

ANNUAL REPORT 2019



ICES
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International Council for
the Exploration of the Sea

Conseil International pour
l'Exploration de la Mer

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H.C. Andersens Boulevard 44-46
1553 Copenhagen V
Denmark

+45 3338 6700
www.ices.dk

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An introduction from ICES General Secretary

WELCOME

Putting together the Annual Report provides an opportunity to reflect back on the year's achievements, and the breadth of work conducted by our community always impresses me. As we look forward to the start of a new decade, I am excited to see how this work will continue to develop and contribute towards the UN Sustainable Development Goals.

During 2019, we released our latest **Strategic, Advisory, and Science** plans. This trilogy lays out how we will achieve our vision of improving and sharing our knowledge about marine ecosystems and use this to provide state-of-the-art evidence to support decision-makers sustainably manage our oceans and seas.

These plans provide the basis for our input to **the UN Decade of Ocean Science for Sustainable Development** (2021-2030), which held the First Global Planning Meeting in Copenhagen in May 2019. The UN Ocean Decade will focus on the science-policy interface and, through our own work and our collaboration with others, our contributions

will demonstrate how we manage to connect profound disciplinary understanding of ocean processes with solution-oriented research to generate best available evidence for decision-makers.

As a world-leading marine science organization, ICES will play a strong leadership role throughout the decade, as we display our ongoing work in developing and producing forecasting products that are relevant to decision-makers. We will take the opportunity to highlight our quality controlled data that is publically accessible on our website. This includes regional information from across Europe, the North Atlantic, and the Central Arctic Ocean on vulnerable marine

ecosystems, noise, and various ecosystem parameters, as well as our assessment tools for eutrophication, contaminants, and fish stock assessments to mention a few.

A substantial amount of ICES work - science, data, and scientific advice - relates to areas beyond national jurisdiction and together with our sister organization, the North Pacific Marine Science Organization (**PICES**), we have a vast scientific network and experience to draw from. This has been of relevance for new legal instruments, such as the Agreement on Prevention of Illegal Fisheries in the Central Arctic Ocean (an area beyond national jurisdiction) and the draft Convention on the Protection of the Biodiversity in Areas Beyond National Jurisdiction.

Our work is driven by the support and needs of our member countries and those that are dependent on our scientific advice, which in itself hinges on the work of a huge scientific community, dedicated to explore and sustain our oceans and seas.

We hope that reading this annual report that displays the wealth our activities inspires you. We value your input and put pride in diverse participation, and we hope to welcome you to Copenhagen for our **Annual Science Conference, 6-9 September 2021.**



Anne Christine Brusendorff

Anne Christine Brusendorff,
ICES General Secretary



The essentials of our organization

ICES AT A GLANCE

The International Council for the Exploration of the Sea (ICES) is a world-leading marine science organization, meeting societal needs for impartial evidence on the state and sustainable use of our seas and oceans.

ICES is a network of 6000 experts from 700 institutes and organizations in 20 member countries and beyond. More than 2800 experts participate in our activities annually.

OUR PRODUCTS

- Ecosystem overviews
- Fisheries overviews
- Annual recurrent advice on 200-250 fishing opportunities, representing 8 million tonnes - almost 90% of catches in Northeast Atlantic and Baltic Sea
- Advice requests on the status and use of marine ecosystems, methods of monitoring, indicators of the state of the environment, evaluating management plans
- Technical advice
- Data used in science and advisory products
- Science highlights and viewpoints in areas of societal importance
- Training
- Publications
- Conferences and symposia

WHERE WE WORK



ICES is an intergovernmental organization with 20 member countries:

Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Russian Federation, Spain, Sweden, United Kingdom, and United States of America.



Through strategic partnerships our work in the North Atlantic Ocean extends into the Arctic, the Mediterranean, the Black Sea, and the North Pacific.

HOW WE WORK



Addressing complexity

ECOSYSTEM SCIENCE

Advance and shape understanding
of the structure, function, and
dynamics of marine ecosystems
– to develop and vitalize marine
science and underpin its applications.



Climate change is an ongoing driver of changes and dynamics in marine ecosystems and we continue to strive to develop understanding of current and future states of the ocean and the implications for managers and society. In 2019, our groups advanced work on ocean predictions on timescales from seasons to decades to support marine resource management (**Working Group on Seasonal-to-Decadal Prediction of Marine Ecosystems**) and a new group was established to understand the impact of temperature on fish growth, to enable predictions of fisheries yield under future warming (**ICES/PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields**).

The occurrence of Harmful Algal Bloom (HAB) events has risen and **our joint working group on HAB dynamics with the Intergovernmental Oceanography Commission (IOC/UNESCO)** has become an increasingly important forum where these events are discussed and reviewed. The group chair Eileen Bresnan was invited to the international workshop on global HABs at **PICES Annual Meeting in October 2019**.



One of our longest running time series is coordinated by the **Working Group on Oceanic Hydrography** who publish an **annual report on ocean climate**, presenting measurements of water temperatures at different depths, salinity, sea level pressure, air temperature, and ice cover throughout the North Atlantic as well as identifying key trends. And the ICES Journal of Marine Science, published a special issue from the ICES co-sponsored symposium on **The Effects Of Climate Change On the World's Oceans Symposium**, that highlighted many advances in climate-ocean science.

Members of **ICES-PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME)** were lead authors in the **IPCC Special Report on the Ocean and Cryosphere in a Changing Climate**: Anne Hollowed and Geir Ottersen for Chapter 3 on Polar Regions and William Cheung, a former winner of the ICES Prix d'Excellence award, for Chapter 5 on Oceans.

ICES has also been active in European projects such as **ClimeFish**, where our role as a knowledge bridging organization meant working with stakeholders to generate useable knowledge on how climate change impacts fisheries. This has also facilitated the strengthening of our advisory system through modelling the impacts of climate change on wild fish stocks in the Northeast Atlantic and on current and potential aquaculture activities in the Northeast Atlantic as well as communicating key scientific findings to relevant policymakers in an efficient and effective manner.



“Trait-based approaches are emerging as novel frameworks for understanding the structure, diversity, and functioning of ecosystems by characterizing organisms based on their ecological traits. While trait-based studies have spurred significant advances in terrestrial plant ecology, adoptions of such approaches in the marine realms are just starting to take off.”

Martin Lindegren, Saskia Otto, and Jasmin Renz, conveners of Theme session G Understanding ecosystem structure and functioning through the use of traits at ICES Annual Science Conference 2019

Bioturbation

Seafloor sediments comprise one of the largest habitats on Earth. Together with the benthic organisms they shelter, they regulate energy flows in marine ecosystems and grant valuable products and ecological services.

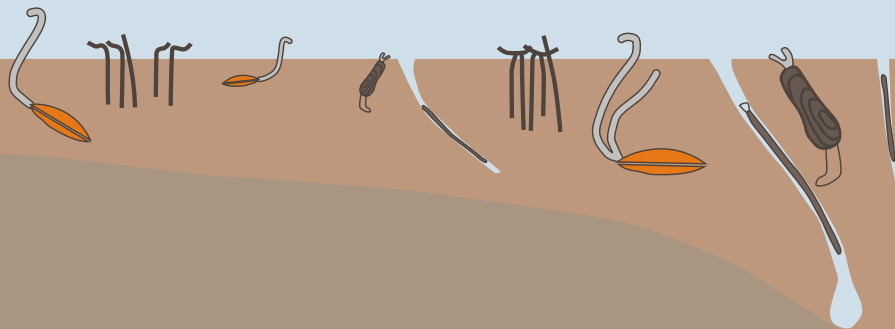
What is bioturbation?

Through a process known as bioturbation, benthic macrofauna rework the seafloor sediments. Bioturbating activities - including burrowing, ingestion, and defecation of sediment grains - have a profound effect on the environment and are thought to be a primary driver of biodiversity.

Why is it important?

Bioturbation is an important process that supports foodwebs, sediment transport, benthic-pelagic coupling, nutrient cycling and other biogeochemical activities, both directly or indirectly, through regulating properties for microorganisms, enhanced physical exchange, and physiological factors.

Species extinctions, invasions and changes in number of individuals or biomass loss could have repercussions for ecosystem functioning. As marine ecosystems experience rapid and pervasive changes in biodiversity and species composition, it is essential to understand the consequences of these changes to effectively manage these systems.



Bioturbating activities have a profound effect on the environment and are thought to be a primary driver of biodiversity.

Studies addressing large scale bioturbation patterns in macrobenthic communities are urgently needed in order to assess dedicated processes and functions across these areas. A publication by **ICES Benthic Ecology Working Group** carried out for the first time, **an analysis of the bioturbation capacity of the macrobenthic community across multiple regions along the European Shelf**.

They identified the region and sediment-specific key species contributing to bioturbation capacity, over four distinctive regions along the European Shelf by analysing regional patterns and drivers by modelling the spatial distribution of the community Bioturbation Potential (BPc), and generated BPc maps that can highlight hot-spots of benthic ecosystem functioning, supporting seabed integrity assessments (Descriptor 6 under the EU MSFD), conservation goals and marine management.

Measuring pressures

IMPACTS OF HUMAN ACTIVITIES

Measuring and projecting the effects of human activities on ecosystems and ecosystem services to elucidate present and future states of natural and social systems.

By estimating the vulnerability of marine ecosystems to pressures and impacts and assessing human impacts on ecosystem goods and services, we can develop approaches to mitigate undesirable impacts.

There is significant interest in renewable energy devices in the marine realm and wave energy is estimated to be the largest global resource of ocean energy. The **OSPAR Commission** (OSPAR) requested advice on the current knowledge of **the environmental impacts of deploying wet renewable technologies**. Our working groups on **marine benthal renewable energy developments** and **marine renewable energy** developed an overview of all currently known marine renewable energy devices and how their deployment will likely change in the future.

Vulnerable marine ecosystems (VME) species and habitats have a degree of protection in European Union (EU) waters through national conservation initiatives. To enable the EU to implement recent legislation regulating access to deep-sea fisheries, which may impact VME, we held a **stakeholder workshop** to gather data and information on areas where VME are known to or likely to occur and the “fishing footprint” of the existing deep-sea fishing area. There was active participation of persons involved in the deep-sea access regulation, both stakeholders and scientists, and the resulting **technical service** will lead to a final advice in 2020 that will help establish the basis for the European Commission (EC) to adopt the implementing regulation.



“Global impacts of shipping”, a special network session at ICES Annual Science Conference 2019 in Gothenburg, brought together experts to discuss the management and scientific advice most urgently needed to address the impacts of shipping on marine ecosystems. These discussions have helped to inform the newly established **Working Group on Shipping Impacts in the Marine Environment**. The group investigates management and mitigation measures that can be used to reduce or eliminate sources of ship-based pollution and synthesize scientific progress in addressing single stressors, such as pollutant discharge, underwater noise, and ship strikes.

Our **marine planning and coastal zone management group** examines the benefit and risk tradeoffs for human activities. In 2019, the group sought to develop expertise in this area through their **training course** on marine planning. Members also contributed to **Maritime Spatial Planning past, present, future**, a comprehensive overview of marine spatial planning and its role in promoting sustainable maritime development.

Cumulative effects are the result of multiple activities that exert pressures on ecosystem components and their functions. Cumulative effects assessment (CEA) approaches have the potential to support sound policymaking and planning in governance and management but have yet to be implemented in marine planning and management processes. Our new **cumulative effects assessment working group** developed a CEA framework for management and will apply this to two case studies (North Sea and the Gulf of St Lawrence).

Reinforcing our expertise and position as the marine contaminants data manager, we completed the **Helsinki Commission (HELCOM)** contaminants assessment tool project. A platform for HELCOM hazardous substances was developed and HELCOM hazardous substances integrated assessment tool (CHASE) will be incorporated into the platform. This work builds on the development of the OSPAR assessment tool which will be used to develop a contaminants assessment tool for **Arctic Monitoring and Assessment Programme (AMAP)**. In this way, ICES acts as a bridge between all three regional programmes, and also ensures non-duplication of data streams and tools for the overlapping contracting parties, who are all ICES member countries.

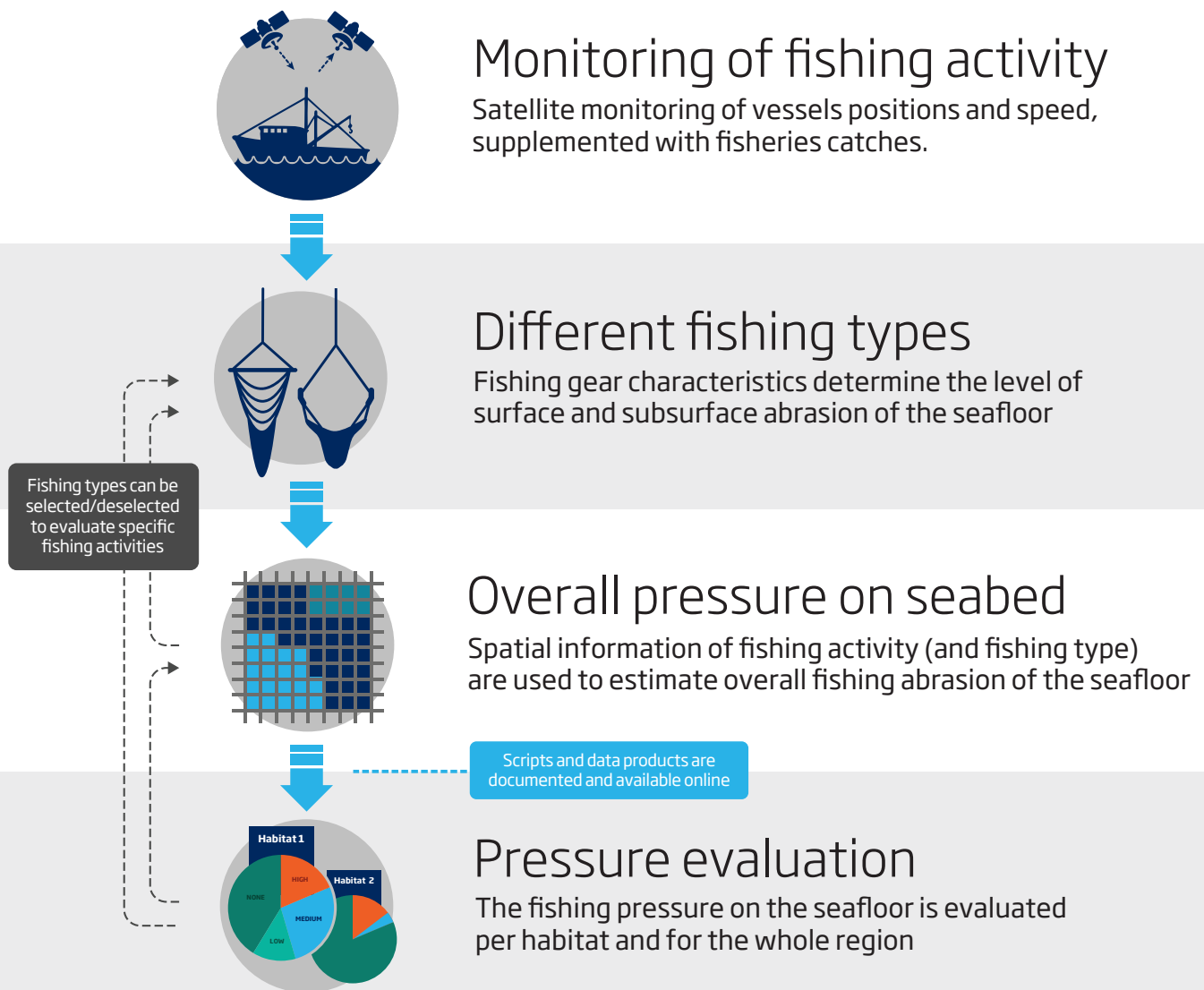


"As a representative from a competent authority who has been active in the MSP process for a couple of years, the course gave me a great amount of inspiration for building up a national process for MSP that would take into account the full stakeholder perspective and also be scientifically sound."

Anni Konsap, Estonian Planning Advisor and participant on ICES Marine Spatial Planning processes Training Course

Seafloor pressure

Bottom fishing is the main human activity causing physical disturbance to the seafloor and its habitats. ICES has advised on an assessment process that expresses the spatial extent and distribution of physical disturbance.



In 2019, we provided a **framework for a seafloor assessment process for physical loss and physical disturbance on benthic habitats**. This relates to the EU Marine Strategy Framework Directive (MSFD), specifically Descriptor 6 on Seafloor integrity (D6). Our framework provides pragmatic steps for how data should be compiled and coordinated between countries.

The aim of D6 is the sustainable management of human activities affecting our seas so that the integrity of the seabed is at a level that ensures the structure and functions of ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

Monitoring the seas

OBSERVATION AND EXPLORATION

Observing, exploring, and monitoring the seas and oceans allows us to track changes in the environment and ecosystems and to identify resources for sustainable use and protection.

Scientists and resource managers rely on monitoring and the resulting data sets to document environmental and population changes. Our expert groups continue to coordinate different types of surveys - egg, larval, acoustic, video transects, and trawl. An estimated 2000 ship days were used for ICES coordinated surveys in 2019, supporting fish stock assessments and the development of science.

Technological advances, climate variability, and unavoidable changes to sampling and support are a few examples of the changes that can alter or disrupt data collection. Attention was drawn to some of the challenges faced by our survey groups in an **ICES Science Highlights** article.

As acoustic broadband technology is routinely adopted into acoustic research and survey applications in fisheries science, scientists need to be prepared to interpret and process the resulting data. To prepare for this, one of our training courses took to the waves with **an advanced course in fisheries acoustics** taking place onboard the Norwegian Research Vessel G.O. Sars in December.

It is likely that model-based survey indices will play a greater role in future advice on the status of fish stocks. Our **Working Group on Improving use of Survey Data for Assessment and Advice** looked at how to develop guidance on using these indices and how to improve the documentation of the scientific process used to make decisions.



Mesopelagic resources – potential and risk, a special issue of ICES Journal of Marine Science took a closer look at life in parts of the ocean that are little explored and the opportunities and risks associated with the exploitation of mesopelagic resources.

ICES Data Centre joined the Horizon 2020 **MEESO** project which will quantify the spatio-temporal distributions of biomass, production and ecosystem role of mesopelagic resources and assess options to sustainably manage and govern their exploitation. We will embed our standards and protocols in the data collection processes of the project, ensuring continued use of the data beyond the project life cycle.

Underwater noise dataset collections provide essential information to advance the study of the impact of noise. After launching an **underwater impulsive noise data portal** in 2016 to support OSPAR and HELCOM in their regional assessments, we joined the **QuietMed2 project** in 2019 that will facilitate EU Member States in the Mediterranean Sea Region to assess MSFD Descriptor 11 (Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment). Our Data Centre also began work on an ambient - or continuous - noise database to further HELCOMs monitoring and assessment of the Baltic Sea.



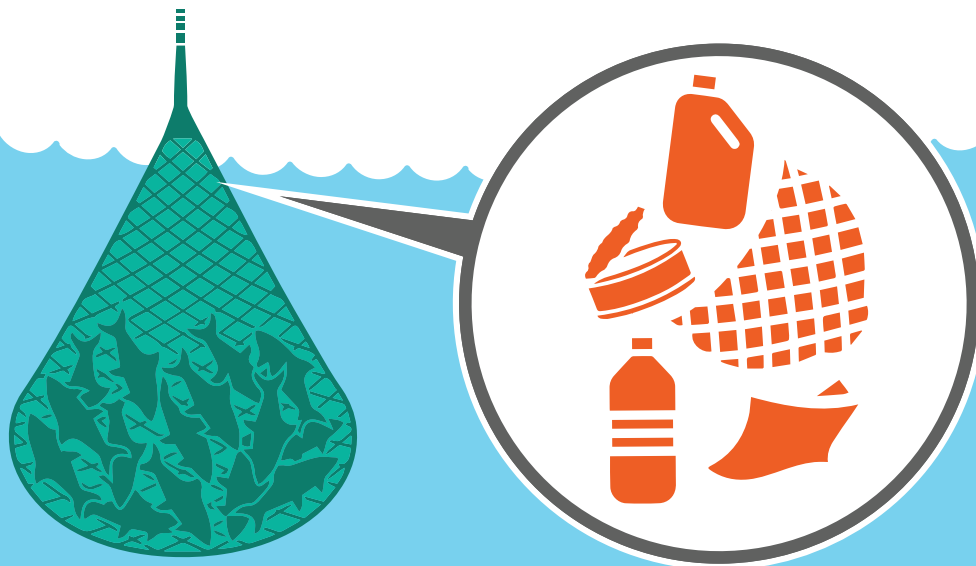
“The 2019 workshop on science-industry initiatives picked up a conversation last reported in ICES twelve years ago (**Workshop on Using Fishers to Sample Catches in 2007**). The themes were relevant then, and ever more so now with increasing capability and willingness of the fishing industry to contribute to scientific research. While industry initiatives for data provision create opportunities for ICES science, they raise important questions about standards for scientific information, an issue discussed at length during the Workshop on Science with Industry Initiative and the subject for a future workshop in June 2020”.

Steve Mackinson, Co-chair of Workshop on Science with Industry Initiatives.

Collecting marine litter data

Litter from the catch of the standard fish trawl used in the International Bottom Trawl Survey (IBTS) is being collected and transferred to ICES trawl survey database - DATRAS.

The data collection started as a pilot but since 2011 became one of the survey objectives at an international level, and is part of the IBTS survey manual. It requires no extra sampling, but does need some extra manpower on-board.



Processing marine litter at sea



While monitoring at sea has taken place for a long time, the focus of monitoring has moved from one specific topic to a wider ecosystem scope, where multiple elements in the system, as well as their presumed relationships, are of importance. **Cooperative Research Report (CRR) No. 347 Moving towards integrated ecosystem monitoring** focuses on this shift and provides structured guidance on how to set up monitoring at sea.

Advancing our approaches

EMERGING TECHNIQUES AND TECHNOLOGIES

Developing, evaluating, and harnessing new techniques and technologies to advance knowledge of marine systems, inform management, and increase the scope and efficiency of monitoring.

It is essential to develop, identify, and test emerging techniques and technologies, and to support uptake when they are shown to advance our capacity to generate data, science, and advice. As such, our **Advisory Plan** has prioritized the incorporation of new knowledge into the advisory process to contribute effectively to the creation of advice on meeting conservation, management and sustainability goals.

SmartDots is an age reading platform developed by ICES. In 2019, our **Working Group on SmartDots Governance** added a new maturity staging module and released SmartDots v.2 with new features such as an onscreen measuring tool and otolith edge type descriptor, both of which can be used to support otolith and fish growth studies. Quality assurance was addressed

with the implementation of an updated otolith reading quality grading scale for all age readings. WGSMAART envisions the streamlining of SmartDots with other data systems within ICES community and will continuously work towards this in cooperation with other expert and Regional Coordination Groups.

2019 saw the establishment of new expert groups dealing with cutting-edge methodologies. Attracting a new set of scientists into our community, the **Working Group on Machine Learning in Marine Science** is looking at machine learning as a method of achieving efficiency and repeatability in analytical classification, as well as exploring ways to more comprehensively analyse the large marine data sets that are becoming available. ▶

The group assembled a comprehensive literature database to document all applications of machine learning in marine sciences: data types (acoustics, imaging, etc.), machine learning techniques (classic learning, deep learning, etc.), and topics (stock assessment, biogeochemistry, etc.). This will help scientists interested in applying machine learning techniques to their questions to get a broad and exhaustive overview of prior work and highlight active topics and future research questions.

Fisheries monitoring technologies are employed in many different ways around the world. Our new **group on technology integration for fishery-dependent data** is approaching electronic technologies in a more systematic and strategic way to harmonize how data is collected and used for fisheries management and science globally.

The **Working Group on Comparative Ecosystem-based Analyses of Atlantic and Mediterranean marine systems** developed an open source application for integrated trend analyses (ITA). ITA are commonly applied to summarize changes

that have occurred in ecosystems on decadal timescales and highlight the possible connections between physical, biological, and human components of socio-ecological systems.

In 2019, we joined forces with **EMODnet** and **Copernicus Marine Service** for the **OpenSeaLab** in Belgium. This event promoted our Data Centre and the winning entry was an example of how ICES advice can be visualized for non-experts, challenging the current format of our advice.

Ghost nets – discarded or lost fishing nets – have become a high-profile environmental issue. It was one of the topics discussed by more than 120 fisheries technology experts from 23 countries who met in Shanghai, China, for **ICES-FAO Working Group on Fishing Technology and Fish Behaviour**. New research findings and examples from field tests included ways to systematically collect and recycle used fishing gear, options to reduce bycatch in trawl fisheries through modifications to the gears, fuel efficiency gains in fisheries through lighter gears, and technologies to monitor fish behaviour with underwater cameras on fishing gear.



Photo by Christine Fagerbakke/IMR

“With the old echo sounders, we used to shout ‘hello’ down into the fjord at one frequency and then record the echo. Now we have five or six echo sounders that all shout ‘hello’ at different frequency bands. You might say that instead of using just one voice, we’re now using a whole choir.

The name “broadband sonar” refers to the frequency band. Compared with a traditional sonar, it produces a hundred times more data, and this detailed information makes it easier to distinguish different species of fish, larvae and plankton – or to count individual Mueller’s pearlsides, each just four centimetres long, at a depth of one hundred metres. But it also requires advanced maths and the right methodology.”

Egil Ona, Institute of Marine Research (IMR), Norway, instructor on ICES training course on Principles and methods of broadband/wideband technologies: application to fisheries acoustics

Discovering environmental DNA

Acoustic, optic, and environmental DNA (eDNA) remote sensing technologies are rapidly evolving, providing unprecedented amounts of data over large spatial and temporal scales at high resolution. Autonomous vehicles and observatories are now able to collect data in previously inaccessible areas not possible using traditional research vessels.

Sources of eDNA in water



"In the open ocean, we've been using real-time acoustic information to target samples for eDNA. We've had mixed success with this as the acoustic information can be biased, especially in deeper depths, towards fish which don't seem to be as detectable as gelatinous creatures using eDNA. But there is a lot of work still to do on eDNA detectability and acoustic detection of soft-bodied animals."

Mike Jech, Chair of the **Working Group on Fisheries Acoustics, Science and Technology**

Securing sustainability

SEAFOOD PRODUCTION

Generate evidence and advice for management of wild capture fisheries and aquaculture – to help sustain safe and sufficient seafood supplies.

In 2019, we provided advice to the European Commission, Norway, the North East Atlantic Fisheries Commission (NEAFC), and the North Atlantic Salmon Conservation Organization (NASCO) on fishing opportunities in the Northeast Atlantic, North Sea, and Baltic Sea. Our advice covered 205 stocks, which represents 8 million tonnes or approximately 90% of landings in the area.

We also received requests which range in complexity from updates of catch-options to evaluation of long-term management strategies (**North Sea cod, saithe, haddock, whiting, and herring**), unavoidable by-catch, and identification of ecological special/valued areas.

The poor status of the eastern Baltic cod stock led to two special requests this year. After advising a **zero catch in 2020**, ICES was asked to provide advice on **measures to safeguard the stock status** as well as **provide information on the distribution and unavoidable bycatches of eastern Baltic cod**.

The portfolio of **our Fisheries Overviews** expanded to include the Barents Sea, the Norwegian Sea, Icelandic Waters, and the Bay of Biscay and the Iberian Coast. Adding to the existing overviews (Baltic Sea, Greater North Sea, and Celtic Seas), the area covered now has almost tripled.

The overviews are summaries of the activities and impacts of the different fleets fishing in each ICES ecoregion, describing fleets, the composition of their catches, fisheries management frameworks/agreements/measures, the status of the fisheries resources, and ecosystem effects of fishing activities.

Mixed fisheries considerations are now included in the Fisheries Overviews. They provide decision-makers with trade-off options and consequences between different management strategies.



Discards and bycatch issues are a global concern for fisheries. Members of **the Working Group on Methods for Estimating Discard Survival** contributed to the publication **The European Landing Obligation: Reducing Discards in Complex, Multi-Species and Multi-Jurisdictional Fisheries**, which looks at methods to deal with these issues in relation to the European Landing Obligation policy.

The 150th anniversary of Johan Hjort, a founding father of ICES and one of the giants of fisheries biology who introduced some of the ideas underpinning current fisheries science, was celebrated. The symposium, **Challenging the scientific legacy of Johan Hjort: Time for a new paradigm shift in marine research?** took place in Bergen and ICES supported the attendance of early career scientists.

We also supported the participation of early career scientists at **Shellfish - Resources and Invaders of the North** symposium where the latest research on the role of cold-water shellfish both as a harvestable resource and as important ecosystem players in northern hemisphere cold marine ecosystem was showcased.

As aquaculture continues to grow rapidly and will contribute increasingly to food security, there is an urgency in being prepared to meet challenges. Emerging pathogens are a threat to aquaculture industries worldwide and our **workshop on emerging mollusc pathogens** addressed fundamental questions regarding capabilities and communication among the pathology community, regulators, and the shellfish industry. This workshop identified strategies to prevent the OsHV-1 microvariant dispersal to North America and to maintain commercial production should an epizootic emerge. The microvariant has caused significant Pacific oyster mortality in Europe, Australia, and New Zealand.

The process of establishing Aquaculture Overviews was initiated this year as we surveyed stakeholders to solicit feedback on potential content. These overviews will describe the distribution, ecosystem interactions, benefits, impacts and potential of aquaculture production at a regional scale.



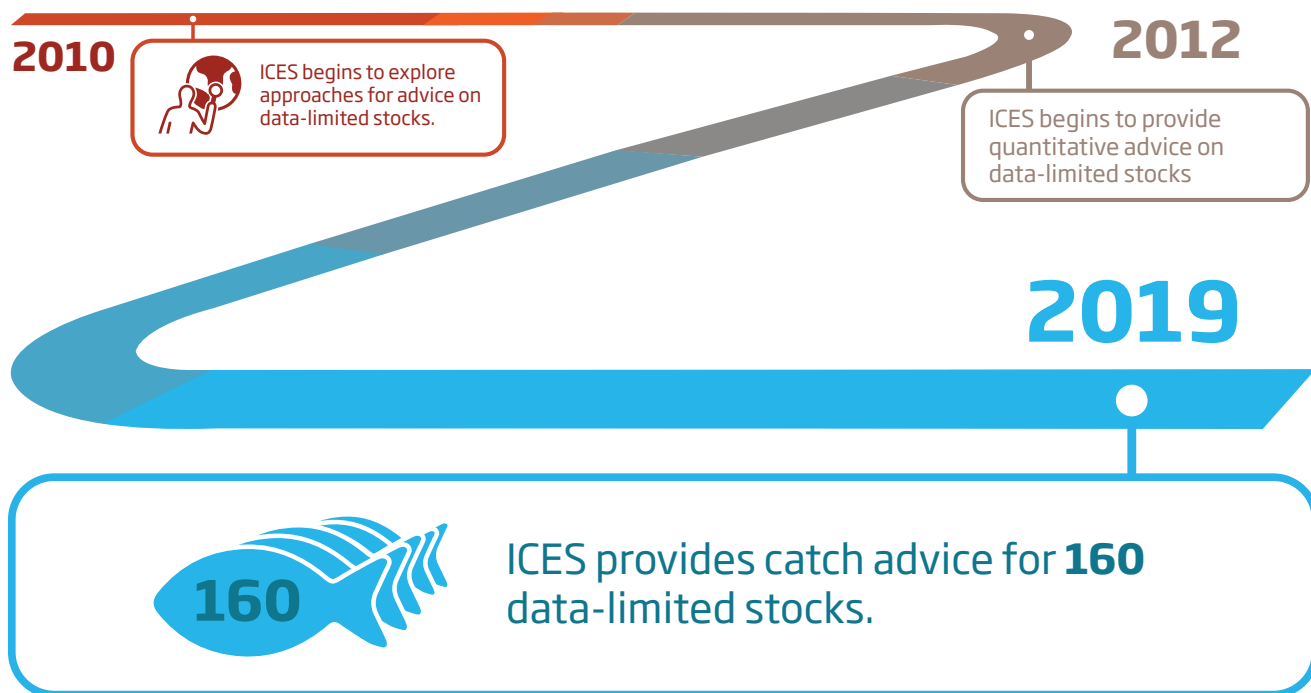
“The last 30 years have demonstrated that management based on scientific knowledge allows stocks to recover while also responding to the needs of fish consumers. For fisheries in the twenty-first century to follow scientific approach, countries must modernize their fleets, so they remain competitive. If they do not, these countries will become mere importers of fish products whose production is subject to rules they do not themselves control.”

Luís Vicente, General Secretary of Association of Industrial Fishing, Portugal

Unlocking data-limited stocks

ICES advice puts scientific findings and information in the hands of decision-makers. The majority of the world's fish stocks lack adequate data for conventional stock assessment methods. These stocks are known as "data-limited" and more than 60% of ICES stocks are data-limited.

Until recently, fisheries science was unable to inform decision-makers on the status and potential of data-limited fish stocks because we lacked suitable assessment methods. Since 2010, ICES has turned this picture around. We are a world leader in developing and applying methods that help decision-makers meet fisheries management and biodiversity policy objectives for data-limited stocks.



Our approach

ICES is a world leader in developing and applying methods that help decision-makers meet fisheries management and biodiversity policy objectives. There is an ever-growing suite of methods and tools available for assessing data-limited stocks and much of this work has been developed through our **WKLIFE** workshop series. We run training courses on data-limited stock assessment methods and reference point estimation and in 2019, a theme session at our Annual Science Conference focused on **advances in data-limited assessment methodologies**.

Providing better options

CONSERVATION AND MANAGEMENT SCIENCE

Develop tools, knowledge, and evidence for conservation and management - to provide more and better options to help managers set and meet objectives.

Conservation and management measures are taken to meet the objectives of those management bodies that are tasked to balance demands for use and protection of the sea.

Our **Ecosystem Overviews** identify the main environmental influences and human pressures in ICES ecoregions, and explain how these affect ecosystem components including marine mammals, seabirds, threatened species, and non-indigenous species. The overviews are a valuable resource for managers, stakeholders, scientists, and others interested in Northeast Atlantic ecosystems.

In 2019, our Ecosystem Overview portfolio strengthened with the addition of the Oceanic Northeast Atlantic and Azores ecoregions. We now produce nine ecosystem overviews, covering the vast majority of ICES ecoregions: Oceanic Northeast Atlantic, Azores, Baltic Sea, Barents Sea, Bay of Biscay and the Iberian Coast, Celtic Seas, Greater North Sea, Icelandic Waters, and Norwegian Sea.

We are working towards full coverage of subarctic waters with an overview for the Central Arctic Ocean and Greenland Sea. Together with the Arctic Council's Protection of the Arctic Marine Environment Working Group (**PAME**) and the North Pacific Marine Science Organization (**PICES**), our **Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean** gives ICES a central role in this remote and changing ecosystem.

These outputs will uphold the commitments that we made at **Our Ocean 2019** conference to provide ecosystem overviews for areas beyond national jurisdiction (ABNJ), and specifically for the **Oceanic Northeast Atlantic** and the Central Arctic Ocean.



All eight Arctic Council countries are members of ICES, and through our cooperation with PICES this collaboration in the Arctic extends even further. Cooperating with PICES, PAME, and NOAA, we co-sponsored a **2019 conference Implementation of the Ecosystem Approach to Management in the Arctic: Integrating information at different scales in the framework of EA implementation.**

Of the more than 150 ICES expert groups and workshops that address diverse marine ecosystem issues, more than one fifth address issues that overlap with ABNJ. We draw upon our network of scientists to provide advice on biodiversity and sustainable exploitation in ABNJ to both the North-East Atlantic Fisheries Commission (NEAFC) and the OSPAR Commission.

In 2019, we also contributed towards the Ecologically or Biologically Significant Marine Area (EBSA) process in the North Atlantic. Following the **workshop on ecological valuing of areas of the Barents Sea**, we **advised on the use of a conceptual framework to consider whether a sea is special/valued.** The workshop used **the globally accepted Convention on Biological Diversity (CBD)** criteria to define EBSAs, which are specifically meant to be used for highlighting the ecological and biological value of a sea area.

Cristina Mangano



Sofia Henriques

"One of the major issues of our time is to pinpoint broadly applicable ecosystem-based tools to drive management and conservation actions, a challenging priority from both a scientific and a policymaking point of view. Our group, WGCOMEDA, has been improving the baseline knowledge and tools, using different integrated ecosystem-based approaches between Atlantic and Mediterranean systems, in support of effective and better options to help managers set and meet objectives. We are looking at functional biodiversity, ecosystems' structure and connectivity, resilience and mechanisms of change, and options to integrate ecological and socio-economic dimensions, to support integrated fisheries advice and marine management."

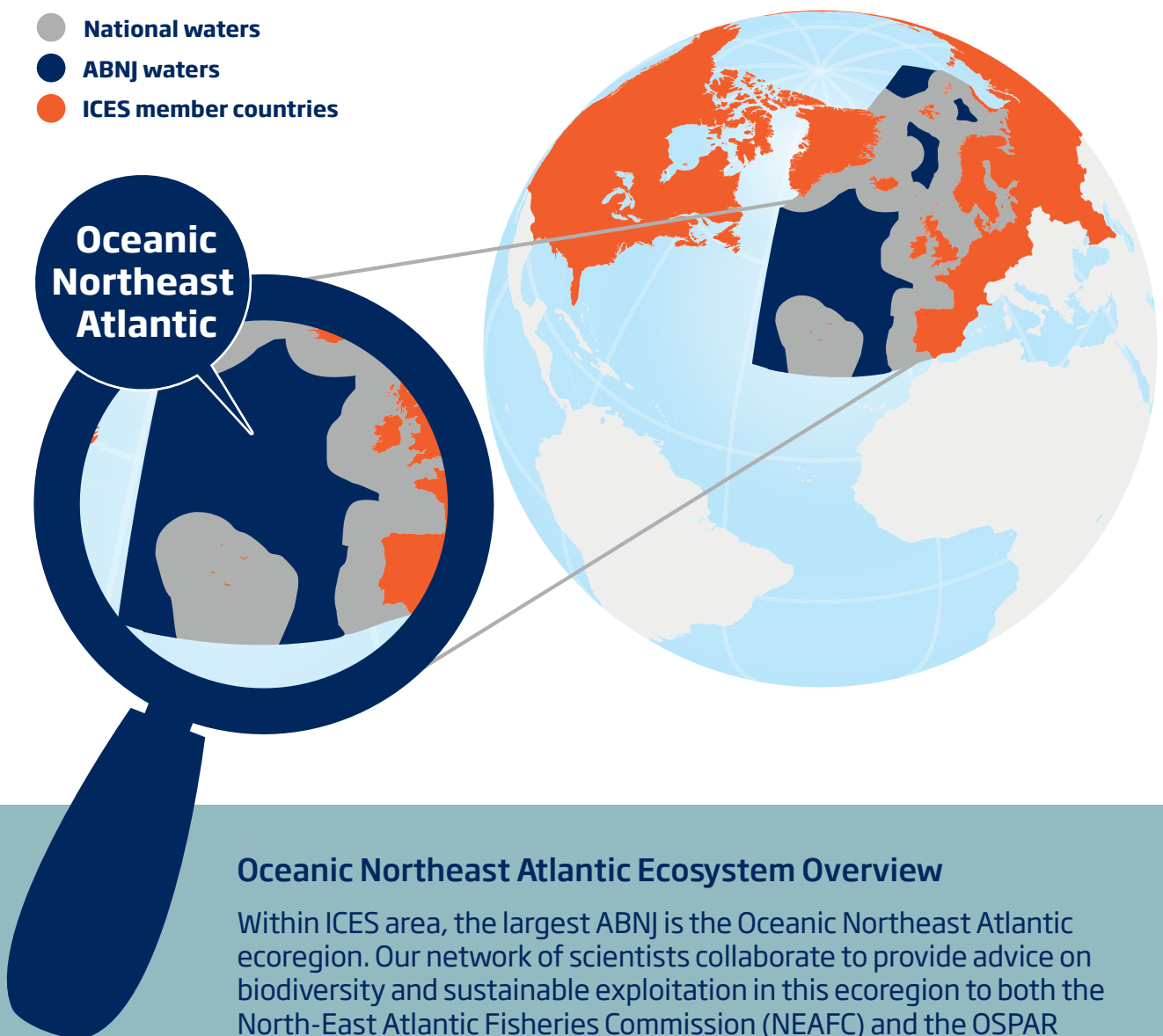
Cristina Mangano and Sofia Henriques, co-chairs of the Working Group on Comparative Ecosystem-based Analyses of Atlantic and Mediterranean marine systems

Advice in areas beyond national jurisdiction

Areas Beyond National Jurisdiction (ABNJ), commonly known as the high seas, are those waters that are beyond countries' 200 mile exclusive economic zone (EEZ). These are areas of ocean for which no one nation has sole responsibility for management.

Areas beyond national jurisdiction in the Northeast Atlantic

- National waters
- ABNJ waters
- ICES member countries



Oceanic Northeast Atlantic Ecosystem Overview

Within ICES area, the largest ABNJ is the Oceanic Northeast Atlantic ecoregion. Our network of scientists collaborate to provide advice on biodiversity and sustainable exploitation in this ecoregion to both the North-East Atlantic Fisheries Commission (NEAFC) and the OSPAR Commission. In 2019, we published an Ecosystem Overview for this vast region. This provides a description of the ecosystem, identifying its main human pressures, and explaining how these affect key ecosystem components.

Benefiting from the sea

SEA AND SOCIETY

Evaluate contributions of the sea to livelihoods, cultural identities, and recreation – to inform ecosystem status assessments, policy development, and management.

Stakeholder engagement provides new insights, innovations, and solutions for use and management of the sea. It helps to ensure that outputs remain relevant to the needs of society and strengthens trust through an inclusive approach.

The **Workshop on an Ecosystem Based Approach to Fishery Management for the Irish Sea** brought together industry stakeholders, environmental NGOs, biologists, fishery scientists, food-web and ecosystem modellers, social scientists, and stock assessment experts to progress towards including ecosystem dynamics in fisheries advice for this region.

Following revisions to advice for Northeast Atlantic mackerel, a **workshop to develop a research roadmap for the stock** and address the challenges to the evidence base of ICES advice was convened. Managers, scientists, and industry representatives took the opportunity to discuss research needs **resulting in a roadmap** where national research authorities, national fisheries institutes, fisheries managers, fishing industry, fishing industry scientists, academics, and ICES will all need to work together for an improved evidence base for ICES advice on North Atlantic mackerel.



While social and cultural aspects of aquaculture production often take a backseat to the biological, technical, and economic ones, our **Working Group on Social and Economic Dimensions of Aquaculture** has researched the opportunities available if the social effects of aquaculture are visualized, providing a more holistic view of the benefits and costs of this industry.

The Working Group on the Northwest Atlantic Regional Sea has particularly focused on the integration of social sciences in the integrated ecosystem assessment (IEA) process and this work has been incorporated into the State of the Ecosystem reports produced annually in the United States. The same suite of indicators have been used in an ecological risk assessment of the Mid-Atlantic Bight for the Mid-Atlantic Fisheries Management Council. The working group continues to develop new models that represent marine ecology and human systems at multiple scales.

ICES has supported transatlantic cooperation since our inception. In the context of the Galway Statement on Atlantic Ocean Cooperation, we led the Atlantic Ocean Research Alliance Coordination and Support Action **Working Group on the Ecosystem Approach to Ocean Health and Stressors**, a trilateral group (Canada, USA, and European Union) that was formed to promote ecosystem-based management research in the North Atlantic. This group's work provided Atlantic Ocean Research Alliance with relevant and responsive information on the status of Ecosystem Approach (EA) research in Europe.

Within the UN project **Strengthening Global Governance of Large Marine Ecosystems and Their Coasts through Enhanced Sharing and Application of LME/ICM/MPA Knowledge and Information Tools**, ICES led **LME:LEARN Ocean Governance Working Group** completed its term in 2019. We organized training courses for LME practitioners and managers resulting in the production of a number of **Marine Toolkits for practitioners**.



"ICES, like many fisheries science and management organizations around the world, has turned to Integrated Ecosystem Assessments (IEAs) as a key tool for conducting Ecosystem-Based Management. Under the aegis of our Integrated Ecosystem Assessment Steering Group, multiple expert groups are studying IEAs, with ten regional seas groups working to implement IEAs in their seas. Ecosystem Overviews are being revised to improve the range of data (including social and economic) they supply for IEA inputs. And ICES expert groups are now publishing some of the cutting edge literature on IEAs."

Patricia Clay, Co-chair of Working Group on Maritime Systems (WGMARS)

Science with industry initiatives

What role can marine industry play in delivering scientific information relevant to ICES advice and marine research?

This is what a **2019 workshop** on science and industry initiatives investigated.

Industry initiatives for data collection and provision create opportunities for ICES in our work to provide a solid evidence base for advice on fish stocks, and also to provide new sources of information on the marine environment that would not otherwise be possible.

Fishers welcome the opportunity to take on new responsibilities and provide scientific data, viewing this as a direct contribution to the continuous improvement of stock assessments and the quality of the scientific advice that managers use when making decisions about the quotas upon which fishing business depend.

Where could industry contribute scientific information?*

Highlighting differences in perception of the state of the stock

Improving data provision and the knowledge base when scientists and fishing industry differ.



The impact of choke species on fishing opportunities for target fisheries

Choke species challenge fishing opportunities, so there is motivation to provide further relevant information for science and management.

Providing market information

Information needed for monitoring business performance and marketing, such as evidence for sustainability certification schemes, can also be relevant for science.



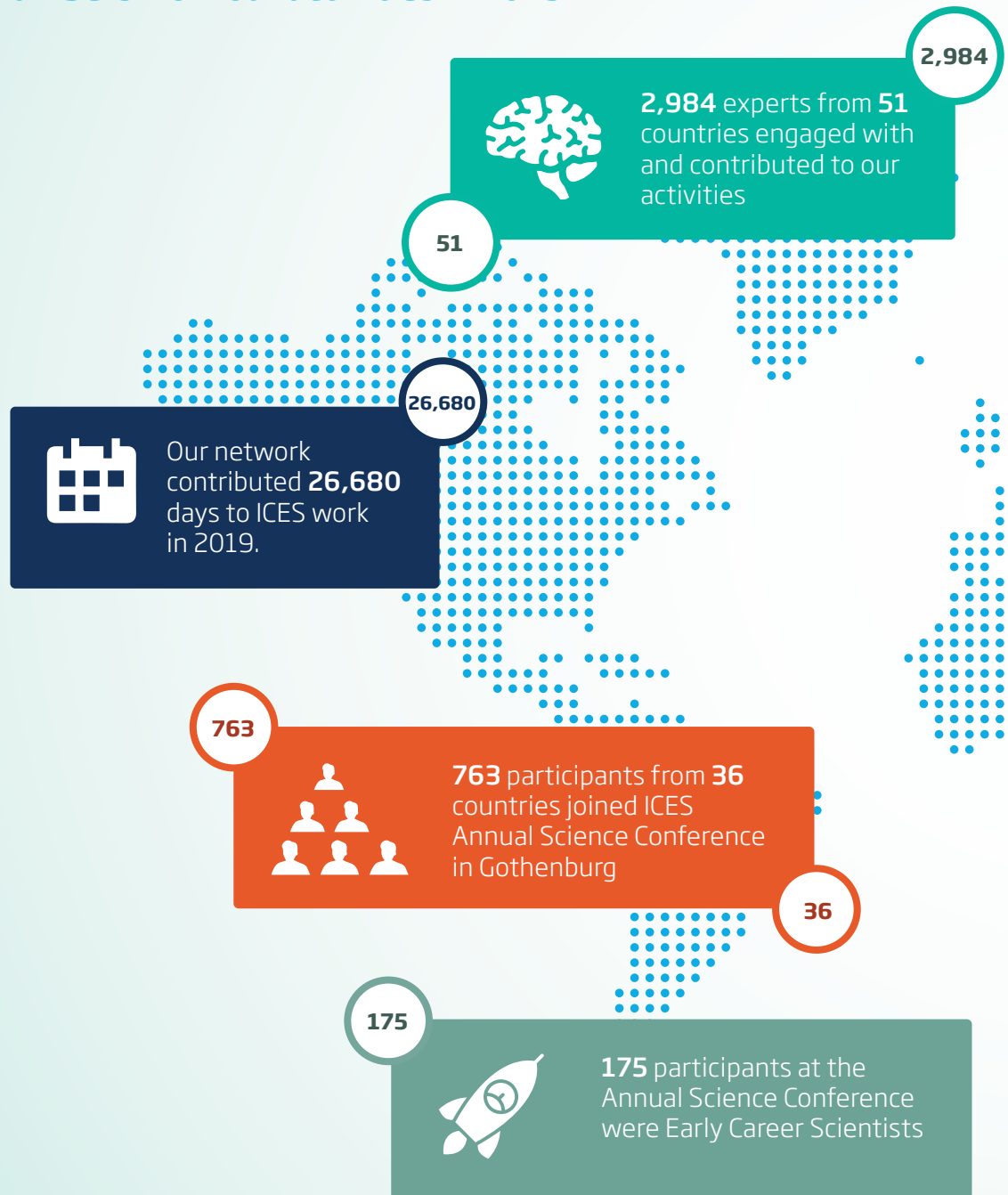
Providing information to support scientific assessment on data limited stocks

Desire to contribute biological information on species and the environment where it is known to be lacking.

* As identified by **Workshop on Science with Industry Initiatives (WKSCINDI)**

ICES IN NUMBERS

Selected numbers from our activities in 2019:



4



We published
4 Cooperative Research Reports
2 Techniques in Marine Environmental Sciences
3 ID Leaflets
94 Scientific Reports

2

94

3

156



156 participants from 24 countries took part in our training courses. We held training courses in 4 different countries.

24

4

291



291 oral and **103** poster presentations took place at the 2019 Annual Science Conference

103

ICES BUDGET

All amounts in Danish kroner

National Contributions	2019
Belgium	847,000
Canada	1,270,500
Denmark	1,270,500
Estonia	423,500
Finland	635,250
France	1,694,000
Germany	1,694,000
Iceland	1,270,500
Ireland	847,000
Latvia	423,500
Lithuania	423,500
Netherlands	1,270,500
Norway	1,694,000
Poland	1,270,500
Portugal	847,000
Russia	1,270,500
Spain	1,270,500
Sweden	1,270,500
United Kingdom	1,694,000
USA	1,270,500
Total National Contributions	22,657,250
Contributions from Faroe Islands and Greenland	423,500
Total Contributions	23,080,750

Income from products and services**2019**

Contribution from EC	11,900,000
Contribution from HELCOM (Data management)	480,000
Contribution from NASCO	549,514
Contribution from NEAFC	2,400,525
Norway MoU	844,500
Contribution from OSPAR (Advice)	728,000
Contribution from OSPAR (Data management)	672,000
Special requests	1,200,000
Total Income from products and services	18,774,539

Other income**2019**

Annual Science Conference (ASC)	490,000
Income from ICES Journal of Marine Science	1,600,000
Net income from projects	2,631,915
Sale of Publications	5,000
Miscellaneous income	920,000
Total Other Income	5,646,915
Expenditure	48,656,315
Transfer from equity	954,111
Interest	200,000
Balance of the year	0

