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SUMMARY

This newsletter (Deliverable 8.14) describes some of the results of the BENTHIS project achieved in 2016 and 2017. It contains relatively few news items, since the main effort in 2017 went into creating a set of 5 animations. The animations will explain the concepts and results of the project, and will be distributed via social media starting in December 2017, together with news items from the next and final newsletter (Deliverable 8.15).

Previous newsletters online:
Newsletter 2015: https://www.benthis.eu/en/benthis/show/BENTHIS-Newsletter-March-2016.htm
News letter 2014: http://www.benthis.eu/en/benthis/show/BENTHIS-Newsletter-February-2015.htm
News letter 2013: http://www.benthis.eu/en/benthis/show/BENTHIS-Newsletter-March-2014.htm

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INTRODUCTION

This newsletter (Deliverable 8.13) describes some of the results of the BENTHIS project achieved in 2016 and 2017. To maximise the impact, the texts and figures are distributed via social media (Facebook, LinkedIn, newsletter mailing list) and the website in different formats. In this document the basic texts and figures are presented. This newsletter contains relatively few news items, since the main effort in 2017 went into creating a set of 5 animations. The animations will explain the concepts and results of the project, and will be distributed via social media starting in December 2017, together with news items from the next and final newsletter (Deliverable 8.15).

ARTICLES FOR THE WEBSITE AND SOCIAL MEDIA

1. Physical impact of fishing gears on the seafloor

The physical impact of fishing gears on the seafloor is largely unknown. Commonly used demersal fishing gears are otter trawls, beam trawls and seines to catch demersal fish species and crustaceans and dredges to catch scallops (Figure 1). These fishing gears all consist of elements that are in contact with the seafloor.

BENTHIS Researchers Barry O'Neill, Keith Summerbell and Ana Ivanović conducted fieldwork in the Moray Firth, Scotland using an experimental towed sledge equipped with electronic sensors to investigate the impact of these elements on the seafloor (Figure 2). Cylindrical and rectangular shaped objects of different weights and sizes were attached to the frame and towed over the seabed to simulate different fishing gear elements.

The experiments demonstrated that varying the weight of the elements does not influence the amount of sediment mobilised into the water column. Furthermore the researchers showed that the amount of sediment mobilised increases as the hydrodynamic drag increases. Hence, one way of reducing the amount of sediment mobilised is to reduce the hydrodynamic drag of the gear.

These results provide a better understanding of the physical and mechanical processes that take place when a towed fishing gear interacts with the seabed. O'Neill: "This research will permit the development of more fuel efficient gears and gears of reduced benthic impact. We will also be able to improve the modelling of the sediment mobilised into the turbulent wake behind towed fishing gears, which will lead to better assessments of the environmental and ecological impact of fishing gears". Lower hydrodynamic drag will also result in reduced fuel costs for the fishermen and reduced emissions of nitrogen oxides, sulphur oxides and greenhouse gases such as CO_2.

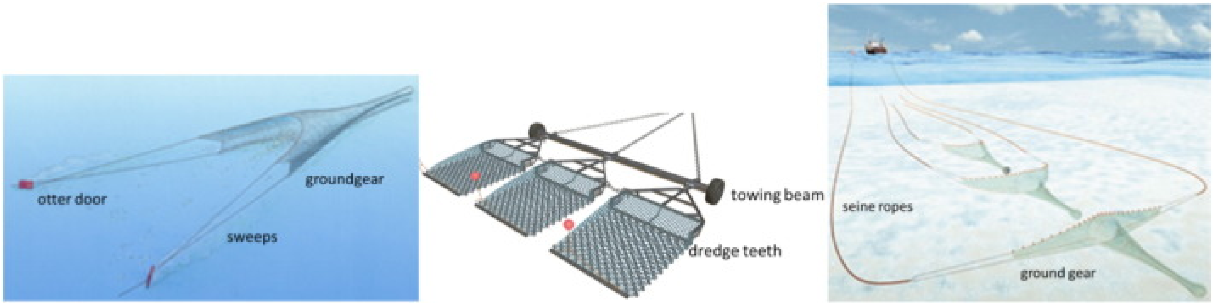

Figure 1. A demersal otter trawl, three scallop dredges on a single beam and a demersal seine net demonstrating some of the components of towed demersal fishing gears that are in contact with the seabed.

Figure 2.The towed sledge used to tow the range of gear components.

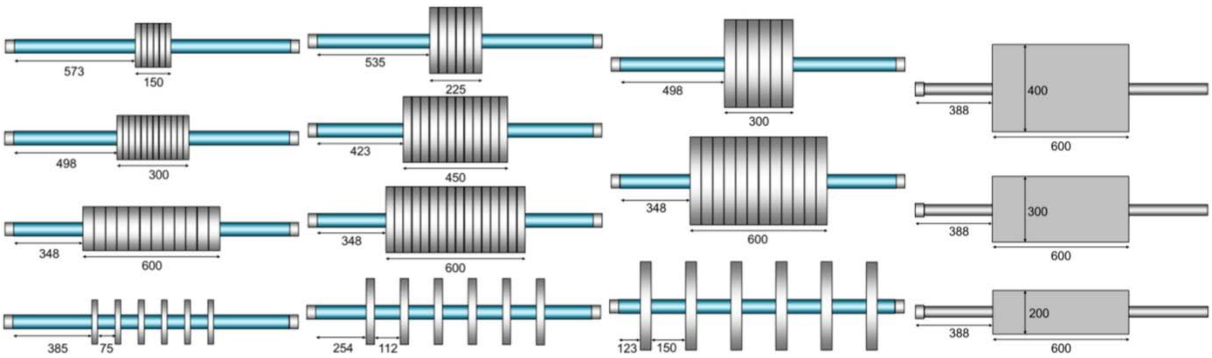

Figure 3. The range of gear components chosen to simulate some of the groundgears, clump weights and doors used in demersal fisheries comprising disks, cylinders and trawl doors. All measurements are in millimetres.

Read the original article:

O'Neill, F.G. and Ivanović, A., 2016. The physical impact of towed demersal fishing gears on soft sediments. ICES Journal of Marine Science. 73 (suppl 1): i5-i14. http://www.sciencedirect.com/science/article/pii/S0924796316302457

O'Neill F.G. and Summerbell K., 2016. The hydrodynamic drag and the mobilisation of sediment into the water column of towed fishing gear components. Journal of Marine Systems. 164, 76 – 84.(http://www.sciencedirect.com/science/article/pii/S0924796316302457).

2. Assessing the impact of fisheries on the seabed

In Europe different types of fisheries exist that impact the seafloor. To quantify their impact, BENTHIS developed an impact assessment framework that requires data on the distribution and intensity of trawl fisheries, on habitat distribution and on species sensitivity to fishing (see Figure 1).

This framework is applicable to all benthic habitats and trawl fisheries and can be applied from small to large spatial scales (local, regional, management areas). The framework is specifically suitable for EU member states that need to report on the impact of their fisheries on the marine ecosystem in 2018 under the Marine Strategy Framework Direction (MSFD).

First maps of fisheries intensity need to be made. For this, VMS-data (Vessel Monitoring System) are used. Different fishing gears have a different physical impact on the seafloor, depending on the mass, size, and speed of the fishing gear elements. The physical impact of a fishing gear is quantified for individual gear elements such as otter boards, twin trawl clump, ground rope, and sweeps that herd the fish. The impact per fishing gear is the sum of the impact of the individual elements.

Second, habitat maps are needed, since the physical impact will differ between e.g. coarse sandy seafloors compared to muddy areas. Such maps have been compiled in various other projects and can be obtained from European data portals.

The third type of information requires monitoring data on benthic species, and information on their vulnerability to each type of fishing gears. In the BENTHIS project, databases of species traits have been made for a few areas. The vulnerability of benthic species to fisheries will depend on their vertical position in the sediment, and their morphology. The recovery rate of benthic species will depend on traits like the longevity, maturation age, reproductive characteristics and way of dispersal.

In the North Sea, results show that the Sublittoral mud (EUNIS A5.3) is affected the most due to the combined effect of intensive fishing and large proportions of long-lived taxa.

Link to habitat maps
(http://www.emodnet-seabedhabitats.eu/default.aspx?mapInstance=MESHAtlanticMap_&page=1974&LAYERS=EUSMMSFD&zoom=3&Y=51.759999999887654&X=2.269999999995032)

Source:
Rijnsdorp, A.D., Bastardie, F. Bolam, S.G., Buhl-Mortensen L., Eigaard O.R., Hamon K.G., Hiddink J.G. Hintzen N.T., Ivanovic A., Kenny A., Laffargue P., Nielsen R.N., O'Neill F.G., Piet G.J., Polet H., Sala A. , Smith C. , van Denderen, P.D. , van Kooten T., Zengin M.A., 2016. Towards a framework for the quantitative assessment of trawling impacts on the sea bed and benthic ecosystem. ICES Journal of Marine Science. https://academic.oup.com/icesjms/article-lookup/doi/10.1093/icesjms/fsv207

3. Can a square-mesh panel inserted in front of the codend reduce bycatch in Mediterranean bottom trawl fisheries?

The majority of the Mediterranean fish stocks are currently overfished (that is, beyond the Maximum Sustainable Yield). This is due to increased fishing intensity in the area and inadequate release efficiency of small fish. In BENTHIS, we try to find technical solutions to help solving this issue. One of the problem of the fishing nets used in the Mediterranean bottom trawl fisheries is the small codend mesh size (40 mm square or 50 mm diamond) so that few juveniles can escape. In one of the experiment carried out in BENTHIS, we investigated whether a 50 mm square-mesh panel placed before the codend improves the exploitation pattern in the Mediterranean bottom trawl fisheries for Atlantic horse mackerel, European hake, Red mullet, Poor cod, Broadtail shortfin squid, and Deep-water rose shrimp.

The results clearly demonstrate that a 50 mm square-mesh panel, placed in the upper portion of the net before the codend, does not contribute much to the overall release efficiency.

For all the species analysed, the majority of escapement happened through the codend, whereas only a small proportion of fish escaped through the square-mesh panel. Various attempts to increase panel efficiency have been made in other studies by placing a hummer device, a black cylinder or a cone behind the panel, other methods have involved attaching the float-ing ropes beneath the panel, to guide the fish toward it. Future studies should focus on improving fish-panel contact probability either through use of stimulation devices or through a greater understanding of fish behaviour inside the trawl.

Read the original article:

Brčić, J., Herrmann, B., Sala, A., 2016. Can a square-mesh panel inserted in front of the codend improve the exploitation pattern in Mediterranean bottom trawl fisheries? Fisheries Research, 183: 13-18.(http://www.sciencedirect.com/science/article/pii/S0165783616301448)

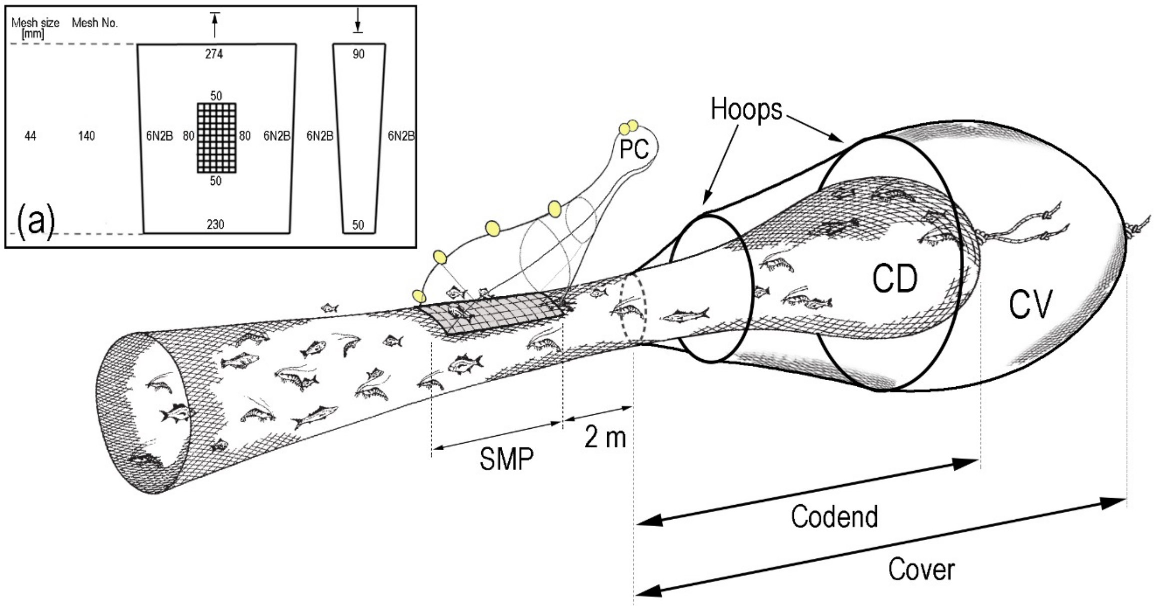

Figure 1. Illustration of the panel-based dual selection system used in the current study. The two covers enabled separate collection and measurement of all the individuals retained by the codend (CD), codend cover (CC) and panel cover (PC). The square-mesh panel (SMP) was made of a polyamide netting (mesh size 51.6 mm) mounted in the upper part of the last tapered section of the trawl belly (a), 8 m from the codline and 2 m from the codend. The mesh number (Mesh No.) of a diamond mesh netting refers to the number of stretched meshes, while the mesh number in the square-mesh panel refers to the number of mesh.

4. Lobster traps (creels) may reduce fishing pressure in the Kattegat and Skagerrak

In the Kattegat between Denmark and Sweden there is a large fisheries on Norway lobster (*Nephrops norvegicus*), or langoustine. Currently, these tasty prawns are fished in three different fisheries: bottom trawling, either in a mixed fisheries or specifically targeted towards this species, and using fish traps (creeling). BENTHIS has studied alternative fisheries strategies to reduce the pressure on the ecosystem.

The researchers show that creeling offers a substantial reduction of fishing mortality of both undersized Nephrops and fish, as well as reduced seafloor pressure per landed kilo of Nephrops. Allocating a larger quota share to creels in the Swedish fishery would therefore contribute to the integration of fisheries- and environmental management as called for in the new European policies: the Marine Strategy Framework Directive and the European Common Fisheries Policy.

Read the original article

Hornborg, S., Ulmestrand, M., Sköld, M., Jonsson, P., Valentinsson, D., Eigaard, O.R., Feekings, J.P., Nielsen, J.R., Bastardie, F., Lövgren, J. 2016. New policies may call for new approaches: the case of the Swedish Norway lobster (*Nephrops norvegicus*) fisheries in Kattegat and Skagerrak. ICES J. Mar. Sci.(https://academic.oup.com/icesjms/article/74/1/134/2669569)

5. Presentations of the final BENTHIS symposium

Published on June 15, 2017

Yesterday the final symposium of the BENTHIS project took place in Brussels. It was a hot and inspiring day, with a mixed public of EU officials, national policy makers, stakeholders from the fishery industry and environmental NGOs, EU officials, national policy makers, and a lot of scientists.

The EU officials emphasised the importance of the BENTHIS project, methodology and results to provide data for the implementation of the Marine Strategy Framework Directive. Also the stakeholders were happy to have tools that allow for having informed discussions with other stakeholders based on scientific data. The project is not finished yet however. In the coming months we will finalise different reports and articles, wrap up the results, and put more effort in the dissemination of the project's outcomes.

Yesterday's presentations can be found in the link below (https://www.benthis.eu/en/benthis/BENTHIS-Final-SymposiumBenthic-Ecosystem-Fisheries-Impact-Studies.htm)

6. Quantifying the environmental cost of fishing on the seabed

Published on July 18, 2017 (source: JG Hiddink)

Trawling contributes 20% of the global landings of fish caught at sea, providing food for millions of people. Despite its importance, bottom trawling causes variable amounts of physical and biological change to seabed habitats, and can induce structural and functional changes in seabed communities. Understanding the ecosystem consequences of trawling is important so that we can reduce negative impacts on the seabed through appropriate management measures.

An international collaboration of scientists, including BENTHIS researchers, conducted a global meta-analysis of 70 comparative and experimental studies on the effects of bottom trawling, to estimate the rates of depletion and recovery of seabed biota following bottom trawling. The researchers were able to quantify the relationship between the reduction of seabed animals and penetration of the fishing equipment into the seabed.

Lead author Professor Jan Hiddink from Bangor University (UK) said ‘We found that otter trawls penetrated the seabed 2.4 cm on average and caused the least amount of depletion of marine organisms, removing 6% of biota per trawl pass on the seabed. In contrast, we found that hydraulic dredges penetrated the seabed 16.1 cm on average and caused the greatest depletion, removing 41% of the biota per fishing pass’. Depending on the type of fishing gear, penetration depth, and environmental variables such as water depth and sediment composition, recovery times for seabed biota ranged between 1.9 and 6.4 years.

Professor Ray Hilborn of the University of Washington, Seattle who led the collaboration with Professors Michel Kaiser (Bangor University) and Simon Jennings (International Council for the Exploration of the Sea, Copenhagen), said ‘These findings fill an essential science gap that will inform policy and management strategies for sustainable fishing practices by enabling us to evaluate the trade-off between fish production for food and the environmental cost of different harvesting techniques’. He added ‘We need to view these results in light of the footprint of each of these activities; while otter trawling has the least impact per trawl pass, it is the most widely used of all the bottom fishing gear types and hence its effects are more wide-spread than are those of more specialised fishing gears such as hydraulic dredges’.

Prof Michel Kaiser added ‘Retailers and seafood processors are particularly concerned about the public perception of bottom trawling, hence this research has made a crucial advance in enabling us to understand what might be considered acceptable amounts of trawling activity in different seabed habitats, and to adjust these to sustainable levels when necessary’. Dr David Agnew, Science and Standards Director at the Marine Stewardship Council said ‘This research has significantly advanced our understanding of how to measure the impact of trawl fisheries on the seafloor. I look forward to these results being used in our future research project with Bangor University and more broadly to assist fisheries as they work to meet the Marine Stewardship Council’s standard for sustainable fishing.’

Download article:

Hiddink JG, Jennings S, Sciberras M, Szostek CL, Hughes KM, Ellis N, Rijnsdorp AD, McConnaughey RA, Mazor T, Hilborn R, Collie JS, Pitcher CR, Amoroso RO, Parma AM, Suuronen P, Kaiser MJ (2017) Global analysis of depletion and recovery of seabed biota after bottom trawling disturbance. Proceedings of the National Academy of Sciences.

SHORT FACEBOOK MESSAGES

Stable isotopes reveal the effect of trawl fisheries on the diet of commercially exploited species

Published July 2017 on Facebook

A new BENTHIS article has been published on how stable isotopes can reveal the effect of trawl fisheries on the diet of commercially exploited species. Have a look at:

http://www.nature.com/articles/s41598-017-06379-6
more results: http://www.benthis.eu/en/benthis/Results.htm

BENTHIS work finds its way to ICES advice

Published July 2016 on Facebook
BENTHIS work finds its way to ICES advice. Read more at:
http://www.ices.dk/news-and-events/news-archive/news/Pages/Assessing-the-sensitivity-of-the-sea-floor.aspx

The sea floor is far from a homogenous landscape. Differing substrates, depths, and environmental conditions ensure diverse habitats that accommodate many species above, on, and below the seabed. Maintaining the integrity of the sea floor is an essential part of conserving marine biodiversity and living resources and is addressed by Descriptor 6 (D6) of the EU's Marine Strategy Framework Directive (MSFD).

Different habitats in the benthic ecosystem have differing levels of sensitivity and the pressures from human activities impact to varying degrees. Having a variety of different indicators and methods is essential for assessing the state of benthic ecosystems if a robust picture of the seafloor and the changes that can be imposed by human activities is to be formed

Highly sensitive areas of the seafloor including cold-water corals are known as vulnerable marine ecosystems (VMEs). These cannot endure any impact from pressures such as trawling, and once documented, are often protected from interference from human activities (for example through the establishment of marine protected areas (MPAs).

From pressure to impact maps
But what about the other areas of the sea floor that are not as sensitive? How do we assess the status of these areas after they have been impacted by trawling? If an area is trawled once every two years, will the majority of benthic communities present recover or do the species in that area require a longer recovery period?

In 2014, ICES provided pressure maps showing the intensity of trawling on the sea floor throughout the Northeast Atlantic. These maps were a major step forward. Based on vessel monitoring system (VMS) data from ten ICES member countries, they indicated the hours fished by year and the different gear types: beam trawls, demersal seines, dredges, and otter trawls. These maps have been updated in 2015 and 2016. Earlier this year, the EUs Directorate for the Environment (DG ENV) requested advice from ICES on how to use these pressure maps of fishing intensity to move towards impact maps that could be used to better assess the state of seafloor habitats. With this advice, those implementing the MSFD would be better equipped to study the trade-offs that need to be made by management when attempting to keep the balance between a productive benthic community and fishing opportunities.

To develop this advice, the ICES Workshop on Fisheries Benthic Impact (WKFBI) evaluated material prepared by ICES working groups and compared similar approaches on assessing benthic impact of fishing developed within European-funded projects and regional seas conventions. The workshop sought to prepare a method of interpreting the pressure maps of fishing intensity so that it was possible to identify both the exposure of benthic habitats to bottom fishing pressures and the sensitivity of these habitats to fishing pressures in order to understand which habitats are likely to be further impacted.

Explaining the management context behind the work, Adriaan Rijnsdorp, Chair of WKFBI pointed out, "We are dealing with habitats that are fished and that have to some degree been impacted by fishing. Within the ecosystem approach to fisheries management, we need to take account of the integrity of the seafloor therefore reducing wherever possible the pressure on the seabed to increase the status of the seabed."

A quantitative approach

Two approaches to develop indicators of habitat sensitivity in particular were analysed: a categorical approach, which employed expert judgement and a mechanistic quantitative approach, which is based on the mechanistic understanding of how trawling affects the sea-floor and the benthic community.

While the categorical approach can be used to identify particularly valued and sensitive habitats and communities that require protection against bottom trawling, it is not suitable for assessing the condition of habitats where managers want to regulate existing fishing pressure and avoid further habitat degradation beyond a certain threshold. The reason for this unsuitability, as stated in today's advice is that, "class boundaries are arbitrarily defined and not quantitatively linked to trawling intensity." The categorical approach was considered inappropriate for this MSFD application as the categories are based on expert judgement with no quantitative links to clear fishing pressures. With this approach, an area can be classed as high impact if it's a highly sensitive one trawled only lightly, but another area can also be classed as high impact because it is trawled heavily even though ecologically these areas are completely different. This means that it is not possible to carry out any meaningful calculations with these scores.

Instead, ICES advises that a mechanical quantitative approach is adopted. More ecologically meaningful scores can be derived from using this type of approach. It is based on basic population dynamic theory, which allows us to estimate the impact of trawling as a function of the mortality imposed by trawling and the recovery rate of the benthic community.

Adding pressures

A further benefit of the quantitative approach is that it allows additional pressures to be combined easily. There are several pressures which can affect which species survive on the sea floor, including from various forms of fishing gear, eutrophication, and aggregate extraction. Managers need to be able to easily compare the impact of further pressures on an area in order to be able to understand the comparative importance of each pressure. If the categorical approach is used to score the impact of trawling, then the whole process of expert analysis must be carried out again to take in another pressure, and there is no certainty in the comparison.

Pressures are on a continuous scale under the quantitative approach, a single number is then associated with a habitat sensitivity number that is specific to each benthic community and also on a continuous scale. The sensitivity score is based on a feature that is measurable and quantitative in the benthic community. Features might include, for example the proportion of long-lived species present.

The MSFD follows the ecosystem approach, which includes humans as part of the ecosystem. There are untouched and very sensitive areas that humans may wish to conserve, but many more widespread habitats are fished and used by humans. The quantitative approach allows mangers to look at the trade-offs there, the impact that we're having on the seafloor relative to, for example, how much revenue you are getting from the fishing, you can make that quantitative analysis of those trade-offs in those areas.

As proof of concept, the European FP7-project BENTHIS presented two example mechanistic approaches that have been partially developed. These examples, while in need of further development, can be used in a management context because thresholds can be defined, they can be combined with other pressures which can quantify the trade-offs in protecting the benthic communities, and time analysis is possible.

Rijnsdorp has pointed out the benefits of the quantitative examples. "If you want to reduce your benthic impact, you can read it off the graph and immediately combine it with the costs in terms of fish you are not catching because you are leaving aside certain areas where the benthic community is more sensitive. That type of information can be generated directly from this mechanistic approach."