology will be used. Based on all available ping information (position, speed and bearing) this interpolation methodology delivers a non-linear estimate of vessel tracks and also informs uncertainty around the estimated interpolation path. The reliability of this interpolation methodology to estimate true trawl tracks based on hourly and tow-hourly VMS pings has been validated with high resolution trawl track data (figure 12) and will be developed further to deliver interpolated tracks for the VMS data collated and analysed in BENTHIS.



Figure 12. Validation of interpolation methodology used in the BENTHIS WP2 fishing pressure estimation. Solid lines are the real trawl tracks and the CHS interpolation is represented by the dashed dark grey line. (Hintzen et al. 2010)

A swept area is assigned to each interpolation track based on logbook information of vessel size in combination with information on vessel size  $\sim$  gear size relationships by metiers informed by the industry survey. By using this methodology it is possible to estimate the actual gear-seabed interactions on a very fine spatial resolution.

The workshop discussed at length the spatial scale at which the fishing intensity will be analysed. It was agreed that annual data of swept area will be made available at a spatial scale of 1 minute latitude by 1 minute longitude. The main arguments for this choice is that (i) at this scale fishing effort is known to approach a random distribution in the fisheries analysed so far; (ii) the scale matches the ICES rectangle codes (is easily scaled upwards to larger grid cells) (iii) this scale is in agreement with the Best Trawling Practice Project (see below). A disadvantage is that the surface area of the grid cells depends on the latitude and change from south to north. As a result the comparison of the statistical distributions (in particular the level of aggregation that is known to depend on the absolute size of the grid cells) will be more complicated. This, however, can be resolved by analysing the statistical distributions for a range of grid sizes.

#### Overlaying intensity maps and habitat maps

When individual partners have estimated annual fishing intensity (proportion of area swept yearly) for the major towed gear types of their fishing fleets and produced aggregated outputs on a 1\*1 minutes grid resolution, it is possible to produce large scale pan-European maps of total fishing pressure on the seafloor by merging these standardized outputs. When overlaying the fishing pressure maps with habitat maps (based on the EUNIS system of habitat classification) it will be possible to identify potential areas of ecosystem service conflicts across the entire case study area.

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#### COORDINATION WITH THE BEST TRAWLING PRATICE (BTP) PROJECT

Adriaan Rijnsdorp introduced the Best trawling Practice (BTP) project that runs in parallel with BENTHIS and partly overlaps in the questions addressed but has a global perspective. BTP is led by Ray Hilborn, Simon Jennings and Mike Kaiser. Details can be found at the project website <u>http://trawlingpractices.wordpress.com/</u>. BENTHIS partners CEFAS, Bangor University and IMARES also participate in BTP. BTP attempts to collate as many data sets as possible on a high spatial resolution (about 1 x 1 km) for different fishing gears such as otter trawl, beam trawl and dredges, and will develop methods to downscale the micro-distribution of trawling effort from effort data available at larger spatial scales such as ICES rectangles. For the benefit of both projects, it is important to fine-tune the activities to warrant maximum efficiency in collaboration and complementarity.

Potentially, both projects may compete in preparing a paper on the assessment of the trawling impact, with the BTP paper with the global analysis potentially having more appeal to the high impact journals than the BENTHIS paper that deals with the European scale only. If we design the BENTHIS study in such a way that we add an extra dimension to the analysis, the paper can be complementary to the BTP paper and still be interesting for a broader audience. Because BENTHIS has detailed information available on the type of bottom trawls used, and thus can distinguish the trawling impact on (i) epifauna (all trawls); (ii) infauna (beam trawls, doors of otter trawls, otter boards and clump of twintrawls); (iii) sediment resuspension, we can provide more detail in our analysis.

# COORDINATION WITH ICES WORKING GROUP ON SPATIAL FISHERIES DATA (WGSFD)

During the BENTHIS WP2 workshop in Copenhagen It was recognized that the coming WP2-work, and in particular the collation of VMS data from all of Europe (including partners as well as non-partner countries), should be conducted in close collaboration with ICES Working Group on Spatial Fisheries data (WGSFD; <u>http://www.ices.dk/community/groups/Pages/WGSFD.aspx</u>) and the related ICES data call requested from HELCOM. Chair of WGSFD is Josefine Egekvist <u>isv@aqua.dtu.dk</u>). An important issue to address for the coming data collection work in both BENTHIS-WP2 and ICES-WGSFD is the technical difficulties of processing and aggregating logbook data and VMS data into the correct formats required to run the developed VMStools procedures of both initiatives, which produce compatible aggregated national outputs. This technical challenge highlights the need for coordination between BENTHIS and ICES-WGSFD.

2013 Terms of reference for ICES WGSFD

- 1. An annual up date of an aggregated product based on VMS and logbook data giving the DCF environmental indicators 5, 6 and 7 as well as MSFD descriptor 6. The aggregated output will contain data from as many ICES member states as possible.
- 2. Work on standardized data products for inter alia WGDEEP, WGDEC, WGECO. Ensure standardized methods and quality assurance.
- 3. Review on-going work for analysing VMS data and developing standardized data products. This might also include new technical solutions like e-logbook, AIS and CCTV data to improve the effort estimate

### PLAN OF WORK FOR WP2 (A)

| Task 2.1     | Completion of delivery<br>2.1                                                  | Completion Industry<br>survey                                                                                            | Completion of inputdata<br>for VMS tools (EFLALO<br>and TACSAT datafiles)                                                                                                                       | Parameterization of vessel-<br>gear size relationships by<br>DCF metiers to deliver<br>logbook proxies for size/width<br>of different gear components<br>affecting the seabed at the<br>epifauna or infauna level | Completion of individual<br>partner outputs of fishing<br>intensity, according to<br>formats agreed upon at WS<br>meeting (annual data at<br>1*1 minute longitude and<br>latitude)                      |
|--------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Action       | D2.1-Report drafted by<br>WP-leader and circulated<br>to partners for comments | Survey completed by<br>all partners and data<br>uploaded to<br>sharepoint or e-mailed<br>to WP-leader in right<br>format | Each partner completes<br>the national TACSAT and<br>EFLALO input file<br>according to formats<br>presented by Niels and<br>Francois at workshop<br>(and available at the VMS<br>tools website) | WP-leader initiates analyses<br>of metier groupings and joint<br>inventory data. Analyses will<br>be developed further and<br>finalized jointly through mail<br>and skype communication                           | Partners process their own<br>VMS and logbook data (this<br>includes merging with gear<br>size proxies/swept area<br>estimates by metier).<br>Guidelines and script<br>available at VMStools<br>webpage |
| Deadline     | ASAP                                                                           | 1. December                                                                                                              | 1. December                                                                                                                                                                                     | 1. January                                                                                                                                                                                                        | 15. January                                                                                                                                                                                             |
| IMARES       | Adriaan Riinsdorn                                                              | Adriaan Riinedorn                                                                                                        | Nials Hintzan                                                                                                                                                                                   | Adriaan Rinsdorn                                                                                                                                                                                                  | Nials Hintzen                                                                                                                                                                                           |
| ILVO         | Hans Polet                                                                     | Hans Polet                                                                                                               | Bart                                                                                                                                                                                            | Hans Polet                                                                                                                                                                                                        | (uu)                                                                                                                                                                                                    |
| CEFAS        | Paulette Posen                                                                 | Paulette Posen                                                                                                           | Paulette Posen                                                                                                                                                                                  | Paulette Posen                                                                                                                                                                                                    | Paulette Posen                                                                                                                                                                                          |
| MarLab       | Barry O'Neill                                                                  | Barry O'Neill                                                                                                            | Rui Catarino                                                                                                                                                                                    | Barry O'Neill                                                                                                                                                                                                     | Rui Catarino                                                                                                                                                                                            |
| IFREMER      | Pascal Laffargue                                                               | Pascal Laffargue                                                                                                         | Pascal Laffargue                                                                                                                                                                                | Pascal Laffargue                                                                                                                                                                                                  | Pascal Laffargue                                                                                                                                                                                        |
| IM           | David Reid                                                                     | David Reid                                                                                                               | (David Reid)                                                                                                                                                                                    | David Reid                                                                                                                                                                                                        | (David Reid)                                                                                                                                                                                            |
| DTU Aqua     | Ole Eigaard                                                                    | Ole Eigaard                                                                                                              | Francois Bastardie                                                                                                                                                                              | Ole Eigaard                                                                                                                                                                                                       | Francois Bastardie                                                                                                                                                                                      |
| SLU          | Hans Nilsson                                                                   | Hans Nilsson                                                                                                             | Patrik Jonsson                                                                                                                                                                                  | Hans Nilsson                                                                                                                                                                                                      | Patrik Jonsson                                                                                                                                                                                          |
| IMR          | Mike Breen                                                                     | Mike Breen                                                                                                               | Genoveva                                                                                                                                                                                        | Mike Breen                                                                                                                                                                                                        | (uu)                                                                                                                                                                                                    |
| CNR          | Antonello Sala                                                                 | Antonello Sala                                                                                                           | Antonello Sala                                                                                                                                                                                  | Antonello Sala                                                                                                                                                                                                    | Antonello Sala                                                                                                                                                                                          |
| HCMR         | Chris Smith                                                                    | Chris Smith                                                                                                              | Chris Smith                                                                                                                                                                                     | Chris Smith                                                                                                                                                                                                       | Chris Smith                                                                                                                                                                                             |
| CFRI         | Mustafa Zengin                                                                 | Mustafa Zengin                                                                                                           | Mustafa Zengin                                                                                                                                                                                  | Mustafa Zengin                                                                                                                                                                                                    | Mustafa Zengin                                                                                                                                                                                          |
| Non-partners | 6                                                                              |                                                                                                                          |                                                                                                                                                                                                 |                                                                                                                                                                                                                   |                                                                                                                                                                                                         |
|              | VMStools workflow:                                                             | http://code.google.com/n/w                                                                                               | setaals / wiki / Roothis W/D7                                                                                                                                                                   |                                                                                                                                                                                                                   |                                                                                                                                                                                                         |
|              | R-script VMStools workflo                                                      | http://code.google.com/p/vr                                                                                              | hstools/source/browse/trunk/vn                                                                                                                                                                  | ns tools /inst/scripts /%23Benthis_WP                                                                                                                                                                             | 2 workflow 19Sep13.r                                                                                                                                                                                    |
|              | VMStools program, vers 6                                                       | http://code.google.com/p/vr                                                                                              | nstools/downloads/list                                                                                                                                                                          |                                                                                                                                                                                                                   |                                                                                                                                                                                                         |
|              |                                                                                |                                                                                                                          |                                                                                                                                                                                                 |                                                                                                                                                                                                                   |                                                                                                                                                                                                         |
|              |                                                                                |                                                                                                                          |                                                                                                                                                                                                 |                                                                                                                                                                                                                   |                                                                                                                                                                                                         |

### PLAN OF WORK FOR WP2 (B)

| Manuscript on scientific paper<br>on EU-wide benthic fishing<br>pressure (D.2.3)                        | A list of contents with task<br>allocations was agreed upon at<br>the WS-meeting. A slightly<br>revised version will be circulated<br>by WP-leader well in advance of<br>the deadline. During the general<br>workflow, methods and results<br>will be added, followed by the<br>text parts. | 30. April   | Adriaan & Niels   | Hans & nn | Paulette       | Barry & Rui  | Pascal           | Dave & nn    | Ole & Francois & Grete | Jørgen Hansen | Hans & Patrik  | Mike & nn | Antonello      | Chris       | Mustafa        | nn & nn &nn |
|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-----------|----------------|--------------|------------------|--------------|------------------------|---------------|----------------|-----------|----------------|-------------|----------------|-------------|
| Manuscript of scientific paper on<br>vessel-gear-targetspecies<br>relationships (D.2.2)                 | A list of contents (and suggested<br>task allocations) will be circulated<br>by WP-leader well in advance of<br>the deadline. During the<br>preceeding workflow, in particular<br>the analysis of the industry data,<br>methods and results will be<br>added, followed by the text parts    | 31. March   | Adriaan & Niels   | Hans      | Paulette       | Barry & Rui  | Pascal           | Dave         | Ole & Francois         |               | Hans & Patrik  | Mike      | Antonello      | Chris       | Mustafa        |             |
| Dverlaying<br>Intensity maps and<br>Inabiatat maps 11                                                   | The combined EU- v<br>wide map of fishing 1<br>intensity will be<br>overlayed with th<br>habitat maps<br>(EUNIS)                                                                                                                                                                            | 15.February | Niels Hintzen     |           |                |              |                  |              | Grete & Francois       | Jørgen hansen |                |           |                |             |                |             |
| Estimation of BENTHIS (<br>coverage of total<br>European effort using h<br>the STECF effort<br>database | Breakdown of STECF<br>database in effort by<br>gear categories and<br>area (ICES+FAO<br>statistical areas) and<br>estimation of the<br>proportion of effort<br>covered by BENTHIS<br>data                                                                                                   | 15.February | Niels Hintzen     |           |                |              |                  |              | Francois & Ole         |               | Patrik Jonsson |           |                |             |                |             |
| Inclusion of non-partner<br>fishing effort intensity                                                    | Non-partner countries will<br>be invited on board the<br>mapping work and<br>subsequent publication as<br>we go along. This effort will<br>be initiated by the WP-<br>leader and tightly<br>coordinated with ICES-<br>WGSFD efforts to collate                                              | 31. January | Adriaan Rijnsdorp |           |                |              |                  |              | Ole Eigaard            |               |                |           |                |             |                | nn & nn &nn |
| Merging of individual<br>partner outputs.                                                               | Merging will take place<br>during a series of video or<br>skype conferences where<br>we make sure that the<br>outputs are merged in a<br>way that will ensure<br>obeying confidentiality<br>restrictions                                                                                    | 31. January | Niels Hintzen     | (uu)      | Paulette Posen | Rui Catarino | Pascal Laffargue | (David Reid) | Francois Bastardie     |               | Patrik Jonsson | (uu)      | Antonello Sala | Chris Smith | Mustafa Zengin |             |

### **APPENDIX 1: AGENDA**





### Agenda for the BENTHIS WP2 workshop meeting Copenhagen, 7-9 October 2013

Venue: DTU Aqua, Copenhagen ("Riddersalen") Address: Charlottenlund Castle, Jægersborg Alle 1, DK-2920 Charlottenlund Local organisor: Ole Ritzau Eigaard (tel: +45 21154565, +45 35883374, <u>ore@aqua.dtu.dk</u>)

#### Monday 7 October

| 1400    | Welcome and introduction                            | Eigaard           |
|---------|-----------------------------------------------------|-------------------|
| 1415    | Agenda and presentation WP2 work plan               | Eigaard           |
| 1445    | Presentation of VMStools methodology                | Hintzen/Bastardie |
| 1615    | Coffe break                                         |                   |
| 1645    | Linking gear proxies to logbooks and VMS            | All participants  |
| 1745    | Data format requirements and challenges             | All participants  |
| 1900    | Closing of day 1                                    |                   |
| Tuesday | 8 October                                           |                   |
| 0900    | Implementation of VMS methods by partners           | All participants  |
| 1000    | Coffee break                                        |                   |
| 1030    | None-VMS case study areas                           | All participants  |
| 1115    | Non-partner effort, habitat maps and scaling issues | All participants  |
| 1200    | Lunch break                                         |                   |
| 1245    | Analyses of industry survey data (inventory status) | All participants  |
| 1315    | Analyses of industry survey data (grouping/metiers) | All participants  |
| 1530    | Coffee break                                        |                   |
| 1600    | Analyses of industry data (gear width/geometry)     | All participants  |
| 1800    | Closing of day 2                                    |                   |
| 1930    | Dinner at a nice restaurant                         |                   |
| Wednesd | lay 9 October                                       |                   |
| 0900    | Analyses of industry data (gear width/geometry)     | All participants  |
| 1100    | Analyses of industry data (habitat-specific impact) | All participants  |
| 1130    | Linkages to WP3 and WP4                             | All participants  |
| 1200    | Lunch break                                         |                   |
| 1300    | Workplan and tasks - Deliverables (report & papers) | All participants  |
| 1400    | Other issues                                        | All participants  |

1500 Closing of meeting

### **APPENDIX 2: LIST OF PARTICIPANTS**

| Name      |           | Institute  | Country     | Partner<br>number |
|-----------|-----------|------------|-------------|-------------------|
| Rijnsdorp | Adriaan   | DLO-IMARES | Netherlands | 1                 |
| Hintzen   | Niels     | DLO-IMARES | Netherlands | 1                 |
| Polet     | Hans      | ILVO       | Belgium     | 2                 |
| O'Neill   | Barry     | MarLab     | UK-Scotland | 6                 |
| Laffargue | Pascal    | IFREMER    | France      | 7                 |
| Reid      | Dave      | MI         | Ireland     | 8                 |
| Bastardie | Francois  | DTU-Aqua   | Denmark     | 9                 |
| Eigaard   | Ole       | DTU-Aqua   | Denmark     | 9                 |
| Nielsen   | J. Rasmus | DTU-Aqua   | Denmark     | 9                 |
| Nilsson   | Hans      | SLU        | Sweden      | 12                |
| Sala      | Antonello | CNR        | Italy       | 14                |
| Zengin    | Mustafa   | CFRI       | Turkey      | 16                |
| Catarino  | Rui       | MarLab     | UK-Scotland | 6                 |
| Jonsson   | Patrik    | SLU        | Sweden      | 12                |

### APPENDIX 3: TABLE OF CONTENTS AND ALLOLOCATION OF TASKS FOR DELIVERABLE 2.3 (MANUSCRIPT ON EU-WIDE BENTHIC FISHING PRESSURE)

- 1. Impact bottom trawls on benthic ecosystem (intro) Ole
- 2. Bottom trawl components that are in contact with the sea bed and benthic organisms. Barry
  - a. Figure of vertical profile of benthic system and the gear components
  - b. Main gear types to consider (otter trawls, beam trawls, dredges) Dave
- 3. Gear types studied in BENTHIS
  - a. Inventory of gear characteristics EU wide Anton, Ole
  - b. Matching up logbooks, STECF and inventory data Ole
  - c. Overview of inventories Ole
  - d. Preliminary results Ole
- 4. Spatial distribution Adriaan Niels
  - a. Brief review of literature (patchiness, spatial scale at which trawling becomes a random activity, importance of statistical distribution in terms of extrapolating and downscaling)
  - b. Choice of spatial scale
  - c. Choice of time scale (annual pattern, seasonal pattern to be discussed)
  - d. VMS and logbook data
  - e. VMS tools
  - f. Confidentiality issue
- 5. STECF data base on fishing effort Patrik
  - a. Gear categories distinguished
  - b. EU wide map of effort by ICES rectangle / GSA
  - c. Proportion of effort of BENTHIS partners
- 6. Habitat maps (Grete Dinesen, Chris Smith)
  - a. EUNIS level 3
  - b. Link with WP3
- 7. Trawling pressure Adriaan
  - a. Methodology (frequency, area, impact by gear component; epifauna, infauna)
  - b. limitations

### **APPENDIX 4A: INDUSTRY QUESTIONNAIRE – OTTERBOARD TRAWLS**

| Country:                              |                                              |               |
|---------------------------------------|----------------------------------------------|---------------|
| Fishing area:                         |                                              | Bottom trawls |
| Date:                                 |                                              | BENTHIS-2013  |
| vessel:                               |                                              | (partner)     |
|                                       |                                              |               |
|                                       |                                              |               |
| Trawl                                 | type and name                                |               |
| Trawling mode*                        | one or two vessels (single or pair trawling) |               |
| Rigging                               | number of trawls per vessel                  |               |
| Net maker                             | company name                                 |               |
| Codend                                | stretched mesh size (mm)                     |               |
| Target species <sup>1</sup> (single)  | only single species fisheries                |               |
| Primary species <sup>1</sup>          | only mixed/multi-species fisheries           |               |
| Secondary species <sup>1</sup>        | only mixed/multi-species fisheries           |               |
| Third species <sup>1</sup>            | only mixed/multi-species fisheries           |               |
| Bottom type                           | bedrock, hard bottom, sand, hard clay, mud   |               |
| Vessel                                | engine power in kW                           |               |
|                                       | tonnage in GRT                               |               |
|                                       | Loa: overall length in metres                |               |
| Trawl circumference                   | number of meshes                             |               |
|                                       | stretched mesh size (mm)                     |               |
| Trawl                                 | Trawl height (metres)                        |               |
|                                       | Wing spread (metres)                         |               |
| Doors                                 | pelagic or bottom                            |               |
|                                       | number                                       |               |
|                                       | producer and model                           |               |
|                                       | length (m)                                   |               |
|                                       | height (m)                                   |               |
|                                       | weight (kg)                                  |               |
| Door spread                           | door spread (metres)                         |               |
| Sweeps                                | sweep length (metres)                        |               |
| Bridles                               | number and length (metres)                   |               |
| Tickler chains/lines                  | number                                       |               |
|                                       | total weight of each chain or line (kg)      |               |
| Groundgear                            | length of groundgear (metres)                |               |
|                                       | type, e.g. rockhopper, bobbins, discs, etc.  |               |
|                                       | diameter of ground-gear (mm)                 |               |
|                                       | total weight of ground gear (kg)             |               |
| Clump                                 | type (e.g. chain or roller)                  |               |
|                                       | weight of clump (kg)                         |               |
| Other chains in gear                  | number and location in gear                  |               |
|                                       | total weight of each (kg)                    |               |
| <sup>1</sup> please inform both commo | n name and FAO 3-Alpha Species Codes (ASFIS) |               |
|                                       |                                              |               |
| Trawling speed (knots):               |                                              |               |
| Steaming speed (knots):               |                                              |               |
| Fuel consumption trawling             | g (litres/hour):                             |               |
| Fuel consumption steamin              | ng (litres/hour):                            |               |
| Consumption other activit             | ies (litres/hour and activity):              |               |
|                                       |                                              |               |

### APPENDIX 4B: INDUSTRY QUESTIONNAIRE – BEAM TRAWLS

| Country:                              |                                               |   |              |
|---------------------------------------|-----------------------------------------------|---|--------------|
| Fishing area:                         |                                               |   | Beam trawls  |
| Date:                                 |                                               |   | BENTHIS-2013 |
| vessel:                               |                                               |   | (partner)    |
|                                       |                                               |   |              |
|                                       |                                               |   |              |
| Trawltype                             | conventional beam trawl, pulse-trawl, sum-    |   |              |
| nawrtype                              | wing, hydrorig, etc.)                         |   |              |
| Total trawl number                    | number of trawls per vessel                   |   |              |
| Net maker                             | company name                                  |   |              |
| Codend                                | stretched mesh size (mm)                      |   |              |
| Target species <sup>1</sup> (single)  | only single species fisheries                 |   |              |
| Primary species <sup>1</sup>          | only mixed/multi-species fisheries            |   |              |
| Secondary species <sup>1</sup>        | only mixed/multi-species fisheries            |   |              |
| Third species <sup>1</sup>            | only mixed/multi-species fisheries            |   |              |
| Bottom type                           | bedrock, hard bottom, sand, hard clay, mud    |   |              |
| Vessel                                | engine power (kW)                             |   |              |
|                                       | tonnage (GT)                                  |   |              |
|                                       | overall length (m)                            |   |              |
| Warp/depth ratio                      | (1/x)                                         |   |              |
| Warp                                  | warp diameter (mm)                            |   |              |
| Beam                                  | beam width (m)                                |   |              |
|                                       | complete beam weight in air (kg)              |   |              |
| Beam shoes                            | number                                        |   |              |
|                                       | width (mm)                                    |   |              |
|                                       | length (mm)                                   |   |              |
| Sumwing                               | width (m)                                     |   |              |
|                                       | corde length (mm)                             |   |              |
|                                       | complete wing with nose weight in air (kg)    |   |              |
| Sumwing nose                          | width (mm)                                    |   |              |
|                                       | total length (mm)                             |   |              |
|                                       | contact plate length (mm)                     |   |              |
| Tickler chains                        | number                                        |   |              |
|                                       | total weight of each (kg)                     |   |              |
| Chain mat                             | total weight (kg)                             |   |              |
| Groundgear                            | length of groundgear (m)                      |   |              |
|                                       | type, e.g. bobbins, rubber discs, chain, etc. |   |              |
|                                       | diameter of ground gear (mm)                  |   |              |
|                                       | total weight of ground gear (kg)              |   |              |
| Electrodes                            | number                                        |   |              |
|                                       | electrode length (m)                          |   |              |
|                                       | electrode diameter (mm)                       |   |              |
|                                       | electrode type                                |   |              |
| <sup>1</sup> please inform both commo | n name and FAO 3-Alpha Species Codes (ASFIS)  |   |              |
|                                       |                                               |   |              |
| Trawling speed (knots)                |                                               |   |              |
| Stooming speed (Kilois).              |                                               |   |              |
| Stearning speed (knots):              |                                               |   |              |
| Fuel consumption trawlin              | g (litres/nour):                              |   |              |
| Fuel consumption steaming             | ng (litres/hour):                             | - |              |
| Consumption other activity            | ties (litres/hour and activity):              |   |              |

### APPENDIX 4C: INDUSTRY QUESTIONNAIRE – DEMERSAL SEINES

| Country:                                  |                                                     |                 |
|-------------------------------------------|-----------------------------------------------------|-----------------|
| Fishing area:                             |                                                     | Demersal seines |
| Date:                                     |                                                     | BENTHIS-2013    |
| vessel:                                   |                                                     | (partner)       |
|                                           |                                                     |                 |
|                                           |                                                     |                 |
| Seine type                                | flyshooter/Scottish seine or anchored/ Danish seine |                 |
| Net maker                                 | company name                                        |                 |
| Codend                                    | stretched mesh size (mm)                            |                 |
| Target species <sup>1</sup> (single)      | only single species fisheries                       |                 |
| Primary species <sup>1</sup>              | only mixed/multi-species fisheries                  |                 |
| Secondary species <sup>1</sup>            | only mixed/multi-species fisheries                  |                 |
| Third species <sup>1</sup>                | only mixed/multi-species fisheries                  |                 |
| Bottom type                               | bedrock, hard bottom, sand, hard clay, mud          |                 |
| Vessel                                    | engine power (kW)                                   |                 |
|                                           | tonnage (GT)                                        |                 |
|                                           | overall length (m)                                  |                 |
| Seine circumference                       | number of meshes in circumference                   |                 |
|                                           | stretched mesh size (mm)                            |                 |
| Seine height                              | height of seine (metres)                            |                 |
| Seine rope                                | total rope capacity (total length in metres)        |                 |
|                                           | rope diameter in (mm or inches)                     |                 |
|                                           | rope weight (kg per meter rope)                     |                 |
| Groundgear                                | length of groundgear (metres)                       |                 |
|                                           | type, e.g. bobbins, rubber discs, chain, etc.       |                 |
|                                           | diameter of groundgear (mm)                         |                 |
|                                           | total weight of ground gear (kg)                    |                 |
| <sup>1</sup> please inform both common na | ame and FAO 3-Alpha Species Codes (ASFIS)           |                 |
|                                           |                                                     |                 |
|                                           |                                                     |                 |
| Steaming speed (knots):                   |                                                     |                 |
| Fuel consumption steaming (               | litres/hour):                                       |                 |
| Fuel consumption fishing (lite            | res/hour):                                          |                 |
| Duration of haul/fishing oper             | ation (hours):                                      |                 |
| Consumption other activities              | (litres/hour and activity):                         |                 |

### **APPENDIX 4D: INDUSTRY QUESTIONNAIRE – DREDGES**

| Country:                              |                                                |                  |
|---------------------------------------|------------------------------------------------|------------------|
| Fishing area:                         |                                                | <br>Dredges      |
| Date:                                 |                                                | <br>BENTHIS-2013 |
| vessel:                               |                                                | (partner)        |
|                                       |                                                |                  |
|                                       |                                                |                  |
|                                       |                                                |                  |
| Dredge                                | type and name                                  |                  |
| Total dredge number                   | number of dredges per vessel                   |                  |
| Net maker                             |                                                |                  |
|                                       |                                                |                  |
| Codend                                | stretched mesh size (mm)                       |                  |
| Target species <sup>1</sup> (single)  | only single species fisheries                  |                  |
| Primary species <sup>1</sup>          | only mixed/multi-species fisheries             |                  |
| Secondary species <sup>1</sup>        | only mixed/multi-species fisheries             |                  |
| Third species <sup>1</sup>            | only mixed/multi-species fisheries             |                  |
| Bottom type                           | bedrock, hard bottom, sand, hard clay, mud     |                  |
| Vessel                                | engine power (kW)                              |                  |
|                                       | tonnage (GT)                                   |                  |
|                                       | overall length (m)                             |                  |
| Warp/depth ratio                      | ratio of warp length and fishing depth (1 /x ) |                  |
| Warp                                  | warp diameter (mm)                             |                  |
| Dredge                                | total width (m)                                |                  |
|                                       | total weight (kg)                              |                  |
| <sup>1</sup> please inform both commo | on name and FAO 3-Alpha Species Codes (ASFIS)  |                  |
|                                       |                                                |                  |
| Trawling speed (knots):               |                                                |                  |
| Steaming speed (knots):               |                                                |                  |
| Fuel consumption trawlin              | g (litres/hour):                               |                  |
| Fuel consumption steami               | ng (litres/hour):                              |                  |
| Consumption other activi              | ties (litres/hour and activity):               |                  |