Individual transferable quotas, does one size fit all?: Sustainability analysis of an alternative model for quota allocation in a small-scale coastal fishery

The introduction of vessel-based Individual Transferable Quotas (ITQs) in Danish demersal fisheries in 2007 caused significant structural changes in the fleet, towards fewer and larger vessels deploying otter trawls. Mainly smaller coastal vessels deploying Danish seines and gillnets reduced in numbers. The ecosystem effects of this structural change were investigated by comparing the sustainability of a local, small-scale, coastal fishery (Thorupstrand) using Danish seines and gillnets with that of demersal trawling by larger vessels using the same fishing grounds. The fisheries were compared using six ecological and socio-economic indicators: 1), discards (food web), 2), by-catch incidences (food web/biodiversity), 3), seabed impacts, 4), fuel use efficiency, 5), quality of fish landed (food provision), and 6), social and cultural gains and drawbacks (social and cultural features). Except for by-catch of vulnerable species, the fisheries using Danish seines and gillnets scored better in all indicators when compared to otter trawls. Additional commercial and cultural benefits of establishing a local fishery guild with share-owned quotas and land-based facilities were investigated. The results and lessons learned are discussed in the context of an ecosystem approach to fisheries management and the current reform of the common fisheries policy of the European Union.
Integrated ecological-economic fisheries models - evaluation, review and challenges for implementation

Marine ecosystems evolve under many interconnected and area-specific pressures. In order to fulfill society's intensifying and diversifying needs whilst ensuring ecologically sustainable development, more effective marine spatial planning and broader-scope management of marine resources is necessary. Integrated ecological–socioeconomic fisheries models (IESFM) of marine systems are needed to evaluate impacts and sustainability of potential management actions and understand, and anticipate, ecological, economic, and social dynamics at a range of scales from local to national and regional. To make these models most effective, it is important to determine how model characteristics and methods of communicating results influence the model implementation, the nature of the advice that can be provided and the impact on decisions taken by managers. This paper presents a global review and comparative evaluation of 35 IESFM’s applied to marine fisheries and marine ecosystem resources to identify the characteristics that determine their usefulness, effectiveness and implementation. The focus is on fully integrated models that allow for feedbacks between ecological and human processes though not all the models reviewed achieve that.

General information

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Living Resources, Section for Oceans and Arctic, National Oceanographic and Atmospheric Administration, Christian-Albrechts-Universität zu Kiel, CSIRO, University of Washington, Plymouth Marine Laboratory, IFREMER, Thünen Institute of Sea Fisheries, New Economics Foundation, University of British Columbia, University of Vigo, AZTI Tecnalia, Université Bretagne Loire, Institut de Ciències del Mar-CSIC, Wageningen University, National Marine Fisheries Research Institute, Scottish Pelagic Fishermen's Association, AZTI Tecnalia, University of Southern Denmark, Swiss Federal Institute of Aquatic Science and Technology, Wageningen IMARES, Commonwealth Scientific and Industrial Research Organisation, University of Copenhagen, Swedish Agency for Marine and Water Management, Stockholm
Differences in biological traits composition of benthic assemblages between unimpacted habitats

There is an implicit requirement under contemporary policy drivers to understand the characteristics of benthic communities under anthropogenically-unimpacted scenarios. We used a trait-based approach on a large dataset from across the European shelf to determine how functional characteristics of unimpacted benthic assemblages vary between different sedimentary habitats.

Assemblages in deep, muddy environments unaffected by anthropogenic disturbance show increased proportions of downward conveyors and surface deposit-feeders, while burrowing, diffusive mixing, scavenging and predation traits assume greater numerical proportions in shallower habitats. Deep, coarser sediments are numerically more dominated by sessile, upward conveyors and suspension feeders. In contrast, unimpacted assemblages of coarse sediments in shallower regions are proportionally dominated by the diffusive mixers, burrowers, scavengers and predators. Finally, assemblages of gravelly sediments exhibit a relatively greater numerical dominance of non-bioturbators and asexual reproducers. These findings may be used to form the basis of ranking habitats along a functional sensitivity gradient.
Effects of changes in stock productivity and mixing on sustainable fishing and economic viability

Within the new FMSY European paradigm, this paper shows how a combination of changes in fish stock mixing, non-stationarity in productivity, and constraints on unit stock concepts undermine the effective management of fisheries, especially when management reference points are not adjusted accordingly. Recent changes in stock structures, conditions and stock mixing between eastern and western Baltic cod can jeopardize the reliability of stock assessments and of the fishery economy. We modelled how different management, individual vessel decision-making, and stock growth and mixing scenarios have induced alternative individual vessel spatial effort allocation and economic performance by affecting fishing costs and by changing the relative stock abundance and size distribution. Stock mixing heavily influences profit and stock abundance for stocks that have experienced increased fishing mortality (F) levels. Western cod F has increased from a higher total allowed catches (TAC) advised in the medium-term due to the westward migration of eastern cod while eastern cod F has increased from reduced growth in the east. Greater pressures on western cod and decreased eastern cod growth and conditions greatly reduce the overall cod spawning stock biomass, thus changing the landing size composition and associated fishery profits. As a cumulative effect, fishing efforts are redirected towards western areas depending on management (quotas). However, total profits are less affected when traditional fishing opportunities and switching possibilities for other species and areas are maintained. Our evaluation indicates that current management mechanisms cannot correct for potential detrimental effects on cod fisheries when effort re-allocation changes landing origins. By investigating different economic starting conditions we further show that Baltic cod mis-management could have resulted in unintended unequal (skewed) impacts and serious consequences for certain fleets and fishing communities compared with others. Our management strategy evaluation is instrumental in capturing non-linear effects of different recommendations on sustainability and economic viability, and we show that fixed F-values management is likely not an attainable or sufficient goal in ensuring the sustainability and viability of fisheries and stocks given changing biological conditions.

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Studiofuga
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Eero, M. (Intern), Fuga, F. (Ekstern), Rindorf, A. (Intern)
Pages: 535-551
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Main Research Area: Technical/natural sciences
Integration of fisheries into marine spatial planning: Quo vadis?
The relationship between fisheries and marine spatial planning (MSP) is still widely unsettled. While several scientific studies highlight the strong relation between fisheries and MSP, as well as ways in which fisheries could be included in MSP, the actual integration of fisheries into MSP often fails. In this article, we review the state of the art and latest progress in research on various challenges in the integration of fisheries into MSP. The reviewed studies address a wide range of integration challenges, starting with techniques to analyse where fishermen actually fish, assessing the drivers for fishermen's behaviour, seasonal dynamics and long-term spatial changes of commercial fish species under various anthropogenic pressures along their successive life stages, the effects of spatial competition on fisheries and projections on those spaces that might become important fishing areas in the future, and finally, examining how fisheries could benefit from MSP. This paper gives an overview of the latest developments on concepts, tools, and methods. It becomes apparent that the spatial and temporal dynamics of fish and fisheries, as well as the definition of spatial preferences, remain major challenges, but that an integration of fisheries is already possible today.

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Authors: Janssen, H. (Ekstern), Bastardie, F. (Intern), Eero, M. (Intern), Hamon, K. (Ekstern), Hinrichsen, H. H. (Ekstern), Marchal, P. (Ekstern), Nielsen, J. R. (Intern), Pape, O. L. (Ekstern), Schulze, T. (Ekstern), Simons, S. (Ekstern), Teal, L. R. (Ekstern), Tidd, A. (Ekstern)
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
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Scopus rating (2013): SJR 1.323 SNIP 1.439 CiteScore 2.64
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Scopus rating (2011): SJR 1.383 SNIP 1.325 CiteScore 2.52
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Is a single dimension enough to explain fishers’ decision-making?

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Queen’s University Belfast
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Lost in translation? Multi-metric macrobenthos indicators and bottom trawling
The member states of the European Union use multi-metric macrobenthos indicators to monitor the ecological status of their marine waters in relation to the Water Framework and Marine Strategy Framework Directives. The indicators translate the general descriptors of ecological quality in the directives into a single value of ecological status by combining indices of species diversity, species sensitivity and density. Studies and inter-calibration exercises have shown that the indicators respond to chemical pollution and organic enrichment, but little is known about their response to bottom trawling. We use linear mixed effects models to analyze how bottom trawling intensity affects the indicators used in the Danish (Danish Quality Index, DKI) and Swedish (Benthic Quality Index, BQI) environmental monitoring programs in the Kattegat, the sea area between Sweden and Denmark. Using year and station as random variables and trawling intensity, habitat type, salinity and depth as fixed variables we find a significant negative relationship between the BQI indicator and bottom trawling, while the DKI is related significantly to salinity, but not to trawling intensity. Among the indicator components, the species diversity and sensitivity indices used in the DKI are not significantly linked to trawling, and trawling only affects the BQI when species sensitivities are derived from rarefied samples. Because the number of species

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Scopus rating (2009): SJR 1.169 SNIP 1.262
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Scopus rating (2008): SJR 1.244 SNIP 1.302
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.114 SNIP 1.355
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.203 SNIP 1.365
Scopus rating (2005): SJR 0.92 SNIP 1.237
Web of Science (2005): Indexed yes
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Scopus rating (2002): SJR 0.694 SNIP 1.25
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.038 SNIP 1.259
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recorded per sample (species density) is limited by the number of individuals per sample (density), we expect species density and density to be positively correlated. This correlation was confirmed by a simulation model and by statistical analysis of the bottom samples in which log species density was highly significantly related to log density ($r = 0.75$, $df = 144$, $p$)

**General information**

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Monitoring and Data
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BFI (2015): BFI-level 2
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BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.239 SNIP 1.603
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.047 SNIP 1.769
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.907 SNIP 1.474
Scopus rating (2007): SJR 0.774 SNIP 1.395
Scopus rating (2006): SJR 0.677 SNIP 0.958
Scopus rating (2005): SJR 0.465 SNIP 1.035
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New policies may call for new approaches: the case of the Swedish Norway lobster (Nephrops norvegicus) fisheries in the Kattegat and Skagerrak

The European Common Fisheries Policy has in its 2013 reform increased in complexity, such as a call for coherence with the Marine Strategy Framework Directive and a landing obligation, posing new requirements and challenges to managers, scientists and the fishing industry. Therefore, re-evaluations of current practice are important as a basis for management actions. The Swedish fishery for Norway lobster (Nephrops norvegicus) in the Kattegat–Skagerrak area provides an interesting case study of relevance to emerging policies. Sprung from an unbalance in available fish- and Nephrops quotas and an ambition to protect coastal areas, the current fishery has been directed towards three separate fisheries (mixed trawling, directed trawling using a sorting grid and creeling). Studying direct and indirect effects from alternative Swedish quota allocations among gear types is therefore interesting. Accordingly, a screening study was conducted, taking into consideration area-gear interactions in catch rates, to compare the three different fisheries regarding quantified pressures on the target species, the by-catch species, and on the seafloor, as well as to qualitatively discuss social and economic dimensions. In the next step, alternative quota allocations were studied. In Swedish fisheries, we show that creeling offers a substantial reduction of fishing mortality of both undersized Nephrops and fish and a reduced seafloor pressure per landed kilo of Nephrops. Given that the fishing areas in many cases may be interchangeable between gears, 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 policies.
Predicting the population-level impact of mitigating harbor porpoise bycatch with pingers and time-area fishing closures

Unintentional mortality of higher trophic-level species in commercial fisheries (bycatch) represents a major conservation concern as it may influence the long-term persistence of populations. An increasingly common strategy to mitigate bycatch of harbor porpoises (Phocoena phocoena), a small and protected marine top predator, involves the use of pingers (acoustic alarms that emit underwater noise) and time-area fishing closures. Although these mitigation measures can reduce harbor porpoise bycatch in gillnet fisheries considerably, inference about the long-term population-level consequences is currently lacking. We developed a spatially explicit individual-based simulation model (IBM) with the aim to evaluate the effectiveness of these two bycatch mitigation measures. We quantified both the direct positive effects (i.e., reduced bycatch) and any indirect negative effects (i.e., reduced foraging efficiency) on the population size using the inner Danish waters as a biological system. The model incorporated empirical data on gillnet fishing effort and noise avoidance behavior by free-ranging harbor porpoises exposed to randomized high-frequency (20- to 160-kHz) pinger signals. The IBM simulations revealed a synergistic relationship between the implementation of time-area fishing closures and pinger deployment. Time-area fishing closures reduced bycatch rates substantially but not completely. In contrast, widespread pinger deployment resulted in total mitigation of bycatch but frequent and recurrent noise avoidance behavior in high-quality foraging habitat negatively affected individual survival and the total population size. When both bycatch mitigation measures were implemented simultaneously, the negative impact of pinger noise-induced sub-lethal behavioral effects on the population was largely eliminated with a positive effect on the population size that was larger than when the mitigation measures were used independently. Our study highlights that conservationists and policy makers need to consider and balance both the direct and indirect effects of harbor porpoise bycatch mitigation measures before enforcing their widespread implementation. Individual-based simulation models, such as the one presented here, offer an efficient and dynamic framework to evaluate the impact of human activities on the long-term survival of marine populations and can serve as a basis to design adaptive management strategies that satisfy both ecological and socioeconomic demands on marine ecosystems.
Scavenging strategies of hagfish in the Kattegat

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Spatial planning for aquaculture: the Georeferenced Interactions Database (GRID)

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Spatial Planning for Fisheries in the Adriatic Sea, – the ECOAST project

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, National Research Council of Italy
Authors: Grati, F. (Ekstern), Bolognini, L. (Ekstern), Bastardie, F. (Intern)
Spatial planning for fisheries in the Northern Adriatic: working toward viable and sustainable fishing

Given the great overfishing of the demersal resources in the Northern Adriatic Sea (geographical sub-area [GSA] 17), along with the fishing pressure in marine habitats, evidence strongly supports the need to evaluate appropriate management approaches. Several fishing activities operate simultaneously in the area, and the need to minimize conflicts among them is also a social concern. We applied a spatially and temporally explicit fish and fisheries model to assess the impact of a suite of spatial plans suggested by practitioners that could reduce the pressure on the four demersal stocks of high commercial interest in the GSA 17 and that could promote space sharing between mutually exclusive activities. We found that excluding trawlers from some areas has lowered the effective fishing effort, resulting in some economic losses but providing benefit to the set netters. Not every simulated fishing vessel is impacted in the same way because some fishing communities experienced different economic opportunities, particularly when a 6-nautical mile buffer zone from the coast was implemented in the vicinity of important fishing grounds. Along this buffer zone, the four stocks were only slightly benefiting from the protection of the area and from fewer discards. In contrast, assuming a change in the ability of the population to disperse led to a large effect: Some fish became accessible in the coastal waters, therefore increasing the landings for rangelimited fishers, but the discard rate of fish also increased, greatly impairing the long-term biomass levels. Our evaluation, however, confirmed that no effort is displaced onto vulnerable benthic habitats and to grounds not suitable for the continued operation of fishing. We conclude that the tested spatial management is helpful, but not sufficient to ensure sustainable fishing in the area, and therefore, additional management measures should be taken. Our test platform investigates the interaction between fish and fisheries at a fine geographical scale and simulates data for varying fishing methods and from different harbor communities in a unified framework. We contribute to the development of effective science-based inputs to facilitate policy improvement and better governance while evaluating trade-offs in fisheries management and marine spatial planning.
of food available. Using δ 13C and δ 15N we investigated potential diet changes of three commercially exploited species across trawling gradients in the Kattegat (plaice, dab and Norway lobster (Nephrops)) and the Irish Sea (Nephrops). In the Kattegat, trawling affected primarily the biomass of benthic consumers, lowering competition. Nephrops showed significant positive relationships for δ 13C and a domed relationship for δ 15N with trawling. In the Irish Sea, intense trawling had a negative effect on benthic prey. δ 13C and δ 15N thus showed the inverse relationships to those observed in the Kattegat. Plaice from the Kattegat, showed a significant relationship with trawling intensity for δ 13C, but not for δ 15N. No relationship was found for dab. Changes of δ 13C and δ 15N correlated with changes in condition of species. The results show that the removal of demersal competitors and benthos by trawling can change the diets of commercial species, ultimately affecting their body condition.

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Mediterranean Institute for Advanced Studies (UIB-CSIC), Instituto Espanol de Oceanografia, Bangor University, Swedish University of Agricultural Sciences
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Scopus rating (2014): SJR 2.103 SNIP 1.544 CiteScore 4.75
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The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity

Mapping trawling pressure on the benthic habitats is needed as background to support an ecosystem approach to fisheries management. The extent and intensity of bottom trawling on the European continental shelf (0-1000 m) was analysed from logbook statistics and vessel monitoring system data for 2010-2012 at a grid cell resolution of 1 x 1 min longitude and latitude. Trawling intensity profiles with seabeck impact at the surface and subsurface level are presented for 14 management areas in the North-east Atlantic, Baltic Sea and Mediterranean Sea. The footprint of the management areas ranged between 53-99% and 6-94% for the depth zone from 0 to 200 m (Shallow) and from 201 to 1000 m (Deep), respectively. The footprint was estimated as the total area of all grid cells that were trawled fully or partially. Excluding the untrawled proportions reduced the footprint estimates to 28-85% and 2-77%. Largest footprints per unit landings were observed off Portugal and in the Mediterranean Sea. Mean trawling intensity ranged between 0.5 and 8.5 times per year, but was less in the Deep zone with a maximum intensity of 6.4. Highest intensities were recorded in the Skagerrak-Kattegat, Iberian Portuguese area, Tyrrenian Sea and Adriatic Sea. Bottom trawling was highly aggregated. For the Shallow zone the seeded area where 90% of the effort occurred comprised between 17% and 63% (median 36%) of the management area. Footprints were high over a broad range of soft sediment habitats. Using the longevity distribution of the untrawled infaunal community, the seabed integrity was estimated as the proportion of the biomass of benthic taxa where the trawling interval at the subsurface level exceeds their life span. Seabed integrity was low (< 0.1) in large parts of the European continental shelves, although smaller pockets of seeded with higher integrity values occur. The methods developed here integrate official fishing effort statistics and industry-based gear information to provide high-resolution pressure maps and indicators, which greatly improve the basis for assessing and managing benthic pressure from bottom trawling. Further they provide quantitative estimates of trawling impact on a continuous scale by which managers can steer

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BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.18
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Bottom trawling affects fish condition through changes in the ratio of prey availability to density of competitors

1. Bottom-trawl fisheries are widespread and cause mortality of benthic invertebrates, which in turn may lead to a decrease in the availability of prey for target fish species. Exploitation also reduces the abundance of the fish species themselves. Modelling studies have shown that bottom trawling could lead to both increases and decreases in fish production, but so far empirical evidence to test these ideas has been very limited. We hypothesize that the effect of bottom trawling on the food intake and condition of fish depends on how the ratio of prey to consumers changes with increasing fishing pressure. 2. We assessed the impact of bottom trawling on the food availability, condition and stomach contents of three flatfishes and the Norway lobster in an area in the Kattegat hat is characterized by a steep commercial bottom-trawling gradient due to the establishment of an area closed to all fisheries, but otherwise has homogeneous environmental conditions. 3. For plaice, prey biomass initially decreased at a slower rate with trawling than the biomass of fish, and as a result, the amount of food available per plaice increased before decreasing at trawling frequencies >5 times year 1. This pattern was mirrored in both the condition and stomach contents of plaice and for long-rough dab. 4. No effect of trawling on dab prey and condition was found. Conversely, the condition of the main target species – Norway lobster – increased as its biomass decreased with increased trawling intensities. 5. Together, these results support the idea that when the abundance of the prey declines in response to exploitation, the ratio of the prey to consumer biomass will determine whether exploitation will result in an increase or a decrease in the food intake and condition of the predator. 6. Synthesis and applications. Our study indicates that fish production may be maximized by keeping bottom-trawling intensities relatively low, although this may negatively effect the economically more important Nephrops fishery. The effects of bottom trawls may be mitigated by switching to gears, which affect prey availability to a lesser extent, such as pots or creels.

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Swedish University of Agricultural Sciences, Bangor University, Instituto Español de Oceanografía, University of Wales Bangor Menai Bridge
Authors: Hiddink, J. G. (Ekstern), Moranta, J. (Ekstern), Balestrini, S. (Ekstern), Sciberras, M. (Ekstern), Cendrier, M. (Ekstern), Bowyer, R. (Ekstern), Kaiser, M. J. (Ekstern), Sköld, M. (Ekstern), Jonsson, P. (Ekstern), Bastardie, F. (Intern), Hinz, H. (Ekstern)
Co-location of passive gear fisheries in offshore wind farms in the German EEZ of the North Sea: A first socio-economic scoping

Monotonous size selection curves have traditionally been sufficient to describe the size selection in the end of a bottom trawl. Such modelling is a good approximation when the size selective system consists of a single selective device. However, in some fisheries the demands for species and size selectivity have motivated the development of selective systems in trawl fisheries that utilize more than one selective device simultaneously. An example can be found in the Swedish demersal trawl fishery targeting Norway lobster (Nephrops norvegicus), which simultaneously aims at avoiding catches of Atlantic cod (Gadhus morhua). In this fishery, the selective system consists of a Nordmøre type sorting grid followed by a size selective square mesh codend. The size selection curve for this system has a characteristic bell-shaped curvature, which cannot be sufficiently described by a monotonous selection curve. An approach that can handle a bell shaped curvature is to use a more flexible empirical size selection model. However, such models primarily use a curve fitting procedure, and do not allow the possibility to investigate the contribution of the individual parts of the selection system. Therefore, we choose to use a structural-based model that directly models the contributions of the individual selectivity devices to the overall performance of the system. We demonstrate that this approach can appropriately describe the experimental size selection data for both Nephrops and cod in a system composed of a sorting grid followed by a size selective codend. Furthermore, this approach provides a direct quantification of the selective processes of the individual parts of the system to the overall size selection in the fishing gear. In addition, we demonstrate how this approach can provide fisheries managers with a new tool when trying to develop more sustainable fisheries through improving fishing gear size and species selectivity.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Thünen Institute of Sea Fisheries, Thünen Institute of Fisheries Ecology, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), Alfred Wegener Institute
Authors: Stelzenmüller, V. (Ekstern), Diekmann, R. (Ekstern), Bastardie, F. (Intern), Schulze, T. (Ekstern), Berkenhagen, J. (Ekstern), Kloppmann, M. (Ekstern), Krause, G. (Ekstern), Pogoda, B. (Ekstern), Buck, B. (Ekstern), Kraus, G. (Ekstern)
Pages: 794-805
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Environmental Management
Volume: 183
ISSN (Print): 0301-4797
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.28 SJR 1.141 SNIP 1.779
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.19 SNIP 1.717 CiteScore 3.86
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.228 SNIP 1.921 CiteScore 3.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.203 SNIP 2.014 CiteScore 3.84
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.377 SNIP 2.513 CiteScore 4.01
ISI indexed (2012): ISI indexed yes
Estimating seabed pressure from demersal trawls, seines, and dredges based on gear design and dimensions

This study assesses the seabed pressure of towed fishing gears and models the physical impact (area and depth of seabed penetration) from trip-based information of vessel size, gear type, and catch. Traditionally fishing pressures are calculated top-down by making use of large-scale statistics such as logbook data. Here, we take a different approach starting from the gear itself (design and dimensions) to estimate the physical interactions with the seabed at the level of the individual fishing operation. We defined 14 distinct towed gear groups in European waters (eight otter trawl groups, three beam trawl groups, two demersal seine groups, and one dredge group), for which we established gear “footprints”. The footprint of a gear is defined as the relative contribution from individual larger gear components, such as trawl doors, sweeps, and groundgear, to the total area and severity of the gear's impact. An industry-based survey covering 13 countries provided the basis for estimating the relative impact-area contributions from individual gear components, whereas sediment penetration was estimated based on a literature review. For each gear group, a vessel size–gear size relationship was estimated to enable the prediction of gear footprint area and sediment penetration from vessel size. Application of these relationships with average vessel sizes and towing speeds provided hourly swept-area estimates by métier. Scottish seining has the largest overall gear footprint of ~1.6 km² h⁻¹ of which 0.08 km² has an impact at the subsurface level (sediment penetration ≥ 2 cm). Beam trawling for flatfish ranks low when comparing overall footprint size/hour but ranks substantially higher when comparing only impact at the subsurface level (0.19 km²h⁻¹). These results have substantial implications for the definition, estimation, and monitoring of fishing pressure indicators, which are discussed in the context of an ecosystem approach to fisheries management.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Institute of Marine Research, Swedish University of Agricultural Sciences, Marine Scotland Science, Marine Institute, National Research Council of Italy, Hellenic Centre for Marine Research, Central Fisheries Research Institute, Wageningen IMARES, IFREMER, Institute for Agricultural and Fisheries Research
Individual Stress Level Analyses (ISLA) communicate impact of spatial management options on national or local fisheries communities to decision makers.

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Thünen Institute of Sea Fisheries
Authors: Schulze, T. (Ekstern), Hamon, K. (Ekstern), Schulte, K. (Ekstern), Bastardie, F. (Intern), Hintzen, N. (Ekstern)
Publication date: 2016
Main Research Area: Technical/natural sciences

**Towards a framework for the quantitative assessment of trawling impact on the seabed and benthic ecosystem**

A framework to assess the impact of mobile fishing gear on the seabed and benthic ecosystem is presented. The framework that can be used at regional and local scales provides indicators for both trawling pressure and ecological impact. It builds on high-resolution maps of trawling intensity and considers the physical effects of trawl gears on the seabed, on marine taxa, and on the functioning of the benthic ecosystem. Within the framework, a reductionist approach is applied that breaks down a fishing gear into its components, and a number of biological traits are chosen to determine either the vulnerability of the benthos to the impact of that gear component, or to provide a proxy for their ecological role. The approach considers gear elements, such as otter boards, twin trawl clump, and groundrope, and sweeps that herd the fish. The physical impact of these elements on the seabed, comprising scraping of the seabed, sediment mobilization, and penetration, is a function of the mass, size, and speed of the individual component. The impact of the elements on the benthic community is quantified using a biological-trait approach that considers the vulnerability of the benthic community to trawl impact (e.g. sediment position, morphology), the recovery rate (e.g. longevity, maturation age, reproductive characteristics, dispersal), and their ecological role. The framework is explored to compare the indicators for pressure and ecological impact of bottom trawling in three main seabed habitat types in the North Sea. Preliminary 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.

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Wageningen IMARES, Cefas, Wageningen University & Research, University of Aberdeen, IFREMER, Marine Scotland Science, Institute for Agricultural and Fisheries Research, CNR-Istituto per la Sintesi Organica e la Fotoreattività, Hellenic Centre for Marine Research, Central Fisheries Research Institute, Bangor University, Institute of Marine Research
Pages: 127-138
Publication date: 2016
Main Research Area: Technical/natural sciences
An integrated end-to-end modeling framework for testing ecosystem-wide effects of human-induced pressures in the Baltic Sea

We present an integrated end-to-end modeling framework that enables whole-of ecosystem climate, eutrophication, and spatial management scenario exploration in the Baltic Sea. The framework is built around the Baltic implementation of the spatially-explicit end-to-end ATLANTIS model, linked to the high-resolution coupled physical-biological model HBM-ERGOM and the fisheries bio-economic FishRent model. We investigate ecosystem-wide responses to changes in human-induced pressures by simulating several eutrophication scenarios that are relevant to existing Baltic Sea management plans (e.g. EU BSAP, EU CFP). We further present the structure and calibration of the Baltic ATLANTIS model and the operational linkage to the other models. Using the results of eutrophication scenarios, and focusing on the relative changes in fish and fishery production, we discuss the robustness of the model linking with respect to the underlying assumptions, strengths and weaknesses of individual models. Furthermore, we describe how to possibly
expand the framework to account for spatial impacts and economic consequences, for instance by linking to the individual-vessel based DISPLACE modeling approach. We conclude that the proposed model integration and management scenario evaluation scheme lays the foundations for developing a robust framework for management strategy evaluation that is of strategic importance to stakeholders from around the Baltic Sea.

**Causes and consequences of technical, biological and spatial interactions in fisheries management modelled from the individual distribution of fishing effort**

Our individual-vessel based bio-economic modeling approach (www.displace-project.org) evaluates the harvesting dynamics using information about fishing ground preferences and experienced vessel-specific catch rates. The assessment computes the daily decision-making of the fishing vessels and the individual or overall economic and stock status indicators together with the size-based spatial distribution dynamics of the main fishery resources. In this application to the western Baltic Sea sprat, herring and cod fisheries of Danish, Swedish and German commercial vessels (>12 m) the biological interactions (fish predation mortality) are included by a dynamic coupling to the Stochastic Multi Species model (SMS) on annual basis, under the mitigation from the "yet to be implemented" NATURA 2000 zonation in the area. The spatial technical interactions between vessels revealed to be the predominant factors affecting the fishery profit and the energy efficiency while species interactions play a minor role, albeit increasing the final profit estimates. Interestingly, the zonation affects the profit depending on the biological interactions from a spatial effect on the size composition of the stocks, therefore the fish size composition in the landings originating from different fishing areas. Such a model coupling contributes to the integration of different spatial activities in certain sea areas considering the combined effects of technical and biological interactions and dynamics for reducing potential inefficient management and use of space according to the aims of both EU CFP regulation (No 1380/2013) and EU MSP (2014/89/EU) directive.

**Co-location of passive gear fisheries in offshore wind farms: Fairytale or future marine spatial planning approach?**

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Stelzenmüller, V. (Ekstern), Diekmann, R. (Ekstern), Bastardie, F. (Intern), Schultze, T. (Ekstern), Berkenhagen, J. (Ekstern), Kloppmann, M. (Ekstern), Pogoda, B. (Ekstern), Kraus, G. (Ekstern)
Publication date: 2015
Event:

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Palacz, A. (Intern), Nielsen, J. R. (Intern), Christensen, A. (Intern), Hoff, A. (Ekstern), Frost, H. (Ekstern), Gislason, H. (Intern), Maar, M. (Ekstern), Bastardie, F. (Intern), Geitner, K. (Intern), Hasler, B. (Ekstern), Ravn-Jonsen, L. (Ekstern), Hutniczak, B. (Forskerdatabase), Fulton, E. A. (Ekstern)
Number of pages: 2
Publication date: 2015
Event: Abstract from ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Additional files:
Competition for marine space: modelling the Baltic Sea fisheries and effort displacement under spatial restrictions

Maritime spatial planning (MSP) and fishery management may generate extra costs for fisheries by constraining fishers activity with conservation areas and new utilizations of the sea. More energy-efficient fisheries are also likely to alter existing fishing patterns, which already vary from fishery to fishery and from vessel to vessel. The impact assessment of new spatial plans involving fisheries should be based on quantitative bioeconomic analyses that take into account individual vessel decisions, and trade-offs in cross-sector conflicting interests. We use a vessel-oriented decision-support tool (the DISPLACE model) to combine stochastic variations in spatial fishing activities with harvested resource dynamics in scenario projections.

The assessment computes economic and stock status indicators by modelling the activity of Danish, Swedish, and German vessels (<12 m) in the international western Baltic Sea commercial fishery, together with the underlying size-based distribution dynamics of the main fishery resources of sprat, herring, and cod. The outcomes of alternative scenarios for spatial effort displacement are exemplified by evaluating the fishers’ abilities to adapt to spatial plans under various constraints. Interlinked spatial, technical, and biological dynamics of vessels and stocks in the scenarios result in stable profits, which compensate for the additional costs from effort displacement and release pressure on the fish stocks. The effort is further redirected away from sensitive benthic habitats, enhancing the ecological positive effects. The energy efficiency of some of the vessels, however, is strongly reduced with the new zonation, and some of the vessels suffer decreased profits. The DISPLACE model serves as a spatially explicit bioeconomic benchmark tool for management strategy evaluations for capturing tactical decision-making in reaction to MSP.
Detecting ecological-economic effects of marine spatial plans from displacing the bottom fishing pressure

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Aarhus University
Authors: Thoya, P. (Intern), Bastardie, F. (Intern), Dinesen, G. E. (Intern), Hansen, J. L. (Ekstern), Nielsen, J. R. (Intern)
Publication date: 2015
Event: Paper presented at ICES Annual Science Conference 2015, Copenhagen, Denmark.
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Publication: Research › Paper – Annual report year: 2015

Effects of recent changes in stock conditions and mixing on sustainability and economic viability of the fishery – The Danish fisheries for Baltic cod

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Rindorf, A. (Intern), Eero, M. (Intern)
Evaluation of integrated ecological-economic models – Review and challenges for implementation

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Ecology and Oceanography, National Oceanographic and Atmospheric Administration, IFREMER, Thünen Institute of Sea Fisheries, Commonwealth Scientific and Industrial Research Organisation, University of Vigo, AZTI-Tecnalia, Agropromar, Wageningen IMARES, Spanish National Research Council, National Marine Fisheries Research Institute, Cefas, University of Southern Denmark, Swiss Federal Institute for Aquatic Science and Technology, Swiss Federal Institute of Aquatic Science and Technology, Swedish Agency for Marine and Water Management, University of Kiel, University of Copenhagen, Johann Heinrich von Thünen-Institute, Stockholm University, Lund University
Number of pages: 3
Publication date: 2015
Event: Abstract from ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
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Publication: Research › Conference abstract for conference – Annual report year: 2015

Integration of fisheries in marine spatial planning: Quo vadis?

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Leibniz-Institute for Baltic Sea Research, Wageningen IMARES, IFREMER, GEOMAR - Helmholtz Centre for Ocean Research Kiel, Agropromar, Thünen Institute of Sea Fisheries, Cefas
Authors: Janssen, H. (Ekstern), Bartelings, H. (Ekstern), Bastardie, F. (Intern), Eero, M. (Intern), Girardin, R. (Ekstern), Hamon, K. (Intern), Hinrichsen, H. (Ekstern), Marchal, P. (Ekstern), Nielsen, J. R. (Intern), Le Pape, O. (Ekstern), Schulze, T. (Ekstern), Simons, S. (Ekstern), Teal, L. R. (Ekstern), Tidd, A. (Ekstern)
Number of pages: 2
Publication date: 2015
Event: Abstract from ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
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Bibliographical note
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Publication: Research › Conference abstract for conference – Annual report year: 2015
Management of fishery: Importance of fish food web dynamics in coupling of multispecies and bio-economic fisheries management evaluation models

**General information**
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Ecology and Oceanography
Authors: Ross, S. D. (Intern), Nielsen, J. R. (Intern), Gislason, H. (Intern), Andersen, N. G. (Intern), Vinther, M. (Intern), Bastardie, F. (Intern)
Publication date: 2015
Event: Abstract from 18. Danske Havforskmøde, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Publication: Research › Conference abstract for conference – Annual report year: 2015

New policies may call for new approaches: the case of Swedish Norway lobster (Nephrops norvegicus) fisheries in the Kattegat and Skagerrak

**General information**
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Hornberg, S. (Ekstern), Ulmestrand, M. (Ekstern), Sköld, M. (Ekstern), Jonsson, P. (Ekstern), Eigaard, O. R. (Intern), Feekings, J. P. (Intern), Nielsen, J. R. (Intern), Bastardie, F. (Intern), Lövgren, J. (Ekstern)
Publication date: 2015
Event: Poster session presented at ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Bibliographical note
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New policies will require new approaches: the case of the Swedish Norway Lobster (Nephrops norvegicus) fisheries in the Kattegat and Skagerrak

**General information**
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, SP Technical Research Institute of Sweden, Swedish University of Agricultural Sciences
Authors: Hornborg, S. (Ekstern), Ulmestrand, M. (Ekstern), Sköld, M. (Ekstern), Jonsson, P. (Ekstern), Eigaard, O. R. (Intern), Feekings, J. P. (Intern), Nielsen, J. R. (Intern), Bastardie, F. (Intern), Lövgren, J. (Ekstern)
Number of pages: 1
Publication date: 2015
Event: Poster session presented at ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Electronic versions:
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Bibliographical note
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Publication: Research › Poster – Annual report year: 2015

Sustainability, fuel use, and profitability: interlinked consequences of stock dynamics and choices of individual vessel spatial effort allocation within the Western Baltic

**General information**
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Publication date: 2015
Event: Abstract from SOCIODE EU-FP7-SYMPOSIUM: the socio-economic impacts of management measures of the new Common Fisheries Policy, Brussels, Belgium.
Main Research Area: Technical/natural sciences
Publication: Research › Conference abstract for conference – Annual report year: 2015
Sustainable development of the Nephrops fishery in the Kattegat-Skagerrak region

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Management Systems, Section for Marine Living Resources, Section for Marine Ecology and Oceanography, Institute Management, Swedish University of Agricultural Sciences, Institute of Marine Research, Danish Fishermen's Producers' Organization, Aalborg University
Number of pages: 23
Publication date: 2015

Publication information
Place of publication: Charlottenlund
Publisher: National Institute of Aquatic Resources, Technical University of Denmark
ISBN (Electronic): 978-87-7481-209-8
Main Research Area: Technical/natural sciences
Publication: Research › Report – Annual report year: 2015

The Baltic ATLANTIS model: Implementing a holistic framework to evaluate ecosystem wide responses to changes in climate and anthropogenic forcing

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Section for Ecosystem based Marine Management, Section for Marine Living Resources, Section for Monitoring and Data, Centre for Ocean Life, Aarhus University
Authors: Palacz, A. (Intern), Nielsen, J. R. (Intern), Christensen, A. (Intern), Gislason, H. (Intern), Bastardie, F. (Intern), Geitner, K. (Intern), Maar, M. (Ekstern), Lindegren, M. (Intern), Hufnagl, M. (Intern), Fulton, E. (Ekstern)
Number of pages: 1
Publication date: 2015
Event: Poster session presented at 18. Danske Havforskermøde, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
Links: http://www.marine-vectors.eu/Core_pages/The_Baltic_ATLANTIS_model_a_holistic_framework_to
Publication: Research › Poster – Annual report year: 2015

A statistical model for estimation of fish density including correlation in size, space, time and between species from research survey data

Trawl survey data with high spatial and seasonal coverage were analysed using a variant of the Log Gaussian Cox Process (LGCP) statistical model to estimate unbiased relative fish densities. The model estimates correlations between observations according to time, space, and fish size and includes zero observations and over-dispersion. The model utilises the fact the correlation between numbers of fish caught increases when the distance in space and time between the fish decreases, and the correlation between size groups in a haul increases when the difference in size decreases. Here the model is extended in two ways. Instead of assuming a natural scale size correlation, the model is further developed to allow for a transformed length scale. Furthermore, in the present application, the spatial- and size-dependent correlation between species was included. For cod (Gadus morhua) and whiting (Merlangius merlangus), a common structured size correlation was fitted, and a separable structure between the time and space-size correlation was found for each species, whereas more complex structures were required to describe the correlation between species (and space-size). The within-species time correlation is strong, whereas the correlations between the species are weaker over time but strong within the year.
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<td>Organisations</td>
<td>National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Living Resources</td>
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<td>Authors</td>
<td>Nielsen, J. R. (Intern), Kristensen, K. (Intern), Lewy, P. (Intern), Bastardie, F. (Intern)</td>
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<td>2014</td>
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**Publication information**

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<td>Volume</td>
<td>9</td>
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<td>e99151</td>
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<td>Web of Science (2006): Indexed yes</td>
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- **Publishers version**
- **DOIs:**
  - 10.1371/journal.pone.0099151
- **Links:**
DISPLACE: a dynamic, individual-based model for spatial fishing planning and effort displacement - integrating underlying fish population models

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Miethe, T. (Ekstern)
Pages: 366-386
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Canadian Journal of Fisheries and Aquatic Sciences
Volume: 71
Issue number: 3
ISSN (Print): 0706-652X
Ratings:
BFI (2018): BFI-level 2
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BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 2.56 SJR 1.322 SNIP 1.163
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.256 SNIP 1.051 CiteScore 2.22
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Scopus rating (2014): SJR 1.443 SNIP 1.379 CiteScore 2.6
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.421 SNIP 1.081 CiteScore 2.25
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.324 SNIP 1.196 CiteScore 2.29
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.423 SNIP 1.09 CiteScore 2.13
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.425 SNIP 1.118
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.451 SNIP 1.196
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.589 SNIP 1.379
This study estimates the seafloor impact of towed fishing gears from a bottom-up perspective. Traditionally fishing pressure, often in terms of indicators, is calculated topdown using the fishing effort information available in large-scale statistics such as logbook and VMS data. Here we take a different approach using the gear itself (design and dimensions) for understanding and estimation of the physical interactions with the seafloor at the individual fishing operation level. With reference to the métier groupings of EU logbooks, we defined 17 distinct towed gear groups in European waters (11 otter trawl groups, 3 beam trawl groups, 2 demersal seine groups, and 1 dredge group), for which we established seafloor "footprints". The footprint of a gear was defined as the relative contribution from individual larger gear components, such as the trawl doors, sweeps and ground gear, to the total area and severity of the gear impact. An industry-based vessel and gear survey covering 13 different countries provided the basis for estimating the relative impact-area contributions from individual gear components, whereas seafloor penetration and resuspension was estimated for different sediment types based on a review of the scientific literature. For each defined gear group a vessel-size (kW or total length) – gear size (total gear width or circumference) relationship was estimated to enable the prediction of gear footprint area and sediment penetration from vessel size. The implications for the definition and monitoring of fishing pressure indicators are far-reaching, and are discussed in context of an ecosystem approach to fisheries management (EAFM).
High-resolution mapping of European fishing pressure on the benthic habitats

Mapping and monitoring of pressure from fishery on the marine benthic environment is necessary to support an ecosystem approach to fisheries management (EAFM). In many cases this need is not reflected in official fisheries statistics and logbooks, where focus typically is on catch rather than effort. Consequently, most logbook information is not well suited for quantitative estimation of seafloor impact (swept area and impact severity) of the different gears and trips. We present a method to overcome this information deficiency of official statistics and develop high-resolution large-scale maps of benthic fishing pressure covering the EU, Norwegian and Turkish waters. First individual logbook observations from 13 countries were assigned to 17 different functional gear groups (métiers) based on target species and gear type information. Secondly, relationships between gear width and vessel size (e.g. trawl door spread and vessel kW) for each métier were used to assign quantitative information of bottom contact to each logbook trip by translating vessel size information into measures of gear size. Thirdly the extended logbook data was merged with highresolution activity data (VMS) and gear width estimates were assigned to individual interpolated vessel tracks based on VMS data. The outcome was European wide highresolution fishing intensity maps (total yearly swept area within grid cells of 1*1 minutes longitude and latitude) for 2010, 2011 and 2012. Finally the high-resolution fishing pressure maps were overlaid with existing marine habitat maps to identify areas of potential ecosystem service conflicts

General information
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, National Marine Fisheries Research Institute, Marine Scotland Science, Johann Heinrich von Thünen-Institute, Marine Institute, Instituto Español de Oceanografía, Institute of Marine Biological Resources and Inland Waters, AFBI, Institute of Marine Research, Aarhus University, Cefas, National Research Council of Italy, Institute for Agricultural and Fisheries Research, Wageningen IMARES, Lund University, IFREMER, Central Fisheries Research Institute
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How spatial planning constrains cross-border fisheries: the bio-economic DISPLACE evaluation on the Baltic Sea

General information
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern)
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Main Research Area: Technical/natural sciences
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Publication: Research › Paper – Annual report year: 2014
Impact assessment of a fisheries closure with effort and landings spatial analyses: A case study in the Western Baltic Sea

Commercial fisheries in the Western Baltic Sea (WBS; ICES Subdivisions 22–24) are dominated by Danish and German vessels. By combining and processing logbook and Vessel Monitoring System (VMS) data for Germany and Denmark, we compare patterns of spatial effort allocation and the origin of the landings before (2005–2007) and during (2008–2010) implementation of the EU long-term management plan (LTMP) for cod. This management plan is likely to have affected the temporal and spatial extent of fisheries in the WBS. Changes that took place between 2005 and 2010 on the large scale of the WBS were therefore considered when selecting an appropriate stable reference period to inform and evaluate small-scale effort-displacement scenarios in the Fehmarn Belt. The WBS fisheries appear not to have been restricted by effort limits until 2010, but rather by total allowable catches (TACs) for cod. The amount of cod landed in the WBS decreased, and the origin of these landings shifted farther east without affecting the seasonal effort allocation. Landings of cod have also decreased in the Fehmarn Belt area, and since 2008, sprat has been the species most landed there. The planned construction of the Fehmarn Belt Fixed Link connecting Denmark and Germany could lead to the temporal closure of fishing activities. Three different effort-displacement scenarios were tested to determine how lost landings, caused by a fishing closure of a corridor near the link during construction, could be counteracted by moving the activities to a nearfield area. To compensate for lost landings, the best strategy appears to be redistributing fishing effort of sprat-targeting métiers to areas that have had relatively high catch rates (landings per unit of effort (LPUE)) or with large absolute sprat landings, assuming spatial stability of sprat distribution in the area. Because high effort did not lead to large sprat landings in all locations, effort displacement to high effort areas may not compensate for lost sprat landings, particularly for mixed fishery métiers that also landed herring.

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Thünen Institute of Baltic Sea Fisheries
Authors: Miethe, T. (Ekstern), Bastardie, F. (Intern), Dorrien, C. V. (Ekstern), Nielsen, J. R. (Intern)
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Scopus rating (2016): CiteScore 2.21 SJR 1.12 SNIP 1.136
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.067 SNIP 1.133 CiteScore 2.01
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.105 SNIP 1.312 CiteScore 2.17
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ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
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Scopus rating (2012): SJR 0.93 SNIP 1.177 CiteScore 1.78
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Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.154 SNIP 1.135 CiteScore 1.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.041 SNIP 1.1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.985 SNIP 1.065
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Scopus rating (2007): SJR 1.022 SNIP 1.075
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Scopus rating (2006): SJR 1.025 SNIP 1.274
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.906 SNIP 1.134
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.944 SNIP 1.023
Web of Science (2004): Indexed yes
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Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.299 SNIP 1.22
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.934 SNIP 0.891
Web of Science (2001): Indexed yes
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Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.546 SNIP 0.865
Original language: English
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Impact of deep-sea fishery for Greenland halibut (Reinhardtius hippoglossoides) on non-commercial fish species off West Greenland
Since the late 1980s, a deep-sea fishery for Greenland halibut (Reinhardtius hippoglossoides) has been developing gradually in West Greenland. Deep-sea fish species are generally long-lived and characterized by late age of maturity, low fecundity, and slow growth, features that probably cause low resilience following overexploitation. In order to evaluate whether populations of nine potential bycatch species are negatively affected by the commercial fishery for Greenland halibut, scientific data from bottom-trawl surveys conducted in the same area and period as the commercial fishery were analysed. During the period 1988–2011, population abundance and size composition changed as catch and effort in the Greenland halibut fishery increased. Two species showed a significant decrease in abundance, and four populations showed a significant reduction in mean weight of individuals (p < 0.05). Correlation analyses show that most of the observed trends in abundance are probably not related to increasing fishing effort for Greenland halibut. The analysis did, however, show that most of the observed decreases in mean weight were significantly correlated with fishing effort during the 24-year period

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management
Authors: Jørgensen, O. A. (Intern), Bastardie, F. (Intern), Eigaard, O. R. (Intern)
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Importance of food web dynamics in coupling of multispecies models and bio-economic fisheries management evaluation models

General information
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Ecology and Oceanography
Authors: Ross, S. D. (Intern), Nielsen, J. R. (Intern), Gislason, H. (Intern), Andersen, N. G. (Intern), Vinther, M. (Intern), Bastardie, F. (Intern)
Number of pages: 1
Publication date: 2014
Indirect effects of otter trawling on the condition and trophic level of Nephrops and flatfish in the Kattegat

The fishing gear used in bottom trawl fisheries cause mortality of benthic invertebrates and this can decrease the long-term availability of prey to exploited fish species by reducing the abundance of benthic invertebrates. Alternatively, low trawling levels could increase food production for species that feed on small invertebrates that are released from competition with large invertebrates by trawling. Both outcomes may have consequences for biodiversity, the food-web and the sustainability of fisheries. We assessed the impact of bottom trawling on the food availability of fish by comparing the condition (as weight-at-length) and trophic level of the fish Pleuronectes platessa, Limanda limanda, Hippoglossoides platessoides and the crustacean Nephrops norvegicus in an area with strong variation in commercial otter-trawling effort owing to the presence of MPAs with different levels of protection in the Kattegat (Sweden and Denmark). The results show that the abundance and body size of Nephrops was much higher in the fully closed areas, whereas that of the flatfish was less affected. The condition and trophic level for Nephrops were highest on intensively trawled areas suggesting that trawling reduces competition and increases food availability for Nephrops. In contrast, the condition of the flatfish species was the highest at low levels of trawling. This study therefore suggests that high effort levels of bottom trawling have a negative effect on the prey availability and thus on the condition of some of the target species, but not others, and that low levels of trawling might positively affect food availability for some flatfish species. Alternatively, flatfishes might avoid areas with high densities of large Nephrops.

Supporting bio-economic evaluation of spatial planning constraining fishing activities: be quantitative, spatially-explicit, vessel-oriented, stochastic, and dynamically coupled to fish populations

The Baltic ATLANTIS model: Implementing a holistic framework to evaluate ecosystem wide responses to changes in climate and anthropogenic forcing
Cod recovery as a new challenge for fisheries management: experience from the Baltic Sea

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Ecology and Oceanography, Section for Marine Living Resources, Institute Management
Authors: Eero, M. (Intern), Hüsey, K. (Intern), Moisegard, H. (Intern), Hansen, J. H. (Intern), Bastardie, F. (Intern), Köster, F. (Intern)
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Critical report of current fisheries management measures implemented for the North Sea mixed demersal fisheries

The present report is an EU-FP7-SOCIOEC Report giving an overview and critical evaluation of the current management measures implemented for the North Sea mixed demersal fisheries and the fish stocks involved in this. Also, this involves review and critical evaluation of the scientific advice supporting the fisheries management for the North Sea mixed demersal fisheries and the stocks involved herein. Management of the demersal roundfish and flatfish fisheries in the North Sea is conducted mainly through the EU Common Fisheries Policy (CFP) and the yearly EU-Norway Bilateral Fishery Agreements. The prevailing management system and principle has been landing quotas (TAC, Total Allowable Catch) mainly based on the EU principle of relative stability in the international sharing of the TAC. Also, general effort limitations and technical measures are set for the EU and Norwegian fisheries on top of the TAC regulations. Technical measures have mainly aimed at reducing the retention and discard of the juveniles through gear measures and to protect the spawners and/or recruits in the fish populations through closures. Furthermore, the management is based on a set of national measures especially concerning control and enforcement measures, national distribution of the overall TAC, individual special technical measures, allocation (distribution) of national TACs to different fisheries and vessels including the share to e.g. Individual Transferable Quotas (ITQs) or Vessel Quota Shares (VQSS). The management of the North Sea demersal fisheries has changed quite a lot over the last decades following the need to rebuild the fish stocks, and in particular the North Sea cod stock in relation to the present case study. The CFP has increasing focus towards implementing multi-annual or long term management plans (MAMPS, LTMPs) partly to avoid the annual political battles over setting the TAC. There has furthermore been a trend during the last decade to move away from the Precautionary Approach and towards Maximum Sustainable Yield as the overarching management objective and Harvest Control Rules (HCRs) based on this. There have been introduced increasingly restrictive fisheries-based effort limitations with possibilities for exemption or for less drastic effort reductions provided that cod avoidance behavior can be demonstrated. Although the decision-makers under the CFP have had a reputation of consistently setting TACs way above the scientific advice, the development in recent years has been towards this gap being reduced.

Management of the fisheries has undergone a number of structural and behavioral changes, and these have already yielded some positive results as the state of the demersal stocks in the North Sea have globally improved. The status of main demersal stocks has considerably improved over the last decade. Fishing mortality has globally decreased and biomass has increased, and most of the assessed demersal stocks are now within sustainable limits. Some issues remain with North Sea cod, for which recovery is slower. At present, cod is the limiting species for all the North Sea demersal fisheries. Over a time span from the 1980s landings of demersal stocks have declined with an accelerating decrease since the mid-1990s in line with the falling stock sizes and regulated reductions in total allowable catches (TACs). A clear decrease in the mean fishing mortality (F) is observed in the 2000-2010 period with current F values between Fmsy and Fpa, and the spawning stock biomass (SSB) has on average been above Bmsy for the period 1983-2010 for the assessed stocks. The effort in the central North Sea and along the Norwegian waters has decreased as well as the number of operating fishing vessels (capacity). Overall, the nominal effort (kW-days) by European fleets using demersal trawl, seine, beam trawl and gillnet in the North Sea, Skagerrak and the Eastern Channel have been substantially reduced (-20% between 2003 and 2011). Since 2000, the total fish biomass for exploited stocks in the North Sea is about 4-5 million tonnes with an increasing trend in the most recent years. Despite the decrease of landings and fishing mortality in the last recent decade, the overall recruitment has shown a clear decreasing trend from 1985-2010. The recent increase in SSB during the last decade, which is likely due to lower landings and fishing mortality levels in the last 15 years, indicate inclinations of the North Sea ecosystem to recover. However, this has not converted in higher recruitment levels in the most recent years in which there may be a time delay. There is a clear trend that both the gross profit and the net profit has improved from 2008-2010 for the main fleets of the North Sea with the only exception of the Dutch beam trawlers 18-24m, for which the gross profit decreased by nearly 90%. The positive development in economic performance measures can be a result of the structural changes that have recently occurred in many fisheries. There are fewer vessels sharing the available resources (reduction in over-capacity). Especially, the movement towards right-based systems is expected to have had positive effects on reducing the over-capacity and improving the economic performance of many fleets. Historically, EU subsidies over the years have contributed to making the fleet more efficient, so the success of the CFP in the area of developing an efficient fleet has historically contributed to its failure in relation to conserve fish stocks, as overcapacity is consistently mentioned as one of the fundamental reasons for the conservation failure historically. Employment in fishing as a social indicator is shrinking, not least for the North Sea, and has been so for many years. There are multiple explanations for this: i) individual vessels are getting more efficient, ii) consolidation of fleets whereby fewer vessels catch the available resources with noticeable decrease in number of operating fishing vessels, and ii) decreasing fishing opportunities in the shape of lower quotas. The raw number of fishers tells a story of a sector that in
reality, at least in the prosperous countries around the North Sea, provides only few jobs. Despite the above trends indicating positive effects of the most recent fisheries management of the North Sea mixed demersal fisheries there are a row of general problems in the present management. Population dynamics with respect to recruitment variations, sub-populations and changes in distribution of several demersal North Sea stocks influenced by environmental factors besides fishery are not fully understood and taken into consideration in management (and management advice). Also, biological multi-species interactions between the stocks are not fully taken into account in the management of the stocks when setting the MSY management and exploitation limits for the stocks. Management is not based on broader ecosystem and multi-species objectives, but based mainly on single stock objectives. Also technical interactions between fisheries are not taken fully into account in management of the North Sea demersal fisheries. The fisheries targeting cod, whiting, haddock, saithe, flatfish and Nephrops in the North Sea and Kattegat-Skagerrak are mixed demersal fisheries for towed gears. Mixed fisheries considerations are of primary importance for the management of North Sea species. Single stock management is a cause of discarding in mixed fisheries, because individual stock management objectives may not be consistent with each other. As such, the TAC of one species may be exhausted before the TAC of another, leading to catches of valuable fish that cannot be landed resulting in over-quotas discard. Overall, present management and fisheries policy is characterized by the CFP having in many ways taken form of a classical intergovernmentalist, state-centric command-and-control, top-down management system, where member states’ ministers in the Council have exercised strong control over the fisheries management measures which have been developed and adopted on the background of proposals from the Commission and the Parliament, though since the ratification of the Lisbon Treaty the Parliament has assumed a role of co-legislator alongside the Council. EC has identified the lack of stakeholder involvement as one of the major weaknesses of the CFP, recognizing that this fact clearly undermine its legitimacy. Establishment of the Regional Advisory Councils (RACs) with the 2003 CFP can be seen as the first formal attempt to generate a network of multinational, multi-interest advisory organizations with a strong regional focus among other involving resource users in the decision making. However, the RACs have at present only an advisory function on decisions and are not formally integrated directly in management on a regional basis, i.e. the RAC system is primarily intended to provide a regional stakeholder perspective to the Commission's deliberations rather than providing stakeholders with real decision-making authority. RACs constitute, nevertheless, a move towards regionalization of the fisheries policy. Present management is, furthermore, characterized by a high degree of complexity, bureaucracy, and examples of micro-management where different management systems and measures are implemented in parallel making evaluation of impact of the individual measures and systems very complicated and the system suffers from lack of transparency. With respect to the complexity the different management measures are acting top of each other with impact on the same fisheries and stocks at the same time (and with time overlap in their implementation) creating a very complex management and associated advisory system, where it is difficult to distinguish specific effects and impacts of each individual measures implemented. Accordingly, it is also very difficult to make scientific management evaluation and advice associated to the individual measures.

**General information**

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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management

Authors: Nielsen, J. R. (Intern), Ulrich, C. (Intern), Hegland, T. J. (Ekstern), Voss, B. D. (Ekstern), Thøgersen, T. T. (Ekstern), Bastardie, F. (Intern), Goti, L. (Ekstern), Eigaard, O. R. (Intern), Kindt-Larsen, L. (Intern)

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**Improved management based on stock identification of eastern and western Baltic cod**

The objective of this project was to establish an empirically founded knowledge base for the sustainable exploitation of the western Baltic cod stock by including the complex stock structure and migration patterns.

Stock mapping: Extensive immigration of “Eastern” cod into the Arkona Basin (SD 24) within the “Western” cod’s management unit was documented using high-powered genetic tools. The majority (91%) of all spawning fish caught in SD 24 in 2011 were “Eastern” cod and only 9% were from the “Western” stock. The results suggest that the stock
structure in the Arkona Basin is highly influenced by mixing of genetically separate stocks. Trends in mixing: Since the 1980's where cod in SD 24 consisted primarily of "Western" type, the proportion of "Eastern" cod has increased, particularly since 2005. Throughout that period, the immigration of "Eastern" cod into SD 24 consisted primarily of adult, older fish. The changes in biological characteristics (mean size at age, condition and maturity) observed in that area since 2005 are thus a direct consequence of the extensive immigration of "Eastern" cod. As no seasonal signals in stock mixing were observed, the immigration is not associated with a change in "Eastern" cod's spawning behaviour.

Management: The stock mixing proportions were successfully implemented in DTU Aqua's modeling framework for management scenarios. "Eastern" immigrants into SD 24 lead the management procedure to advice for higher TACs that enhance the pressure on the fishing mortality level in SD 22. The fishing mortality level in SD 22 in this situation will need to be lowered i.e. by allocating more effort and catch from SD 22 to SD 24. Higher landings are expected if effort is re-directed/re-allocated to SD 24, profiting from the "Eastern" immigrants. By lowering the fishing mortality in SD 22, the SSB in SD 22 is also preserved, which is assumed to be the main source of recruits for the whole "western" stock (i.e. SD 22 + SD 24). In conclusion: Within the frame of this project we showed that substantial immigration "Eastern" cod into SD 24 has occurred and that these stock dynamics should be incorporated in evaluations of future management plans.

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Integrating individual trip planning in energy efficiency – Building decision tree models for Danish fisheries
Danish fishermen have provided information on dynamics in their fuel consumption, running costs, and fishing patterns through a web-based questionnaire. This detailed documentation of the fishing practices is used in spatial modelling tools to improve advice and research for fisheries. The tools integrate detailed information on vessel distribution, catch and fuel consumption for different fisheries with a detailed resource distribution of targeted stocks from research surveys to evaluate the optimum consumption and efficiency to reduce fuel costs and the costs of displacement of effort. The energy efficiency for the value of catch per unit of fuel consumed is analysed by merging the questionnaire, logbook and VMS (vessel monitoring system) information. Logic decision trees and conditional behaviour probabilities are established from the responses of fishermen regarding a range of sequential hypothetical conditions influencing their trip decisions, covering the duration of fishing time, choice of fishing ground(s), when to stop fishing and return to port, and the choice of the port for landing. Fleet-based energy and economy efficiency are linked to the decision (choice) dynamics. Larger fuel-intensive but efficient vessels conducting pelagic or industrial fishing are more inclined to base their decision on fish price only, while numerous smaller and less efficient vessels conducting demersal mixed or crustacean fishery usually consider other flexible factors, e.g., the potential for a large catch, weather, previous knowledge and experience, and the distance to/from port, which affect the number and duration of trips and the fuel consumption. Integration of the results into our recently developed spatially explicit individual-based fishing vessel model (IBM) incorporate the variability and predict the adaptations of individual fishermen to resource availability dynamics, increasing fuel prices, changes in regulations, and the consequences of socioeconomic external pressures on harvested stocks. A new methodology is described here to obtain quantitative information on the fishermen's micro-scale decisions initially required

General information
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Management Systems
Localisation of nursery areas based on comparative analyses of the horizontal and vertical distribution patterns of juvenile Baltic cod (Gadus morhua)

Knowledge of the spatial distribution of juvenile cod is essential for obtaining precise recruitment data to conduct sustainable management of the eastern and western Baltic cod stocks. In this study, the horizontal and vertical distribution and density patterns of settled juvenile 0- and 1-group Baltic cod are determined, and their nursery areas are localised according to the environmental factors affecting them. Comparative statistical analyses of biological, hydrographic and hydroacoustic data are carried out based on standard ICES demersal trawl surveys and special integrated trawl and acoustic research surveys. Horizontal distribution maps for the 2001–2010 cohorts of juvenile cod are further generated by applying a statistical log-Gaussian Cox process model to the standard trawl survey data. The analyses indicate size-dependent horizontal and distinct vertical and diurnal distribution patterns related to the seabed topography, water layer depth, and the presence of hydrographic frontal zones (pycnoclines) as well as intraspecific patterns in relation to the presence of adult cod. The extent of the nursery areas also depends on the cod year class strength. Juvenile cod (≥3 cm) are present in all areas of the central Baltic Sea (CBS), showing broad dispersal. However, their highest density in the Baltic Basins is found at localities with a 40–70 m bottom depth in waters with oxygen concentrations above 2 ml O2.l−1 and temperatures above 5°C. The smallest juveniles are also found in deep sea localities down to a 100 m depth and at oxygen concentrations between 2–4 ml O2.l−1. The vertical, diurnally stratified and repeated trawling and hydroacoustic target strength-depth distributions obtained from the special surveys show juvenile cod concentrations in frontal zone water layers (pycnocline). However, the analyses indicate that in the CBS, juvenile cod of all sizes do not appear to aggregate in dense schooling patterns, which differs from what has been reported from the North Sea.
Challenges and opportunities for fleet- and métier-based approaches for fisheries management under the European Common Fishery Policy

The inconsistency of single-species objectives in a mixed-fisheries context has repeatedly been highlighted as a key issue in the current European Common Fishery Policy, and it has long been suggested that this issue would be better addressed through fleet (group of vessels) and métier (type of activity) based approaches. Since the late 1980s, when such approaches were first introduced, there have been substantial developments in this area of science, to the point where the concepts of fleet and métier now underpin the whole EC Data Collection Framework. However, their implementation in the management system has been slow and difficult, being hampered by a number of intrinsic issues. Mixed fisheries are an ongoing “governance headache” combining management complexity, scientific uncertainty and political sensitivity. This paper summarises the current state of play for fleet-based approaches in EU fisheries management, and highlights our views on both their potential and the challenges they face in the context of the future CFP. As a convenient layer between the current single-stock level and the level of the individual vessel, fleet/métier-approaches could potentially address a wide range of issues, especially with regards to the policy emphasis on ecosystem-based fisheries management. However, the rigid categorisation they induce may not properly address the flexibility of individual vessels, and should therefore be supplemented by more detailed considerations at the local scale.
Coupled economic – ecological models for EBFM

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Organisations: National Institute of Aquatic Resources, Section for Management Systems
Authors: Nielsen, J. R. (Intern), Schmidt, J. (Ekstern), Thunberg, E. (Ekstern), Bastardie, F. (Intern)
Publication date: 2012
Event: Abstract from IIFET Biennial Conference of the International Institute of Fisheries Economics & Trade, Dar-Es-Salaam, Tanzania, United Republic of.
DISPLACE: a dynamic, individual-based model for spatial fishing planning and effort displacement: Integrating underlying fish population models

We previously developed a spatially explicit, individual-based model (IBM) evaluating the bio-economic efficiency of fishing vessel movements between regions according to the catching and targeting of different species based on the most recent high resolution spatial fishery data. The main purpose was to test the effects of alternative fishing effort allocation scenarios related to fuel consumption, energy efficiency (value per litre of fuel), sustainable fish stock harvesting, and profitability of the fisheries. The assumption here was constant underlying resource availability. Now, an advanced version couples the vessel model to selected size-based population models and considers the underlying resource dynamics in the distribution and density patterns of the targeted stocks for the cases of Danish and German vessels harvesting the North Sea and Baltic fish stocks. The stochastic fishing process includes direct and local depletion by stock that is specific to the vessel catching power, which is proportional to the encountered size-based population on the visited ground and is based on stock assessment and research survey data. The impact of the potential fishing effort displacement by vessels on the fish stocks, with resulting fishing mortality, and the vessels’ economic consequences are evaluated on high spatial and seasonal disaggregation levels by simulating different individual choices of vessel speed, fishing grounds and ports. All tested scenarios led to increased overall energy efficiency, except for the fishing closures that increased fuel consumption and costs for most of the vessels due to increased travel distance. On an individual scale, the simulations led to gains and losses due to either the technical interactions between vessels exploiting the same stocks or to the alteration of individual fishing patterns. We demonstrate that integrating the spatial activity of vessels and local fish stock abundance dynamics allow for interactions and more realistic predictions of fishermen behaviour, revenues and stock abundance.

Do Norway pout (Trisopterus esmarkii) die from spawning stress?: Mortality of Norway pout in relation to growth, maturity and density in the North Sea, Skagerrak and Kattegat

The mortality patterns of Norway pout (NP) are not well understood. It has been suggested that NP undergo heavy spawning mortality, and this paper summarizes and provides new evidence in support of this hypothesis. The very low–absent fishing activity in recent years provides a unique opportunity to analyse the natural life-history traits of cohorts in the NP stock in the North Sea. Based on the ICES trawl survey abundance indices, cohort mortality is found to significantly increase with age. We argue that this cannot be explained by selectiveness in the fishery, potential size-specific migrations out of the area, higher predation pressure on older individuals, or differences in survey catchability by NP age from before to after spawning and that it is higher in the main spawning areas than outside. We found that natural mortality (M) is significantly correlated with sexual maturity, sex, growth, and intraspecific stock density. All of this is consistent with a greater mortality occurring mainly from the first to the second quarter of the year, i.e. spawning mortality, which is discussed as being a major direct and indirect cause of stock mortality.
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.63
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.18
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.46
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.35
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.32
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
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Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
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Source: orbit
Source-ID: 316575
Publication: Research - peer-review › Journal article – Annual report year: 2012

Impact assessment (IA) of alternative HCRs to the current multiannual Baltic Sea plan on the bio-economy of fleets – coupling the SMS model to the FLR Baltic model

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Management Systems, Section for Public Sector Consultancy
Regional métier definition: A comparative investigation of statistical methods using a workflow applied to the international otter trawl fisheries in the North Sea

The European Common Fisheries Policy recognizes the importance of accounting for heterogeneity in fishing practices, and métier-based sampling is now at the core of the EU Data Collection Framework. The implementation of such an approach would require Member States to agree on the standard regional métier definitions and on practical rules to categorize logbook records into métiers. Several alternative approaches have been used in the past to categorize landings profiles, but no consensus has yet emerged. A generic open-source workflow is developed to test and compare a selection of methods, including principal components analysis (PCA), hierarchical agglomerative clustering (HAC), K-means, and Clustering LARge Applications (CLARA), and to provide simple allocation rules. This workflow is applied to a unique regional dataset consisting of bottom-trawl logbooks of five North Sea countries. No method proved to be infallible, but combining PCA with either CLARA or HAC performed best. For 2008, a hierarchical classification with 14 species assemblages is proposed. Discriminant analysis proved more robust than simple ordination methods for allocating a new logbook record into an existing métier. The whole approach is directly operational and could contribute to defining more objective and consistent métiers across European fisheries.
Transforming knowledge into quantitative modelling: Danish fishers respond to a web-based survey on dynamics in fuel consumption and fishing patterns

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Andersen, B. S. (Intern), Eigaard, O. R. (Intern)
Publication date: 2012
Event: Abstract from World Fisheries Congress, Edinburgh, United Kingdom.
Main Research Area: Technical/natural sciences
Publication: Research › Conference abstract for conference – Annual report year: 2012

Use of high resolution spatial analysis of effort and landings for supplementing impact assessment on Western Baltic fisheries

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources
Authors: Miethe, T. (Ekstern), Bastardie, F. (Intern), von Dorrien, C. (Ekstern), Nielsen, J. R. (Intern)
Publication date: 2012
Event: Poster session presented at World Fisheries Congress, Edinburgh, United Kingdom.
Main Research Area: Technical/natural sciences
Publication: Research › Poster – Annual report year: 2012

VMStools: Open-source software for the processing, analysis and visualization of fisheries logbook and VMS data
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 removal, 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, calculate indicators of fishing impact as listed under the Data Collection Framework at different spatio-temporal scales. Finally data can be transformed into other existing formats, for example to populate regional databases like FishFrame. This paper describes workflow examples of these features while online material allows a head start to perform these analyses. This software incorporates state-of-the art VMS and logbook analysing methods standardizing the process towards obtaining pan-European, or even worldwide indicators of fishing distribution and impact as required for spatial planning

**General information**

State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Public Sector Consultancy
Authors: Hintzen, N. T. (Ekstern), Bastardie, F. (Intern), Beare, D. (Ekstern), Piet, G. J. (Ekstern), Ulrich, C. (Intern), Deporte, N. (Ekstern), Egekvist, J. (Intern), Degel, H. (Intern)
Pages: 31-43
Publication date: 2012
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Fisheries Research
Volume: 115-116
ISSN (Print): 0165-7836
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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Scopus rating (2016): CiteScore 2.21 SJR 1.12 SNIP 1.136
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.067 SNIP 1.133 CiteScore 2.01
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.105 SNIP 1.312 CiteScore 2.17
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.037 SNIP 1.173 CiteScore 1.85
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.93 SNIP 1.177 CiteScore 1.78
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.154 SNIP 1.135 CiteScore 1.7
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.041 SNIP 1.1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.985 SNIP 1.065
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.938 SNIP 1.142
Evaluation of effort and TAC quota uptake and capacity use by country as well as efficiency of effort measures according to fishing mortality and fishing power in the Western and Eastern Baltic cod fishery during 2005-2010 in relation to the multi-annual cod management plan

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Public Sector Consultancy
Publication date: 2011

Host publication information
Place of publication: Luxembourg
Publisher: Publications Office of the European Union
Main Research Area: Technical/natural sciences
Conference: EU STECF EWG-11-07a, Hamburg, Germany, 01/01/2011
Source: orbit
Source-ID: 278754
Publication: Research › Article in proceedings – Annual report year: 2011

Stock-based and fleet-based evaluation of the multi-annual management plan for the cod stocks in the Baltic Sea with respect to cod stock mixing and TAC vs. effort regulation under different constraints and stock conditions

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern)
Publication date: 2011

Host publication information
Detailed mapping of fishing effort and landings by coupling fishing logbooks with satellite-recorded vessel geo-localisation

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Public Sector Consultancy
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Ulrich, C. (Intern), Egekvist, J. (Intern), Degel, H. (Intern)
Publication date: 2010
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 268926
Publication: Research › Poster – Annual report year: 2010

Detailed mapping of fishing effort and landings by coupling fishing logbooks with satellite-recorded vessel geo-location

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Public Sector Consultancy
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Ulrich, C. (Intern), Egekvist, J. (Intern), Degel, H. (Intern)
Pages: 41-53
Publication date: 2010
Main Research Area: Technical/natural sciences

Publication information
Journal: Fisheries Research
Volume: 106
Issue number: 1
ISSN (Print): 0165-7836
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.21 SJR 1.12 SNIP 1.136
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.067 SNIP 1.133 CiteScore 2.01
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.105 SNIP 1.312 CiteScore 2.17
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.037 SNIP 1.173 CiteScore 1.85
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Effect of fishing effort allocation scenarios on energy efficiency and profitability: An individual based model applied to Danish fisheries

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Andersen, B. S. (Intern), Eigaard, O. R. (Intern)
Publication date: 2010
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 268928
Publication: Research › Conference abstract for conference – Annual report year: 2010
Effects of fishing effort allocation scenarios on energy efficiency and profitability: an individual-based model applied to Danish fisheries

Global concerns about CO2 emissions, national CO2 quotas, and rising fuel prices are incentives for the commercial fishing fleet industry to change their fishing practices and reduce fuel consumption, which constitutes a significant part of fishing costs. Vessel-based fuel consumption, energy efficiency (quantity of fish caught per litre of fuel used), and profitability are factors that we simulated in developing a spatially explicit individual-based model (IBM) for fishing vessel movements. The observed spatial and seasonal patterns of fishing effort for each fishing activity are evaluated against three alternative effort allocation scenarios for the assumed fishermen's adaptation to these factors: (A) preferring nearby fishing grounds rather than distant grounds with potentially larger catches and higher values, (B) shifting to other fisheries targeting resources located closer to the harbour, and (C) allocating effort towards optimising the expected area-specific profit per trip. The model is informed by data from each Danish fishing vessel >15 m after coupling its high resolution spatial and temporal effort data (VMS) with data from logbook landing declarations, sales slips, vessel engine specifications, and fish and fuel prices. The outcomes of scenarios A and B indicate a trade-off between fuel savings and energy efficiency improvements when effort is displaced closer to the harbour compared to reductions in total landing amounts and profit. Scenario C indicates that historic effort allocation has actually been sub-optimal because increased profits from decreased fuel consumption and larger landings could have been obtained by applying a different spatial effort allocation. Based on recent advances in VMS and logbooks data analyses, this paper contributes to improve the modelling of fishing effort allocation, fuel consumption and catch distribution on a much disaggregated level compared to the fleet-based models we developed so far.

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Andersen, B. S. (Intern), Eigaard, O. R. (Intern)
Publication date: 2010
Main Research Area: Technical/natural sciences
Page numbers: 501-516
Publication: Research › Poster – Annual report year: 2010
This study evaluated the EU 2008 multi-annual plan for Baltic cod stock recovery. The plan combines harvest control rules that set TACs with reductions in direct effort (E) and fishing mortality (F). Performance and robustness of the plan are tested with a management strategy evaluation model (MSE). Stochastic simulations are carried out under different scenarios of recruitment and sources of uncertainties. Under the different magnitudes of errors investigated, the plan in its current design is likely to reach precautionary targets for the Eastern and the Western Baltic cod stocks by 2015. It is, however, more sensitive to implementation errors (e.g. catch misreporting) than to observation errors (e.g. data collection) when the (i) current settings of the ICES single-stock assessment model are maintained, (ii) intended fishing effort reduction is fully complied with, and (iii) biological parameters are assumed constant. For the Eastern Baltic stock, additional sources of uncertainties from fishery adaptation to the plan are tested using a fleet-based and spatially explicit version of the model which leads to higher reductions in F and no significant change in management robustness. The relative difference between both approaches is mainly due to differences in exploitation patterns in catching the same
amount of fish. The effort control is demonstrated to be more efficient when supplemented with a TAC and avoids unintended effects from fishery responses, e.g. spatial effort reallocation. Medium term economic evaluation of fishery performance shows an initial reduction in profit with effort and TAC reductions, but profit is always positive. (C) 2009 Elsevier B.V. All rights reserved.
The eastern Baltic cod fishery: a fleet-based management strategy evaluation framework to assess the cod recovery plan of 2008


General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Population- and Ecosystem Dynamics
Authors: Bastardie, F. (Intern), Nielsen, J. R. (Intern), Kraus, G. (Intern)
Pages: 71-86
Publication date: 2010
Main Research Area: Technical/natural sciences

Publication information
Journal: ICES Journal of Marine Science
Volume: 67
Issue number: 1
ISSN (Print): 1054-3139
Ratings:
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.63
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.18
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.46
ISI indexed (2013): ISI indexed yes
A model-based evaluation of Marine Protected Areas: the example of eastern Baltic cod (Gadus morhua callarias L.)

The eastern Baltic cod stock collapsed as a consequence of climate-driven adverse hydrographic conditions and overfishing and has remained at historically low levels. Spatio-temporal fishing closures [Marine Protected Areas (MPAs)] have been implemented since 1995, to protect and restore the spawning stock. However, no signs of recovery have been observed yet, either suggesting that MPAs are an inappropriate management measure or pointing towards suboptimal closure design. We used the spatially explicit fishery simulation model ISIS-Fish to evaluate proposed and implemented fishery closures, combining an age-structured population module with a multifleet exploitation module and a management module in a single model environment. The model is parameterized based on (i) the large amount of biological knowledge available for cod and (ii) an analysis of existing spatially disaggregated fishery data. As the population dynamics of eastern Baltic cod depend strongly on the climate-driven hydrographic regime, we considered two production regimes of the stock. MPAs were only effective for stock recovery when they reduced overall fishing effort. The performance of MPAs needs to be evaluated relative to environmental regimes, especially for stocks facing strong environmental variability.

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Management Systems
Authors: Kraus, G. (Intern), Pelletier, D. (Ekstern), Dubreuil, J. (Ekstern), Möllmann, C. (Ekstern), Hinrichsen, H. (Ekstern), Bastardie, F. (Intern), Vermard, Y. (Ekstern), Mahevas, S. (Ekstern)
Pages: 109-121
Publication date: 2009
Main Research Area: Technical/natural sciences

Publication information
Journal: ICES Journal of Marine Science
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.63
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.18
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.46
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.35
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.32
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Web of Science (2001): Indexed yes
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Original language: English
Model, Stock recovery, Fishery management, Baltic cod, Marine Protected Areas
DOIs:
10.1093/icesjms/fsn166
Source: orbit
Source-ID: 236793
Publication: Research - peer-review › Journal article – Annual report year: 2009

Biological ensemble modelling of the Eastern Baltic cod future

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Management Systems
Authors: Gårdmark, A. (Ekstern), Möllmann, C. (Ekstern), Neuenfeldt, S. (Intern), Blenckner, T. (Ekstern), Lindegren, M. (Intern), Aro, E. (Ekstern), Bastardie, F. (Intern), Heikinheimo, O. (Ekstern), Müller-Karulis, B. (Ekstern), Niiranen, S. (Ekstern), Tomczak, M. (Intern), van Leeuwen, A. (Ekstern), Wikström, A. (Ekstern)
Evaluating biological robustness of innovative management alternatives

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Bastardie, F. (Intern), Baudron, A. (Ekstern), Bilocca, R. (Ekstern), Boje, J. (Intern), Bult, T. P. (Ekstern), Garcia, D. (Ekstern), Hintzen, N. T. (Ekstern), Nielsen, J. R. (Intern), Petursdottir, G. (Ekstern), Sanchez, S. (Ekstern), Ulrich, C. (Intern)
Number of pages: 269
Pages: 119-142
Publication date: 2009

Evaluation of the multiannual plan for the cod stocks in the Baltic Sea

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Public Sector Consultancy, Section for Monitoring
Authors: Bastardie, F. (Intern), Vinther, M. (Intern), Nielsen, J. R. (Intern), Ulrich, C. (Intern), Storr-Paulsen, M. (Intern)
Number of pages: 29
Publication date: 2009

Encapsulating root and soil heterogeneity in models using the concept of functional architecture

General information
State: Published
Organisations: French National Institute for Agricultural Research, Université d'Avignon et des Pays de Vaucluse
Authors: Pierret, A. (Ekstern), Doussan, C. (Ekstern), Capowiez, Y. (Ekstern), Bastardie, F. (Intern), Pagés, L. (Ekstern)
Pages: 269-281
Effect of sludge and municipal solid waste composts disposal on earthworm communities under crop field conditions
Sublethal effects of imidacloprid on the burrowing behaviour of two earthworm species: modifications of the 3D burrow systems in artificial cores and consequences on gas diffusion in soil

General information
State: Published
Organisations: Université d’Avignon et des Pays de Vaucluse, INRA Institut National de La Recherche Agronomique
Authors: Capowiez, Y. (Ekstern), Bastardie, F. (Intern), Costagliola, G. (Ekstern)
Pages: 285-293
Publication date: 2006
Main Research Area: Technical/natural sciences
Publication information
Journal: Soil Biology & Biochemistry
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Issue number: 2
ISSN (Print): 0038-0717
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.132 SNIP 1.832 CiteScore 5.17
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.305 SNIP 1.71 CiteScore 4.48
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.349 SNIP 1.858 CiteScore 4.84
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 2.271 SNIP 1.99 CiteScore 4.96
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 2.292 SNIP 1.74 CiteScore 4
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 2.146 SNIP 1.717 CiteScore 3.91
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.868 SNIP 1.537
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.044 SNIP 1.575
Web of Science (2009): Indexed yes
Three-d simulations of burrow systems made by earthworm communities and study of some physical consequences

General information
State: Published
Organisations: Unknown
Authors: Bastardie, F. (Intern), Capowiez, Y. (Ekstern), Ruy, S. (Ekstern)
Publication date: 2006
Event: Poster session presented at International Symposium on Earthworm Ecology, Krakow, Poland.
Main Research Area: Technical/natural sciences
Publication: Research › Poster – Annual report year: 2006

3D characterisation of earthworm burrow systems from natural soil cores collected on a 12 year old pasture

To link earthworm burrow distribution with the spatial variability of soil functions, accurate mapping of their spatial burrowing patterns is required. Eight natural soil cores (25 cm in diameter; up to 60 cm long) were collected from a pasture in spring 2001–2003. Earthworm populations were sampled on the first date and the anecic species Nicodrilus giardi was found to be dominant (55% of the average density of 101 worms m⁻²). Soil cores were imaged using medical X-ray tomography equipment. These tomography images served as a basis for 3D reconstructions generated using specifically written software. Finally, the reconstructed burrow systems were measured and analysed using mathematical morphological approaches. The 3D reconstructions thus derived showed dense systems of interconnected burrows. A number of burrows extending vertically from the top to the bottom of the cores, but most were short, disconnected burrows. These two classes of burrows could not be linked with the activity of a particular species. In addition to the visual appraisal of the burrow system shape, structural parameters such as burrow volume, burrow wall surface area, burrow length density, topology and burrow angles were computed from the 3D reconstructions. Total burrow length density ranged from 687 to 1212 m m⁻³. Burrow volume density represented less than 2.5% of total soil volume and ranged from 13.3 × 10³ to 24.2 × 10³ cm³ m⁻³. Inspite of the apparently high continuity of burrows, only 9–43% of the volume was connected to the soil surface. Total burrow wall area ranged from 7721 to 12764 cm² m⁻³ while surface-connected burrow wall surface area ranged from 1069 to 7237 cm² m⁻³. The drilosphere volumes (i.e. a 2 mm thick sheath around burrows) were estimated to range from 44.9 × 10³ to 52.9 × 10³ cm³ m⁻³. Earthworm activity was found to vary throughout the year as revealed by changes in burrowing patterns. The burrow systems in spring 2001 were denser than that in others years, and the burrow systems in spring 2003 appeared to be partially re-filled close to the surface. This temporal variability demonstrates that it is virtually impossible to obtain true replicates of burrow systems of a given earthworm community without knowing (1) which burrows were created by which species and (2) the burrows age. However, the accurate description and quantification of earthworm burrow systems using powerful image processing tools
allows a detailed discussion of the potential impact of earthworms on soil functions under natural conditions.
A radio-labelled study of earthworm behaviours in artificial soil cores in term of ecological types

**General information**
State: Published
Organisations: Laboratoire Fonctionnement des Ecosystèmes et Biologie de la Conservation
Authors: Bastardie, F. (Intern), Capowiez, Y. (Ekstern), Renault, P. (Ekstern), Cluzeau, D. (Ekstern)
Pages: 320-327
Publication date: 2005
Main Research Area: Technical/natural sciences

**Publication information**
Journal: Biology and Fertility of Soils
Volume: 41
Issue number: 5
ISSN (Print): 0178-2762
Ratings:
- BFI (2018): BFI-level 1
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 1
- Web of Science (2017): Indexed Yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): SJR 1.343 SNIP 1.419 CiteScore 3.76
- BFI (2015): BFI-level 1
- Scopus rating (2015): SJR 1.605 SNIP 1.288 CiteScore 3.05
- BFI (2014): BFI-level 1
- Scopus rating (2014): SJR 1.503 SNIP 1.518 CiteScore 3.44
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 1.454 SNIP 1.658 CiteScore 3.37
- ISI indexed (2013): ISI indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 1.345 SNIP 1.339 CiteScore 2.59
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): SJR 1.318 SNIP 1.342 CiteScore 2.44
- ISI indexed (2011): ISI indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 1.099 SNIP 1.098
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 1.098 SNIP 1.08
- BFI (2008): BFI-level 2
- Scopus rating (2008): SJR 1 SNIP 1.112
- Scopus rating (2007): SJR 0.799 SNIP 1.028
- Scopus rating (2006): SJR 1.141 SNIP 1.227
- Scopus rating (2005): SJR 1.027 SNIP 1.261
- Web of Science (2005): Indexed yes
- Scopus rating (2004): SJR 1.227 SNIP 1.305
- Web of Science (2004): Indexed yes
- Scopus rating (2003): SJR 0.94 SNIP 1.054
- Scopus rating (2002): SJR 1.022 SNIP 1.131
- Web of Science (2002): Indexed yes
- Scopus rating (2001): SJR 1.003 SNIP 1.201
- Scopus rating (2000): SJR 1.11 SNIP 0.948
- Scopus rating (1999): SJR 1.388 SNIP 1.014
Assessment of earthworm contribution to soil hydrology: a laboratory method to measure water diffusion through burrow walls

General information
State: Published
Organisations: National Centre for Scientific Research "Demokritos"
Authors: Bastardie, F. (Intern), Ruy, S. (Ekstern), Cluzeau, D. (Ekstern)
Pages: 124-128
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
Journal: Biology and Fertility of Soils
Volume: 41
Issue number: 2
ISSN (Print): 0178-2762
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 1.343 SNIP 1.419 CiteScore 3.76
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.605 SNIP 1.288 CiteScore 3.05
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.503 SNIP 1.518 CiteScore 3.44
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.454 SNIP 1.658 CiteScore 3.37
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.345 SNIP 1.339 CiteScore 2.59
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.318 SNIP 1.342 CiteScore 2.44
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.099 SNIP 1.098
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.098 SNIP 1.08
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1 SNIP 1.112
Scopus rating (2007): SJR 0.799 SNIP 1.028
Scopus rating (2006): SJR 1.141 SNIP 1.227
Scopus rating (2005): SJR 1.027 SNIP 1.261
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.227 SNIP 1.305
Studying earthworm behaviours: putting the ecological categories to the test

General information
State: Published
Organisations: Unknown
Authors: Bastardie, F. (Intern), Capowiez, Y. (Ekstern), Renault, P. (Ekstern), Cluzeau, D. (Ekstern)
Publication date: 2004
Event: Poster session presented at XIV International Colloquium on Soil Zoology and Ecology, Rouen, France.
Main Research Area: Technical/natural sciences
Publication: Research › Poster – Annual report year: 2004

Burrowing behaviour of radio-labelled earthworm revealed by analysis of 3D-trajectories in artificial soil cores: The 7th international symposium on earthworm ecology, Cardiff, Wales, 2002

General information
State: Published
Organisations: Université d'Avignon et des Pays de Vaucluse, Centre National de la Recherche Scientifique
Authors: Bastardie, F. (Intern), Capowiez, Y. (Ekstern), Cluzeau, D. (Ekstern)
Pages: 554-559
Publication date: 2003
Main Research Area: Technical/natural sciences
Publication information
Journal: Pedobiologia
Volume: 47
Issue number: 5-6
ISSN (Print): 0031-4056
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.737 SNIP 0.73 CiteScore 1.85
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.766 SNIP 0.959 CiteScore 1.83
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.819 SNIP 0.84 CiteScore 1.88
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.944 SNIP 1.015 CiteScore 2.03
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.951 SNIP 0.997 CiteScore 1.88
ISI indexed (2012): ISI indexed yes
X-ray tomographic and hydraulic characterization of burrowing by three earthworm species in repacked soil cores

General information
State: Published
Organisations: Laboratoire Fonctionnement des Ecosystèmes et Biologie de la Conservation
Authors: Bastardie, F. (Intern), Capowiez, Y. (Ekstern), de Dreuzy, J. (Ekstern), Cluzeau, D. (Ekstern)
Pages: 3-16
Publication date: 2003
Main Research Area: Technical/natural sciences

Publication information
Journal: Applied Soil Ecology
Volume: 24
Issue number: 1
ISSN (Print): 0929-1393
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.38
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.84
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.96
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.91
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
3D simulation of earthworm burrow systems by the way of "multi-agent" method

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Management Systems
Authors: Bastardie, F. (Intern)
Publication date: 2002
Event:
Main Research Area: Technical/natural sciences
Publication information
Journal: Biology and Fertility of Soils
Volume: 36
Issue number: 2
ISSN (Print): 0178-2762
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1

A new simulation for modelling the topology of earthworm burrow systems and their effects on macropore flow in experimental soils

General information
State: Published
Organisations: IPREM, Université de Rennes, INRA Institut National de La Recherche Agronomique
Authors: Bastardie, F. (Intern), Cannavacciuolo, M. (Ekstern), Capowiez, Y. (Ekstern), de Dreuzy, J. (Ekstern), Bellido, A. (Ekstern), Cluzeau, D. (Ekstern)
Pages: 161-169
Publication date: 2002
Main Research Area: Technical/natural sciences
Publication information
Journal: Biology and Fertility of Soils
Volume: 36
Issue number: 2
ISSN (Print): 0178-2762
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Studying boundary effects on animal movement in heterogeneous landscapes: the case of Abax ater (Coleoptera: Carabidae) in hedgerow network landscapes

General information
State: Published
Organisations: Centre National de la Recherche Scientifique
Authors: Martin, M. (Ekstern), Bastardie, F. (Intern), Richard, D. (Ekstern), Burel, F. (Ekstern)
Pages: 1029-1035
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Comptes rendus de l'Académie des sciences. Série 3, Sciences de la vie
Volume: 324
Issue number: 11
Projects:

Fishery and Fisheries Ecosystem Impact Modelling
National Institute of Aquatic Resources
Period: 01/06/2017 → 31/05/2020
Number of participants: 5
Phd Student:
Rufener, Marie-Christine (Intern)
Supervisor:
Dinesen, Grete E. (Intern)
Kristensen, Kasper (Intern)
Nielsen, J. Rasmus (Intern)
Main Supervisor:
Bastardie, Francois (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

Evaluation of Sustainable Exploitation of Major Baltic Fish Stocks under different Climate, Eutrophication and Fishing Pressures
National Institute of Aquatic Resources
Period: 01/07/2016 → 30/06/2019
Number of participants: 5
Phd Student:
Bossier, Sieme (Intern)
Supervisor:
Bastardie, Francois (Intern)
Christensen, Asbjørn (Intern)
Neuenfeldt, Stefan (Intern)
Main Supervisor:
Nielsen, J. Rasmus (Intern)
New methodologies for an ecosystem approach to spatial and temporal management of fisheries and aquaculture in coastal areas (ECOAST) (38339)

ECOAST aims to identify, develop and test new methodologies for spatial and temporal management of fisheries and aquaculture in coastal areas. The overall approach will assess the impact of fisheries and aquaculture on coastal ecosystems, including essential fish habitats and conservation priority habitats, as well as synergies and conflicts between human activities.

Building on previous methodologies and experiences the project will evaluate marine spatial planning in seven coastal case study areas having different ecological and socio-economic characteristics: 1) Adriatic Sea (ADR), 2) Ionian Sea (ION), 3) Black Sea (BLK), 4) Tyrrhenian Sea (TYR), 5) Baltic Sea (BAL), 6) Norwegian Fjords (NOR) and 7) NE Atlantic Coasts (ATL).

The project outcomes will produce case specific evaluation of the ecological footprints of aquaculture and fisheries in coastal areas, maps of optimal areas for fisheries and aquaculture, evaluation of compatibility between fisheries, aquaculture and other human activities in coastal areas, as well as implementation of holistic methods and an operational modelling framework to evaluate and predict stakeholder responses to coastal spatial management options covering marine cross sector occupation of space. Several methodologies already exist to assess the impacts on the ecosystem and the socio-economic effects of some spatial management measures, as well as to spatially manage some cross sector marine activities, but none of them integrate all relevant management aspects for coastal areas. Therefore, the holistic methodology will cover in a single system different approaches and management aspects, identifying realistic spatial and temporal potentials and limitations for the integration of fisheries and aquaculture in coastal areas, in order to allow policy makers and stakeholders to evaluate management measures from different points of view and share decisions in a transparent manner on case specific basis. ECOAST results will support the EU and national policies through the provision of tools and data for an ecosystem based allocation of space and sustainable use of marine resources in coastal areas on case specific basis.

This project is coordinated by Institute of Marine Science of the National Research Council, Italy.

This project is funded by EU, COFASP, ERA-NET.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Institute of Marine Science of the National Research Council
Italian National Institute for Environmental Protection and Research
International Research Institute of Stavanger
Institute of Marine Research
Hellenic Centre for Marine Research
National Institute for Marine Research and Development “G. Antipa” Constaata

University of Porto
Period: 01/03/2016 → 31/12/2018
Number of participants: 2
Research area: Fisheries Management
Contact person:
Bastardie, Francois (Intern)
Project participant:
Nielsen, J. Rasmus (Intern)

Baltic Sea project to boost regional coherence of marine strategies through improved data flow, assessments, and knowledge Base for development of measures (BalticBOOST) (39312)

General objectives
The general objective of the project is to enhance regional coherence in the accomplishment of the 2018 reporting under the EU MSFD by developing joint tools, defining data needs and to set up data arrangements to support indicator-based assessments of the state of and pressures on the Baltic Sea. The project take steps towards development of joint environmental targets for pressures affecting seabed habitats by developing a knowledge base and principles for defining
such targets. The project addresses in particular MSFD Descriptors 1, 6, 8 and 11.

BalticBOOST is based on five themes with one or several work packages: Theme 1 (Biodiversity), Theme 2 (Hazardous substances), Theme 3 (Physical loss and damage to seabed habitats), Theme 4 (Noise), and Theme 5 (Joint documentation of Programmes of Measures).

DTU Aqua is involved in themes 3 and 5:
- Theme 3, Physical loss and damage to seabed habitats, develops joint principles for defining environmental targets for pressures affecting seabed habitats (WP 3.1). The development of such environmental targets is challenging and as a starting point the WP explores ways to determine how much disturbance from different activities that specific seabed habitats can tolerate while remaining in Good Environmental Status (GES). Under this Theme, a tool for assessing the impacts of fishing gear on specific habitat types and species is also developed (WP 3.2). Finally, an arrangement for regular collection of data and information on pressures and activities that affect the Baltic Sea is piloted, to provide support to this Theme as well as future assessment of pressures impacting the Baltic Sea (WP 3.3). A shared component across Themes 1-3 is improving access to high quality data to carry out future assessments feeding into the MSFD reporting. This involves alignment of the formats of reported data to relevant international or European data format and making the resultant spatial data products (indicator maps) available as INSPIRE compliant (OGC WMS/WFS) web map services.
- Theme 5, Joint documentation of Programmes of Measures (PoMs), provides support for HELCOM GEAR, the working group responsible for regional coordination in the implementation of the HELCOM BSAP and the MSFD. Support is provided to the agreed development of a joint document on regional coordinated PoMs and a system to follow-up actions agreed by HELCOM.

**Tasks and Deliverables**

DTU Aqua is involved in Theme 3, WP3.1 and especially WP3.2, where we will develop methods for assessing and apply fishing intensity maps according to fishing gear (footprint), explore benthic sensitivity indicators of fishery, and evaluate fishing impact according to MSFD indicators, all with focus on the Femern Belt Case Study. DTU Aqua is responsible for and coordinating the Technical WP3.2 (coordinator Prof. J. Rasmus Nielsen).

This project is coordinated by DTU Aqua.

The project is funded by EU, Calls for proposals/tenders (DG ENV/MSFD Action Plans/2014).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Helsinki Commission - Baltic Marine Environment Protection Commission
Finnish Environment Institute
NIVA Denmark Water Research
University of Tartu
Swedish University of Agricultural Sciences
Totalförsvarets Forskningsinstitut
Latvian Fund for Nature
Swedish Museum of Natural History
Johann Heinrich von Thünen-Institute
Leibniz-Institute for Baltic Sea Research
Secretariat for International Council for the Exploration of The Sea

Period: 15/09/2015 → 31/12/2016
Number of participants: 4
Research area: Fisheries Management
Project participant:
Bastardie, Francois (Intern)
Geitner, Kerstin (Intern)
Phd Student:
Bossier, Sieme (Intern)
Project Coordinator:
Nielsen, J. Rasmus (Intern)
**Tender for scientific support to the Saudi Arabian fisheries sector (SaudiTender I) (39153)**

**Objective**
The general aim of the Fisheries Program at the Marine Studies Section, Center for Environment and Water, Research Institute, King Fahd University of Petroleum and Minerals (KFUPM/RI), is to establish a modern system of data collection, biological and ecological assessment, stock assessment modelling, and government management, in order to evaluate the exploitation status and enhance the sustainability of finfish and invertebrate stocks of Saudi Arabia (SA) Exclusive Economic Zone in the Arabian Gulf. The overall principle underlying this effort is the food security of SA, and the duty to carry out the best efforts to guarantee sustainable exploitation of fishery resources and ensure economic viable fisheries. The Program is organized in four main branches, or Work Packages: Population Dynamics and Stock Assessment, Essential Fish Habitats, Environmental Impacts of Fishing Methods, and Management Strategy Framework.

**Background**
The KFUPM/RI of Saudi Arabia and AZTI-Tecnalia, Marine and Food Research Institute of the Basque Country, Spain, in partnership with DTU-Aqua, runs this project with an extensive collaboration program in fisheries monitoring, research, and management advice. A service contract according has been signed between KFUPM/RI and AZTI. A sub-contract to this service contract has been made between AZTI and DTU Aqua where parts of the service contract forms an integral part of the subcontract and where DTU Aqua is co-responsible for the below listed specific tasks and deliverables.

**Tasks and Deliverables**
Population Dynamics and Stock Assessment: Provision and further development of suitable model software to carry out stock assessment for data limited fish stocks. Stock assessment models suitable to data-poor fisheries are applied to historical catch and effort data (2002-2012) and to data from the new Data Collection Framework (2013-) for major stocks. DTU Aqua is responsible for provision of model software to carry out assessments and application of this to 5 major finfish stocks out of the appointed 13 major stocks exploited by SA in the area. The work include estimation of fish stock growth parameters, performing yield per recruit analyses, and conducting stock assessments with application of a stochastic stock production model using the above data to estimate MSY (Maximum Sustainable Yield) sustainability reference levels according to exploitation. Templates for assessment and advice are developed on the basis of the data and knowledge available in cooperation with AZTI which includes a Stock Summary Sheet for each of the stocks.

Management Strategy Evaluation (MSE) for Major Stocks: Conducting and reporting MSE for data-poor fisheries considering several prospective harvest control rules in the short to medium term according to MSY. This involves identification of biological reference points (biomass- and fishing mortality based reference points) and identification of input or output based harvest control rules according to short term forecast for the 5 major fish stocks. Also, this involves provision and further development of model software to carry out MSE according to MSY in the short to medium term.

Management Strategy Framework: Provision of formal considerations, evaluations, recommendations and reporting of relevant and appropriate management regimes and systems of data collection and stock assessments for scientifically-based advice to the SA Ministry of Agriculture on basis of current fishery system and exploitation of the 13 major stocks. This addresses needs for data, methods, institutional set-up, provision of advice, and possible management systems. This project is coordinated by AZTI Technalia, Spain.

The project is funded by AZTI Technalia, Spain as to KFUPM University Saudi Arabia.

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**National Institute of Aquatic Resources**

**Section for Ecosystem based Marine Management**

**AZTI-Tecnalia**

**King Fahd University of Petroleum and Minerals**

**Period: 01/05/2015 → 30/06/2017**

**Number of participants: 5**

**Research area: Fisheries Management**

**Project participant:**

Pedersen, Martin Wæver (Intern)
Berg, Casper Willestofte (Intern)
Degel, Henrik (Intern)
Bastardie, Francois (Intern)

**Project Coordinator:**

Nielsen, J. Rasmus (Intern)

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**The effect of bottom trawling on marine bottom fauna and eelgrass (ØB Bundfauna) (39192)**

The project provided input to the analysis of the impact of fishing on the ecological quality of the Danish marine environment to the Danish Nature Agency in relation to the water plans needed in connection with the implementation of
the Water Framework Directive. It contained three subprojects:
- Quantifying the area of seabed swept by Danish bottom trawl fisheries.
- Quantifying the impact of bottom trawling on marine benthos.
- Quantifying the possible interaction between bottom trawling and the depth distribution of eelgrass (Zostera marina).
This project was coordinated by DTU Aqua.
The Project was funded by the Danish Nature Agency.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Aarhus University
Period: 01/05/2014 → 31/12/2015
Number of participants: 6
Research areas: Ecosystem based Marine Management & Coastal Ecology & Fisheries Management
Project participant:
Eigaard, Ole Ritzau (Intern)
Bastardie, Francois (Intern)
Egekvist, Josefine (Intern)
Sørensen, Thomas Kirk (Intern)
Project Manager, academic:
Dinesen, Grete E. (Intern)
Project Coordinator:
Gislason, Henrik (Intern)

The shrimp fisheries in the Skagerrak area of Sweden, Norway and Denmark analyzed using a systems perspective (39191)
In recent years the Shrimp stock in the Skagerrak has been drastically reduced. The three countries, who fish on the stock, differ substantially in terms of fleet structure, national quota management, fishing patterns and market. The market situation combined with the quota being fished has led to incentives for discarding of smaller shrimps (high-grading), mainly in the Swedish fishery. Discard of shrimp has been banned in Europe for a few years, and in 2016 more general EU discard ban will be implemented. Therefore the development of more size selective gear is being pushed in several countries.

The developments in the stock, the differences in the three countries’ resource utilization and the coming management changes makes it very interesting to map and compare environmental and socio-economic aspects of the three countries’ shrimp fishing in the Skagerrak. Life Cycle Assessment (LCA) is an ISO-standardized methodology that maps resource consumption and environmental impact of products from a systems perspective. There are now a number of case studies where you look at the role of management in the impact of the product. In these cases the product is mostly followed only during fishing until landing (not during processing, packaging and distribution after landing). A Canadian study compared Canadian and American fishing on the same stock of lobster using LCA and demonstrated significant differences in environmental impacts that mainly depended on the countries' management.

The aim of this study was to quantify a set of indicators that together give a broad picture of the sustainability of the three fisheries to provide an objective basis for a discussion on needed measures. The different indicators concerned environmental, economic or social aspects of sustainability and were quantified per tonne of shrimp landed by each country in 2012. The Danish fishery was most efficient in terms of environmental and economic indicators, while the Swedish fishery provided most employment per tonne of shrimp landed. Fuel use in all fisheries was high, also when compared with other shrimp fisheries. Interesting patterns emerged, with smaller vessels being more fuel efficient than larger ones in Sweden and Norway, with the opposite trend in Denmark. The study also demonstrated major data gaps and differences between the countries in how data are collected and made available. Various improvement options in the areas data collection and publication, allocation of quotas and enforcement of regulations resulted and are described in more detail in a scientific paper in ICES Journal of Marine Science in 2016.

This project was coordinated by SIK-SP Food and Bioscience.
The project was funded by Nordforsk, Nordic Council of Ministers.
Benthic ecosystem fisheries impact study (BENTHIS) (39021)

There is general concern about the adverse impact of fisheries on benthic ecosystem which may negatively affect the fisheries yield and integrity of the sea bed. In an integrated approach to marine management, there is a need to develop quantitative tools to assess the impact of fisheries on the benthic ecosystem and at the same time collaborate with the fishing industry to develop innovative technologies and new management approaches to reduce the impact on benthic ecosystems. BENTHIS will provide the knowledge to further develop the ecosystem approach to fisheries management as required in the Common Fisheries Policy and the Marine Strategy Framework Directive. It will study the diversity of benthic ecosystem in European waters and the role of benthic species in the ecosystem functioning. Fisheries impacts will be studied on benthic organisms and on the geo-chemistry. The newly acquired knowledge will be synthesized in a number of generic tools that will be combined into a fishing/seabed habitat risk assessment method that will be applied to fisheries in the Baltic, North Sea, Western waters, Mediterranean and Black Sea. Fisheries will be selected with the fishing industry based on the impact on the benthic ecosystem. BENTHIS will integrate fishing industry partners to collaborate in testing the performance of innovative technologies to reduce fishing impact. Finally, in collaboration with the fishing industry and other stakeholders, new management approaches will be developed and tested on their effects on the ecosystem and their socio-economic consequences. As such BENTHIS will substantially improve the scientific basis to integrate the role of marine benthic ecosystems in fisheries management.

The project has 33 partners from 12 countries.

The project is coordinated by Institute for Marine Resources & Ecosystem Studies (IMARES), Wageningen University, The Netherlands.

The project is funded by EU, Framework Programme 7.
The aim of this project was to improve the management of western Baltic cod by incorporating stock identification routines in order to discriminate between eastern and western Baltic cod stocks. In recent years evidence from fishery patterns and otolith structures have indicated an increasing degree of mixing between the two cod stocks which up until 2013 were managed as two separate stocks. Changes in fishing pressure and patterns would therefore result in a risk for local depletion of the smaller western stock.

Stock identification methods were based on established approaches using genetic discrimination and otolith shape analysis, and improved by linking these methods. This method provides a tool to estimate the degree of stock mixing using the existing otolith archives. This approach documented an increase of eastern Baltic cod from 30% to > 80% in the eastern part of the western Baltic Sea management area. As a consequence of this stock mixing, a new procedure incorporating stock mixing on an annual basis was set in place in 2016. As a consequence of this stock mixing, a new procedure incorporating stock mixing on an annual basis was set in place in 2016. The knowledge gained also influenced recent management regulations, particularly a prolongation of spawning closer of the fishery in 2016.

The project was coordinated by Centre for Environment, Fisheries & Aquaculture Science, UK. The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

National Institute of Aquatic Resources
Section for Marine Ecology and Oceanography
Cefas
Period: 27/06/2011 → 29/03/2013
Number of participants: 18
Research areas: Marine Populations and Ecosystem Dynamics & Marine Living Resources & Population Genetics & Fisheries Management
Project participant:
- Hansen, Jakob Hemmer (Intern)
- Huwer, Bastian (Intern)
- Bastardie, Francois (Intern)
- Eero, Margit (Intern)
- Nielsen, J. Rasmus (Intern)
- Worsøe Clausen, Lotte (Intern)
- Mosegaard, Henrik (intern)
- Storr-Paulsen, Marie (Intern)
- Olesen, Hans Jakob (Intern)
- Kirkegaard, Eskild (Intern)
- Larsen, Peter Vinggaard (Intern)
- Hansen, Frank Ivan (Intern)
- Lundgaard, Louise Scherffenberg (Intern)
- Willandsen, Maj-Britt (Intern)
- de Jong, Noortje (Intern)
- Mensberg, Karen-Lise Dons (Intern)
- Meldrup, Dorte (Intern)
Project Coordinator:
- Hüsey, Karin (Intern)
Project

Socio-economic effects of management measures of the future CFP (SOCIIOEC) (38940)
Objectives and Background
The main aim of the SOCIIOEC FP7-KBBE-2011-5 project under KBBE.2011.1.2-10 (Socio-economic effects of the main management principles of the future CFP: impact of new policy framework and opportunities for the fishing sector) was to evaluate innovative fisheries management measures and develop self- and co-management. It has been important that the project focused on the interpretation of overarching (i.e. EU) objectives in local and regional contexts.

Deliverables and Tasks
In the first step the project developed a coherent and consistent set of objectives for fisheries management, which
addressed ecological, economic and social sustainability targets. The objectives were consistent with the aims of the CFP, MSFD and other EU directives, but also understandable by stakeholders and the community and engaged their support. This led to the proposal of a number of innovative management measures, based on existing or new approaches. The second step was to analyze the incentives for compliance provided by these measures through examination of fisher’s responses to and perceptions of measures based on historical analysis, direct consultation and interviews, and how the governance of the measures operated.

Finally, the project examined the impact of the measures that emerge from this process, particularly in terms of their economic and social impacts on the industry and the wider community. All this was done through a generic analysis of the wide range of current and emerging measures in the current CFP and possible measures introduced in the future. This required and has resulted in interdisciplinary work across a range of scientific disciplines (economics, social and natural sciences).

DTU Aqua was involved in the North Sea and Baltic Sea case studies and in the project Steering Group. For the North Sea, DTU Aqua focused on analyses of catch quotas compared to landing quotas in mixed consume fisheries including related discard processes. Also, small meshed pelagic fisheries in the North Sea were addressed for efficient management of those. For the Baltic Sea, DTU Aqua focused on evaluation of spatial management measures among other in relation to NATURA 2000 areas and implementation of windmill farms, and larger marine constructions. This resulted in evaluation of success and failures of several management measures, and enabled us to draw conclusions on which measures are best introduced in which circumstances, possibly on a regional basis. On this basis DTU Aqua has produced several peer reviewed journal papers under SOCIOEC. In the CFP we need to distinguish between the basic, overarching regulations of the EU or regional seas level and the specific and local management by Member States in sea areas where self- and co-management schemes are often already informally in place. Here the cooperation with the ACs was essential to derive objectives applicable for the CFP based on the ecological, economic and social drivers and to reconsider management at more regional or local levels. This process involved: (i) investigation of how the objectives regarding ecological, economic and social sustainability could be defined in the short term and ensures the long-term sustainability and viability of fisheries; (ii) analyzing which management measures and at what organization level, created the right incentives to tackle structural failings in the CFP with focus on technical measures, command and control instruments (TACs, quotas, effort), market instruments (transferability of collective or individual rights) and social instruments (self- or co-management possibilities); and (iii) determination of the socio-economic and spatial effects of these management measures.

The project had 30 project participants from European universities and National Fisheries Economics and Fisheries Research Institutes as well as SMEs.

The project was coordinated by Institute of Sea Fisheries, Johann Heinrich von Thünen Federal Research Institute for Rural Areas, Forestry and Fisheries, Germany.

The project was funded by EU, Framework Programme 7.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Period: 01/01/2011 → 31/12/2014
Number of participants: 4
Research area: Fisheries Management
Project participant:
Bastardie, Francois (Intern)
Ulrich, Clara (Intern)
Eigaard, Ole Ritzau (Intern)
Project Manager, academic:
Nielsen, J. Rasmus (Intern)

Vectors of change (VECTORS) (38907)
Marine life makes a substantial contribution to the economy and society of Europe. VECTORS aimed at elucidating the drivers, pressures and vectors that cause change in marine life, the mechanisms by which they do so, the impacts that they have on ecosystem structures and functioning, and on the economics of associated marine sectors and society. VECTORS particularly focused on causes and consequences of invasive alien species, outbreak forming species, and changes in fish distribution and productivity. New and existing knowledge and insight was synthesized and integrated to project changes in marine life, ecosystems and economies under future scenarios for adaptation and mitigation in the light of new technologies, fishing strategies and policy needs. VECTORS also evaluated current forms and mechanisms of marine governance in relation to the vectors of change. Based on its findings, VECTORS outlined solutions and tools for relevant stakeholders and policymakers during the lifetime of the project. The VECTORS consortium included a mixture of natural scientists with knowledge of socio-economic aspects, and social scientists (environmental economists, policy and governance analysts and environmental law specialists) with interests in natural system functioning.

DTU Aqua contributed to VECTORS by developing new statistical models of fish species distributions, by further
developing spatially resolved bio-economic models of fishing, and by analyzing fish species richness and distribution in the north Atlantic and the general relationship between changes in fish stock abundance and distribution area. We coordinated the Baltic WP where we implemented the ATLANTIS end-to-end model and performed initial scenario testing. We also analyzed the most important drivers of fish population dynamics in the Baltic, and contributed to the study of invasive species.

VECTORS comprised a total of 37 European Universities, research institutions and professional associations dealing with applied maritime and marine research.

The project included marine environmental scientists, fisheries scientists, conservation biologists, sociologists and economists from across the European scientific community providing expertise in marine ecosystems, management, fisheries, maritime transport, tourism and coastal development.

The project was coordinated by Plymouth Marine Laboratory, UK.

The project was funded by EU, Framework Programme 7.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Period: 01/01/2011 → 31/01/2015
Number of participants: 9
Research areas: Ecosystem based Marine Management & Fisheries Management & Marine Living Resources
Contact person:
Köster, Fritz (Intern)
Project participant:
Nielsen, J. Rasmus (Intern)
Lewy, Peter (Intern)
Rindorf, Anna (Intern)
Bastardie, Francois (Intern)
Kristensen, Kasper (Intern)
Huwer, Bastian (Intern)
Project Manager, academic:
Gislason, Henrik (Intern)
Eero, Margit (Intern)

Integrated management of agriculture, fishery, environment and economy – a strategic research alliance (IMAGE/MAFIA) (38772)

Background and Objectives
Management of terrestrial and aquatic ecosystems is legally defined in several European directives. The scientific basis for implementing the directives has been limited by insufficient models, deficiencies in terms of uncertainties, local and regional aspects and lack of knowledge on the interplay between agriculture, fishery, environmental qualities in all surface waters, and economy. The project aimed to establish an interdisciplinary and international approach designed to establish a body of knowledge to develop tools, models, scenarios and predictions in order to integrate science and management from agriculture, fishery, aquatic environments and economy into a common platform. The main aims were to link the complex interplay between land use in the drainage basins, the transport of nutrients to water bodies, biogeochemistry of freshwater and marine water, marine ecosystem dynamics and the removal of biomass and nutrients in marine fisheries all integrated into a management strategy evaluation (MSE) framework consisting of linked catchment area and river-run-off models, marine bio-geo-chemical models, end-to-end marine ecosystem models, fishery models, economic and cost-minimization models, and ecosystem services assessments models. Such a complex model and MSE framework could be used to assess effects of changing market conditions, changed agricultural and fishery support policies, as well as fulfillments of water related directives.

Tasks and Deliverables
The Danish Strategic Research Council financed project IMAGE was a strategic research alliance between central Danish and international fisheries and marine environment based university institutes. The project integrated, educated, and trained new researchers and private and public end-users to develop and work with a number of empirical and dynamic models and management tools, further developed into cross traditional media and science-based decision support systems, to strengthen national and international environmental management. The results published in a high number of scientific peer reviewed articles have provided major scientific progress. The results and research quality included analyses of novel processes and development of new and improved models, integrated prognoses and scenarios for the interplay between changes in the drainage basins and the ecological and economic consequences, and a number of science-based decision support tools. The work involved (i) identification of key elements and reduction of uncertainties in using complex models, (ii) designing, developing and integrating important new concepts in the models, (iii) linking models
and evaluating their ability to detect and follow changes in terrestrial environments into ecological and economic consequences, and (iv) strengthened Danish research in linking science, modeling and management of the environment and economics and thereby consolidating a strong international position. The DTU Aqua has focused on further development, implementation and validation of advanced models and fisheries and ecosystem management evaluation tools: Development, calibration and implementation of the Baltic ATLANTIS end-to-end ecosystem and tropho-dynamic model linked to the HBM-ERGOM physical and bio-geo-chemical models and the FISHRENT fishery economic model; Further development and implementation of the bio-economic and individual vessel based multi-stock-multi-fleet DISPLACE simulation model; Dynamic coupling of the Baltic FLR multi-stock-multi-fleet bio-economic model to the SMS-Multi-Species model. The focus has been on biological interactions and integrated fisheries interactions.

**Partners**
The project had 12 project partners mainly from Danish universities (AU, DTU, KU, SDU) and national fisheries economics and fisheries research institutes (SMHI Sweden), but also from American, Swedish and Finnish universities as well as SMEs (e.g. DHI). The project was coordinated by Aarhus University. DTU Aqua was main project developer, WP4 leader and member of the Project Steering Group.

This project was funded by the Danish Council for Strategic Research.
Development of tools for logbook and VMS data analysis (38751)

Objectives and Background
The project “Development of tools for logbook and VMS data analysis” was an EU project under studies for carrying out the common fisheries policy (No MARE/2008/10 Lot2). The aim of the project was to develop a set of standard protocols for coupling and simultaneous analyses of EU fisheries logbook and VMS satellite vessel record data.

Tasks and Deliverables
The process began with the construction of standardized data formats for logbook (EFLALO) and VMS (TACSAT). The software for analyzing the data took the form of a fully documented package called vmstools, built using the freeware package, R (http://cran.rproject.org/). Once the data have been imported into R in the correct format, a series of R programs or ‘functions’ enable all tasks necessary to be completed in a single software environment. The software can ‘clean’ data and format input data, estimate distances between VMS positions, and métiers can be identified objectively from species assemblages in catch data using multivariate statistical techniques.

We have included a range of complimentary methods for determining fishing activity from VMS position registrations. Positions at sea, for example, can be distinguished from vessels in harbor or erroneous positions on land. Position registrations of vessels actually fishing can be separated from those engaged in other activities (e.g. steaming) using their speed in conjunction with other information such as vessel size and gear being used. Logbook and VMS data can be merged such that high-resolution spatial maps of catches of various commercial species can be generated. Individual vessel tracks can be reconstructed for more realism through different interpolation techniques (both linear and non-linear, i.e. using Hermite spline functions). Further, all the fishing activity indicators required under the Data Collection Framework can be calculated using vmstools. The package can also be used to explore the impact of different spatial (grid size) and temporal aggregations (month, quarterly, annual) which need to be explicitly considered when assessing fishing impact on the sea floor. There are also scripts for displaying results using Google Earth which is a useful aid for dissemination.

The combination of all these routines ‘under one roof’ permitted and permits the construction of ‘Regional’ databases (i.e. FishFrame developed by DTU Aqua - a regional database hosted by one of the project partners) and scripts to produce output suitable for this are included with the vmstools package.

As proof of concept, all analyses performed within each work package have been tested, using the vmstools package, against national datasets with contributions from the French, Danish, Irish, UK and Dutch institutes. As an example, FishFrame has been populated with Dutch and Danish combined VMS and logbook data for 2005-2009. The project demonstrated emphatically that logbook and VMS data from disparate countries with often different data collection regimens can be combined and compared using generic tools and that the output can be sent to regional databases permitting more holistic assessments of fishing activity.

The project has built further on the networks and platforms produced under EU FP6 EFIMAS Project coordinated by DTU Aqua, and the DTU Aqua team associated with the project has produced several peer reviewed journal papers under Lot 2.
The project is coordinated by Institute for Marine Resources and Ecosystem Studies (IMARES), Wageningen UR, The Netherlands. This project is funded by EU, Framework Programme 7.

Software Engineering
National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Wageningen IMARES
Cefas
IFREMER
Marine Scotland
Sea Fisheries Institute

Marine Institute
Period: 01/01/2009 → 31/12/2012
Number of participants: 5
Research areas: Fisheries Management & Marine Living Resources

Project participant:
Bastardie, Francois (Intern)
Ulrich, Clara (Intern)
Egekvist, Josefine (Intern)
Degel, Henrik (Intern)

Project Manager, academic:
Nielsen, J. Rasmus (Intern)

Fehmarn Belt science provision project: Fehmarn Belt fish and fisheries and related environmental investigations (38669)

Objectives and Background
The purpose of the project was to investigate main exploited fish stock and fisheries dynamics in relation to the marine environment with focus on the Fehmarn Belt area in the Western Baltic Sea, and to provide science and research based investigations and results, as well as reports and scientific peer reviewed journal papers on this. The work was associated to the scientific baseline investigations (2009-13) and impact assessment of the projection of the Fehmarn Belt Fixed Link between Denmark and Germany involving a science cooperation between DTU Aqua, Thünen-Institute and Femern Bælt A/S in order to generate knowledge on potential impacts of establishment of the fixed link. Focus was on the most important commercial fisheries and fish stocks in the area (cod, herring, and sprat, but also flatfish and eels).

Tasks and Deliverables
The work covered WP0: Prospecting, planning and development of the investigations, producing outline and main contents of the science provision contract and coordination of tasks hereunder with DTU Aqua as inter-national project coordinator; WP1: Review of know-led-ge: Review, provision of data, and analyses of selected historical data on fish stock and fisheries dynamics; WP2: Extension of existing, standard research surveys and linking to standard survey time series to detect potential effects on important fish stocks; WP3: Evaluation of potential integrated effects on important fish stocks and fisheries; WP4: Evaluation of potential effects of change and variability in hydrographic features and conditions on recruitment for important fish stocks (cod, herring, sprat); WP5: Evaluation of herring occurrences and migrations as well as separation of spring and autumn spawning herring stock components in the area.

WP 1 included provision of state of the art knowledge from historical surveys and review of quality of survey indices, commercial fisheries data, and information on recruitment dynamics with emphasis on fluctuations in distribution and productivity with respect to environmental and anthropogenic drivers of change including species interactions and fisheries.

WP 2 included extension of existing standard surveys in the near field area and analyses of both the standard and extended time series with respect to variability in distribution, density and abundance patterns of relevant stocks, as well as developing advanced scientific survey evaluation models and methods for doing this.

WP 3 analyzed stock and fisheries dynamics by use and development of complex multi-fleet-multi-stock bio-economic management evaluation models performing analyses on a very high spatial and temporal resolution scale using integrated fisheries, stock and survey data. The models evaluated different management options and scenarios relevant for the establishment of the fixed link.

WP 4 evaluated variability in recruitment and important spawning areas according to hydrographic features and in relation to impact of the fixed link among other by use and further development of complex hydro-dynamic models.

WP 5 evaluated herring stock occurrence and migration patterns in the Baltic area by use of genetic identity markers, otolith micro-structures and information from fisheries and research surveys in order to evaluate impact of the fixed link.
The project has besides a long row of project reports produced around 30 scientific peer reviewed journal papers where DTU Aqua are first author on more than half and co-author on more than 20 of the papers. The project was coordinated by DTU Aqua. The project was funded by the 3 partners with external Funding from Femern Bælt A/S.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Johann Heinrich von Thünen-Institute
Femern A/S
Period: 01/01/2009 → 31/12/2013
Number of participants: 15
Research areas: Fisheries Management & Fish Biology & Marine Living Resources & Population Genetics
Project participant:
Worsøe Clausen, Lotte (Intern)
Bastardie, Francois (Intern)
Bekkevold, Dorte (Intern)
Huwer, Bastian (Intern)
Hüssy, Karin (Intern)
Storr-Paulsen, Marie (Intern)
Stæhr, Karl-Johan (Intern)
Sparrevohn, Claus Reedtz (Intern)
Jepsen, Niels (Intern)
Lewy, Peter (Intern)
Kristensen, Kasper (Intern)
Dutz, Jörg (Intern)
Christensen, Asbjørn (Intern)
Geitner, Kerstin (Intern)
Project Coordinator:
Nielsen, J. Rasmus (Intern)

Development of fisheries with minimized emission of greenhouse gases (38686)

Identification of methods and prioritization of areas for actions of minimizing greenhouse gas emissions, optimizing fuel consumption and, thus, improve the economy and reducing the environmental effects of fishing on marine habitats. The focus is on fishing with trawls. Two different strategies (work packages) are considered in the project:

1) Development of new and more energy efficient trawls: This work package targets the development of trawl design with improved relationship between capture efficiency and/or catch value in relation to energy use for towing the gear. In this work package we apply an internationally developed computational model based on fluid mechanics and finite element methods and models to predict the capture efficiency of trawl. Through computer simulations we investigate the predicted ratio between catch value and fuel consumption for different trawl designs. These simulations are accordingly applied to identify the most favorable trawl design with optimized value of the catch in relation to the fuel consumption to tow the trawl. Through international cooperation, we also experimentally examine the consequences on catch efficiency of applying high strength thin twine netting with low drag in sections of trawls.

2) Fisheries tactics and management in relation to energy efficiency in fisheries effort allocation for different fisheries: This work package analyze management options for different types of fisheries, to investigate opportunities and incentives to achieve the same value (and catch) in fisheries with less effort or re-allocation of effort and consequently less fuel consumption. Advanced computer based bio-economic fisheries simulation models are developed and used in fleet and stock-based scenario analyses for energy efficiency in fishery by integrated evaluation of fishing effort, catch, catch composition and utilization, economics, and fuel consumption under given effort allocation schemes. This involves development and implementation of a generic bio-economic Individual Based Model (IBM) that works on individual vessel basis and which can simulate multi-stock-multi-fleet (mixed) fisheries and evaluate on a scale of very high resolution in time and space. This computer based management evaluation tool and simulation model can evaluate economic cost-benefits, biological impacts according to fish stock sustainability, as well energy efficiency according to catch in weight and value per fuel volume consumed and/or in relation to total fuel costs for different management scenarios. The implementation of the IBM model involves additionally development of advanced statistical and computer based models and methods for coupling information from logbook databases with information from VMS tracking (satellite monitoring) databases on vessel and fishing trip basis. Furthermore, it involves development of a web-based questionnaire and platform to obtain information from the Danish fishery on cost dynamics with focus on fuel costs and effort allocation.
The project is coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management

IFREMER

Johann Heinrich von Thünen-Institute

Technical University of Denmark
Period: 01/01/2008 → 31/12/2012
Number of participants: 7
Research area: Fisheries Technology & Fisheries Management
Project participant:
Krag, Ludvig Ahm (Intern)
Bastardie, Francois (Intern)
Andersen, Bo Sølgaard (Intern)
Eigaard, Ole Ritzau (Intern)
Madsen, Niels (Intern)
Project Manager, academic:
Herrmann, Bent (Intern)
Nielsen, J. Rasmus (Intern)

**Marine ecosystem evolution in a changing environment (MEECE) (38131)**

In order to advance our understanding and the predictive capacities necessary to resolve how marine ecosystems will respond to global change MEECE employed a combination of data synthesis, numerical simulation and targeted experimentation to further our knowledge of how marine ecosystems will respond to combinations of these climate change and anthropogenic drivers.

A key objective of MEECE was to advance model coupling across trophic levels and create concepts and infrastructure to enable end-to-end modeling, from physics to fish, which has empirically been difficult due to different space and time scales involved, as well as relative emphasis of statistical and mechanistic aspects. Finally MEECE integrated modeling advancements with fishery management perspectives.

The project was coordinated by Plymouth Marine Laboratory, UK, and had 21 partners from the EU.

The project was funded by EU, Framework Programme 7.

National Institute of Aquatic Resources
Section for Marine Living Resources
Period: 01/01/2008 → 15/10/2012
Number of participants: 11
Research areas: Marine Living Resources & Marine Populations and Ecosystem Dynamics & Fisheries Management
Acronym: MEECE
Contact person:
Christensen, Asbjørn (Intern)
Project participant:
Vinther, Morten (Intern)
Neuenfeldt, Stefan (Intern)
MacKenzie, Brian (Intern)
Nielsen, J. Rasmus (Intern)
Eero, Margit (Intern)
Andersen, Ken Haste (Intern)
Bastardie, Francois (Intern)
Neumann, Viola (Intern)
Grigorov, Ivo (Intern)
Project Manager, academic:
Köster, Fritz (Intern)
Indicators for fisheries management in Europe (IMAGE) (38225)

The Common Fisheries Policy (CFP) requires the progressive implementation of an ecosystem-based approach to fisheries management (EBFM). To implement effective management, it is essential to develop a framework that allows for the evaluation of different management strategies based on indicators. Indicators can support the decision making process by (i) describing the pressures affecting the ecosystem, the state of the ecosystem and the response of managers, (ii) tracking progress towards meeting management objectives and (iii) communicating trends in complex impacts and management processes to a non-specialist audience. The aim of this project was to develop an indicator-based operational framework that can support ecosystem-based management, and also show how this can be applied to test and evaluate different management strategies or sampling programs.

The principal objectives of IMAGE were:-To develop an operational framework of candidate indicators (ecological, economic, social) that can support ecosystem-based fisheries management at the regional and pan-European scale-To elaborate these indicators in comprehensive dashboards (e.g. current values, trends, reference levels)-To develop methodology to integrate this information into tools supporting the decision-making process-To develop a framework that can evaluate management strategies based on indicators-To advise on how indicators can be used to support EBFM in selected regional case studies based on the RAC areas.

The project consisted of a conceptual phase where the operational framework was designed. This was followed by a phase of methodology development, an implementation phase consisting of regional case studies linked to the RACs and finally a pan-European evaluation and synthesis of the projects results. The results of this project contribute to the development of an effective EBFM in the context of the CFP, while also contributing to the applied science needed to support the emerging European Marine Strategy and Maritime Policy.

The project was coordinated by Institute for Marine Resources and Ecosystem Studies (IMARES), The Netherlands.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Wageningen IMARES
Cefas
IFREMER
Aalborg University
COISPA Tecnologia & Ricerca
University of Tartu
Period: 01/01/2006 → 31/12/2009
Number of participants: 11
Research area: Ecosystem Based Marine Management
Contact person:
Nielsen, J. Rasmus (Intern)
Köster, Fritz (Intern)
Project participant:
Jarre, Astrid (Intern)
Bastardie, Francois (Intern)
Andersen, Ken Haste (Intern)
Sørensen, Thomas Kirk (Intern)
Mosegaard, Henrik (Intern)
Thomsen, Kirsten (Intern)
Tomczak, Maciej (Ekstern)
Jacobsen, Jonathan Broch (Ekstern)
Project Manager, academic:
Eero, Margit (Intern)
Management plans and Danish fishery (2245)
The objectives of the project were with reference to the EU Commissions proposals on multi-annual management plans, to deliver high quality advice on management of the fishing effort in Danish fisheries in the Baltic Sea, the North Sea, the Skagerrak and the Kattegat.

To be able to deliver the advice the project addressed the need for detailed and accurate data on catches, effort and economical performance in the main demersal Danish fisheries in the concerned areas and the need for accurate stock assessment of the economically most important fish and shellfish stocks. The project also developed a systematic method to give a qualified prediction of the selectivity of a trawl based on information on the trawl design.

The project included seven work packages: (i) Description of development in catches, fishing effort and economical performance of the main demersal Danish fisheries including creation of a single database; (ii) Develop a reference fleet system to collect detailed information on catches and fishing effort; (iii) Development of a software to be used to simulate trawl selectivity; (iv) Establish a fisheries independent monitoring survey on Norway lobster in the Skagerrak and the Kattegat; (v) Provide advice on a fishing effort management system for the demersal fisheries in Kattegat including proposal for enhancement of the cod selectivity in trawl fisheries; (vi) Provide advice on fishing effort in form of days at sea by métier; and (vii) Evaluate the impact of the effort management system in the Baltic Sea on the Danish fishery and the stocks.

The project was coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
University of Copenhagen
Period: 01/01/2006 → 31/12/2008
Number of participants: 13
Research areas: Fisheries Management & Fisheries Technology
Project participant:
Munch-Petersen, Sten (Intern)
Madsen, Niels (Intern)
Bastardie, Francois (Intern)
Pedersen, Eva Maria (Intern)
Christensen, Steen (Ekstern)
Project Manager, academic:
Kirkegaard, Eskild (Intern)
Andersen, Bo Sølgaard (Intern)
Jørgensen, Ole A. (Intern)
Herrmann, Bent (Intern)
Storr-Paulsen, Marie (Intern)
Dalskov, Jørgen (Intern)
Nielsen, J. Rasmus (Intern)
Krag, Ludvig Ahm (Intern)

Understanding the mechanisms of stock recovery (UNCOVER) (38104)
The UNCOVER project has produced a rational scientific basis for developing Long-Term Management Plans (LTMP) and recovery strategies for 11 of the ecologically and socioeconomically most important fish stocks/fisheries in the Norwegian and Barents Seas, the North Sea, the Baltic Sea and the Bay of Biscay and Iberian Peninsula.

UNCOVER’s objectives were to:
(i) identify changes experienced during stock depletion/collapses,
(ii) to understand prospects for recovery,
(iii) to enhance the scientific understanding of the mechanisms of fish stock/fishery recovery, and
(iv) to formulate recommendations how best to implement LTMPs/recovery plans.

The project recommends that such plans ideally should include:
(i) Consideration of stock-regulating environmental processes,
(ii) Incorporation of fisheries effects on stock structure and reproductive potential,
(iii) Consideration of changes in habitat dynamics due to global change,
(iv) Incorporation of biological and technological multispecies interactions,
(v) Integration of economically optimized harvesting,
(vi) Exploration of the socio-economic implications and political constraints from existing and alternative recovery plans,
Investigations on the acceptance of plans by stakeholders and specifically incentives for compliance by the fishery.

UNCOVER has provided imperative policy support underpinning the following fundamental areas:
(i) Evolution of the Common Fisheries Policy with respect to several aims of the ‘Green Paper’;
(ii) Contributing to the Marine Strategy Framework Directive with respect to fish stocks/communities;
(iii) achieving Maximum Sustainable Yield (MSY) for depleted fish stocks. This has been done by contributing to LTMPs/recovery plans for fish stocks/fisheries, demonstrating how to shift from scientific advice based on limit reference points towards setting and attaining targets such as MSY, and furthering ecosystem-based management through incorporating multispecies, environmental and habitat, climate variability/change, and human dimensions into these plans.

The project was coordinated by Institut für Ostseefischerei, Bundesforschungsanstalt für Fischerei, Germany.

National Institute of Aquatic Resources
Section for Marine Living Resources
Bundesforschungsanstalt für Fischerei
Marine Research Unit, Marine and Food Technological Centre
Cefas
University of Portsmouth
Marine Laboratory
Instituto Español de Oceanografía
Aalborg University
Leibniz Institut für Meereswissenschaften, Universität Kiel
IFREMER
Institute of Marine Research
Sea Fisheries Institute
Knipovich Polar Research Institute of Marine Fisheries and Oceanography
Nederlands Instituut voor Visserij Onderzoek b.v.
University of Aberdeen
University of Bergen
University of Hamburg
Period: 01/01/2006 → 31/12/2010
Number of participants: 14
Research areas: Marine Living Resources & Fish Biology
Contact person:
Köster, Fritz (Intern)
Project participant:
Tomkiewicz, Jonna (Intern)
Vinther, Morten (Intern)
Payne, Mark (Intern)
Munk, Peter (Intern)
Støttrup, Josianne Gatt (Intern)
Storr-Paulsen, Marie (Intern)
Eg Nielsen, Einar (Intern)
Brander, Keith (Intern)
Andersen, Ken Haste (Intern)
Huwer, Bastian (Intern)
Bastardie, Francois (Intern)
Project Manager, academic:
Neuenfeldt, Stefan (Intern)
MacKenzie, Brian (Intern)
Comparative evaluations of innovative solutions in European fisheries management (CEVIS) (38105)
CEVIS is an FP6 project that assessed potential innovations for European fisheries management regimes with respect to four general management objectives: biological robustness, economic efficiency, the cost effectiveness of management activities, and social robustness. CEVIS examines four types of regime-level innovations: the use of participatory approaches to fisheries governance, rights-based regimes, effort-control regimes and decision rule systems. These innovations are assessed in respect to four general management objectives: biological robustness, economic efficiency, the cost effectiveness of management activities, and social robustness. The four regime level innovations measured against the four general management objectives define the CEVIS research's conceptual framework. The conceptual framework is tested against four European test cases. However, before these case studies begin, the research will take a close look at international cases of innovative fisheries management in other developed countries. Visits will be made to four places outside the EU that have similar fisheries and have implemented these four types of innovations.

The project has built further on the networks and platforms produced under EU FP6 EFIMAS project (38094) which DTU Aqua coordinated, and the DTU Aqua team associated to the project has produced several peer reviewed journal papers under CEVIS and been co-authors to a book published by Elsevier in relation to CEVIS. Besides this, CEVIS has two final products. The first is an Innovation Evaluation Framework made up of indicators of inputs and outcomes in relation to the four general management objectives. This is an aid to fisheries managers wishing to assess the suitability of possible changes in EU fisheries management practice. The second is a report based on the case studies that evaluates this specific set of potential regime-level innovations for use in EU fisheries management. The developed framework makes it possible for managers to evaluate the extent to which any given management system will contribute positively to attaining Common Fisheries Policy objectives. A range of options for implementing cost-effective and participatory management systems have been provided and finally, the CEVIS project helps fishery managers to be better informed about the ecological, social and economic consequences of implementing any particular management regime.

The project was coordinated by Innovative Fisheries Management (IFM), Aalborg University, Denmark.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Aalborg University
University of Copenhagen
Marine Scotland
University of Tromsø
Lulea University of Technology
Institute of Marine Research
European Commission - Joint Research Center
Sea Fisheries Institute
Marine and Food Technological Centre
Öko-Institut
Netherlands Institute for Fisheries Research
Period: 01/01/2005 → 31/12/2009
Number of participants: 5
Research area: Fisheries Management
Project participant:
Bastardie, Francois (Intern)
Ulrich, Clara (Intern)
Baodrun, Alain (Ekstern)
Sparre, Per J. (Ekstern)
Project Manager, academic:
Nielsen, J. Rasmus (Intern)

Operational evaluation tools for fisheries management options (EFIMAS) (38094)
Existing models in fisheries management advice (FMA) only consider effects of overall fishing on single fish stocks, while not taking broader ecosystem, social and economic impacts of management decisions into account. Mixed fisheries aspects where several fishing fleets fish on several stocks in the same fishery, spatial planning, and long-term
In response to this situation, managers launched EFIMAS aiming to develop alternative management evaluation tools and management strategies that have broader, multi-disciplinary and long-term perspectives. These include social and economic impacts and ecosystem impacts (e.g. by-catch and discards), besides biological consequences on single stocks.

This is a new way of thinking international fisheries research and FMA, by developing conceptual and comprehensive multi-fleet and multi-stock bio-economic simulation tools and management evaluation frameworks (MEF), being spatial and seasonal explicit. A successful implementation of ecosystem, social and economic dynamics and factors on a spatial scale in the advisory process is a major leap towards more holistic and sustainable management within EU waters and fisheries. MEFs enable higher degree of participatory management evaluation by involving various stakeholders in FMA.

EFIMAS, and sister projects, develop and integrates a set of new and existing software tools and simulation models (especially FLR – Fisheries Library in R), generating a more robust Management Strategy Evaluation (MSE) framework, that allows testing plausible hypotheses about dynamics of fish stocks, fisheries and fleets.

The MEF contributes to a conceptual change and paradigm shift in generating advice and management with entire fleets and fisheries as the central units. Here the basic management instrument is the input, i.e. the capacity of fishing fleets, the vessel efficiency, and the effort (activity). This differs from the traditional output based ICES approach, providing advice on single fish stock catch limit from rather uncertain terminal year stock assessments and under strong assumptions on future total stock fishing mortality (F) without much consideration on factors, creating and controlling F and partial Fs by fleet.

The developed frameworks allow simulating and evaluating, respectively, the biological, social and economical consequences of a range of proposed management options and objectives within different management regimes. They can evaluate fleet and mixed fisheries interactions and fisheries behavior, uncertainties in stock and fisheries dynamics, data collection, assessment, modelling, as well as the advisory management and implementation processes. Being capable of evaluating the relative performance of multiple alternative options the MEFs possess strong capacity in performing sensitivity and risk analyses of consequences.

Managing fisheries in a virtual environment provides more reliable scientific advice to stakeholders: In the same way that a pilot might fly in a simulator before flying for real, the simulation tools evaluates the robustness of alternative strategies and virtual regimes to give more holistic FMA in broader context before implementation. This provides managers and stakeholders a better idea of the consequence of a given strategy or intervention before opting for a particular management approach.

The overall evaluation comprises process evaluation (PE) and technical evaluation (TE). PE focuses on participatory management. Here participatory and iterative scenario-based MEF modelling is used to obtain input and cyclic feedback from multiple stakeholders for different options, and to test the general utility of the operational MEF.

Participants: 30 European universities and national fisheries research institutes with biological and economic expertise as listed under www.efimas.org.

The project was coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Period: 01/01/2004 → 31/12/2009
Number of participants: 11
Research area: Fisheries Management
Project participant:
Bastardie, Francois (Intern)
Munch-Petersen, Sten (Intern)
Eigaard, Ole Ritzau (Intern)
Andersen, Bo Solgaard (Intern)
Nielsen, Jacob (Ekstern)
Blæsbjerg, Mette (Intern)
Vestergaard, Ole (Intern)
Project Manager, academic:
Ulrich, Clara (Intern)
Degnbol, Poul (Ekstern)
Sparre, Per Johan (Intern)
Project Coordinator:
Nielsen, J. Rasmus (Intern)

Project

Activities:

**ICES - Working Group on Spatial Fisheries Data - WGSFD (External organisation)**

**Period:** 2015

Francois Bastardie (Participant)

National Institute of Aquatic Resources

Section for Ecosystem based Marine Management

Degree of recognition: International

Related external organisation

**ICES - Working Group on Spatial Fisheries Data - WGSFD**

Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

**Recent changes in stock conditions and spatial mixing on sustainability and economic viability of the fishery - The Danish Baltic cod fisheries**

**Period:** 2015

Francois Bastardie (Speaker)

National Institute of Aquatic Resources

Section for Ecosystem based Marine Management

Links:


Related event

**ICES MYFISH Symposium: Targets and Limits for Long Term Fisheries Management**

27/10/2015 → 30/11/2015

Athens, Greece

Activity: Talks and presentations › Conference presentations

**Supporting bio-economic evaluation of spatial planning constraining fishing activities: be quantitative, spatially explicit, vessel-oriented, stochastic, and dynamically coupled to fish**

**Period:** 10 Jul 2014

Francois Bastardie (Speaker)

National Institute of Aquatic Resources

Section for Ecosystem based Marine Management

Description

Oral presentation at IIFET 2014, Brisbane, Australia

Related event

**International Institute of Fisheries Economics and Trade Conference 2014**

07/07/2014 → 11/07/2014

Brisbane, Australia

Activity: Talks and presentations › Conference presentations

**How spatial planning constrains transnational fisheries: the bio-economic DISPLACE evaluation on the Baltic Sea**

**Period:** 17 Jun 2014 → 18 Jun 2014

Francois Bastardie (Speaker)

National Institute of Aquatic Resources

Section for Ecosystem based Marine Management
Related event

Baltic MSP Forum
17/06/2014 → 18/06/2014
Riga, Latvia
Activity: Talks and presentations › Conference presentations

ICES - Baltic Fisheries Assessment Working Group - WGBFAS (External organisation)
Period: 2012 → …
Francois Bastardie (Participant)
National Institute of Aquatic Resources
Section for Management Systems
Degree of recognition: International

Related external organisation

ICES - Baltic Fisheries Assessment Working Group - WGBFAS
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea - WGIAB (External organisation)
Period: 2012 → …
Francois Bastardie (Participant)
National Institute of Aquatic Resources
Section for Management Systems
Degree of recognition: International

Related external organisation

ICES - ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea - WGIAB
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - Training Course on Analysing and visualization of VMS and EU logbook data using the VMStools R package (External organisation)
Period: 2012 → …
Francois Bastardie (Participant)
National Institute of Aquatic Resources
Section for Management Systems
Degree of recognition: International

Related external organisation

ICES - Training Course on Analysing and visualization of VMS and EU logbook data using the VMStools R package
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar