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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Rijnsdorp	Reference MYGEAR project added		19 August 2014

SUMMARY

Deliverable 2.1

This report presents the minutes and outcome of the WP2 workshop (and preceding work) held on the 7th, 8th and 9th 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 (http://trawlingpractices.wordpress.com/) 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; http://www.ices.dk/community/groups/Pages/WGSFD.aspx) and related ICES data call requested from HELCOM. Chair of WGSFD is Josefine Egekvist jsv@aqua.dtu.dk). 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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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).

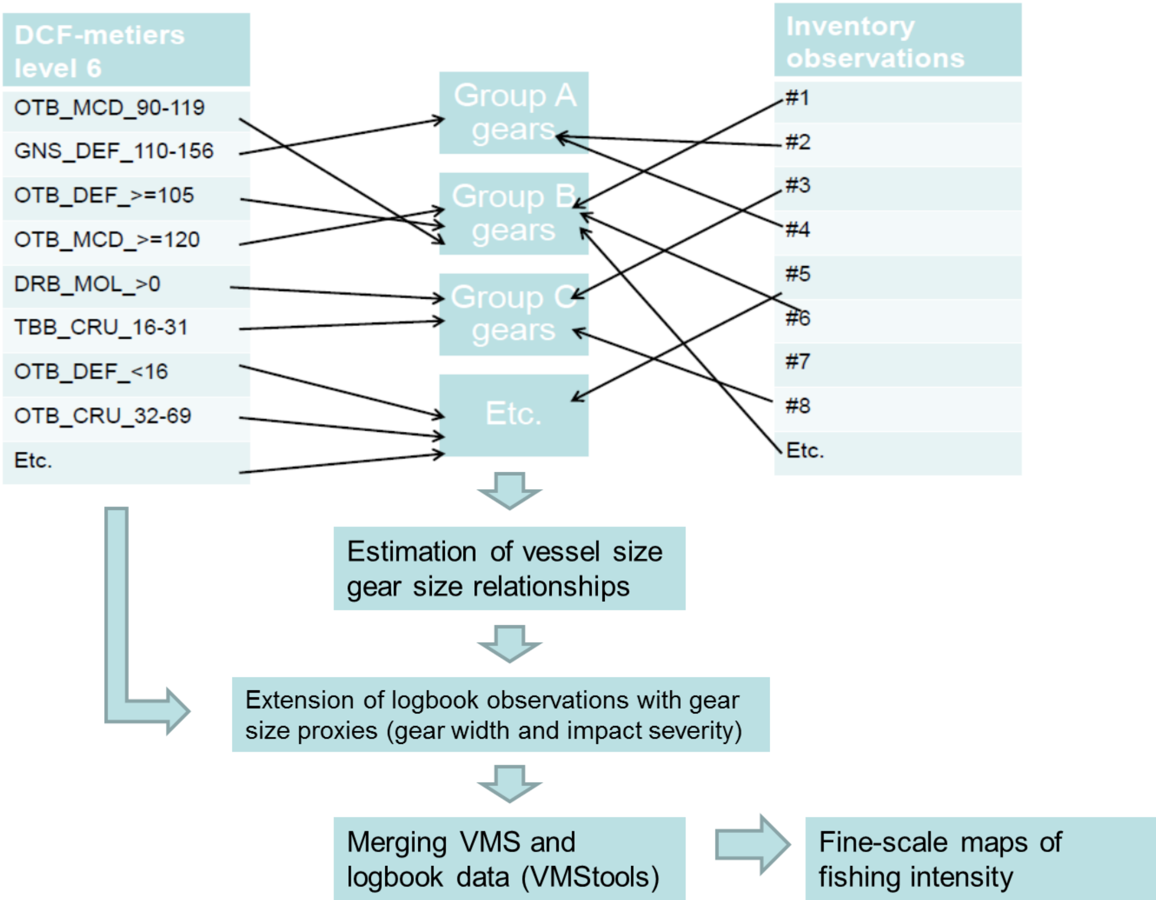

Figure 1. Diagram of BENTHIS framework for estimating fishing pressure from logbooks, VMS data and vessel-gear size information from industry survey.

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).

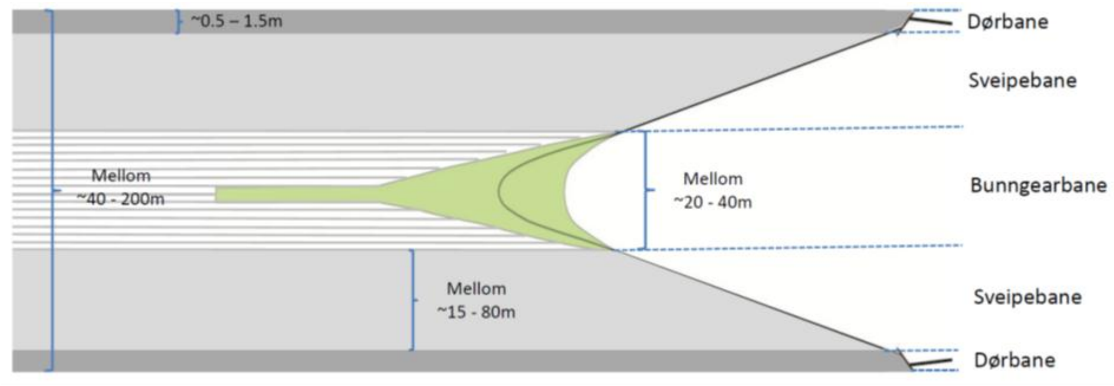

Figure 2. Conceptual footprint from standard otter trawls with three types of sea bed impacts: 1) the track affected by the otter boards ("Dørbane"), 2) the track influenced by the sweeps ("Sveipbane") and 3) the track affected by the trawl itself ("Bunngearbane"). Illustration from Buhl-Mortensen et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

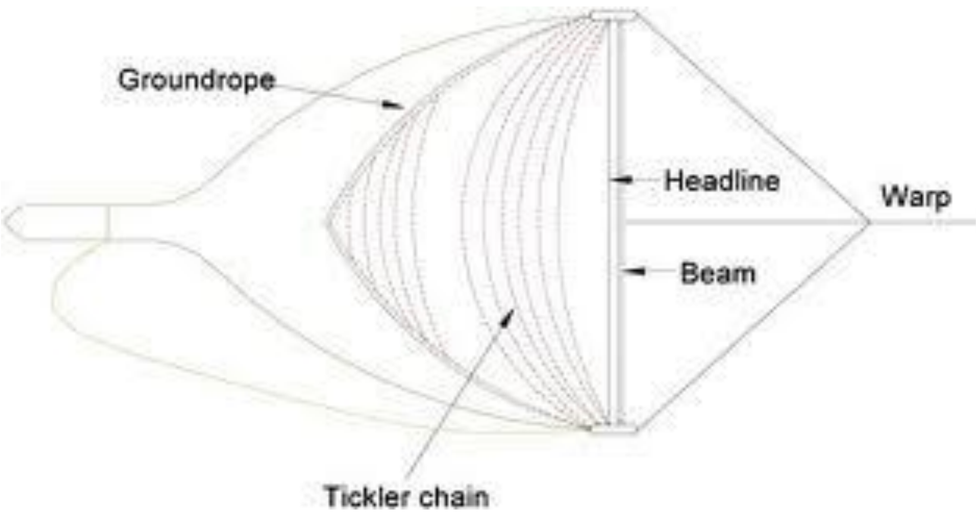

Figure 3. Drawing of beam trawl with warp, beam, shoes, tickler chains and ground gear (illustration from FAO Fisheries Technical Paper 472)

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.

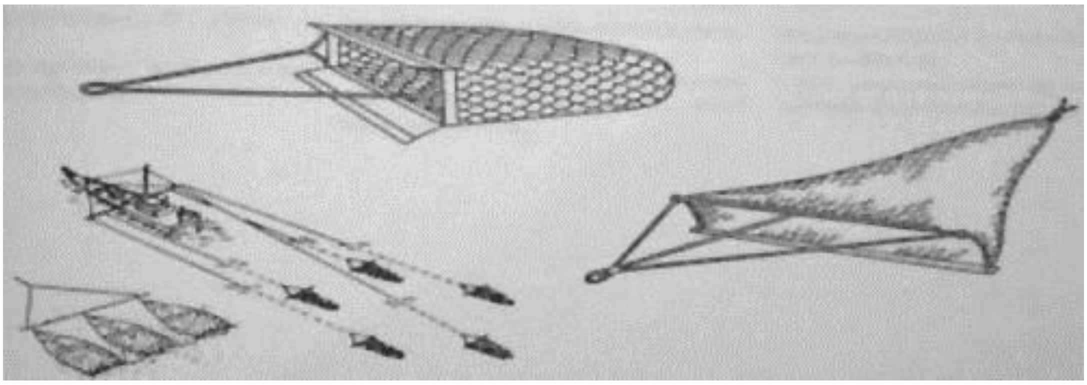

Figure 4. Two different dredge types, with and without with shearing edge, and towed in different ways and numbers (drawing from FAO Fisheries Technical Paper No. 419)

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.

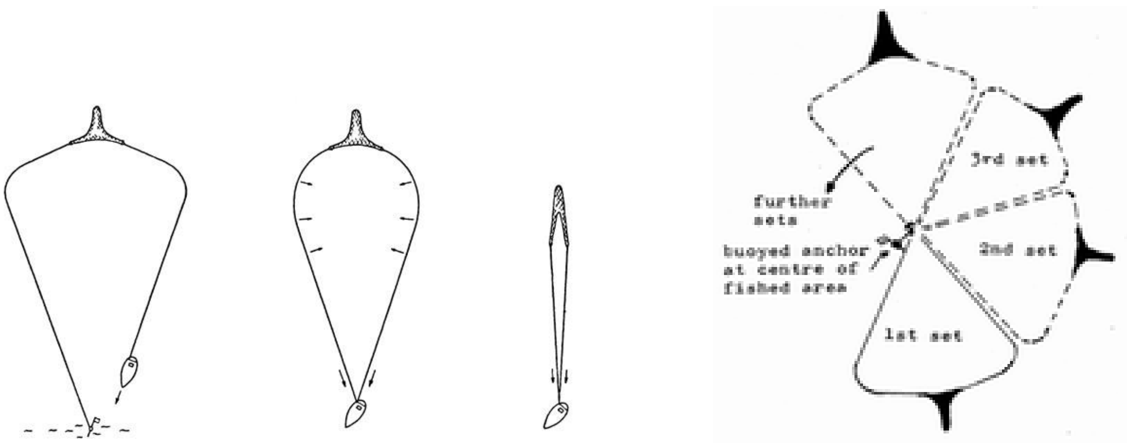

Figure 5. Left: Illustration of three steps in an individual anchored seine haul, Right: the combined gear footprint of a series of four seine hauls (illustration from http://www.fao.org/fishery/geartype/203/en)

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).

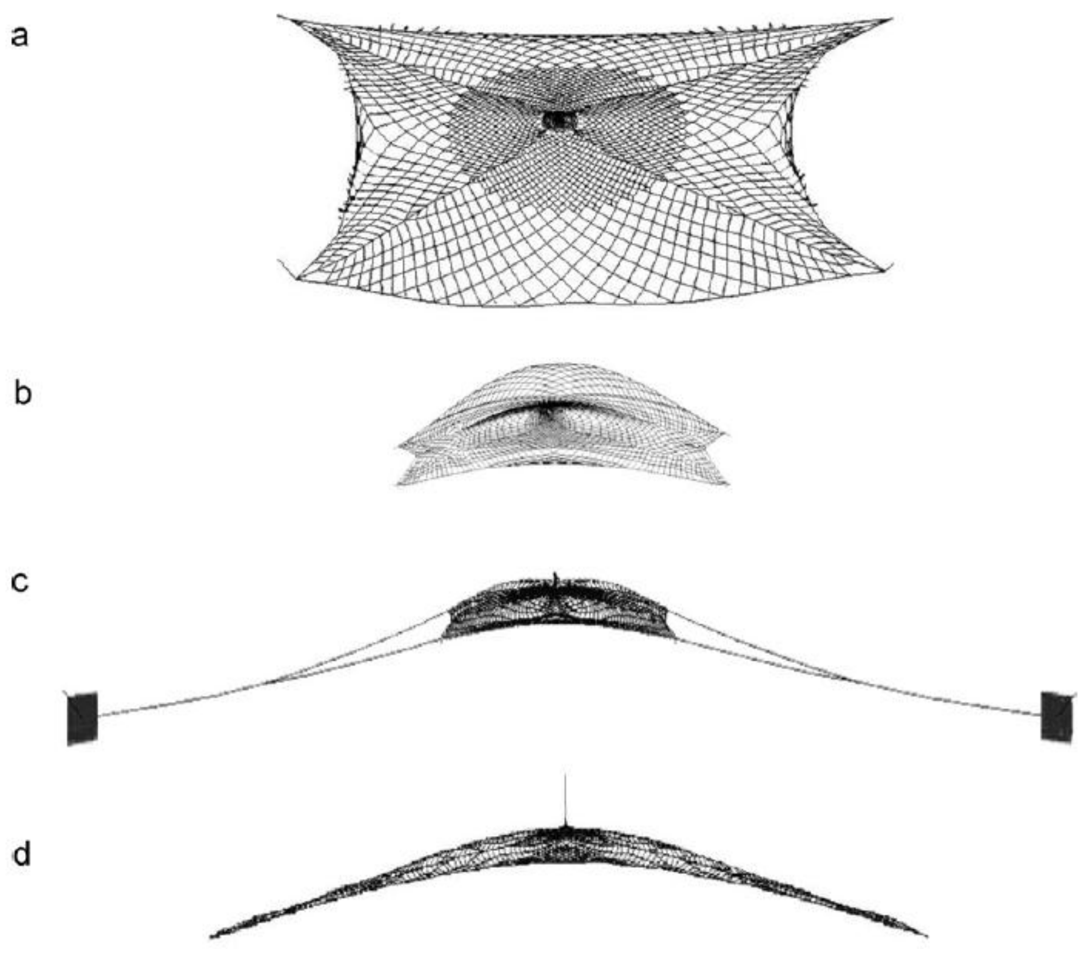

Figure 6. The four trawl types defined, (a) herded volume, (b) non-herded volume, (c) herded area, and (d) non-herded area.

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. Demersal 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. The data set was augmented with the data collected in the MYGEAR-project (Sala et al., (2013). Table 1 shows the response up to date.

	Observations collected				Inventory format			
	OT	TBB	DS	DRB	OT	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).

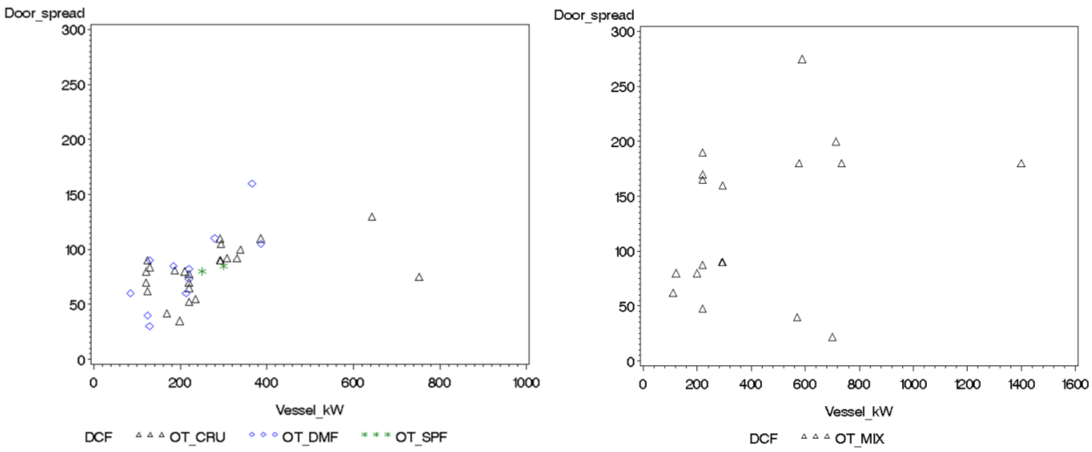

Figure 7. Door Spread against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, SPF=small pelagic fish and MIX=mixed crustaceans and demersal fish).

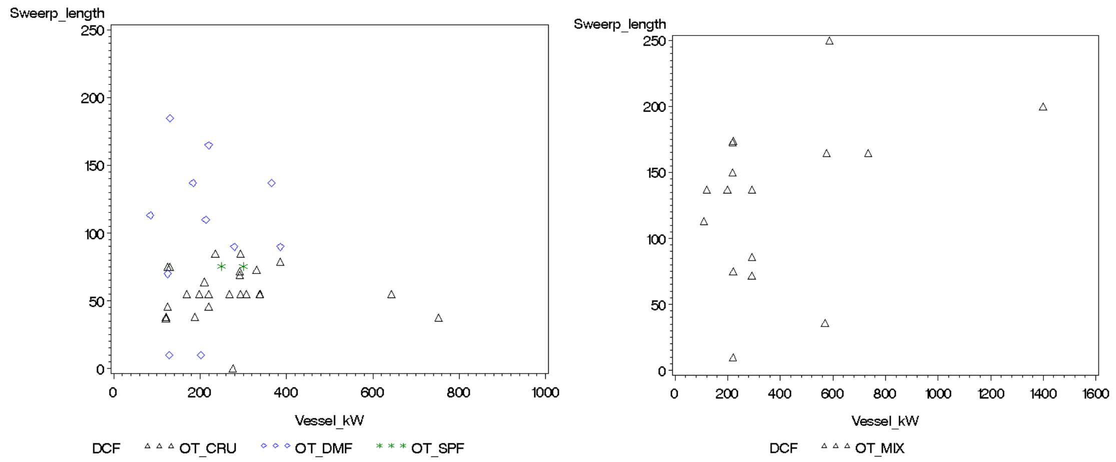

Figure 8. Sweep length against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).

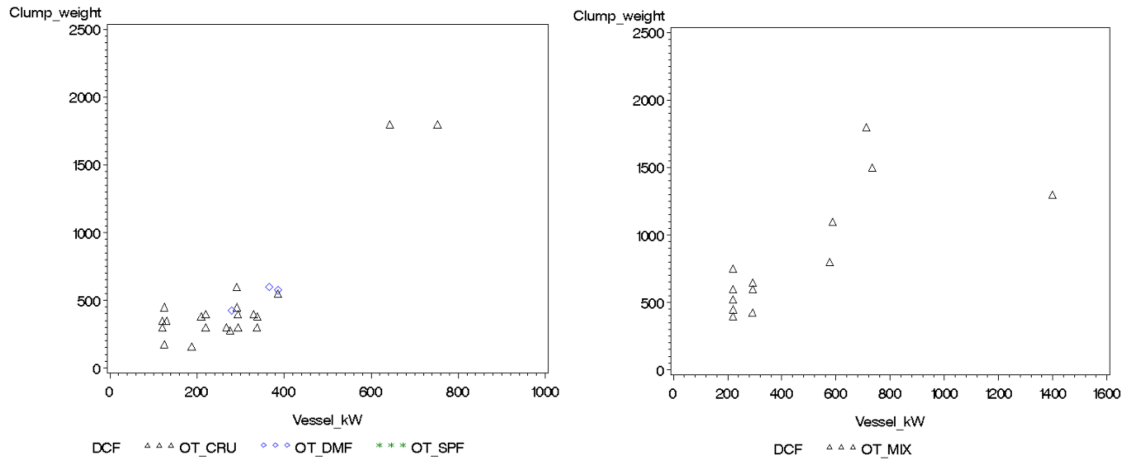

Figure 9. Twin trawl clump weight against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).

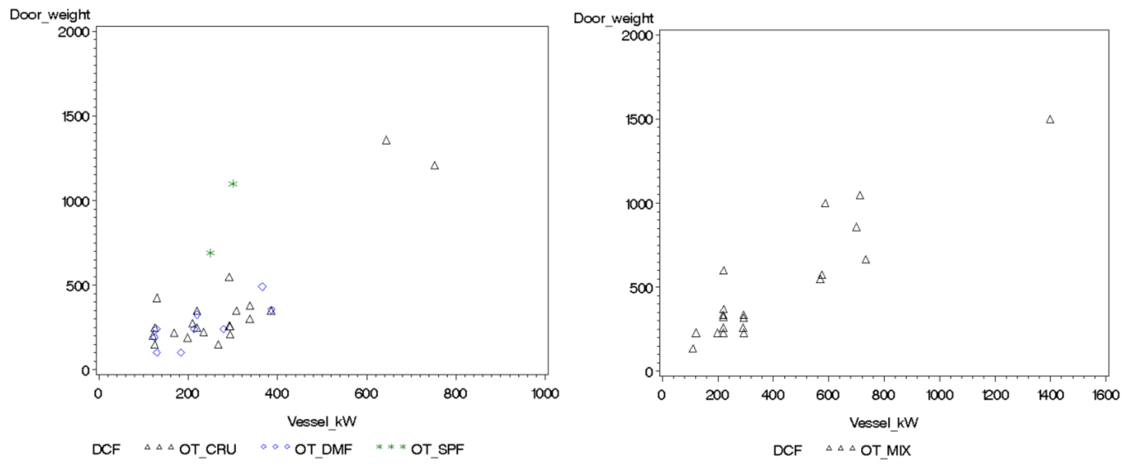

Figure 10. Otterboard (door) weight against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, MIX=mixed crustaceans and demersal fish, SPF=small pelagic fish).

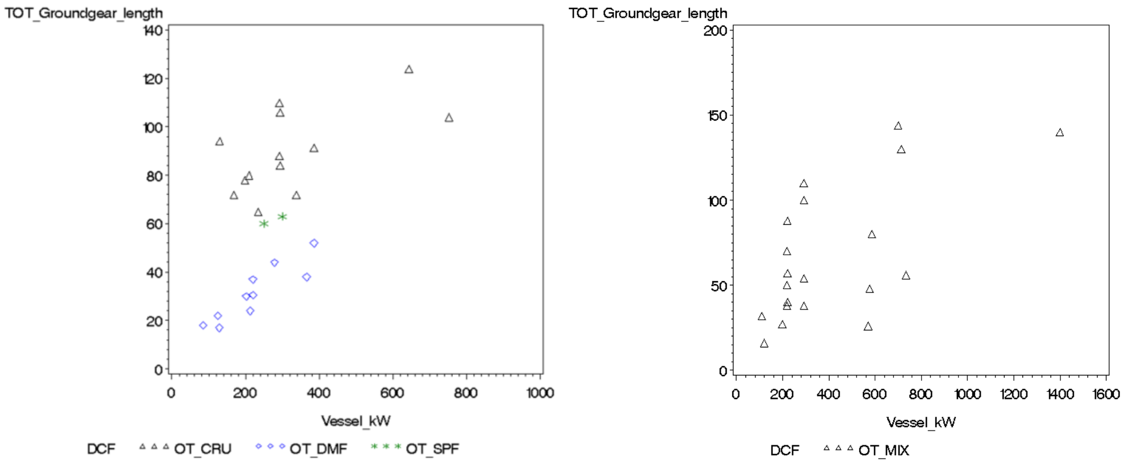

Figure 11. Ground gear length against vessel kW by metier (OT=Otter board trawls, CRU=crustaceans, DMF=demersal fish, SPF=small pelagic fish and MIX=mixed crustaceans and demersal fish).

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.

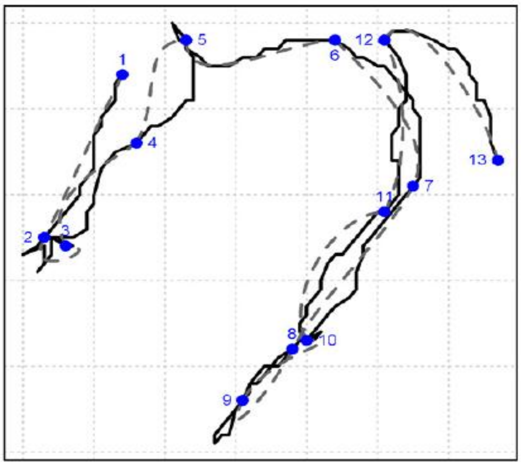

Figure 12. Validation of interpolation methodology used in the BENTHIS WP2 fishing pressure estimation. Solid lines are the real trawl tracks and the CHS interpolation is represented by the dashed dark grey line. (Hintzen et al. 2010)

A swept area is assigned to each interpolation track based on logbook information of vessel size in combination with information on vessel size ~ 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.

References

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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 http://trawlingpractices.wordpress.com/. 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; http://www.ices.dk/community/groups/Pages/WGSFD.aspx) and the related ICES data call requested from HELCOM. Chair of WGSFD is Josefine Egekvist jsv@aqua.dtu.dk). 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 2.1	Completion Industry survey	Completion of inputdata for VMS tools (EFLALO and TACSAT datafiles)	Parameterization of vessel-gear size relationships by DCF metiers to deliver logbook proxies for size/width of different gear components affecting the seabed at the epifauna or infauna level	Completion of individual partner outputs of fishing intensity, according to formats agreed upon at WS-meeting (annual data at 1*1 minute longitude and latitude)
Action	D2.1-Report drafted by WP-leader and circulated to partners for comments	Survey completed by all partners and data uploaded to sharepoint or e-mailed to WP-leader in right format	Each partner completes the national TACSAT and EFLALO input file according to formats presented by Niels and Francois at workshop (and available at the VMS tools website)	WP-leader initiates analyses of metier groupings and joint inventory data. Analyses will be developed further and finalized jointly through mail and skype communication	Partners process their own VMS and logbook data (this includes merging with gear size proxies/swept area estimates by metier). Guidelines and script available at VMStools webpage
Deadline	ASAP	1. December	1. December	1. January	15. January
IMARES	Adriaan Rijnsdorp	Adriaan Rijnsdorp	Niels Hintzen	Adriaan Rijnsdorp	Niels Hintzen
ILVO	Hans Polet	Hans Polet	Bart	Hans Polet	(nn)
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
MI	David Reid	David Reid	(David Reid)	David Reid	(David Reid)
DTU Aqua	**Ole Eigaard**	Ole Eigaard	Francois Bastardie	**Ole Eigaard**	Francois Bastardie
AU					
SLU	Hans Nilsson	Hans Nilsson	Patrik Jonsson	Hans Nilsson	Patrik Jonsson
IMR	Mike Breen	Mike Breen	Genoveva	Mike Breen	(nn)
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					
	VMStools workflow:	http://code.google.com/p/vmstools/wiki/BenthisWP2			
	R-script VMStools workflo	http://code.google.com/p/vmstools/source/browse/trunk/vmstools/inst/scripts/%23Benthis_WP2_workflow_19Sep13.r			
	VMStools program, vers 6	http://code.google.com/p/vmstools/downloads/list			

PLAN OF WORK FOR WP2 (B)

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

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, ore@aqua.dtu.dk)

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	

Wednesday 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 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[1] (single)	only single species fisheries		
Primary species[1]	only mixed/multi-species fisheries		
Secondary species[1]	only mixed/multi-species fisheries		
Third species[1]	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)		

[1] please inform both common name and FAO 3-Alpha Species Codes (ASFIS)

Trawling speed (knots):	
Steaming speed (knots):	
Fuel consumption trawling (litres/hour):	
Fuel consumption steaming (litres/hour):	
Consumption other activities (litres/hour and activity):	

APPENDIX 4B: INDUSTRY QUESTIONNAIRE – BEAM TRAWLS

Country:			
Fishing area:			**Beam trawls**
Date:			*BENTHIS-2013*
vessel:			(partner)
Trawl type	conventional beam trawl, pulse-trawl, sum-wing, hydrorig, etc.)		
Total trawl number	number of trawls per vessel		
Net maker	company name		
Codend	stretched mesh size (mm)		
Target species[1] (single)	only single species fisheries		
Primary species[1]	only mixed/multi-species fisheries		
Secondary species[1]	only mixed/multi-species fisheries		
Third species[1]	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		

[1] please inform both common name and FAO 3-Alpha Species Codes (ASFIS)

Trawling speed (knots):		
Steaming speed (knots):		
Fuel consumption trawling (litres/hour):		
Fuel consumption steaming (litres/hour):		
Consumption other activities (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[1] (single)	only single species fisheries		
Primary species[1]	only mixed/multi-species fisheries		
Secondary species[1]	only mixed/multi-species fisheries		
Third species[1]	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)		

[1] please inform both common name and FAO 3-Alpha Species Codes (ASFIS)

Steaming speed (knots):	
Fuel consumption steaming (litres/hour):	
Fuel consumption fishing (litres/hour):	
Duration of haul/fishing operation (hours):	
Consumption other activities (litres/hour and activity):	

APPENDIX 4D: INDUSTRY QUESTIONNAIRE – DREDGES

Country:			
Fishing area:			**Dredges**
Date:			*BENTHIS-2013*
vessel:			(partner)

Dredge	type and name		
Total dredge number	number of dredges per vessel		
Net maker	company name		
Codend	stretched mesh size (mm)		
Target species[1] (single)	only single species fisheries		
Primary species[1]	only mixed/multi-species fisheries		
Secondary species[1]	only mixed/multi-species fisheries		
Third species[1]	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)		

[1] please inform both common name and FAO 3-Alpha Species Codes (ASFIS)

Trawling speed (knots):

Steaming speed (knots):

Fuel consumption trawling (litres/hour):

Fuel consumption steaming (litres/hour):

Consumption other activities (litres/hour and activity):