numbers are used as input for the assessments of both North Sea sole and plaice. Since 2018 also age information of sole and plaice is collected. Since 2018, marine litter is collected, categorized and weighted.

Besides biological information, also a series of abiotic parameters are collected in both surveys: temperature, salinity, wind speed, etc. Due to the wide range of data on a diversity of species and environmental parameters, the data can be used as input for the Marine Strategy Framework Directive (MSFD), OSPAR, the ecosystem approach or research about fish adaptation to climate change.

The key value of survey data lies in the fact that data are collected every year, same period of the year with the same protocol, same area. This very valuable long-time series does not only serve many ICES working groups but also acts as the backbone in diverse science projects (e.g. EMFF project IRIS2, Pulsvisserij Vlaamse Kust Deel 1, Marine Litter), MSc theses and PhDs.

Work related to ICES via SCICOM, ACOM, EOSG, WGBEAM, WGNSSK, WGISDAA, WGISUR, DATRAS, WGCRAN, PGDATA, WGBIOP, WKREO, WKBECOSS, WKPETSAMP, WKSHARK, WGEF, WGCSE, WGDG, WKICDAT, WGTIFD, WGBYC, WGMEDS, WGML.

## (9) Some points to consider for exposed aquaculture: first experiences in Belgium

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Marine aquaculture presents an opportunity for increasing seafood production in the face of growing demand for marine protein and limited scope for expanding wild fishery harvest. With the convergence of environmental and aesthetic concerns, aquaculture, which was already competing for space with other more established and accepted uses, is having an increasingly difficult time expanding in nearshore waters. Farming in offshore marine waters has been identified as one potential option for increasing seafood production and has been a focus of international attention for more than a decade. Investment in robust technologies and investigation in system designs for high energy environments has started but is still in its infancy. Despite the technical challenges for farming in the hostile open ocean environment, there is sufficient rational for pursuing the development of offshore farming.

When mapping the existing human uses, the ocean is a crowed place. Therefore, it is worthwhile to explore possibilities for co-location of facilities, like in this case wind turbines and shellfish farms. Although not obvious, one benefit to be gained is the reduction of the overall footprint of human uses in the ocean. Meeting challenges of multi-use facilities in the open ocean definitely requires innovation. The concept is intriguing however and is consistent with the goals of the Belgian Marine Spatial Plan (2020-2026).

The project “Edulis” (FIVA/EFMZV 16/UP2/05/Aqua) was the first pilot in the world to explore the possibilities to grow blue mussels inside the concession of windfarms in the Belgian part of the North Sea. It was coordinated by Ghent University and involved partners from the private and public sector. Besides the technical challenges, possible synergies were looked at between the production of sustainable seafood and renewable energy as well as the economic reality to grow seafood under exposed conditions in windfarms.

Work related to ICES via WGOOA (newly created Working Group on Open Ocean Aquaculture)

## (10) Hakaton: An interactive fish stock assessment tool

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Built as a web application, the interactive fish stock assessment displays a map and allows the user to choose the fish species and the timeline. Once these are chosen, the advice for that time will display with a traffic light system, by displaying an area as green, orange, or red. If there are many years of data available, the data series can be displayed as an animation. If the user clicks on a certain stock, the data that the advice is based on appears. The tool is based on ICES

advice, and the user could link through to the actual advice or the Advice drafting group report if they wanted more information.

## (11) Understanding vessel ownership and firm organization in French Atlantic fisheries: a typology

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The European fishing industry is largely perceived as existing of a multitude of individually owned, locally operated fishing vessels, despite growing evidence of concentration through vertical integration and companies owning fishing vessels across multiple Member States. The drivers behind capital accumulation and concentration in the fishing sector remain poorly understood, however. Most studies on investment behaviour have looked at entry and exit of vessels from two angles. First, they consider that investment decisions depend on current economic incentives (e.g., anticipated levels of returns, current profits, stock-dependent costs of harvesting). Second, they consider that changes in the regulatory environment may shift these economic incentives, causing new investment patterns. Widely studied examples of such changes are government interventions aimed at reducing excess capacity: subsidies, buyback programs and access regulations. However, reducing this question to a matter of investment behaviour is limiting, and it has been suggested that the organizational structure of fishing firms must be taken into account to better understand the strategies behind vertical integration and the investment in multiple fishing vessels. In this paper, we analyse multi-ownership in the light of the characteristics and strategies that lie at the basis of the organizational structure of French Atlantic fishing firms (i.e., fishing strategy, firm management, vessel maintenance, marketing strategy, ownership structure, etc.). Research questions include: (1) which organizational forms exist (and co-exist) today in the French Atlantic fishing sector (2) what defines them, (3) how did they emerge and (4) what can be expected from them in the future (in terms of their evolution and persistence). A typology was constructed based on 80 semi-structured interviews with vessel owners along the French Atlantic coast, in which both qualitative and quantitative information was collected. Multiple Correspondence Analysis (MCA) in combination with hierarchical clustering was used to construct the typology.

Work related to ICES via WGECON (Working Group on Economics)

## (12) Genetic structure of sole in the Irish and Celtic Sea

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Sole (*Solea solea*) is a species with a complex life cycle evolving between the spawning grounds where adults release gametes, nursery grounds where juveniles settle and metamorphose, and feeding grounds were (sub)adults feed. Spawning stock biomass in the Irish Sea (ICES area 7a) and Celtic Sea-Bristol Channel (ICES area 7g) has reached an all time low leading to concerns for its recruitment and future viability. We address here the connectivity of adult and juvenile sole based on an intensive sampling campaign between 2003 to 2009 (adults) and 2016 (juveniles). Fish were genotyped either with 426 gene-linked single nucleotide polymorphisms or with 5000 Single Nucleotide Polymorphisms (SNPS) obtained through ddRAD (double digest Restriction site Associated DNA markers) sequencing. Irish and Celtic Sea sole represent a distinct genetic group, identifiable at specific loci. The results point to limited connectivity between the area and adjacent waters. It allows to trace Irish and Celtic Sea sole with molecular markers. In addition, juveniles of Liverpool Bay, Cardigan Bay and Bristol Channel represent distinct subpopulations, again pointing to restricted gene flow within the area, linked to