DTU

22nd Danske Havforskermøde

23-25 January 2024

DTU Aqua, Lyngby

Abstract book

Danske Havforskermøde

Kære Havforskere

Det er med stor fornøjelse vi præsenterer denne abstraktbog, der dækker alle de spændende emner, der vil blive præsenteret på det 22. Havforskermøde her på DTU 23.-25. januar 2024.

FN har udnævnt perioden 2021-30 til Havets årti. Som havforskere arbejder vi til dagligt med bæredygtighed – ikke mindst *SDG14 Liver under havet.*

De fem keynotes er nøje udvalgt til at dække de emner, der i disse år er i fokus i befolkningen, i medierne og hos os forskere. Vi skal sikre at den rigtige viden er tilgængelig til at møde de udfordringer, vi oplever såsom: næringsstofbelastning, stormfloder og havspejlsstigning, klimaforandringer og effekter af bundtrawling på havbunden. Endelig tager vi et kig tilbage i geologien for at se, om vi kan lære noget om vores fremtid ved at se på fortidens klimavariationer.

Den røde tråd i dette Havforskermøde skulle således gerne være emner, der er vigtige for vores allesammens hav - den viden vi har, og hvorledes vi forvalter det nu og i fremtiden. Vi har brug for handling – ikke kun ord!

Jeg håber, vi alle får et godt Havforskermøde!

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We take great pleasure in presenting this abstract book, which covers all the exciting topics that will be presented at the 22nd Havforskermøde here at DTU 23-25 January 2024.

2021-30 has been designated by UN as the Ocean Decade. As researchers, we work daily with sustainability – not least *SDG14 Life under water*.

The five keynotes have been carefully selected to cover the most relevant topics in focus these years among the public, in the media and among us researchers. We have an obligation to ensure that the right knowledge is available to meet the challenges we are experiencing such as: nutrient loads, storm surges and sea level rise, climate change and effects of bottom trawling on the seabed. Finally, we look back into the past using geology to see if we can learn something about our future by looking at past climate variations.

The common thread for this Havforskermøde should therefore be topics that are important to our shared ocean - the knowledge we have and how we manage it now and in the future. We need actions – not only words!

I hope you enjoy Havforskermødet!

Karen Edelvang
Head of Section
Section for Oceans and Arctic
DTU Aqua

Abstract Book

22nd Danske Havforskermøde

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Keynotes Abstracts

Keynote Talks	
Title	Eutrophication in Danish coastal marine systems; past, current status and research gaps
Speaker	Stiig Markager
Affiliation	Inst. Ecoscience, Aarhus Universitet
Abstract	
The aim of this lecture is to provide an overview of the factors influencing eutrophication in Danish coastal marine systems and how they have changed over time since 1900, but with a focus on the last 40 years and particularly the last 12 years. Data is presented for nutrient loadings, nutrient concentrations and biological factors like chlorophyll, primary production and light attenuation up to and including 2023. The main findings are that the current status is a non-functioning ecosystem, that is far below the thresholds for 'good ecological status'. The trend is that no significant improvements have occurred since about 2003 and that a deterioration has occurred since 2012, however with some positive signs for primary production in release of phosphorous from the sediments. The reason for the deterioration since 2012 is unclear but might be related to a break down in the food web due to overfishing or the increase we see in temperature. Other factors are also discussed. Suggested research gaps are effects of loss in top-down control and a better understanding of the metabolism of the large pools of organic matter that have accumulated over the last 50 years with eutrophication.	
Title	The North Atlantic in transition
Speaker	Katherine Richardson
Affiliation	Globe Institute, University of Copenhagen
Abstract	
The North Atlantic (NA) is a critical region in an Earth system context at it is important for global climate development. It is also important at the local/regional scale as a habitat for the biological resources upon which human societies depend. We know that the NA has changed through geological time. Not only is it warmer now than it has been at any time during at least the last 60,000 years, and it continues to warm at an alarming rate. This means its currents and hydrography are in a state of transition. This talk addresses our understanding of the changes occurring here, i.e., the risk of crossing a "tipping point" with respect to the AMOC (Atlantic meridional overturning circulation), the transport of heat to this region, and the potential effects on both climate and biology of the area.	
Title	Storms can be devastating-is that why we forget them?
Speaker	Per Sørensen
Affiliation	Miljøministeriet
Abstract	
Denmark has been hit by major storms many times in different parts of the country. These storms cause a rise in sea level and creates waves. Both can cause devastating damages for the individual landowner, but the storms are rapidly forgotten. The storm also impacts the seabed significantly and cause huge variations in morphology and biology, but these variation is seldom addressed and included in our management of the seabed.	
Title	The effect of bottom trawling on benthic diversity
Speaker	Henrik Gislason
Co-authors	Ole Ritzau Eigaard and Grete Elisabeth Dinesen
Affiliation	DTU Aqua
Abstract	
The effect of bottom trawling on marine biodiversity is a hot topic. Recent high-resolution estimates suggest that Danish fisheries annually disturb over a quarter of the seabed in the Danish EEZ. In this talk we will describe and discuss the knowns and unknowns regarding the effects of bottom trawling on marine benthos, the sensitivity of different species and benthic communities, the sampling problems, and the approaches to model the effects. We highlight the unique opportunities provided by the benthic	

samples collected by C. G. Johs. Petersen in the Kattegat in the 1880s before bottom trawling started, and discuss the adequacy of the present monitoring system. We conclude that further information is necessary about the penetration depths of the gears and the depletion rates of benthos in the most important fisheries and habitats, and recommend to expand the monitoring system to include vulnerable epibenthos and particularly sensitive habitats.	
Title	Sea-ice dynamics north of Greenland and in the Labrador Sea since the last glacial
Speaker	Henrieka Detlef[1]
Co-authors	Christof Pearce[1], Marit-Solveig Seidenkrantz[1], Joanna Davies[1,2], Matt O'Regan[3], Christian Stranne[3], Martin Jakobsson[3], Mads Mørk Jensen[4], Marianne Glasius[4], Jesper Olsen[5,6], Thomas Cronin[7], Brendan Reilly[2], Anne Jennings[8], Rasmus Andreasen[1]
Affiliation	[1]Department of Geoscience, Aarhus University, Aarhus, Denmark [2]Lamont Doherty Earth Observatory, Columbia University, Palisades New York, USA [3]Department of Geological Sciences, Stockholm University, Stockholm, Sweden [4]Department of Chemistry, Aarhus University, Aarhus, Denmark [5]Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark [6]School of Culture and Society – Centre for Urban Network Evolutions, Højbjerg, Denmark [7]U.S. Geological Survey, Florence Bascom Geoscience Center, Reston, VA, USA [8]Institute of Arctic and Alpine Research, University of Colorado, Boulder, USA
Abstract	
Sea ice is a vital component of the Arctic environment, influencing the global climate and hosting unique ecosystems. Nonetheless, predictions of Arctic sea-ice retreat, as well as its causes and consequences are associated with significant uncertainty. Reconstructions of sea-ice extent throughout Earth's history can help to understand the sensitivity of sea ice to climate perturbations, the rate of sea-ice retreat and recovery in response to a given forcing, the effect of changes in the sea-ice cover for the ecosystem, and the interactions of sea ice with the ice sheets and the ocean. Here we will present three examples from the Lincoln Sea and Nares Strait north of Greenland and from the southern Labrador Sea. These highlight the sensitivity of the Arctic's last ice area to early Holocene warming, the influence of sea ice on the stability of floating ice tongues across the Holocene, and the role of sea ice for destabilising ice shelves during millennial-scale climate oscillations of the last glacial. The results demonstrate the importance of sea ice in the coupled climate system. Future research will focus on the role of sea ice for climate-ecosystem coupling.	

Session Abstracts

Session	Ocean Observation Technologies
Title	Study processes at the seafloor with autonomous landers: methods & applications
Authors	[1]Anders Tengberg, [2]Mikhail Kononets and [2]Per Hall
Affiliation	[1]Aanderaa-Xylem, Bergen, Norway, [2]University of Gothenburg, Sweden
Abstract	Oral
Biological, chemical and physical processes at the seafloor plays an essential role for aquatic environments. In-situ incubations of sediment with overlying water provide valuable and consistent information on sediment-water solute exchanges. This presentation will describe experiences learned from use of Gothenburg University benthic chamber landers during more than 300 deployments/1000 incubations in water depths ranging from 5 to 5600 m. Measurements of different solutes/contaminants will be be presented as well as manipulative injection experiments to study the N-cycle, phosphate retention and the effects of sediment re-suspension. Methods to increase the data quality will also be discussed.	
Title	A multi-spectral confocal high-resolution LIDAR for in vivo underwater classification of zooplankton and microplastics
Authors	[1*]Joaquim Santos, [2]Hans H. Jakobsen, [1]Paul Michael Petersen, and [1]Christian Pedersen
Affiliation	[1]DTU Electro, Department of Electrical and Photonics Engineering, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark. [2]Department of Ecoscience, Aarhus University, Frederiksborgvej 399, 4000 Roskilde, Denmark. *Correspondence: joasan@dtu.dk
Abstract	Oral
The productivity of zoo and phytoplankton in aquatic ecosystems is vital on local and global scales and is tightly linked to environmental factors. The distribution and abundance of these organisms are shifting due to climate change, impacting food web transfer and food security. In situ monitoring is challenging, with existing techniques limited to small close-range volumes and often requiring vertical dives. We introduce a novel multi-spectral Light Detection and Ranging (LiDAR) system for underwater remote sensing. We demonstrate inelastic detection of sub-millimeter microalgae and free-swimming copepods, classifying them using machine learning. The sensor non-intrusively captures high-resolution volumetric images of microorganisms with voxel-level spectral data, revealing species-specific autofluorescence features used for classification. Furthermore, we accomplish depth-resolved measurements and 3D reconstruction of microplastic layers in the water column with suppression of out-of-focus contributions from intervening scatterers that would otherwise degrade the performance of conventional imaging technologies. Our approach combines morphology with spectral information, representing a unique and non-intrusive tool for quantitative studies of plankton.	
Title	Can you shed new light on the murkiness of optically complex Danish water from space?
Authors	Sanjina Upadhyay Stæhr, Andreas M. Holbach, Peter A.U. Stæhr og Stiig Markager
Affiliation	Institut for Ecoscience, Aarhus Universitet
Abstract	Oral
Lysvækkelse koefficienten (Kd) definerer lysets nedtrængning i vandsøjlen, og indgår som en støtteparameter til vurdering af god økologisk tilstand i fht. dybdegrænsen af ålegræs. Variationer i Kd skyldes primært lysabsorbans fra pigmenter, partikler og opløst organisk stof. I det marine NOVANA program bestemmes Kd primært ved lysprofilmålinger som gør det muligt at beregne en Kd -værdi for den målte del af vandsøjlen i den fotosyntetisk aktive del af lysspektret (Kd PAR; 400-700 nm). Kd PAR målingerne er forbundet med især to usikkerheder: 1) Dels antages en homogen (ikke lagdelt) vandsøjle, og 2) dels er Kd PAR estimater baseret på målestationer langt væk fra ålegræsengene, hvor ophvirvling af materiale og gradienter i de lysabsorberende komponenter gør, at Kd PAR er betydelig højere og mere variabel end på dybt vand. Her viser vi en ny metode til at kortlægge Kd PAR fra Sentinel-3 (S3). Fra S3 hentes daglige data for klorofyl, TSM og absorbans fra pigmenter, detritus og CDOM samt	

tilbagespredning af lys. Koblet med en optisk model, beregnes Kd PAR for udvalgte NOVANA stationer. Vi sammenholder S3-baserede Kd PAR-estimater med Kd PAR fra lysprofiler og vurderer metodens anvendelighed i den fremtidige monitering.	
Title	Integrating Ocean Technology and Ecology: Advanced Monitoring of Danish Waters for Sustainable Blue Economy and Environmental Protection
Authors	Patrizio Mariani & Fletcher Thompson
Affiliation	DTU Aqua
Abstract	Oral
Advanced autonomous observations in Danish coastal waters are a major element for balancing the needs of blue economy and to understanding climate and human impacts on marine ecosystems.This presentation highlights the use of diverse autonomous and automated platforms to effectively improve ocean observations, generating partially or fully automated maps resolving biogeochemical and ecological processes in Denmark including examples in the fjord systems, the Øresund, North Atlantic, Greenland, Baltic Sea and beyond. For comprehensive monitoring of these waters a diverse range of autonomous and automated platforms are considered including ARGO floats, WaveGlider USV, Otter USV, BlueROV2, towed image acquisition systems, multi-camera 3D systems, and LiDAR/multi-beam 3D mapping.The application of these technologies has led to breakthroughs in environmental monitoring, such as 3D reconstructions of mussel reefs and farms, 2D mappings of eelgrass meadows and mussel reefs, long-endurance unmanned acoustic surveys, and detailed infrastructure inspection and monitoring. These advancements provide new best practices for the effective monitoring of the health and dynamics of marine ecosystems, playing a critical role in guiding sustainable practices for the blue economy and critical infrastructure monitoring.	
Title	Monitoring phytoplankton dynamics in Nuup Kangerlua with ocean color remote
Authors	[1]Rafael Gonçalves-Araujo,[1]Colin A. Stedmon, [2]Tobias R. Vonnahme, [2,3]Efrén López-Blanco, and [2]Thomas Juul-Pedersen
Affiliation	[1] National Institute of Aquatic Resources, Technical University of Denmark (DTU Aqua),[2] Greenland Institute of Natural Resources, [3] Department of Ecoscience, Arctic Research Center, Aarhus University
Abstract	Oral
The MarineBasis Nuuk Monitoring Programme has performed monthly sampling of hydrography, water chemistry and phytoplankton in Nuup Kangerlua for over 15 years, which may not capture changes in phytoplankton communities occurring at shorter time windows. Likewise, the sampling location is limited to a single station which may not cover the patchy phytoplankton distribution. Here, we investigate the performance of Sentinel-3 (S3) chlorophyll-a (Chl-a) estimates (2016-2022) in relation to in situ data collected in Nuup Kangerlua with the aim to use S3 data to increase both spatial and temporal coverage. Overall, the S3 estimates were significantly correlated with the in situ measurements, with a few exceptions: during spring, when in situ measurements report the highest Chl-a values that are underestimated by S3; and during late-summer and autumn, when Chl-a values are low but with an overestimation by S3, likely due to the presence of glacier flour (silt) in the water.	
Title	In-situ analysis of nitrogen in coastal waters: a Danish case study
Authors	[1*] Christian Lønborg and [1]Peter A.U. Stæhr
Affiliation	[1]Department of Ecoscience, Aarhus University, Roskilde, Denmark *Corresponding: c.lonborg@ecos.au.dk
Abstract	Poster
Impacts of human activity on nutrient cycles in coastal waters are globally evident. In Danish coastal waters research has clearly demonstrated that since the beginning of the 20th century, the quantity, concentration, and relative form of nutrients entering the systems from rivers and the atmosphere has been altered. Danish waters are characterized by strong gradients in e.g. salinity, concentration of nutrients and chlorophyll. These dynamic characteristics make them not only expensive but also difficult to monitor at a high enough resolution. Due to this they are often under sampled through routine biweekly to monthly sampling. Therefore, monitoring the environmental conditions effectively is important for obtaining a better understanding of overall condition and to achieve a good environmental condition as stipulated in the goals of both the European Water Framework Directive and the Marine Strategy	

Framework Directive. Sensor-based technologies for in-situ nutrient analysis are beginning to be commercially available and they have the potential to provide data at very high resolution. Nonetheless, the usefulness of these sensors depends strongly on whether the obtained outputs are consistent with historical data and standard laboratory methods. In this study we tested the usefulness of a total nitrogen (TN) and nitrate (NO3-) sensor in Roskilde fjord, Denmark. Our results demonstrate that sensors are capable to some degree of detecting changes in nitrogen concentrations. However, there is a clear need to validate these sensors by further inter-comparisons and standardization of measurements.	
Title	Developing a GES indicator based on eelgrass areal distribution derived from orthophotos.
Authors	Mihailo Azhar, Peter A.U. Stæhr, Jesper Christensen, Cordula Göke, Sanjina U. Stæhr, Jacob Carstensen, Dorte Krause-Jensen
Affiliation	Aarhus University, Department of Ecoscience, Roskilde
Abstract	Poster
The maximum depth limit of eelgrass is currently used as an important indicator for assessing good ecological status (GES) according to the Water Framework Directive (WFD). Here we investigated the use of areal coverage of eelgrass in the 2-to-5-meter depth range as a potential supplementary GES indicator. Areal cover was estimated for previously GES assessed coastal WFD water bodies around Denmark, using RGB orthophotos obtained in the summer of 2018. A robust classification of eelgrass presence based on gradient boosted forests was conducted using in situ ground truth data, colour bands in the orthophotos and ancillary information from the national marine monitoring (NOVANA) of eelgrass. To develop the areal GES indicator, we applied a GIS based habitat suitability model to determine eelgrass areal cover under different light, climate, and GES scenarios derived from refence conditions of historical eelgrass distributions. We compare the GES assessment based on mapped areal cover with GES based on observed depth limits and evaluate the potential use of areal information for assessing the ecological status in our coastal water bodies.	
Title	Side Scan Sonar: Tracking Tracks – footprints from towed fishing gears
Authors	Alex Jørgensen and Niels Madsen
Affiliation	Aalborg University; alexj@bio.aau.dk
Abstract	Poster
Side scan sonar was used to map the seabed and analyze the impact of different fishing methods in heavily fished areas in Jammerbay, Skagerrak. Side scan sonar is a powerful underwater imaging tool, that offers high-resolution acoustic images of the seafloor, enabling detailed topographic analysis. The integration of this technology into marine research facilitates the assessment of seabed morphology, sediment composition, and habitat characterization.Additionally, the study utilized side scan sonar to map and analyze the impact of different fishing methods on the seabed. By capturing real-time data on physical impacts left by fishing activities and associated seabed disturbances, the technology provides crucial insights into the ecological impacts of fishing methods. This information is vital for sustainable fisheries management, aiding in the identification of sensitive marine areas and guiding the implementation of conservation measures.The study emphasizes the significance of employing side scan sonar as a non-invasive and efficient tool for seabed mapping and monitoring fishing activities. The findings contribute to the broader understanding of marine ecosystems, assisting in the development of informed strategies to balance ecological conservation with the demands of fisheries.	
Title	Adaptation of the Argo Technology and Strategies for Shelf Observation
Authors	Bodil Toftegård
Affiliation	DTU Aqua
Abstract	Poster
The Argo program delivers real-time oceanographic data worldwide. It is an international initiative with around 4000 units deployed in most of the world's oceans. So far the majority of the floats are deployed in deep water and follow a standardised program. A typical profile for a deep-water float will consist of diving to 1000m, drifting for around 10 days, descending to the bottom, and then surfacing, measuring on the way, and transmitting data via satellite connection while at the surface.The Northeast Greenland Shelf is an example of a region of global scientific significance, but which currently lacks observations. The export of freshwater from the Arctic plays a potentially important role in regulating Atlantic Meridional Ocean Circulation and hereby the global climate. With few observations at hand, ocean circulation	

models often also perform poorly in the region. The remote and harsh nature of the environment makes routine measurements a challenge.This project aims to investigate and solve the challenges associated with deploying Argo floats in the rough conditions of the Northeast Greenland Shelf. This will include the systematic mapping of challenges based on existing research on the subject. Once the challenges are identified, a set of specifications and criteria will be determined for potential solutions. Based on the specifications and criteria, possible solutions will be developed and tested.	
Title	Low-Cost Hyperspectral Imaging in Macroalgae Monitoring
Authors	Marc Allentoft-Larsen - mca@ecos.au.dk Joaquim Santos - joasan@dtu.dk Christian Pedersen - chrp@dtu.dk Paul Michael Petersen - pape@dtu.dk Hans Jakobsen - hhja@ecos.au.dk
Affiliation	AU, DTU
Abstract	Poster
In this study, we present an approach to macroalgae monitoring using an innovative, cost-effective hyperspectral camera system.Kelp beds, acknowledged for their ecological significance, provide essential fish habitats and contribute to nutrient cycling. With the increasing importance of responding to environmental changes, continuous monitoring has become essential, driven by European Union (EU) legislation. Hyperspectral imaging (HSI) is a powerful tool in this context due to its ability to detect pigment-characteristic fingerprints, but its high cost is a barrier to in situ monitoring. Our study showcases the development of an inexpensive HSI setup combining a GoPro camera with a rotating continuous variable spectral band pass filter, with cost-effective design and application. Experimental tests comprised a selection of two macro-algae species with overlapping spectral features and a controlled aquatic environment. Using a support vector machine (SVM) model for species discrimination, we were able to demonstrate promising discriminatory power of HSI over conventional RGB imaging. This work represents a leaping step towards achieving large-scale, automated ecological monitoring.	
Title	The drones are coming – Mapping the seabed
Authors	Amanda Irlind (afir@bio.aau.dk); Niels Madsen (nm@bio.aau.dk)
Affiliation	Aalborg University
Abstract	Poster
This study investigates the usage of underwater drones for assessing the impact of demersal towed fishing gear on seabed habitats in Jammer Bay, Skagerrak. The advancements in underwater drones, combined with rapid developments in image and video analysis software, are making these tools increasingly useful in marine research. Deploying an underwater drone in Jammer Bay provided videos of the seabed, facilitating habitat differentiation and taxa annotation. Stone reefs were more pronounced, while sandy habitats tended to blend with the turbid water. Faunal differences between habitats were also observed, with epifauna more visible on sandy substrates and more hidden in stone reefs. Ongoing software and machine learning advancements hold promise for habitat and species recognition but require substantial data for effective model training. Despite its high potential, it showed limited suitability in high-current waters and difficulties in obtaining high-resolution data in turbid conditions. This study shows the potential of underwater drones in seabed mapping and can enhance marine research and management.	
Title	Autonomous profile measurements for water quality monitoring in Danish offshore waters
Authors	Stedmon, C.A., Thompson, F. Toftegård,B., & Mariani, P.
Affiliation	DTU Aqua
Abstract	Poster
The Danish Environment Agency aims to integrate autonomous technology into the national marine monitoring program as part of its Integrated Marine Monitoring (IMM) initiative. This sub-project investigates the feasibility of adapting technology and infrastructure available in the global ARGO program for open water monitoring. Initial results indicate that the technology can deliver valuable near real-time data on water column properties such as position and extent of density stratification, light attenuation coefficients, and bottom water oxygen conditions.	

Title	Advancing Seabed Imaging: Integrated Mosaicking Technologies for Enhanced Marine Exploration
Authors	Fletcher Thompson
Affiliation	DTU Aqua
Abstract	Poster
Underwater video capture platforms are used to photograph the seabottom for benthic surveys. Most mapping technologies rely upon external positioning to create maps from this video data, which vastly increases the cost of the platform. This work introduces two pioneering software solutions with minimal external positioning requirements for seabed imagery processing for marine science. The first package, "mosaic-library," is a Python-based tool tailored for creating detailed mosaics from videos with complex 3D motion. It streamlines seabed exploration by offering video processing tools, image registration methods, and mosaicking map generation, essential for bottom feature classification and biodiversity monitoring. The second package, "SledgeStitcher", automates the manual process of analyzing seabed videos obtained from benthic sledge platforms for ecological studies. By converting video and navigation data into geographically tagged bottom map images, it eases the operator's workload in identifying and counting marine organisms like burrows, sea pens, and flatfish, providing accurate comparisons across different studies.	
Session	**Multiple Pressures**
Title	Modeling multiple pressures in marine ecosystems: state of the art and future directions
Authors	Andy Stock
Affiliation	NIVA Denmark, Njalsgade 76, 2300 København S
Abstract	Oral
People use the coasts and oceans in many ways. Understanding the effects of the resulting multiple pressures is a prerequisite for sustainable human uses of the sea yet remains an unresolved challenge in marine ecology. Because experimental manipulation of whole ecosystems is not feasible, modeling is a crucial component of addressing this challenge. Illustrated with example studies, I will discuss the potential and limitations of three fundamentally different approaches to modeling: geographical information systems, machine learning, and mechanistic ecosystem modeling. For example, while machine learning can in principle extract complicated relationships between combinations of pressures and indicators of ecosystem condition, applying this approach to typical marine data is prone to misleading statistical biases. I will close by proposing future research directions that combine the strengths of all three modeling approaches.	
Title	Variable lyskrav for vækst af ålegræs under multiple stressorer
Authors	Timi L. Banke[1], Rune C. Steinfurth[1], Benjamin Nielsen[1], Rasmus J. Kjær[1], Anders H. Petersen[1], Anders Barnewitz[1], Mia Gommesen[1], Thor S. Jørgensen[1], Paula Canal-Verges[1] og Mogens R. Flindt[1]
Affiliation	[1]Biologisk Institut, Syddansk Universitet, Campusvej 55, 5230 Odense M
Abstract	Oral
Gennem brug af test-transplantationer over stressgradienter har det været muligt at identificere individuelle stressorer og deres grænseværdier for positiv tilvækst af ålegræs. Stressorer agerer dog sjældent alene og den potentielle vækst af ålegræs vil være et resultat af multiple stressorer. Lysmangel er den primære begrænsende faktor for dybdeudbredelse af ålegræs. For at undersøge det specifikke lyskrav for ålegræs er der i Vejle Fjord blevet lavet en række dybdegradienter med varierende afstand fra inderfjorden og derved variable stressorer. Knyttet til hver dybdegradient blev den bentiske lysintensitet kontinuerligt målt ved brug af PAR-loggere kombineret med monitering af skududvikling. Resultaterne fra undersøgelsen viste at lyskravet for ålegræs var variabelt og generelt faldende med afstanden fra inderfjorden. Dette indikerer at lyskravet i stor grad er styret af de lokale stressfaktorer, der afhængigt af stressfaktoren kan have en skyggende effekt eller direkte medfører et forøget energibehov. Herudover viste resultaterne vækst af ålegræs dybere end naturlige populationers udbredelse, hvilket har implikationer for fremtidig naturgenopretning.	
Title	Stability of subtidal blue mussel beds in eutrophic coastal areas

Authors	Isabelle Johansson[1], Camille Saurel[1], Daniel Taylor[1], Jens K. Petersen[1], Pernille Nielsen[1]
Affiliation	[1] Technical University of Denmark (DTU Aqua), Kemitorvet, Building 202, 2800 Kgs. Lyngby
Abstract	Oral

Mussel populations (*Mytilus edulis*) around the coasts of Europe and the North Atlantic are often ephemeral and have notably experienced a large decline in abundance. Since 1993, annual blue mussel stock surveys have been carried out in the Limfjorden, Denmark. We used the stock survey data combined with electronic monitoring fishing data and a Mechanistic Model for Limfjorden, providing environmental data to investigate the impact of various stressors of blue mussel beds. Multiple factors were found to affect the longevity of subtidal mussel beds in Limfjorden. Predation by starfish, fishing activities, shell length of the mussels, amplitude in summer temperature, consecutive days of oxygen depletion and stratification had a negative impact on the bed longevity. Conversely, increased biomass and the presence of multiple cohorts demonstrate stabilizing effects on mussel beds. These analyses can help inform environmental, conservation, and fisheries managers on the long-term trends of population dynamics and gain a deeper understanding of what factors can affect mussel bed longevity in the context of declining stocks.

Title	Hvad regulerer iltsvinds udbredelse og intensitet?
Authors	Jens Würgler Hansen
Affiliation	Aarhus Universitet, 8000 Aarhus
Abstract	Oral

Iltsvind er den ultimative konsekvens af eutrofiering. Men iltsvind påvirkes af andet end tilførslen af næringsstoffer. Vejrliget, især i form af vindforholdene, har stor betydning for, hvornår iltsvind opstår, hvor intenst det bliver, og hvor længe det varer. Stigende temperatur og mere nedbør fremmer også iltsvind. Fiskeri med bundtrawl i iltsvindsfølsomme områder har ligeledes en negativ indvirkning på iltforholdene. Lokalt påvirkes iltforholdene i havet også af menneskelige aktiviteter i form af byggeri af kystnære konstruktioner, råstofindvinding, klapning, havbrug etc. Etableringen af offshore installationer forventes at have både en lokal og en regional negativ effekt på iltforholdene. Men hvordan er samspillet mellem alle disse påvirkningsfaktorer i forhold til iltsvind?

Title	Multiple pressures and their effects in Danish waters: from mapping to analyses
Authors	Andersen, J.H.[1,2], A.L. Eskildsen[3], T. Harvey[1] & C.J. Murray[1,2]
Affiliation	*[1] NIVA Danmark, Njalsgade 76, 2300 København S* *[2] Aquatic Synthesis Research Centre (AquaSYNC), Njalsgade 76, 2300 København* *[3] Miljøministeriet, Frederiksholms Kanal 26, 1220 København K*
Abstract	Oral

The EU Marine Strategy Framework Directive (MSFD) require Member States to produce so-called Initial Assessments (In Danish: Basisanalyser) describing the current environmental status of the waters concerned and the environmental impact of human activities thereon including an assessment of potential cumulative effects of multiple pressures. Danish Initial Assessments (IA) have been produced and reported in 2012 and 2018. The next Danish IA includes a chapter on potential cumulative effects, including analyses and results focusing on 1) mapping of cumulative effects, 2) ranking of pressures (nation-wide, regional, coastal vs. offshore), and 3) a novel analysis of the relative importance of 'classic' pressures, 'new' pressures (noise, marine litter, non-indigenous species) and 'climate change' pressures for three different scenarios (baseline, 2030 and 2050). Pressure analyses are required by several marine EU directives (MSFD, WFD and MSPD), and it is proposed to coordinate and harmonize the methods applied striving towards a full harmonization and a more efficient use of available resources.

Title	Hypoxia reduces the predation impact on the non-indigineous jellyfish *Mnemiopsis leidyi*
Authors	Magnus Heide Andreasen[1], Jane Behrens[1], Mollie Elizabeth Brooks[1], Sergejs Gorbacovs[1], Cornelia Jaspers[1], Leo Kühnemann[1], Blanca Morillo Rosado[1], Patrick Nørgaard Skovlod[1], Jon Svendsen[2], Torkel Gissel Nielsen[1]
Affiliation	[1] National Institute of Aquatic Resources, Technical University of Denmark, Kgs. Lyngby, Denmark [2] National Institute of Aquatic Resources, Technical University of Denmark, Silkeborg, Denmark

Abstract	Poster
The non-indigenous jellyfish *Mnemiopsis leidyi* thrives in the brackish waters of the Baltic Sea without known predators. Here, it competes with small fish for mesozooplankton prey, particularly copepods. M. leidyi tolerates severe hypoxia, potentially making it more resilient in the face of increasing hypoxic areas in the Baltic Sea. We hypothesize that potential predators do exist but that their predatory impact will be determined by oxygen availability. To explore this hypothesis, we applied video analyses of potential predators, functional response experiments and choice tank setups using oxygen concentrations spanning from anoxic (0%) to normoxic (100%). All experiments were carried out in salinities (20 PSU) and temperatures (18 ˚C) representative for Danish coastal waters during summer and early autumn. Our findings reveal that predators exist throughout the Baltic Sea. However, even moderate hypoxia significantly hampers their predatory impact. Our findings thus support existing claims that M. leidyi may benefit from anthropogenic pressures and emphasizes the importance of further studies on the trophic interactions between fish and jellyfish in the increasingly hypoxic Baltic Sea.	
Title	Danmarks havstrategi og påvirkninger af havbunden
Authors	Michelle Obenhausen Mortensen
Affiliation	Miljøministeriets departement
Abstract	Poster
Tilstanden i de danske havområder påvirkes af menneskelig aktivitet på land, ved kysten og på det åbne hav. Havstrategidirektivets formål er at fremme en bæredygtig udnyttelse og samtidig bevare de marine økosystemer. Et af de 11 emner i havstrategien er havbundens integritet. Havbunden påvirkes af en række menneskelige aktiviteter, f.eks. fiskeri, klapning og fysiske installationer. Visse aktiviteter fører til tab af havbunden, mens andre fører til midlertidig forstyrrelse. For at kunne vurdere, hvorvidt havbunden er i god miljøtilstand, er Danmark sammen med andre EU-lande forpligtet til at fastsætte tærskelværdier for havbunden. Der er dog fortsat afgørende spørgsmål omkring havbundspåvirkninger, som vi endnu ikke kan svare på, og det er blandt andet derfor ikke let at fastsætte disse tærskelværdier. I præsentationen dykker vi ned i Miljøministeriets arbejde med Danmarks Havstrategi, herunder resultaterne af den seneste tilstandsvurdering og fortæller om det komplekse arbejde vedrørende havbunden i internationale fora.	
Title	Effects of food and temperature on the lipid accumulation strategy of arctic copepods: experimental approach
Authors	Sigrún H. Jónasdóttir[1] & Richard Broughton[2]
Affiliation	[1]DTU Aqua, Denmark; [2]University of Stirling, United Kingdom
Abstract	Poster
Crucial organisms in Arctic food webs are large lipid rich copepods. Their size and high energy content makes them directly sought after food source by pelagic fish, birds, and whales. Lipid accumulation by copepods is a life history trait that allows them to leave the surface for deep waters to overwinter during periods of low food availability, where they can stay torpid and avoid predators at low metabolic cost. This period can last up to 9 months. An important question is, if and how increasing temperatures and freshening in the Arctic will affect phytoplankton community, and then the copepod lipid accumulation rate and type. The lipid type accumulated, wax esters, is crucial for this life history trait, and is composed of fatty acid types linked to the phytoplankton food source and can therefore be directly affected by such changes. We investigated the effect of food type, temperature and salinity on the lipid accumulation and wax ester structure of the copepod Calanus finmarchicus in experimental settings. There was a clear difference in both amount and type accumulated, with diatoms giving the best accumulation rate.	
Title	Establishing a baseline for environmental impact assessment for the Østlig Ringvej project: perspectives on water flow, ecological conditions, water quality
Authors	Gunnar P.Jensen
Affiliation	Sund & Bælt
Abstract	Poster
This abstract describes the collaborative initiatives between Sund & Bælt and environmental consultants in establishing a baseline for marine Environmental Impact Assessment (EIA) for the Østlig Ringvej Project. The collaborative efforts involve the identification and refinement of key parameters related to ecological conditions and water quality. Methods and tailored data collection strategies are employed to characterise and describe the local flow dynamics, the environmental baseline conditions of the marine environment influenced by the Østlig Ringvej Project, the potential impacts associated with the close	

proximity to the Amager coastline, and the significant role of dredging. The technical approach aims to establish a solid baseline and achieve a precise understanding of the complex interconnections between these factors on a local scale.The paper underscores how the joint efforts of Sund & Bælt and environmental experts contribute significantly to establishing a comprehensive baseline, ensuring a well-informed foundation for future environmental impact assessments linked to the Østlig Ringvej project.

Session	**Operational oceanography**
Title	The Copernicus marine service and the Baltic sea model products
Authors	V. Huess[1*], I. Ringgaard[1], V. Korabel[1], M. Hilt[1], J. Murawski[1], J. She[1]
Affiliation	[1]Danmarks Meteorologiske Institut. [*]Correspondent Author: Vibeke Huess, vh@dmi.dk
Abstract	Oral

Five national oceanographic institutes from five countries around the Baltic Sea have since 2015 formed the Baltic Sea Monitoring and Forecasting Centre (BAL MFC) under EU's Copernicus Marine Service coordinated by Mercator Ocean International. All five institutes have obligations within operational oceanography at national level and have decades of experience for running full operational services for the Baltic Sea area. We are pooling this knowledge and expertise into a joint developed model system complex used to deliver the Copernicus Marine Service's Baltic Sea forecast and reanalysis products. The production system we use is based on these state-of-the art models: the wave model WAM, the ocean-ice model NEMO-SI3, and the biogeochemical model ERGOM all tuned for and applied for the Baltic Sea area. The production system is continuously developed with the goal to deliver improved Baltic products. With this presentation we will present the status and quality of the Baltic Sea products within the Copernicus Marine Service, with special focus on the newly released reanalysis products for 3D ocean and biogeochemical state of the Baltic Sea.

Title	On the evidence of the impact of offshore wind farms on wave climate: a case study in the Baltic sea
Authors	Natacha Fery[1,*] and Simon Jury[1]
Affiliation	[1]Vattenfall Vindkraft A/S [*]Corespondent author: natacha.fery@vattenfall.com
Abstract	Oral

This study offers fresh insights into how offshore wind farms, specifically the Danish Kriegers Flak in the Baltic, influence the wave climate. It delves into the wind farm layout, the prevailing wind climate, and the key findings based on wave radar measurements mounted on 3 platforms. The study provides evidence that offshore wind farms can reduce the wave heights primarily during dominant westerly winds but also during easterly and southerly winds. The reduction in wave height has considerable implications for various aspects of offshore activities, incl. structure and scour protection design, forecasting, O&M. Furthermore, this study highlights the accuracy of wave height forecasting under the above-mentioned wind conditions. By means of comparisons with in-situ observations, feedback for real-time corrections in the forecast can be provided. Various open topics pertains to this discussion, notably the need for ongoing research within the numerical modelling community to enhance our understanding of the complex interactions between wind farms and wave climates. The results gained from this research have the potential to influence the design and operation of future wind farms.

Title	Near coastal ocean, ice and sea ice information for the Greenlandic waters
Authors	Till Soya Rasmussen
Affiliation	Danish Meteorological Institute; tar@dmi.dk
Abstract	Oral

The Danish Meteorological Institute (DMI) produces historical, present and future information about ocean and sea ice at different time scales for the Arctic with focus on the Greenlandic waters. The primary goal for DMI is to provide information that will increase safety at sea; however, this will also provide tools for planning for the users and additional downstream applications, which are based on both historical runs and present day forecast. Traditionally the Ice Service has provided services and products based on aircraft reconnaissance and manual interpretation of satellite images. New methods are being developed based on artificial intelligence, integration of new observational data and high-resolution forecasts with focus on coastal areas.This presentation will focus on the value chain from remotely

sensed observations to forecasts and further to the efforts of providing these data as useful services. The main Focus will be on the ocean and sea ice forecast that DMI provides and the efforts to improve the skill in the near coastal areas.

Title	High resolution modelling of the Godthåbsfjord
Authors	Johan Söderqvist[1*], Per Berg[1] and Brian Sørensen[1]
Affiliation	[1]Joint GEOMETOC Support Centre, *Correspondent author: jos@fcoo.dk
Abstract	Oral

The Godthåbsfjord at the Greenland west coast is a complex system with several branches and three sills. The fjord is nearly 200 km long and about 600 m deep. The Godthåbsfjord is a very dynamic region with up to 2 m tides, large freshwater discharges from glaciers, and warm subsurface water are transported into the fjord. The Joint GEOMETOC Support Centre has been tasked to set up an operational model to provide surface current forecasts to assist search and rescue (SAR) operations in the area. To model the high complexity of the fjord a nested model setup with an outer 600 m model and an inner 200 m model, both with 60 layers, has been implemented. Preliminary results show that there are two regimes in the area. Tides are the main driver for the ocean currents near the entrance, but tidal currents are much weaker east of the three sills, where other mechanisms come into play. Here, freshwater outflow together with temperature variations generate eddies, coastal currents and upwelling. During storm events, wind is the single most important factor for generating surface currents above 1.0 m/s.

Title	From operational oceanography to digital oceanography – a modelling perspective
Authors	Jun She[1*], Jens Murawski[1], Jacob Woge Nielswn[1], Vilnis Frishfelds[1]
Affiliation	[1]Danish Meteorological Institute; *Corresponding author: js@dmi.dk
Abstract	Oral

Ocean plays a key role in tackling the challenges of climate change to ensure sustainable development. Green transition poses new challenges on marine service that the latter should be able to be adaptive to dynamic user requirements and interactive with users in a digital cloud. Therefore operational oceanography is transformed into digital oceanography. This presentation introduces recent modelling developments at Danish Meteorological Institute (DMI) focusing on such a transformation for green transition. This includes blue carbon restoration, digital information for offshore wind energy, coastal adaptation, and underlying coastal-estuarial models for the digital twin of the ocean.Offshore Wind Farming (OWF): The Baltic-North Sea region is currently experiencing a rapid expansion of OWF that is expected to 380 GW by 2050. This expansion necessitates a re-examination of the environmental and ecological impacts of OWF. This requires multi-sectorial public-private cooperation. The OWF applications (such as optimal siting, operations and maintenance, seabed cable protection, wake and lee effects, contamination, security, and ecological impacts) across various scales (from individual turbines to farms, farms to coast, cross-farm, cross-border, and regional scales) demand information products that can address multi-scale processes. The JERICO (Joint European Research Infrastructure for Coastal Observation) project has recently investigated observation requirements and gaps, employing an integrated modeling-monitoring approach, to serve the purposes of multi-applications for OWF.Restoration of Blue Carbon: The recently initiated EU Lighthouse project OLAMUR (Offshore Low-Trophic Aquaculture in Multi-use Scenario Realisation in the North and Baltic Seas) aims to demonstrate the impacts of seaweed farming on carbon sequestration, water quality, and food production when co-located with offshore wind farms, by providing robust digital records. Impacts of OWFs on weather, currents and waves have been assessed using numerical models with OWF parameterization. Coastal Adaptation: Climate change exposes significant risks in coastal zones, including buildings and infrastructure. This leads to increasing storm surges, coastal erosion, flood protection challenges, and degradation of coastal ecosystems. The resolution of local requirements, spanning from synoptic to climate scales, as well as the transportation and transformation of pollutants, carbon, and nutrients from inland waters through estuarine-coastal continua to the open sea, demands seamless and hybrid modeling and observations. Ecosystem-based management is now being reinforced through the use of nature-based solutions. Digital Twin of the Ocean: DMI operational ocean model HBM is transmitted into on-demand models, characterized by open-source code and input data, relocatability, replicability, auto-configuration, and high resolution (down to tens of meters). These models also address user

requirements for what-if scenarios and focused applications. The EU project EDITO Model Lab is currently developing such model capabilities.	
Title	Marine hedebølger omkring Danmark – fortiden, nutiden, fremtiden
Authors	Mark R. Payne[1*], Ioanna Karagali[1], Ida Ringgaard[1] and Jian Su[1]
Affiliation	[1]Danmarks Meteorologiske Institut (DMI), Lyngbyvej 100, Copenhagen, Denmark * Corresponding author: mapa@dmi.dk
Abstract	Oral
Marine hedebølger er sammenhængende perioder af usædvanligt varme temperaturer i havet. Disse fænomener har globalt set fået meget opmærksomhed i løbet af de sidste fem år, som følge af nem adgang til daglige havtemperaturmålinger fra satellitter. Dramatiske påvirkninger af marine økosystemer er blevet observeret, eksempelvis arter mange tusinde kilometer fra deres naturlige habitat, massedød af havfugle, giftige algeopblomstringer og blegning af koralrev. I Danmark har marine hedebølger dog ikke fået den samme opmærksomhed. Vi analyserede højopløste satellitmålinger af havtemperaturen omkring Danmark og fandt en markant stigning i hyppigheden af marine hedebølger, især i Østersøen. Vi viser hvordan near-real time målinger kan bruges til at danne et overblik over den aktuelle hedebølgetilstand. Klimafremskrivninger fra DMI's Klimaatlas viser, at tendensen med flere og flere hedebølger vil forsætte og vil blive ekstremt i nogle scenarier ved udgangen af århundredet. Til sidst diskuterer vi behovet for yderligere forskning, hvordan resultaterne kan bruges og potentialet for et marint hedebølgevarslingssystem omkring Danmark.	
Title	Assessing the wave set-up contribution to coastal sea-level rise impact: A climate projection study for Denmark
Authors	Jian Su*, Jens Murawski, Jacob Woge Nielsen, Kristine Skovgaard Madsen
Affiliation	Danish Meteorological Institute (DMI), Lyngbyvej 100, Copenhagen, Denmark; * *Corresponding author: jis@dmi.dk
Abstract	Oral
Coastal locations around the world face the complex issue of rising sea levels, which can be attributed to several processes such as thermal expansion, ice sheet dynamics, and atmospheric surges. The objective of this study is to investigate the distinct impact of wave-induced phenomena, particularly wave setup, on the dynamics of sea-level fluctuations along Denmark's coastline. This will be achieved by analysing wave data from DMI's operational models spanning from 2006 to 2022, as well as climate projections that extend until the middle of the 21st century. Our research focusses on analysing storm surge conditions and investigating the relationship between wave dynamics and sea level changes. We conducted a detailed analysis of wave conditions during "stormy days" with significant wave heights exceeding 2%. Our results suggest that the impact of climate change on extreme wave events along the Danish coast may be less significant than previously thought when focussing solely on the wave component. To gain a more comprehensive understanding of sea-level rise contributions, we turned our attention to "storm surge conditions". Our study found that wave setup significantly influences sea-level dynamics during storm surge events. While wave height and period exhibit generally consistent patterns throughout these events, the impact of wave setup is expected to double by the middle of the century, with a possible four-fold rise in comparison to the present climate. Our findings highlight the importance of considering wave setup when developing strategies for climate engineering protection in coastal towns, especially those with a coastal line complexity similar to Denmark. This study provides crucial information for policy makers and coastal planners working to improve coastal resilience in the face of climate unpredictability.	
Session	**Biodiversity monitoring including eDNA**
Title	Bringing data from the North Sea back to life: Ecosystem-based analytics to assess the changes in biodiversity of an ecosystem
Authors	Mortensen, L.O. [1*] Schrameyer, V.[2] and Jesper Goodley Dannisøe.[1]
Affiliation	[1]Offshore Ecology and Biodiversity, DHI A/S, Denmark [2]Environmental Solutions, DHI A/S, Denmark lamo@dhigroup.com
Abstract	Oral
For 30+ years, large areas around Oil & Gas infrastructures in the North Sea has been monitored regularly. This data is now being made available to the public through a new portal, initiated by TotalEnergies. Concurrently, concerns for marine biodiversity have increased, due to the alarming	

decline of species. This has led to an emphasis on biodiversity protection, as seen in initiatives like the EU MSFD. It has also sparked interest in net-positive contributions to biodiversity from the private sector. However, the current metrics of biodiversity often concentrates solely on taxonomic diversity, while neglecting the multi-facets that make up the diversity of an ecosystem. Consequently, there is a need for a framework that considers multiple dimensions of biodiversity within an ecosystem context. This study reconciles various biodiversity measures and indicators with ecosystem structure and functioning, enabling marine operators, stakeholders, and managers to assess the broader effects of their biodiversity efforts. Additionally, the study shows how working across decades of seabed data can provide new knowledge to year-to-year changes in the composition of species and their ecological role.	
Title	Camera based documentation of biodiversity improvements in harbors
Authors	Maria Moltesen, Tim Wilms, Jeannet L. Bertelsen, and Jon C. Svendsen
Affiliation	
Abstract	Oral
Traditionally, most harbors were designed for commercial fishing and transport of goods and passengers. But in recent years, harbors have gained a more central place in many cities, where people want to live near the water. The water quality has improved in many harbors, and marine biodiversity is growing in importance. In this study, concrete elements, with specific structures and compositions, were deployed on harbor seawalls and in a coastal protection area to improve marine biodiversity and fish abundance in Spain. Using underwater cameras, we assess the biodiversity associated with the concrete elements and compare with suitable control areas. We evaluate underwater biodiversity, including fish abundance and diversity, by analyzing the underwater footage. We test the hypothesis that concrete elements, with optimal shapes and compositions, can improve local biodiversity and fish abundance in harbors and in coastal protection areas. The project is carried out in northwestern Spain, but the project results are also relevant for Danish harbors where marine biodiversity is growing in importance and where harbors are renewing or expanding.	
Title	Biotic and abiotic factors of foundation water replenishment holes in offshore wind farm Hollandse Kust Zuid
Authors	Frank Jacobs[1], Eline van Onselen[1], Sytske van den Akker[2] & Tim Wilms[3]
Affiliation	[1] De Rijke Noordzee, Arthur van Schendelstraat 600, 3511 MJ, Utrecht, The Netherlands, [2] Environment & Sustainability, Vattenfall, Hoekenrode 8, 1102 BR Amsterdam, The Netherlands, [3] Environment & Sustainability, Vattenfall, Ørestads Blvd. 114, 2300 Copenhagen, Denmark; f.jacobs@derijkenoordzee.nl
Abstract	Oral
The vision to achieve biodiversity enhancement in Offshore Wind Farm (OWF) construction is endorsed by windfarm developer Vattenfall and The Rich North Sea programme. Vattenfall is operating the Hollandse Kust Zuid (HKZ) wind park, officially opened in 2023. The Rich North Sea investigates methods for nature enhancement within OWFs and is working on an open access toolbox for wind park operators that includes, among other things, best practices. Vattenfall and The Rich North Sea are conducting field experiments within the HKZ OWF area aimed at monitoring water replenishment holes (WRHs) in the turbine foundations. The question is whether these WRHs can provide habitat inside the foundation for key species such as cod, and increase biodiversity.Spot measurement were conducted inside and outside three monopiles at HKZ in late 2021 and early 2022, to investigate differences in water quality and associated species a few months after construction. For this, Chl-a and O2 parameters were selected as leading factors. In addition, biodiversity analyses were carried out using photo and video surveys and collection of water samples for environmental DNA analysis (eDNA). During this presentation, preliminary results from these monitoring efforts will be discussed.	
Title	The core of the matter – Importance of identification method and biological replication for sediment-based marine monitoring
Authors	Mads Reinholdt Jensen [1†] , Sune Agersnap [1†] , Eva Egelyng Sigsgaard [1] , Marcelo De Paula
Affiliation	[1]Department of Biology, Aarhus University, Ny Munkegade 116, Building 1540, DK-8000 Aarhus C, Denmark. [2]Department of Biological Sciences, University of Bergen, Bergen, Norway. [3]Center of Macroecology and Climate, GLOBE, University of

	Copenhagen, Copenhagen, Denmark. [4]Sasakawa Global Ocean Institute, World Maritime University, Malmö, Sweden *† These authors contributed equally to the work*
Abstract	Oral

Benthic macrofauna are ideal as biological indicators of marine ecosystems, and have been the main focus of benthic monitoring schemes as they have limited mobility and therefore integrate the effects of local environmental stressors over time. However, in recent years, environmental DNA (eDNA) analysis has widened expanded the group of potential indicator taxa, and provided a potentially more resource-efficient method for benthic biomonitoring.
Several studies have compared the eDNA approach to the traditional morphology-based one, but few have compared the two methods using the exact same sediment cores, and the meiofauna and pelagic organisms obtained as "bycatch" using eDNA have been largely disregarded from comparisons. Here, we address these shortcomings through comparative analyses of invertebrate communities from six sample replicates of sediment from each of four sites in Denmark, using eDNA metabarcoding and morphological identification. Our results revealed little overlap in taxon compositions, and while the morphological dataset was dominated by molluscs and annelids, the eDNA dataset was dominated by arthropods and annelids. We generally found large variation across the six replicates for both methods, and here evaluate the proportion of taxa found with six samples per site in relation to the expected total richness inferred from extrapolated accumulation curves of detected taxa. The four sampling sites, which differed in taxonomic composition and richness, could be distinguished equally well with eDNA as with the morphological dataset. Our results add to the evidence that morphological and eDNA methods should preferably be used as complimentary tools for marine bio assessment, but also demonstrate that eDNA more broadly represents marine communities and requires less replication for maximum coverage of diversity to be reached.

Title	Environmental DNA sampling comparison for biodiversity detection of otherwise elusive communities
Authors	Brodnicke, OB[*,1,2], Jensen, MR[3], Thomsen, PF[3], Brorly, T[1], Andersen, BL[1], Knudsen, SW[4,5], Præbel, K[6], Brandl, SJ[7], Sweet, MJ[8], Møller, PR[4,6], Worsaae, K[1]
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Abstract	Oral

Marine surveys often underestimate biodiversity due to oversight of small, hidden, and elusive species. Detection of these often requires extensive and labor-intensive survey methods. On a Maldivian coral reef, we applied such collection-based surveys of the elusive cryptobenthic reef fishes and five low labor environmental DNA (eDNA) sampling techniques also targeting benthic annelids. The eDNA analysis detected 176 fish and 140 annelid taxa across all sites, effectively doubling the number of described annelid taxa in the region. Water filtered near the reef benthos yielded the highest species richness. Based on the eDNA sampling comparison, we found that through exact sampling, eDNA analysis can detect distinct fish communities at small spatial scales. For annelid detection, co-amplification of non-target taxa may have distorted such patterns. This underscores the potential and accuracy of low labor eDNA analysis in detecting elusive communities and contributing to biodiversity monitoring, provided suitable sampling and molecular methodologies are employed.

Title	Using quantitative Polymerase Chain Reaction and digital droplet Polymerase Chain Reaction for detection of environmental DNA from nonindigenous marine species

Authors	Steen Wilhelm Knudsen[1,2], Peter Rask Møller[2], Jesper H. Andersen[1]
Affiliation	[1]NIVA Denmark, Njalsgade 76, 2300 Copenhagen S, Denmark [2]Natural History Museum of Denmark, Universitetsparken 15, 2100 Copenhagen East, Denmark
Abstract	Oral

Detection of environmental DNA (eDNA) from specific species is mainly done using quantitative polymerase Polymerase Chain Reaction (qPCR), but recently more studies have employed digital droplet Polymerase Chain Reaction (ddPCR) for increasing the probability of detecting very rare molecules of eDNA. Using 48 filtered marine water samples collected around the coast of Denmark, we compared these two platforms in their ability to detect eDNA from 17 marine nonindigenous species, by analysing the same water samples with both qPCR and ddPCR platforms. We found that the ddPCR platform is capable of detecting the same levels of eDNA as the qPCR platform. The many technical replicates in the ddPCR, however increased the probability of detecting very low concentrations of eDNA target molecules, and thereby increased the number of positive detections at sampling sites. The thousands of replicates prepared in a single well in the plate in the ddPCR setup, exceeds what can be achieved with multiple technical replicates in a qPCR setup, and reduces the preparation time considerably compared to what can be achieved in a qPCR setup.

Title	Impact of deoxygenation on microbial distribution and roles in the biogeochemical cycles in the tropical south Atlantic oceaN
Authors	Peihang Xu[1], Christian Furbo Reeder[1,2], Damian L. Arévalo-Martínez[3,4], Joan A. Carreres-Calabuig[5], Nicole R. Posth[5], Carolin Regina Löscher[1,6]
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Abstract	Poster

Deoxygenation and the expanding oxygen minimum zone (OMZ) highlight the growing importance of OMZ microbes in global biogeochemical cycles. However, a detailed overview and comparison of key cycles conducted by microbes between marine OMZ and non-OMZ is lacking. Herein, we employed metagenomics to explore microbial communities and their metabolic potential involving carbon, nitrogen, sulfur, and phosphorus cycling across a gradient in the tropical South Atlantic, from oligotrophic and well-oxygenated open ocean water to highly productive and oxygen-depleted coastal shelf waters. We found that nitrogen (e.g., nitrification), carbon (e.g., CO oxidation), phosphorus (e.g., alkaline phosphatase) and sulfur (sulfide oxidation) pathways were negatively correlated with oxygen and tend to be more abundant within the OMZ. Some key microbial drivers were unveiled in different regions. Both N_2O producers and consumers were positively correlated with N_2O concentration. Our results provide a holistic analysis of the metabolic potential present in the OMZ and non-OMZ of the tropical South Atlantic, thus offering a valuable toolset for full pathway analysis and informing predictive models.

Title	WINDNA: eDNA based solutions for biodiversity monitoring at offshore wind farms
Authors	Jos Kielgast[1], Ida Hedal[1], Magnus Wulff Jacobsen[1], Andrea Fischel[2], Einar Eg Nielsen[1]
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Abstract	Poster

The transition towards renewable energy may have substantial impact on marine ecosystems in the near future. Wind energy is planned to expand by a factor 10 in the North Sea region alone by 2050. The ambitious political objectives seek to shift from a "no net loss" (NNL) to a "marine net gain" (MNG)

approach when licensing projects. Hence, there is a pressing need to document the impact of offshore wind on marine biodiversity. However, traditional methods are costly, labor-intensive, and lack both taxonomic and spatio-temporal resolution. The "WINDNA" project will evaluate the potential of environmental DNA (eDNA) and aim to provide new cost-effective and comprehensive marine biodiversity data. Key aspects involve examining the spatial and temporal scales of marine biodiversity using traditional water sampling by boat as well as an offshore-deployed automated environmental sample processor and an autonomous underwater vehicle (ESP2 and ESP3). Furthermore, "WINDNA" focuses on monitoring biodiversity changes during the early stages of artificial reef succession. The "WINDNA" project provides a pragmatic approach, aligning with environmental and political goals contributing to the sustainable growth of renewable energy while prioritizing positive biodiversity impact. The presentation will include preliminary data.

Title	Biodiversity monitoring of offshore structures in the Danish North Sea using environmental DNA (eDNA)
Authors	Magnus W. Jacobsen[1], Katrina Povidisa-Delefosse[2], Einar Eg Nielsen[1]
Affiliation	[1]National Institute of Aquatic Resources, Technical University of Denmark, Vejlsøvej 39, 8600 Silkeborg, Denmark; [2]TEPDK HSE Environment, TotalEnergies EP Denmark A/S, Britanniavej 10, 6700 Esbjerg, Denmark
Abstract	Poster

Environmental DNA (eDNA) is a cheap and accurate method for biodiversity monitoring based on sampling and analyzing the DNA that all living organisms shed to the environment. To investigate biodiversity at sites of interest in the sea, such as at and around platforms and natural reefs, it is necessary to understand the spatial and temporal variation of eDNA observations to accurately interpret and evaluate the results. Here, we used a metabarcoding approach to analyze top and bottom water samples collected along a transect from the DanF platform to Esbjerg harbor, which included both natural reefs and control stations. Temporal samples collected across 3 days using an onsite robotic sampler (ESP) were also analyzed to investigate short-term temporal variations. While general data analysis was performed using Illumina sequencing, a subset of data was further re-sequenced on the transportable 'MinION' sequencer from Oxford Nanopore to assess the suitability of this new technology for future on-site data generation.

Title	Discovery of 3 new invasive copepod species in the years 2021 to 2023, not formerly found in Danish Waters
Authors	Kirsten Engell-Sørensen[1], Poul Seebach[2]
Affiliation	[1]Fishlab, Hasselager Allé 8, 8260 Viby J; [2]Zooplankton ID, Boltonvej 22, 2300 Kbh S; Corresponding author: kes@fishlab.dk
Abstract	Poster

Since 2021 three new copepod species were found in the Danish Waters during the NOVANA surveillance programme by the Danish Ministry of the Environment. Copepods comprise a major part of the marine zooplankton biomass in Danish Waters. The calanoid copepod Pseudodiaptomus marinus Sato, 1913, was first discovered in The Limfjord in 2021 and in the northern North Sea in 2022 (M. Utteri et al., 2023). The calanoid copepod Tortanus (Boreotortanus) discaudatus Thompson I.C. & Scott A. (In Herdman, Thompson & Scott, 1897), was first discovered in The Limfjord 2022 (P. Seebach, unpublished).The cyclopoid copepod Oithona davisae Ferrari F.D. & Orsi, 1984. Established in The Sound, the strait between Zealand, Denmark, and Skåne, Sweden, connecting the Kattegat strait (northwest) with the Baltic Sea (south) in 2023 (K. Engell-Sørensen, unpublished). The poster describes the 3 invasive copepods, visualizes the occurrence in Danish Waters and discusses possibilities of pathways of introduction.

Session	**Miljøfarlige stoffer**
Title	Mixing zones – the regulatory dilution solution to pollution – environmental implications
Authors	Henriette Selck[a,b*] and Philip Tomasen[a]
Affiliation	[a]Tænketanken Hav, Denmark, [b]Roskilde University, Denmark.
Abstract	Oral

Effluents from wastewater treatment plants (WWPT) are introduced to the marine environment from sewage- and industrial WWTPs. The chemical composition and concentrations vary widely in effluent water and depend on the WWTP catchment area, the specific input from e.g., households and industries

and their treatment efficiency. There exist specific water quality criteria (WQC) for many chemicals, and the WQC represents the threshold level below which no environmental impact is expected. These WQCs are used by the regulatory agencies to assess, and potentially approve or reject, the effluent discharge into the marine environment. However, WWTPs do not necessarily reduce the chemical concentrations below their threshold levels. The regulatory solution has been to employ chemical mixing zones to allow effluent discharge in cases where chemical concentrations exceed their WQC - thus employing the concept of "the solution to pollution is dilution" as a management strategy. This presentation discusses the potential environmental implications of mixing zones for marine ecosystems.

Title	Skagerrak som et akkumuleringsområde for marint affald
Authors	Jakob Strand
Affiliation	Aarhus University, Institut for Ecoscience, Roskilde
Abstract	Oral

Forskellige undersøgelser har vist, at høje niveauer af marint affald inklusive plastik forekommer på kysterne og i havfugle fra Skagerrak-området. Området modtager marint affald fra både land- og hav-baserede kilder, samt fra grænseoverskridende transport via havstrømme fra Nordsøen. Derfor vil der i dette område være store udfordringer med at opnå EU's målsætninger for at opnå god miljøtilstand. Dette oplæg vil præsentere resultaterne fra tre undersøgelser i Skagerrak. 1) Den nationale overvågning med trends i mængder og sammensætning af marint affald på referencestrande, der siden 2016 har indgået som en del af HSD og OSPAR overvågningen. 2) En dedikeret "Litter-ID" workshop i 2022 med undersøgelser af store mængder af indsamlet affald fra forskellige Skagerrak-kyster i Danmark og Sverige med fokus på at bestemme geografisk oprindelse og kilder til affaldet. 3) Den nationale overvågning af plastik i maver fra stormfuglen mallemuk indsamlet som døde på strandene ved Skagen. Hovedparten af de fugle, der blev undersøgt i 2022-23, indeholdt plastik, heraf også individer med meget høje indtag af plastik. For mindst én fugl var dette formentligt også forbundet med den primære dødsårsag.

Title	PFAS i det danske havmiljø
Authors	Martin M. Larsen, Jakob Strand, Rosanna Bossi, Katrin Vorkamp
Affiliation	Aarhus University
Abstract	Oral

Flourstofferne er for alvor kommet på dagsordenen, men allerede i 2005-6 blev den første screening undersøgelse gennemført (Strand et al, 2007) og fulgt af en videnskabelig publikation med fokus på PFOS og fluorstofferne (Bossi et al, 2008). PFOS og 6 andre PFAS'er kom ind i NOVANA fra 2011, og tidstrend undersøgelser indikerer faldende koncentrationer i de mere åbne farvande. Siden tilkom PFAS i vandløbs fisk til, og der ses forskellige mønstre af PFAS'er i søer og vandløbs fisk i forhold til de marine fisk, som vil diskuteres i forhold til potentielle kilder som renseanlæg og nedbrydning i vandløbene. Status for de danske havområder og ferskvands områder vil blive præsenteret, og sammenholdt med kendte udledninger fra renseanlæg og målte vandkoncentrationer i vandløb, ligesom nye miljøkvalitetskriterier for fisk vil blive diskuteret.

Title	Determining ecotoxicity drivers and biodegradation kinetics of discharged chemicals in produced water from oil and gas extraction in the North Sea
Authors	Skjolding L. M., Møller M.T., Nielsen A. F., Poulsen T. F., Rasmussen S. B., Birch H., Mayer P., Baun A.
Affiliation	DTU Sustain
Abstract	Oral

Since the late 1990's the "zero harmful discharge" regime related to offshore oil and gas extraction has been implemented on the Norwegian Continental Shelf. It has also gained traction in other areas of the North Sea due to OSPAR regulations. However, the holistic understanding of ecotoxicity drivers and biodegradation kinetics of this complex mixture is still lacking. The main goal of the MERIT project (Intelligent testing strategy for Minimizing EnviRonmental ImpacTs of produced water) was to develop a method for the quantitative estimation of drivers and the potential for reducing environmental impacts to acceptable levels. We summarize the findings of the project with focus on 1) identifying ecotoxicity drivers through whole effluent testing supported by toxicity identification evaluation and 2) determining environmentally relevant biodegradation kinetics of discharged chemicals in produced water. We present a testing strategy using empirical data and samples from five different platforms in the North Sea to align with the goals of minimizing environmental impacts of produced water.

Title	Ecotoxicity testing for regulatory use
Authors	Amalie Thit Bruus Jensen* and Anja Kamper
Affiliation	Environmental and Ecotoxicological laboratory, DHI, Hørsholm, Denmark.
Abstract	oral
Ecotoxicity testing is a critical tool for regulatory purposes, playing a vital role in ensuring the protection the environment from hazardous substances. Many European regulations (e.g., REACH, the Pesticide Regulation, the Biocidal Products Directive) recommend or require comprehensive ecotoxicological assessments to evaluate the potential adverse effects of hazardous substances on a selection of representative organisms, including marine species. Here we focus on ecotoxicological testing on effluents from wastewater treatment plants (WWTP) or industrial facilities. There are several regulations that require ecotoxicity testing of wastewater effluents which may contain a complex mixture of hazardous substances. The regulations are based on the principles of the Water Framework Directive (WFD) which sets out a framework for protecting and improving the water quality in Europe. This presentation provides an overview of the marine ecotoxicological tests that are frequently required by the authorities.	
Title	New concept for integrated assessment of pollution sources in the sea (NEWSEA)
Authors	Marie Maar[1], Cordula Göke[1], Søren Gram[3], Niels-Kristian Tjelle Holm[3], Martin M Larsen[1], Janus Larsen[1], Vibe Schourup-Kristensen[1], Jesper Christensen[1], Kim Gustavson[1], Rossana Bossi[2], Jakob Strand[1], Zhanna Tairova[1]
Affiliation	[1]Department of Ecoscience, Aarhus University; [2]Department of Environmental Science, Aarhus University; [3]Danish Board of Technology; Corrosponding: zt@ecos.au.dk
Abstract	Poster
Environmentally hazardous substances (HS) are released to coastal waters from various point sources. Despite the increasing interest of HS in the marine environment, there is still limited knowledge on the amount, origin, and toxicity of released HS. This makes it difficult to assess the impact of HS and if they pose a risk to marine life. The aim of the NewSea project is to develop a new concept including several tools for assessing distribution and effects of HS discharged from several point sources to coastal waters. Such a concept and tools can guide future management with respect to estimating current conditions and finding solutions to mitigate the ecosystem effects in relation to various levels and discharge locations of point sources to reach a 'good chemical status (GES)' sensu the EU Water Framework Directive (WFD). The selected case study area is in the south-eastern Great Belt and Smålandsfarvandet, which is exposed to many different point sources and is presently in a none-good chemical status. Development of new concepts and tools will be important to achieve the UN Sustainability Development Goal (SDG) of a healthy ocean with emphasis on Life under Water (SDG 14.1).	
Session	**Fisheries technology**
Title	Assessing fisheries of shore crab (*Carcinus maenas*) as mitigation measure to support the restoration of benthic ecosystems in temperate waters.
Authors	Paula Canal-Vergés[1], Anders Barnewitz[1], Timi L. Banke[1], Rune C. Steinfurth[1], Mia Gommesen[1], Miguel A. Pardal[2]
Affiliation	[1]Biologisk Institut, Syddansk Universitet, Campusvej 53, 5230 Odense M. [2]UC · Department of Life Sciences, University of Coimbra, Portugal.
Abstract	Oral
Shore crab, *Carcinus maenas* is a resilient mesopredator, that due to the decline of apex predators, is currently overpopulated in Danish waters. The decline of predator fish has been linked to overfishing and to the decline of key benthic habitats. C. maenas has been shown to have a negative effect (when overpopulated) in key benthic habitats e.g., eelgrass and mussel beds. *C. maenas* reduces therefore the possibilities for the recovery in these habitats, favoring their mesopredator control. In Vejle fjord (VF), we studied fisheries of *C. maenas* as mitigation tool to assist the restoration of benthic habitats. *C. maenas* population in VF had one clutch per year, peaking in July. Our study shows a seasonal gender bias in the fisheries, were the abundance of females per catch was higher in March-June (temp. < 11 °C). The total biomass catch during early spring was lower than that during summer. However, the number of crabs caught was higher, due to the smaller size of the females. Therefore, we recommend extensive	

fishing effort in early spring, to reduce the *C. maenas* population. We further recommend to research targeted fishing gear and baits to improve fishing and reduce bycatch.	
Title	Autofisk: Automatiseret monitering af torskefangsten fra fiskefartøjer
Authors	Stefan H. Bengtson[1], Daniel Lehotský[1], Malte Pedersen[1], Thomas B. Moeslund[1] and Niels Madsen[2]
Affiliation	[1]Institut for Arkitektur og Medieteknologi, Visual Analysis and Perception Lab, Aalborg Universitet; [2]Institut for Kemi og Biovidenskab, Environmental Biology Monitoring, Aalborg Universitet
Abstract	Oral
Fiskeriet bliver i stigende grad underlagt større krav til registrering af deres fangst, hvilket kan være ressourcekrævende hvis det skal gøres manuelt. I dette projekt undersøges mulighederne for brug af kunstig intelligens (AI) til automatisk billedanalyse (computer vision) for at automatisere dele af denne registrering, herunder artsbestemmelse samt længdemåling af fiskefangsten. Vi har derfor opsamlet et datasæt bestående af 30.000 annoteringer fordelt på 1500 billeder af fisk fra dansk farvand - heriblandt forskellige arter i torskefamilien (Gadidae). Billederne i datasættet indeholder i gennemsnit 20 fisk per billede og er indsamlet i et kontrolleret miljø i et laboratorie, hvor vi har forsøgt at simulere forholdene på et fiskefartøj. Baseret på vores datasæt har vi trænet nogle af de nyeste computer vision modeller til både at segmentere fiskene i billederne samt at artsbestemme dem. Vores foreløbige resultater indikerer at de trænede modeller er i stand til at segmentere og artsbestemme fiskene i størstedelen af billederne, også fiskearter som er nært beslægtede. Desuden demonstrerer vi hvordan man kan automatisere længdemåling af fiskene ud fra billeddata.	
Title	Catch welfare in commercial fisheries
Authors	[1]Mike Breen, [2]Themis Altintzoglou, [1]Neil Anders, [3]Michelle Boonstra, [4]Endre Grimsbø, [5]Thi Thu Thuy Nguyen, [6]Bjørn Roth, [7]Ragnhild Svalheim, and [8]Hans van de Vis
Affiliation	[1]Fish Capture Group, Institute of Marine Research, Norway; [2]Marketing Research, Nofima, Norway; [3]Catch Welfare Platform, Netherlands; [4]Department of Automation and Process Engineering, UiT The Arctic University of Norway, Norway; [5]School of Tourism, University of Economics HCMC – Vietnam; [6]Processing Technology, Nofima, Norway; [7]Seafood Industry, Nofima, Norway; [8]Department Animal Health and Welfare, Wageningen Livestock Research, Netherlands; Corresponding: michael.breen@hi.no
Abstract	Oral
Commercial wild capture fishing currently produces total annual global catches of approximately 90-100 million tonnes, which equates to between 0.79 and 2.3 trillion aquatic, wild animals. There is a large body of scientific evidence demonstrating that commercial fishing practices can be severely stressful and injurious for animals in both retained and released catches. Despite this scale and severity, animal welfare in commercial catches is under-researched and rarely promoted within fisheries management. We will present examples of growing evidence that the introduction of welfare-conscious fishing practices could lead to improvements in sustainability, product quality and shelf-life, in addition to the ethical standing of the fishing industry. However, there are challenges facing the introduction of catch welfare to commercial wild capture fisheries, including: characterising the hazards and risks facing animals during capture; defining the scientific principles and tools for implementing good catch welfare; understanding the technical and socio-economic pathways to introducing welfare conscious fishing practices; and facilitating a better understanding of the benefits of good catch welfare amongst stakeholders and wider society through transparent and balanced communication, and development of engaging education in fish welfare. Implementing good catch welfare practices will utilise established sustainable capture technologies, including methods to reduce unwanted catches and avoid ghost fishing. But it will also require new and innovative technologies including welfare monitoring systems (incorporating machine learning), as well as stunning and slaughter technologies working at industrial scales. The Catch Welfare Platform has recently been established to expedite the urgently needed transition in world fisheries toward practices and technologies that improve the welfare of the catch throughout the entire capture process, including post-capture slaughter. It aims to achieve this by establishing and coordinating a network of multi-disciplinary teams, comprising innovators from the fishing and technology industries, research institutes and regulatory authorities.	
Title	Udvikling af skånsomme og effektive fiskeredskaber

Authors	Rikke P. Frandsen
Affiliation	DTU Aqua
Abstract	Oral
Fiskeriet er i høj grad en blind proces hvor fangsten først kendes når den lander på dækket. Nye teknologier er på vej ind i fiskeriet og det åbner muligheden for et præcisionsfiskeri, der kan tilpasses så målarten fanges effektivt og uønskede arter undgås. Hvad sker der med skånsomheden af fiskeriet når processen bliver mere effektiv? I sektionen for Fiskeriteknologi på DTU Aqua undersøger vi hvordan valget af fiskeredskab påvirker fangster og bifangster og hvordan AI kan bruges til at optimere informationsniveauet i styrhuset samt dokumentationen af fiskeprocessen.	
Title	Reduktion af miljøpåvirkninger fra erhvervsfiskeri med bundslæbende redskaber – anbefalinger fra Tænketanken Hav
Authors	Mads Christoffersen and Mathilde Højrup
Affiliation	Tænketanken Hav
Abstract	oral
Havbunden er fundamentet for et sundt og rigt havmiljø, men havbunden er presset på grund af påvirkning fra forskellige faktorer. Fiskeri med bundslæbende redskaber er den mest udbredte aktivitet på den danske havbund og dermed en væsentlig presfaktor for det danske havmiljø. I dansk fiskeri efter bundlevende fisk anvendes der forskellige former for fiskeriteknologier. Generelt har fiskeri med bundslæbende redskaber en højere påvirkning på havbunden, mere bifangst af fisk og skaldyr samt højere brændstofforbrug end andre former for fiskerier. Der er et behov for en omstilling af fiskeriet og brug for udvikling af nye redskaber og -designtiltag - og behov for et fokus på, hvordan disse integreres og implementeres i det nuværende fiskeri. Tænketanken Hav har på baggrund af forskning og udvikling fra DTU Aqua samlet relevante aktørers input og ideer til anbefalinger til en miljømæssig bæredygtig udvikling af fiskeriet med bundslæbende redskaber. I præsentationen vil både ovenstående proces og de konkrete anbefalinger og udviklingsmål blive præsenteret.	
Session	**Monitoring of fish stocks**
Title	Rådgivning for torsk i Grønland baseret på genetik
Authors	Anja Retzel
Affiliation	Grønlands Naturinstitut
Abstract	Oral
Den Atlantiske torsk (Gadus morhua) i Grønland er et mix af flere forskellige populationer med oprindelse/gydepladser i Grønland og Island. Når torsken bliver gydemoden vandrer den tilbage til dens oprindelses sted, hvilket betyder at migration er en stor del af bestandsdynamikken. Især i de indenskærs områder i VestGrønland sker der stor opblanding af bestandene som kan ændre sig over tid, især hvis der kommer en stor årgang med oprindelses sted i Island. Denne dynamik har skabt stor udfordring i forhold til rådgivning. Med over 10.000 genetiske prøver i perioden fra 2000 til i dag har det været muligt at skabe aldersopdelte survey og fiskeri data per bestand i Grønland. Modellen GAM (Generalized Additive Model) bruges til at beregne splittet i 3 bestande på en given position ved en given alder i VestGrønland. Således bliver survey og fangstdata splittet i 3 datasæt der bruges i modellen SAM (State-space Assesment) til at fastsætte et niveau for udnyttelse af bestanden udtrykt ved en fiskeridødelighed (F) efter principperne for maksimum bæredygtig udnyttelse (maximum sustainable yield (MSY)). Forvalterne kan efterfølgende bruge et excell-værktøj (GreenCod Manager) der beregner hvad et fiskeri i et givent område i Grønland har af udtag for de enkelte bestande.	
Title	Arktiske ekkoer
Authors	Teunis Jansen
Affiliation	Grønlands Naturinstitut
Abstract	Oral
Ultralydsscanning af havet med avancerede ekkolodder er særligt velegnet i Arktis. Derfor har Grønlands Naturinstitut (GN), i samarbejde med DTU-AQUA, iværksat en række akustiske aktiviteter. Udstyr er blevet monteret på GNs skibe og bøjer igennem de sidste 10-15 år. Akustiktogter til monitering af fiskebestande fra GNs skibe bruges til rådgivning og giver geografisk overblik og ny viden om fisks vandring og udbredelse. Dette kombineres med ekkolodder der hænger på 200 m dybde og er programmerede til at aktivere en gang i timen året rundt, hvilket giver ny viden om døgn-, og sæsonvariationer i vertikale dynamikker mellem trofiske niveauer som f.eks.: Macrozooplankton (krill), planktivore fisk (lodde), prædatorer (torsk) og topprædatorer (grønlandshaj). Disse aktiviteter vil blive	

gennemgået med et konkret eksempel på en ny teknologi til monitering og et kort indblik i den uddybende forståelse af det pelagiske økosystem som de igangværende dataanalyser bibringer.	
Title	Time-space documentation of recovery/expansion of summer feeding habitat in the Northeast Atlantic by Bluefin tuna based on observations from multiple sources
Authors	Brian R. MacKenzie, Kim Aarestrup, Olafur S. Asthorsson, Kim Birnie-Gauvin, Thomas Brereton, Erling Boge, Max Cardinale, Michele Casini, Keno Ferter, Lucy Hawkes, Thomas W. Horton, Teunis Jansen, Duncan Jones, Hannah Jones, Leif Nøttestad, Jens Peder Jeppesen, Luis Ridao, David Righton, Andreas Sundelöf, Jeroen van der Kooij , David Wall, Matthew J. Witt
Affiliation	Brian R. MacKenzie, National Institute for Aquatic Resources (DTU Aqua), Technical University of Denmark, 2800 Lyngby, Denmark; brm@aqua.dtu.dk
Abstract	Oral
Highly migratory species present challenges to fisheries management and sustainable exploitation, due to their movements within and across jurisdictions. These challenges are amplified by data limitations including reliance on commercial catch data gathered at times and places when the species is most abundant and a lack of research surveys for estimating stock distribution and abundance. Here, we use data from multiple sources from the Øresund to Denmark Strait and far north into Norwegian waters to describe a major change in the seasonal range, habitat use and migration of a large, highly migratory species, Atlantic bluefin tuna. The data we have compiled include citizen science data, including (1) direct sightings of bluefin tunas swimming and jumping at the surface, (2) stranding of tunas on beaches, and (3) some limited bycatch data. These observations provide new time-space insights to the recovery and expansion of the former habitat of bluefin tunas, and how this event might be related to fishery management decisions and large-scale climate-ocean variability. The findings demonstrate the value of multiple data sources for understanding species ecology and its dynamics.	
Title	Danish historical fisheries data
Authors	Jasmin Ann-Christine Thomassen[1], Ole Ritzau Eigaard[1] og Mikael van Deurs[1]
Affiliation	[1]National Institute of Aquatic Resources, Technical University of Denmark
Abstract	Oral
We often hear or read in the media that many of the coastal fish stocks are in decline and local fishermen struggle to make a living, because of regulations or declining catches. But where do we come from? What was the size of the fisheries and the catch opportunities one hundred years ago?Catch and effort in varying data formats across time have been reported for the Danish fisheries since the late 1800. Based on these data, we will present an overview of the Danish fisheries going back ca. one hundred years. The effort information consists of yearly records of the number of fishers, number of vessels and the number of gears, creating a potential opening for estimating long catch-per-unit-effort time series. An investigation of the Danish coastal fisheries at an even finer geographical scale is also made possible by these reports, at least for a shorter period up until the 1920s, where after the registrations by so-called “districts” ended. As part of this fine-scale investigation, we will focus on selected fjords on the east coast of Jutland, where the fisheries are very limited today, but also Jammerbugt, where fisheries are still succeeding today.	
Title	Ocean-climate conditions and spawner biomass affect the survival of blue whiting early-life history stages
Authors	Costanza Cappelli, A. Sofia A. Ferreira, Hjálmar Hátún, Jan Arge Jacobsen, André W. Visser, Casper W. Berg, Brian R. MacKenzie
Affiliation	Costanza Cappelli, National Institute of Aquatic Resources (DTU Aqua), cosca@aqua.dtu.dk
Abstract	Oral
Blue whiting (BW) recruitment has shown wide fluctuations since the early 1980s. Hitherto, no models have accurately explained these past recruitment variations, potentially due to the lack of studies addressing BW stock dynamics in relation to large-scale oceanographic processes. Here we hypothesize that the wind stress curl (WSC) may affect recruitment through several potential mechanisms and through a lagged effect on basin-scale oceanographic properties. In particular, the long-term mean location of the transition zone between areas having positive and negative WSC (WSC zero-line) coincides with the largest BW spawning area in the Northeast Atlantic. We assess the relationship	

between WSC variability in the zero-line region and a BW recruit survival index between 1981 and 2021. We found that coupling stock-recruitment relationships to WSC variability significantly improves the prediction abilities and forecast horizon of BW survival. It also suggests new processes driving BW recruit survival which could inform sustainable, ecosystem-based management practices for this important fishery resource.

Title	PIT-mærkning afslører tobisens rumlige livshistorie-parametre
Authors	Hans J. Olesen[1], Eva Maria Pedersen[1], Anders Nielsen[1], Asbjørn Christensen[1], Christoffer Moesgaard Albertsen[1], Josefine Egekvist[1], Karin Hüssy[1], Mikael van Deurs[1], Ole Henriksen[1], Belén J. Mena[2], Dorte Bekkevold[2], Jes Dolby[2], Søren Anker Pedersen[3], Claus R. Sparrevohn[4], Henrik S. Lund[5], and Henrik Mosegaard[1]
Affiliation	[1]Danish Technical University, Kgs. Lyngby, Denmark. e-mail: hjo@aqua.dtu.dk; [2]Danish Technical University, Silkeborg, Denmark; [3]Marine Ingredients Denmark, Copenhagen, Denmark; [4]Danish Pelagic Producers Organisation, Copenhagen, Denmark; [5]Danish Fishermen PO, Fredericia, Denmark
Abstract	Oral

For at forbedre forvaltningsmulighederne for fiskeri i Nordsøen efter havtobis (Ammodytes marinus), blev der udviklet et stor-skala mærknings- og genfangstforsøg, hvor tobis blev mærket med Passive Integrated Transponders (PIT-mærker) for at få højopløselig rumlig og tidsmæssig information om tobisens livshistorieparametre. Under fire år, der dækkede både vinter-nedgravningen og forårs-fiskeri-sæsonen, blev over 25.000 tobis mærket og sluppet ud på deres sandbanke-habitater i forskellige områder af Nordsøen. Genfangster blev identificeret ved hjælp af scannere monteret på fabrikspumpestationer, der modtager fangster fra industrifiskeriet. Scanner-effektiviteten blev estimeret til >98%, og flertallet af alle danske tobislandinger blev scannet. Fangstrejser med genfangster blev rekonstrueret, og den mest sandsynlige fangstlokalitet blev estimeret ved at kombinere logbogsdata og fiskeriindsats. Genfangster fra tre fiskesæsoner (i alt 61, 141 og 509) viste overensstemmelse med den lokale fiskeri-udvikling under sæsonen med høj stationær adfærd for tobis. Data muliggør estimering af migration, lokal forekomst samt relativ fiskeri- og naturlig dødelighed.

Title	The key fisher project: a citizen science programme to monitor Danish coastal fishes
Authors	Mette K. Schiønning, Eva Maria Pedersen, Elliot J. Brown, Alexandros Kokkalis, Josianne G. Støttrup & Mikael van Deurs
Affiliation	National Institute of Aquatic Resources, Technical University of Denmark
Abstract	Poster

Standardised monitoring of marine species and their populations is important for fisheries management. However, implementing monitoring programmes require extensive resources. In Denmark, a portion of the income obtained from the angling and recreational fishing license is supporting several scientific projects in fresh and coastal marine environment, including stocking, restoration and monitoring. This is known as Fiskepleje. The Key Fisher Project (Nøglefiskerprojektet) is a citizen science programme that has been monitoring the Danish coastal zone for 20 years, supported by Fiskepleje, where no other official monitoring is in place. Each month, recreational fishers deploy standardised gear on fixed positions along the Danish coasts and inside the fjords where they register the fish catches, as a proxy for fish assemblages in the area. The Key Fisher Project is a successful example of how a long-term citizen science programme can contribute to the monitoring of coastal fish stocks in an efficient and cost-effective manner, providing important time-series data on coastal fish assemblages.

Title	Seven years of data collection through an electronic angler citizen science platform: lessons learned
Authors	Christian Skov[1], Hans Jakob Olesen[2], Finn Sivebæk[1] & Casper Gundelund[1]
Affiliation	[1]Section of Freshwater Fisheries and Ecology, Technical University of Denmark, DTU Aqua, Silkeborg, Denmark; [2]Section for Monitoring and Data, Technical University of Denmark, DTU Aqua, Lyngby, Denmark
Abstract	Poster

Electronic citizen science platforms has been highlighted in recent years, often in combination with smartphone applications, as a useful tool in management of recreational fisheries. This apply to data collection for research and management and as a tool to educate and inform recreational fishers such as anglers. One such platform is the Danish electronic citizen science platform “Fangstjournalen”

developed by DTU Aqua and launched in 2016. Since then, about 16.000 anglers have signed up for the platform and registered approximately 80.000 fishing trips. Here we present some of the lessons learned from the first years driving this platform. The main challenges relate to participation, e.g., the inability to recruit participants who are representatives of the general angling population and from all recreational fisheries. Despite this, data quality evaluations also indicate that data in several cases was good and similar to that of traditional survey methods. Further, the citizen science approach makes it possible to explore management topics that traditional survey methods would not have allowed for.	
Title	Where do you come from, where do you go: inferring connectivity and stock mixing from otolith microchemistry
Authors	Karin Hüssy , Christoffer Moesgaard Albertsen, Maria Krüger-Johnsen, Jakob Hemmer-Hansen, Morten
Affiliation	DTU Aqua
Abstract	Poster
The prerequisites for sustainable management of fish stocks is knowledge about the stocks geographic distribution and the extent of migration between adjacent management units. In recent decades the use of otolith chemical fingerprints for stock identification purposes has gained increasing interest. Owing to their time-keeping properties and their lifelong record of environmental history, otoliths are a useful tool for studying stock affiliation and individual fish's migration patterns. Otoliths consist of calcium carbonate,organic matrix and small quantities of trace elements. Trace elements are absorbed primarily fromthe water across the gill surface and therefore provide a record of environmental conditions experienced by the fish. The chemical composition of the water depends on the geochemistry of the surrounding catchment and therefore provides an area-specific chemical "fingerprint", which is reflected in the fish's otoliths. Otolith chemistry has over the last three decades gained increasing attention as a tool for analysing fish stock dynamics, migration patterns, and connectivity between areas, and plays an increasingly important role as a fisheries management tool. In this study we will demonstrate the power of this approach to identify large-scale movement patterns of cod in the transition zone between the North Sea and the Baltic Sea. This area is ideal for such studies because the environmental conditions are dominated by a pronounced horizontal salinity gradient and a progressively more coastal-type environment in the Kattegat, Sound and western Baltic Sea compared to the North Sea. The cod stocks in these waters are known to consist of genetically unique populations with overlapping distribution areas. With the current low stock sizes of cod it is crucial to identify each stocks' spatio-temporal distribution for sustainable management. Our results demonstrate the need for a stock assessment that takes these complex drift/migration patterns into account.	
Session	**Modelling of marine environments**
Title	Modeling impact of blue mussel mitigation farms in coastal ecosystems. Skive Fjord, Denmark, an example
Authors	Tobias Kuhlmann Andersen[1], Alexandra Murray[2], Trine Cecilie Larsen[2], and Karen Timmerman[1]
Affiliation	[1]DTU Aqua, National Institute of Aquatic Resources, Technical University of Denmark [2]DHI A/S, Agern Allé 5, Hørsholm, Denmark
Abstract	Oral
Mussels are an important component of many coastal ecosystems and estuaries and mussel beds can mediate the benthic-pelagic coupling via among others filter-feeding activities. In recent years, mussel aquaculture productions for human consumption have been increasing in Denmark. In addition, it has been proposed that mussel aquacultures can serve as a tool to mitigate eutrophication effects by removing nutrients from the system through mussel harvesting. To evaluate the effects of blue mussel mitigation cultures on the water quality in Skive Fjord and neighboring water bodies, an individual-level mechanistic model for blue mussel growth was scaled to farm-level and implemented in a coupled hydrodynamic-biogeochemical coastal model setup for the estuary Limfjord. This presentation provides model results on the effects of blue mussel mitigation cultures on water quality and the light environment, both at a farm and basin scale. The validity and certainty of the model results are discussed and compared to previous model and observational studies, with a focus on their relevance for management and policy analysis.	
Title	Anvendelsesmuligheders af en landsdækkende ålegræsmodel

Authors	Cordula Göke, Andreas M. Holbach, Carmen Leiva-Dueñas, Dorte Krause-Jensen, Peter A.U. Stæhr, Sanjina U. Stæhr
Affiliation	Institut for Ecoscience, Aarhus Universitet
Abstract	Oral

Ålegræs spiller en afgørende rolle i danske kystfarvande, men ålegræs har oplevet markante reduktioner i udbredelse og densitet som følge af eutrofiering. Selvom der er blevet foretaget forbedringer af vandkvaliteten, er udbredelsen af ålegræs stadig begrænset, hvilket peger på andre relevante faktorer. For at evaluere betydning af de forskellige miljøforhold og menneskelige påvirkninger har vi udviklet en landsdækkende ålegræsmodel, baseret på lys, vandtemperatur, salinitet, hyppighed af lav iltkoncentration, bølgeeksponering og sedimenttype. Ålegræsmodellen gør det muligt at estimere tætheder og arealudbredelse på landsplan og kan anvendes til at teste forskellige scenarier for f.eks. ændringer i vandets klarhed og ekstreme temperaturer som vi viser eksempler på. Da modellen estimerer den potentielle udbredelse af ålegræs, er det desuden muligt at vurdere påvirkningen fra andre presfaktorer som f.eks. bundtrawling, råstofindvinding mv. under de givne miljøforhold. Endelig kan modellens resultater sammenlignes med data for den nuværende udbredelse ogherved bidrage til at identificere områder hvor man kan genoprette ålegræsbedene.

Title	Dispersal pathways of non-indigenous in the Wadden Sea; a model study
Authors	Vibe Schourup-Kristensen, Janus Larsen, Peter Stæhr and Marie Maar
Affiliation	Aarhus University
Abstract	Oral

The introduction-rate of non-indigenous species (NIS) to coastal water bodies has accelerated over the last century. We present a model study assessing the fate of NIS released in likely point sources of the Danish Wadden Sea. We show that NIS-particles released in the deep North Sea are generally transported away from the Wadden Sea, while those released in the coastal North Sea and the Wadden Sea show large variability in track pattern and settlement location. Consequently, the introduction of NIS from ships entering the port of Esbjerg pose a threat to the Wadden Sea through primary and secondary spreading, while transport of species from sources in the south likely causes a slow and steady settling of NIS in the Wadden Sea andcoastal North Sea. Further, we show recent results of NIS dispersal in the North Sea, pointing to the role of man-made structures as stepping stones for non-indigenous species. The study points to the importance of enforcing an efficient monitoring system to ensure early detection of changes to the species composition of the Wadden Sea and North Sea areas.

Title	Integreret Fjord- og oplandsmodellering, Ringkøbing Fjord og opland
Authors	Flemming Gertz
Affiliation	SEGES
Abstract	Oral

I forbindelse med landbrugsaftalen fra 2021 blev det under afsnittet om ”second opinion” besluttet at afsætte midler til ”lokale analyser” for at finde alternative veje til at nå god økologisk tilstand for kystvande. Miljøstyrelsen har udmøntet dette i 4 pilotprojekter – 4 ”kystvandråd”. Ringkøbing-Skjern Kommune har i den forbindelse ansøgt og fået tildelt et projekt. Projektet blev afsluttet med udgangen af 2023. Som del af projektet er der blevet opsat et modelsystem, bestående af en sluse- og fjord model, en hydrodynamisk fjordmodel, en økologisk fjordmodel, samt en oplandsmodel. Sluse- og Fjordmodel kan beskrive sluseoperationer og vandgennemstrømningen gennem slusen, salinitet og vandstand i fjorden (Se indlæg ” Slusemodellen for Ringkøbing Fjord og undersøgelse af fremtidige scenarier for fjordens tilstand”). Yderligere er der opsat en open source hydrodynamisk model (Delft3D) til beskrivelse af hydrodynamikken for fjorden. Modellen får sit input fra den opsatte sluse- og fjordmodel. Den økologiske model er en boksmodel (EcoWin), som anvender output fra den hydrodynamiske model. I den økologiske model er udviklet en model for sandmuslinger, som kan beskrive vækst, overlevelse og filtrering og der er udviklet et vegetations modul foruden, at modellen beskriver klorofyl og de vandkemiske parametre. I oplandet er opstillet en open source SWAT+ oplandsmodel, der indeholder spildevand og beskriver ”landuse” herunder inkluderer 20 type sædskifter til at beskrive landbrugets næringsstoftab. Der i forbindelse med opsætningen af model foretaget en modeltilpasning for at sikre en optimeret beskrivelse af vådområder i oplandet. Modellen kører i daglige tidskridt og leverer afstrømning af vand og næringsstoffer til fjordmodellerne. Kystvandrådet har holdt adskillige møder gennem 2023 og diskuteret tilstand og mulige løsninger for fjorden. Via det opsatte modelsystem har det været muligt at kvantificere forskellige muligheder, som fx justering af slusepraksis, ændret markdrift og

udtagning af arealer til vådområder	
Title	Measurements of photo inhibition and modelling its impact on primary productivity in the North Sea and North Atlantic
Authors	Line Dam Jessen[1], Jørgen Bendtsen[2], Katherine Richardson[1]
Affiliation	[1]Globe Institute, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark; [2]Section for Geobiology, Globe Institute, University of Copenhagen, DK-1350 Copenhagen K, Denmark
Abstract	Oral
Because photosynthesis in the surface layer of the ocean is limited by light availability, it is assumed phytoplankton photosynthesis will be greatest at the surface. However, high light levels can actually reduce the photosynthetic efficiency of a phytoplankton cell. This photoinhibition can decrease photosynthesis during periods with high light levels. Photosystem recovery can only occur during periods with low light levels. The implications of this photoinhibition-recovery cycle on ocean productivity are poorly understood. We present results of photoinhibition measurements determined by Fast Repetition Rate Fluorescence (Fv/Fm) in naturally occurring phytoplankton populations from the North Sea and the Irminger Sea/Denmark Strait. The measurements showed significant photoinhibition in the upper part of the surface layer and down to ~20 m depth in the North Sea and even deeper in the North Atlantic. The recovery time of the photosynthetic apparatus was determined to 5-6 hours under weak light conditions. Photoinhibition was implemented in a one-dimensional model of the upper ocean of the North Sea and the North Atlantic and its influence on primary productivity was analyzed.	
Title	Turbulence along the shelf edge in the North Sea appears to generate heterogenity in plankton food web structure
Authors	Axelle Cordier[1], Jørgen Bendtsen[2], Niels Daugbjerg[3], Nikolaj Petersen From[4], Sigrún H. Jónasdóttir[5], Serra Pompei Maria Camila[6], Erik Askov Mousing[7], Jens Tang Christensen[8], Teresa Sofia Giesta da Silva[9], Katherine Richardson[1]
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Abstract	Poster
Previous studies have demonstrated localised regions where mid-water column turbulence leads to elevated vertical nitrate flux at the shelf edge in the northeastern North Sea and predicted these fluxes to result in “patches” of enhanced new production in these regions. Here, we use data collected on the same cruise (July 2016) as these earlier studies to empirically test the hypothesis that this localised nutrient upwelling is reflected up the food web by first influencing phytoplankton community structure and production, which thereafter influences higher trophic levels in the plankton. Greater heterogeneity in plankton ecosystem structure was found in the shelf edge region compared to the rest of the study area. This was the only region where phytoplankton communities dominated by large cells were recorded and where the highest values for and greatest variability in Fv/Fm were found. Greater abundances of larger calanoids were also found here as well as the highest rates of Centropagus typicus egg production. We conclude that a signal from the localised nutrient upwelling previously recorded near the shelf edge cascades up the planktonic food web here.	
Title	OLAMUR project – Ocean model application for sustainable aquaculture
Authors	Jens Murawski, Jun She1, Vilnis Frishfelds
Affiliation	Danish Meteorological Institute (DMI), Lyngbyvej 100, 2100 Copenhagen, Denmark.
Abstract	Poster

Aquaculture is a fast growing food production sectors and an important contributor to the global food supply and blue economic growth. The European Commission with its focus on sustainable and resilient oceans launched a mission to protect and restore marine ecosystems and make blue economy, including aquafarming, carbon-neutral and circular until 2030. In the EU lighthouse project OLAMUR: Offhore Low-Trophic Aquaculture in Multi-use Scenario Realisation in North and Baltic Sea, DMI studies the effect of offshore wind farms on the atmospheric and ocean conditions, to investigate positive impacts of offshore wind farms on lower-trophic layer aquafarms. Three pilot sites have been selected: two windfarm pilot sites near Helgoland in the North Sea, at Kriegers Flak in the southern Baltic Sea and one fishfarm pilot site near the port of Veere in Estonian waters. Combined atmospheric, ocean-wave and circulation simulations for winter and summer scenarios are used to assess the impacts of offshore wind farms on the ocean conditions: currents, mixing, turbidity and to study the impacts of the hydrographic conditions on the environmental conditions at co-located aquafarms in the proximity of the wind farm. The combined study allows it to develop design criteria for offshore aquafarms and to derive siting criteria for identifying optimum location in the wind farm proximity. This requires very high-resolution model simulations in the order of 100m and below, to resolve the effects of wind-turbine-arrays on the ocean conditions. We use DMI's operational wave model WAM and circulation model HBM, with its 2-way grid nesting feature, that allows it to increase the spatial resolution flexibly near wind farm locations. The presentation demonstrates the ability of the model to resolve the characteristic scales of the offshore wind farm and analyses the model results and the outcomes of the model validation study. Suitable sites for aquafarming activities are located.

Title	Motion and commotion at great meteor seamount, an underwater giant in the North Atlantic
Authors	Vibe Schourup-Kristensen, Janus Larsen, Christian Mohn
Affiliation	Department of Ecoscience, Aarhus University, Roskilde, Denmark
Abstract	Poster

Seamounts are ubiquitous features of the global deep-sea seascape. They often provide habitat for unique benthic species communities and support increased production and aggregation of phytoplankton, zooplankton, micronekton, and fish. Seamounts interact with the surrounding currents generating flow phenomena over a wide range of frequencies from stable Taylor caps to energetic internal waves and turbulent mixing, all with the potential to enhance productivity, biomass, and biodiversity. We use the FlexSem model to study the three-dimensional circulation at Great Meteor Seamount at sub-mesoscales less than 1 km. The model uses a high-resolution bathymetry composed of the global bathymetry GEBCO2022 and data from local high-resolution multibeam surveys. At the open boundaries, the model receives input from the basin-scale North Atlantic model VIKING20X and barotropic tides from the OTIS-OSU inverse tidal model. We present results from a one-year simulation and analyse ocean currents and water mass properties to describe and map seamount-induced circulation patterns and their spatial and temporal variability.

Title	Dynamic models are versatile tools for predicting how ecosystems behave; Examples from Youngsound, Greenland and turbulent flow around windmill foundations.
Authors	Janus Larsen, Vibe Schourup-Kristensen, Christian Mohn, Marie Maar
Affiliation	Aarhus University
Abstract	Poster

A dynamic/mechanistic model is a set of (partial) differential equations, that are solved using initial conditions and boundary forcings. Unfortunately, it is rarely possible to find an analytical solution and we therefore discretize the equations in space and time and use numerical methods to find an approximate solution. This is how a weather forecast predicts the weather and we use the same methods on water to predict how the water moves, how biogeochemical processes reworks the nutrients, how shellfish grow and many other things. One of the strengths of this methods is the possibility to use the models to look at how a system behave under different pressures; how does the system react to higher temperatures? more freshwater? less nutrients? more wind? etc.We present two examples of use, one from the Youngsound fjord in northeast Greenland and an idealized setup, which investigates the effects of a windmill foundation and scour protection in a constant flow.

Title	Towards ecosystem-based techniques for tipping point detection
Authors	Ashley D. Hemraj and Jacob Carstensen

Affiliation	Aarhus University, Department of Ecoscience, Frederiksborgvej 399, DK-4000, Roskilde, Denmark
Abstract	Poster
An ecosystem shifts to an alternative stable state when a threshold of accumulated pressure is exceeded. Detecting this threshold remains a challenge because ecosystems are governed by complex interactions and multiple mechanisms can make ecosystem resilient to state shifts. Unless a broad ecological perspective is used to detect state shifts, it remains questionable to what extent current methods really capture ecosystem state shifts and can be implemented in ecosystem management. We reviewed current techniques to detect state shifts from empirical data. We show that these do not take a broad ecosystem perspective because ~85% do not combine intervariable dynamics and high-dimensional data from ecosystem variables. Thus, our perception of state shifts seems limited by methods based on datasets unrepresentative of whole ecosystems. We look at the advantages and limitations of the current techniques to identify some methods with the potential of incorporating a broad ecosystem-based approach. We therefore provide perspectives into developing techniques better geared towards detecting ecosystem state shifts by integrating intervariable interactions and high-dimensionality data.	
Session	**Marine research funding and strategies**
Title	Den danske, grønlandske, og færøske komite for FN's Tiår for havet
Authors	Adrian Lema, Steffen M. Olsen, Mie Gundertofte Vestergaard
Affiliation	DMI
Abstract	Oral
FN har erklæret 2021-2030 for tiåret for havforskning og opfordrer til transformative forskningsbaserede løsninger til bæredygtig udvikling der knytter bånd mellem mennesket og havet. Den danske, grønlandske, og færøske komite for FN's Tiår for havet er nedsat på opfordring af FN om national handling og samarbejde. Komitéen danner rammen om et engagerende netværk og dialog om forskningsprioriteter for – 'det hav vi ønsker'. Organiseringen bygger på et antal tematiske grupper med en fælles vision om at præge den videnskabelige dagsorden. Oplægget introducerer komiteen, dens grupper samt den rolle nationale komiteer spiller i den internationale koordination. Vi diskuterer mulighederne for at bidrage direkte til havets tiår gennem de åbne kald for indlejring af aktiviteter samt muligheden for at påvirke implementeringen frem mod 2030 gennem det internationale rådgivningsudvalg.	
Title	EU Mission Ocean og den danske Mission HUB
Authors	Niels Gøtke
Affiliation	Uddannelses- og Forskningsstyrelsen
Abstract	Oral
EU´s havmission er nyt initiativ i Horizon Europe med det formål at samle alle relevante initiativer i EU, nationalt og regionalt og levere effektfulde resultater inden 2030. NG vil i sit oplæg komme nærmere ind på missionen, finansieringsmuligheder, hvordan vi arbejder med missionen i Danmark og hvordan man kan blive tilknyttet missionen.	
Title	Dansk Center for Havforsknings finansieringsmuligheder
Authors	Colin Stedmon and Christian Riisager-Simonsen
Affiliation	Dansk Center for Havforskning / DTU Aqua
Abstract	Oral
Dansk Center for Havforskning (DCH) har som formål at styrke og stimulere dansk havforskning på tværs af alle havforskningsinstitutioner i Danmark. Det sker ved at være et formelt samlingspunkt for dansk havforskning i formelle sager, samt primært ved administration af midler til chartring af forskningsskibe samt ved samarbejde med Forsvaret og Marinehjemmeværnet om anvendelse af deres fartøjer til forskning. På dette oplæg vil DCH's sekretariat fremlægge muligheder for finansiering, lån af udstyr samt give en update på byggeriet af Danmarks næste store oceangående havforskningsskib Dana V.	
Session	**Marine birds and mammals**
Title	Predator-prey interactions between fish, mammals and birds in an environment subjected to heavy human influence
Authors	Martin L. Kristensen, Xavier Bordeleau, Anders Koed, Kim Aarestrup, Jonas Teilmann, Niels Jepsen, Henrik Baktoft
Affiliation	NIRAS; mlkr@niras.dk
Abstract	Oral

Hjarbæk Fjord embodies multiple stressors to migratory sea trout. Access to and from the fjord is hampered by a storm surge dam with closable gates, the fjord is highly eutrophicated and it is visited frequently by both Eurasian otter, cormorant and harbour seal. We used a fine-scale telemetry system to track the detailed behaviour of sea trout in Hjarbæk Fjord and the dam area during their seaward migration. Despite dam gates being open 88 % of the time, this anthropogenic structure caused important migration delays for sea trout, increasing their vulnerability to predation through aggregating cormorants, harbour seals and otters. Only one third of the fish that entered the area upstream of the dam successfully passed through the dam and continued their migration, while the remaining fish were predated or otherwise unsuccessful in their attempts to leave the fjord. The study highlights how human interference in marine ecosystems and addition of stressors can significantly alter the migratory behaviour and survival of anadromous salmonids, and modify predator-prey dynamics by creating predation corridors. This can result in increasing conflicts between management of fish, mammal and bird species.	
Title	Seabirds and offshore wind farms – advancing the understanding of collision risk
Authors	Jesper Kyed Larsen
Affiliation	Vattenfall
Abstract	Oral
Among seabirds, the gannet and gulls, in general, are the ones most likely to find themselves sharing the airspace with wind turbine rotors, hence being at risk of collision. While the flight heights are reasonably understood, the collision risk is much less so. Understanding the latter is key to making realistic predictions of collision numbers for new wind farms. As counting collided birds below the turbines is not an option offshore, the focus has been on documenting the degree to which the birds adapts their flight paths to the presence of wind turbines, as an alternative way of deriving the avoidance rate – the critical variable in collision risk models. This ideally requires collecting detailed 3D tracks of flying birds, and being able to do so at a species specific level, as avoidance rates are likely to differ between species. Here we present two studies conducted at the Aberdeen offshore wind farm deploying forefront technology with the aim of doing exactly that: a recently concluded two-year study using a combination of radar and camera technology and a currently ongoing study looking at the potentials of camera and AI technology to take us the last bit of the way.	
Title	The acoustic sensory ecology of diving Alcid seabirds and potential noise impacts
Authors	Adam B. Smith[1,2], Michelle Kissling[3], Alyssa Capuano[2], Iris Fischer-McMorrow[4], Yann Kolbeinsson[5], Stephen B. Lewis[6], Michelle R. Shero[2], Marianne Rasmussen[7], Jim N. McElwaine[8], T. Aran Mooney[2]
Affiliation	[1]Marine Research Centre, University of Southern Denmark, Kerteminde, DK; [2]Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA; [3]University of Montana, 32 Campus Dr, Missoula, MT; [4]Merck Animal Health, 2 Giralda Farms, Madison, NJ; [5]Northeast Iceland Nature Research Centre, Húsavík, Iceland; [6]U.S. Fish and Wildlife Service, 3000 Vintage Blvd #201, Juneau, AK; [7]The University of Iceland's Research Center in Húsavík, Húsavík, Iceland; [8]Department of Earth Sciences, Durham University, Durham DH1 3LE, UK; Corresponding: adams@biology.sdu.dk
Abstract	Oral
Seabirds are important components of holarctic coastal ecosystems. As humans increasingly utilize these sensitive areas, deep-diving seabirds like alcids face a unique combination of pervasive anthropogenic sound exposure in terrestrial and marine environments. However, the acoustic sensory ecology of this threatened group is largely unknown, which complicates assessment of potential anthropogenic noise impacts. Here, aerial auditory sensitivities and nesting soundscapes are compared between three deep-diving alcids: the colonial-nesting common murre (Uria aalge) and Atlantic puffin (Fratercula arctica), and the solitary nesting marbled murrelet (Brachyramphus marmoratus). Auditory evoked potentials (AEPs) were used to assess aerial hearing in temporarily sedated wild individuals placed inside a field-deployed anechoic chamber. For all species, AEPs were detected across a 0.5–6 kHz frequency range, similar to other birds with available data. Lowest mean auditory thresholds were between 16- and 35-dB SPL, while hearing was generally sensitive across a range extending from 1 to 3.5 kHz. Short-term soundscape dynamics of nesting habitats were also investigated via passive acoustic recordings which show that nesting acoustic environments can vary significantly among	

species. Overall, frequencies of sensitive hearing in each species overlap with many anthropogenic noise sources, indicating alcid susceptibility to disturbance from a range of noise types.	
Title	Cormorant predation – a potential threat to coastal fish populations
Authors	Niels Jepsen
Affiliation	DTU Aqua
Abstract	Oral
The European population of Great cormorant (Phalacocorax carbo sinensis) has increased from few thousand pairs in 1980 to app. 300,000 now, equalling more than one million individuals. The number of cormorants foraging in the Danish waters vary from 15,000 in mid-winter to 250,000 in the fall. Each bird eats on average 500g of fish daily, so the birds' annual consumption is app 16,000 tonnes. Cormorants eat fish of almost all species in all sizes up to 1.5 kg and is an efficient hunter in streams, rivers, lakes, fjords and open coast and forage in few cm water to 50 meters depth. In fresh water, the predation from cormorants have been documented to have a severe negative impact, especially on stationary river fish species, even on healthy, natural populations in habitats of high ecological quality. Recently, the apparent collapse of coastal fish populations, have revived focus on the role of "natural predation" and older research and data indicate that the predation from cormorants may indeed be high on fish like flounder and cod along Danish coasts. DTU-Aqua initiated a pilot study to look closer to this and the results from this PIT-tagging study point to predation being important. In this presentation, the background of conflict between cormorant conservation and fishery interest and fish conservation is discussed and the relevant research so far is presented.	
Title	Far reaching effects on harbour porpoises to ship presence and pile driving of a new oil and gas platform in the North Sea
Authors	Jonas Teilmann[1], Emily T. Griffiths[1], Jeppe Balle Dalgaard[1], Line Anker Kyhn[1], Katrina Povidisa-Delefosse[2], Jakob Tougaard[1] and Floris M. van Beest[1]
Affiliation	[1]Marine Mammal Research, Department of Ecoscience, Aarhus University, Frederiksborgvej 399, 4000 Roskilde, Denmark; [2]TEPDK HSE Environment, TotalEnergies EP Danmark A/S, Britanniavej 10, 6700 Esbjerg, Denmark; Contact: Jonas Teilmann, jte@ecos.au.dk, Frederiksborgvej 399, 4000 Roskilde, Denmark
Abstract	Oral
Ship noise and pile driving are known to disturb the behaviour of harbour porpoises. In this study the world's largest pile driving vessel were replacing new jacket foundations for an oil and gas platform in the North Sea. Acoustic recorders were deployed at distances from 200 m to 45 km from the construction site. Recordings of harbour porpoise echolocation activity and broad-band noise recordings were used to study the effect of the activities on harbour porpoises. The results shows that when the ship arrived a significant decrease in echolocation activity was seen out to about 25 km and a reduced foraging effect out to 13 km. When pile driving began (unmitigated) the negative effect on porpoise echolocation activity was observed at stations 35 km from the pile driving site. The received noise levels of the pile driving pulses at 35 km distance corresponded to the threshold level where behavioural responses can be expected. After 10 days normal echolocation activity was restored. These far reaching and unexpected results suggest that the behavioural effect on harbour porpoises from certain ships and pile driving in certain areas may be much stronger than previously thought.	
Title	Acoustic responses of white-beaked dolphins (*Lagenorhynchus albirostris*) to changes in maritime traffic A case study in Skjálfandi bay, Iceland
Authors	Mathieu Reverberi, Charla J. Basran, Marianne H. Rasmussen
Affiliation	DTU Aqua
Abstract	Poster
The worldwide spread of Covid-19 and the ensuing period of reduced human activity – the "anthropause" – created an opportunity for researchers to study the effects of quieter oceans on wildlife. Skjálfandi Bay in the northeast of Iceland provides habitat for a wide range of cetaceans. In this bay, whale-watching operations began in 1995 and continue to attract thousands of tourists each year. This study investigates the changes in maritime traffic associated with the Covid-19 pandemic and the impact on the communication of white-beaked dolphins (Lagenorhynchus albirostris) using passive acoustic monitoring, visual observations, and Automatic Identification System (AIS) data. White-beaked dolphins tended to whistle more during periods of low traffic with two times more whistles heard on average in the evening and at night, or when local maritime traffic was disrupted in 2020, with significant differences	

compared to the same period in 2022 (p=0.04). A better understanding of the anthropogenic impacts on marine fauna could lead to more effective regulations in Skjálfandi Bay, and could also serve as a basis for further studies elsewhere in Iceland or in other countries.	
Title	Harbour porpoise displacement by a bottlenose dolphin in Southern fyn
Authors	Olga Filatova[1], Ivan Fedutin[1], Freja Jacobsen[1], Lotte Kindt-Larsen[2], Magnus Wahlberg[1]
Affiliation	[1]Department of Biology, University of Southern Denmak; [2]National Institute of Aquatic Resources, Technical University of Denmark
Abstract	Poster
The most common cetacean species in Danish waters is the harbour porpoise. A few years ago, a group of bottlenose dolphins arrived from Scotland and settled around Thyborøn and Svendborg. Bottlenose dolphins are known to harass and kill harbour porpoises. The male dolphin that settled in Svendborg was reported killing harbour porpoises at least twice, in August 2020 and 2022. It is therefore important to monitor the effects of dolphin presence on the local population of harbor porpoises. Here we report the results of passive acoustic monitoring of the dolphin and porpoise presence in Svendborg and other areas of southern Fyn. We used F-PODs (underwater dataloggers) to detect click trains of porpoises and the dolphin. We found that there were significantly fewer detections of porpoises in Svendborg harbour and in Svendborgsund where the dolphin regularly occurred, compared to the nearby dolphin-free areas in the same period. After the dolphin left the area in April 2023, the occurrence of porpoises within his former range increased significantly. The results of our study demonstrate that harbour porpoises actively avoided the area inhabited by the bottlenose dolphin.	
Session	**Blue carbon accounting**
Title	Drivhusgasser i kystnære vådområder - case study Gyldensteen Strand
Authors	Erik Kristensen, Susan G.G. Petersen, Cintia O. Quintana
Affiliation	Biologisk Institut, Syddansk Universitet
Abstract	Oral
Klimaændringer og miljøproblemer vil i de kommende år tvinge os til at oversvømme kystnære lavbundsjorde. Dette kan ske ved uddigning og oversvømmelse med havvand, eller ved at oversvømme med ferskvand bag ved diger. I dette studium har vi undersøgt drivhusgasbalancen i to af sådanne områder ved Gyldensteen Strand på Nordfyn. Før oversvømmelsen i 2014 havde hele området, som var landbrugsjord, en stor netto emission af CO_2 på grund af aerob mikrobiel nedbrydning i jorden. I Gyldensteen Kystlagune, som blev oversvømmet med havvand, faldt netto emissionen af CO_2 til omtrent nul på grund af langsom nedbrydning i den iltfrie bund. Desuden forhindrer tilstedeværelsen af sulfat i havvandet CH_4-dannelse i jorden. Til gengæld dannes der meget CH_4 i bunden af den nærtliggende Engsø, som er landbrugsjord oversvømmet med ferskvand. Emissionen af CH_4 fra Engsøen er så stor, at der omregnet til CO_2-enheder faktisk frigives mere drivhusgas end fra landbrugsjorden før oversvømmelsen. Oversvømmelse af landbrugsjord med havvand giver således en stor klimagevinst i form af stærkt mindsket CO_2-udledning, mens frigivelse af CH_4 fra områder oversvømmet med ferskvand modvirker denne gevinst.	
Title	Spatial modeling of soil organic carbon stocks and accumulation rates in Danish eelgrass meadows
Authors	Carmen Leiva Dueñas[1*], Andreas M. Holbach[1], Cordula Göke[1], Peter A. U. Staehr[1], Dorte Krause-Jensen[1]
Affiliation	[1]Department of Ecoscience, Aarhus University, C.F. Møllers allé, building 1131, Denmark; [1]Department of Ecoscience, Aarhus University, Frederiksborgvej 399, DK-4000 Roskilde, Denmark; dkj@ecos.au.dk
Abstract	Oral
Seagrass meadows store and accumulate organic carbon (OC) efficiently in their sediments, OC also known as blue carbon. Although seagrasses are widely distributed along the Danish coast, their blue carbon potential has mostly been studied at local scales. In this study, our aim was to predict and map the magnitude and spatial variability of the top 10 cm of sediment OC stocks in eelgrass meadows at a national level in Denmark as well as to identify the key environmental variables driving this spatial variability. We used a OC stock dataset for the top-10 cm of eelgrass sediments from 59 sites across Denmark, together with spatially explicit marine environmental information. Generalized additive models (GAM) were used to predict OC stocks based on sets of physico-chemical covariates. The most	

parsimonious and best-performing models after validation (split-sample-cross-validation) were able to capture 50 to 60% of the spatial variability of the OC stocks but showed poor prediction accuracy (R2 = 0.20-0.25). The model estimated that 2.1 Tg OC (range: 0.22-2.08 Tg OC) is stored in the top 10 cm of Danish eelgrass sediments and identified minimum salinity, maximum seawater temperature, irradiance, wave exposure, sediment type and field sediment compaction as the key predictors of size of the stocks. The model predicted the largest OC stocks in inner, sheltered fjord areas and along the coasts of the Island of Zealand and the lowest OC stocks along the Kattegat coast. The associated uncertainty map (predictions' interval width) showed large uncertainties associated with the highest predicted OC stocks. The maps obtained here can help to inform local decisions on effective conservation and restoration projects.

Title	Blue Carbon in Danish saltmarsh soils: medium organic carbon stocks, low sequestration rates and associated drivers
Authors	Carmen Leiva-Dueñas[1]* & Anna Elizabeth Løvgren Graversen[1]*, Gary T. Banta[2], Jeppe Najbjerg Hansen[1,2], Marie Louise K. Schrøter[3], Pere Masqué[4,5], Marianne Holmer[2] and Dorte Krause-Jensen[1]
Affiliation	[1]Department of Ecoscience, Aarhus University, C.F. Møllers allé, building 1131, DK-8000 Aarhus C, Denmark; [2]Department of Biology, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark; [3]Department of Science and Environment, Roskilde University, Universitetsvej 1, 4000 Roskilde; [4]International Atomic Energy Agency, 4a Quai Antoine 1er, 98000, Principality of Monaco, Monaco [5]School of Science & Centre for Marine Ecosystems Research, Edith Cowan University, 270 Joondalup Drive, Joondalup, WA, 6027, Australia * These authors contributed equally to this work
Abstract	Oral

Saltmarshes are known for their ability to act as effective sinks of organic carbon (OC). However, some regions lack information on saltmarsh OC storage, which includes the Nordic region. To address this knowledge gap, we assessed OC storage and accumulation rates in 17 saltmarshes distributed along the Danish coasts and investigated their main drivers. Danish saltmarshes store a median of 10 kg OC m-2 in the top meter and sequester 31.5 g OC m-2 yr-1. In a global context, these values are comparatively low. Soils with abundant clay, older and stable saltmarshes in mesohaline settings, and with low proportion of algal organic material showed higher OC densities, stocks, and accumulation rates. Scaling up, Danish saltmarsh soils, comprising about 1% of the country's area, have the potential to yearly capture up to 0.1% of Denmark's annual consumption-based CO2 emissions. Our research expands the baseline data needed to advance blue carbon research and management in the Nordic region while highlighting the need for a more comprehensive approach to saltmarsh management that considers the full range of services of these ecosystems and does not only focus on climate benefits.

Title	Carbon mineralization and greenhouse gas dynamics of an eelgrass meadow in Dalby Bay Denmark: Implications for blue carbon assessments
Authors	Gry Overvad Frederiksberg[1], Marianna Lanari[1], Pere Masque[2,3,4], Erik Kristensen[1], Cintia Organo Quintana[1,5]
Affiliation	[1]Department of Biology, University of Southern Denmark, Odense M, Denmark; [2]School of Science and Centre for Marine Ecosystems Research, Edith Cowan University, Joondalup, Western Australia, Australia; [3]International Atomic Energy Agency, Marine Environmental Laboratories, Principality of Monaco, Monaco; [4]Departament de Física and Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Bellaterra, Spain; [5]SDU Climate Cluster, University of Southern Denmark, Odense M, Denmark
Abstract	Oral

Eelgrass meadows (*Zostera marina*) are widely considered as "blue carbon"-hotspots, with increasing interest on their potential for capturing and storing significant amounts of carbon which may help reach global climate mitigation goals. However, carbon mineralization and greenhouse gas production can possibly offset "blue carbon" potentials, creating a need for further research on these functions to fully elucidate the role of eelgrass meadows in climate mitigation. Therefore, the focus of this study is to investigate carbon mineralization and greenhouse gas dynamics in eelgrass meadows and unvegetated habitats in Dalby Bay, Denmark. This was carried out by seasonal in situ flux incubations measuring the

benthic dissolved inorganic carbon, methane, and nitrous oxide exchange rates using a static chamber approach. Additionally, soil carbon pools and carbon sequestration rates were measured by elemental and 210Pb analysis. The findings from this study contribute to advance knowledge on the "blue carbon" potential of eelgrass meadows and aim in building improved assessments of the carbon budgets provided by these systems.	
Title	Impacts of physical disturbance on sediment organic matter reactivity: an experimental approach
Authors	Christian Lønborg[1*], Stiig Markager[1], Simon Herzog[2], Catia Carreira[3] and Signe Høgslund[4]
Affiliation	[1]Department of Ecoscience, Aarhus University, Roskilde, Denmark; [2]Department of Science and Environment, Roskilde University, Denmark; [3]Centre for Environmental and Marine Studies, Department of Biology (CESAM), University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal; [4]Department of Ecoscience, Aarhus University, Aarhus, Denmark; [*]Corresponding author: c.lonborg@ecos.au.dk
Abstract	Oral
Many coastal sediments are frequently disturbed by a wide range of physical anthropogenic processes (e.g. bottom trawling, dredging) which cause resuspension of sediment derived organic matter into the overlaying water column. However, the potential impacts of this resuspension on the standing stocks and degradation pathways of organic matter remains to be determined. In this presentation, we will discuss results from an experiment designed to test if reoccurring physical disturbance of sediments, mimicking anthropogenic processes, influences the organic matter pool in coastal waters. Our results demonstrate that reoccurring disturbances increased the organic carbon degradation and sediment release of ammonium. These results are not only of importance for understanding carbon and nutrient cycles but also for guiding possible conservation efforts aiming at reducing human impacts on coastal waters.	
Title	A marine sediment blue carbon database for European regional seas (Euro-carbon)
Authors	Anna Elizabeth Løvgren Graversen[1*], Anna Maria Addamo[2], Christian Lønborg[3], Mark John Costello[2], Dorte Krause-Jensen[1*]
Affiliation	[1]Department of Ecoscience, Aarhus University, Aarhus, Denmark; [2]Faculty of Biosciences and Aquaculture, Nord University, Bodø, Norway; [3]Department of Ecoscience, Aarhus University, Roskilde, Denmark; [*]Corresponding author: au513721@ecos.au.dk and dkj@ecos.au.dk
Abstract	Poster
	Marine sediments are one of the major organic carbon (OC) reservoirs on the planet and are important in regulating Earth's climate. These OC stocks, termed blue carbon, have received increased attention over the past decade. However, blue carbon data are currently spread across different databases and publications, which limit their use at a European scale. As part of the Horizon Europe project "MPA Europe" (https://mpa-europe.eu/), we are compiling, mapping and quantifying OC stocks at a European scale as a baseline to inform better management of the seafloor. We therefore invited the research community to contribute data for a comprehensive blue carbon database termed EURO-CARBON. In this presentation we give an overview of the current status of the database, and discuss the variability in blue carbon stocks across habitats and regions, and how blue carbon maps may be used to guide protection of these important OC stocks at a European scale.
Title	Residence Times and Legacy of Blue Carbon Reservoirs
Authors	Andre W. Visser
Affiliation	DTU Aqua
Abstract	Poster
Quantifying the carbon sequestration potential of blue carbon reservoirs is critically dependent on residence times – how long carbon remains in these reservoirs before being re-exposed to the atmosphere. Simple mass balance considerations provides estimates – or at least constraints - for many of the major blue carbon reservoirs in the earth system. For vegetated coastal ecosystems (mangroves, sea grass meadows and salt marshes) constituting a global reservoir of about 25 PgC, this is of the order 1000 to 2000 years. For carbon sequestered by the biological carbon pump in the worlds oceans, a	

reservoir of about 1800 PgC, it is 700 to 1300 years. It is over these time scales that the these respective reservoirs reach equilibrium with influx and efflux in near balance. The degradation of habitats and the over-exploitation of marine living resources have tipped these natural processes out of balance, to the extent where these blue carbon reservoirs are now net emitter of legacy carbon back to the atmosphere. Nature-based solutions can be sought to address parts of this crisis, for instance in improving ecosystem health and biodiversity. However, it is unlikely that nature-based solutions to carbon management exist on a scale commensurate with anthropogenic emissions. The best we can do is to limit net carbon emissions by restoring what we can, and to ensure that future practices do not further tip blue carbon reservoirs out of balance.

Session	**Jammerbugt – et naturligt observatorium**
Title	Carbon Capture and Storage in the Jammerbugt subsurface: Investigating the deep geology offshore NW Jutland and its potential for CO_2 storage
Authors	Michael B.W. Fyhn[1*], Thomas Funck, Axel Ehrhardt[2], Egon Nørmark[3], Tomi A. Jusri, Shahjahan Laghari, Tanni J. Abramovitz, Nicklas Christensen, Ulrik Gregersen
Affiliation	[1] Geological Survey of Denmark & Greenland, GEUS; [2] Bundesanstalt für Geowissenschaften & Rohstoffe; [3] Aarhus University; * mbwf@geus.dk
Abstract	Oral

The Danish deep subsurface holds a vast potential for underground storage of CO_2 and plays a fundamental role in the transition away from fossil fuels. Jammerbugt has been designated as one of the important areas presumably suited for permanent underground CO_2 storage as geological structures in the subsurface have been identified, each of which may store permanently millions of tons of CO_2.·Up till now, the Jammerbugt structure constituted the least known of these structures, but acquisition of a dense grid of reflection seismic data has revealed the structure as a large and complexly faulted structure formed through a combination of deep-seated faulting and gravitational sliding and associated detachment faulting soling out in both a thin veneer of Zechstein salt and Triassic Oddesund Formation salt. Understanding the geology of the Jammerbugt structure and its complex tectonic evolution is essential for evaluating its potential for safe and permanent CO_2 storage.

Title	En geologisk model for Jammerbugten baseret på multiprojekt data
Authors	Niels Nørgaard-Pedersen[1*], Nicklas Christensen[1], Jørgen O. Leth[1], Sofie Kousted[1], Lars. Ø. Hansen[1], Mikkel S. Andersen[1], Isak. R. Larsen[1], Silas Clausen[1], Jacob R. Jørgensen[1], Lars-Georg Rödel[1], Sigurd B. Andersen[1], Peter Sandersen[1], Zyad Al-Hamdani[1] & Verner B. Ernstsen[1]
Affiliation	[1] De Nationale Geologiske Undersøgelser for Danmark og Grønland; * nnp@geus.dk
Abstract	Oral

Jammerbugten var for bare 10 år siden et af de geologisk set mindst undersøgte farvandsområder i Danmark. Projekter med fokus på offshore råstofindvinding, vindenergi, CCS-lagring, kyst- og habitatbeskyttelse har igennem de seneste år bidraget med et væld af nye geofysiske data og boringer, som samlet danner grundlag for etablering af en overordnet geologisk model for området. I forbindelse med JAMBAY projektet er der specielt fokus på de overfladenære geologiske formationer, som giver ophav til en varieret geo- og biodiversitet på havbunden. Et dække af holocænt marint sand, aflejret som dynamiske bundformer, præger større dele af Jammerbugten. Hvor det holocæne sand er mere eller mindre fraværende, ses stenførende glaciale aflejringer og lavninger i den glaciale overflade udfyldt med senglaciale finkornede sedimenter. I JAMBAY fokusområdet er der foretaget meget detaljeret kortlægning af flere senglaciale udfyldninger, som danner et komplekst og skjult dalsystem af glacial oprindelse. I den nordlige og nordvestlige del af Jammerbugten dykker den glaciale overflade markant ned, og et større område her er præget af en meget stor udbygning af senglaciale-holocæne aflejringer. Den nordvestlige rand af udbygningen danner den nutidige skråning mod større dybde i Skagerrak, hvor lagdelt mudder aflejres. Lagserien af senglaciale-holocæne aflejringer kan forklares med udviklingen af det relative havniveau i området over de sidste ca. 20.000 år. Under de glaciale og holocæne aflejringer findes specielt i den sydlige del af Jammerbugten overfladenært prækvartær kridt-kalk, som dels er deformeret i større foldestrukturer langs Sorgenfrei-Tornquist forkastningszonen, og dels indgår i mere overfladenære glacialtektoniske overskydningskomplekser.

Projektet ”Mapping of seabed habitats and impacts of beam trawling and other demersal fisheries for spatial ecosystem-based management of the Jammer Bay (JAMBAY) er finansieret af Den Europæiske Hav- og Fiskerifond og Fiskeristyrelsen.

Title	Havbundens morfologi og habitater i Jammerbugt: Diversitet og dynamik
Authors	Mikkel S. Andersen[1*], Lars. Ø. Hansen[1], Isak. R. Larsen[1], Silas Clausen[1], Jacob R. Jørgensen[1], Niels Nørgaard-Pedersen[1], Nicklas Christensen[1], Jørgen O. Leth[1], Sofie Kousted[1], Lars-Georg Rödel[1], Sigurd B. Andersen[1], Peter Sandersen[1], Zyad Al-Hamdani[1] & Verner B. Ernstsen[1]
Affiliation	[1] De Nationale Geologiske Undersøgelser for Danmark og Grønland (GEUS); * man@geus.dk
Abstract	Oral
Fiskeri med bundslæbende redskaber kan have en effekt på havbundens morfologi og naturlige fysiske habitater. Detaljeret kortlægning af havbunden, samt undersøgelse af de naturlige dynamiske processer, kan bidrage til at vurdere denne effekt. Som en del af JAMBAY projektet, der koordineres af DTU Aqua, har GEUS gennemført en kortlægning i Jammerbugten af havbundens morfologi, substrattyper og fysiske habitater samt identifikation af spor efter bundslæbende redskaber. Grundlaget for kortlægningen er primært geofysiske data, herunder sidescan sonar, multibeam sonar og sedimentekkolod, indsamlet i foråret 2023 indenfor rammerne af JAMBAY projektet. Derudover er data fra andre projekter i området, som blev indsamlet i samme tidsperiode, inddraget, samt eksisterende arkivdata. I dette projekt har vi inddelt Jammerbugten i to områder; et fokusområde på 300 km^2 med fulddækkende fin-skala kortlægning, og et screeningsområde på 5.230 km^2 med ikke-fulddækkende stor-skala kortlægning. De dynamiske processer har vi belyst ved at sammenholde de nye data med overlappende arkivdata. Vi præsenterer her resultater og betragtninger fra projektet. Projektet ”Mapping of seabed habitats and impacts of beam trawling and other demersal fisheries for spatial ecosystem-based management of the Jammer Bay (JAMBAY) er finansieret af Den Europæiske Hav- og Fiskerifond og Fiskeristyrelsen.	
Title	Testing and comparing biological seabed indicators in response to bottom trawling in the Jammer Bay
Authors	Esther D. Beukhof[1], Ciaran McLaverty[1], Anne-Mette Kroner[1], Josefine Egekvist[1], Jonathan Stounberg[1], Ole R. Eigaard[1], Grete E. Dinesen[1]
Affiliation	[1] DTU Aqua; * estb@aqua.dtu.dk
Abstract	Oral
A range of biological indicators have been developed and applied to evaluate the condition of the seabed in Danish coastal waters. However, some of these indicators were primarily designed to measure their response to eutrophication, a stressor that is not always the most prevalent factor in areas where bottom trawling occurs. Recently, new indicators have been developed specifically to assess the impact of trawling on the benthic community. In this study, we aim to test and compare a variety of biological seabed indicators along a trawling gradient, while also taking into account natural conditions, seabed habitat types, and other stressors, such as nutrient and oxygen concentrations. The study is situated in Jammer Bay and uses high-resolution spatial fisheries data and benthic fauna sampled collected during three recent field campaigns in the area. The results are expected to enhance the national assessments of the seabed in Danish coastal waters.	
Title	Sporing af spor efter fiskeri og spor af liv i sporene
Authors	Amanda Irlind[1], Alex Jørgensen[1], Karen Ankersen Sønnichsen[1], Kim Pless-Schmidt[1,3], Nadieh de Jonge[1], Jeppe Lund Nielsen[1], Malte Pedersen[2], Jonathan Eichild Schmidt[2], Anders Skaarup Johansen[2], Micheal Østed, Thomas B. Moeslund[2], Christian Lønborg[4], Niels Madsen[1]
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Abstract	Oral
I Jammerbugt i Skagerrak findes nogle af de mest intensivt fiskede danske havområder. Området er specielt karakteriseret ved at alle af de væsentligste typer af danske fiskerimetoder finder steder. Det gælder garn som er faststående fiskeredskaber samt bomtrawl, snurrevod og trawl. De forskellige	

redskaber påvirker havbunden fysisk på forskellige vis men kan også påvirke pelagiske habitater. Desuden er habitaterne på havbunden i området og faunaen tilknyttet denne varierende. Gennem moniteringsarbejde i 2023 har et forskningsprojekt forsøgt at undersøge fiskeriaktiviteter, påvirkning fra bundslæbende redskaber habitater, fauna og biodiversitet generelt. Mange forskellige moniteringsredskaber har været overbords for at give en bredere forståelse af disse forhold, bl.a. sidescan sonar, fartøjs satellitdata, undervandsdrone, undervandsvideokamera, trukken Ockelmanslæde, Van Veen grab til bundprøver, lydoptagelser og senest også e-Dna. Sammenlagt giver undersøgelserne en ny generel indsigt i marin natur og påvirkninger fra fiskeriaktiviteter.
Projektet er finansieret af: Den Europæiske Union, Den Europæiske Hav og Fiskerifond (EHFF) og Ministeriet for Fødevare Landbrug og Fiskeri, Fiskeristyrelsen. Projekttitel: Undersøgelser af havbundsforhold og bundslæbende redskabers påvirkning i Jammerbugt (Jambo, 33113-B-23-190)

Title	Computer vision og kunstig intelligens under overfladen i Jammerbugt
Authors	Malte Pedersen[1], Anders Skaarup Johansen[1], Jonathan Eichild Schmidt[1], Amanda Frederikke Irlind[2], Alex Jørgensen[2], Niels Madsen[2], og Thomas Moeslund[1]
Affiliation	[1] Institut for Arkitektur og Medieteknologi, Visual Analysis and Perception Lab, Aalborg Universitet; [2] Institut for Kemi og Biovidenskab, Environmental Biology Monitoring, Aalborg Universitet; * mape@create.aau.dk
Abstract	Oral

Det marine miljø omkring Danmark er under pres fra flere sider som følge af bl.a. klimaforandringer, iltsvind og fiskeri. Dette manifesterer sig fra en nedgang i biodiversitet til kollaps af fiskebestande. Interessen for at overvåge livet under havoverfladen som en del af monitorerings-, beskyttelses- og genopretningsprojekter er kraftigt stigende, hvilket nødvendiggør opskalering af dataindsamling og analyse. Dette er både svært og dyrt at imødekomme ved hjælp af konventionelle manuelle metoder.Computer vision og kunstig intelligens omfatter en bred vifte af værktøjer, der er nået til et punkt, hvor de er modne til anvendelse i monitoreringsopgaver under havoverfladen for at bistå under dataindsamling og analyse. I dette projekt fokuserer vi på Jammerbugt-området i Skagerrak, hvor der er bekymring for, hvorvidt bundslæbende redskaber forringer levevilkårene for marine organismer. Vi har bl.a. anvendt sonar og undervandsdrone til at indsamle data fra områder, der har været udsat for betydelig aktivitet fra bundslæbende redskaber og ved hjælp af computer vision og kunstig intelligens har vi forsøgt at afdække i hvilken grad der efterlades visuelle påvirkninger af bundforholdene.
Projektet er finansieret af: Den Europæiske Union, Den Europæiske Hav og Fiskerifond (EHFF) og Ministeriet for Fødevare Landbrug og Fiskeri, Fiskeristyrelsen. Projekttitel: Undersøgelser af havbundsforhold og bundslæbende redskabers påvirkning i Jammerbugt (Jambo, 33113-B-23-190)

Title	Assessing the impact of demersal towed fishing gears on benthic macrofaunal assemblages in Jammerbugten
Authors	Amanda Irlind[1], Alex Jørgensen[1], Karen Ankersen Sønnichsen[1], Kim Pless-Schmidt[1,3], Nadieh de Jonge[1], Jeppe Lund Nielsen[1], Malte Pedersen[2], Jonathan Eichild Schmidt[2], Anders Skaarup Johansen[2], Micheal Østed, Thomas B. Moeslund[2], Christian Lønborg[4], Niels Madsen[1*]
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Abstract	Poster

The impact of demersal towed fishing gear on marine habitats is widely acknowledged to be a substantial source of anthropogenic disturbance on benthic ecosystems worldwide. The passage of demersal towed fishing gears can cause physical changes in the seabed that have a direct effect on benthic macrofaunal assemblages. Jammerbugten, Skagerrak is an extensively fished area of the North Sea with global and local economic importance. This study aims to quantitatively assess the influence of three specific demersal towed fishing gears—bottom otter trawl, beam trawl, and Danish seine—on the benthic macrofauna within Jammerbugten. Utilizing AIS data, precise locations where these fishing gears were

deployed were identified. Subsequently, grab samples, bottom sledge, e-Dna, Acoustic sonars, underwater drones, underwater video cameras, have been in used in each designated area, and analyzed for the presence of benthic macrofauna and habitats. The biodiversity and overall species sensitivity based on biological traits of the macrofaunal assemblages from each designated area was compared to determine the impact of each type of fishing gear on seabed communities. This study highlights the impact of demersal towed fishing gear on the biota of the seabed and emphasizes the continued need for sustainable fishing practices in Jammerbugten.

This project is financed by: The European Union, The European Maritime, Fisheries and Aquaculture Fund (EMFAF) and the Fishery Agency of the Danish Ministry of Food, Agriculture and Fisheries. Project title: Investigations of seabed conditions and the impact of demersal towed fishing gear in Jammerbugt (Jambo, 33113-B-23-190)

Session	**Maritime activities and Arctic**
Title	Identifying drivers of phytoplankton diversity and communities in Arctic fjords – from time series modelling to experiments
Authors	Tobias R Vonnahme[1], Thomas Juul-Pedersen[1], Diana Krawczyk[1], Anna Vader[2], Cheshtaa Chitkara[2]
Affiliation	[1]Greenland Institute of natural Resources, Greenland Climate Research Centre, Kivioq 2, 3905 Nuuk, Greenland; [2]UNIS – University Centre in Svalbard, Department of Arctic Biology, Forskningsparken, N-9170 Longyearbyen, Svalbard
Abstract	Oral

In Arctic fjords, the base of the food web is typically comprised of lipid-rich chain-forming diatoms, but at times a variety of other phytoplankton taxa such as the colony-forming flagellate *Phaeocystis* may dominate. Different species may not be equally suitable or nutritious as food sources for higher trophic levels. Increased Atlantic water inflow, with warmer temperatures, altered salinity, and changes in sea ice cover, and glacier interactions will likely change the community structure of the dominant primary producers. We studied the role of different drivers in an Arctic fjord system on Svalbard (Isfjorden), and in Greenland (Nuup Kangerlua) using two different approaches. Firstly, we analyzed time series in both fjords using multivariate autoregressive state space models to identify potential environmental drivers of different key phytoplankton groups. Our model in Greenland found the nutrients phosphate and silicate to determine the dominance of diatoms or flagellates. Based on the model output, we incubated natural phytoplankton communities from both fjords under different nutrient conditions confirming the regulatory role of phosphate and silicate.

Title	Marine biological hotspots along the continental slopes between Greenland and Canada
Authors	Thomas Juul-Pedersen[1], Tobias R. Vonnahme[1], Marja Koski[2], Caroline Bouchard[1], Else Ostermann[1]
Affiliation	[1]Greenland Climate Research Centre, Greenland Institute of Natural Resources, Nuuk, Greenland; [2]National Institute of Aquatic Resources, Technical University of Denmark, Lyngby, Denmark
Abstract	Oral

Marine ecosystems and their living resources are of vital economical and societal importance to Greenland. Offshore waters along the continental slopes support important fisheries, due to their oceanographic conditions sustaining high biological production. While animals such as shrimps, fishes, and mammals are well studied and surveyed in this offshore region, due to their commercial importance, relatively few studies exist on the seasonal and spatial dynamics of phyto-, zoo- and ichthyoplankton, despite their crucial role in sustaining the marine food web. Phytoplankton biomass and production are often underestimated, due to a lack of *in situ* data, necessitating a reliance on remote sensing estimates with limited depth resolution. This knowledge gap is limiting our understanding of the production capacity of these important offshore ecosystems. We present a large plankton dataset from offshore waters between Greenland and Canada along with commercial fishing activity. We found remarkably high phytoplankton biomass throughout the productive season from spring to autumn, solidifying the growing consensus that continental slopes are important biological hotspots.

Title	A floats journey in a Greenland fjord
Authors	Lorenz Meire, John Mortensen, Josh Willis, and Mike Wood

Affiliation	Greenland Institute of Natural Resources, Nuuk, Greenland
Abstract	Oral
The Greenland Ice Sheet is losing mass at an average rate of 240 Gt yr^{-1} during the last decades, contributing to global mean sea level rise. Particularly at Greenland's marine-terminating glaciers, draining 88 % of the ice sheet in area, discharge has increased significantly. Heat transport from the ocean to these glaciers has been identified as one of the critical processes for understanding future mass loss. In addition, there is increasing attention to the impact of meltwater discharge on fjord and its cascading impact on Greenland's marine ecosystems. Using a profiling float deployed in inner fjord around Nuuk, measuring temperature, salinity, chlorophyll, turbidity and oxygen, we study the dynamical physical and biogeochemical conditions in the fjord. We present the data, challenges and opportunities of high resolution sampling compared with ship-based samplings in our dynamic Greenland fjords.	
Title	Cumulative impacts of climate change and oil pollution on Arctic copepods
Authors	Sinja Rist[a], Sofie Rask[a], Iliana V. Ntinou[b], Øystein Varpe[b], Martin Lindegren[a], Kevin Ugwu[c], Maria Larsson[c], Viktor Sjöberg[c], Torkel G. Nielsen[a]
Affiliation	[a]National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark, Kemitorvet, Kgs. Lyngby, Denmark; [b]Department of Biological Sciences, University of Bergen, Norway; [c]Man-Technology-Environment Research Centre (MTM), Örebro University, Örebro, Sweden
Abstract	Oral
Climate change and pollution are expected to increase in the Arctic in the future. Still, the combined impact on the marine ecosystem is not well understood. In this study, we investigated the cumulative impact of crude oil and two climate change scenarios on the feeding of the copepod species *Calanus glacialis* and *Calanus finmarchicus*. Adult females were exposed to ambient conditions and two scenarios of warming and freshening. All three conditions were tested in the absence and presence of mechanically dispersed oil (1 µL L^{-1}). During the 6 days of exposure, incubations were renewed daily and the number of fecal pellets was counted. The fecal pellet volume was measured three times. Warming from 0 to 5°C plus freshening from 33 to 27 psu resulted in a significant increase in feeding for both species. However, when salinity dropped to 20 psu (at 5°C) feeding decreased for *C. glacialis*, while fluctuating for *C. finmarchicus*. For both species, oil had the strongest effect, leading to a 68-83% reduction in feeding, overshadowing any differences between climatic conditions. The results demonstrate the sensitivity of Arctic copepods to all three parameters, with some cumulative effects.	
Title	Forsøg på reducering af bifangst i det grønlandske stenbiderfiskeri
Authors	Søren L. Post
Affiliation	Greenland Institute of natural Resources, Greenland Climate Research Centre, Kivioq 2, 3905 Nuuk, Greenland
Abstract	Oral
	The Greenland lumpfish fishery, the world's second-largest, is a vital income source for many small-scale fishers. While holding MSC certification, the risk of losing recognition looms due to bycatch challenges, especially seabirds and marine mammals.To address bycatch, we've taken multiple measures over the years. We initially quantified bycatch by observing fishers' activities and catches in 2019 and 2021.Subsequently, we tested modified gillnets with small-meshed black net additions in 2021 and 2022 to deter diving birds and benthic fish. The nets reduced diving bird bycatch but also affected female lumpfish, leading to limited fisher support.In 2023, we examined the impact of LED-illuminated gillnets on both target and non-target species. Results are under analysis, to be presented at the Danish Marine Science Meeting, alongside findings on time-varying catch rates linked to seabird migration and lumpfish spawning behavior. During the presentation I will go over the different experiences and results we have observed.
Title	Wet wipes discharged by wastewater as a contribution to plastic pollution in the Arctic
Authors	Bach L[1], Salame H[2]; Strand J[1]; Fritt-Rasmussen J[1], Jensen PE[2]
Affiliation	[1]Aarhus University, Denmark. Department of Ecoscience; [2]Denmark Technical University, Department of Environmental and Resource Engineering
Abstract	Oral

Plastic litter is ubiquitous in our environment and the world oceans act as sinks for plastic waste. Even remote areas in the Arctic are shown to be polluted by plastics. The understanding of sources, quantities and mitigation for the Arctic remains limited. In Greenland as many other places in the Arctic, sewer wastewater discharged untreated to the sea may be a potential source of plastic pollution. Wastewater from two towns in Greenland, Sisimiut and Nuuk, was collected to determine the contribution of litter from wastewater to ocean plastic pollution. Litter > 25mm from wastewater from both cities was sampled, characterized, quantified, and type specified by FTIR spectroscopy. The results showed that among few other microlitter items as ear buds, sanitary pads and condoms, wet wipes were found in a high number in the wastewater. In 90 liters of wastewater, 12 and 23 wet wipes were found in the two cities. Here off were most of the wet wipes found to be of plastic or plastified origin, with an identified composition of 100% PET in Sisimiut and 50% PET and 25% viscose in Nuuk. The remaining 25% wet wipes in Nuuk were of cellulose. In this study, we identified wet wipes discharged by wastewater as a potential source of not only macrolitter pollution, and with fragmentation of the wet wipes also a source of synthetic white microplastic fibers to the marine environment.

Title	The sensitivity of primary productivity in Disko Bay, a coastal Arctic ecosystem, to changes in freshwater discharge and sea ice cover
Authors	Eva Friis Møller[1], Asbjørn Christensen[2], Janus Larsen[1], Kenneth D. Mankoff[3,4], Mads Hvid Ribergaard[5], Mikael Sejr[1], Philip Wallhead[6], Marie Maar[1]
Affiliation	[1]Department of Ecoscience, Aarhus University, 4000 Roskilde, Denmark; [2]DTU Aqua, Technical University of Denmark, DK-2880 Kgs. Lyngby, Denmark; [3]Department of Glaciology and Climate, Geological Survey of Denmark and Greenland, 1350 Copenhagen, Denmark; [4]National Snow and Ice Data Center (NSIDC), Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder, Boulder, CO, 80390, USA;[5]Danish Meteorological Institute, 2100 Copenhagen, Denmark; [6]Section for Oceanography, Norwegian Institute for Water Research (NIVA Vest), Bergen, Norway
Abstract	Poster

The Greenland Ice Sheet is melting, and the rate of ice loss has increased 6-fold since the 1980s. At the same time, the Arctic sea ice extent is decreasing. Melt water runoff and sea ice reduction both influence light and nutrient availability in the coastal ocean with implications for the timing, distribution, and magnitude of phytoplankton production. We evaluate the relative importance of these processes for the primary productivity of Disko Bay, one of the most important areas for biodiversity and fisheries around Greenland. We use a high-resolution 3D coupled hydrodynamic-biogeochemical model validated against *in situ* observations and remote sensing products. The model estimated net primary production (NPP) varied between 90-147 gC m^{-2} $year^{-1}$ during 2004-2018. Freshwater discharge had a strong local effect within ~25 km of the source sustaining productive hot spot's during summer. When considering the annual NPP at bay scale, sea ice cover was the most important controlling factor. Our study indicates that decreasing ice cover and more freshwater discharge can work synergistically and will likely increase primary productivity of the coastal ocean around Greenland.

Title	Low Sulphur Fuel Oils- Effects and response options in an Arctic context
Authors	Janne Fritt-Rasmussen[1], Susse Wegeberg[1], Pia Lassen[2], Kim Gustavson[1]
Affiliation	[1]Aarhus University, DCE, Department of Ecoscience, [2]Aarhus University, DCE, Department of Environmental Science
Abstract	Poster

New regulations of the sulphur content of ship fuels (IMO 2017) entail, that maximum sulphur content of fuels used by ships is 0.1% in SEACs area and 0.5% worldwide. A growing number of LSFOs are being marketed to replace the traditional fuel types with a high content of sulphur (1–3.5%S). LSFOs are a wide group of different oil products with varying chemical compositions that exhibit a wide span in properties such as viscosity, density and pour point. The project included small-scale laboratory experiments to investigate the effectiveness of combating LSFO spills in cold seawater by in-situ burning and chemical dispersion, respectively. The overall purpose was to evaluate which key organisms are at most risk in the marine environment from a LSFO spill when mitigated by in situ burning or chemical dispersant. Three different LSFOs were included in the small-scale laboratory experiments: wide range diesel (WRD), ultra-low sulphur fuel oil (ULSFO 2018) and heavy distillate marine ECA 50 (HDEM50).

The study only includes fresh oils and not weathered (i.e. evaporated and emulsified) oils. Oil weathering will further reduce the potential for oil spill combatting.	
Title	Concentration and tolerance of mercury (Hg) and methylmercury (MeHg) in Arctic zooplankton
Authors	Delove, Jens, Torkel, Sigrun, Thomas, Marja Koski
Affiliation	DTU Aqua
Abstract	Poster
Arctic marine ecosystems are particularly vulnerable to Hg contamination due to the melting of polar ice, which traps Reactive Gaseous Mercury. In response to climate-induced warming, Hg concentrations in Arctic marine ecosystems are thus expected to be altered. We investigated the total Hg (THg) concentration in lower trophic level marine organisms — plankton— of different size fractions (> 200, 50-200 and 50-20 µm) coarsely representing mesozooplankton, microzooplankton and phytoplankton, respectively, in the fjords and open sea transect along the West Coast of Greenland. In addition, we investigated the LC_{50} of dominant arctic zooplankton species, *C. glacialis*, *C. finmarchicus*, *Pseudocalanus* sp., *Oithona* sp. and calanoid nauplii when exposed to Hg and MeHg. The lowest THg concentration (18 ± 3.51 ng/g dw) was observed in the > 200 µm size fraction and the highest concentration (25.5 ± 3.7 ng/g dw) in the size fraction of 50-200 µm, suggesting some form of depuration of Hg in mesozooplankton. Also, planktonic organisms from fjord transects had significantly higher THg concentrations than those from the open sea. The 72-hour LC_{50} of Hg and MeHg decreased with decreasing prosome length and lipid content of dominant zooplankton species in the rank order of *C. glacialis* > *C. finmarchicus* > *Pseudocalanus* sp. > *Oithona* sp. > nauplii, with lower LC50 values for MeHg than for Hg. Our results demonstrate the presence of mercury in the lower trophic levels of the Arctic marine environment and species-specific responses of zooplankton to Hg pollution. Since concentrations in higher trophic level organisms such as fish are likely to depend on the concentrations at the basis of the marine food web, it is necessary to understand the potential and mechanisms of bioaccumulation in this environment.	
Title	Effect of zooplankton community structure on the biological pump in Arctic
Authors	Marja Koski, Sigrun Jónasdóttir and Camilla Svensen
Affiliation	DTU Aqua
Abstract	Poster
Zooplankton influence the biological pump in multiple ways, including production of sinking particles through fecal pellets, degradation of sinking particles through fragmentation and consumption, and active carbon transport. The importance of these processes varies, depending on the behavioral and metabolic traits of organisms, so that a community dominated by large vertically migrating herbivorous copepods would increase the vertical flux, whereas a community dominated by small aggregate-feeding copepods would contribute to flux attenuation. We investigated the vertical distribution, fecal pellet production and aggregate feeding of large primarily herbivorous calanoids compared to small aggregate-feeding copepods in the west coast of Greenland and Davis Strait in summer. We sampled zooplankton at 35 stations, using a Multinet with a 50 µm mesh, and conducted incubations to measure pellet production and aggregate feeding rates. Although the small copepods always dominated zooplankton abundance, the ratio of small vs. large copepods varied by 8-fold between the stations as did the pellet production and feeding rates. Our results demonstrated highly different particle production vs. degradation profiles between the stations and indicated that changing environment will influence the effect of zooplankton on biological pump, both through its effect on community composition and Our preliminary results indicate large differences both in proportional abundances of species and pellet production rates between the stations, suggesting that changing environment influences the effect of zooplankton on the biological pump, both through its effect on community composition and through its effect on the metabolic rates of copepods.	
Session	**Exploring the untapped potential of aquaculture**
Title	Organic live feed cultures for marine fish hatcheries
Authors	Per M. Jepsen
Affiliation	Roskilde University pmjepsen@ruc.dk
Abstract	Oral
On of the bottlenecks in marine aquaculture is the supply of fish larvae. The reason for this is that in the early life history of most marine fish larvae they depend on live feed, like copepods. Copepods are difficult	

to cultivate but are for some marine fish larvae the only valid live feed to sustain their survival, growth, and health. But what if one could use a nutritious relevant copepod as live feed that on top were organic produced.A few years ago, we found a marine copepod species that could survive in harsh conditions. It could tolerate rapid fluctuations in abiotic factors (pH, salinity, oxygen). Furthermore, the surrounding food for the copepods was of very low quality. So, we set out to investigate, how does it do it? And can we utilize this for a new live feed for marine aquaculture?First, we discovered that the copepod is capable of bio synthesize essential long chained fatty acids (Omega3 and 6) from short chained FAs. This explained the copepods capability to survive in a poor food environment, since it can utilize and "change" the available low-quality food for its own needs. Secondly, we recently discovered that it is an osmoregulator, so it the copepod is actively combating rapid changes in salinity. These were all promising traits for a live feed so we decided to test how dense we could produce the copepods. In small scale we have achieved densities up to 10,000 ind. L^{-1} and in our larger scale cultures we regularly have 5000 to 6000 ind L^{-1}. Now we were on to something very promising. So, we started testing different food items for the copepods, both of more traditional aquafeed origin but also of organic aquafeed origin. These feeding trials has given us promising results, and we are currently testing industrial waste streams from organic productions to see if they can be turned into a side stream by using them as food for copepods. At the same time, we are feeding the copepods with organic food and thereby creating a new organic live feed concept for marine aquaculture. At lats, we have used the copepod as live feed for turbot larvae as a proof of concept, with interesting, good results. In conclusion, we believe we have a very new interesting live feed that is ready to be tapped into for marine aquaculture.

Title	Multi-use platforms combining offshore wind farms with low-trophic aquaculture show great potential to support the global sustainability goals
Authors	Marie Maar**[1]**, Andreas Holbach[1], Teis Boderskov[2,3], Marianne Thomsen[4,5], Bela H. Buck[6,7], Matthieu Povidis-Delefosse[8] and Annette Bruhn[2,3]
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Abstract	Oral

Multi-use platforms combining offshore wind farms with low-trophic aquaculture can provide sustainable energy, nutritious seafood, and positive ecosystem services through emission (CO_2 and nutrients) capture and utilization. Our study from the transition zone between the saline North Sea and the brackish Baltic Sea showed that by allocating 10% of existing and projected wind farm areas to blue mussel and sugar kelp aquaculture, 81, 74 and 41 kt-fresh weight per farm hectare could be harvested from the North Sea, the Danish Straits, and the western Baltic Sea, respectively. This corresponds to 5% and 3% of the required N and P reductions, respectively, in the Baltic Sea Action Plan and 35% of the CO_2 emissions from the Danish agricultural sector. Current and projected wind farm areas were compiled for the different continents and the potential for multi-use was upscaled. Globally, there is great potential to mitigate the eutrophication effects and produce blue biomass offshore with less user conflicts and a negative or low carbon footprint supporting the global sustainable development targets.

Title	Cultivation of sugar kelp in Danish waters – best available technology, challenges and opportunities
Authors	Teis Boderskov[1,2], Mette Møller Nielsen[3], Peter Søndergaard Schmedes[3], Michael Bo Rasmussen[1,2] and Annette Bruhn[1,2]
Affiliation	[1]Aarhus University, Department of Ecoscience; [2]Aarhus University, Centre for Circular Bioeconomy (CBIO); [3]Aarhus University, Danish Technical University, National Institute for Aquatic Resources, Section for Coastal Ecology
Abstract	Oral

Longline cultivation of sugar kelp (*Saccharina latissima*) has been performed at different scale in Limfjorden, Kattegat and the Belt Sea by commercial companies, maritime gardens and science institutions since 2008. The development of the hatchery methods and grow out design for the Best Available Technology, has enabled a biomass yield above 5 kg/m during one season in both Limfjorden and Horsens Fjord, which is comparable to other regions of Europe. However, the area specific biomass yield remains low.This talk will give an overview of the cultivation practices used for sugar kelp in Denmark by giving insight into the trials and developments made within the cultivation practices for the last 10 years and looking ahead, where the expectation is that the Best Available Technology can be further developed with focus on design of cultivation structures, multiple harvests and future use of breeding practices.	
Title	Monitoring in aquaculture is win-win-win-win
Authors	Anders Tengberg, Inger Graves, Jarle Heltne and Reidun Dalland
Affiliation	Aanderaa-Xylem, Bergen, Norway
Abstract	Oral
As European aquaculture is changing from small family run businesses to large industrial companies the requirements for efficient automatized remotely controlled operations have increased and so have the demands from governments to minimize the environmental impact. Efficient production requires constant monitoring with sensors and cameras in and around the facilities and high-speed data connections to shore. This presentation gives examples of monitoring at aquaculture sites and how the EuroSea project has contributed to this with two buoy platforms that serves multiple purposes: for Fish Production that becomes more efficient, For the Environment that is less impacted, For the Fish that has better living conditions and for Science that benefits from the data to improve prediction models for e.g. heat waves, oxygen deficit, jelly fish "invasions" and toxic algae blooms.	
Title	Ready, set, grow! - Species selection of local Danish green tide algae for land based integrated multi-trophic recirculated aquaculture systems (IMRAS)
Authors	Kristoffer Larsen-Ledet [1], Teis Boderskov [1], Nina Simonsen [2], Birgit Olesen [3], Sanne Sandberg Overby [2], Lone Jytte Lund Ottosen [3], Kitte Linding Gerlich [1], Esben Rimi Christiansen [4], Lasse Hornbek Nielsen [4], Olivier De Clerck [5], Sofie D'hondt [5] and Annette Bruhn [1]
Affiliation	[1]Department of Ecoscience, Aarhus University, Denmark; [2]Department of Biological and Chemical Engineering, Aarhus University, Denmark; [3]Department of Biology, Aarhus University, Denmark; [4]Pure Algae Denmark APS; [5]Department of Phycology, Ghent University, Belgium
Abstract	Oral
The macroalgae genus *Ulva* has been targeted for cultivation in Integrated Multitrophic Recirculated Aquaculture Systems (IMRAS). However, it is important to carefully select the right *Ulva* species before cultivation. This study investigated nine Danish green algae strains and their direct applicability in land based IMRAS. Firstly, all algae strains were subjected to steady conditions (883 µM nitrate N, 42 µM phosphate P, 160 µmol m^{-2} s^{-1} PAR). Secondly, two selected algae strains were subjected to different temperature treatments (10, 16, 22 and 28 °C). The specific growth rate (%FW day^{-1}) and biomass yield (gDW m^{-2} day^{-1}) were estimated during the study. Only three individual strains of *Ulva compressa* (Strain ID: S2, S4 and S9) and one *Ulvaria obscura* had stable growth rates (15 – 22 %FW day^{-1}) during steady conditions. The biomass yield increased slightly with temperature for strain S9/*U. compressa* (18 – 35 gDW m^{-2} day^{-1}). Biomass yield decreased with temperature for *U. obscura* (16 – 21 gDW m^{-2} day^{-1}). Our results indicate that not all *Ulva* strains can be directly used for IMRAS. However, the *U. compressa* strains investigated here might prove interesting for further research.	
Title	Degradation of macroalgae detritus: how does detritus from macroalgae cultivation affect carbon release from marine sediments?
Authors	Julie Lyhne Ehrenreich[1], Signe Høgslund[1], Birgit Olesen[2], Daniel Taylor[3] & Annette Bruhn[1]
Affiliation	[1]Aarhus University, Department of Ecoscience; [2]Aarhus University, Department of Biology; [3]Danish Technical University, Aquatic Resources
Abstract	Poster
Macroalgae cultivation can lead to loss of detritus before the algae are harvested, either from loss of whole thalli or erosion of tissue. When labile organic matter (LOM) is added to the sediment, a “priming	

effect" of the degradation of organic matter in the sediment can occur. A previous study found indications of microbial priming, as the mineralized carbon exceeded the amount of carbon in the added macroalgae. The aim of this study is to investigate microbial degradation of detritus from the species *Ulva* sp. and *Saccharina latissima*, and the potential priming effect in the sediment. Two laboratory experiments were conducted using sediment cores collected in Limfjorden. To start the flux experiment fresh algae tissue was added to each core. Measurements of O_2, DIC and dissolved inorganic nutrient fluxes were taken at day 1, 5, 12, 20, 40 and 80 after the addition of algae. Results of the first lab experiment indicates significant effect of treatment and time on O_2 flux. The results contribute to the discussion of whether macroalgae detritus from cultivation will contribute to carbon sequestration or stimulate increased degradation of carbon buried in the sediment.	
Title	Seasonal variation in fertility status, gamete release, germination success rate and growth of *Fucus serratus*
Authors	Levinsen JUG[1], Andreasen AB[2], Boderskov T[1], Bruhn A[1,3]
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Abstract	Poster
Culture of seaweed is done by closing the life cycle, fragmentation, and vegetative growth or a combination. Neither is well established for *Fucus serratus*. In an ongoing study in Begtrup Vig, Aarhus Bay area of Kattegat, a population of *F. serratus* is observed for fertility status monthly through one year. Fertile individuals are collected when available, and 10 females and 10 males are identified. Gamete release for each individual is induced, gametes are counted and immediately followed by seeding of substrates. Germination success is counted after a week and substrates are deployed in Begtrup Vig where growth is quantified, by counting and length measurements, during the monthly visits. Unseeded substrates act as control and as means of testing wild seeding viability as seen in mussel culture. The results will be discussed with focus on when to source wild *F. serratus* breeding material with high gamete release and germination success, and to test whether quick deployment of seeded substrates, or even wild seeding directly in the field, might be viable strategies to further investigate for culturing this species.	
Title	Impacts of climate change on water quality, benthic mussels and suspended mussel culture in a shallow, eutrophic estuary
Authors	Marie Maar[1*], Janus Larsen[1], Momme Butenschön[2], Trond Kristiansen[3, 4], Hans Thodsen[5], Daniel Taylor[6], Vibe Schourup-Kristensen[1]
Affiliation	[1]Department of Ecoscience, Aarhus University, Frederiksborgvej 399, PO Box 358, 4000 Roskilde, Denmark; [2]Ocean Modeling and Data Assimilation Division (ODA), Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC), Bologna, Italy; [3]Farallon Institute, 101 H St., Petaluma, CA 9495, USA; [4]Actea Inc, San Francisco, California, USA; [5]Department of Ecoscience, Aarhus University, CF Møllers Allé 3, 8000 Aarhus C, Denmark; [6]Section for Coastal Ecology, National Institute of Aquatic Resources, DTU Aqua, 7900 Nykøbing-Mors, Denmark
Abstract	Poster
Climate change is a global problem that causes severe local changes to ecosystem functioning and services. Three future climate change scenarios ranging from low greenhouse gas emissions (SSP1-2.6), to intermediate (SSP2-4.5) and very high emissions (SSP5-8.5) were combined with nutrient load reductions according to the National Water Plans to investigate potential impacts on blue mussels for the two periods 2051-2060 and 2090-2099, relative to a reference period from 2009-2018. The FlexSem model combined 3D hydrodynamics with a pelagic biogeochemical model, a sediment-benthos model, and a dynamic energy budget - farm scale model for mussel culture. The Limfjorden was sensitive to climate change impacts with the strongest responses of physics and water quality in the worst case scenario. In the two low emissions scenarios, expected improvements of bottom oxygen and Chl *a* due to reduced nutrient loads were counteracted by climate change impacts. Suspended mussel culture was intensified in all scenarios showing a high potential harvest, whereas the benthic mussels suffered from reduced food supply and hypoxia.	
Session	**Science to support marine spatial planning in Denmark**
Title	Et samlet dansk datagrundlag til en økosystembaseret tilgang til havplanlægning

Authors	Søren Laurentius Nielsen and Ditte Mandøe Andreasen
Affiliation	Tænketanken Hav
Abstract	Oral

Tænketanken Hav arbejder for at udbrede anvendelsen af en økosystembaseret tilgang i dansk havforvaltning og havplanlægning. I den forbindelse har Tænketanken Hav igangsat et arbejde, der kan danne grundlag for en politisk beslutning om at etablere og finansiere en marin dataplatform, der skaber overblik over marine data til brug for en økosystembaseret tilgang til havplanlægningen i Danmark. Tanken er at den marine dataplatform skal give overblik over både offentlige og private miljødata. Præsentationen vil give et indblik i Tænketanken Havs arbejde om dette. Der vil også være mulighed for at give input til Tænketanken Havs arbejde.

Baggrund:

I juni 2023 blev der indgået en politisk aftale om Danmarks Havplan. Aftalen fastsætter, at der skal iværksættes en undersøgelse af, hvordan der kan ske en ny, fokuseret anvendelse af data, der kan styrke havplanlægningen fremadrettet. Aftalepartierne er enige om, at Danmarks havplan skal udarbejdes ud fra en økosystembaseret tilgang, at den skal være i overensstemmelse med havstrategiens miljømål og udarbejdes med afsæt i internationalt anerkendte principper for økosystembaseret tilgang, operationaliseret ift. havplanlægning i regi af HELCOM.

Title	Marin habitatkortlægning i Østersøen 2022-2023
Authors	Lars Øbro Hansen[1], Zyad Al-Hamdani[1], Mikkel Skovgaard Andersen[1], Lara F. Perez[1], Lars-Georg Rödel[1], Sigurd Bøgelund Andersen[1], Eric J. Haase[1], Jørn Bo Jensen[1], Thomas Vangkilde-Pedersen[1], Jan F. Nicolaisen[2], Sanne Kjellerup[2], Cecilie Kjer Elkjær[2], Cecilie Lara[2], Frederik Gai[2], Karen Søby Özdemir[2], Verner Brandbyge Ernstsen[1]
Affiliation	[1]De Nationale Geologiske Undersøgelser for Danmark og Grønland (GEUS); [2]WSP Danmark
Abstract	Oral

Udlægning af marine beskyttede områder er afgørende for at skabe bedre vilkår for naturen i havet. GEUS og WSP har, for Miljøstyrelsen, kortlagt havbunden i fire områder i Østersøen omkring Bornholm i forbindelse med et høringsforslag til udpegning af beskyttede områder, som del af et udkast til Danmarks Havplan, bl.a. med det formål at fastsætte en baseline for naturtilstanden. Områderne er kortlagt i henhold til Miljøstyrelsens substrattyper, overordnede habitattyper under havstrategidirektivet samt habitatdirektivets naturtyper. Herunder blev artssammensætningen og artsdiversiteten af flora og fauna knyttet til de forskellige substrattyper og overordnede habitattyper kortlagt og beskrevet. Påvirkning af havbunden efter menneskelige aktiviteter blev identificeret ud fra tolkning af geofysisk data, understøttet af søkort. Der blev indsamlet ~3.100 linje-km med sidescan sonar, sedimentekkolod og multibeam sonar. Derudover blev der indsamlet 376 HAPS-bundprøver og foretaget 170 visuelle observationer med ROV. Vi præsenterer her et udsnit af projektets resultater.

Anerkendelse/acknowledgement

Projektet "Kortlægning af havbunden i beskyttede områder", udført for Miljøstyrelsen, er muliggjort gennem Hav- og Fiskeriudviklingsprogrammet (EHFF) 2014-2020 samt en finanslovsbevilling i forbindelse med udførelse af overvågningsaktiviteter i regi af Havstrategidirektivet.

Title	Miljøkortlægning af havvindspotentialet og vurdering af kumulative effekter
Authors	Eva Friis Møller, Jake Badger, Tony Erik Bergøe, Rasmus Bisschop-Larsen, Martin Emil Blicher, Jonathan Carl, Karsten Dahl, Morten Elmeros, Andrea N. Hahmann, Janus Larsen, Marie Maar, Louise Rønde Mønster, Jacob Nabe-Nielsen, Jonas Nyfeldt-Nüchel, Ib Krag Petersen, Jakob Tougaard, Maria Wilson
Affiliation	Aarhus University
Abstract	Oral

Projektet "Screening og miljøkortlægning af havvindspotentialet i Danmark" belyser effekter af storskalaudbygning af havvind på natur- og miljøforhold med det formål at understøtte den langsigtede planlægning af udbygning af havvind i Danmark under størst mulig hensyntagen til natur og miljø.

En central del af projektet er at præsentere et samlet overblik over hvilke dele af havarealet, der forventes særligt sårbare over for udbygningen, hvilke områder der umiddelbart vurderes mere egnede, hvor sameksistens med andre interesser er muligt, samt hvor der stadig mangler viden.

En anden væsentlig del af projektet omhandler vurderingen af potentielle kumulative effekter af de mange nye havvindmølleparker. Målet er en vurdering af den samlede påvirkning af den marine natur, ikke blot effekten af havvindmølleparker enkeltvis. Samtidig stræbes mod at evaluere på tværs af de individuelle dele af økosystemet, og at tage hensyn til havvindudbygningen på tværs af nationale grænser.
Ved Havforskermødet 2024 præsenteres projektets tilgang og udvalgte foreløbige resultater.

Title	Danmarks fremtidige havmiljø – klimadata til brug for planlægningen på havet
Authors	Mark R. Payne[1*], Fredrik Boberg, Ida Ringgaard, Julie Stensballe, Jian Su, and Rasmus Pedersen
Affiliation	[1]Danmarks Meteorologiske Institut (DMI), Lyngbyvej 100, Copenhagen, Denmark
Abstract	Oral

Vores samfund er nødt til at tilpasse sig de udfordringer, der opstår, som følge af klimaforandringerne. Dette kræver information som er lokalt, tilgængeligt, aktionærbare og ikke mindst, videnskabelig troværdigt. DMI's Klimaatlas blev lanceret i 2019 som en autoritativ og ensartet kilde til klimainformation for at understøtte klimatilpasning i Danmark. Klimaatlas indeholder i dag de forventede ændringer i temperatur, nedbør, vind, havniveau og stormfloder og anvendes af alle 98 kommuner i Danmark samt af regionerne, forsyningsselskaber, rådgivende ingeniør og Staten, med flere. Men selvom klimaforandringerne er en vigtig udfordring for vores havmiljø i Danmark, findes der ikke nogen tilsvarende informationskilde for havmiljøet. Som en del af Danmarks bidrag til UN Ocean Decade er DMI ved at udvide Klimaatlas til også at dække havmiljøet. I dette foredrag vil vi præsentere vores foreløbige arbejde, inklusiv brugerinddragelse, det tekniske grundlag og en forsmag på de første indikatorer. Planer for den videre udvikling, yderligere brugerinddragelse samt samarbejdsmuligheder diskuteres, for derved at opnå en bedre forståelse af behovet for klimainformation om Danmarks fremtidige havmiljø.

Title	Life cycle assessment of concrete in artificial reefs: A case study of Køge Bay's circle reef project.
Authors	Siff N. Lørup[1,2], Nestor R. Padró[1], William B. Feldthus[1], Lisbeth M. Ottosen[1] , Wolfgang Kunther[1,3*]
Affiliation	[1]Technical University of Denmark, 2800 Kgs. Lyngby, Denmark; email: sinl@dtu.dk email: wolku@dtu.dk
Abstract	Poster

Stone fishing, resource extraction and discharge of wastewater in Køge Bay, has influenced the local ecosystems negatively. The restoration project, Køge Bay Marine Park, plans to compare concrete and granite reefs to investigate similarities and differences between the two types of materials when used as (artificial) boulder reef. A framework was developed to assess the design of artificial reefs as tool for ecosystem creation, which includes categories like material properties, biological overgrowth etc. aiming to compare the performances of different concrete and cement types. The results of the framework have been incorporated in a comparative LCA to find the optimal concrete design. Multiple impact categories have been analyzed besides global warming impact to ensure a more complete analysis of different materials. The results of these comparisons highlight the importance of designing for lower amounts of cement in the reef units to decrease the environmental impact. The framework revealed a need for protocols for reporting essential information on both engineering and biological parameters. These aspects are of great importance in creating success criteria for coastal management.

Title	Tænketanken Hav – en uafhængig og vidensbaseret tænketank, som arbejder for et rent, sunt hav og en bæredygtig brug af havet.
Authors	Liselotte Hohwy Stokholm
Affiliation	Tænketanken Hav
Abstract	Poster

Tænketanken Hav er en uafhængig, vidensbaseret og løsningsorienteret tænketank. Vi sætter os i spidsen for samarbejdet ml. virksomheder og beslutningstagere, der arbejder for et rent, sundt hav og en bæredygtig brug af havet. Tænketanken blev oprettet i 2021 og er finansieret af Velux Fonden (75 mio. kr. i 2021-2026).
Tænketanken Hav arbejder gennem at:

- Bearbejde og strukturere viden, tænkning og erfaringer, bl.a. fra dansk og international forskning og arbejde med havet.

- Facilitere samarbejde og fælles løsninger mellem aktører, der vil bidrage til et sundt hav, og bane vej for virksomheders innovation og omstilling og nødvendige politiske beslutninger.
- Sætte dagsordener med analyser og perspektiveringer, der bidrager til at skabe en stærk folkelig bevidsthed om havets problemer og løsninger, og gør omstillingen uomgængelig.

Tænketanken Hav arbejder ud fra 5 dogmer:

1. Hver gang vi peger på et problem, tilstræber vi også at pege på mindst én løsning.
2. Vi udtaler os altid vidensbaseret, og sætter viden i sagligt perspektiv.
3. Vi inddrager vores medlemmer og hører deres perspektiv.
4. Vi orienterer vores medlemmer om vores resultater, inden de offentliggøres.
5. Vi er kun en del af svaret. Svaret findes altid i samarbejde med andre.

Session	**Marine tools for nature restoration**
Title	Næringsstofreduktioner -en forudsætning for marin naturgenopretning
Authors	Karen Timmermann[1] and Anders Erichsen[2]
Affiliation	[1]DTU Aqua; [2]DHI
Abstract	Oral

Det danske havmiljø har ikke opnået god tilstand. Vandet er uklart, ålegræsset er presset og der er udbredt iltsvind. I den tredje og indtil videre sidste vandområdeplan er målet, at de danske udledninger skal reduceres til 38.000 tons N/år fra de nuværende ca 56.000 tons N/år. Men vil det sikre god økologisk tilstand og hvordan går det med sænke næringsstofudledningerne? I foredraget vises resultater for hvordan de danske reduktionskrav afhænger af hvad de andre lande gør, betydningen af fosfor, mulighederne for at sæsonoptimere næringsstofreguleringen og anvende marine virkemidler til at forbedre miljøtilstanden. Vi belyser de forventede miljøgevinster, når de danske næringsstoftilførsler er blevet reduceret og ser på hvor langt Danmark er nået ift at implementere virkemidler til reduktion af næringsstoffer.

Title	Etablering af biogene rev, Hvorfor og hvordan gøres det?
Authors	Pernille Nielsen[1*], Jens Kjerulf Petersen[1], Lisbeth Damsgaard Jørgensen[2], Henrike Semmler Lê[2], Thomas Kirk Sørensen[2] og Tommy Kristoffersen[3]
Affiliation	[1]DTU Aqua, Sektion for Kystøkologi, Kemitorvet, 2800 Kgs. Lyngby; [2]WWF Danmark, Svanevej 12, 2400 København NV; [3]Ørsted, Nesa Allé 1, 2820 Gentofte; peniel@aqua.dtu.dk
Abstract	Oral

Biogene rev er vigtige marine habitater, der består af hårde strukturer skabt af dyr som fx hestemusling, europæisk flad østers, blåmusling og rørbyggende orme, som rager op fra havbunden. Der opbygges således over tid en kompleks tredimensionel struktur, hvor andre marine organismer kan bosætte sig, skjule sig eller søge føde. Derfor er der ofte er en høj biodiversitet associeret til biogene rev. Siden 1800-tallet har der generelt været tilbagegang i forekomsten af biogene rev, men i de senere år, har der internationalt og nationalt været en øget interesse i at genskabe biogene rev. Imidlertid har miljøforholdene ændret sig siden 1800-tallet, hvorfor der er en række parametre, der skal overvejes og vurderes i forhold til at udvælge områder egnede til etablering af biogene rev. Præsentationen vil tage udgangspunkt i vejledningen for etablering af biogene rev fra Center for Marin Naturgenopretning samt et konkret eksempel på proces og udfordringer.

Title	Site selection of areas with potential for eelgrass transplantation in Denmark
Authors	Paula Canal-Vergés[1], Mikkel K Lees[1], Anders Barnewitz[1], Karen Timmerman[2], Flemming T Hansen[2] & Mogens R Flindt[1]
Affiliation	[1]Biologisk Institut, Syddansk Universitet, Campusvej 53, 5230 Odense M.; [2]Danmarks Tekniske Universitet, Anker Engelunds Vej 101, 2800 Kongens Lyngby
Abstract	Oral

Eelgrass, *Zostera marina,* is a key habitat to ensure good quality status within the Water Framework Directive. However, within the last decade, the status of eelgrass populations in Denmark has not naturally improved in response to the National efforts to improve marine water quality. Hence, restoration of eelgrass has been pointed out as mitigation tool in the Danish River Management Plans. We present a GIS site selection tool that screens for areas with good potential for eelgrass restoration in Denmark. This GIS tool utilize up to 9 environmental parameters that affect the survival success of transplanted eelgrass. The GIS tool was run with the best available data for all Danish coastal waters and gives a rough National overview on the potential for eelgrass restoration. We furthermore present a guideline,

which stepwise describes which steps should be taken prior to big scale transplantation of eelgrass taking place.	
Title	Kolonisering af bentisk infauna efter udlægning af sand cap i Gyldensteen kystlagune
Authors	Katrine Grønbæk Ahlmann[1*], Karoline Killerich[1], Cintia O. Quintana[1], Erik Kristensen[1], Mogens R. Flindt[1]
Affiliation	[1]Biologisk Institut, Syddansk Universitet, Campusvej 55, 5230 Odense M
Abstract	Oral
Siden Gyldensteen Kystlagune blev uddiget i 2014, er koloniseringen af bentisk infauna blevet moniteret tæt. Imod forventningerne har det vist sig, at den bentiske infauna har svært ved at kolonisere kystlagunen. En dybdepløjning foretaget i 1960'erne har medført et højt indhold af ler i sedimentet, som let resuspenderes of skaber høj turbiditet. Dette studie kombinerer laboratorieforsøg og feltmonitering for at undersøge hvordan koloniseringen af infauna forløber efter udlægning af sand cap, en restaureringsmetode til at minimere resuspension af sediment. Resultater fra laboratorieforsøg indikerer, at infauna tilpasset de originale forhold i lagunen har lav overlevelsesrate under sand cappede forhold, hvorimod overlevelsesraten for potentielt nytilkomne arter var signifikant højere. Foreløbige resultater fra feltmonitering viser tydelige tegn på succesfuld tidlig kolonisering af børsteorme samt juvenile muslinger. Selvom der er tidlige tegn på vellykket kolonisering, er det nødvendigt at fortsætte den intense monitering for at følge den videre kolonisering i de nyskabte habitater.	
Title	Historisk analyse af stenrev, stenfiskeri og dybdeforhold
Authors	Nathalie B. Zak, Peter A.U. Stæhr, Karsten Dahl, Cordula Göke
Affiliation	Aarhus Universitet, institut for Ecoscience, Roskilde og Nationalt center for marin naturgenopretning
Abstract	Oral
Mennesker har fisket sten i flere århundrede, men intensiteten af stenfiskeriet tog for alvor fart som følge af industrialiseringen op gennem 1900'tallet. Stenrev vurderes at være en af de marine naturtyper i Danmark, der har være under størst påvirkning som følge af menneskelige aktiviteter, og det estimeres at mere end 50 km^2 stenrevshabitat er gået tabt som følge af et intensivt og målrettet stenfiskeri. Stenrevene spiller en nøglerolle i de marine økosystemer, som et vigtigt levested for en lang række af makroalger, søanemoner og havsvampe, mv. og fungerer desuden som levested og fødeområde for flere smådyr, fisk og havpattedyr. Der er en stigende interesse for at restaurere og genoprette stenrev og i forbindelse med udpegningen af egnede områder, er der et behov for at kunne dokumentere dels den oprindelige udbredelse af revene, og derudover dokumentere hvor der er fjernet sten. Vi har digitaliseret og analyseret gamle søkort fra 1800' og 1900'tallet med henblik på at undersøge om kortene kan bruges som redskab til at identificere den historiske udbredelse af stenrevshabitater i Danmark. Derudover har vi undersøgt, om man kan identificere, hvor der er fisket sten ved at sammenligne historiske og aktuelle dybdeforhold, sammenholdt med den nuværende viden relateret til tidligere stenfiskerilokaliteter. På basis af vores analyse, kommer vi med anbefalinger til, hvordan de gamle søkort kan indgå som led i en historisk analyse af danske stenrev. I de to nedenstående figurer ses et af resultaterne fra et 'case study' fra Vordingborg Kommune, hvor vi har digitaliseret historiske stenforekomster mm. i områderne omkring Knudshoved Odde og Møn.	
Title	Marine Virkemidler — Implementeringsscenarier og Miljøeffekter i de Danske farvande
Authors	Andreas Holbach[1], Sanjina Upadhyay Stæhr[1], Paula Canal-Vergés[2], Flemming T Hansen[3] Trine Larsen[3], Karen Timmermann[4]
Affiliation	[1]Aarhus Universitet, Institut for Ecoscience, Roskilde; [2]Syddansk Universitet, Biologisk Institut, Odense; [3]DHI; [4]Danmarks Tekniske Universitet, Institut for Akvatiske Ressourcer, Lyngby
Abstract	Poster
Marine virkemidler bliver betragtet som potentielle redskaber i forbindelse med implementering af 'Aftalen om grøn omstilling af dansk landbrug'. To potentielle marine virkemidler er reetablering af ålegræs og dyrkning af tang. Som en del af fremtidig vandplanlægning kunne virkemidlerne bidrage til at forbedrede miljøforhold i de Danske farvande. Implementeringen af marine virkemidler skal dog ske så miljø- og omkostningseffektiv som muligt og derfor er det nødvendigt at analysere deres egnethed og potentielle miljøeffekter på landsplan. På baggrund af rumlige modeller for egnetheden til implementering af virkemidlerne og modelbaserede estimater af tilknyttede miljøeffekter, er der blevet udviklet et	

interaktivt rumligt GIS værktøj. Værktøjet udpeger arealer, der er til rådighed under forskellige rumlige interesse-/konfliktscenarier i de marine områder og beregner aggregerede estimater for tilknyttede miljøeffekter på vandområdeniveau. Udvalgte scenarier, der kan bidrage til rumlig planlægning af virkemiddelaktiviteter i de Danske farvande, vil blive præsenteret.	
Title	Høst af søsalat som habitatrestaurerende virkemiddel
Authors	Annette Bruhn[1,2], Michael Bo Rasmussen[1,2], Teis Boderskov[1,2], Helge Juul Skou[1], Georgiana Apetroaei[1], Mette Kring Baunsø[1], Freja Christiansen[1], Helle Buur[1], Marianne Thomsen[3], Louise Juul[2,4], Signe Nissen[2,4], Palle Juul[5], Anna Skriver[6], Trine Kastrup Dalsgaard[2,4]
Affiliation	[1]Aarhus Universitet, Institut for Ecoscience. [2]Aarhus Universitet, Center for Cirkulær Bioøkonomi (CBIO). [3]Københavns Universitet, FOOD. [4]Aarhus Universitet, Institut for Fødevarevidenskab. [5]HedeDanmark. [6]WSP
Abstract	Poster
Søsalat (*Ulva* spp.) danner massive opblomstringer i næringsrige fjorde i Danmark. De store mængder søsalat nedsætter turn-over af næringsstoffer i fjordene henover sommeren, men bidrager til forringet miljøkvalitet og rekreativ værdi, når biomassen nedbrydes.I Skive Fjord er opblomstringer af søsalat dokumenteret med droneteknologi fra 2018 til 2023. Opblomstringerne topper i august/september med biomassetætheder op til 58 ton søsalat/ha. Høst med sejlende maskiner er mulig, men udfordret af lav vanddybde og begrænset mulighed for at sortere i den høstede biomasse. Potentialet for fjernelse af næringsstoffer er estimeret op til 110 kg N og 30 kg P/ha. Den høstede søsalat indeholder op til 14 % in-fauna med lav biodiversitet. Hvis metoden optimeres, kan høst af søsalat potentielt fungere som habitatrestaurerende virkemiddel og bidrage til forbedret miljøkvalitet i næringsrige fjorde som Skive Fjord. Biomassen kan efterfølgende potentielt anvendes til fødevare- eller foderprotein.	
Title	Projekt Sund Vejle Fjord - Biodiversitet i naturgenoprettede ålegræsbede, blåmuslingebanker og stenrev
Authors	Rune C. Steinfurth, Timi L. Banke, Benjamin Nielsen, Paula Canal-Vergés, og Mogens R. Flindt.
Affiliation	Biologisk Institut, Syddansk Universitet, Campusvej 53, 5230 Odense M.
Abstract	Poster
Projekt Sund Vejle Fjord har siden 2020 gennemført en række naturgenopretningstiltag med det formål at reetablere kollapsede økosystemer under fjordens overflade. Fokus i dette projekt har været at genskabe de fysiske rammer for livet i fjorden blandt andet ved at etablere ålegræsbede, etablere kunstige muslingebanker og stenrev. Projektet har haft til formål at kombinere naturgenopretningstiltagene således at der kan opstå synergi mellem habitaterne. Det er bl.a. gjort ved at placere stenrevene som barrierer til beskyttelse af ålegræs-udplantning mod fysisk stress. Muslingebankerne placeres ligeledes opstrøms for de genoprettede områder for at skabe klart vand til det udplantede ålegræs og tangskove på stenrevene, samt som fødekammer og habitat for fisk. Stenrevenes evne til at huse større rovfisk, såsom torsk og sej, samt placeringen af de beskyttende stenrev omkring nyanlagte ålegræs-bede, skaber yderligere positiv interaktion mellem ålegræsset som opvækstområde for fiskeyngel og stenrevene hvor de voksne fisk fouragerer. Projektet har indtil videre genoprettet cirka 6 ha ålegræs, 40 ha muslingebanker og 8 ha stenrev, samt oprettet 50 ha fredningszoner omkring de udlagte stenrev. Samtidig er der i løbet af de senere år pågået en kvantificering af hvorledes faunaens biodiversitet har udviklet sig efter reetablering af disse habitater. I alle habitater har der været en positiv udvikling i antallet af arter, dyretæthederne og biomassen af dyr, derudover er den funktionelle diversitet også øget sammenlignet med tidligere tilstande. Vi konkluderer på denne baggrund af marine naturgenopretnings tiltag er biodiversitetsforbedrende og at de bidrager til stabile fødekæder, med øget produktion i alle trofiske niveauer	
Title	How to reuse dredged marine sediment
Authors	Cátia Carreira[1], Sandra M. Bollwerk[1], Signe Marie Ingvardsen[2]
Affiliation	[1]COWI, Parallelvej 2, 2800 Kongens Lyngby, Denmark; [2]COWI, Visionsvej 53, 9000 Aalborg, Denmark
Abstract	Poster
Sediment accumulated in estuaries and harbors due to riverine deposition or coastal dynamics, can obstruct navigation, and thus needs to be dredged and then disposed of. In Denmark, current options are to bypass the dredged sediment, reuse it (e.g. backfilling or coastal protection), or if the sediment	

cannot be used for these purposes or is contaminated, it is typically disposed at sea. Currently, most of the dredged sediment is disposed of at sea. However, this practice can have adverse physicochemical and biological impacts for the ecosystems receiving the sediment. Instead of being regarded as a waste, dredged sediment needs to be considered a valuable resource. In this way, dredged sediment can benefit society and the environment, and have a 'beneficial use'. The reasons why beneficial use of sediments is not yet a common practice is many fold and require a change to long-established dredging and disposal practices. In this presentation we will present options for beneficial use of marine dredged sediment that are available, and how could these be possibly used in Denmark to stimulate beneficial use practices of dredged sediment.	
Title	Habitat restoration and protection effects on european lobsters (*Homarus gammarus*): the livø stone reef marine protected area, Limfjorden
Authors	Pedro S. Freitas, Elliot J. Brown, Jon C. Svendsen, Trine G. Hansen, Martin H. Larsen, Henrik Baktoft, Martin L. Kristensen, Josianne G. Støttrup, and Jens K. Petersen
Affiliation	DTU Aqua; email: psfr@aqua.dtu.dk
Abstract	Poster
The Limfjorden has a significant European lobster (*Homarus gammarus*) population since the mid-2000's, following 4 decades of being virtually absent, supporting the largest Danish lobster fishery currently at 45 tonnes and 7 Mio.kr. per year, with significant economic and cultural value to local coastal communities. The Livø stone reefs (LR) were established in 2016 to restore a rare, degraded habitat and associated ecosystem services. A small, protected area (MPA) surrounding the reefs and closed to fishing was created in 2018. The effects of the LR-MPA on lobsters by providing rare reef habitat as well as fishing protection, were evaluated in 2021. Higher abundance, larger sizes and increased reproductive potential were observed in the LR-MPA relative to fished areas, as well as indication of sex specific habitat and protection effects. Lobsters showed high-site fidelity, occasionally with significant movements between LR-MPA and adjacent non-MPA areas. A clear positive effect of LR-MPA on the lobster population was thus observed after only 3 years since its implementation, likely resulting from increased survival and growth but also immigration and retention of large lobsters.	
Title	Cultivation of sugar kelp for nature restoration
Authors	Annette Bruhn[1,2], Teis Boderskov[1,2], Mette Møller Nielsen[3], Peter Søndergaard Schmedes[3], Daniel Taylor[3], Line Hermannsen[3], Johnna Holding[1], Alina Mostovaya[1], Niels Holst[4], Sidsel Juul Vinbæk[1], Sidsel Gurholt Pedersen[1], Freja Christiansen[1], Signe Høgslund[1] and Karen Timmermann[3]
Affiliation	[1] Aarhus University, Department of Ecoscience; [2] Aarhus University, Centre for Circular Bioeconomy (CBIO); [3] Danish Technical University, National Institute for Aquatic Resources, Section for Coastal Ecology; [4] Aarhus University, Department of Agroecology
Abstract	Poster
Since 2016, cultivating sugar kelp as a tool for marine nature restoration has been investigated in several national and international projects, with focus on nutrient removal, economy, and ecosystem effects. In 2022-2023, Best Available Technology (BAT) was tested in large-scale (12 hectares) in Sallingsund, Limfjorden. For modelling, small-scale deployments were made in 16 maritime gardens all over Danish waters. The results indicate that kelp production in Limfjorden per m of line can exceed 5 kg fresh kelp with a nutrient removal efficiency of 23 g N and 0.9 g P. Extrapolating here using BAT, the area efficiency can be 24.4 kg of N and 0.9 kg of P per hectare. The impact of sugar kelp cultivation on current velocities and benthic light environment was very limited. Sedimentation of organic matter and related benthic oxygen and nutrient fluxes were not significantly affected. Carbon sequestration via burial or export of dissolved or particulate C was negligible. Modelling confirmed that the nature restoration potential of sugar kelp cultivation is confined to high saline, eutrophic waters, resulting here in removal of N and P after 7 months, and supporting circular bioeconomy.	
Title	Udpegning af egnede områder til genetablering af stenrev med et gis baseret værktøj
Authors	Peter A.U. Stæhr, Sanjina U. Stæhr, Andreas M. Holbach, Cordula Göke, Karsten Dahl
Affiliation	Aarhus Universitet, institut for Ecoscience, Roskilde og Nationalt center for marin naturgenopretning
Abstract	Poster

I løbet af de sidste ca. 100 år er der opfisket større sten i samtlige danske kystnære farvande. Det anslås at vi har mistet mere end 50 km^2 stenrevshabitat, primært i dybdeintervallet 2-10 m. Erfaringerne viser at genetablering af stenrev kan berige vores havnatur med vigtige levesteder, styrke udvikling af robuste fødekæder og udvikling af god vandkvalitet, særligt hvis de anlægges de optimale steder. Vi præsenterer et GIS baseret site selection tool, som leverer en første udpegning af egnede områder. Værktøjet omfatter datalag for relevante miljøforhold, historiske rev og arealanvendelse. Egnethed i fht miljøforhold baseres på en empirisk model som kvantificerer dækning af makroalger ud fra lokale forhold med fokus på lys, fysisk eksponering, salinitet, ilt, temperatur og sedimentforhold. Data for historiske stenrev er baseret på digitalisering af historiske søkort og viden om stenfiskeri. Og data for arealanvendelse baseres offentlig tilgængelige data. Elementerne i værktøjet er vist i nedenstående figur. Præsentationen vil gennemgå et eksempel på anvendelse af værktøjet.

Session	**Marine geoscience I**
Title	Seabed sediment grain size estimation by application of remote sensing: A simple geo-acoustic inversion method used for multibeam echosounder
Authors	Gorm Wendelboe
Affiliation	Teledyne RESON, Fabriksvangen 13, 3550 Slangerup, Denmark
Abstract	Oral

The RESON SeaBat T50 high frequency (200-400kHz) multibeam echosounder is commonly applied for depth measurements in shallow water ocean environments. Meanwhile, the “SeaBat Normalized Backscatter” feature provides estimates of the seabed backscattering strength (S_b), which facilitates seabed classification. Here, estimates of the seabed sediment mean grain size are presented in terms of digital maps that hold a resolution which corresponds to the beam footprint areas. The underlying method is based on recent results which show S_b increases linearly with the normalized grain size (JASA Express Lett. (3), 026001). The normalized grain size is defined as $\log_{10}(d/\lambda)$, where d is the mean grain diameter and λ is the acoustic wavelength. The validity of the method is limited to d/λ-values ranging between 0.001-0.1. Two sediment maps are presented: An 2x2 km^2 area at Sequim Bay (State of Washington, USA) and a 1000x0.2 km$_2$ area in Øresund (Copenhagen, Denmark).

Title	Geological screening for offshore wind farms in Danish waters
Authors	Thomas Vangkilde-Pedersen[1], Niels Nørgaard-Pedersen[1], Nicklas Christensen[1], Lara F. Perez[1], Lis Allaart[1], Jørgen Overgaard Leth[1], Luna Holland Winther[1], Sunny Singhroha[1], Rasmus Ørnekoll Stenshøj[1], Ole Bennike[1], Henrik Jønsson Granat[1], Lars-Georg Rödel[1], Sigurd Bøgelund Andersen[1], Lisbeth Lyngkjær Pedersen[1], Lars Øbro Hansen[1], Mikkel Skovgaard Andersen[1], Katrine Elnegaard Hansen[1], Jørn Bo Jensen[1]
Affiliation	[1]Geological Survey of Denmark and Greenland, Department of Near Surface Land and Marine Geology
Abstract	Oral

Offshore wind is crucial in the development of a green and sustainable energy supply in Denmark. To assess the suitability of the marine geological conditions for offshore wind installations, GEUS is currently conducting a geological screening of the entire Danish waters for the Danish Energy Agency. The work is part of the project “Screening and Environmental mapping of offshore Wind potential in Denmark” with the overall aim to provide a comprehensive overview of the combined offshore wind potential, including sensitivity mapping of nature-, environmental- and other interests as well as assessment of potential cumulative effects from large-scale offshore wind development. To improve the geological knowledge-base of the Danish waters, GEUS has acquired 6405 km UHRS single- and multichannel sparker seismic, subbottom profiler, sidescan and multibeam data as well as 168 vibrocores to support the seismic interpretation. We present here the initial analysis of data gaps and the extent of the recently completed survey activities. In addition, we present the first results of the geological mapping that will support the long-term planning of offshore wind farms in Denmark.

Title	Landslide deposits in Karrat Fjord, West Greenland
Authors	Freja A. Nielsen[1]; Lara F. Pérez[2]; Lars Ole Boldreel[1]; Camilla S. Andresen[2]; Paul C. Knutz[2]; Thorbjørn J. Andersen[3]; Kristian Svennevig[2]; Marie-Louise Siggaard-Andersen[4]; Mikkel Fruergaard[3]; Rasmus Rasmussen[2]
Affiliation	[1]Department of Geosciences and Natural Resource Management, Section for Geology, University of Copenhagen, Copenhagen, Denmark;[2]Geological Survey of Denmark and Greenland – GEUS, Denmark; [3]Department of Geosciences and

	Natural Resource Management, Section for Geography, University of Copenhagen, Copenhagen, Denmark; [4]Globe Institute, Section for Geogenetics, University of Copenhagen, Copenhagen, Denmark
Abstract	Oral
Landslides are common in the fjords of West Greenland. A rock avalanche occurred in Karrat Fjord on 17 June 2017 and the displacement wave caused four casualties in the nearby village of Nuugaatsiaq. Sediments deposited during this and other events are recorded in the sedimentary record of Karrat Fjord. Archive data provides information of the geomorphology of the fjord before the 2017 event. GEUS expedition SANNA 2021 in the fjord obtained multibeam bathymetry, reflection seismic (single and multichannel sparker) and seven gravity cores. Our work identifies and map landslide deposits in Karrat Fjord with special focus on the 2017 rock avalanche within the framework of the Geocenter Denmark project "Landslides in a changing climate: geohazards and benthic habitats in northwest Greenland". Interpretation of the seismic data in Petrel, together with XRF, grain-size analyses, and ^{210}Pb-dating of the cores, have led to the identification of several paleo-landslides in the north slope and allowed us to map the distribution of the sediments related to the 2017 rock avalanche. Preliminary results indicate east-west migrating paleo-landslides and southwest location of the 2017 deposits.	
Title	Deglacial retreat patterns and dynamics of the Norske Trough ice stream, NE Greenland
Authors	Adrián López-Quirós[1,2*], Tuomas Junna[1], Joanna Davies[1], Mads Ramsgaard Stoltenberg[1], Katrine Juul Andresen[3], Tove Nielsen[4], Lukas Wacker[5], Aage Kristian Olsen Alstrup[6,7], Ole Lajord Munk[6,7], Tine L. Rasmussen[8], Christof Pearce[1], Marit-Solveig Seidenkrantz[1,*]
Affiliation	[1]Department of Geoscience, iCLIMATE Centre, and Arctic Research Centre, Aarhus University, 8000 Aarhus C, Denmark; [2]Department of Stratigraphy and Paleontology, University of Granada, 18071 Granada, Spain; [3]SeisLab Aarhus, Department of Geoscience, Aarhus University, 8000 Aarhus C, Denmark; [4]Geological Survey of Denmark and Greenland GEUS, 1350 Copenhagen K, Denmark; [5]Laboratory of Ion Beam Physics, ETH Zürich, Zürich, Switzerland; [6]Department of Nuclear Medicine & PET, Aarhus University Hospital, Aarhus, Denmark; [7]Department of Clinical Medicine, Aarhus University, Aarhus, Denmark; [8]Centre for Arctic Gas Hydrate, Environment and Climate, Department of Geosciences, UiT the Arctic University of Norway, Tromsø, Norway; *presenting author: mss@geo.au.dk
Abstract	Oral
A better understanding of the past extent and dynamics of the Greenland Ice Sheet (GrIS) is required to provide a context for present-day ice-sheet extent, to constrain numerical climate models, and to evaluate and better predict future scenarios of ice-sheet response to the ongoing climatic change. We here investigate the retreat history and dynamics of the GrIS across the NE Greenland shelf after the Last Glacial Maximum (LGM), based on high-resolution shallow-seismic (subbottom profiler) data combined with multi-proxy analyses of marine sediment cores from the Norske Trough. Our results indicate that an ice stream advanced through the trough and across the shelf to the outer shelf at the LGM. After the LGM the ice sheet started retreating. Recessional moraines and grounding zone wedges (GZWs) on the seafloor of the outer to middle shelf show that the initial retreat was episodic, punctuated by two major stillstands, as the pinning points for grounding-zone stabilization were controlled by pre-LGM trough topography. In contrast, preserved large-scale glacial lineations on the seafloor of the inner shelf, formed during the advance, indicate that ice retreat from the inner trough to a position proximal to the coast was rapid. The ice retreat commenced before 16.6 cal. kyr BP, earlier than previously known for this sector of the NE Greenland shelf. The inner shelf was free from grounded ice at least by 12.5 cal. kyr BP, and likely before. Retreat occurred in a glaciomarine setting and the ice sheet was fringed by a floating ice shelf. There is no evidence of grounded-ice readvances during the Younger Dryas, although a floating ice shelf with vigorous sea-ice and iceberg rafting production occupied the inner shelf at 11.3 cal. kyr BP. ^{14}C dates revealed that initial stepwise ice retreat followed by a fast retreat coincide with Heinrich Stadial 1 and the Bølling-Allerød interstadial, respectively. During both periods there was increased inflow of warm Atlantic Water, indicating ocean/climate impact on the late deglaciation of Norske Trough.	
Title	Seismic imaging of shallow marine sediments offshore Denmark using ultra-high resolution multi-channel seismic data

Authors	Sunny Singhroha[1], Rasmus Ørnekoll Stenshøj[1], Thomas Vangkilde-Pedersen[1], Egon Nørmark[2], Lara F. Perez[1], Lars-Georg Rödel[1], Sigurd Bøgelund Andersen[1], Nicklas Christensen[1], Lis Allaart[1], Niels Nørgaard-Pedersen[1], Luna Holland Winther[1], Lars Øbro Hansen[1], Mikkel Skovgaard Andersen1, Lisbeth Lyngkjær Pedersen[1], Jørn Bo Jensen[1]
Affiliation	[1]Geological Survey of Denmark and Greenland (GEUS); [2]Department of Geoscience, Aarhus University
Abstract	Oral
The in-depth knowledge of the shallow marine sedimentary record is essential to access the potential of offshore areas for windfarm installations and to assess associated risks effectively. GEUS is currently conducting a geological screening of the entire offshore area in Denmark for the Danish Energy Agency as a part of the project "Screening and Environmental mapping of offshore Wind potential in Denmark", with an aim to gain a comprehensive overview of the combined offshore wind potential. As part of the screening, GEUS has acquired 6405 km multi-channel (48-96 channels) ultra-high resolution seismic data in 2022-23 for mapping of the shallow (<100-150 m below the seafloor) sedimentary units. The dataset was acquired using a sparker source with dominant signal in the 100-1200 Hz frequency range. Here, we present the processing workflow, challenges, and preliminary results from the processed dataset. We also highlight additional geological insights deduced from the interpretation of the ultra-high-resolution seismic data. The project has a wider significance as it greatly enhances our geological understanding of shallow marine sediments in Denmark's offshore regions.	
Title	Crustal scale seismic studies in the Arctic with ocean bottom seismometers – taking advantage of declining sea-ice
Authors	Thomas Funck[1], Wolfram H. Geissler[2], Andreas Brotzer[3], Bernard J. Coakley[4], Alexander Minakov[5]
Affiliation	[1]Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark (tf@geus.dk); [2]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), Bremerhaven, Germany;[3]Geophysical Observatory, Department of Earth and Environmental Sciences, Ludwig-Maximilians University (LMU), Munich, Germany;[4]Department of Geosciences, University of Alaska Fairbanks, Fairbanks, Alaska, USA;[5]Centre for planetary habitability, Department of Geosciences, University of Oslo, Oslo, Norway
Abstract	Oral
Acquisition of seismic data in the ice-infested Arctic Ocean has always been challenging. This is particularly true when it comes to crustal-scale seismic studies that often rely on ocean bottom seismometers (OBS). These instruments are deployed on the seafloor and return to the surface by their own buoyancy once released from their anchors. Ideally OBS rise up into open water. Retrieval of OBS stuck below the sea-ice is impossible or in the best case very time consuming, which prevented the use of OBS until recently. Global warming has resulted in a decline of the ice, enabling OBS experiments in the Arctic. We present results from three studies in the Arctic Ocean that were carried out in areas with light to moderate ice conditions, assisted by remotely operated vehicles (ROV) in heavy ice. One study (*Polarstern* cruise PS115/1) shows the magmatic overprint of the crust north off Greenland. In an NSF-funded cruise on RV *Sikuliaq* north of Alaska, deviations from typical oceanic crust were detected in Canada Basin. Finally, the GoNorth 2022 expedition provided the first ever complete and high-quality crustal image of an Arctic continental margin in the area north of Svalbard.	
Title	Time transgressive response of benthic foraminifera to the deglaciation of the Northeast Greenland shelf
Authors	Mads Ramsgaard Stoltenberg[1], Tuomas Junna[1], Joanna Davies [1], Karoline Kristensen [1], Christof Pearce[1], Marit-Solveig Seidenkrantz[1]
Affiliation	Department of Geoscience, Arctic Research Center, and iClimate, Aarhus University, 8000 Aarhus C, Denmark
Abstract	Oral
Recent studies from the Belgica Trough on the Northeast Greenland shelf (~78°N) reveal that the shelf edge was deglaciated before 16.6 cal. kyr BP. Ice retreat through the Belgica Trough occurred initially stepwise, followed by a rapid retreat through the inner shelf which was deglaciated likely before 12.5 cal. kyr BP. Here, we present the response of benthic foraminiferal assemblages to the deglaciation based	

on three marine sediment cores constituting a transect through Belgica Trough. Our preliminary results indicate a consistent time transgressive assemblage succession across core sites. Following the deglaciation of the core sites, the initial foraminiferal assemblage is dominated by *Stetsonia horvathi*, indicative of a benthic paleoenvironment located beneath a floating ice shelf and extensive sea ice conditions. With increasing distance to the retreating ice sheet margin, the foraminiferal concentration increases together with the dominance of nutrient-dependent species (*Melonis barleeanus*, *Elphidium clavatum*, and *Alabaminella weddellensis*), suggesting a productive paleoenvironment with seasonal sea ice. This scenario is followed by another decrease in foraminiferal concentrations occurring with a rapidly rising dominance of agglutinated taxa, signifying a development toward stable sea-ice conditions. The results also yield a consistent presence of *Cassidulina neoteretis* at the onset of the marine stage following the deglaciation, implying the potential significance of Atlantic Water in promoting ice retreat. The consistent pattern of the assemblage development across the shelf allows us to establish a conceptual model of the foraminiferal response to deglaciation. Initial comparisons of this model are corroborated by other cores from Northeast Greenland and future work will expand this comparison to other Arctic regions.	
Title	Fluid flow and natural geologic seepage offshore northeast Greenland
Authors	Christoph Böttner[1], Frank Werner Jakobsen[2], Tove Nielsen[3], Katrine Juul Andresen[1], Michael Bryld Wessel Fyhn[3], John Hopper[3], Sverre Planke[4], Reidun Myklebust[5], Monica Winsborrow[2], Marit-Solveig Seidenkrantz[1]
Affiliation	[1]Department of Geoscience, Aarhus University, Denmark; [2]iC3: Centre for ice, Cryosphere, Carbon and Climate, Department of Geosciences, UiT The Arctic University of Norway, Tromsø, Norway; [3]Geological Survey of Denmark and Greenland, Copenhagen, Denmark; [4]Volcanic Basin and Energy Research (VBER), Oslo, Norway; [5]TGS, Oslo, Norway
Abstract	Oral
Rising concentrations of greenhouse gases in the atmosphere since pre-industrial times cause the Arctic to warm at a faster pace compared to the rest of our planet. This is known as Arctic amplification and causes an exacerbation of climatic effects such as melting of the ice sheets. This warming may also increase greenhouse gas emissions from natural geologic sources by rapidly changing the environmental conditions. However, the distribution and contribution of geological methane sources in the Arctic is poorly constrained. Our understanding of the involved geologic processes predominantly relies on observations from natural cold seeps around Svalbard. In Northeast Greenland, these cold seeps have received little attention despite their importance for the local environment and global climate. Here, we use an integrated geoscientific data set to present observations of undocumented methane and oil seepage from marine geologic sources to the Arctic Ocean in Northeast Greenland. The documented emissions should be considered in future greenhouse gas budgets. Our findings fill a white gap in the Arctic and will significantly improve predictions of the carbon budget in the Arctic.	
Title	Reconstructing Pliocene bathymetry in Baffin Bay through flexural backstripping
Authors	Mia Nørholm[1], John Hopper[1], Paul C. Knutz[1] and Christian J. Bjerrum[2]
Affiliation	[1]GEUS, Øster Voldgade 10, Copenhagen [2]University of Copenhagen, IGN, Øster Voldgade 10, Copenhagen; Correspondence: Mia Nørholm, mn@geus.dk
Abstract	Oral
The presence of extensive Pliocene (~2.6-5.3 Ma) contourite deposits on the West Greenland shelf margin in Baffin Bay has been theorized to be associated with a stronger paleo-Irminger current in a warmer climate equilibrium. Fully coupled global climate models struggle to simulate present day ocean circulation in Baffin Bay and paleo-currents associated with the contourite deposits in Pliocene simulations, due to coarse resolution. Pliocene regional bathymetry in Baffin Bay is recreated by flexurally backstripping the Base Pliocene seismic horizon using PALEOSTRIP. The process corrects present day bathymetry for first order flexural effects such as sediment unloading, decompaction and glacio-isostatic response of the present day Greenland Ice Sheet loading. Ocean current/seafloor interactions are central for ocean circulation and contourite formation, and a regional ocean model applying this higher resolution bathymetry will thus increase resolution of these baroclinic processes in the bottom boundary layer. As global ocean circulation is sensitive to regional processes in Baffin Bay, the implications of improved regional resolution will be important beyond regional circulation.	
Title	Landslides in a changing climate: Geohazards and benthic habitats in west Greenland

Authors	Lara F. Pérez[1]*; Megan E. Sexton[1,2]; Freja A. Nielsen[1,3]; Katrine J. Andresen[2]; Lars Ole Boldreel[3]; Camilla S. Andresen[1]; Verner B. Ernstsen[1]; Mikkel Fruergaard[3]; Paul C. Knutz[1]; Diana Krawczyk[4]; Nicolaj K. Larsen[5]; Tove Nielsen[1]; Egon Nørmark[2]; Matthew Owen[6]; Christof Pearce[2]; Marit-Solveig Seidenkrantz[2]; Kristian Svennevig[1]
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Abstract	Oral
The increased incidence of landslides on nearshore slopes in high latitude areas may be linked with the ongoing climatic warming. In addition to the threat to human life, landslides drastically change the environmental physical properties causing long lasting effects on the local economy. While global warming is consistently reflected both in observation data and in modelled future projections, any link between climate and landslide occurrence remains to be evaluated in observations that extend beyond the instrumental time period. The nearshore sedimentary record preserves the deposits of landslides from coastal slopes in the form of mass transport deposits (MTDs). The *Geocenter Danmark* project 'Landslides in a changing climate' is implementing detailed studies on the MTDs found in the sedimentary record of Karrat Fjord and Vaigat Strait, both located in West Greenland. The distribution of MTDs across the stratigraphic succession shows spatial and temporal variability in the occurrence of landslides. Further investigation is required to assess the preconditioning factors and triggers of these events.	
Title	SEEP ecology – a multiproxy approach to establish a seabed ecological baseline in the North Sea prior to human activities in the subsurface
Authors	Bodil Wesenberg Lauridsen[1], Katrine Elnegaard Hansen[1], Lasse Tésik Prins[1], Katrine Juul Andresen[2], Ole Rønø Clausen[2], Rishmita Mukherjee[3], Hans Røy[3], Paul Knutz[1]
Affiliation	[1]Geological Survey of Denmark and Greenland; [2]Department of Geoscience, Aarhus University; [3]Department of Biology, Aarhus University
Abstract	Oral
The SEEP and SEEP ecology projects were established to generate a preproduction and syn-production baseline which can distinguish between absence of hydrocarbons (HC), natural seepage, and environmental impacts related to HC exploration and production by a multiproxy approach. The results can also be used to establish a seabed ecological baseline in the North Sea prior to human activities in the subsurface and relevant for discussing the impact of offshore wind and marine infrastructure to determine the environmental health of the seabed pre/post human activities. To develop a methodology for an ecological baseline we use three key communities that have widely differing roles in the marine ecosystem: microbes, benthic foraminifera, and bivalves. The microbial community reveal the presence of HC degrading microbes. The different benthic foraminiferal species have adapted to distinct environments with changing oxygen and food conditions and are therefore excellent candidates for the study of both past and recent ecological conditions. The bivalves are long lived filter feeders that deposit pollutants from the benthic and planktonic environment in their shells. ´They are present in the oldest parts of the marine sediment cores dating back at least 8000 years.	
Title	Holocene regime shifts in Southwest Greenland linked to Atlantic Water influence and ice sheet dynamics
Authors	Anna Bang Kvorning[1,2*], Maija Heikkilä[3], Christof Pearce[4], Marit-Solveig Seidenkrantz[4], Gavin L. Simpson[5], Mimmi Oksman[1], Nicolaj Krog Larsen[2], Sofia Ribeiro[1,2]
Affiliation	[1]Department of Glaciology and Climate, Geological Survey of Denmark and Greenland, Copenhagen, Denmark; [2]Globe Institute, University of Copenhagen, Copenhagen, Denmark; [3]Ecosystems and Environment Research Programme, Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland; [4]Department of Geoscience, iClimate and Arctic Research Center, Aarhus University, Aarhus, Denmark;[5]Department of Animal and Veterinary Science, Aarhus University, Aarhus, Denmark; email: asbn@geus.dk
Abstract	Oral

Greenlandic fjords, situated at the interface between the ice sheet and the ocean, are highly sensitive to climate variability. The impact of climate change on fjord systems can lead to large and persistent changes in the ecosystem from one stable state to another. Such changes are conceptualized as regime shifts and are predicted to increase in the future. We reconstructed the Holocene environmental history of Nuup Kangerlua, by investigating a sedimentary record covering ~10.5 cal ka BP and a 1-year sediment trap. Based on microfossil (dinoflagellate cysts) and biogeochemical data we identified four regime shifts during the Holocene. We infer maximum marine productivity at ~7.5 cal ka BP, coinciding with high meltwater discharge. From ~6.2 to 2.5 cal ka BP the Greenland Ice Sheet reached Holocene minimum extent and an unprecedent strong influence of Atlantic Water is recorded in the fjord sediments. Our Holocene perspective shows parallels between present-day fjord conditions and conditions during the deglaciation. In contrast, mid-Holocene conditions with minimum ice-sheet extent and peak Atlantic Water influence have no recent analogue.

Title	North Sea tunnel valleys – architecture, genesis and prediction (NOARG)
Authors	Lis Allaart[1], Lasse Tésik Prins[1], Paul Knutz[1], Thomas Vangkilde-Pedersen[1], Niels Nørgaard-Pedersen[1], Nicklas Christensen[1], Lara F. Perez[1], Jørgen Overgaard Leth[1], Luna Holland Winther[1], Sunny Singhroha[1], Rasmus Ørnekoll Stenshøj[1], Ole Bennike[1], Henrik Jønsson Granat[1], Lars-Georg Rödel[1], Sigurd Bøgelund Andersen[1], Lisbeth Lyngkjær Pedersen[1], Lars Øbro Hansen[1], Mikkel Skovgaard Andersen[1], Katrine Elnegaard Hansen[1], Peter Sandersen[1], Rasmus Bødker Madsen[1], Jørn Bo Jensen[1], Katrine Juul Andresen[2], Ole Rønø Clausen[2], Lars Ole Boldreel[3], Tala Maria Aabø[3], Nicolaj Krog Larsen[4]
Affiliation	[1]Geological Survey of Denmark and Greenland; [2]Department of Geoscience, Aarhus University; [3]Department of Geosciences and Natural Resource Management, University of Copenhagen; [4]Globe Institute, University of Copenhagen
Abstract	Oral

Buried, glacial tunnel valleys occur widespread in the North Sea and are a potential geohazard for offshore constructions and related infrastructure. The NOARG project, recently funded by Geocenter Danmark, aims to utilize existing data, available geological information and recently acquired ultra-high resolution seismic data to map buried tunnel valleys and related, shallow subsurface features to study their evolution. The objectives are: (1) to improve the definition of the main Last Glacial Maximum stationary line offshore western Jutland and connect it to known ice margin positions in the marine sector of other North Sea countries; (2) identify different generations of tunnel valleys based on seismic stratigraphy and sediment core data (e.g. ^{14}C ages and biostratigraphy); (3) document potential linkages to deeper tectonic structures by comparing valley trends with deep-seated faults identified by automated 3D seismic data analyses; (4) to test a hypothesis that a connection exists between deeper faults and salt-structures and location of tunnel valleys. Based on GEUS advisory work, NOARG will deliver research that can help to facilitate marine spatial planning in the North Sea.

Title	Using glacial rock flour for marine carbon dioxide removal: Studies from Kangerlussuaq Fjord
Authors	Jørgen Bendtsen[1], Niels Daugbjerg[2], Clara Rodriguez Vives[1], Kristina Vallentin Larsen[1], Rasmus Dyrberg Dahms[1], Márcia Branquinho[2], Katherine Richardson[3]
Affiliation	[1]Section for Geobiology, Globe Institute, University of Copenhagen, DK-1350 Copenhagen K, Denmark; [2]Department of Biology, University of Copenhagen, Universitetsparken 4, DK-2100 Copenhagen Ø, Denmark; [3]Globe Institute, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark
Abstract	Oral

Glacial rock flour (GRF) originates below the Greenland Ice Sheet, where the ice abrades basement rocks to a very fine powder with a similar consistency as the flour that is used for baking bread. GRF is a naturally occurring silicate-rich sediment and besides silica it contains small amounts of phosphate and different trace metals and, therefore, it has the potential to stimulate phytoplankton growth and alter the concentration of surface CO_2. We investigate the potential of GRF as a source for marine Carbon Dioxide Removal (CDR), i.e., removal of atmospheric CO_2 by transporting carbon into the ocean interior. Thus, marine CDR is an alternative to land-based methods, e.g., planting trees, and mCDR may potentially store large amounts of CO_2. However, a better understanding of how GRF influences the marine biota and surface CO_2 is required before field experiments can be carried out. We present results and

observations from Kangerlussuaq Fjord in the summer 2023 where we measured the distributions of GRF, nutrients and trace metals from the Greenland ice sheet and into the fjord. Laboratory experiments were also made in the field where phytoplankton growth was stimulated with GRF.	
Title	Doggerlands changing landscapes – late glacial to early Holocene geo-archaeology
Authors	Katrine Juul Andresen[1], Nina Kvist Andersen[2], Anna Katharina Baltz[3], Lasse Tésik Prins[4]
Affiliation	[1]SeisLab Aarhus, Department of Geoscience, Aarhus University, Denmark; katrine.andresen@geo.au.dk [2]Energinet, Denmark; [3]Faculty of Geoscience, Bremen University, Germany; [4]Geological Survey of Denmark and Greenland, SURFACE Department, Denmark
Abstract	Oral
Doggerland, the former now submerged landscape in the North Sea Basin, has fascinated geo-archaeologists for decades. Stray findings of archaeological artefacts indicate that people occupied Doggerland during the late glacial and early Holocene, but concrete evidence for preserved settlements is still lacking. This is partly due to poor knowledge of how the landscape looked like and evolved during the deglaciation and flooding. Geophysical data show that much of the paleolandscape is preserved and further holds information about a variety of landscape types including shallow marine to coastal, estuarine and terrestrial environments. Studying Doggerland's submerged landscapes presents an opportunity to use geological archives that are normally not preserved in present-day terrestrial settings for investigating the environments and living conditions of Stone Age populations. In the presentation, we will show the newest results of paleolandscape analysis from the eastern Doggerland, where the Elbe Paleo Valley together with large tributary river and estuarine systems defined a low-topography landscape highly susceptible to the fluctuating sea level.	
Title	Particle aggregation and sedimentation in a high Arctic Fjord, NE Greenland
Authors	Andersen, T.J.[1*], Attard, K.[2], Balmonte, J.P.[3], Sejr, M.K.[4,5], Glud, R.[2]
Affiliation	[1]Department of Geosciences and Natural resource Management, University of Copenhagen, Denmark, *e-mail: Tja@ign.ku.dk; [2]Department of Biology, University of Southern Denmark, Denmark; [3]Department of Earth and Environmental Sciences, Lehigh University, USA; [4]Department of Ecoscience, Aarhus University, Aarhus, Denmark; [5]Arctic Research Centre, Aarhus University, Aarhus, Denmark
Abstract	Oral
Sediment supply, particle dynamics and sedimentation were studied in Young Sound fjord in NE Greenland during a three week period in the summer of 2015 in order to examine the behaviour and fate of sediment particles in meltwater plumes entering the fjord. The fieldwork included measurements of water column properties (CTD and water samples), suspended sediment flocculation (LISST 100C and Pcam) and sediment settling velocity (settling tubes and sediment traps).Suspended sediment quickly flocculates upon entering the fjord, which increases the mean particle size of the fine-grained suspended sediment from around 10 to 100-200 µm. Settling velocity also increases, but bulk settling velocity of the flocculated sediment is still only in the order of 0.1 mm s^{-1}. This low settling velocity indicates that the flocs are relatively porous with effective densities of only 30 to 105 kg m^{-3}. The fine-grained suspended sediment and substances associated with it (e.g. carbon and nutrients) mainly settles inside the fjord due to the flocculation and relatively slow water circulation in the fjord.	
Title	Salt tectonism with implications for CCS
Authors	Cecilia Elisabeth Nielsen*, Ole Rønø Clausen*, Michael Fyhn[#] & Ulrik Gregersen[#]
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Abstract	Oral
Injecting CO_2 in saline reservoirs onshore and offshore Denmark is a major opportunity for reaching the required net reduction in CO_2 emission. Many of the suggested reservoirs are in connection to salt structures in the marine subsurface, and an understanding of salt tectonics is therefore of big importance both with respect to reservoir geometry and the integrity of the sealing overburden.New up to date 2D infill seismic data is currently being acquired and processed over structures spread across Denmark including the Jammerbugt and the Sejerø Bay in the CCS2022-2024 project at GEUS. Together with existing and the new seismic data and deep wells these structures are being mapped and evaluated as	

potential sites for CO_2 storage. The new data and mapping allow a much better analysis of the formation of different salt structures with respect to deposition, basement tectonism, late thin-skinned extension etc. than hereto possible. The intension of this ongoing study is both to acquire a new regional understanding of salt dynamics in the Danish Area, and also to analyze how salt kinematics over time has affected the future CO_2 storage sites with respect to porosity, the potential leakages, and how future longtime monitoring of the sites must be designed.

Title	New multibeam mapping data from Ammassalik Basin, SE Greenland: A tale of glacial landforms influenced by variable basement lithologies
Authors	John R. Hopper[a,d], Lara R. Peréz[b], Katrine Juul Andresen[c], Thomas Funck[a], Ole Rønø Clausen[c], Emil Fønss Jensen[d], Stig Hjalte Graeser Kinnerup[d]
Affiliation	[a]Department of Geophysics and Sedimentary Basins, Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark, jrh@geus.dk, tf@geus.dk; [b]Department of Near Surface Land and Marine Geology, GEUS, Aarhus, Denmark, lfp@gues.dk; [c]Institute of Geosciences, Aarhus University, Aarhus, Denmark, katrine.andresen@geo.au.dk, ole.r.clausen@geo.au.dk; [d]Institute of Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen, Denmark, hopper@ign.ku.dk, grf787@alumni.ku.dk, hfd793@alumni.ku.dk
Abstract	Oral

The Ammassalik Basin, offshore SE Greenland near Tasiilaq, is a Mesozoic rift basin bounded to the west by Precambian basement rocks. The basin was heavily influenced by Paleogene volcanism associated with the Iceland mantle plume and eventual opening of the North Atlantic (Gerlings et al., 2017). Eastward of where basin sedimentary rocks sub-crop below the seabed, subaerially extruded flood basalts cover the basin and give way seawards to a thick pile of seaward dipping reflectors characteristic of volcanic rifted margins (Peréz-Gussinyé et al., 2023). In addition, it has been suggested that parts of the margin may be underlain by older, Proterozoic–early Paleozoic meta-sedimentary rocks (e.g. Fyhn et al., 2012; Guarnieri et al. 2022). In 2022 as part of the SEAMS project (SurvEy of AMmassalik basin Sediments), a collaborative effort between GEUS and Aarhus University with support from the Danish Center for Marine Research and Danish Arctic Command, we collected ~3000 km^2 of multibeam data supplemented by Innomar sub-bottom profiler data on the Danish patrol vessel *HDMS Lauge Koch*. The data illuminate a number of glacially influenced landforms that appear to be in part controlled by the underlying substrate. Areas interpreted by Gerlings et al. (2017) as older meta-sedimentary rocks appear strongly eroded by ice tongues that must have covered the shelf, with several broad U-shaped valleys. Over the main part of the Mesozoic basin, only limited erosion is observed, but crag-and-tail features associated with sub-cropping basaltic sills are apparent, not unlike similar features that have been found in the Vaigat in West Greenland, where a sill intruded Cretaceous basin sub-crops below seabed. The hard Precambrian basement to the west, and the flood basalts to the east, do not appear to be greatly affected by glaciation, with no evidence for flow parallel striations, though these areas appear to have scour marks that could have resulted from icebergs.

Title	Marine diatom assemblages in Arctic paleoceanography – qualitative and quantitative approaches
Authors	Christof Pearce[1], Audrey Limoges[2], Beth Caissie[3], Kaarina Weckström[4], Mimmi Oksman[5], Tiia Luostarinen[4]
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Abstract	Oral

Diatoms are one of the most important primary producers in the world's oceans. They secrete siliceous frustules that are often well preserved in sediments, and due to their diversity and selective environmental preferences, they are ideal proxies for paleoceanographic studies. In the Arctic, marine sedimentary diatoms are widely used to reconstruct sea-surface conditions, including temperature (SST), salinity, and sea-ice cover. Reconstructions range from qualitative (e.g., presence of sea ice) to quantitative (e.g., seasonal SST values), but their robustness as paleoenvironmental indicators fundamentally depends on our understanding of the modern autecology of individual species. Although this can be studied through plankton surveys, sediment traps, and lab-culturing, the most common approach is by the study of surface sediment diatom assemblages and linking these to surface ocean conditions (so-called

calibration data sets). Over the last decades, hundreds of Arctic surface sediments have been analyzed for this purpose. This work has however been carried out by several independent research groups around the world, often using slightly different methodologies and diatom taxonomies. To enable their full potential for quantitative diatom-based surface ocean reconstructions, the newly-formed PAGES Working Group MARDI (Marine Arctic Diatoms) aims to align and integrate the various surface datasets resulting in an open-access Pan-Arctic diatom dataset.	
Title	Greenland Ice Sheet evolution – What new insights to expect from IODP Exp 400?
Authors	Paul C. Knutz[1], Lara F. Perez[1] and Heike Zimmermann[1]
Affiliation	[1]GEUS
Abstract	Oral
When was the onset of glacial expansion in northern Greenland? And how has the Greenland Ice Sheet responded to past climate warmings? Motivated by these key questions IODP Expedition 400 drilled six sites, U1603-U1608, along a transect covering the deep basin of Baffin Bay and the glaciated margin of north-west Greenland. With the overall aim of obtaining high-resolution records capturing the late Cenozoic evolution, we recovered 2,299 m of sediment core, primarily from hemipelagic and contourite settings, forming part of the continental margin succession. The recovered sediments represent a a composite stratigraphic section of >3 km covering the last 25 Myr, i.e. from the Oligocene/Early Miocene to Holocene. From four of the sites we obtained a full suite of wireline logging data. This presentation provides an overview of the preliminary results, and the scientific objectives for understanding the late Cenozoic climate development in Greenland.	
Session	**Coexistence between offshore energy sector and the marine environment – the need for research, multisector collaboration, and knowledge dissemination**
Title	Upscaling offshore activities in denmark – the urgent need for data, research, and mitigation
Authors	Liselotte Hohwy Stokholm
Affiliation	Tnk. Hav
Abstract	Oral
Denmark is planning a fast, large-scale development of offshore wind farms and CO2 storage. These developments need to take into account the status of the marine environment and the goal of reaching good environmental status in Danish sea areas. In order to reach a strategic and ecosystem-based approach to and strategic planning of offshore activities, there is an urgent need for research, data sharing and collaboration. With the aim of creating the best possibilities for co-existence between offshore constructions and the marine environment, Liselotte will explain the need for collaborations between research communities and developers of offshore constructions, the need for cumulative impacts assessments and the need for development of various mitigation measures.Presenter: Liselotte Hohwy Stokholm is the CEO for the Danish think tank, Ocean Institute. She has great experience in promoting solutions and strategies for small businesses and the business community. She now uses this experience to work for clean and healthy seas by promoting knowledge and solutions for a sustainable blue economy. She finds it important to have a cross-sectoral approach with focus on dialogue and cooperation with scientists and businesses as well as NGOs.	
Title	Shared experience from collaborative long-term offshore monitoring in Belgium
Authors	Steven Degraer
Affiliation	RoBINS,Belgium
Abstract	Oral
The WinMon.BE was set in 2005 to investigate the effect of offshore wind farm in Belgium. Steven will present the Belgian model for conducting the benefit of a collaborative and long term approach in monitoring of offshore wind in Belgium. Steven will shortly present the centralized funding scheme on which the Belgian monitoring is based and highlight the benefits of this model that leads lead to improving our understanding of offshore wind farm impact mitigation. Presenter: Steven Degraer is a senior scientist at the Institute of Natural Sciences in Belgium, where he is coordinating the Marine Ecology and Management team with a broad expertise in marine mammals and seabirds, rocky shore fauna and invasive species, and underwater noise, embedded in an ecosystem management context. Steven is the scientific coordinator of the Belgian offshore wind farm environmental monitoring program WinMon.Be since 2008	
Title	INSITE (UK)

Author	Henk van Rein
Affiliation	Howell marine consulting
Abstract	Oral
The INSITE Programme has been looking at some of the fundamental science questions needed to understand the influence and value of structures in our marine environment over the last 10 years. When INSITE was set up, it was the first real joint industry partnership of its kind in UK marine research. This partnership grew over the second phase bringing together the combined interests of offshore industries, the Natural Environment Research Council and the Centre for Environment, Fisheries and Aquaculture Science in a larger, more ambitious programme. INSITEs aim has always been to provide stakeholders with the independent scientific evidence to better understand the influence of man-made structures on the ecosystem of the North Sea.	
Title	The impact of offshore wind farms on marine biodiversity (biowind)
Author	Karolina Reducha Andersen[1,2]
Affiliation	[1] Department of Ecoscience, Aarhus University, 4000 Roskilde, Denmark [2] NIRAS A/S, 3450 Allerød, Denmark; email: krea@ecos.au.dk
Abstract	Poster
Offshore wind farms (OWFs) are an essential part of the global green-energy transformation, however, the current level of knowledge on impacts and synergies between OWFs and marine biodiversity is limited and often based on extrapolations and expectations. BIOWIND is an Industrial PhD project and a collaboration between NIRAS and Aarhus University. The project started in autumn 2023 and will investigate the impact of the large-scale development of OWFs on the benthic biodiversity in Danish waters. Pre- and postconstruction data will be used to describe any negative and positive impacts. Conventional sampling as well as modern molecular tools will be applied and developed. Prior to constructing an OWF, an Environmental Impact Assessment (EIA) must be prepared to assess the effects of the construction on the environment. By investigating the effects of OWFs on the marine benthic biodiversity, this project will provide new knowledge and recommendations to improve NIRAS' services on OWF-EIA, as well as postconstruction monitoring. Since BIOWIND was only recently launched, the poster will mainly focus on the project goals, as no results have been obtained yet.	
Title	A multidisciplinary toolbox for investigating methane seepage sources and origins in the Danish North sea
Authors	Katrine Elnegaard Hansen[1], Bodil Wesenberg Lauridsen[1], Lasse Tésik Prins[1], Katrine Juul Andresen[2], Ole Rønø Clausen[2], Rishmita Mukherjee[3], Hans Røy[3], and Paul Knutz[1]
Affiliation	[1]Geological Survey of Denmark and Greenland, 8000 Aarhus and 1350 Copenhagen, Denmark; [2]Department of Geoscience, Aarhus University, 8000 Aarhus, Denmark; [3]Department of Biology, Aarhus University, 8000 Aarhus, Denmark; email: keha@geus.dk
Abstract	Poster
As societies transition to renewable energy, many offshore oil and gas wells will be abandoned, while some will be transformed to facilitate carbon storage. To mitigate any methane leakage associated with abandonment, it is necessary to understand whether the leakage has a natural or anthropogenic origin. We aim to develop a Danish North Sea baseline for methane seepage in the shallow subsurface, near oil and gas platforms and in areas without any hydrocarbon production. To accomplish this, we developed a toolbox consisting of geophysical and sediment core data, benthic faunal variations, dating and geochemistry of the benthic fauna, chemical and isotopic composition of the dissolved gas, and the composition of gas-degrading bacteria. Benthic foraminifera are excellent candidates to study ecological conditions. Different species have adapted to environments with distinct oxygen, methane and food conditions. Establishing an endemic benthic foraminiferal fauna for seep environments in the Danish North Sea will aid our identification of past and present seepage events. We present preliminary results on the distribution of benthic foraminifera from surface samples and a sediment core.	
Title	Offshore wind farm decommissioning and its impacts on marine biodiversity and social acceptance

Authors	Liv Kristensen Stranddorf[1,2*], Tracey Colley[3], Wolfgang Kunther[2], Jacob Ladenburg[4], Lena Landström[5], Matthieu Delefosse[1], Jon Christian Svendsen[6], and Stig Irving Olsen[2]
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Abstract	Poster
While major wind farm development projects are put in motion to support the green transition, the first offshore wind farms (OWF) are reaching the decommissioning phase. OWF decommissioning potentially includes a broad range of options from “remove all” to “leave in place” with different impacts on biodiversity. Throughout the lifetime of an offshore wind farm, the ecosystem around the wind farm structures often transforms into a more species-abundant and diverse ecosystem as the wind farm foundations act as artificial reefs. The impacts of removing these ecosystems are largely unknown, and at the same time, objective methods for assessing such impacts are needed to support decision-making around OWF decommissioning. Furthermore, understanding the social perception of different decommissioning options and their impacts on marine biodiversity will be essential to ensuring transparency and acceptance from society. Based on a literature review, we identified impact pathways for impacts on marine biodiversity from decommissioning activities, which will form a basis for the development of a quantitative model (life cycle impact assessment model) for biodiversity assessment. Furthermore, we investigate the social perception around decommissioning in Danish civil society and by national authorities, environmental NGOs, and marine specialists.	
Title	Temporary organizing with nature: reconfiguring the organization-natural environment interplay
Authors	Jonathan Feddersen[1*], Miriam Feuls[1], Sunny Mosangzi Xu[1], Tor Hernes[1,2], Majken Schultz[1]
Affiliation	[1]Department of Organization & Centre for Organization and Time, Copenhagen Business School, 2000 Frederiksberg, Denmark; [2]Department of Business, History and Social Sciences, USN School of Business, 3184 Borre, Norway; email: jfe.ioa@cbs.dk
Abstract	Poster
This study explores how organizations engage in temporary organizing to reconfigure their relationship with the natural environment. Pursuing a situated temporal view, we investigated three exemplary cases: Ørsted’s deployment of artificial reefs and biohuts in association with the Anholt offshore wind farm, Arla’s experimentation with regenerative farming practices, and Novo Nordisk’s development of a circular solution for plastic waste from insulin pens. Even though each case organization pursued another envisioned organization-natural environment relationship, which we label decoupling from, reconnecting with, and rekindling of the natural environment, they followed a similar process of temporary organizing, which we synthesize in an empirical model. In all three cases, the temporalities of non-human actors extended beyond the temporal boundaries of temporary organizing efforts, what we theorize as temporal overflows. We consider how the dynamics of these temporal overflows varied across cases and affected which scaling pathways organizations pursued. Finally, we discuss the implications for temporary organizing research.	
Title	Biodiversity monitoring of offshore structures in the Danish North Sea using environmental DNA (eDNA)
Authors	Magnus W. Jacobsen[1,*], Katrina Povidisa-Delefosse[2], Einar Eg Nielsen[1]
Affiliation	[1]National Institute of Aquatic Resources, Technical University of Denmark, Vejlsøvej 39, 8600 Silkeborg, Denmark; [2]TEPDK HSE Environment, TotalEnergies EP Denmark A/S, Britanniavej 10, 6700 Esbjerg, Denmark; email : lmwj@aqua.dtu.dk
Abstract	Poster

Environmental DNA (eDNA) is a cheap and accurate method for biodiversity monitoring based on sampling and analyzing the DNA that all living organisms shed to the environment. To investigate biodiversity at sites of interest in the sea, such as at and around platforms and natural reefs, it is necessary to understand the spatial and temporal variation of eDNA observations to accurately interpret and evaluate the results. Here, we used a metabarcoding approach to analyze top and bottom water samples collected along a transect from the DanF platform to Esbjerg harbor, which included both natural reefs and control stations. Temporal samples collected across 3 days using an onsite robotic sampler (ESP) were also analyzed to investigate short-term temporal variations. While general data analysis was performed using Illumina sequencing, a subset of data was further re-sequenced on the transportable 'MinION' sequencer from Oxford Nanopore to assess the suitability of this new technology for future on-site data generation.

Title	Exploring fish aggregations at oil and gas platform foundations in the North Sea
Authors	Bruno Ibanez-Erquiaga[1*], Henrik Baktoft[1], Tim Wilms[2], Tobias K. Mildenberger[1], Jonas Teilmann[3], Lars Kleivane[4], Leandra M. Kornau[5,6], Mette D. Agersted[7], Sixten M. Hüllert[3] & Jon C. Svendsen[1]
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Abstract	Poster

As offshore oil and gas platforms age and their productivity diminishes, current regulations mainly advocate the complete removal of these aging platforms through decommissioning. Just in the North Sea, >€90 billion will be needed for decommissioning by 2060. Growing evidence suggests that platform foundations may provide productive habitats for fish communities through reef effects. In addition, the areas within and around the platforms may act as *de facto* marine protected areas of limited or no fishing. However, the mechanisms underpinning the platforms' effects are poorly understood, and the assessment of the ecological outcomes concerning fish ecology and fisheries is limited. Here, we aim to provide an understanding of the potential role that platforms play for fish communities in the Danish North Sea. Using catch-per-unit-effort, we found that fish abundance increases towards platforms. Also, we observed that Atlantic cod (*Gadus morhua*) abundance and body size are positively influenced by platform proximity. Our results highlight the need to evaluate different decommissioning options in the context of platforms' habitat provisioning for fish.

Title	Environmental DNA based insights of fish diversity associated to oil platforms in the Arabian Gulf
Authors	Sørensen, Johan M. [1,2]. Knudsen, Steen W.[1]. Torquato, Felipe[2]. Chapman, Constance F.[2]. Araujo, Gonzalo[2]. Basseres, Anne[4]. Carara, Mathieu[4]. Godina, Alexei[4]. Faulkner, Lauren[3]. Lowe, Christopher G.[3]. Range, Pedro[2]. Ben-Hamadou, Radhouan[2]. Møller, Peter R. [1]
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Abstract	Poster

In the Arabian Gulf, the depletion of natural reefs has reduced marine fish diversity. However, manmade offshore structures like oil and gas platforms offer potential as artificial reefs. Previous studies suggest a diverse fish community around these structures, including large whale shark aggregations. Still it remains to be answered which species benefits from these artificial reefs and if the observed whale shark aggregations also causes a unique associated fish diversity.
Environmental DNA was extracted from water samples near oil platforms and whale shark aggregations in the Arabian Gulf, with mitochondrial DNA amplified and sequenced using MiFish primers. Results reveal the presence of 97 fish species across all survey sites, with significantly higher diversity near the

platforms compared to nearby areas. Species composition varies between platform and reference sites, as well as with depth near platforms. Seasonal whale shark aggregations within a Qatari oil field are associated with a unique fish assemblage. These preliminary findings highlight the role of platforms as local biodiversity hotspots, underscoring their conservation value for marine fishes in the Arabian Gulf.	
Title	Bats offshore in the Kattegat and SWBaltic – combining efforts to get the bigger picture
Authors	Bjarke Laubek [1,*], Morten Christensen[2], Søren Keller[3], Rasmus Bisschop-Larsen[4], Bent Sømod[5], and Signe Marie Mygind Brinkløv [6]
Affiliation	[1]Environment and Sustainability, Vattenfall, 6000 Kolding, Denmark; [2]WSP Denmark, Linnés Allé 2, 2630 Høje Tåstrup; [3]Center for Renewable Energy, Danish Energy Agency; [4]NIRAS, Ceres Allé 3, 8000 Aarhus; [5]Environment & Geoscience, Energinet, Tonnes Kjærsvej 65, 7000 Fredericia ; [6]Department of Ecoscience, Danish Centre for Environment and Energy, Aarhus University, 8000 Aarhus C; email: bjarke.laubek@vattenfall.com
Abstract	Poster
Collision of bats at wind turbines have been well documented at onshore facilities at many places around the world. The possible impacts are now also increasingly discussed as part of development of wind farms offshore. Offshore interaction as well as basic knowledge on occurrence of bats is however still very limited.Vattenfall and collaborators are coordinating a comprehensive effort to investigate bat occurrence and behavior in offshore wind farms and development areas in the Kattegat - SW Baltic Sea region. The project spans across several countries including Sweden, Denmark, Germany, and Norway. With over 140 bat detectors throughout the area, we aim to map the geographical variation in bat migration, activity patterns, phenology, and how this variation relate to weather conditions. Data has been collected from all stations simultaneously during spring, summer, and autumn 2023, and analysis and results are expected to be available during 2024. Vattenfall, the Danish Energy Agency, and Energinet collaborates with consultanties (WSP and NIRAS) to collect data and Aarhus University for the analyses of data. The findings are expected to boost our knowledge base on bats offshore in the covered waters and will feed into a national feasibility screening for offshore wind potential in Danish waters by DCE/Aarhus University and NIRAS together with data collected from areas in the North Sea. That projects broad-scale, cross-border, and multi-collaborator scope aims to provide a robust baseline for strategic planning and impact assessments for future offshore wind development and to evaluate appropriate mitigation measures to support coexistence with offshore renewable energy projects.	
Title	Coexistence initiatives in an offshore windfarm - a Danish case study, Anholt offshore windfarm (ANH, Ørsted)
Author	Andrea Fischel
Affiliation	Ørsted, Offshore, Central Europe, Kraftværksvej 53, 7000 Fredericia; ANDRF@orsted.com
Abstract	Poster
	Ørsted has applied multiple approaches to gain knowledge and expertise on coexistence spanning from biodiversity enhancement via reef restoration and Nature Inclusive Design to introducing aquaculture into Ørsted windfarms. In 2022, Ørsted piloted a project testing how 3D-printed reefs benefit biodiversity in the Kattegat, which is experiencing a historically low cod stock. The project is the first time 3D-printed reefs are used in Danish waters, and they will complement existing boulder reefs that Ørsted established when constructing the ANH. Since 2023, Ørsted pilots a European project on aquaculture deployed at ANH. The pilot aims to i) investigate the production potential of commercially viable species; ii) focuses on monitoring systems, biodiversity effects, and the development of innovative cultivation techniques
Sessions	**Communication of marine science**
Title	Charting a course for ocean literacy in the Ocean Decade
Authors	Bridget Burger and Auður Pálsdóttir
Affiliation	University of Iceland; Beb66@hi.is; audurp@hi.is
Abstract	Oral
Ocean Literacy has three defined aspects: knowledge about the ocean, ability to communicate about the ocean, and responsible action toward the ocean. However, relatively little research has been done on Ocean Literacy and how to achieve it. UNESCO has declared the years 2021–2030 the Decade of Ocean	

Science for Sustainable Development, and emphasized Ocean Literacy as a key strategy to achieve the Decade goals. The purpose of this research is to examine Ocean Literacy in a global and cross-cultural context. Cited international research on Ocean Literacy was analyzed. The findings are in three parts. First, that an internationally used definition stems from a single definition of Ocean Literacy. Second, a more culturally-relevant definition of Ocean Literacy is needed. Third, in terms of school development, an Ocean Literacy measurement tool would be of help for schools to find the collective constraints and challenges within each school who want to achieve the UN goals. These findings have implications for science and education researchers and communciators as efforts to achieve Ocean Literacy are undertaken across sectors and in diverse cultural and geographic contexts.	
Title	Arctic sense: Using visual virtual reality in marine education
Authors	Rasmussen, MH, Stoller, A, Grove, T, Ydesen, K, Káradóttir, E, Mesiti, S and Heide, A
Affiliation	University of Iceland
Abstract	Oral
Arctic Sense was supported by Nordplus for a 3-year project involving schools and museums in 3 countries (Denmark, Norway, and Iceland), with the aim of promoting stewardship for fragile marine ecosystems through virtual mobility. Above- and below-water 360° videos were collected during Arctic sailing expeditions (barba.no) in 2019/2021 and edited video clips were uploaded to Pico 360 Virtual Reality headsets. The museums had 1–2 headsets and a poster explaining the expedition, research, and featured wildlife; while logbooks with problem-solving activities and lesson plans for teachers were used in schools with classroom headsets which were linked by Redbox VR. The materials were first trialed in Iceland (autumn 2022), followed by Norway (winter 2022) and finally Denmark (spring-summer 2023), with one participating museum and school in each country. Overall, school children and museum guests were excited about the videos and the general VR experience. Based on user feedback, we next aim to make the museum resources more user-friendly and streamline the school program.	
Title	Local distribution and breeding timing of harbour porpoises (Phocoene phocoena) determined with citizen science
Authors	Freja Jakobsen[1], Signe Sveegaard[2], Martin Slusarczyk Hubel[3], Thomas Kaarsted[3], Mette Thybo[4], Magnus Wahlberg[1]
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Abstract	Oral
The conservation status of the Belt Sea harbour porpoise (*Phocoena phocoena*) population is under concern. Data on the status of porpoise populations is traditionally obtained with surveying techniques. We used a complemental method of citizen science to observe porpoises around the Danish Island of Funen. Porpoise sightings were reported with a custom-made app *Marine Tracker,* disseminated to the public through community meetings, events, and posters. App users could choose between three types of reports: Single porpoise, multiple porpoises, and observations of mother-and-calf pairs. Of 13,883 reported sightings, 6,251 were validated and from Funen between 2019-2022. These observations were as expected concentrated mainly around larger harbour towns, but also in the southern region of Funen, which previously not has been recognized as a significant porpoise habitat, especially for mother-and-calf pairs. Discussed is the problematic of citizens science and its possibilities. In conclusion, the citizen science reports provided insights into the spatial and temporal distribution of porpoise calving. This highlights the possibilities of citizen science as an interesting tool complementing traditional surveying techniques in understanding marine mammal distribution and population structures.	
Title	Formidling direkte fra universiteter til skolebørn
Authors	Signe Brokjær, Marianne Knudsen, Peter Bondo Christensen
Affiliation	Hovedet i Havet, Institut for Ecoscience Aarhus Universitet
Abstract	Oral
Projekt Hovedet i Havet har igennem de sidste syv år sat fokus på det danske havmiljø og har haft en vision om at få havet på skoleskemaet. Naturfagenes evaluerings- og udviklingscenter (NEUC) har evalueret projektet, og resultaterne peger på, at universiteterne kan spille en vigtig rolle for både elever	

og lærere i grundskolen. Vi har gennem projektet haft direkte kontakt med knap 100.000 personer heraf ca. 42.000 elever og lærere. Vi har besøgt mere end 150 skoler og samarbejdet med 36 kommuner for at forankre projektets vision rundt omkring i landet. Derudover har vi haft et stort fokus på læreruddannelsen. I samarbejde med Det Marine Netværk har vi udviklet platformen 'Havet i Skolen', https://havetiskolen.dk/, der giver lærere og elever et overblik over størstedelen af det eksisterende undervisningsmateriale om havet . Undersøgelser viser, at interessen for STEM-fagene falder hos både piger og drenge mellem 4-9. klasse, og andre analyser peger på, at det er svært at påvirke unges uddannelsesvalg, når de først er startet på en ungdomsuddannelse. Universiteterne har her en masse at byde ind med. Bl.a. gennem unge entusiastiske studerende, der mestre ung til ung formidling.	
Title	Communicating uncertainty associated with indicator-based assessment – the waters tool
Authors	Murray, C.J.[1,2], M. Lindegarth[3,4], J. Carstensen[5]
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Abstract	Oral
Indicators representing the condition of biological components, species and functional groups ("quality elements"), as well as important abiotic features of ecosystems, such as nutrient concentrations present a picture of the status of an ecosystem. The need to combine diverse individual indicators to give an overall integrated assessment (IA) of ecological status has led to the development and increasing application of IA tools.Integrating diverse data to arrive at a representative overall status necessarily simplifies the picture and presents a challenge for communicating the associated uncertainty. IA tools provide an answer to the question "is the status in good or bad?". We have developed a tool which, whilst based on rigorous statistical analysis, can communicate visually how the uncertainty associated with indicator results propagates from observations to the level of overall IA assessment.The WATERS tool is developed in a Swedish context for Water Framework Directive (WFD) assessments but the approach has potential applications in other countries and policy areas.	
Posters	**Free Style (Regardless to the sessions)**
Title	Evidence for connectivity between Siberian river runoff and the lower limb of the Atlantic meridional overturning circulation
Authors	Caroline Gjelstrup[1], Craig Lee[2], Paul Myers[3], Kumiko Azetsu-Scott[4] and Colin Stedmon[1]
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Abstract	Poster
Freshwater originating from the central Arctic Ocean participates in the globally important Atlantic Meridional Overturning Circulation (AMOC). However, the origins of this freshwater contribution are currently unknown. Here, we use high-resolution, in-situ observations of dissolved organic matter (DOM) fluorescence to trace the origins of freshwater and organic carbon in the densest component of the AMOC, namely the Denmark Strait Overflow Water (DSOW). We find a distinct terrestrial DOM signal in DSOW that can be traced upstream to the Siberian shelves in the central Arctic Ocean. This implies a riverine origin of freshwater in DSOW, and we estimate a 0.94 % contribution of Siberian Shelf water to DSOW. Modelling confirms the large-scale connectivity between high Arctic rivers and the deep water in the AMOC inferred from observations. Our results demonstrate biogeochemical connectivity on large regional scales and offers a potential to monitor freshwater and organic carbon export in the AMOC, which will be vital for enhancing our understanding climate variability, particularly given the anticipated changes in the coming decades.	
Title	SUBMUSSEL – udvikling af undersænket muslingeopdræt

Authors	Louise Dahl Kristensen[1], Maren Moltke Lyngsgaard[1] & Rasmus Wittrup[2]
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Abstract	Poster
To barrierer forhindrer lige nu en udvidelse af produktionen af blåmuslinger; is og uønskede visuelle effekter i kystområder. Derfor er Wittrup Seafood A/S og partnere med støtte fra GUDP, gået i gang med at udvikle permanent undersænkede muslingeopdræt uden visuelle effekter på overfladen. Dertil udvikles undervands høsteknikker og biomasse estimater. Ved undersænkning elimineres risikoen for is-skader, og vækstsæsonen kan forlænges, så muslingerne kan opnå konsumstørrelse og derved skabe en rentabel forretning. Projektet arbejder konstruktivt med barrierer, da vi har akut behov for fjernelse af næringsstoffer fra vores fjord- og kystsystemer for at opnå vores mål for god miljøtilstand, og muslinger er et veldokumenteret marint virkemiddel til netop dette. Ifølge Det Nationale Bioøkonomipanel har de danske farvande et potentiale for at kunne dyrke op til 300.000 t blåmuslinger svarende til en fjernelse af kvælstof og fosfor på ca. 4.200 t N og 390 t P. Samtidig udgør muslingeopdræt en miljøvenlig og klimaeffektiv fødevareproduktion.	
Title	Forvaltningsværktøj til placering af muslingeopdræt med fokus på natur og miljø
Authors	Maren Moltke Lyngsgaard[1], Per Dolmer[2], Louise Dahl Kristensen[1], Anders Jensen[1], Bo Thamdrup[3], Kirsten Engell Sørensen[4] Bent Vismann[5]
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Abstract	Poster
Miljøeffekter af muslingeopdræt i Limfjorden blev undersøgt på fire anlæg beliggende på en gradient fra Skive fjord (ringe vandudskiftning) til Venøsund (god vandudskiftning). På basis af resultaterne er et forvaltningsværktøj blevet udviklet. Værktøjet skal hjælpe til fremadrettet at placere muslingeopdræt med fokus på natur og miljø, således muslingeopdræts positive effekter øges og de negative effekter minimeres. Danmark har en forpligtigelse til at leve op til EUs vandrammedirektiv, hvor vi skal opnå god miljøtilstand i vores kystvande og fjorde. Dette mål kan ikke opnås grundet de høje koncentrationer af næringssalte, der udledes fra land til vand samt den høje interne næringsbelastning, der har bygget sig op i havbunden over årtier. Denne eutrofiering har medført en forringet biodiversitet. Danmark har derfor behov for at implementere et veldokumenteret virkemiddel som muslingeopdræt til fjernelse af næringsstoffer fra det marine miljø og en forbedring af vandkvaliteten, så der gendannes sunde habitater. Undersøgelser af muslingeopdræts miljøeffekter, herunder sedimentspredning, vandets klarhed, bundfauna sammensætning og biomasse, iltforbrug i sedimentet, sedimentets indhold af organisk materiale samt N og P og endelig omsætning af nitrat til frit kvælstof via denitrifikationsraten i sedimentet peger på nøgleelementer som vandudskiftning, og tab af muslinger til bunden som afgørende for muslingeopdræts positive effekter på havmiljøet ud over fjernelse af næringsstoffer og klimaeffektiv og sund fødevareproduktion.	