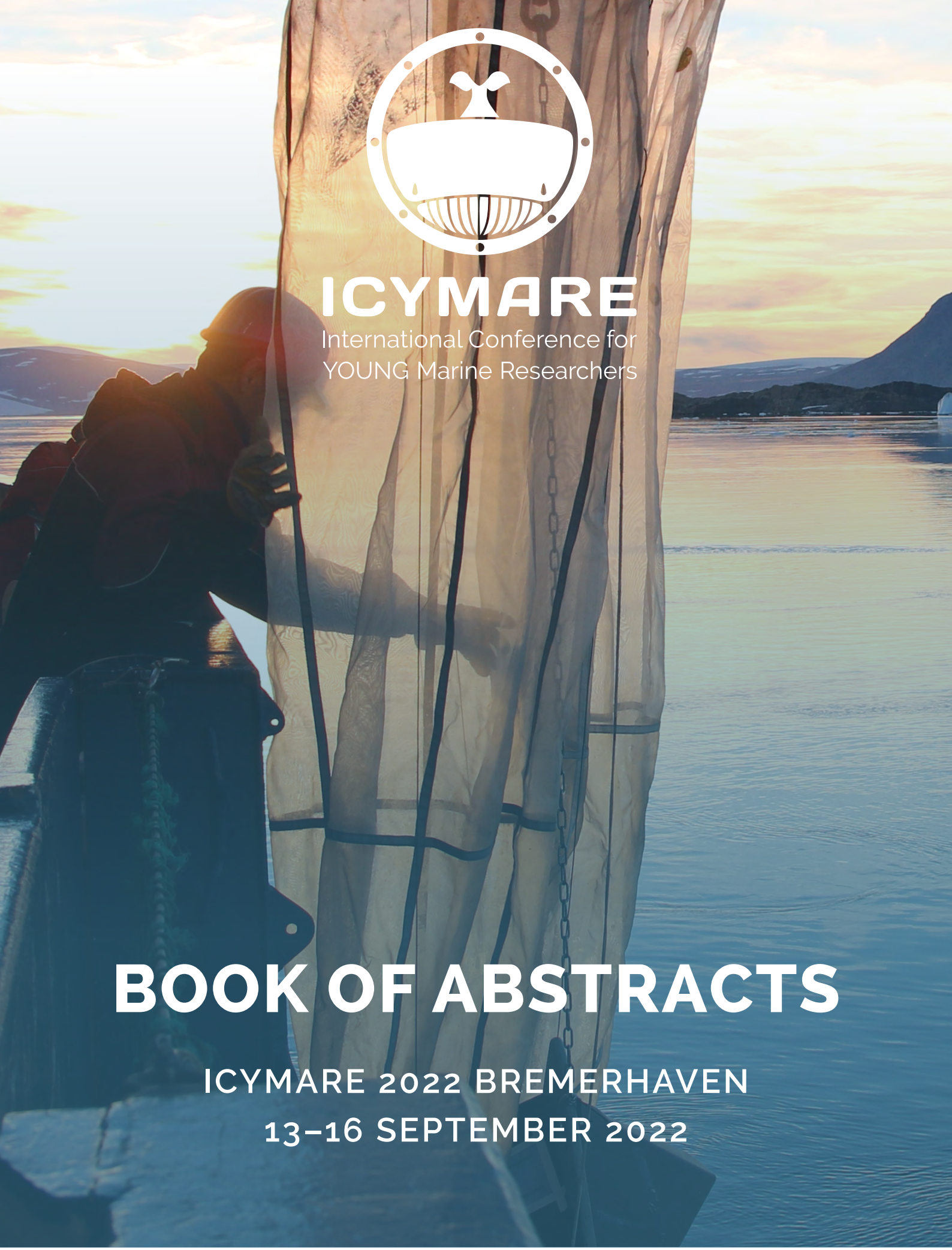

ICYMARE
International Conference for
YOUNG Marine Researchers

BOOK OF ABSTRACTS

ICYMARE 2022 BREMERHAVEN
13–16 SEPTEMBER 2022

ICYMARE
International Conference for
YOUNG Marine Researchers

THE BREMEN SOCIETY FOR
NATURAL SCIENCES from 1864

eco
environment coastal & offshore

www.icymare.com

ICYMARE 2021 BREMERHAVEN

Book of Abstracts

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Content

Welcome to ICYMARE 2022 BREMERHAVEN

We are happy to welcome all of you to the 2022 edition of the "International Conference for Young MArine REsearchers" – ICYMARE. After two online-years we are especially happy that we can come together in-person for a meeting in Bremerhaven. Thanks to all of you who kept contact and welcome to all the new faces. We are glad to have you!

ICYMARE is completely organized by young volunteers and offers a powerful and inspiring international set-up for an excellent network opportunity and some first conference experience in your early career. Let's follow up with the ICYMARE tradition and meet every year to discuss our research, ideas, and plans for the future.

What is special about ICYMARE:

- ICYMARE aims to be a networking event for YOUNG marine researchers
- ICYMARE is completely organized by young marine researchers on voluntary basis
- ICYMARE will have changing locations and hosting support

But most of all: we stay open minded for your ideas and input and our team takes extra care for ICYMARE to get that easy-to-talk-to atmosphere where you can build your network as well as make friends. Our mission at ICYMARE 2022 BREMERHAVEN is that we are all equals in our research, every opinion matters, you matter, and we respect each other.

We are very grateful to all volunteers, partners & sponsors and session hosts who helped to make ICYMARE 2022 BREMERHAVEN possible.

We are most thankful for you presenters. Without you, organizing a conference would not make any sense. We warmly welcome you in Bremerhaven and hope that you will have an amazing time at ICYMARE 2022 BREMERHAVEN. We hope that you learn a lot during this conference and that this is a great start to build your own personal professional network.

Welcome as a part of the ICYMARE family!
Your ICYMARE 2022 BREMERHAVEN organization team

Organization Team

Thanks to all of you – you are great!

Dr. Viola Liebich
Dr. Simon Jungblut
Lena Heel
Lena Rölfer
Dr. Yvonne Schadewell
Dr. Carolin Müller
Jan Boelmann
Lénia Rato
Inês Morão
Anna Joelle Greife
Louisa Karl
Lea Kappas
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Sophie Steinhausen
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Merle Scheib
Kira Kaul
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About ICYMARE

ICYMARE is an event of the **Bremen Society for Natural Sciences** ("Naturwissenschaftlicher Verein zu Bremen"). In the following, we would like to introduce this society to you. Although it has a pretty long history, this society acts modern and is open for any people interested in natural sciences to join.

THE BREMEN SOCIETY FOR NATURAL SCIENCES from 1864

History & Aims

At the end of the 18th and the beginning of the 19th century, citizens interested in natural sciences organized themselves in natural history societies. In Bremen, this was, e.g., the "Physical Society" which was later re-named into "Museum Society". This society organized scientific talks, the members purchased and read scientific books together, and established first museum collections. In these times, shared interest for natural history was already able to overcome class distinctions. As these societies were not stable and consistent enough, the "Bremen Society for Natural Sciences" was founded in 1864. Ever since, the overall aim of the society was and is "to spread scientific knowledge and to promote scientific research, especially in northern Germany".

This aim is central to the society until today and was defining the Sciences in Bremen for a long time. The connection between professional and laic research is central and helps to transfer the appreciation of science into the broader public. The most important tools to reach these aims are publicly accessible talks, excursions, and the scientific journal of the society "Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen" ("Essays of the Bremen Society for Natural Sciences")

The Bremen Society for Natural Sciences today

Today, the activities of the Bremen Society for Natural Sciences are mostly organized in working groups. These working groups are dedicated to different groups of botanical or zoological organisms as well as geological sciences. During excursions, organisms may be systematically collected and examined. The results are then later presented in talks

or in the scientific journal of the society. Since the 1980s, nature conservation plays an increasing role in such activities. For instance, mapping of organisms, together with the University of Bremen, is of importance as the society is also member of different organizations of environmental protection.

Furthermore, the society organizes a public lecture series together with the University of Bremen in the rooms of the Übersee-Museum. The topics of this lecture series go beyond pure faunal and floral reflections into topics of organismic biology and ecology. The society is also involved in the Bremen Award for Local History Research, which supports professional and laic research with topical connection to the region of northwestern Germany.

Marine Sciences in the Bremen Society for Natural Sciences

The founding of the Bremen Society for Natural Sciences dates back to a time where there was not much professional or laic marine research in Bremen. Therefore, the society never had a marine focus. In April 2018, the Association of Marine Sciences was founded within the Bremen Society of Natural Sciences.

One working group of this association is the working group ICYMARE, which is organizing the new conference series of the same name. With the aim to establish marine sciences as an inherent part of the society, to connect marine professionals and laics, and to raise awareness of marine knowledge into the public, the Association of Marine Sciences is open for everybody who is interested in the field.

The International Conference for YOUNG Marine Researchers – ICYMARE – is a bottom-up initiative organized by young researchers on voluntary basis for young researchers of all marine related disciplines. It provides an inspiring international set-up for an excellent network opportunity and some first conference experience for Bachelor, Master and PhD candidates. The ICYMARE family is open for everyone and meets yearly with changing locations and hosting support to discuss results, ideas, and plans for the future.

But most of all: at ICYMARE we stay open minded for your ideas and input and our team takes extra care for ICYMARE to get that easy-to-talk-to but nevertheless professional atmosphere where you will build your network as well as make friends.

What is special about ICYMARE:

- ICYMARE is an annual on-site conference for young marine researchers with changing locations and hosting support.
- ICYMARE is an opportunity to build your network of young marine researchers in a professional as well as easy-to-talk-to atmosphere.
- ICYMARE offers you the chance to engage in our community to become a part of the ICYMARE family.

Bremerhaven

ICYMARE 2022 BREMERHAVEN will take place in Bremerhaven from 13 to 16 September 2022! We are happy to be hosted by the **University of Applied Sciences Bremerhaven** for the conference and by the **Alfred Wegener Institute – Helmholtz Centre for Polar and Marine Research (AWI)** for the icebreaker event.

Welcome to the Seaside City of Bremerhaven

Bremerhaven is located where the sky kisses the sea. The view sweeps far over dike and water to the horizon. Ships pass by, bringing goods from distant lands or taking cars and containers to foreign ports. The table is richly laden with delicacies from the sea. Exciting worlds of knowledge and experience invite visitors to discover and marvel. Attractions known far beyond the borders of Bremerhaven, such as the Climate Experience Center Bremerhaven or the German Maritime Museum. While fishing and wind power dominated in the past, Bremerhaven is changing into a science location with a variety of different research institutes, many of them involved in marine research such as the University of Applied Sciences Bremerhaven. The bigger area around Bremerhaven is most likely the biggest place in Europe for marine research.

Besides the University of Applied Sciences Bremerhaven some other maritime institutes in Bremerhaven are:

AWI – Alfred Wegener Institute for Polar and Marine Research
J. H. v. Thünen Institute of Fisheries Ecology
J. H. v. Thünen Institute of Sea Fisheries
DLR – Institute for the Protection of Maritime Infrastructures

Further Institutes are also located in the City of Bremen:

MARUM – Center for Marine Environmental Sciences
MPI – Max Planck Institute for Marine Microbiology
ZMT – Leibniz Centre for Tropical Marine Research

We are very happy to welcome you in such a marine science-related environment close to the northern sea and we are happy to introduce some of the local institutions so you during the conference.

Venues & Directions

Conference Venue:
The University of Applied Sciences Bremerhaven

The conference will take place in **building T central** on the campus of the University of Applied Sciences Bremerhaven (An der Karlstadt 8, 27568 Bremerhaven).

The University can be reached from different directions. You can use the bus stop "Hochschule Bremerhaven/Stadttheater" or "Deutsches Schifffahrtsmuseum".

The bus stop "Hochschule Bremerhaven/Stadttheater" can be reached with the lines 509, 508, 502, 505, 506. It is located directly in front of one of the university buildings. Looking towards the historical Geeste-bridge, turn right and move between the buildings towards the pedestrian zone, passing buildings Z, L and K. As soon as you have reached the pedestrian zone and move to the left, you will see building T on the right side It can be recognized by its special diagonal front shape above the stairs which will lead you directly to the entrance.

The bus stop "Dt. Schifffahrtsmuseum" with the lines 501 and 511 is located on the other side of the university. The first thing to do is to move in the direction of the Kennedy bridge. You have to cross the Erich-Koch-Weser-Square straight to the pedestrian zone. Now turn right and you will see Building T.

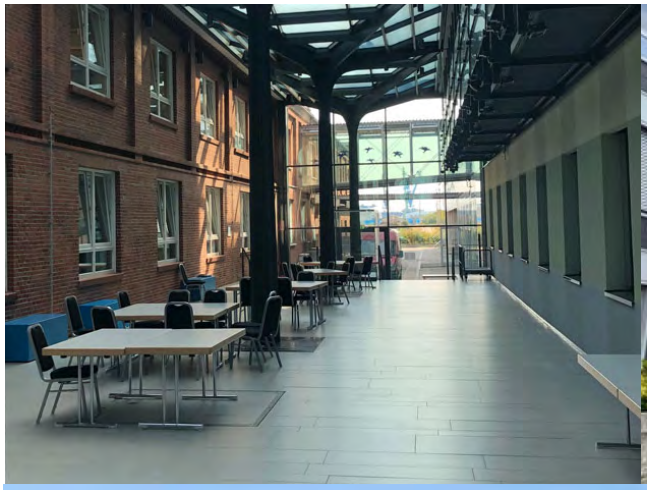
Icebreaker Venue:
The Alfred-Wegener-Institute (AWI)

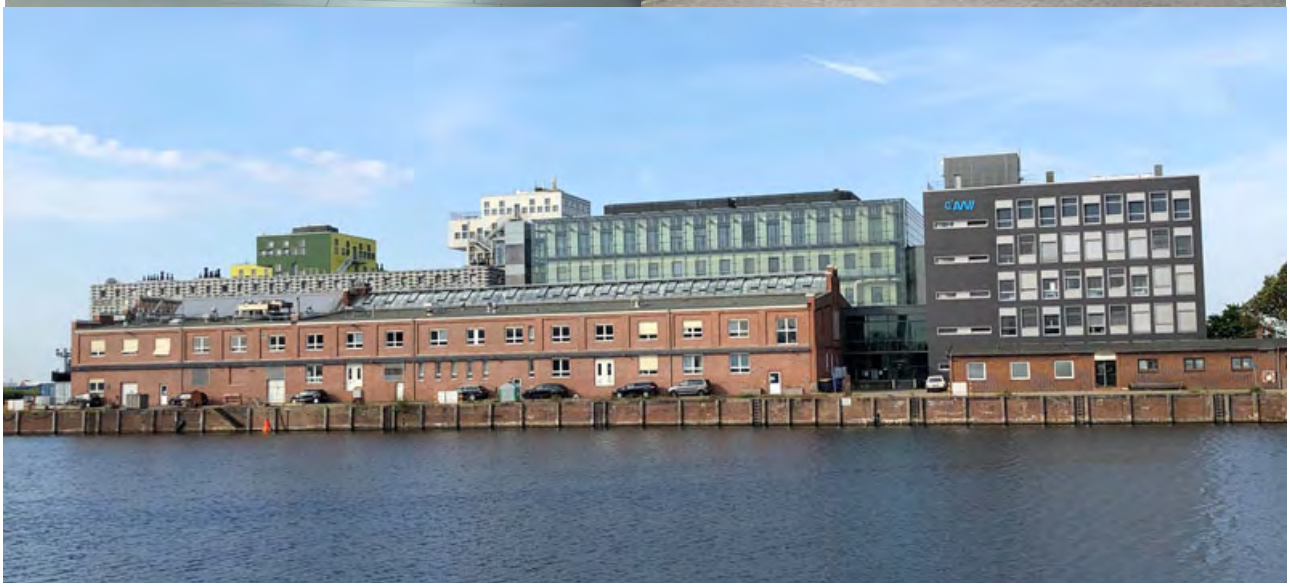
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

The ICYMARE Icebreaker will take place from 6 to 9 PM on 13th of September in the Alfred-Wegener-Institute (AWI) - Helmholtz Centre for Polar and Marine Research in Bremerhaven (Am Handelshafen 12, 27570 Bremerhaven).

From the central station of Bremerhaven you can take several bus routes: bus route 501 up to „Weserfähre" or bus routes 505, 506 up to „Columbusstraße/Weserfähre" or bus routes 440, 503, 507, 528, 531, 579 up to „Elbinger Platz". From here it is a walk of 10-15 minutes.

Additionally the bus route 510 goes directly from the central station up to „Doppelschleuse/AWI", but just a few times per day.





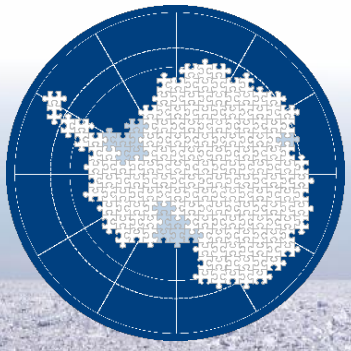
DFG Deutsche Forschungsgemeinschaft

Universität Rostock Traditio et Innovatio

Priority Program 1158

Antarctic Research

with comparative investigations in Arctic ice areas



More Information:
www.spp-antarktisforschung.de

Background

The Polar Regions play a major role in the climate and the Earth system. Serious changes can be observed. The understanding of this can only be fully attained with multi-disciplinary, coordinated research.

Research Topics

- Linkages with Lower Latitudes
- Dynamics of Climate System Components
- Response to Environmental Change
- Improved Understanding of Polar Processes and Mechanisms

Prospects

The priority program provides researchers with funding and facilitates the available infrastructure from the AWI Bremerhaven, DLR and the BGR Hannover.

Application

- Once a year
- Closing date: 1st November
- Obligatory presentation of the new projects at the coordination workshop in September
- Up to 3 years funding

Useful information

Upon Arrival at the Conference

When you arrive at the conference venue, the University of Applied Sciences Bremerhaven, on the 14th-16th, please go to the Registration Desk.

On Wednesday morning, we will have two registration tables, one for the first names A to J and another one for the first names from K to Z to hand out a name tag and a welcome bag to you.

Upon arrival on Wednesday, you can already enter your name in a participant list for the workshops. First come, first serve. Please think beforehand about which workshop you would like to participate in. Information can be found in the Book of Abstracts.

On all other days, the registration desk is for all letters. The registration will be open from 7:30 am on the first day (all other days: 8 am). Please be on time and do not only appear 5 min before we start.

The ICYMARE Family and most likely a number of participants will take photos at the conference - if you do not want to be photographed, we will put a big red dot on your name tag in order to sort out photos of yourself later and to let others know you do not like to be featured on photos and videos.

Presentation Guidelines

If you are presenting a talk, please have both the Powerpoint file and a PDF version of your presentation ready on a USB drive to submit to the talk collector, who you can find at the registration desk. Please adhere to the following structure in labelling your file (according to the identification number that you received for your presentation and which you can find in the program):
SESSION-PRESENTATION-Identifier_LASTNAME
EXAMPLE: 7_1_20_SMART

If you carry a poster with you, please write your name on your roll and hand it to the registration desk, and we will hang your poster to the poster & coffee area.

Please pay close attention to the presentation guidelines available **online** (see PDF document SUBMISSION GUIDELINES).

Presentation Awards

We will award three best poster and three best talks with a book voucher, kindly sponsored by Springer Nature. You are eligible for an award if you are BSc, MSc or PhD candidate or if you are within 5 years of having your BSc or MSc title. Voucher no. 7 will be raffled among all voters.

Certificate of Attendance

If you want, you can get a Certificate of Attendance that also serves as a proof for all your efforts regarding the ICYMARE 2022 BREMERHAVEN conference. Whether you were a listener, a presenter, a session host, or a helper, you will get such a certificate. All your functions during the conference will be listed. If you contributed a poster or talk, the title and the session of your contribution and the type of contribution (oral/poster) can be mentioned. Please check, whether everything is correct.

Drop by the registration desk to ask for your certificate – we are happy to print out your personal certificate on demand.

Book Charity

If you have (ocean/science) books you read a dozen times and know by heart or kept some books you do not need any longer, please consider bringing them along as donations for the ICYMARE NWV Society. You are invited to swap your 'old' book with a 'new' read of someone else, to donate your books or to give a monetary donation to take another book home with you after the conference.

`(Y)our Ocean Stories'

Let's celebrate each of our unique connections to the ocean and get to know each other through what the Ocean means for us.

If you want – we welcome you to bring an object along that symbolises your personal connection to the ocean and add your story to our story sculpture. Our story sculpture will consist of a long rope that everyone can tie their objects and celebrate what connects us to the ocean. Your object can be anything at all, just make sure you can easily carry it with you and take it back again from the conference. The stories are not shared in a large public space, butwill be exhibited in one of the lounge rooms throughout the conference as an opportunity to meet and get talking with the other conference participants by exploring what their connection to the ocean looks like.

COVID-19 Related Instructions

To keep everyone as safe and healthy as possible, we kindly ask all ICYMARE participants to

- Wear a mask during the talks and when sitting close to people,
- Conduct a covid test before coming to the conference and stay away / at home when being tested positive and/or feeling sick
- Wash hands, sanitize, and act according to the house rules of the University of Applied Sciences, Bremerhaven

Please pay also attention to the following: for access to public transport, you need to wear a FFP2 mask, which can also be bought at the airport or train stations, however we strongly encourage everyone to be prepared and bring along at least one FFP2 mask when travelling.

Mobile Phones

All participants are kindly requested to turn their mobile phones and other electronical devices silent during the oral sessions.

WiFi Information

The University of Applied Sciences Bremerhaven is member of the eduroam network. So all participants should be able to access the internet with their normal accounts.

Some 'Concluding' Words

We are delighted that you want to become part of the ICYMARE family and hope that you will learn and network a lot but especially that you will have fun! Please feel free to link ICYMARE on any related social media activities, so that we can spread the impressions more widely to our community! #ICYMAREfamily

If you like to stay in contact with us or built up your network, you can join our Slack Network. Please send a mail to: support@icymare.com

Your ICYMARE Organization Team

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Program

Program (13 & 14. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

Tuesday, 13th September 2022

18:00 - 21:00	ICEBREAKER	

Wednesday, 14th September 2022

7:00-9:00	REGISTRATION & WELCOME COFFEE	*Main Hall*
9:00 - 9:15	OPENING	
9:15 - 10:45	KEYNOTE – "The Arctic Ocean in the Ocean Decade" Julia Olsen from the Nordland Research Institute, Norway PLENARY DISCUSSION – "ECRs navigating the marine sciences in the Ocean Decade"	*Main Hall*
10:45 - 11:00	COFFEE BREAK	*Main Hall*
11:00 - 11:45	SCIENCE SPEED MEETING	*S318*
11:45 – 12:30	PARALELL SESSION	

Session 1.1 (part 1)

11:45 – 12:30

"SCIENCE AS THE BEST SHIELD FOR OUR OCEANS.": EARLY CAREER OCEAN PROFESSIONALS AND MARINE CONSERVATION

hosted by Jorge Moreno & Fiona-Elaine Strasser

S207

1.1.1 Habitat suitability of the whale shark *Rhincodon typus* in the Eastern Tropical Pacific.
by Walter Ernesto Pisco Limones

1.1.2 Study on By-catch, Reproduction and Postmortem Examinations of Marine Snakes of Sri Lanka
by Mannage Lenin Indrajith De Silva

1.1.3 Life-history of Icelandic minke whales *Balaenoptera acutorostrata* using scar-based analysis
by Miguel Pisco

Session 2.6

11:45 – 12:30

AQUATIC ANIMAL TELEMETRY

hosted by Eleanor Greenway & Jena Edwards

S201

2.6.1 Among-individual variation in white seabream (*Diplodus sargus*): spatial behaviour and protection by a coastal no-take area
by Carmela de Benito Abello

2.6.2 Telemetry based study of northern pike movement in the southern Baltic Sea: space use, connectivity, and implications for management
by Olga Lukyanova

2.6.3 Diel vertical migrations of the blonde skate (*Raja brachyura*) and the spotted skate (*R.montagui*) in the Northeast Atlantic
by Eleanor Greenway

12:30 – 13:30	LUNCH BREAK	
13:30-15:30	PARALELL SESSION	

Session 1.1 (part 2)

13:30 - 14:45

"SCIENCE AS THE BEST SHIELD FOR OUR OCEANS.": EARLY CAREER OCEAN PROFESSIONALS AND MARINE CONSERVATION

hosted by Jorge Moreno & Fiona-Elaine Strasser

S207

1.1.4 Influence of oceanographic and atmospheric parameters on the abundance on whale sharks in La Paz Bay
by Tristan Wünnemann

1.1.5 MESO_Alborán: and innovative project to explore and protect mesophotic communities of Alboran Sea.
by Alfredo Rosales Ruiz

1.1.6 Knowledge Co-Production in the Marine Sciences - Meeting the Needs of ECRs
by Lena Rölfer

1.1.7 Silence of Global Oceans: Using Open Data to Measure Acoustic Impact of the COVID-19 Lockdown
by Artash Nath

1.1.8 OutBe: the citizen science start-up connecting outdoor sports and marine conservation
by Arianna Liconti

Session 2.1

13:30 - 14:45

MONITORING IN MARINE- ALTERNATIVE METHODS FOR SUSTAINABLY MONITORING MARINE WILDLIFE & RESOURCES

hosted by Constanze Hammerl

S201

2.1.1 Old problems, new solutions: analysis approaches to estimate fishing effort of small-scale fisheries in the German Baltic Sea
by Thaya Mirinda Dinkel

2.1.2 Monitoring and highlighting of fishing gears impact on vulnerable elasmobranchs species in the Alboran Sea (West of Algerian coast)
by Ahmed Inal

2.1.3 A south Mediterranean country's demand on available marine biomass: Assessment and orientations
by Sonia Akrour

2.1.4 Optical-acoustic methods to study Marine Protected Areas
by Alberto Garcia Baciero

2.1.5 The golden opportunity - biomonitoring sandy beach marine biodiversity using environmental DNA
by Heath Cook

Session 5.1

13:30 - 14:15

MATHEMATICAL ANALYSIS OF MARINE COMMUNITIES

hosted by Ellen Oldenburg

S318

5.1.1 Cluster-wise Abundance Forecasting for F4 location around the Fram Strait using Machine Learning
by Raphael M. Kronberg

5.1.2 Modelling the effect of climate change and nutrient saturation on dinoflagellate spring blooms in the Baltic Sea
by Pia Marina Falter

5.1.3 Predicting spatio-temporal distributions of Arctic gelatinous zooplankton in Fram Strait in a changing environment
by Dmitrii Pantiukhin

Program (14. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

Session 1.5

14:45 - 15:30 **WHAT IS AT STAKE? – SOCIO-ECOLOGICAL SYSTEMS IN THE ANTHROPOCENE**

hosted by Frane Madiraca & Helene Gutte

S207

1.5.1 Reef islands in SE Asia and their response to changes in the environment
by Yannis Kappelmann

1.5.2 Diagnosing governance challenge in milkfish aquaculture village, a case study in Pangkah Wetan, Indonesia
by Citra Fitrie Riany

1.5.3 Slipping away! Socio-ecological system approach to provide insights into reviving the slipper lobster fishery
by Shubha Singh

Session 5.2

14:15 - 15:30 **ACROSS THE SEASONS: SEA ICE IN ALL ITS FACETS**

hosted by Hannah Niehaus & Linda Thielke

S318

5.2.1 Calculating Drag Coefficients from NASA's ICESat-2 Satellite Altimeter
by Alexander Mchedlishvili

5.2.2 Assessing SAR Capabilities for Producing Arctic Sea Ice Concentration
by Jozef Rusin

5.2.3 Remote sensing of melt ponds on Arctic sea ice – impressions from aircraft and helicopter campaigns since 2010
by Lena G. Buth

5.2.4 Triangular Perspective on the alteration of Sea ice
by Hayat Nasirova

5.2.5 Automatic mapping of ice internal stratigraphy
by Hameed Moqadam

15:30 - 15:45 **COFFEE BREAK** *Main Hall*

15:45 - 18:00 **PARALELL SESSION**

Session 1.2

15:45 - 17:45 **FROM SCIENCE TO POLICY: VARIOUS CONSERVATION CONCEPTS AND CONTEXTS**

hosted by Sonia Akrour & Solomon Sebuliba

S207

1.2.1 From Ice to Water - The Role of Science for a More Dynamic Approach to Ocean Management in the Polar Regions
by Katharina Heinrich

1.2.2 Turning the tide on protection illusions: The underprotected MPAs of the 'OSPAR Regional Sea Convention'
by Julia Roessger

1.2.3 The benthic community of the pilot oyster reef at Borkum Reef Ground (North Sea)
by Miriam Corinna Niewöhner

1.2.4 Spearfishing: tools for sustainable management
by João Serdora dos Santos

1.2.5 From the ocean to the plate: A value chain analysis to address conservation knowledge gaps in artisanal mobulid fisheries in Sri Lanka
by Hélène Buchholzer

1.2.6 How Biologically informed are Indian coastal fisheries policies
by Mayuresh Gangal

1.2.7 Catalysing Blue Growth: A roadmap for balancing economic and environmental forces in coastal regions
by Jessica Giannoumis

1.2.8 Post-harvest regeneration dynamics of stalked barnacle patches in the SW European coast
by Víctor Gómez

Session 1.3

17:45 - 18:00 **THE FUTURE OF MARINE RESEARCH: A GROWING NEED FOR INTEGRATING SOCIAL AND NATURAL SCIENCES IN THE FACE OF CLIMATE CHANGE**

hosted by Emily Chen

S207

1.3.1 Biographical perspectives of small-scale Baltic fishers to understand social-ecological transformations
by Marjan Braun

Session 2.4

15:45 - 17:00 **FROM TAXA AND TRANSECTS TO TRAITS AND METABARCODING – PROGRESSION IN STUDYING MARINE BIODIVERSITY**

hosted by Eileen Heße & Kim Ellen Ludwig

S201

2.4.1 A functional perspective: Trait-based approaches in vulnerability and ecosystem state assessments
by Frane Madiraca

2.4.2 A functional perspective on the driving factors behind coastal macrophyte carbon stocks in the Tvärminne archipelago, Finland
by Roel Lammerant

2.4.3 The phylogeography of two Beroe species in the Arctic Ocean based on one mitochondrial and one ribosomal marker
by Meret N. Jucker

2.4.4 Using metatranscriptomics to disentangle seasonal functional diversity of North Sea microeukaryotic plankton
by Michiel Perneel

2.4.5 Bridging the gap between morphological and molecular identification of diatoms
by Brishan Kalyan

Session 5.5

15:45 - 17:30 **VARIABILITY AND TRENDS IN THE MAJOR OCEANIC GATEWAYS TO THE ARCTIC FROM LARGE- TO SUBMESOSCALE**

hosted by Zerlina Hofmann & Finn Heukamp

S318

5.5.1 Sea-ice derived meltwater stratification slows the biological carbon pump: results from continuous observations
by Wilken-Jon von Appen

5.5.2 Atlantic Water Circulation in Nordic Seas: Role of Large-Scale Atmosphere-Ocean Dynamics and Influence on Sea-Ice Concentration
by Sourav Chatterjee

5.5.3 Understanding the Temperature Variability in Fram Strait through the Use of Complementary Observation Datasets
by François Challet

5.5.4 Subduction as Observed at a Sub-Mesoscale Front in the Marginal Ice Zone in Fram Strait
by Zerlina Hofmann

5.5.5 Impact of Cyclonic Wind Anomalies Caused by Massive Winter Sea Ice Retreat in the Barents Sea on Atlantic Water Transport towards the Arctic
by Finn Heukamp

5.5.6 Rapid Trends in Barents Sea Opening Heat Transport
by Ole Rieke

5.5.7 Circulation Changes Derived from CFCs and SF6 along Two Transects in the Arctic Ocean
by Wiebke Körtke

18:00 - 21:00 **POSTER SESSION** *Main Hall*

Program (15. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

Thursday, 15th September 2022

8:30-9:00	**REGISTRATION & WELCOME COFFEE**	*Main Hall*
9:00 - 9:15	**OPENING**	
9:15 - 10:00	**KEYNOTE: "Where Art meets Science..."** Caroline Ngorobi from Jukwaa Arts Productions, Kenya	*Main Hall*

10:00-10:45 — **PARALELL SESSION**

Session 1.4

10:00 - 10:45 **WEAVING INDIGENOUS KNOWLEDGE INTO YOUNG MARINE RESEARCH**

hosted by Megan Ranapia & Natalie Prinz

S207

- 1.4.1 Weaving indigenous knowledge into marine research, case studies from Canada and Aotearoa New Zealand — *by Megan Ranapia & Natalie Prinz*
- 1.4.2 Toitū te Mauri - Designing and studying mauri (life-force) in experimental research — *by Heni Unwin*
- 1.4.3 The Hidden Gems for Conservation - Indigenous and Local Knowledge of Fishers in Fiji — *by Salanieta Kitolelei*

Session 2.3

10:00 - 10:30 **BIOBANKING, BIOPROSPECTING, BIODIVERSITY**

hosted by Darya Chernikhova

S201

- 2.3.1 The benefits of long-term databasing of cetaceans in Skjálfandi Bay, Iceland — *by Charla Jean Basran*
- 2.3.2 Open up the black box of "The Unknows" creation of an open access platform for marine fungi holding polyphasic described model-organisms — *by Miriam Phoebe Sternel*

Session 5.4 (part 1)

10:00 - 10:45 **OF WHIRLS AND WAVES: EXPLORING THE IMPACTS OF SMALL-SCALE MOTIONS IN THE OCEAN**

hosted by Nicolas Dettling & Simon Reifenberg

S318

- 5.4.1 Of whirls and waves: Exploring the impacts of small-scale motions in the ocean — *by Stephan Juricke*
- 5.4.2 Scattering and Refraction of Low-Mode Internal Tides by Interaction with Mesoscale Eddies — *by Zoi Kourkouraidou*
- 5.4.3 Quantifying Spectral Energy Transfers in the Eastern South Atlantic using Satellite Data — *by Emelie Breunig*

10:45 - 11:00 — **COOFFE BREAK** — *Main Hall*

11:00-12:30 — **PARALELL SESSION**

Session 1.7

11:00 - 12:00 **MARINE RESOURCES: ECONOMICAL INTEREST AND POLLUTANTS**

hosted by Marta Moriano Ortiz

S207

- 1.7.1 Traceability implications for heavy metal risks in commercial seafood — *by Marta Pilar Moriano Ortiz*
- 1.7.2 Integrated methodologies for the tracking of illegally traded glass eels — *by Hugo Campillo Gancedo*
- 1.7.3 Microplastics in marine macrophytes in the Asturian coast — *by Amaia Kareaga Bilbao*
- 1.7.4 Entrepreneurial ecosystem and innovative entrepreneurship: elements for a conceptual framework for red seaweed farming in Madagascar — *by Mihary Rabearison*

Session 1.6

12:00 - 12:15 **NORTHERN COASTAL COMMUNITIES: TRANSFORMING GOVERNANCE FOR A SUSTAINABLE FUTURE**

hosted by Maria Wilke

S207

- 1.6.1 Education for Sustainability Futures Research — *by Tanya MacDonald*

Session 1.8

12:15 - 12:30 **DOES TROPHIC-LEVEL MATTER? AQUACULTURE OF MARINE LOW-TROPHIC ORGANISMS**

hosted by Beatrice Brix da Costa & Lara Elisabeth Stuthmann

S207

- 1.8.1 Technical feasibility study for the cultivation of the red algae *Halymenia durvillei* in the South-West of Madagascar — *by Rakotonandrasana Santatriniaina Nambinintsoa*

Session 2.5

11:00 -12:15 **MOLECULAR TOOLS IN MARINE BIOLOGY: FROM METHODS TO APPLICATIONS**

hosted by Paulina Urban, Lara Jansen, Yassine Kasmi & Anna Joelle Greife

S201

- 2.5.1 Range expansions of scyphozoan jellyfish – the case study of *Periphylla periphylla* and *Cyanea capillata* — *by Niko Steiner*
- 2.5.2 Who's there? A comprehensive eDNA metabarcoding survey of gelatinous zooplankton biodiversity in the Fram Strait — *by Ayla Murray*
- 2.5.3 Utility of environmental DNA in biomonitoring of Tanzanian cryptobenthic fishes: Does the environmental DNA approach perform better than the traditional visual census method? — *by Cretus Mtonga*
- 2.5.4 Genetic studies in the coral *Parazoanthus axinellae* for taxonomic determination — *by Alfredo Rosales Ruiz*
- 2.5.5 eDNA: Reality or Myth? Qualitative and quantitative approach — *by Yassine Kasmi*

Session 5.4 (part 2)

11:00 -12:15 **OF WHIRLS AND WAVES: EXPLORING THE IMPACTS OF SMALL-SCALE MOTIONS IN THE OCEAN**

hosted by Nicolas Dettling & Simon Reifenberg

S318

- 5.4.4 The Influence of Topography on Mesoscale Ocean Mixing — *by Miriam Sterl*
- 5.4.5 Spiralling Inverse Method (SIM): A new inverse method to estimate ocean mixing — *by Niek Kusters*
- 5.4.6 Modulation of a Dissipation Parameterization with time: Mixing over the Reykjanes Ridge — *by Peter Farrell*
- 5.4.7 Mixing along the Weddell Sea Gravity Current — *by Ole Pinner*
- 5.4.8 The Impact of Submesoscale Dynamics on the Air Sea Exchange — *by Moritz Epke*

Program (15 & 16. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

12:30 – 13:30 LUNCH BREAK

13:30 - 18:00 WORKSHOPS

Acoustic Telemetry - Innovative Solutions for Tracking Aquatic Species
Andre Steckenreuter
Innovasea - Fish Tracking

A quick-start guide to environmental DNA: theory, practice and applications
Andrea Barco
biome-id Barco & Knebelsberger GbR

Connecting Early Career Ocean Professionals with Ocean Observing and Forecasting - EuroSea
Fiona-Elaine Strasser
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel - Project EuroSea

Becoming an Ocean Carer
Inna Zrajaeva
Umeå Institute of Design

We Want to Se(a) You as You are - Building an inclusive ICYMARE Community
Julia Jung
Cobra Collective, Egham, United Kingdom

Sustainability in Science
Linda Thielke
Institute of Environmental Physics, University of Bremen, Bremen, Germany

Friday, 16th September 2022

8:30-9:00 REGISTRATION & WELCOME COFFEE — *Main Hall*

9:00 - 9:15 OPENING — *Main Hall*

9:15-10:45 PARALELL SESSION

Session 3.5

09:45 - 10:00 **JUST KEEP SWIMMING: MARINE SPECIES REDISTRIBUTION IN A CHANGING CLIMATE**
hosted by Annabell Klinke & Svea Vollstedt
S207

3.5.1 Effects of climate change and anthropogenic disturbance on the interaction of two delphinid species: competition or co-existence?
by Katharina Leeb

3.5.2 Habitat suitability of the whale shark *Rhincodon typus* in the Eastern Tropical Pacific.
by Walter Pisco

3.5.3 Geographical distribution and characterization of some non-native species of the Algerian coast
by Kenza Ghozel

Session 4.5

09:45 - 10:00 **MARINE FORESTS: AN UNDERESTIMATED ECOSYSTEM?**
hosted by Florian Stahl & Lea Kappas
S201

4.5.1 The Helgoland kelp forest - First estimation of summer productivity
by Kiara Franke

4.5.2 Contributions of macrofauna to carbon cycling in *Fucus vesiculosus* habitats
by Eva Karin Rohlfer

4.5.3 Microscopic life stages of Arctic kelp differ in their resilience and reproductive output in response to Arctic seasonality
by Cláudio Figueira Silva

Session 6.1

09:45 - 10:00 **MARINE BIOTECHNOLOGY - AN OCEAN OF BIOAPPLICATIONS**
hosted by Cátia Gonçalves & Inês Moutinho Cabral
S318

6.1.1 Advances in the bioprospecting for novel bioreactives from marine invertebrates: Multi-omics and computational strategies
by Ana P. Rodrigo

6.1.2 Boosting nutrient turnover in Arctic marine oil-degrading biofilms
by Jennie Spicker Schmidt

6.1.3 Nitrogen and Phosphorus balance of an aquaponic vs hydroponic system with Tilapia and basil
by Benedikt Merk

Session 3.7

10:00 - 10:30 **NEW PLASTIC POLLUTION TYPES AND NOVEL SOURCES OF MICROPLASTIC POLLUTION IN MARINE SYSTEMS**
hosted by Mánus Cunningham & Sonja Ehlers
S207

3.7.1 Frequent field observations of novel plastic forms in estuarine habitats
by Julius A. Ellrich

3.7.2 Vertical distribution of microplastics including tire wear particles in the marine environment - A cross section through air, sea surface microlayer and underlying water in Swedish fjord systems
by Isabel Goßmann

Session 4.2

10:00 - 10:45 **CORAL REEFS: PAST, PRESENT, AND FUTURE**
hosted by Jessica Bellworthy & Ronen Liberman
S201

4.2.1 Stress-hardening of corals through thermal pre-conditioning
by Erik Francesco Ferrara

4.2.2 Bacterial community dynamics of two coral species in the Andaman Sea (Thailand): Towards linking thermal resistance with microbiome traits
by Marie Rutsch

4.2.3 High molecular weight exudates of hard corals and macroalgae may enhance virus abundance in reef water
by Bianca M. Thobor

10:45 - 11:00 COFFEE BREAK — *Main Hall*

Program (16. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

11:00-12:30 — **PARALELL SESSION**

Session 3.3

11:00 - 12:00 **LONG-TERM ECOLOGICAL OBSERVATIONS TO ASSESS ECOLOGICAL CHANGES IN THE MARINE ENVIRONMENT**

hosted by Anabel von Jackowski & Magda Cardozo-Mino

S207

3.3.1 Is the phenology of phytoplankton blooms in the Baltic Sea changing?
by Oscar Beltran

3.3.2 Reproduction and recruitment patterns of black corals in the Toliara Region, southwest Madagascar
by NY AINA MISANDRATRA Edena Salom

3.3.3 Fish Diversity in the Tidal Region of the River Ems, Northwest Germany
by Silvia Blum

3.3.4 Benthic megafauna in the Arctic Ocean – future dominion by sea cucumbers?
by Lillian Boehringer

3.3.5 Wiggling in the deep – Diversity of Arctic deep-sea nematodes at the long-term ecological research observatory HAUSGARTEN
by Jannik Schnier

3.3.6 Deciphering the Holocene history of Arctic marine mammals using sedimentary ancient DNA
by Lennart Schreiber

Session 4.6

11:00 - 11:45 **RECENT ADVANCES IN TROPICAL COASTAL ECOSYSTEMS RESEARCH**

hosted by Fedor Lishchenko & Andrew Balashov

S201

4.6.1 Population genetic structure and connectivity of a marine foundation species (*Halodule wrightii*) inferred from genetic and biophysical methods
by Ana I. Tavares

4.6.2 Scleractinian coral density and the structure of macrosymbiont community
by Roman Petrochenko

4.6.3 Software for coral health assessment
by Andrew Balashov

Session 4.4

11:45 - 12:30 **ECO-PHYSIOLOGICAL EFFECTS OF CLIMATE CHANGE IN MARINE ANIMALS – BIOLOGICAL STUDIES FROM THE WHOLE ANIMAL TO ITS GENETIC INFORMATION**

hosted by Nina Krebs

S201

4.4.1 Impact of rapid temperature rising on reproducing and non-reproducing polar cod (*Boreogadus saida*)
by Nicole Vogt

4.4.2 Goby fish populations in intertidal environments: gene networks and epigenetic regulators modulating energy metabolism in response to seasonal warming and local climate regimes
by Miguel Nunes

4.4.3 Physiological larval fish models as a powerful tool to understand current and future dynamics of Fish Recruitment
by Tahereh Nakisa

Session 6.2

11:00 - 12:00 **MARINE ENGENEERING**

hosted by Max Anders & Noah Becker

S318

6.2.1 Using a laser distance sensor for volumetric measurements in benthic chambers
by Anna Sieve

6.2.2 Prototyping of a Tethered Undersea Kite to Harvest Energy from Low Velocity Currents
by Leonard Günzel

6.2.3 Development of a SubSea battery manager for Li-ion batteries of the AUV PAUL 3000
by Noah Becker

6.2.4 Redesign of a portable Launch and Recovery System (LARS) for shallow lakes
by Jonas Holt

12:30 – 13:30 — **LUNCH BREAK**

Program (16. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

13:30-15:30 — **PARALELL SESSION**

Session 3.2

13:30 - 14:45

(SUB-)TROPICAL COASTAL ECOSYSTEMS IN A CHANGING ENVIRONMENT

hosted by Johanna Berlinghof & Selma Mezger

S207

3.2.1 Seagrass Ecosystems Under Times of Change
by Stephanie Helber

3.2.2 Nitrogen cycling by the *Posidonia oceanica* holobiont under ocean acidification
by Johanna Berlinghof

3.2.3 Tropical reef ecosystems and water quality: interlinkage between habitat and nutrient fluxes
by Francine M. van Hee

3.2.4 Deciphering the trophic strategy of the widespread, pulsating soft coral *Xenia umbellata*
by Nele Eichhorn

3.2.5 The soft coral *Xenia umbellata* is highly tolerant against key environmental change factors
by Selma Mezger

Session 3.1

14:45 - 15:30

CLIMATE CHANGE-BIODIVERSITY-ECOSYSTEM SERVICES NEXUS

hosted by Christian Simeoni & Fabiola Espinoza Cordova

S207

3.1.1 Bidirectional interaction between phytoplankton diversity and biomass in the ocean
by Livia Oliveira

3.1.2 Multi-scale modelling of biogeochemical fluxes along the Danube land-sea continuum
by Lauranne Alaerts

3.1.3 A Machine Learning risk-based cumulative impacts assessment on seagrasses in the Mediterranean Sea under a changing climate
by Christian Simeoni

Session 4.1 (part 1)

13:30 - 15:30

INTERACTIONS BETWEEN MARINE SPECIES

hosted by Jana Vetter

S201

4.1.1 A Sticky Situation: Copepod-Diatom Interaction in the Context of Oil Spills
by Emiliana Tupper Carabaño

4.1.2 Studying species interactions on a microscopic scale – how to map, track, and eavesdrop on super tiny stuff
by Marrit Jacob

4.1.3 Biodiversity-productivity effects in stony coral assemblages
by Jana Vetter

4.1.4 Contact-free modulation of coral productivity by sessile reef organisms
by Kara Elena Engelhardt

4.1.5 The diet spectrum of fish in South Greenland waters: the role of gelatinous zooplankton as prey
by Julia Katharina Throm

4.1.6 DNA metabarcoding uncovers prey diversity overlap among tunas and seabirds of Eastern Tropical Atlantic
by Ana Rita Carreiro

4.1.7 Friend or foe? – Larvae of the invasive Pacific oyster (*Magallana gigas*) trade-off predator and conspecific cues in their decision making for settlement
by Sarah Schmidlin

4.1.8 Expansion of the harmful dinoflagellate *Alexandrium pseudogonyaulax* in Northern European Waters
by Kristof Möller

Session 7.1 (part 1)

13:30 - 15:30

OPEN SESSION

hosted by Lea Kappas & Anna Joelle Greife

S318

7.1.1 Waves of Freedom
by Kyra Lenting

7.1.2 Relationships between metal pollution in female green (*Chelonia mydas*) and hawkbill (*Eretmochelys imbricata*) sea turtles of São Tomé Island and their egg composition
by Inês Morão

7.1.3 Plasticity of native and invasive crabs to a new generation pesticide: an integrative approach
by Lènia Rato

7.1.4 Protecting the sea living fossil: Frontier Social Conservation Action and Research of Horseshoe Crabs in Indonesia
by Rizky Eko Muliawan

7.1.5 Number of primordial follicles in juvenile ringed seals (*Pusa hispida*)
by Britta Schmidt

7.1.6 Effects of TNT from of dumped munitions on fish under the light of climate change
by Michael Gabel

7.1.7 Measuring the purity of meta-Cresol purple
by Rieke Schäfer

7.1.8 Hydrothermally modified DOM: An analytical perspective on DOM alteration under hydrothermal conditions using radiocarbon dating, FT-ICR-MS, and NMR
by Annika Morische

15:30 - 15:45 — **COFFEE BREAK** — ***Main Hall***

Program (16. September 2022)

ICYMARE
International Conference for YOUNG Marine Researchers

15:45 - 17:30 — **PARALELL SESSION**

Session 3.4

15:45 - 17:30 — **HOW FAR CAN THEY GO? PUSHING THE LIMITS**

hosted by Antonia Uthoff, Jasmin Stimpfle & Linda Rehder

S207

3.4.1	Light, iron and manganese availability: important drivers of Southern Ocean phytoplankton ecology and productivity	*by Jenna Balaguer*
3.4.2	The phytoplankton holobiont in a changing Arctic Ocean	*by Jakob Giesler*
3.4.3	Phytoplankton in the Elbe estuary	*by Nele Martens*
3.4.4	Beyond the optimum: The effect of increasing temperature and N:P supply ratios on the performance of a North Sea phytoplankton community	*by Anika Happe*
3.4.5	Blooms in the Baltic Sea: insights into limiting nutrients acclimation strategies of toxic diazotrophic cyanobacteria	*by Mariano Santoro*
3.4.6	Cyanobacteria in a changing environment	*by Cynthia Medwed*
3.4.7	Hydraulic investigation of the effects of artificial structures as restoration facilitator for seagrass	*by Lars Kamperdicks*

Session 4.1 (part 2)

15:45 - 16:00 — **INTERACTIONS BETWEEN MARINE SPECIES**

hosted by Jana Vetter

S201

4.1.9	The diversity of Mollusca from marine lakes in Raja Ampat, West Papua, Indonesia	*by Ludi Aji*

Session 7.1 (part 2)

15:45 - 17:30 — **OPEN SESSION**

hosted by Lea Kappas & Anna Joelle Greife

S318

7.1.9	Influence of hydrothermal heating on the biogeochemistry of dissolved organic matter in Guaymas Basin sediments	*by Jana Günther*
7.1.10	Mobilization of petroleum-derived dissolved black carbon in hydrothermal sediments of the Guaymas Basin (Gulf of California)	*by Melina Knoke*
7.1.11	Dissolved Organic Sulfur in the North Sea: Is Sulfurization a Mechanism for Recalcitrant Organic Carbon Formation?	*by Wiebke Freund*
7.1.12	Unravelling the effects of meio- and macrofauna bioturbation on methanotrophic activity	*by Markus Olsson*
7.1.13	Copepod-mediated effects on the biological carbon pump in the subtropical South Atlantic	*by Lívia Oliveira*
7.1.14	Parasitic fungi – Small but powerful vampires of phytoplankton	*by Anna Feuring*
7.1.15	Exploring the Role of Blue Economy in Sustainable Development: A Perspective from Pakistan	*by Shahzad Ali Gill*

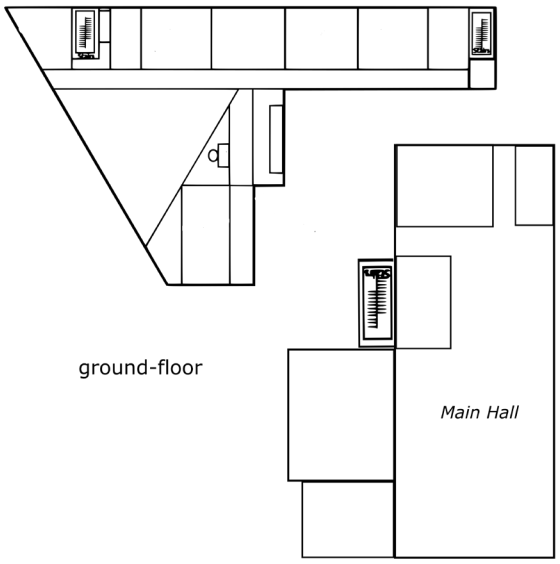
17:30 - 18:00 — **FAREWELL**
Awards for the best talk and poster — *Main Hall*

20:00 - open end — **POST CONFERENCE PARTY** — *Main Hall*

Program (Conference Rooms)

ICYMARE
International Conference for
YOUNG Marine Researchers

Haus S



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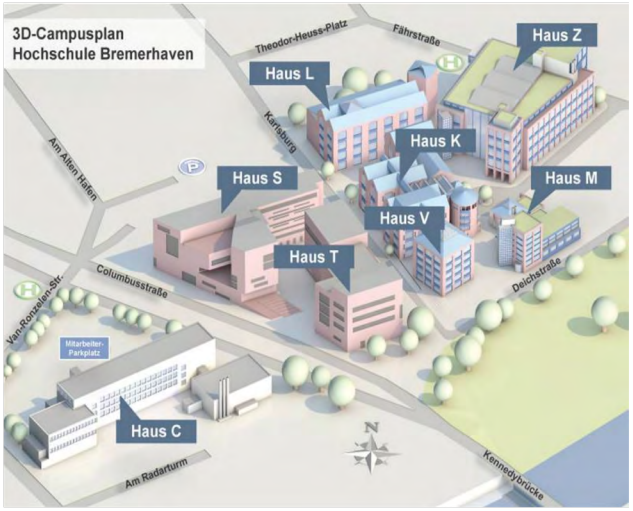

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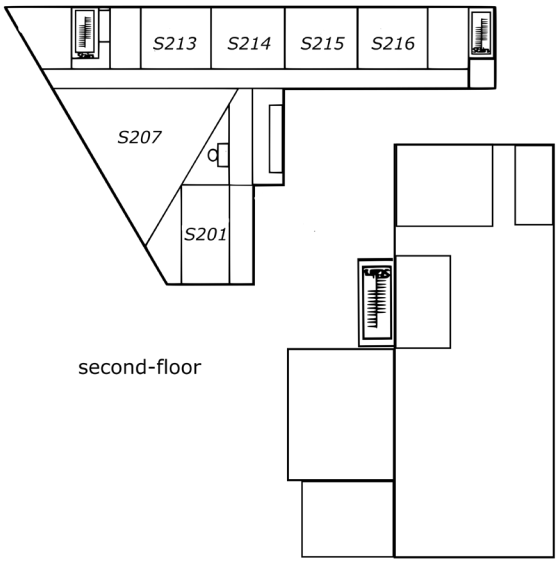

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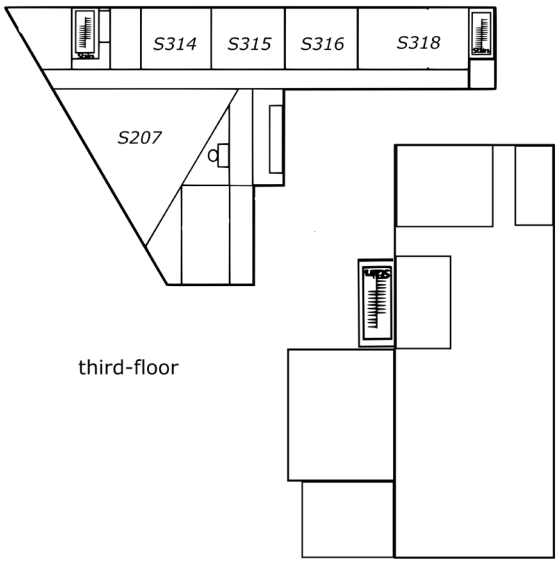

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Abstracts of all Workshops

Workshops

Acoustic Telemetry - Innovative Solutions for Tracking Aquatic Species

Andre Steckenreuter

Innovasea - Fish Tracking

Places available: No restrictions

Acoustic telemetry is a well-established tool that has been used around the world for more than three decades to get an understanding of the spatio-temporal movements and associated behaviour of a wide range of aquatic animals. This workshop will provide an overview about this innovative technology and how to use it in a wide array of applications. It is geared toward students and young researchers who are starting their careers in marine biology and who want to learn more about novel techniques to answer crucial research questions. Participants will also have the opportunity for live demos of some of the newest advancements in acoustic telemetry equipment. A few technological highlights that will be covered are: (1) The possibility of real-time observations of aquatic animals and environmental variables utilizing Innovasea's Fathom Live system and aquaMeasure sensors; (2) How to obtain fine-scale positioning data compared to presence/absence data; (3) What are the latest developments in transmitter/sensor options, e.g. predation sensors; (4) Cloud-based solutions and mobile apps for data management; and (5) How to visualize animal detections, diagnostic information, and environmental variables.

Workshops

A quick-start guide to environmental DNA: theory, practice and applications

Andrea Barco

biome-id Barco & Knebelsberger GbR

Places available: 25

The DNA released by all organisms in their surroundings is referred to as "environmental DNA" (eDNA). These DNA traces can be extracted from environmental samples (water, sediment, air) and used to identify the species they originated from. The use of eDNA as a source of biodiversity data offers the possibility to generate detailed biodiversity inventories with a precise taxonomic resolution for many groups of organisms. Thanks to the rapid development of new technological solutions, all eDNA-based methods are making very swift progress and are opening up new opportunities for biodiversity research. Those approaching eDNA-based methods without the right background might feel overwhelmed by the amount of available information, and one of the major hurdles is to sift through it and find the best solution to a particular question. This workshop aims to provide a quick-start guide for those wanting to adopt eDNA-based methods, and to present an overview of established knowledge, available protocols and applications. During the workshop, participants will be offered first-hand, real-life examples - particularly from marine environmental studies – to use as a reference for planning and developing eDNA-based research.

Workshops

Connecting Early Career Ocean Professionals with Ocean Observing and Forecasting - EuroSea

Fiona-Elaine Strasser

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel - Project EuroSea

Places available: 20-25

EuroSea is a European Union Innovation Action titled 'Improving and Integrating European Ocean Observing and Forecasting Systems for Sustainable Use of the Oceans' and is funded through the European Commission research funding programme Horizon 2020 under a call supporting the G7 Future of Seas and Oceans Flagship Initiative. It brings together key European actors of ocean observing and forecasting with users of oceanographic products and services focussing on coastal resilience and operational services, ocean health, and climate. In this workshop, we will engage young ocean professionals with the overall theme of ocean observing, monitoring and forecasting, and provide information about the project. We will give you an insight into the work we do, why it is so important and relevant for our changing oceans, and present potential job profiles in this field to inspire and encourage you to pursue a career in ocean observation. If you are curious to learn more about ocean observing and forecasting systems, and why it is essential for human wellbeing and safety, sustainable development and blue economy in a changing world - then join us!

Workshops

Becoming an Ocean Carer

Inna Zrajaeva

Umeå Institute of Design

Places available: 12

Becoming an Ocean Carer is a workshop developed to invite the participants to consider ocean data from the perspective of non-human ocean actors. In the workshop, the participants are introduced to some approaches for thinking in more than human ways in an applied and accessible manner. At the beginning of the workshop, each participant is assigned a marine species living in the area of Bremerhaven. They will get a small booklet with information which will contain descriptions of their species. For example, how can blue mussels be seen as political? How can bladderwrack be seen as caring? What kind of interactions did those species create with human-made structures and influences? As a next step, participants will be divided into small ecosystem groups of three. In these groups, they will be given a map of Bremerhaven and then from their species perspective develop a strategy for what data they would like to collect from their species perspective. If the location and weather allow, the participants then would go on a short walk close to the water, reflecting on what they learned. Finally, the teams will return to the workshop room and be given different crafty materials, like coloured paper, lego bricks, pens and scissors. In their team, they will be asked to create a presentation of the ocean data strategy they developed. This workshop has been developed to bring an affectionate component to ocean data. For there is a need for it to carry stories and relationships of care. Moreover, this workshop hopes to introduce participants to think outside of the human and nonhuman divide and intends to offer an approach to thinking of human culture and marine species as an interconnected assembly of actors.

Workshops

We Want to Se(a) You as You are - Building an inclusive ICYMARE Community

Julia Jung

Cobra Collective, Egham, United Kingdom

Places available: 17

With the ICYMARE community, we want to create supportive spaces for each of us to fully be who we are as people in all our different elements. In this workshop, we want to celebrate and highlight the plurality of experiences within the ICYMARE family and think about how to support the different needs we have from an intersectional perspective. The workshop will consist of a storytelling circle and a following discussion about how to make ICYMARE more intersectional. During the storytelling circle, each of us will be invited to share a spontaneous 2-minute story about an experience you want to share with us. We want to create an open space to discuss all the things often pushed to the side that are so fundamental to who we are, how we want to be treated and what we need from others. These might include experiences related to queerness, gender, race, religion, different disciplinary perspectives or interests, family and anything else that feels like a part of yourself you would like to share or be more seen for. From our stories, we will then have an open discussion about possible strategies, events or other things we as the ICYMARE community can do to make you feel more supported and comfortable and to just imagine a flourishing intersectional future together. You don't have to share a personal perspective to attend the session and there is no need to prepare what you want to talk about beforehand. We invite anyone who is interested in these topics as a listener and wants to see what emerges in the space together during our conversation.

Workshops

Sustainability in Science

Linda Thielke

Institute of Environmental Physics, University of Bremen, Bremen, Germany

Places available: 30

Sustainability becomes more important in a changing climate and with more possibilities to travel and do fieldwork. In this workshop, we will discuss different aspects of sustainability in science: (i) in the office, (ii) in the field, and (iii) work-related travel. We will define the current problems and discuss possible solutions. With solutions by hand, it is important to communicate this knowledge. We will do a brainstorming about possible ways to implement measures and action in research - at the workplace or around fieldwork. The goal of the workshop is to compile a list of action items so everyone can use this information for potential further activities.

frontiers | Frontiers in Marine Science

Exploring ocean-based solutions for emerging global challenges

@FrontMarineSci

Oral and Poster Presentations

1) Management and Conservation

1) “Science as the best shield for our Oceans.”: Early Career Ocean Professionals and Marine Conservation

Jorge Moreno

Whale Shark Mexico

Fiona-Elaine Strasser

GEOMAR Helmholtz Centre for Ocean Research Kiel

The oceans are a vast resource, providing food, raw materials (extractive activities), as well as supporting tourism activities all over the world (non-extractive). As such, it is fundamental to protect and conserve this system and its inhabitants. Adequate management and enforcement are necessary for conservation, but they can only be accomplished through science. Therefore, it is our best tool for marine conservation. If your research is contributing to the conservation of the marine environment, we invite you to submit an abstract for this section and share your experience with the rest of early career ocean professionals and conservationists!

Habitat suitability of the whale shark *Rhincodon typus* in the Eastern Tropical Pacific

Walter Pisco[1]; César Peñaherrera[2] ;Alex Hearn[2] ; Héctor Gúzman[2]

[1]*Instituto Politécnico Nacional (CICIMAR)* [2]*MIGRMAR*

Keywords: Niche, Distribution, Telemetry, Movement, Entropy

The whale shark, *Rhincodon typus* is an elasmobranch species categorized as endangered by the International Union for Conservation of Nature (IUCN). This species is found in tropical and warm-temperate regions with high productivity. They have great spatial mobility and can travel long distances in search of food. In the Eastern Tropical Pacific (ETP) (22°N-10°S, 80°W-150°W), whale sharks are distributed from the Gulf of California in Mexico, to the coast of Peru, where its presence has been associated with primary productivity systems and oceanic fronts present in the region. As such, this study focused on modeling the ecological niche of *R. typus* in the ETP area. For this purpose, the occurrence of 115 individuals tagged between 2011 and 2019 in the Galapagos Marine Reserve were obtained. The estimation of the probability of occurrence of the species in the study area was carried out through maximum entropy modeling (Maxent), superimposing satellite information with environmental data such as Chlorophyll-a (CHL), sea surface temperature (SST), currents and bathymetry. The models were constructed according to the seasonality of the species in the study area. The monthly and seasonal models showed an optimal fit (AUC > 0.90). The CHL- a variable was the largest contributor to the model, followed by currents and finally bathymetry. The results show how the habitat suitability of the species is associated with cold waters. In the cold months in the ETP, individuals preferred habitats in oceanic waters, while in the warm months the habitat of the individuals was found with greater affinity to the coast, in upwelling areas. As a conclusion, this study is the first to suggest the suitability habitat of *R. typus* in the ETP area. This information supports evidence to enforce measures to further protect the species in the ETP.

Study on By-catch, Reproduction and Postmortem Examinations of Marine Snakes of Sri Lanka

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Keywords: Marine snakes, *Hydrophis schistosus*, parasites, infections, Sri Lanka

Marine snakes are resulted as by-catch as they regularly inhabit fishing grounds and records suggests high mortalities around the world. Recordings of marine snake observations in Sri Lanka are mainly from fish landing sites, but data on mortality cases are scant. This study targets to address the mortality and subsequent postmortems examinations of marine snakes associated with fishing activities in Sri Lanka. During the study period from August 2021 to April 2022, 35 specimens of marine snakes belonging to six species namely, *Acrochordus granulatus, Cereberus rynchops, Hydrophis schistosus, Hydrophis curtus, Hydrophis ornatus* and *Hydrophis spiralis* were resulted as by-catch in hook and line, beach seine, trawling and gill net fishing methods in several fish landing locations around the Island. The resulted marine snake by-catch mortality was 74% with 100% mortality in hook and line method. 87% of mortality cases were before the first 24 hours and postmortem examinations revealed damages to internal organs with internal and external bleeding. Specimens of *Hydrophis schistosus*, *Hydrophis ornatus* and *Cereberus rynchops* were in active reproductive status and several species of internal and external parasites were found recording new observations for the first time in Sri Lanka. Lack of knowledge, awareness and baseline data on these species were identified as main problems. Addressing conflict between fishers and marine snakes with both scientific and practical solutions is crucial for the survival of these marine reptiles.

Life-history of Icelandic minke whales *Balaenoptera acutorostrata* using scar-based analysis

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Keywords: Entanglement, Minke whale (*Balaenoptera acutorostrata*), Scar analysis, Photo- ID, Parasite load

Entanglement in fishing gear is regarded as one of the most prevalent threats to baleen whales, with lethal and non-lethal fitness implications. Surveys conducted in the central North Atlantic showed a significant decrease in the population of common minke whales, *Balaenoptera acutorostrata*. This study uses a scar-based analysis to report frequency of non-lethal entanglement and external parasite load in minke whales across Icelandic coastal waters. As such, photographic data collected during 41 sightings between 2014 and 2021 led to the identification of 13 individuals, 11 of which were included in the scar analysis following desired photographic quality requirements. Furthermore, the presence of marks in the head, dorsal and flank regions was inspected for evidence of entanglement and parasite scars. Results showed that between 9% and 55% of all assessed whales exhibited signs of entanglement scarring when first sighted. Parasitical scars were found in 4 of the 11 individuals, all of which also share entanglement scars. Compared to entanglement studies in other cetacean species, minke whales in Iceland reveal a lower prevalence. However, this underestimation could be caused by difficulties in identification and a higher incidence of underreported mortality. Entanglement frequency is expected to increase when the Reykjavík dataset is included due to higher fishing effort. Evaluating changes over time in the population is critical for implementing proper management measures.

Influence of oceanographic and atmospheric parameters on the abundance on whale sharks in La Paz Bay

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Keywords: Whale shark, *Rhincodon typus*, Abundance, Gulf of California, Oceanography, El Niño Southern Oscillation

Whale sharks (*Rhincodon typus*) are a highly migratory filter feeding species. Previous studies have shown that the coast of La Paz Bay is an aggregation site for juveniles of this endangered shark (IUCN), which are more abundant during winter season. These seasonal aggregations yield a great importance on the local tourist industry. However, the drivers behind this aggregation are poorly understood. As such, this study aims to investigate the seasonal pattern of abundance and explore its relationship with oceanographic parameters. The whale shark abundance was monitored over a 20-year period following mark-recapture and using photo-identification methodology. Generalized linear models were tested to assess the effect of Sea Surface Temperature (SST), wind speed and direction, Chlorophyll a concentration, lunar phase, ONI (Ocean Niño Index) and Southern Oscillation Index (SOI). Results showed a total of 591 identified individuals, including almost 200 re-sightings between years. Fluctuations of identified individuals varied between 8 and 121 whale sharks per season over the years. The sex ratio was 66% males, 24% females and 10% unknown. Preliminary results show a significant correlation between low SST values and positive values of SOI with the whale shark abundance ($p<0.05$), with higher abundance during December and January. Overall years with a high positive SOI value also showed higher abundance. Hence, the in-depth analysis of this study will provide a better insight into the physical oceanographic conditions which drive the seasonal aggregation of whale sharks at La Paz Bay.

MESO_Alborán: and innovative project to explore and protect mesophotic communities of Alboran Sea

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Keywords: Mesophotic, Exploration, ROV, Alboran, Conservation

The Alboran Sea is the westernmost regional sea of the Mediterranean. This point of flux between continents (Africa and Europe) and water masses (the Atlantic Ocean and the Mediterranean Sea) is characterized by highly dynamic and variable water masses. Therefore it is one of the most productive areas in the Mediterranean Sea. In the Alboran sea, mesophotic habitats can be distributed between 30m and 120-150m. as such, their limits are highly affected by hydrodynamic effects such as tidal motion or upwelling phenomena. However, this apparently favorable framework is juxtaposed with the fact that only 2.1% of the publications about the twilight zone in the Mediterranean are focused on the Alboran Sea. This could be explained by the fact that research about this topic has been restricted by recreational diving limits (30-40m) and roof limits of most ROVs (100-150m). The MESO_Alboran project explored mesophotic zones in both north and south, coastlines of the Alboran Sea, focused on the presence of bio constructive communities that can act as a refuge for endangered and fisheries targeted species. Using technical diving methods and the ROV, we have been working on 8 micro-escarpment zones, previously selected due to their geomorphological nature (rocky bottoms, submarine mountains, cliffs and canyons, slopes, etc.) and their possible influence over hydrodynamics conditions, their proximity to Natura 2000 MPAs or active fisheries and bathymetric ranges in the mesophotic zone. We analysed the oceanographic nature of the areas using remote sensing data and in-situ data loggers, analyzing the species founded by morphological and molecular techniques. Our results highlight new mesophotic habitats and communities, taxons, distribution ranges for endangered species, oceanographic milestones to understand diversity, and report important hazards for the environments derived from anthropic activities. These will be included in a proposal to redesign existing MPAs or create new ones.

Knowledge Co-Production in the Marine Sciences - Meeting the Needs of ECRs

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Keywords: Transdisciplinary research , Actionable science, Stakeholder engagement, Career development, Science-policy interface

Knowledge co-production involving researchers and non-academic actors is becoming important for tackling sustainability issues. Coastal and marine social-ecological systems are one example where knowledge co-production is important, yet also particularly challenging due to their unique characteristics. Early-Career Researchers (ECRs) often face specific obstacles when engaging in the process of knowledge co- production. In this presentation, we study the particular characteristics of knowledge co-production in marine social-ecological systems and the obstacles ECRs in marine sciences face. Based on these obstacles, we discuss actions that can be taken at different organizational levels (institutional, community, supervisor, and individual) to leverage change towards a more inclusive environment for ECRs engaging in knowledge co-production. We conclude that both bottom-up (individual to institutions) and top-down (institutions to individual) actions are required. However, we emphasize the responsibilities of institutions to create conditions in which the needs of ECRs are met. This will be necessary to adequately support ECRs engaging in knowledge co-production and thus contribute to tackling sustainability challenges in coastal and marine social- ecological systems.

1.1.7

Silence of Global Oceans: Using Open Data to Measure Acoustic Impact of the COVID-19 Lockdown

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Keywords: Underwater Noise, Hydrophone, COViD-19 Lockdown, Anthropogenic, Marine Shipping

Low-frequency noise from marine shipping is an underwater acoustic pollutant in oceans. The noise spectrum overlaps with frequencies marine mammals use to communicate and navigate, leading to stress and increasing collision with ships. As such, this research established a model to measure the contribution of anthropogenic activities to underwater noise levels. The COVID-19 lockdown led to a global decline in commercial and cruise shipping. The model quantified the reduction in noise levels before and during the lockdown in the Arctic, Atlantic, Pacific Oceans, and the Mediterranean Sea. Underwater ocean sound peaks between 10 – 100 Hz and is dominated by noise from shipping traffic. Hydrophones (underwater microphones) data from seven ocean observatories were analyzed at 1 Hz spectral and 1-minute temporal resolution. Power spectral densities were calculated, aggregated into monthly long-term spectral averages, and noise levels in the 63 Hz third- octave band compared to previous years. The analysis revealed that global oceans quietened by an average of 4.5 dB, or the peak sound intensity decreased 2.8 times during the lockdown period. The maximum decrease was at locations close to major shipping channels and cruise tourism destinations. The findings were validated by comparing shipping traffic using the satellite-based Automated Identification System. This study proved that strategic "anthropauses" can reduce underwater noise levels and give marine mammals a chance to reverse the decline in their population. A web application MonitorMyOcean.com was created to provide updated anthropogenic noise levels in global oceans. Policymakers can determine if measures such as shifting shipping channels or moratorium on new shipping routes are leading to "Quieter Oceans."

OutBe: the citizen science start-up connecting outdoor sports and marine conservation

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Keywords: Citizen science, Participatory approach, Marine ecology, Biodiversity conservation, Start up

The sea is vast, deep, and little known. It covers about 71% of the surface of our Planet, being down to 10.9 km deep in some places. However, only less than 10% has been explored. Due to its extension and the scientific limited knowledge, it is difficult to achieve an effective protection of the ocean. The less we know about marine ecosystems and the physical characteristics influencing them, the less we will be able to cope with imminent problems including climate change, overfishing and pollution. Therefore, citizen science (i.e. participatory science), stands as a cost-effective means for collecting extensive data sets across vast spatio-temporal scales, which is needed for effective marine conservation. In particular, the water sports community represents a potential fleet of outdoor enthusiasts, ready to be the many eyes and hands scientists need to understand and protect the Ocean. With adequate training and the right tools, swimming training, paddling, sailing, or recreational diving can become real scientific sampling and monitoring tools. Aiming to connect those who love and explore the sea every day, with those who study and protect it, OutBe was born. OutBe is an innovative start-up with a social vocation which, starting from the sea, aims to connect outdoor sport communities to marine research projects. Through an online ecosystem and modern communication, OutBe is creating a new model of interaction between people and nature where sport is at the service of environmental conservation, and businesses can support and participate in meaningful and fun marine conservation actions. This presentation will showcast OutBe's case study, gathering the current connections and future potential between outdoor sports and marine citizen science projects, and analysing the proposed start-up model reframing citizen science in modern times of uncertainty, climate change and financial difficulties.

A methodological approach to assess the sensitivity of coastal areas in pollution episodes

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Keywords: Coastal management, GIS, Multi-criteria analysis method, Marine pollution, Sensitivity analysis

The coastal zone represents one of the most dynamic and sensitive ecosystems of the natural environment, offering a variety of resources. However, human overexploitation has severely impacted this unique ecosystem, making necessary the establishment of a strategic coordination framework for decision-making focusing on the sustainable use of the coastal areas. The latter could be achieved through the impact assessment of human activities on the quality of the coastal environment. Therefore, the aim of this study is to propose a methodological approach to assess the sensitivity of the coastal areas of Cyprus in terms of their vulnerability to potential pollution incidents. Data collection and spatial data processing using Geographic Information Systems (GIS), the distinction of the Cypriot coastline in zones, the application of the Regime multi-criteria analysis method, setting evaluation criteria based on the characteristics of the Cypriot coastline and sensitivity analysis were integrated in the proposed methodology. Two scenarios were considered; the first, focused on the environmental impact of potential pollution incidents, while the second one on the relevant economic impact. The results, revealed the most vulnerable zones in pollution incidents, indicating therefore their priority in the adoption of protection measures. The proposed methodological process is widely applicable and could be used as a tool to support decision-making focusing on the prevention of coastal degradation.

1) Management and Conservation

2) From science to policy: various conservation concepts and contexts

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Effective conservation and management of biodiversity depends on defining, measuring, and representing the different levels of biodiversity (e.g., species, genes, and ecosystems) in time and space when formulating policies. Therefore, all research processes (investigations, data collection, dissemination of results) are critical. This session is for researchers who have studied a particular area or ecosystem and are interested in disseminating their results or finding out how their data can be used to promote management policy. It may also be of use to individuals who wish to replicate conservation actions that have been conducted in other countries/contexts.

From Ice to Water - The Role of Science for a More Dynamic Approach to Ocean Management in the Polar Regions

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Keywords: Climate Change, Ice-Shelf Retreat, Special Areas for Scientific Study (SASS), Dynamic Ocean Management, Marine Scientific Research

In the Polar Regions, where climate change impacts are amplified, new marine areas are exposed through the decreasing extent of Arctic sea ice and the retreat or collapse of Antarctic ice shelves. As these changes expose pristine and largely unexplored marine ecosystems, fast and dynamic responses enabling adequate and effective conservation of those areas and their ecosystems are required. Therefore, Marine scientific research is critical in collecting, conducting, and providing scientific information on these areas, which will shape their future management and uses. Conservation measure (CM) 24-04, adopted by the Commission on the Convention of Antarctic Marine Living Resources (CCAMLR) in 2016, enables the Parties to the Convention to establish Special Areas for Scientific Studies (SASS) in newly exposed marine areas following an ice shelf retreat or collapse in specific areas around the Antarctic Peninsula. Through this measure, the area is closed for ten years, during which scientific research shall be conducted to understand the ecosystem processes concerning climate change better. While dynamic approaches to effective conservation of marine biodiversity and especially their establishment through clear legal frameworks are still largely a theoretical concept and lacking, it is explored to what extent a measure, such as CM 24-04, can provide a way forward toward more dynamic and holistic ocean management within and beyond these areas. By doing so, deficiencies of current ocean management regarding climate change impacts and ecosystem dynamics but also opportunities to enhance ocean management guided and initiated by science, shall be highlighted. Accordingly, current international efforts, such as the ongoing negotiations on a new international legally binding instrument (ILBI) on the conservation and sustainable use of marine biodiversity beyond national jurisdiction (BBNJ), will be considered.

Turning the tide on protection illusions: The underprotected MPAs of the 'OSPAR Regional Sea Convention'

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Keywords: OSPAR Marine Protected Area network, North-East Atlantic, Regulation-based classification system, Protection levels, Conservation

Contracting Parties of the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') have agreed to establish an effective network of marine protected areas (MPAs). Although the network currently covers about 7% of the Northeast Atlantic, the extent to which existing MPAs provide adequate protection remains unknown. The regulation-based classification system allows classifying MPAs according to their permitted uses and activities while considering the number and intensity of fishing gear, bottom extraction such as oil and gas, or renewable energy production. Using this regulation-based classification system, we assessed the levels of protection of 946 zones belonging to 476 strictly marine OSPAR MPAs. We show that only 0.03% of the OSPAR MPA network is covered with full or high protection levels, which are the protection levels exhibiting significant conservation benefits. According to this study, more than 60% of MPAs are unprotected, leading to uncertainties about their potential to deliver positive conservation outcomes. MPA coverage alone should not be used as an indicator for MPA performance, but when presented with the actual protection levels, a light can be shed on MPA quality. To be able to reach the 2030 ocean targets agreed under the European Biodiversity Strategy, to which most OSPAR Contracting Parties are committed, substantial efforts are required not only to strategically enlarge the MPA network coverage to 30% but mostly to reach the EU sub-target of 10% of strict protection. Enhancing effective protection by increasing the coverage of fully and highly protected areas to safeguard marine ecosystems is urgently needed to sustainably support human well-being.

The benthic community of the pilot oyster reef at Borkum Reef Ground (North Sea)

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Keywords: Biodiversity, Reef Communities, *Ostrea edulis*, Biologic Trait Analysis, Ecosystem functioning

Centuries of overfishing and destruction of the natural stocks of the European flat oyster (*Ostrea edulis*) led to the functional extinction of the species by the 20th century. European countries have since launched initiatives to restore the diverse and ecologically important *O. edulis* reefs. One of these initiatives is the RESTORE project, which aims to establish a pilot reef in the Borkum Reef nature reserve, to serve as a starting point for the restoration. In 2020, the foundation stones for a pilot oyster reef were laid and the scientific monitoring of the reef began as an essential component of the project. Besides the goal of reintroducing the oyster, RESTORE aims to increase the overall biodiversity in the pilot reef. This master thesis examines the new biocoenosis that is developing in the reef, the species that make up the pilot reef, and the biological and functional composition of this community, and thus the services that the reef provides to the ecosystem. It builds on previous data obtained by scientific divers on behalf of the RESTORE team. The divers used imaging techniques such as seafloor transects and underwater visual counts to assess the successional stage of the pilot oyster reef. The first imaging data were collected during the "Arctic Ocean" cruise in September 2021, with two additional cruises planned for June/ July 2022. Ecological and functional data from 2021 confirmed an increase in species diversity on the established pilot reefs, one year after pilot reef establishment. Small sessile actinaries were identified as the predominant group on the reef, but larger and motile species such as Asterias rubens and Cancer pagurus were also frequently documented. In this thesis, I will further use the image data to assess the condition of the pilot oyster reefs in comparison to data from historical *O. edulis* reefs in the German Bight.

Spearfishing: tools for sustainable management

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Keywords: Spearfishing, Environment, Sustainability, Ocean activity, Fishing

The impact of recreational fishing, especially spearfishing, on the ecosystem is a subject of debate. To date, there have been few studies on spearfishing in different regions. To fill this gap, we conducted an online survey to identify and characterize the individuals who practice this activity/sport in Portugal and to analyze their habits related to this activity. We tried to evaluate the target species and to identify the most frequently caught species. We also asked respondents what happens to the fish they catch, whether they are for personal consumption, to give away or to sell. The survey targeted practitioners and social media associations or groups and received 101 responses. In summary, all participating spearfishermen were male and started this activity at the average age of 20. They enjoy what they do and catch only the species they want to eat. The average catch per person per dive is 5 kg. The main target species are cuttlefish and sea bass, and most of the catches have been cuttlefish and bream (*Diplodus* spp.). In terms of current recreational fishing regulations, respondents agreed with a closed season, the minimum length and weight of species, and the number of fish they are allowed to catch. They also agreed that some measures must be taken for people applying for a license, such as a course on species identification and their biology to be able to identify the animals correctly and another course on free diving techniques. In conclusion, spearfishing in itself does not seem to harm the environment or threaten endangered species and can be considered a sustainable activity or sport, in Portugal.

From the ocean to the plate: A value chain analysis to address conservation knowledge gaps in artisanal mobulid fisheries in Sri Lanka

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Keywords: Indian ocean, Small scale fisheries, Mobula, Manta

In developing countries such as Sri Lanka, the expansion of fishing activities increases the pressure on marine species. Mobulids (manta and devil rays) have some of the most conservative life-history strategies of any elasmobranch. Their slow growth, late maturity, and low reproductivity make them extremely vulnerable to fishing and result in population declines. While actions to protect Mobulids through international and regional agreements were adopted (such as CITES, CMS, and IOTC), progress at the national level has been slow and Mobulid fisheries remain unmanaged. Including stakeholder livelihoods in conservation measures is key to avoid regulation failure. Therefore, this study applied neoclassical economic perspective using value chain analysis to address the knowledge gap in the supply chain of Mobulid products (gill plates and meat) in Sri Lanka. To analyse the value chain, semi-open interviews from different key actors such as fishers and traders were conducted to provide information on the characteristics and linkage between actors, profit/cost structures, and transformation of the product to provide managers valuable socio-economic knowledge for better management. Results show that although Mobulids are not a target species, their products are consumed in Sri Lanka (meat) and exported (gills plates) leading to a complex supply chain. Moreover, this study provides evidence of the intricate networks in low-income communities, reinforcing the fact that social factors must be analysed to understand the full context of mobulid fisheries.

How Biologically informed are Indian coastal fisheries policies

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Keywords: Indian Fisheries, Fisheries policy, Science-Policy Interaction, Overfishing,

In the last seventy years, marine fisheries in India have seen a rapid transformation from a largely sustenance livelihood to a large-scale industry. This transformation has been facilitated by policy level directives targeted at increasing fish catch. The nature and extent of capture fisheries have been influenced by several policy instruments initiated and managed by local and central governments. Over the last twenty years, Indian coastal fisheries are facing the ecological and economic impacts of overfishing. To understand and address overfishing in a fishery which is heavily influenced by policy directives, analysing how much fishery policy is guided by fish biology and ecology becomes critical. We conducted a detailed textual analysis of official fishing policy documents of last 75 years. We compared policy directives against the information from contemporary fisheries science to unpack how meaningfully the policy has engaged with the fish biology. Our exploration has shown that, Indian marine fisheries policy engages with fish biology mainly in the context of identifying production possibilities. Use of biology and ecology in fisheries regulations is ad-hoc, reactive and it seldom has any biological basis. Indian fisheries have become a classic case of Hutchings "selective use of science" phenomenon. More worryingly, Indian fisheries policy finds it difficult to re-examine the narrative of ever- increasing production. As a response to overcapacity policy promotes spatial fixes like fishing in international waters and aquaculture while continuing to incentivise coastal fisheries. The current governance apparatus is ineffective in compelling fisheries policy to adopt contemporary biological knowledge. We conclude that in order to address overfishing Indian fisheries policy need to recognise the biological nature of fish, marine communities and ecosystems and let fisheries management be determined by biological rather than political expediency. The policy also needs to find institutional means by which science can feed into adaptive management.

Catalysing Blue Growth: A roadmap for balancing economic and environmental forces in coastal regions

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Keywords: Blue growth, Blue economy, Sustainable Development, Coastal Development, Economic Development

Effects of climate change and unsustainable marine practices have left a trail of destruction in the marine environment. Current management approaches to sustainable development in the marine space appear to be ill-fitted as marine degradation is ongoing. In 2007, the EU implemented the blue growth policy initiative to balance environmental and economic forces and sustainably develop coastal regions. However, little guidance has been provided for decision makers, to reach their full blue growth potential. This research considers blue growth as the sustainable development of marine resources, generating livelihoods, and securing wellbeing from innovation in emerging marine sectors. With this definition in mind, this study utilised a qualitative case study approach conducting semi-structured interviews in two emerging marine sector cases: 1. aquaculture in Norway and 2. offshore wind development in Scotland. This study investigates the dialectic tensions to achieve sustainable development in emerging marine sectors. Consequently, three dialectic tensions have been identified at the core of managing blue growth, i.e., 1. Government interventions and laissez-affaire approach to manage marine resources, 2. Hard sustainability and soft sustainability approaches to marine management, and 3. State-of the-art and legacy technologies which influence management approaches to regional marine resources. To balance these dialectic tensions, decision-makers implement collaborative synergies between regional stakeholders, including government, academia, and industry to nurture blue growth. Understanding the dialectic tensions will enable decision-makers to take appropriate actions to unlock blue growth development in a short-term (1-5 years), mid-term (5-10 years), and long-term (10-20 years) perspective. The roadmap starts with focusing on a baseline understanding of marine ecosystem services, followed by the identification of regional antecedent factors of blue growth. Then establishing dialectic processes between the stakeholders before moving on to regional level considerations including monitoring of environmental conditions, assessing and monitoring marine governance mechanisms, and assessing and realising commercial opportunities. The findings of this study suggest that on a local level, blue growth can be fostered by nurturing skills and entrepreneurship and by implementing business development strategies to help scale the industry.

1.2.P1

The relationship between seasonal distribution of *Katsuwonus pelamis* (Skipjack tuna) and environmental variables in the western Indian Ocean

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Keywords: Ecosystem approach to fisheries management, GAM model, Distribution pattern, Skipjack tuna, Western Indian Ocean

The first step in implementing the ecosystem approach to fisheries management is to have sufficient knowledge of the ecosystem, particularly the habitat suitability of target species and their distribution in relation to environmental variables. Distribution patterns of *Katsuwonus pelamis* (skipjack tuna, SKJ) were modeled using satellite imagery and environmental data. Redundancy analyses and generalized additive models (GAMs) were applied to provide a preliminary overview of the relationships between SKJ occurrence and environmental variables such as sea surface height (SSH), Chlorophyll a (Chl a), sea surface current velocity, sea surface salinity (SSS), and sea surface temperature (SST). Data were collected at monthly intervals between 2015 and 2019 from Iranian tuna purse seine fisheries in the western Indian Ocean. In this study, annual and seasonal variations in SKJ catch per unit effort (CPUE) were investigated. The results show that the spatial factor (latitude) has a large influence on the presence of SKJ in the range of 5° N to 5° S and 20-25° N, with the probability of presence with increasing latitude. Among the independent factors (SST, Chl a, SSS, SSH, and current velocity), SSH was the most important influencing factor, and the deviation explained by GAM, increased significantly after SSH was added to the model. The results show that as the SSH value increased in the range of 0.7 to 1 m, the probability of the presence of SKJ increased. On the other hand, the probability of the presence of SKJ increased when the sea surface current velocity ranged from 90 to 601 cm/s, the SST in the range of 25.78 to 33.17 °C and the SSS in the range of 35.9 to 36.1 psu. These results indicate that Chl a has a limited effect on the probability of the presence of SKJ. Based on this study, the relationship between environmental fluctuations and the distribution of skipjack tuna was established. Such studies help to promote sustainable fisheries by avoiding the incidental capture of other tuna species, through identifying the suitable habitat for the target species, and thus also reducing the amount of money spent on tuna by purse seiners.

Post-harvest regeneration dynamics of stalked barnacle patches in the SW European coast

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Keywords: Goose barnacle, Recruitment, Exploitation, Patch dynamics, Rocky intertidal

Stalked barnacles (*Pollicipes pollicipes* (Gmelin, 1789)) represent an economically relevant marine resource along the south-western European coasts. They are scrapped from the intertidal rocks during low tides, leaving gaps which may recover after some time. Although the recovery rate of those gaps is key to understand the dynamics of barnacle populations and to manage the fishery, the process has never been investigated with sufficient detail. We have followed the recovery of gaps left by harvesters and other potential causes (n=198) or experimentally cleared (n=54) in Asturias (n=253). Only 11 out of 86 patches showed symptoms of recovery after 2 years of monitoring, and only 10 out of 45 after 3 years of monitoring. Just 2 out of the 253 patches recovered completely after 30 months of follow up. In general, recovery was associated to unscrapped barnacles which remained in contact with the gap, thus serving as regeneration nucleii. This is consistent with the behavior of their planktonic larvae, which tend to attach preferentially to the stalks of adult barnacles, and then grow while moving gradually towards the underlying rock to eventually become part of a barnacle patch. Our data reveal that the recolonization of scrapped surfaces is very slow. If exploitation does not leave individuals to initiate the recovery process, the regeneration timescale may far exceed that of exploitation. In these conditions, exploitation can be regarded as a mining activity of a non-renewable resource. Sustainability of the fishery may require appropriate management at the patch scale.

1) Management and Conservation

3)The Future of Marine Research: *A* Growing Need for Integrating Social and Natural Sciences in the Face of Climate Change

Emily Chen

Institute of Oceanography, Polish Academy of Sciences

There is a global need to address the social impacts of marine conservation, especially since the communities most vulnerable to climate change impacts are rarely given an equal voice. We welcome abstracts of studies conducted on the inclusion of any social science field in marine research, from traditional knowledge to socioecological consequences to linguistic barriers in policy decisions. Submissions should focus on interdisciplinarity and best practices to approach and standardize social science methods into marine research. We hope to receive submissions on a range of original topics and invite you to take part in this important conversation!

Biographical perspectives of small-scale Baltic fishers to understand social-ecological transformations

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Keywords: Fisheries, Qualitative research, Perceptions, Blue justice, Social-ecological systems

The social-ecological fisheries system of the German Western Baltic Sea is undergoing major transformations and is currently on the verge of collapsing. Complex interrelated social environmental challenges have led to a drastic decline in landings and diminishment of the fleet size. Most lately catch quotas have been lowered near to zero for the main target species cod and herring. The social-ecological system dynamics are to some extend influenced by subjective individuals, while these influences strongly depend on their subjective perception of their surroundings. Perceptions in this case include observations, understandings, interpretations, and evaluations. Understanding fishers' perception can be seen as an important first step to create a common understanding to be able to shift transformation towards sustainable livelihoods. To better understand the fishers' perceptions of the local social-ecological system under change, in depth biographical interviews are conducted with small-scale fishers in Mecklenburg-Western Pomerania. This specific form of open, narrative interviews allows to reconstruct individual professional career paths from the fishers' stories and to understand the meanings they are ascribing to their actions and social reality and how these are influenced by their course of socialization. The interviews are analyzed using a thematic qualitative text analysis. The fishers perceive that the ecosystem is in an unhealthy state but see the reasons for this not in their own activities but rather due to their neighboring states, construction projects, recreational fishing and increasing numbers of wildlife such as seals and cormorants, leading to a strong perception of environmental injustice. Further their perceptions differ in parts strongly from scientific results leading to science-fisheries conflicts, hindering important cooperation for sustainable fisheries management. Factors influencing the perceptions such as family history, secondary networks, income sources and the fishing form are discussed, to elaborate how this knowledge can be used to shape a sustainable future.

Reconnecting Qualitative and Quantitative Approaches to geographies of the sea, a sunken opportunity?

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Keywords: Interdisciplinary, Geography, Data-Science, Shipping

The geographies of the sea today are strongly disconnected from the more quantitative fields dealing with marine topics, like Port- or Transport- geography. This divide runs along similar lines as other fields where social and natural sciences that are topically close but have cut their connections and become very distinct entities. In the marine sector of geography the quantitative fields did embrace a view closer to economists and mathematicians, mainly driven by desire to optimise logistic chains and transport security, while qualitative scholars of the sea are content to explore the realm of subjective experience and phenomena on a case by case basis. Recombining these two might provide us with a framework for viewing the ocean in a more holistic way, providing explanations for patterns in the data driven models that have been elusive so far. On the other hand it allows us to check for identified qualitative phenomena on greater scales refocusing and pinpointing areas of interest. In our work we explored how such a cooperation could be designed and how though from the different sides of the social/natural science divide can be integrated to view local phenomena on a greater/global scale. The described phenomenon were so called lay ups, ships on roadside that are put aside to fix global freight rates. We were able to identify these ships from positional data and link the phenomenon in space and time. For the future this allows for a greater exploration of the economic factors influencing this surplus of shipping as well as the fates and origins of those sailors serving onboard the ships. Thereby improving understanding and potential knowledge in both fields at the same time.

1) Management and Conservation

4) Weaving Indigenous Knowledge into Young Marine Research

Megan Ranapia

University of Waikato, Aotearoa New Zealand

Natalie Prinz

University of Waikato, Aotearoa New Zealand

Managing and restoring our complex marine ecosystems from past and present anthropogenic activities requires a comprehensive understanding of social ecological interactions. Globally, there is increasing appreciation that indigenous and traditional ecological knowledge (TEK) can provide valuable lessons towards conservation and contribute significantly to ecosystem management. Despite this proposition, indigenous knowledge is severely underutilized, partly because there is a large void as to how practitioners can synthesize different knowledge systems. Our interest lies in research by ECRs who collaborate with local communities, how to overcome obstacles and seize opportunities. We invite presenters from multiple disciplines to contribute to our online session.

1.4.1

Weaving indigenous knowledge into marine research, case studies from Canada and Aotearoa New Zealand

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Keywords: Traditional Ecological Knowledge, Co-development , Co-management, Marine Restoration, Mātauranga Māori

Managing and restoring our complex marine ecosystems requires a comprehensive understanding of social-ecological interactions. Globally, there is increasing appreciation that indigenous and traditional ecological knowledge (TEK) can provide valuable lessons towards conservation and contribute significantly to marine ecosystem management. Despite this proposition, indigenous knowledge has been severely underutilized, partly because there is a large void as to how practitioners can synthesize different knowledge systems. In many parts of the world, we observe increasing efforts to include indigenous knowledge into marine research, here we provide examples from Canada and Aotearoa New Zealand. There are a rising number of projects that co-develop between Inuvialuit (Canada) / Iwi (tribes, Aotearoa New Zealand) partners and western science trained researchers to employ existing knowledge for the benefit of the marine environment. Our case studies demonstrate research that traverses across Inuvialuit knowledge / mātauranga Māori (Māori knowledge), marine ecology and environmental management. We delineate how research was co-developed with local tribes to improve the management of culturally important species and understand wildlife patterns.

1.4.2

Toitū te Mauri - Designing and studying mauri (life-force) in experimental research

Heni Unwin[1,2,3]

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Keywords: Indigenous knowledge, Maori, Mussel, Microplastic

Interweaving indigenous knowledge, thoughts, approaches and values into research can be difficult from a scientific approach. Beginning with an Te Ao Māori (Māori world view) and incorporating science principles changed the approach for system design, methodology and markers in experimental trials. The research looked at the effect that microplastic and natural fibers had on the mauri of mussels. Mauri is the life force or the vital essence that can be in an individual, physical object, ecosystem or a large grouping. Understanding the mauri of mussels meant designing the mauri of the experiment with the health and care of the mussel at the forethought of every decision. The mauri of the mussels was measured by gaping behaviour, faeces production and algae intake in a flow through system. The results revealed different states of mauri an animal can be in: mauri noho (languishing); mauri rere (unsettled), mauri oho (activated); mauri tau (in balance), mauri ora (flourishing). Interweaving of dual knowledge systems is possible however both need to equally be the beginning of the research.

The Hidden Gems for Conservation - Indigenous and Local Knowledge of Fishers in Fiji

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Keywords: Fishing, Indigenous and local knowledge (ILK), Indigenous taxonomies, Pacific Islands, Traditional knowledge

Pacific Island fishers have been fishing for millennia and developed an intimate understanding of their resources. Indigenous and local knowledge (ILK) is used by fishers of the Pacific Islands to either conserve or systematically exploit the resources. ILK reflects the interconnected nature of fisher resource relationship as fisheries resources provide food, income and medicine for communities. Over time, ILK was passed orally through generations Islanders linking them to the wisdom and skills of their ancestors. Today, although documentation is ongoing, ILK is still seriously threatened due to its lack of proper documentation and transmission. Losing their link to the sea and ILK means losing an important cultural part of themselves and a source of livelihood. This research looks into engaging men and women in fisheries of Fiji (both current and former fishers) who use/used their ILK to fish and provide food for their families. The accurate and correct documentation of ILK is important because ILK is increasingly becoming recognized as a science on its own; and resource management and conservation in local communities can be enhanced through the marriage of ILK with Western science. This means using a sex-age lens to document in-depth ILK from fishers in communities without any bias and reviewing scientific information which is available. ILK of fishers can enrich the work of scientists, resource managers and the policy makers. Acknowledging that older fishers usually hold a vast amount of ecological knowledge, which they are willing to share to their younger generation, is a step toward a holistic approach to management and conservation. Information gathered for this research is done with prior informed consent, using questionnaires, in depth interviews and informal storytelling (talanoa) which prompts fishers to impart their wisdom comfortably and allow the wealth of historical accounts and experiences of fishers to be documented.

1) Management and Conservation

5) What is at stake? - Socio-ecological systems in the *A*nthropocene

Frane Madiraca

University of Hamburg, Germany

Helene Gutte

University of Hamburg, Germany

Marine ecosystems are increasingly threatened by a multitude of anthropogenic pressures. Identifying systems at risk and vulnerable components is therefore highly important for ensuring the sustainability of our oceans. However, this can be challenging as pressures often interact with each other, leading to cumulative impacts and feedback loops. This warrants not only for single species assessments evaluating multiple pressures but also holistic approaches focusing on entire ecosystems. We therefore invite everyone working on risk and vulnerability evaluations ranging from single species to ecosystems, including status and distribution assessments and services they provide, especially under the influence of combined impacts

Reef islands in SE Asia and their response to changes in the environment

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Keywords: Carbonate sediment, Sea-level rise, Monsoon, Shoreline, Reef ecosystem

Reef islands consist mainly of reef-derived carbonate and usually form on top of reef complexes, where they exceed mean sea-level by a few meters. Due to their unconsolidated nature and proximity to sea-level, these socially important landforms naturally experience both erosion and accumulation on their shorelines due to wave-driven processes. To maintain this balance, a constant supply of sediment from surrounding reef ecosystems is considered a key factor for island stability. In a changing environment and under anthropogenic influence, the future stability of reef islands is a subject of societal interest, but one that is to date poorly understood. Here we reconstruct the Holocene and modern dynamics of two strongly inhabited reef islands from the Spermonde Archipelago, Indonesia. We combine sedimentological data with targeted radiocarbon dating and remote sensing data to improve our understanding of the islands' interaction with their environment. One of the islands began to form around 7,000 years BP, and shows a mid-Holocene hiatus in accumulation during a time of a small sea-level highstand and shifts in the monsoon wind system. This observation highlights the sensitivity of depositional carbonate system to fluctuating sea-level and climate. Contrary to other studies, we also find that a higher sea-level does not necessarily lead to increased accumulation. Shoreline reconstruction from the second island shows, that the surface area of the island doubled after human settlement intensified one century ago but reveals also a shoreline retreat in the past decades. Interestingly, the younger sediment shows a different composition compared to the sediment from the older parts of the island. This implies that even though anthropogenic influence affected the supplying ecosystems, production remained sufficiently high to allow island-growth. Our findings offer new insights into the response of reef island to various alterations in their environment.

Diagnosing governance challenge in milkfish aquaculture village, a case study in Pangkah Wetan, Indonesia

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Keywords: Socio-Ecological System Framework, Governance challenge, Collective action, Public good, Traditional aquaculture

Fish production is increasing globally, not only for direct human consumption but also for generating products from food processing, drugs, cosmetics, fuel, and other industrial products and thus contributing to ecosystem services. Rapid growth in production and transformation of behavior towards intensification exemplify pressures on the environment and creates socio-ecological challenges for governing aquaculture. However, challenges for governing aquaculture need to be identified to ensure a sustainable future for the sector. The purpose of this study is to contribute to the knowledge of governing aquaculture commons in coastal pond aquaculture as a complex socio ecological system, with the aim to better understand challenges in aquaculture associated with sustainable outcomes. This study applies the Socio-Ecological System Framework (SESF) by Ostrom to identify key variables influencing collective action through semi-structured interviews with relevant actors in milkfish aquaculture in a village in Gresik, Indonesia. A descriptive qualitative approach was applied to give a better understanding of the system. Our analysis reveals that pond location and government investment are the most important drivers of collective action. On the contrary, low monitoring (or absence in this case) and exclusion from discussion processes lead to negative collective action efforts. However, social capital, network structure, and trust reciprocity between fish farmers and private sectors (patron) can be considered as an alternative governance strategy.

1.5.3

Slipping away! Socio-ecological system approach to provide insights into reviving the slipper lobster fishery

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Keywords: Fishery, Lobster, Management, Model, Regulation

Lobsters are harvested for consumption at an alarming rate. Members of the Scyllaridae family (slipper lobsters) are more abundant and are understudied compared to their close relatives the Panuliridae (spiny lobsters). In recent years, due to the catch constraints on spiny lobsters and an increase in management regulations, Japanese fishermen are now turning towards slipper lobsters to meet the growing consumer demands. Due to this increasing pressure, the catch of slipper lobsters has fallen by almost 75% in the last 7 years. Despite implementing a few management measures in Amami and Okinawa Islands, the decline continued. Due to a lack of information on slipper lobsters and gaps in knowledge, identifying problems and reviving this fishery is currently a challenge. Therefore, my research aims to investigate the Scyllaride squammosus (blunt slipper) and evaluate the external factors influencing this fishery as well as look into the management strategies currently in place. Qualitative modelling approaches such as fuzzy cognitive mapping and causal loop diagrams help to account for limited data availability and uncertainty as is the case for this fishery. Finally, socio-ecological system models might provide valuable insights into this fishery and help pinpoint areas of concern in order to successfully revive this fishery.

1) Management and Conservation

6) Northern coastal communities: Transforming governance for a sustainable future

Maria Wilke

Agricultural University of Iceland

As the Arctic ice is melting, coastal communities of the North face some of the most uncertain futures, battling increasing maritime activities, economies dependent on limited resources, depopulation, non-representation and consequences of rapid climate. To adapt to such conditions, transformative approaches to governance need to be applied. This session will explore governance issues and transformative approaches to enable shared understanding across the Arctic and beyond. We invite you to submit your abstract on research relating to governance issues and solutions in coastal communities in the North. Submissions are accepted from all scientific fields with special focus on interdisciplinary work.

NORTHERN COASTAL COMMUNITIES: TRANSFORMING GOVERNANCE FOR A SUSTAINABLE FUTURE

1.6.1

Education for Sustainability Futures Research

Tanya MacDonald

Keywords: Sustainability, Futures Research, Community

In an ever-changing world and as the climate crisis becomes increasingly concerning; human-nature connection is on the decline. By using futures research, we can better understand both what we currently envision for our future and expand that further to what might be possible. By applying the Manoa Method, we can explore what communities imagine these futures to look like and how we might achieve them. This type of research can help us to explore what barriers, challenges, and drivers currently exist. In addition, we can use futures research to develop an account of the future that can help inform people's decisions and actions. By identifying these potential accounts of the future, we can better understand how to work through barriers and with drivers. In this talk, we will discuss how this can act as a transformative approach to enable shared understanding.

1) Management and Conservation

7) Marine resources: economical interest and pollutants

Marta Moriano Ortiz

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Hugo Campillo Gancedo

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Amaia Bilbao Kareaga

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The proper control of the exploited marine resources is essential for the adequate management either from an environmental or human health point of view. Different approaches can be applied to reach an appropriate transparency regarding the product that is being consumed, such as the identity of the species, its origin or the possible contaminant content. For this, different techniques might be used: genetic tools, pollutants analysis, etc. Avoiding commercial fraud and raising awareness about possible health hazards and the troubling management of some species (especially those of conservation interest) are factors that may be of special importance in the future.

Traceability implications for heavy metal risks in commercial seafood

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Keywords: Mislabelling, Heavy Metals, Prawns, Shrimps, Seafood

Mislabelling of commercial products not only leads to damage to the resource, but also to risks for human consumers, when the substitute species contains contaminants, such as heavy metals. Species in commercial samples will be determined using DNA barcoding to determine whether mislabelling is occurring or not. The species chosen for this study are shrimps and prawns as they are potentially exposed to less traceability than other marine species due to their long production chains. In addition, they will be analysed for a set of 8 heavy metals, and health risks will be assessed using current WHO indices.

Integrated methodologies for the tracking of illegally traded glass eels

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Keywords: Anguilla, Trafficking, Microplastic, RFLP, Glass eel

Anguilla anguilla is cataloged as a critically endangered species in the IUCN red list, with many factors threatening its existence. Illegal trafficking of the larval stages of this animal (glass eels) and their exportation to Asia are contributing to the depletion of the population, and many organisations around Europe fight against this issue by cooperating and organising operations against glass eel trafficking. In this study, a batch of undeclared, illegally transported eel larvae confiscated in the airport of Asturias (Northern Spain) was analysed with a combination of forensic techniques to try to track down the origin of the fish, which is crucial to fight this problem. As a physical marker, the profile of microplastics carried by the fish was compared to that of different European rivers. As genetic markers, barcoding to ascertain the species and genome-wide PCR-RFLP techniques were employed to refine the spatial resolution. The microplastic profiles for colour, shape and polymer type from eight rivers of Spain, Portugal, France and Italy allowed to identify Asturian rivers as the most probable region of origin of the confiscated fish. The forensic genetics analysis confirmed the eels were *Anguilla anguilla* (discarding other species) and pointed to rivers located at the eastern zone of Asturias as the more probable place where the animals were captured. These results, although should be interpreted with caution in absence of a complete baseline of eels from other European regions and temporal replicates, highlight the value of these complementary methodologies as forensic tools for tracing the origin of illegally trafficked eels.

Microplastics in marine macrophytes in the Asturian coast

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Keywords: Agar-agar, Beaches, *Gelidium sesquipedale*, Microplastics

Microplastic pollution is widespread throughout the world, affecting all marine ecosystems and all the organisms that inhabit them. The red alga *Gelidium sesquipedale* is the source of best-quality agar, and is directly consumed as seafood in many countries, but there is little information about its microplastics pollution. In this study we have quantified microplastics in *G. sesquipedale* harvested along the Asturian coast (southwest Bay of Biscay), from sampling points differently influenced by sandy substrate, ports, rivers, water treatment plants, population density and tourism. Results show that Gelidium collected near sandy substrates accumulates significantly more microplastics than those from rocks, regardless the rest of stressors, suggesting that the dynamics of the substrate is key to allow microplastics to reach these algae and enter the human diet. More research to identify microplastics sources and measures to prevent them in the Cantabrian coast need to be put in place.

Entrepreneurial ecosystem and innovative entrepreneurship: elements for a conceptual framework for red seaweed farming in Madagascar

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Keywords: Ecosystem, Innovation, Entrepreneurship, Seaweed, Madagascar

Global constraints due to climate change drives human being to adapt visions and actions toward a more sustainable way of proceeding. In this vein, the ability of research to design "innovation" conciliating human needs with planetary boundaries will be more than essential. This research contributes to this reflection by proposing a new sustainable value chain of bioplastics in Madagascar. Through an integrated seaweeds farming carried out by farmers coastal communities in the South West region, the production of seaweed-based plastics provides an alternative Income-Generating Activities to fishing in upstream. Afterwards, bioplastics contribute to reduce global downstream plastic waste for the sake of marine biodiversity and CO_2 reduction. Throughout this paper which relies on a Massachusetts Institute of Technology approach to innovation, bioplastics as innovation implies three main concepts: ecosystems, capacities and stakeholders. As application of the concept to Madagascar's case, we conducted an opinion survey within 125 companies and used secondary data on innovation and entrepreneurship. As a result, we found out that in order to set up this sustainable and innovative activity, five stakeholders are essential: coastal communities, Non Governmental Organizations as support for environmental conservation, entrepreneurs with companies working on seaweed and plastic manufacturing, research institute in marine sciences and biochemistry, Government as foundational institutions provider. Together, these stakeholders will interact to enable capacities required for bioplastics production through five core elements: human capital, funding, infrastructures, demand, culture and incentives. Moreover, as universities are providing highly qualified employees as well as Research & Development products, Government can foster the development of an upper entrepreneurial ecosystems through tax incentives, subsidies and grants, security for investments and intellectual property protection. Finally, as the South-West region benefits from a long coral reef system as a barrier, it represents a potential seaweed supplier for global market, specifically for bioplastics industry.

1) Management and Conservation

8) Does trophic-level matter? *A*quaculture of marine low-trophic organisms

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In marine aquaculture systems organisms throughout the natural food chain are cultured. However, contrary to the general assumption, marine aquaculture production is dominated by extractive species, mostly seaweeds, but also filter feeders and deposit feeders like bivalves or echinoderms. In order to push forward sustainable aquaculture, integrated systems where organisms of different trophic-levels are complementary cultured, gain in interest. We are inviting researchers from both, natural and social sciences to share their story on low-trophic aquaculture organisms, techniques and challenges.

Technical feasibility study for the cultivation of the red algae Halymenia durvillei in the South-West of Madagascar

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Keywords: Culture, Halymenia durvillei, Seedlings, Long-line, South-West of Madagascar

Another project on the farming of a red seaweed species Halymenia durvillei is accomplished. This species is often used for cosmetics and therapy. This study aims at assessing technical feasibility of the farming of this species within the coastal community in the south-west region of Madagascar in order to contribute to the improvement of their income. To conduct this study, three parameters were taken into account and monitored: weight of seedlings (expressed in grams, [70; 82], [82; 94], [94; 106], [106; 118], [118; 135]), duration of culture (30, 60 and 90 days), and depth of the seedling setting (1m and 4m depth). Two way ANOVAs were used to assess the difference between daily growth rate (DGR) of seedlings and the culture duration while one way ANOVA was used for the depth. As result, DGR (fresh weight) varied from 3,9gday-1 (1st 30 days of the culture for the class weight [70;82]) to 8,81gdays-1n (2nd 60 days of culture for the class weight [118;130]). Statistical analysis showed that weight of seedlings (70 to 135g) did not have an influence on the DGR of H. durvillei (p_{2ways} = 0.22), while the duration of the culture did (p_{2ways} < 0.05). The highest DGR was observed during the 60 days of culture, whatever the initial weight of the seedlings was. For the depth, 47.5% and 4.5% of seedlings' loss were recorded for the cultivation at respectively 1m and 4m depth and this had an impact on the production. At the beginning, the seedlings weights were 15.5kg for each experiment, after 30 days of cultivation, a significant difference ($p_{1way\ ANOVA}$ < 0.05) was observed (4.5kg and 34.5kg respectively at 1 and 4m depth). Indeed, culture depth influenced the cultivation success. This study proved the social and technical feasibility of H.durvillei farming in the south-west of Madagascar.

Integration of Baylonia areolata in existing tidal ponds of *Caulerpa lentillifera*

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Keywords: Algae Aquaculture, Gastropods, Co-Culture

Aquatic algae cultivation is an important and growing branch within aquaculture and could lead to sustainable food supply and source of income in the future. Due to the algae's need for nutrients, it seems a plausible method to co-culture the algae with animals that produce these specific nutrients through their metabolism. Such an approach could also help to make algae aquaculture more lucrative for local farmers as the co-cultured animals would lead to an extra income. The green alga *Caulerpa lentillifera*, also known as sea grapes, is widely cultivated in Van Phong Bay, Vietnam, and enjoys popularity across countries. The same applies to the snail Babylonia aerolata which is also traded as a delicacy in Asia. Both organisms are extensively farmed in tidal ponds. Due to their comparatively easy handling and high price, an integration of the snails into existing tidal ponds for the cultivation of sea grapes seems to be reasonable. At the Institute of Oceanography in Nha Trang, we investigate the influence of snails on growth and quality of sea grapes, examine suitable stocking densities, compare culture methods of the sea grapes in presence of the snails and collected data for an economic evaluation of this co-culture. The following research questions are to be clarified: Does the presence of B. aerolata affect sea grape growth and quality? In the presence of B. aerolata which culture method yields better quality and quantity of sea grapes? Do the snails need to be spatially separated from the sea grapes? We assume to see an impact of the snails on the physiology of the seaweed due to the extra nutrients which are accumulated in the water by the snails metabolism.

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2) New Age of Monitoring

1) Monitoring in marine science – alternative and more sustainable methods for monitoring marine wildlife & resources

Constanze Hammerl

Thünen-Institute of Baltic Sea Fisheries

Monitoring is a key aspect of managing marine environments. It has enabled the development of a science-based understanding of marine ecosystems and human impacts affecting it. In the context of increasing construction at sea, the establishment of no-take zones and the associated inappropriateness of many traditional methods, as well as the general societal quest for more efficient and sustainable technologies, the following question arises: How can future monitoring be designed? This session is for anyone investigating more sustainable methods of marine monitoring, whether you are working on new monitoring devices, sampling strategies and concepts or more efficient data processing.

Old problems, new solutions: analysis approaches to estimate fishing effort of small-scale fisheries in the German Baltic Sea

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Keywords: Monitoring, Passive fishing gear, Data deficiency, Sustainable fisheries, Governance

Small scale fisheries (SSF) are highly diverse, with many different gear types, vessel features, and complex patterns of harvest that vary worldwide. Current fisheries information systems mostly fail to capture the fishing characteristics of this fleet segment. The resulting lack of integrated and up-to date data makes it difficult to sustainably manage the affected fishing resources, and provides a weak base for policy making and governance. As a last consequence, this marginalizes the small-scale fishing sector. The amount of fishing effort and range in which the fishing activity occurs are critical measures to understand the activities at sea and to make realistic predictions about the ecological, social and economic impact of it. New monitoring technologies are developing with more attention being paid to find solutions to better SSF data collection. This new set of data requires automatic analysis tools that can identify features such as fishing trips or fishing events, extract fishing effort for different gear types, calculate soak times for passive gears and so on. While the use of tracking technologies and machine learning analytical algorithms have significantly increased for industrial fisheries in the last decades, the exploration of the fishing effort for SSF has only been explored anecdotally. A common framework to analyse SSF data and passive gear spatio-temporal dynamics is currently missing. Different indicators can be defined to analyse this data sets, e.g.: vessel speed thresholds can help to understand the activity that small boats are conducting; overlapping GPS coordinates could identify soak times for passive gears. Algorithms should be developed to automate these tasks. This presentation will look at some initiatives to process available data from SSF operating in the German Baltic Sea. This will give an insight into potential automated processes that could be adjusted and applied for specific fleet segments.

2.1.2

Monitoring and highlighting of fishing gears impact on vulnerable elasmobranchs species in the Alboran Sea (West of Algerian coast)

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Keywords: Monitoring, Fishing gears, Elasmobranchs species, Alboran sea, Algerian coast

The location of the Algerian west coasts in the Alboran Sea just at the western limit of the Mediterranean Sea, make it a mixing zone between the Mediterranean and the Atlantic. Thus, this area is considered a passageway for all migratory species, which are mostly vulnerable (marine mammals, seabirds, sea turtles and elasmobranchs). One of the most vulnerable species living in this area are the elasmobranchs that are under increasing threats, these threats include fishing in its various types. So, the highlighting of the impact of fishing on these species is necessary to monitor the behavior of vulnerable elasmobranchs species for a purpose of a conservation measures. Therefore, the present study considered a first of its kind in this part of the Algerian coast, is of great local and regional importance. The study aims to highlights the impact of five fishing gears on the elasmobranch species based on five (05) main and complementary approaches was implemented at two ports located in the west of the Algerian coast (Beni Saf and Ghazaouet), over a period of 22 months (from February 2020 until September 2021).The results show that during the period of study, twenty six (26) species of elasmobranchs were identified, these species are distributed among 10 species of rays, 15 species of sharks and 01 species of chimera. Thus, *Galeus melastomus* and *Scyliorhinus canicula* are the two most abundant species in the fisheries. The analysis of the interaction of the fishing gears deployed in the study area with the elasmobranchs shows a significant difference which is mainly affected by the fishing technique, the behavior of the species and the fishing depth. An in-depth analysis of the data is essential for the proposal of effective management measures based on the conservation of the elasmobranchs vulnerable species.

2.1.3

A south Mediterranean country's demand on available marine biomass: Assessment and orientations

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Keywords: Marine Footprint, Algeria, Sustainable fishing, Algerian fisheries, Required Primary Production

This study focuses on fishing activity in Algeria, specifically the extraction of marine resources in Algerian costal and offshore zones. This sector is expected to meet several objectives and should contribute to Algeria's food security. Seafood is a significant source of protein and highly favoured by Algeria's coastal communities (Zaimen et al., 2021). However, with limited data available describing the biomass that could be exploited, the pressure could eventually increase, on a common stock shared by all users and is already regarded as poorly studied (Chikhi, 2018). Therefore, this work includes the estimation of the marine footprint MF, which is the ratio between the demand of each fished species, known as the required primary production PPR (Pauly and Christensen, 1995), and the available biomass in terms of primary production PP of the marine ecosystems in Algerian fishing waters. The latter is derived from the literature, relying on studies covering the considered area (Tellai, 1964; Kessouri et al., 2017). The goal is to assess the mode and intensity of human demand on the natural resource to gain a general overview of the sustainability of fishing in Algeria and compare it to its neighboring Mediterranean countries.

2.1.4

Optical-acoustic methods to study Marine Protected Areas

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Keywords: Hydroacoustics, Fish biomass, Photogrammetry, Seamount, Acoustic monitoring

A first and direct approach to assess whether the implemented regulations of a MPA are being successful consists in monitoring the sizes and abundances of fish species of interest, determining species richness or other community attributes, and studying the ecosystem´s complexity, among others. In this sense, reef fishes provide valuable information regarding fishing pressure and changes in the reef ecosystem dynamics. Frequently, these species are assessed using underwater visual census (UVC) methods. However, UVC methods show biases for counting fish in large aggregations as well as in estimating their size. In this study we use optical-acoustic monitoring methods, which combine the use of a scientific echo sounder and stereo-video systems, in El Bajo Espiritu Santo Seamount, located in the southwest Gulf of California (Mexico), to estimate more accurately fish species biomass and their average individual sizes. This will contribute to its better management and to evaluate the seamount´s ecosystem services provision. Out of 19 fish species identified in four surveys carried out between September 2021 and March 2022, Chromis atrilobata showed the highest relative abundance values (52.72%), followed by Paranthias colonus (28.94%) and Decapterus macarellus (10.51%). The Nautical Area Scattering Coefficient (NASC), which is proportional to fish density of the individuals detected within the acoustic beam in the water column, was separated from zooplankton acoustic biomass. Zooplankton NASC showed its highest values in December (28.9 643.3 m2·nmi-2), whereas fish NASC values were higher in October (1.07-168,756 m2·nmi-2). These Acoustic-optical preliminary results indicate a temporal variation in fish and zooplankton biomass that can be used as a baseline for MPA managers and scientists to monitor fish populations trends.

The golden opportunity - biomonitoring sandy beach marine biodiversity using environmental DNA

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Keywords: Metabarcoding, Fish, Invertebrates, Surfzone, Molecular

Sandy beaches make up over 70% of the world's open-ocean coastlines and provide important ecological, economic, recreational, and cultural services. Threats to these ecosystems continue to accelerate including climate change, sea level rise, global population growth, and coastal development. However, the traditional marine biomonitoring method, the seine net has many problems, for example, it is not effective in heavy waves, misses highly mobile large predators, and is challenging to deploy on a crowded beach. Emerging technologies may provide a solution and this study uses environmental DNA (eDNA) metabarcoding to survey the biodiversity of surf zone fauna. eDNA metabarcoding is successful at detecting surf zone fish and invertebrate species with some surprising detections. Though results are mixed in distinguishing species utilising different habitats within the surf zone. Finally, this study aims to inform beach managers of another potential tool for aiding the conservation of these important but difficult ecosystems.

Deep sea floor images show distribution and diversity of Antarctic octopods

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Keywords: In-situ technology, Cephalopods, Weddell Sea, Biodiversity, Habitat analysis

The Southern Ocean is a challenging study site due to its remoteness and climate. Octopods have an important trophic role as both predator and prey in this extreme habitat and belong to the diverse, endemic megafauna of the benthic communities found in Antarctica. Yet, major parts of their lifestyle, diversity and distribution are unknown for most areas. Sampling efforts such as trawling already gave insights on the benthic octopod community composition. However, in recent years the development of situ observation technology provided new research opportunities for remote and challenging regions such as the deep Southern Ocean. During two cruises of the RV Polarstern in 2015 and 2021 more than 10,000 of seafloor images of the Filchner region in the southeastern Weddell Sea were collected via towed camera systems in depths from 380-1700 m. These images were analysed for octopod diversity and distribution as well as their surrounding habitat. This new approach for biodiversity estimation of Antarctic octopods showed that incirrate octopods such as Pareledone are dominant on the shelf regions, which is in line with previous knowledge. So far, seven genera (Cirroctopus, Opisthoteuthis, Muusoctopus, Adelieledone, Graneledone, Megaleledone, Pareledone and Thaumeledone) of four families could be identified. Depth distribution plots indicate vertical taxon assemblages, and a habitat analysis will show if octopod taxa of the Filchner region prefer certain substrates or can even be associated with the known distinctive benthic communities of the Filchner region. In the future, camera surveys like these could help understanding and monitoring the benthic communities in the Southern Ocean which are especially threatened by ocean warming.

2.1.P2

Benthic Habitat Mapping in Soariake MPA, Southwestern Madagascar

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Keywords: Benthic habitat, Coral reef, Object-based image analysis (OBIA), Mapping, MPA Soariake

Coral reefs are an essential source of marine biodiversity and the lives of millions of people depend on them. Currently, they are in peril under the effects of climate change and human pressure. In Madagascar, research conducted on coral reef monitoring by in-situ observation is very expensive, and therefore does not allow a complete representation of coral reef systems. Satellite remote sensing is an alternative and complementary approach that allows for larger scale and more affordable coverage. This study, will use freely available high-resolution satellite imagery to provide an affordable and effective solution for marine scientists and policymakers to monitor the health of the remaining coral reef systems so that appropriate measures can be taken. The objective is to provide a benthic map for Soariake MPA. Ground truthing was carried out in the Soariake MPA on 28 transects of 500m in length each. 4833 geo-referenced photos were taken. The photos were analyzed on CPCe (Coral Point Count with Excel extension) to obtain the benthic coverage by assigning to each photo the corresponding benthic class. The combination of field data and high resolution satellite images, using the OBIA (Object_based image analysis) method, allowed the creation of high precision maps of the benthic classes covering all the Soariake MPA. The accuracy of the classification was evaluated with the Kappa coefficient.The OBIA method allowed to give a map with a KAPPA accuracy of 82% at the Soariake MPA. Divided into 5 benthic classes. Among the 701 validation points, 575 points were well mapped. These classes are Corals and Macroalgae, Debris, Macroalgae and Sand, Sand, and Marine Vegetation. User and producer accuracy by class exceeds 63% reliability. This study demonstrated the feasibility of creating high accuracy maps from existing free satellite data such as sentinel 2 by combining OBIA and field validation data.

Nutrient monitoring via UV spectroscopy – A way to improve our understanding of ecosystems in the Baltic Sea?

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Keywords: Nitrate, Bisulfide, OPUS sensor, SUNA sensor, In-situ

Algae blooms are a reoccurring phenomenon in the Baltic Sea, and an increase in summer blooms are expected with rising temperatures. Primary producers need both inorganic nitrogen as well as phosphorous for growth and energy. Cyanobacteria, on the other hand, can fixate gaseous nitrogen from the atmosphere. The excess nitrogen the cyanobacteria brings into the aquatic system has been seen as a way to regulate nitrogen in the air. However, studies have come to question if we have underestimated the possible nitrogen toxicity this could bring. Although there have been several investigations on harmful algae blooms, and how much nutrients would be necessary for such episodes, we still lack information about the nutrient distribution throughout the water column over space and time. In order to gain further knowledge about the bloom activities and their effects in the Baltic Sea, we need to improve our understanding of the nutrient distribution. In recent years, the field of UV spectroscopy has made great strides in developing robust in-situ sensors for this particular purpose. We have investigated how two UV-nitrate sensors (OPUS; TriOS, Germany and SUNA; Sea Bird SAtlantic, USA) perform in the characteristic marginal sea, which is the Baltic Sea. Our investigation shows that these sensors are able to determine both nitrate and bisulfide concentrations throughout the water column, where anoxia and CDOM could cause interference. Our data show that both sensors can detect variations in nitrate as well as bisulfide around the redox-cline, something that has proven to be challenging despite today's technological advancements. Depending on the measurement frequency, as well as CTD speed, monitoring can be conducted down to a 0.3-0.5 meter resolution. Combining high-resolution nutrient data, with existing monitoring data such as chlorophyll, turbidity, and particles, can greatly influence our understanding of algae blooms and the ecosystem as a whole.

2) New Age of Monitoring

2) Bioarchaeology of Marine Systems: Understanding Past Human Impacts on Marine Systems

Magie Aiken

University of Copenhagen

Bioarchaeological investigation of marine species adds to our understanding of human exploitation and its impact on marine ecosystems. This directly ties into modern ecological studies by contextualizing current research within a long-term approach not otherwise feasible. We invite researchers who use bioarchaeological methods to study any aspect of marine systems to share their research. This session invites contributions from a broad range of bioarchaeological methods, research questions, time periods, and target species to share their perspective on the past, present, and future of marine systems.

2) New Age of Monitoring

3) Biobanking, Bioprospecting, Biodiversity

Darya Chernikhova

University of Iceland

Marine samples archiving (biobanking) is a growing field. Repositories offer hedges against rapid biodiversity declines and sources of reference samples for research. They also pose new and accelerating problems to be explored. Are you interested in cryopreservation or -omics databases? Do you work with bioactives and biomaterials? Do you study equitable access or organize citizen/community science efforts? Join our interdisciplinary conversation on coalition building, citizen science, information accessibility, and technical methodologies, as applied to wide-scale distributed biobanking efforts. This session aims to bring together participants with diverse backgrounds and interests, to share complementary views on the future of archival collections.

The benefits of long-term databasing of cetaceans in Skjálfandi Bay, Iceland

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Keywords: Whales, Photo-identification, Dolphins, Database

In 2001, long-term photo-identification, sighting location and animal behaviour data collection began in Skjálfandi Bay, Northeast Iceland by the Húsavík Whale Museum, and then the University of Iceland's Húsavík Research Centre, in collaboration with whale watching vessels. Over the past 20 years, this database now contains over 1000 individually identifiable humpback whales (*Megaptera novaeangliae*), as well as 352 white-beaked dolphins (*Lagenorhynchus albirostris*) over the past 10 years, and 50 minke whales (*Balaenoptera acutorostrata*) over the past 8 years. The data collection is conducted through a student internship program, which hosts an average of 20 students per year, allowing them to earn credit and use the data for their bachelor or master's degrees. In addition to this database supporting approximately 10 research projects per year of different sizes and scopes, it has also provided insight into changing trends in the bay such as an increase in humpback whale sighting per unit effort, a decrease in minke whale sightings per unit effort, and the introductions of new behaviours such as bubblenet feeding, showing the great value of long-term, collaborative, and low-cost data collection.

Open up the black box of " The Unknows" creation of an open access platform for marine fungi holding polyphasic described model-organisms

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Keywords: Marine fungi, Biobank, Polyphasic identification, Database, Ecology

Marine fungi are an important group of organisms that play an active role in marine decomposition processes, are part of the marine food web, and are prominent interaction partners. For a long time, they received little attention in marine research, resulting in scarce data, compared to prokaryotic actors. For example, there is a lack of model organisms that can be used to perform directed experiments for a quantitative and qualitative statement on carbon flux in fungal degradation processes or organismal interactions. So far, most marine fungal sequences in databases are from unknown taxa and without preserved isolates. Therefore, it is not possible to link physiological and ecological functions with sequence-based data. The presented project aims to close this gap by creating a unique open access platform linking freely available fungal model organisms deposited in culture collections with polyphasic taxonomic identification data. Two isolation campaigns were conducted at Helgoland Roads, Germany and in Norwegian fjord waters resulting in ~150 phylogenetically distinct isolates. Long-read sequences of the ribosomal RNA cluster covering four prominent fungal marker genes were generated. Isolate-specific information will be further enriched with Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF) patterns, phenotypic descriptions, growth behaviours and biochemical analyses. Data will be published in existing databases, and on a platform where the different datatypes can be combined. Generated sequences will be further used to update the phylogenetic fungal reference tree. All isolates will be deposited in accessible culture collections. Since this approach is unique in the marine fungi scientific world, it will be a great leap for the databases and culture collections. The ICYMARE 2022 BREMERHAVEN open access strategy will motivate other researchers to use these platforms and contribute their labs' data. This project provides a solid foundation and opens a platform that will enable replicable and comparable research.

2) New Age of Monitoring

4) From Taxa and Transects to Traits and Metabarcoding - Progression in Studying Marine Biodiversity

Eileen Heße

University of Veterinary Medicine Hannover; Institute for Terrestrial and Aquatic Wildlife Research, Büsum

Kim Ellen Ludwig

Thuenen Institute of Sea Fisheries

Marking the 30th anniversary of the Convention on Biological Diversity, this session will be dedicated to modern approaches to studying marine biodiversity. In a conceptual context, functional biodiversity has gained much attention over recent years, considering species characteristics ("traits") rather than -identities and thereby allowing for new insights into the drivers of biodiversity. Technologically, molecular methods such as metabarcoding have emerged and provide new possibilities for identifying cryptic species. In this session, we invite speakers working on marine biodiversity questions to share their experiences with, and insights gained from, using modern techniques of biodiversity research in marine ecosystems.

A functional perspective: Trait-based approaches in vulnerability and ecosystem state assessments

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Keywords: Biological trait, Functional trait, Ecosystem function, Ecosystem indicator, Vulnerability assessment

Taxa-based research is a renowned staple in the field of ecology practiced throughout the history of this ever-developing field. However, trait-based approaches have become increasingly more popular in recent years. Having a closer look at biological traits as building blocks of ecosystem structure and dynamics, instead of taxa that live within them, has helped answer questions that have for a long time existed out of the scope of scientific inference. Despite this important development, many new directions are waiting to be fully exploited in trait-based approaches. In its beginnings, this novel approach was mostly used for describing and quantifying traits that could be easily measured. However, as time has passed, so has the focus shifted from simple analyses onto elaborate questions about ecosystem functioning that biological traits can answer. This goes hand in hand with the growing acknowledgement that choosen traits need to be tied to and are appropriate for proper description of ecosystem functions one whishes to understand. Exciting new developments are already making their mark in research endeavours of today. In particular, trait-based assessments of vulnerability to anthropogenic pressures and development of trait-based indicators for ecosystem state assessments are promising new applications of this modern approach in ecological research.

A functional perspective on the driving factors behind coastal macrophyte carbon stocks in the Tvärminne archipelago, Finland

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Keywords: Marine biodiversity, Carbon cycling, Seasonal

Increasing atmospheric concentrations of greenhouse gases and associated impacts of global warming have led to an urgent need to identify and protect ecosystems with high carbon stock capacity. A wealth of studies exists on the role of seagrass biodiversity for carbon burial, however, in the northern Baltic Sea, the seagrass Zostera marina only contributes marginally to carbon burial. Nevertheless, submerged vegetation in the area consists of a wide array of different aquatic plant species of marine and limnic origin, which differ in their trait characteristics with potentially differential effects on ecosystem functions, including carbon burial. With few studies having assessed the links between biodiversity and ecosystem functions, we sought to test (i) how functional composition (i.e., mass ratio effects) and diversity (i.e., niche complementary effects) of aquatic plants relate to carbon stocks, and (ii) if seasonality affects the mechanism by which biodiversity influences aquatic plant carbon stocks. To address these points, we conducted multiple field surveys (i.e., October, March, June and August) in the Tvärminne archipelago, Finland, where we sampled six soft bottom communities dominated by aquatic vascular plants. We found that biodiversity was associated with aquatic plant carbon stocks through mass ratio effects, but the direction and importance of these effects depend on the trait considered. Mass ratio effects remained the main mechanism throughout the year by which biodiversity influenced aquatic plant carbon stocks, suggesting a marginal effect of seasonality. Overall, our results suggest that the dominance of *Myriophyllum spicatum* is a major driver of aquatic plants carbon stocks within the protected bays of the Tvärminne archipelago.

The phylogeography of two Beroe species in the Arctic Ocean based on one mitochondrial and one ribosomal marker

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Keywords: Genetic connectivity, Polar, Gelatinous zooplankton, Jellyfish, Barcoding

The rapid rate of warming affecting the Arctic is causing unprecedented changes to the marine communities inhabiting this region. Gelatinous zooplankton or jellies span several distantly related groups (ctenophores, cnidarians and tunicates) and have previously been overlooked as potential key components of this polar ecosystem. In warmer waters jellies have been known to rapidly increase in biomass forming jelly blooms with potentially harmful consequences. Therefore, understanding the role of jellies in Arctic ecosystems is key to predict the consequences of warming temperatures not only for jellies but other species in the Arctic food web. The ctenophore family Beroidae is of particular importance due to their role as a predator of other gelatinous zooplankton, thereby helping control their abundances, as seen with *Beroe ovata* for *Mnemiopsis leidyi* in the Black Sea. Understanding the distribution of this predator will help predict its future role and significance in Arctic food webs. To assess potential factors influencing the distribution patterns of Beroe species in the Arctic, this study focusses on the widely distributed *Beroe cucumis* and the deeper dwelling *Beroe abyssicola*. Recent papers have attempted to uncover the phylogeny and genetic connectivity of ctenophore species, including Beroe. However, due to standard cytochrome c-oxidase subunit 1 (COI) primers not working for ctenophores and other markers such as 18s not yielding the resolution necessary, the phylogeny of Beroidae remains unclear. Applying newly published primers for COI, in addition to ITS1, this study compares the genetic structure and connectivity revealed by one nucleic and one mitochondrial marker. Genetic diversity indices, hierarchical population structure and demographic history were determined for samples from Greenland, Svalbard and mainland Norway. Evaluating the congruence between the different markers will help understand not only the population structure of the two species, but also the potential for these markers in future genetic studies of Beroe.

Using metatranscriptomics to disentangle seasonal functional diversity of North Sea microeukaryotic plankton

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Keywords: RNA-seq, Bioinformatics, Systems biology, Plankton, Functional diversity

Planktonic organisms are ubiquitous drifters in seas and oceans where they dominate life in terms of abundance and biomass. The world's oceans host an enormous diversity of planktonic life, encompassing possibly more than 150,000 species of eukaryotes. Of this number, less than 10 % have been formally described. Fortunately, advances in molecular biology and computational biology have resulted in the establishment of omics approaches as cost-efficient ways of generating data of relevant scale that can be used to describe the unknown diversity of our oceans' plankton. Expanding beyond taxonomic descriptions, metatranscriptomic workflows allow us to draw accurate pictures of the realized functional diversity of marine planktonic ecosystems. However, most metatranscriptomic data available today stems from unique cruises while seasonality is a major driver of ecosystem functioning. Our study aimed to advance the field of marine metatranscriptomics by generating a time-series dataset of expressed genes in a coastal microeukaryotic plankton ecosystem. A multiyear sampling effort was set up, where we collect surface water micro-eukaryotic plankton on a monthly basis from fixed locations in the Southern North Sea. After a first sequencing run with samples from July 2020 to July 2021, a set of over 5 million unique transcripts was generated. After annotation and quantification, these data allowed us to gain some first insights into the seasonal dynamics of the plankton ecosystem. We could identify key species, functions, and explore how environmental conditions influence biodiversity and/or metabolic processes.

Bridging the gap between morphological and molecular identification of diatoms

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Keywords: Bacillariophyceae, Barcoding, BOLD, eDNA, rbcL

Phytoplankton is frequently dominated by diatoms, single-celled algae that may be found in colonies and have cell walls composed of silica. Diatoms can be used to infer environmental change as species composition may act as an indicator for environmental change and can differentiate between natural and anthropogenic stressors, which may help to manage coastal waters. To evaluate the diversity and species composition of diatoms in marine ecosystems, metabarcoding is a promising method, as it can be used to analyse the genetic material in a water sample (also referred to as environmental or eDNA). The identification of species based on a genetic barcode, however, requires the existence of a reference library of DNA barcodes, which is unavailable for many diatom species. This study aimed to identify diatoms by morphological and molecular methods from monocultures. These monocultures were morphologically identified by digestion using two different organic matter digestion methods and imaged on light and scanning electron microscopes. Then, through molecular analysis by DNA barcoding the ribulose-1,5-bisphosphate carboxylase/oxygenase gene region was amplified using a standard hexadecyl-trimethyl-ammonium bromide protocol and Sanger sequencing. Four monocultures were identified to species and six monocultures to genera. Their molecular barcodes have been published through the Barcode of Life Data Systems and were given accession numbers from GenBank. Species identified; *Cylindrotheca closterium* is a known harmful species to the environment and surrounding organisms whereas *Skeletonema grethae*, *Amphora incrassata* and *Psammodictyon panduriforme* var. continuum have no defined bioindicator values to evaluate environmental change. The procedures and workflows utilised in this study can be adapted and used for marine organisms in the development of barcode reference libraries. This study adds to the global barcode reference libraries of diatoms, contributing to their use as a biomonitoring tool within coastal waters.

2) New Age of Monitoring

5) Molecular tools in marine biology: from methods to applications

Anna Joelle Greife

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Lara Jansen

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Yassine Kasmi

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Paulina Urban

DTU Aqua

The use of Environmental DNA (eDNA) is increasingly applied within molecular biology for the detection of species based on DNA-traces left behind in the environment. In this session, we want to explore the technical advancements made, and hear all about the hands-on applications of the concept.

Technological progress in high-throughput sequencing and bioinformatics has raised questions about the necessity of continuing with invasive methods for biodiversity and single species stock assessments in aquatic habitats. This subchapter aims to highlight applied molecular and computational biology methods as well as bio-modelling to solve these questions.

The concept of eDNA can be applied to activities within ecosystem surveillance, monitoring or conservation. This subchapter focuses on WHERE, WHEN and WHY eDNA is used, including, but not limited to fields like fisheries management, population dynamics, modelling, invasive species detection, studies on aDNA, nsDNA or iDNA and more!

Range expansions of scyphozoan jellyfish – the case study of *Periphylla periphylla* and *Cyanea capillata*

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Keywords: Jellification, eDNA, Metabarcoding, Genetic diversity, Barcoding

Jellyfish abundances have been reported to increase significantly in different aquatic ecosystems. Particularly in areas of rapid change such as the warming Arctic waters, jellyfish blooms might occur more frequently and cause problems for local fisheries. However, until today jellyfish remain an understudied part of zooplankton due to their fragility and historically proposed irrelevance in marine food webs. This study aims to investigate the genetic diversity of the two species *Periphylla periphylla* and *Cyanea capillata* using a set of molecular methods. To monitor future range expansions, we aim to validate eDNA as a viable detection method for jellyfish. The analysis consists of three parts: first, the intraspecific genetic diversity of the two species is investigated using DNA barcoding. Second, to characterize the status quo of high-Arctic jellyfish species diversity, we apply eDNA metabarcoding of sediment samples around Svalbard. Lastly, species-specific primers are developed and tested, with the aim to optimize quantitative real-time PCR as a cost-effective, accurate monitoring. A high intraspecific genetic diversity has been shown in the studied area for both species. For *C. capillata* three divergent species-level lineages were uncovered. Genetic structure according to geographic region was lacking for both species. The metabarcoding analyses of the Svalbard sediment samples did not represent the pelagic community well, compared to net catches from the same stations. Many of the zooplankton and especially jellyfish species caught with nets were not represented in the eDNA. However, differences in pelagic species composition could be observed between North and West Svalbard fjords. In the Arctic-influenced fjords, consistently more jellyfish species were found. The design of a species-specific primer was successful for *C. capillata*. This study shows how important it is to investigate jellyfish with modern molecular tools, which may help to inform us on their potential range expansions or populations increases in the future.

Who's there? A comprehensive eDNA metabarcoding survey of gelatinous zooplankton biodiversity in the Fram Strait

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Keywords: Metabarcoding, Arctic Ocean, Environmental DNA, Jelly Fish

The Arctic is warming two times faster than the global mean, and a phenomenon known as the 'Atlantification of the Arctic' via the Fram Strait is having growing influences on both physical and biological processes in the region. Changes to community composition and function are already underway and these environmental changes will continue to rapidly alter ecosystems in the Arctic and its marginal seas. Greater understanding of how these changes impact local marine biodiversity is crucial for future management and mitigation decisions as well as accurately predicting future Arctic marine ecosystems. Gelatinous zooplankton (GZP) is a highly diverse group of taxa, including cnidarians, ctenophores and tunicates. Very little is currently known about GZP ecology, particularly in the Arctic Ocean, and even less about how they are being impacted by climate-related changes. Not only are they often actively left out of zooplankton surveys, but GZP are notoriously difficult to catch in good condition because their fragile bodies are easily destroyed by traditional sampling methods. GZP are therefor regularly underestimated in biodiversity, distribution and abundance, which contributes to the lack of reliable and comprehensive baseline data available. The aim of this study is to: a) genetically barcode net-caught Arctic GZP specimens to supplement existing reference datasets; and utilize these to b) apply non-invasive environmental DNA (eDNA) metabarcoding methods to investigate GZP biodiversity across the Fram Strait. A short fragment of the COI mitochondrial gene will be amplified from water samples, sequenced using Next Generation Sequencing (NGS) and validated with net catch data from the same locality and period where possible. Oceanographic data will then be incorporated in order to form a holistic baseline dataset of summer GZP biodiversity across the region. Such data would be a valuable contribution to future research into the deviations in Arctic GZP biodiversity and community composition, as a result of on-going environmental changes.

Utility of environmental DNA in biomonitoring of Tanzanian cryptobenthic fishes: Does the environmental DNA approach perform better than the traditional visual census method?

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Keywords: Cryptobenthos, Diversity, Monitoring, Metabarcoding

Notwithstanding the increased biodiversity loss overtime, monitoring of fish is essential for conservation and sustainable fishery management. But assessment of fish diversity in the Western Indian Ocean region in particular relied mostly on the traditional visual census technique. This method has proven to be not reliable as it requires an extensive expertise in fish identification and in most cases overlooked cryptobenthic, pelagic fish that swim over the diver and fish larvae. In this study we compare the efficiency of the environmental DNA (eDNA) technique against the visual census method in detecting fish species at the Mafia archipelago. A series of water samples were collected from a total of 10 sites with varying habitat composition (seagrasses, coral reefs and macroalgae) and further subjected to filtration, DNA extraction and metabarcoding. To have a good comparison of the methods, snorkelling was accomplished concurrently at the study sites. A total of 62 species were identified using visual census, and metabarcoding is underway to affirm the observed diversity. This will be a very first research in the WIO region that assess the effectiveness of the eDNA technique in biomonitoring of Tanzania fishes.

Genetic studies in the coral Parazoanthus axinellae for taxonomic determination

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Keywords: Zoanthid, Barcoding, Genome, Mitochondrial, Taxonomy

Parazoanthus axinellae is one of the most common corals in the Mediterranean Sea reefs ecosystems, characterizing upper circalittoral and cave-scyaphilic habitats. It can grow incrusting freely over rocky walls or as parasitic species over sponges, mainly the Axinella genus. This ecological variety and its high morphological plasticity led to taxonomic uncertainties. Therefore, a genetic characterization is crucial for a correct taxonomic assignment and for the development of conservation strategies. In this study, we have used two amplified DNA regions, cytochrome oxidase I (COI) and internal transcribed spacers from ribosomal genes (ITS) to elucidate the genetic differences between five morphotypes of *P. axinellae* present in the Alboran Sea ("stocky", "slender", "granatensis", "middling", and "cinnabar"). These morphotypes were initially identified on macrostructural and histological characteristics. The genetic analyses carried out in this study have shown that the COI gene is not a suitable marker for variability detection between the morphotypes, due to its low genetic variation, while ITS regions/primer revealed three genetically different clusters. To confirm these results, whole mitochondrial DNA was sequenced for determination of taxonomic status of these morphotypes. Our results suggest that "Stocky" or *P. axinellae* var. brevitentacularis and "granatensis" can be separated from Parazoanthus and integrated in two new independent taxa due to the differences shown by morphological and molecular analyses. The other three morphotypes ("slender", "middling", and "cinnabar") could be included in *P. axinellae* sensu lato. In conclusion, our findings confirm that a deeper taxonomic re-evaluation for the morphotypes of *P. axinellae* based on morphologic and genetic characters is necessary.

eDNA: Reality or Myth? Qualitative and quantitative approach

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Keywords: Environmental DNA (eDNA), Qunatitative, qPCR, Metabarcoding, Qualitative

The rapid technological progress in high-throughput sequencing and bioinformatics has raised questions about the necessity of continuing with invasive methods for biodiversity and single species stock assessments in aquatic habitats. The environmental DNA (eDNA) is an emerging and promising non-invasive tool in aquatic biomonitoring to overcome the limits of traditional biological sampling of marine biodiversity. However, there are still major unanswered questions, mainly are related to the standardization of the qualitative and quantitative aspects of the eDNA analyses. In this work, we evaluated the performance of a qualitative eDNA metabarcoding analysis based on mitochondrial 12S rDNA through a comparison with bottom trawl sampling. In a quantitative approach we evaluated a bottom trawl-based biomass estimation for Atlantic cod (*Gadus morhua*) by a qPCR assay based on eDNA copies. For the qualitative part, from 12 stations in the North Sea and Baltic Sea, 107 fish species were detected, of which 5 species were detected only by trawling, due to their unavailability in public databases, while 32 were detected by both methods and 69 were detected by eDNA only. For the quantitative part, we obtained a 40% simple correlation between the eDNA of *Gadus morhua* and trawling, which increased to 90% by applying a GLS regression model. The results show the stability and competitiveness of eDNA analyses compared to reference methods in the assessment of marine biodiversity, both, for the qualitative and quantitative aspect, highlighting the importance of adopting non-invasive monitoring tools. However, one of the prerequisites is the development of a database covering most species with high taxonomic accuracy. Nevertheless, further investigations are required to establish standardizations in terms of key genes and the exploitation of quantitative outputs of NGS for eDNA-based biomass estimations.

2) New Age of Monitoring

6) Aquatic Animal Telemetry

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Wageningen University and Research

Jena Edwards

NIOZ Royal Netherlands Institute for Sea Research

In aquatic ecosystems, observations of individual animal behaviours are limited by factors such as broad-scale habitat connectivity, study site inaccessibility, and physical properties including extremes in ambient pressure, temperature, and light levels. By employing biotelemetry, numerous approaches are now available for capturing individual movement behaviours remotely and for extended periods, providing insight into broader ecological consequences related to species distributions, migratory patterns, and habitat use. This session aims to explore all aspects of aquatic animal movement ranging from long-distance movements to diel vertical migrations and fine-scale behaviours to better understand the links between individual behaviours, population dynamics, and community-level processes.

Among-individual variation in white seabream (*Diplodus sargus*): spatial behaviour and protection by a coastal no-take area

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Keywords: Acoustic telemetry, *Diplodus sargus*, Effectiveness, Marine protected areas, Spatial behaviour

Marine protected areas (MPAs), and especially no-take areas, play an important role in protecting target populations from fisheries. When developing spatial conservation tools, the design has mainly focused on population-level measures of fish home ranges, spawning and feeding areas, and migration routes. Intra-specific differences in fish behaviour, however, are often not accounted for, even though it could influence the level of achieved protection. In this study we investigated the intraspecific variation in spatial behaviour of a harvested fish, *Diplodus sargus*, and how it impacts the degree of protection granted by a no-take area in the South of Portugal. We identified four behavioural groups according to their spatial behaviour: residents, commuters, seasonal visitors and single visitors. Time at risk greatly varied among the four groups, but also over the year for the seasonal and the single visitors. We did not identify diel variation in the level of protection, although excursions out of the no-take area tended to occur at predictable times for residents and commuters. Our study provides compelling evidence that intraspecific behavioural differences determine protection granted by an MPA and suggests that considering population-level measures on MPA planning can lead to a lack of protection of part of the individuals.

Telemetry based study of northern pike movement in the southern Baltic Sea: space use, connectivity, and implications for management

Olga Lukyanova[1,2,3], Félicie Dhellemes[2,4], Robert Arlinghaus[1,2]

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Keywords: Acoustic telemetry, *Esox lucius*, Network analysis, Island of Rügen, Systematic conservation planning

Knowledge about spatial and temporal variability in the distribution and behaviour of aquatic animals is essential to designing effective management and conservation approaches. We used passive acoustic telemetry to explore seasonal and spatial movement patterns of northern pike, a typically freshwater fish, which, however, also colonised low-salinity areas, such as brackish sea lagoons around the island of Rügen, Germany. We examined the residency, connectivity, and selective use of protected areas by pike. Based on that, we further evaluated the effectiveness of existing spatial protection measures and possibilities for their improvement. The study revealed significant differences in residency and connectivity across different areas and across seasons, especially during spawning migration. Selective use of MPAs has also varied considerably: some protected areas were selected by fish throughout the year, while others were selected only during spawning season or not at all. These findings contribute to the understanding of space use and connectivity patterns of northern pike in the southern Baltic Sea. They show that such patterns should be carefully considered when optimizing spatial conservation and management strategies.

Diel vertical migrations of the blonde skate (*Raja brachyura*) and the spotted skate (*R.montagui*) in the Northeast Atlantic

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Keywords: Activity Budgets, Diel vertical migration, Northeast Atlantic, Rajidae, Tagging

Horizontal and vertical movements of marine organisms are reflective of habitat preference and behavioural patterns in activity. Since the development of electronic monitoring devices, studies into the migrations and movements of many marine species are increasing. However, such studies into the vertical movements of benthic predators remain understudied. In this study, blonde skates, *Raja brachyura*, and spotted skates, *R. montagui*, were tagged with 'pop-off' data storage tags in the North Sea and English Channel. Diel vertical migrations, time-at-depth profiles and activity budgets were used to determine space-use patterns and preferences concerned with depth and temperature for mature individuals. The outcomes of this research will contribute a deeper understanding of the underlying processes that drive fish movements and distribution.

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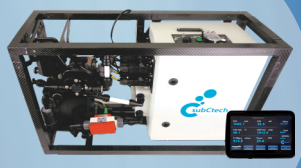

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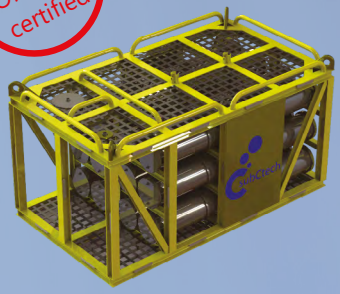

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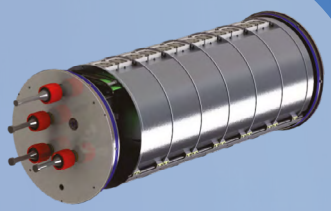

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3) Insights into a changing ocean

1) Climate change-biodiversity-ecosystems services nexus

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Marine coastal ecosystems play a central role in maintaining healthy marine regions. However, cumulative impacts arising from multiple pressures are threatening their ecological conditions and the services they provide, decreasing their ability to response to impacts such as climate change. Therefore, unravelling the climate change-biodiversity-ecosystem services nexus, paying attention to both environmental and socio-economic dimensions is a priority for researchers. This session invites presentations on methods and applications from various field of studies, exploring how integrated frameworks and models can expand our current knowledge on this nexus, and, guide ecosystem-based practices to both address and adapt to climate change.

Bidirectional interaction between phytoplankton diversity and biomass in the ocean

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Keywords: Biodiversity-Ecosystem Function, Phytoplankton, Biodiversity loss, Functional traits, Size diversity

Rapid biodiversity loss poses a threat to ecosystem functioning and its ability to provide goods and services. This is particularly true for system productivity, with the potential to rival even the effects of global environmental changes such as elevated CO_2, drought and nitrogen deposition. Diversity productivity relationships have been the focus of biodiversity and ecosystem function (BEF) research for almost three decades. BEF theory states that these relationships are mainly shaped by the presence of dominant species with favourable traits ("selection effect") or by a diverse number of resource acquisition and utilization strategies ("complementarity effect"). Marine phytoplankton are an abundant component of our oceans, accounting for almost half the net primary production on Earth, but the high diversity of their communities hinders detailed assessments, so the overall effect on productivity remains poorly understood. On top of that, time and spatial scale together with environmental disturbances may play a bigger role in dictating the tradeoffs between diversity and productivity. The links between phytoplankton diversity, environmental parameters, and productivity pose a challenge on BEF studies, and functional traits are the key to help us disentangle the processes mediating the complex diversity-productivity link. Our study employs the use of a multivariate approach to assess how phytoplankton trait diversity (i.e. size) affects productivity. By analysing a large data set (>25 years) that comprises records of both environmental and biological parameters in the San Francisco Bay (USA) area, we determine the effects of phytoplankton trait diversity on productivity and their feedbacks by using multivariate modelling. Finally, our results will provide crucial information on the functional changes of natural phytoplankton communities and clarify their role in the biodiversity-ecosystem function relationship in the oceans under anthropogenic pressure.

Multi-scale modelling of biogeochemical fluxes along the Danube land-sea continuum

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Keywords: Unstructured-mesh, Hydrodynamic model, Interactions, Eutrophication, Climate change

The Danube River is the second longest river in Europe. It passes through 10 countries before emptying in the Black Sea. The Danube Delta, largest nearly undisturbed wetland in Europe, plays a buffering role between the river and the sea (Tockner, Uehlinger, and Robinson 2009). Eutrophication in the coastal zone due to the increase of nutrients coming from the river causes important biological and financial losses since the 1970s (Berlinskyi and Cheroy 2020; Strokal and Kroeze 2013). However, despite this and the importance of the Danube-Danube Delta-Black Sea system, the hydro and biogeochemical fluxes in this system remain largely understudied. We aim to model and quantify the interactions between the Danube delta and the Black Sea, from hourly to multi-annual time scales, using an unstructured-mesh hydrodynamic model. More specifically, we aim to evaluate how the biogeochemical fluxes of the North-western shelf (NWS) (i.e. limited by the 100m isobath) impact and are impacted by the small-scale variability of the three branches of the Danube Delta (i.e. Chilia, Sulina and Sfântul Gheorghe). We will then assess the potential impact of climate change and socioeconomic development on the transfer of water, salt and biogeochemical elements to the sea by running the model under different IPCC scenarios (SSP1-2.6 and SSP5-8.5).

A Machine Learning risk-based cumulative impacts assessment on seagrasses in the Mediterranean Sea under a changing climate

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Keywords: Multi-risk assessment, Cumulative impacts, Machine learning, Scenario analysis

Marine coastal ecosystems (MCEs) are of vital importance for human health and well-being. However, their ecological condition is increasingly threatened by multiple risks induced by the complex interplay between endogenic (e.g. coastal development, nutrients, water transparency, turbidity, etc.) and exogenic (e.g. sea surface temperature, currents, wave, etc.) pressures. Assessing cumulative impacts resulting from this dynamic interplay is a major challenge to achieve Sustainable Development Goals and biodiversity targets, as well as to drive ecosystem-based management in marine coastal areas. To this aim, a Machine Learning model (i.e., Random Forest), integrating heterogenous data on multiple pressures and ecosystems' health and biodiversity was developed to support the evaluation of multi-risk scenarios affecting seagrasses condition and their services capacity within the Mediterranean Sea. The RF model was trained, validated and tested by exploiting data collected from different open-source data platforms (e.g., Copernicus Services) for the baseline 2017. Moreover, based on the designed RF model, future scenario analysis was performed by integrating projections from climate numerical models for sea surface temperature and salinity variables under the 2050 and 2100 timeframes. Particularly, under the baseline scenario, the model performance achieved an overall accuracy of about 82%. Overall, the results of the analysis showed that the ecological condition and services capacity of seagrass meadows (i.e. spatial distribution, Shannon index, carbon sequestration) is mainly threatened by human-related pressures mainly linked to coastal development (e.g., distance from main urban centres), as well as to changes in nutrient concentration and sea surface temperature. This result also emerges from the future scenario analysis, highlighting a decrease in seagrass coverage and related services capacity, in both the 2050 and 2100 timeframes. The developed model provides useful predictive insight on possible future ecosystem condition in response to multiple pressures, thus supporting marine managers and planners towards a more effective ecosystem-based adaptation and management measures, needed to protect and restore MCEs.

3) Insights into a changing ocean

2) (Sub-)Tropical Coastal Ecosystems in a Changing Environment

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Selma Mezger

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(Sub-)tropical coastal waters are among the most diverse and productive ecosystems, providing various ecosystem services and sustaining human well-being. However, coastal ecosystems, like coral reefs, seagrass meadows, and mangrove forests are impacted by local and global environmental stressors (e.g., climate change, eutrophication, overfishing). Understanding their ecological and biogeochemical responses to environmental changes is key and can ultimately help to inform managers, policymakers, and stakeholders as a step towards better conservation and restoration. We welcome presentations on all kinds of (sub-) tropical coastal ecosystems to discuss and learn about the impacts of changing environments.

Seagrass Ecosystems Under Times of Change

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Keywords: Seagrass, Eutrophication, Global warming, Multiple stressors, Conservation

Seagrass meadows are becoming increasingly threatened, as their distribution along coastal areas makes them especially vulnerable toward local anthropogenic pressures. Seagrasses are disappearing four times faster than tropical rainforests, causing great concern considering the biodiversity associated with seagrass meadows, alongside the wide range of valuable ecosystem services and functions that these meadows provide. Eutrophication on a local scale and climate change on a global scale are the most prominent threats to seagrass ecosystems. Global warming and eutrophication rarely occur in isolation in the environment and these stressors may interact additively, synergistically, or antagonistically. Thus, it is of highest importance to understand the response of seagrass species to combined stressors in their environment, to be able to give sound guidelines for adequately managing and restoring these endangered ecosystems. Therefore, we undertook field studies to explore and compare the combined effects of seasonal warming and nutrient enrichment in the water column and in the sediment on a small- bodied, fast- growing seagrass species and a large-bodied, slow growing seagrass in their natural environments.

Nitrogen cycling by the Posidonia oceanica holobiont under ocean acidification

Johanna Berlinghof[1,2], Luis M. Montilla[1], Friederike Peiffer[1,2], Grazia M. Quero[3], Ugo Marzocchi[1,4], Travis B. Meador[5], Francesca Margiotta[6], Maria Abagnale[6], Christian Wild[2], Ulisse Cardini[1]

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Seagrass meadows form highly productive ecosystems occurring in coastal areas worldwide, where they are increasingly exposed to ocean acidification (OA). This can affect the seagrass holobiont (i.e., the assemblage of the plant host and the associated epiphytic community) by changing both the plant's ecophysiology and the composition and functioning of its epiphytic community. While rhizosphere N cycling has been the focus of extensive research, precise quantification of N transformations on seagrass leaves, as well as an evaluation of the effects of OA, are missing. We performed incubation experiments to assess nitrogen (N) cycling by Posidonia oceanica leaves and the associated epiphytic community collected from inside and outside natural CO_2 vents off the coast of Ischia Island, Italy. We show that complete N cycling occurs on leaves of the iconic seagrass *Posidonia oceanica* in the Mediterranean Sea and OA accelerated the N cycle, while the prokaryotic community structure remained largely unaffected. Ammonium uptake of the seagrass leaves was significantly increased under OA. This increased N demand is potentially sustained by increased microbial daylight N_2 fixation on its leaves. Contrary to expectations, we found higher potential nitrification rates associated with the *P. oceanica* phyllosphere under OA, and anoxic parts of the epiphytic biofilm were suitable microhabitats for nitrate reduction. Our results suggest that the equilibrium between N gains and losses may change under OA and highlight that functional adaptation of their N cycling microbiome plays a key role in biogeochemical cycling.

Tropical reef ecosystems and water quality: interlinkage between habitat and nutrient fluxes

Francine M. van Hee[1,2], Lennart de Nooijer[2], Furu Mienis[2], Virginia Sanchez[2]

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Keywords: Land-derived substances, Reef builders, Curaçao, SEALINK, Currents

Water quality can alter reef ecosystems, yet the effect of land-derived substances on coral reef ecosystems is not fully understood. The Caribbean coastline of Curaçao offers an opportunity to investigate the interaction of land- vs. ocean-derived substances with local reef habitats. By measuring nutrients (phosphate, ammonium, nitrate, nitrite), silicate, total alkalinity, dissolved (in)organic carbon and suspended particulate organic matter), at multiple locations along the coastline, as well as over a depth gradient in different habitats, fluxes in these substances can be measured. The results of this research would contribute to increasing our understanding of tropical reef ecosystems and the influence of and/or effect on quality of the surrounding water. As it is part of the interdisciplinary SEALINK program, which aims to link terrestrial pollutants and inputs to nearshore coral reef growth to identify novel conservation options, results of this research could also contribute to our understanding of land-sea interactions in Caribbean coastal zones.

Deciphering the trophic strategy of the widespread, pulsating soft coral Xenia umbellata

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Keywords: Soft coral, Trophic strategy, Metabolism, Nutrition, POC/ DOC

Corals that utilize a mixotrophic strategy with high heterotrophic capacity may be more resilient under future scenarios as they are able to dynamically shift their acquisition of organic carbon (C). Soft corals in particular currently become more dominant in coastal ecosystems, but knowledge about their trophic strategies is scarce. In this experiment, we thus investigated different organic C acquisition strategies of the pulsating symbiotic soft coral *Xenia umbellata*, i.e., just autotrophy, or paired with heterotrophy. As such, we exposed *X. umbellata* fragments to four treatments; 1) control (no food addition), dissolved organic C (DOC) in the form of 2) glucose, and particulate organic C (POC) in the form of 3) zooplankton and 4) phytoplankton. To ensure comparability, each food source was added daily to a total concentration of 20 mg L-1 of organic C. Preliminary results show 7.6 % mortality in zooplankton and 6.0 % mortality in phytoplankton treatments while colonies in control and DOC treatments showed no mortality. Also, first observations indicate a visual paling of both control and DOC colonies, while colonies exposed to both plankton treatments visually darkened. Remaining response variables, e.g., growth, Symbiodiniaceae cell density, chlorophyll a (chl a), pulsation rate, photosynthesis, and respiration are pending analysis, but will be presented at the ICYMARE. The observed mortality in both POC feeding treatments indicates that the investigated soft coral may be stressed by high concentrations of POC. These stressful conditions may force *X. umbellata* to increase Symbiodiniaceae cell densities and/or chl a concentrations (as evidenced by the visual darkening) to meet their organic C demand. Generally, disentangling the potential trophic strategies of *X. umbellata* may help to shed a light on how this coral will cope with future scenarios, particularly eutrophication, which directly increases DOC and indirectly POC concentrations in the water.

The soft coral *Xenia umbellata* is highly tolerant against key environmental change factors

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Coral reefs worldwide are affected by global (e.g., ocean warming and acidification) and local (e.g., eutrophication) factors. Alone, or in combination, these factors can lead to phase shifts, often from hard coral to algae dominated reefs, yet also to alternative states dominated by soft corals. While reefs show increasing abundances of soft corals worldwide, knowledge about the effects of global and local factors on these organisms is scarce. Thus, we here investigated how such factors impact the ecophysiology of the widespread pulsating species *Xenia umbellata* as a model for soft corals. In an interconnected series of five laboratory experiments, we exposed *X. umbellata* to different concentrations of dissolved organic carbon (DOC; 10, 20, and 40 mg/L), nitrate (NO3; 5.5 and 37 µM), or phosphate (PO4; 1, 2, and 8 µM) under warming (from 26°C as control, to 28, 30, 32°C) and acidification scenarios (from a pH of 8.3 as control, to 7.9, 7.7, and 7.5). Along with a range of ecophysiological parameters, we quantified mortality, pulsation, and gross photosynthesis (Pgross) as indicators of coral fitness. Findings revealed that there was no significant mortality observed under any factor, alone or combined. Pulsation was significantly reduced by acidification, alone and in combination with inorganic eutrophication, as well as warming. Interestingly, both DOC and PO4 had a mitigating effect on pulsation under warming. Pgross was significantly reduced under high NO_3 concentrations (37 µM) alone. Further parameters are still pending analysis, but will be presented at the ICYMARE. Overall, *X. umbellata*, other than hard corals, seems to be tolerant against most of the investigated global and local factors, alone and combined. Thus, our findings contribute to explaining the observed competitive advantage of soft corals under currently changing environmental conditions.

Studying the effects of tourism on water quality of a tropical small island holiday hotspot – pandemic style

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Keywords: Wastewater pollution, Bioindicators, COVID-19, BACI, Risk assessment

During pre-pandemic times, up to 500,000 tourists visited the 6 km^2 small Indonesian island Gili Trawangan annually. While the rapid development of tourism provided livelihood and economic growth for the islanders, it also caused socio-environmental conflicts. One of them is the disproportionate amount of wastewater generated by the tourism sector, which overwhelmed local treatment infrastructure and eventually led to measurable pollution of the marine environment. From early 2020 to early 2022, however, the devastating COVID-19 pandemic reduced global tourism to a minimum, therewith, interrupting the discharge of tourism-generated wastewater on Gili Trawangan. This condition, as devastating as it is to the local tourism industry, has presented the unprecedented scientific opportunity to study the effects of tourism on biogeochemical and microbiological water quality on the island. The presented study leverages this quasi-experiment by measuring established physico-chemical and microbial indicators of water quality and wastewater contamination in groundwater and coastal waters i. before, ii. during, and iii. after mass tourism recovery at more and less impacted sites around the island. Analyzing the generated time series, we quantify the impact of tourism on the island's water quality and further assess the responsiveness of the chosen indicators to evaluate their suitability in small island wastewater monitoring.

3) Insights into a changing ocean

3) Long-Term Ecological Observations To *A*ssess Ecological Changes In The Marine Environment

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Global climate change, increasing temperatures and pollution affect the health of the oceans with distinct effects on marine systems on multiple scales. Tracking the ecological and physicochemical impacts of environmental change might be monitored better if we coordinate global observing systems more cohesively. This includes better coordination, standard practices and harmonised outputs across observatories. Long-term studies are key to detect comprehensive indicators and generate valuable assessments. In this session we aim to bring together transdisciplinary research working on bioindicators of the Global Ocean's health and on coordinated efforts. We invite researchers from multiple disciplines and all career stages, but early career researchers are especially encouraged.

Is the phenology of phytoplankton blooms in the Baltic Sea changing?

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Keywords: Diatoms, Cyanobacteria, Spring bloom, Summer bloom, Inter-annual variability

Phenology studies describe the key stages of the life cycle of species, e.g. seed sprouting, bird migration or phytoplankton growth. Phenological events are seasonal and therefore provide insight about the sensitivity of an ecosystem to environmental changes. Alterations in phytoplankton phenology affect the timing of food availability with consequences across the entire food web. Phytoplankton blooms occur regularly in all sub-basins of the Baltic Sea, frequently during spring and summer seasons. Although phytoplankton growing season plays an integral role in the functioning of the ecosystem, there is still uncertainty how phytoplankton blooms will respond to environmental changes in the Baltic Sea. We study the inter-annual variability and phenology of diatom and cyanobacteria blooms between 1990 and 2019 in the eastern Baltic Sea. For this purpose, we developed a simple physical-biological model and simulated a 30-year period based on realistic atmospheric forcing and initial conditions from the study site. The results showed a significant change in phenology, especially in the cyanobacteria bloom, which is on average occurring 9 days earlier and lasting 15 days longer over the 30-year period studied.

Reproduction and recruitment patterns of black corals in the Toliara Region, southwest Madagascar

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Keywords: Antipatharians, Toliara, Madagascar, Larval recruitment, Reproduction

Antipatharians are colonial marine organisms characterized by polyps with six unbranched tentacles. They are threatened marine organisms which are illegally fished mainly for jewellery trade. In Madagascar, such illegal fishing activities have already been documented these last years. Consequently, studies about the biology and ecology of black corals from this region have increased recently in order to improve our knowledge for future conservation. In this work, these objectives are accomplished through the assessment of the larval recruitment and juvenile growth patterns in three distinct sites: (i) in the turbid waters of Soalara, (ii) in the Reef of Toliara, and (iii) at the reef of Ifaty. Firstly, linear transects were performed to describe the antipatharians diversity. Then, nine tables were placed in the study areas, on which 30 recruitment plates were fixed. In each recruitment table, three different types of plates including ceramic, terracotta and limestone were tested for larval recruitment, as well as two types of position each table. The average height recorded was 116 ± 100 cm in Toliara, 82,7 ± 58,5 in Ifaty and 33,5 ± 26 Soalara. Statistical analyses have shown that the Reef of Toliara has the largest specific richness as expected at the time of the submission of this abstract, plates will be retrieved out of the water in the following weeks. The next steps will be to do (i) a complete characterization of the species coverage on each plate, (ii) the evaluation of the recruitment rates depending on the study site, (iii) a morphological and molecular description of the recruits, and (iv) the evaluation of the growth rate of the juveniles. Data between sites will be the, compared and correlated to the water temperature and environmental characteristics of each site. Conservation perspectives will finally be drawn out of the results of this work.

Fish Diversity in the Tidal Region of the River Ems, Northwest Germany

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Keywords: Biodiversity, Temporal changes, Diadromous fish species, Estuarine ecology

The tidal Ems estuary at the German-Dutch border serves as a spawning and feeding ground for many fish species. Also, it connects marine and freshwater habitats, and is thus a transit area for various anadromous and catadromous migratory fish species, such as lamprey, eel, smelt, or salmon. However, the area is heavily affected by anthropogenic influences. Modifications for ship traffic and flood control, for example, have resulted in heavy sediment loads and oxygen depletion. Consequently, the water quality has decreased, and many fish species have declined in abundance. In order to observe temporal changes and seasonal patterns in the fish community structure, we analyzed stow net catches in the oligohaline zone of the tidal river Ems on a weekly basis from November 2020 to December 2021. We found substantial temporal variations in catch rate, diversity and dominance structure within that period. Moreover, our data show typical seasonal migration patterns of single species. In context with previous studies on fish abundance, and abiotic factors, such as temperature and oxygen availability, this comprehensive data set contributes to a better understanding of fish communities in German estuarine ecosystems.

Benthic megafauna in the Arctic Ocean – future dominion by sea cucumbers?

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Keywords: Long-term research observatory, Image analysis, Community composition, HAUSGARTEN

Benthic megafauna in the Arctic Ocean are important for the functioning of deep-sea ecosystems and influence the global carbon cycle. Food availability, as represented primarily by the phytodetrital flux from surface layers, influences the structure of benthic communities in the Arctic Ocean. Along the highly productive marginal sea-ice zones, benthic communities benefit from enhanced food supply. With the advance in climate change, marginal sea-ice zones are shifting and organisms at the seafloor are faced with changing environmental fluxes. This study was designed in order to deepen our understanding of benthic megafauna community dynamics in the Arctic Ocean, from which to infer predictions about the future. Benthic megafauna was quantified by annotating image data from 2016 to 2021. Image data was derived from three different stations, located in the north (N_3), centre (HG-IV) and south (S_3) of the HAUSGARTEN observatory in the Fram Strait, and was analysed in context with sea-ice coverage measurements. The benthic megafauna communities showed a shift in dominant functional traits, from sessile suspension feeders, to mobile deposit feeders at all stations over the study period. The dominance of mobile deposit feeders was attributed to one species, the sea cucumber Elpidia heckeri. This species showed increases in density of more than 20% across all three stations during the study period. Variations in phytodetrital quality and quantity are most likely the reasons for these strong density increases of the opportunistic sea cucumber. Additionally, a positive relationship between benthic megafaunal density and the extent of sea-ice coverage at N_3 and HG-IV was indicated. From these data, into the future, similar strong variations in deposit feeding holothurian densities are expected, given their ability to quickly respond to changing phytodetrital fluxes. This research shows how valuable long-term image-based data studies are in order to detect trends in the future Arctic Ocean.

Wiggling in the deep – Diversity of Arctic deep-sea nematodes at the long-term ecological research observatory HAUSGARTEN

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Keywords: Meiofauna, Benthos

Nematodes are the most abundant multicellular organisms on this planet and yet our knowledge of them is still very limited. They occur as parasites or free-living in virtually every environment, ranging from terrestrial soils, to sediments in fresh-, brackish-, and marine waters, down to the deepest trenches in the oceans. Free-living nematodes constitute a major part of the so called meiofauna, a group of different animal phyla with a size between 32 µm and 500 µm, which inhabits the interstitial space between the sand grains. In deep-sea sediments, more than 95% of all meiofauna organisms are free-living nematodes, with abundances ranging from 1mio. to 12mio. individuals per square meter. They express different feeding types, ranging from selective microbial feeders to predators and play a big role in nutrient recycling. But in one way or the other are all feeding-types reliant on food input from the water column above, whose composition is changing with changing environmental conditions in surface waters. Therefore, studying nematode diversity can be a way of monitoring surface/deep-sea relations and also effects of climate change in the deep ocean. The annual meiofauna sampling in the long-term ecological research deep-sea observatory HAUSGARTEN, which has been established by the Alfred-Wegener-Institute in the marginal ice zone of the Fram Strait more than 20 years ago, provides the world's longest time series on deep-sea meiofauna, allowing for a comprehensive investigation of the deep-sea nematode community with abundance- and functional-based biodiversity analyses over spatial and temporal scales.

Deciphering the Holocene history of Arctic marine mammals using sedimentary ancient DNA

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Keywords: Arctic marine mammals, Holocene, sedaDNA, ddPCR, Metagenomics

Palaeo-archives such as sediment cores are invaluable for the reconstruction of past environmental changes and biological processes. However, most research has focused on resolving dynamics of physical parameters and obtaining proxy time-series from organisms at the base of the food web, whereas higher trophic levels are so far neglected. Therefore, long-term data on the response of marine mammals to abrupt climatic perturbations remains scarce. Our project aims at leveraging recent advances in the development of molecular tools for the analyses of ancient genetic material to characterize the histories of marine mammals in the Arctic region. For this purpose sedimentary ancient DNA extracted from Holocene marine sediment cores from around Greenland will be analysed. Specifically, shotgun metagenomic sequencing is used to comprehensively describe DNA from all organisms present, targeted assays for the quantification of Arctic marine mammal DNA (ddPCR) are used and past populations are characterized based on mitogenomes retrieved by hybridization capture. We integrate our findings with proxy data that document the timing and magnitude of environmental changes, as well as community structure and abundance of lower trophic levels. This allows for a holistic perspective on the processes that cause spatial and temporal variability in marine mammals, which will also aid answering the question whether demographic changes in marine mammals were driven by bottom-up ecosystem processes or anthropogenic pressure such as whaling.

3) Insights into a changing ocean

4) How far can they go? Pushing the limits

Linda Rehder

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Marine primary producers play a fundamental role within oceanic ecosystems. Not only do they form the base of marine energy flux and provide half the atmosphere's oxygen, they furthermore contribute significantly to major biogeochemical cycles and thus carbon export. Due to global change, they are partially facing drastic alterations of their habitat in terms of temperature, nutrient availability, pH and salinity. Especially in extreme environments such as polar regions, the tropics, intertidal systems, and estuaries, primary producers could be pushed beyond their limits. We encourage all scientists working on marine primary producers – from algae to seagrass – to join our session.

Light, iron and manganese availability: important drivers of Southern Ocean phytoplankton ecology and productivity

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Keywords: Phytoplankton, Southern Ocean, Iron, Manganese, Primary productivity

The Southern Ocean (SO) is the world's largest High-Nutrient Low-Chlorophyll region, where the scarcity of trace metals such as iron (Fe) drives SO phytoplankton composition and biomass build-up. As dissolved manganese (Mn) concentrations in the Atlantic sector of the SO are very low (0.04 nM), it was hypothesized that phytoplankton growth may not be limited by Fe only, but also by Mn availability. In addition, future scenarios indicate negative correlation between light and trace metal availability. The effect of these interactives processes on SO species composition is still lacking in the field. Our Fe-Mn bottle amendment experiments with natural phytoplankton communities of the Drake Passage and the Weddell Sea show that only some members of the phytoplankton community were Fe-Mn co-limited under low light, including the biogeochemical important diatom group Fragilariopsis. An additional laboratory experiment confirms that requirements for trace metals can greatly diverge among phytoplankton species. Hence, light, Fe and Mn availability are key factors for shaping SO phytoplankton community structure, with important implications for the efficiency of the biological carbon pump.

The phytoplankton holobiont in a changing Arctic Ocean

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Keywords: Holobiont, Microbiome, Thalassiosira, Nitrification, Symbiosis

Rapidly changing ocean properties are leading to an invasion of temperate organisms into the Arctic, raising the question of how poleward migrating phytoplankton species cope with lower temperatures, longer periods of darkness, and increasing rates of nitrification. Given that phytoplankton performance is also highly dependent on its associated microbiome, it is crucial to consider how bacterial symbionts and opportunists modulate and influence the physiology and performance of poleward migrating phytoplankton species. To address this research gap, three stepwise experiments are planned to better understand the contribution and adaptation of temperate and Arctic phytoplankton holobionts in the context of climate change.

Phytoplankton in the Elbe estuary

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Keywords: Metabarcoding, Picophytoplankton, Salinity gradient

In the Elbe estuary, phytoplankton are exposed to multiple stressors (e.g. high turbidity, changing salinities, biotic interactions) when drifting downstream. While many of them die, this might offer opportunities for those who are able to deal with or benefit from those rather 'inconvenient' circumstances. In my PhD, I am exploring phytoplankton in the Elbe estuary with a combination of methods that has not been applied for this group in this ecosystem before (including metabarcoding and single species experiments). My aim is to shed some light on drivers of phytoplankton abundance and composition along the environmental gradients of the estuary. I am focussing on the lower estuary which has not been investigated since the 1990s and put a special emphasis to those groups commonly not found with conventional techniques, such as picophytoplankton. By the means of metabarcoding (4 stations, 2 seasons), I found several species previously not reported from the Elbe estuary, including pico- and nanophytoplankton such as Synechococcus and Minidiscus. An unexpectedly high number of species peaked around the slightly saline (~ 1.5 PSU during sampling) maximum turbidity zone in the lower estuary, which intuitively appears as a highly "unfavourable" habitat for phytoplankton. Though this accumulation might partially be based on the dynamics of tidal currents (which also cause the turbidity in this area), some species show an extremely distinct spatial pattern which could indicate their ability to grow extensively in this area despite low light availability and changing salinities. In my upcoming research, I want to do further metabarcoding studies and laboratory experiments with single species (e.g. salinity and light treatments) to analyse what possibly makes specific species able to survive and grow in the lower estuary.

Beyond the optimum: The effect of increasing temperature and N:P supply ratios on the performance of a North Sea phytoplankton community

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Keywords: Nutrient concentrations, Stoichiometry, Growth rate, Thermal performance, N:P Ratio

Increasing temperatures and shifts in nutrient availability are predicted to be among the most consequential changes driving the performance of phytoplankton communities and thus ecosystem functioning in the future. However, these important drivers are often examined independently, using laboratory studies with monospecific populations and/or under moderate temperature and nutrient regimes. Alongside a large-scale mesocosm experiment investigating the effect of increasing temperatures on various biological response variables of a natural marine plankton community, we exposed such community to three temperature ramps (increase by 1°C per day to final temperatures of 6°C, 12°C and 18°C) and their resulting constant regime (with and without acclimation via the temperature ramp) across 25 combinations of phosphorus (P) and nitrogen (N) supply creating a wide range of N:P ratios in bottle incubations. Within this experiment we monitored growth rates, stoichiometry, biomass and community composition. This multifactorial design allows us to disentangle how individual and interacting effects of warming and rising N:P supply ratios beyond optimum conditions alter the stoichiometric and growth response in marine phytoplankton. In turn, this understanding is prerequisite for predicting the elemental composition of future marine phytoplankton communities which is crucial for global biogeochemical cycles (including carbon sequestration) and food quality aspects for higher trophic levels.

Blooms in the Baltic Sea: insights into limiting nutrients acclimation strategies of toxic diazotrophic cyanobacteria

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Keywords: Cyanobacteria, Blooms, Phosphorus, -Omics, Baltic

In the last decades the occurrence of toxic cyanobacterial blooms in the Baltic Sea has been increasingly observed and attributed to global warming and eutrophication. In addition to physical parameters, low concentrations of dissolved inorganic nitrogen (DIN) and a surplus of dissolved inorganic phosphorus (DIP) are considered favourable factors to enhance the bloom formation of diazotrophic cyanobacteria. Under inorganic nutrient depletion, the ability of specific cyanobacterial species such as *Nodularia* spp. to take up DIP or organic phosphorus and to control their buoyancy may represent an advantage over other aquatic microorganisms. A multi-level study has been initiated to particularly understand the role of DIP as trigger for the occurrence of cyanobacterial summer blooms in the Baltic Sea. The study includes three approaches: (1) controlled conditions were applied in laboratory experiments with *Nodularia spumigena* strain CCY9414 to characterize acclimation mechanisms towards long-term DIP starvation; (2) semi-controlled conditions were applied in mesocosm experiments conducted at the Tvärminne Zoological Station (Finland), in which dissolved organic carbon (DOC) or inorganic nutrient sources (DIN) were supplied in a 15-day experiment. This experiment aimed to identify the members of the phytoplanktonic community that benefit from DIP that is naturally available during the summer season; (3) uncontrolled, field conditions were investigated using an Automated Fixation multi-Sampler Systems (AFISsys) for in situ samplings at the IOW-MARNET research stations (Southern Baltic Sea). This approach allows cyanobacterial field samples to be processed for "meta-omics" studies to assess their role in the Baltic Sea microbial communities. An overview of the study will be presented. Particularly, polyphosphate accumulation and transcriptomic profiles of long-term DIP-starved *Nodularia spumigena* CCY9414 cultures will be under the spotlight. Furthermore, insights from the field and the mesocosm approaches on the role of diazotrophic cyanobacteria within the microbial communities of Southern and Western Baltic Sea will be also illustrated.

Cyanobacteria in a changing environment

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Keywords: Nostocales, Resurrection, Harmful algal blooms, Baltic Sea

Climate warming and eutrophication increase toxic cyanobacterial blooms in the Baltic Sea, which in turn have far-reaching consequences with negative impacts on the Baltic Sea ecosystem (e.g. sea bottom anoxia). Therefore, it is important to understand their current success and the impact of climate warming during the past 150 years on Cyanobacteria. Cyanobacteria from the order Nostocales, produce resting stages (akinetes) that can survive in sea sediments for up to centuries. We therefore sampled two sediment cores from eastern Gotland Basin and from Gulf of Finland and use a resurrection approach to revive historical cyanobacteria strains. In temperature experiments, those strains will be characterised ecologically and morphologically to investigate and compare trait specific reaction norms to increasing temperatures between 150-year-old filamentous cyanobacteria and recent strains. I here represent my PhD concept including resurrection studies as well as the investigation of morphology and molecular diversity of historical cyanobacteria strains from the Gulf of Finland and from the eastern Gotland Basin.

Hydraulic investigation of the effects of artificial structures as restoration facilitator for seagrass

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Keywords: Coastal engineering, Wave flume, Wave attenuation, Bathymetry, Ecosystem

Seagrass meadows provide several ecosystem services needed to combat climate change, the loss of biodiversity and coastal erosion. Even though it can be found almost all over the globe, the distribution of seagrass declined ever since monitoring was started and the acceleration of losses over the last decades threatens coastal ecosystems. Established meadows introduce a positive seagrass sediment-light feedback which creates the needed hydrodynamic conditions for further seagrass growth. Therefore, seagrass growth in areas without seagrass meadows is unlikely and even seagrass restoration is often unsuccessful. This talk discusses the capability of biodegradable, fully submerged artificial structures to create hydrodynamic conditions suitable for seagrass reestablishment. Two structures – a willow fence and an artificial reef – serving as restoration facilitators are tested through prototype scale experiments in a wave flume. Wave attenuation is measured using ultrasonic wave gauges. An acoustic Doppler velocity-meter measures at multiple locations around the facilitator to gain knowledge about the alteration of the wave induced flow. Moreover, to understand the structures' effects on the bathymetry and limit scouring, any changes of the model's sandbed are monitored with help of a 3D laser scanner. For both prototypes an attenuation of the flow velocities could be observed for a distance half of the wavelength behind the structure. Due to the reduced flow, sedimentation is occurring for both tested structures. While for the fence the accumulation of sand is limited to a relative distance kl_s < 1 behind the structure, the experiments showed an accumulation in the whole measurement area for the artificial reef. Around the mounting poles of the willow fence, strong scouring is detected, but can be limited by introducing a scour protection. Within the scope of the project SeaStore, the knowledge gained through the flume experiments is used to test the restoration facilitators in the Baltic sea.

3) Insights into a changing ocean

5) Just keep swimming: Marine species redistribution in a changing climate

Svea Vollstedt

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Annabell Klinke

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Species are on the move because of human-mediated climate change, shifting their distribution (generally) poleward at regional to global scales. This, in turn, alters ecosystem structures, functions, and services with consequences for human well-being. Species redistribution dramatically affects fisheries and socioecological systems worldwide, yet leaving some more vulnerable than others (i.e., Small Island Developing States). Therefore, we invite presenters from natural and social sciences to advance our knowledge on the challenges generated by climate-driven species redistribution. We welcome abstract submissions from studies filling knowledge gaps related to climate change effects on marine species, communities, ecosystems, or socioecological systems.

Effects of climate change and anthropogenic disturbance on the interaction of two delphinid species: competition or co-existence?

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Keywords: Delphinids, Interaction relationship, Ecological niche modelling, Multiple stressors, Spatial-temporal ecology

Marine top predators, such as many cetacean species, play an essential role in the functioning and structuring of marine ecosystems. Yet, abundance estimates for many species are still unknown and the importance of the interaction relationship between these species often remains unclear. This is especially important for their response to climate change. Studies for other species groups have found that species interaction relationships considerably determine the species' response to changing environmental conditions. The present study focuses on two delphinid species, the short beaked common dolphin (*Delphinus delphis*) and the Atlantic spotted dolphin (*Stenella frontalis*) which are seasonally co-occurring in mixed pods and might compete for the same resources. Yet, their distribution ranges differ with S. frontalis occuring in more tropical, warmer waters. This suggests that changing environmental conditions might have a substantially different effect on their distribution and alter their interaction relationship. A long-term dataset of common and spotted dolphin occurrences collected by the Azores Fisheries Observer Programme (POPA) in combination with climatic environmental data will be used in different modelling approaches to study the effect of changing environmental conditions on their distribution and subsequently anthropogenic stressors to assess population dynamics. This research project will contribute to the descriptors of the Marine Strategy Framework Directive (MSFD) of the European Union by providing still missing abundance data for two cetacean species in the Azores region, as well as to a better understanding of how climate change and anthropogenic disturbance affect marine top predators. As such it adds to existing knowledge for better marine management on a regional and European level. It will also provide insights into the interactions between marine top predators and develop a novel approach to include interactions in climate climate change predictions, which will considerably improve the performance of predictive models for the field of marine mammal science.

Habitat suitability of the whale shark *Rhincodon typus* in the Eastern Tropical Pacific.

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Keywords: Niche, Distribution, Telemetry, Movement, Climate change

The whale shark *Rhincodon typus* is an elasmobranch species categorized as endangered by the International Union for Conservation of Nature (IUCN). This species is found in tropical and warm temperate regions with high productivity, due to the high concentration of phytoplankton and zooplankton, which in turn are the main food of the whale shark. They have great spatial mobility and can travel long distances in search of food. In the Eastern Tropical Pacific (ETP) (22°N-10°S, 80°W-150°W) it can be found from the Gulf of California, Mexico to the coast of Peru, where its presence has been associated with primary productivity systems and oceanic fronts present in the region. This study focused on modeling the ecological niche of R. typus in the ETP area. For this purpose, the occurrence of 115 individuals tagged between 2011 and 2019 in the Galapagos Marine Reserve were obtained. The estimation of the probability of occurrence of the species in the study area was carried out through maximum entropy modeling (Maxent), superimposing satellite information with environmental data such as Chlorophyll-a (CHL), sea surface temperature (SST), currents, and bathymetry. The models were constructed according to the seasonality of the species in the study area. The monthly and seasonal models showed an optimal fit (AUC > 0.90). The Chl- a variable was the largest contributor to the model, followed by currents and finally bathymetry. The results show how the habitat suitability of the species is associated with cold waters. In the cold months in the ETP, individuals preferred habitats in oceanic waters, while in the warm months the habitat of the individuals was found with greater affinity to the coast, in upwelling areas. As conclusion, this study is the first to suggest the suitability habitat of R. typus in the ETP area. This information supports evidence to enforce measures to further protect the species in the ETP.

Geographical distribution and characterization of some non-native species of the Algerian coast

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Keywords: National database, Invasive species, Phylum, Descriptive sheets

Even though predicting the spread of non-native invasive species (NIS) as a result of human activities and climate change is of utmost importance, our knowledge on the biology of NIS is very limited. Hence, our study aims to highlight the distribution and spread of NIS along the Algerian coast by comparing occurrence records of NIS from 2018 to present. In order to better understand the geographical distribution of NIS along the Algerian coast, we established a list of NIS according to phyla and site. Our list incapsulates 38 newly introduced species for a total of 106 NIS. Species with unknown distribution are especially important to map, in particular a species of bryozoan, Bugulina fulva, because it is suspected to be crucial to the existence of non-indigenous species, that are present along the Algerian coast. We note local fishermen, divers and socials hunters contributed to the collection of the data and our results will contribute to the national database BANBIOM on marine biodiversity in Algeria which is located at ENSSMAL.

3) Insights into a changing ocean

7) New plastic pollution types and novel sources of microplastic pollution in marine systems

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Mánus Cunningham

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Recently, novel microplastic sources such as ship paint contamination have been identified. These polymer-based paints have been recorded in the relatively pristine environment of Antarctica, from the surface waters of the Weddell Sea to the depths of the South Sandwich Trench, and in rocky intertidal gastropods from the North Sea, Mediterranean and Atlantic Ocean. Furthermore, novel plastic pollution types ('plasticrusts', 'pyroplastics' and 'plastiglomerates') which were recently identified may become part of the future sedimentary record. We welcome you to submit an abstract on novel plastic sources and types and join us at ICYMARE Bremerhaven 2022.

Frequent field observations of novel plastic forms in estuarine habitats

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Keywords: Plastiglomerate, Environmental monitoring, Fourier-transform infrared (FTIR) spectroscopy, Environmental drivers, Seto Inland Sea

Pyroplastic and plastiglomerate constitute novel plastic forms that are currently being reported from marine shorelines worldwide. Pyroplastic is burned plastic. Plastiglomerate is a solid bond consisting of either melted plastic on rock (in-situ plastiglomerate) or melted plastic containing (in)organic components (clastic plastiglomerate). However, information on pyroplastic and plastiglomerate from other habitats, such as estuaries, is very scant and information on pyroplastic and plastiglomerate dynamics as well as their underlying drivers does not exist. To address these knowledge gaps, we surveyed estuarine habitats along the Ariho River estuary (San'yō-Onoda City, Yamaguchi Prefecture, Seto Inland Sea, Japan) for pyroplastic and plastiglomerate over seven months (from 17 April 2021 to 17 November 2021) and subsequently examined all collected samples macroscopically, microscopically and spectroscopically at the Federal Institute of Hydrology in Koblenz, Germany. In total, we found 37 pyroplastics (including seven polymer types) and seven plastiglomerates (comprising three polymer types). While pyroplastics occurred frequently, plastiglomerates occurred occasionally which shows that both plastic forms were common. Pyroplastic (but not plastiglomerate) occurrence and density were related to intertidal elevation with strandline pyroplastic density contributing heavily (82 %) to the pyroplastic and plastiglomerate entirety. Most pyroplastics (97 %) and clastic plastiglomerates (80 %) floated in water which indicates that rivers can transport these plastic forms. Moreover, strandline pyroplastic density increased under prevailing onshore winds which revealed that such winds are environmental drivers of pyroplastic density. Eventually, we detected several indicators, including upstream pyroplastic and plastiglomerate sources such as campfires and large construction sites and the orientation of the surveyed estuary shoreline relative to the Ariho River mouth, which point out that both plastic forms mainly derived from upstream sources. Thereby, our study contributed to the fundamental understanding for pyroplastic and plastiglomerate dynamics and their underlying drivers in estuaries.

Vertical distribution of microplastics including tire wear particles in the marine environment - A cross section through air, sea surface microlayer and underlying water in Swedish fjord systems

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Keywords: Microplastics, Tire wear particles, Py-GC/MS, Vertical Distribution, Sea Surface Microlayer

The sea surface microlayer (SML) is a natural, predominantly organic film, which extensively covers the ocean's surface. It is the uppermost layer of the ocean with a thickness of up to 1000 µm. Studies and quantitative data regarding microplastics (MP) including tire wear particles (TWP) in the SML, the air and the vertical distribution and transport of these contaminants are scarce. Furthermore, little is known about potential enrichment of certain polymer types in the SML compared to underlying water masses and whether the sources of MP are dominated by riverine or aeolian input. In this study, we analyzed air, SML and underlying water samples from one meter depth, which were taken simultaneously with a remote-controlled catamaran. Sampling was conducted in three Swedish fjords with different anthropogenic impacts, including urban environment, industrial sites and natural conservation areas. Samples were measured with pyrolysis-gas chromatography-mass spectrometry (Py-GC/MS). The analyzed polymers were quantified as backbone-related clusters indicated by the prefix "C". The analysis included clusters of high-demand polymers such as polyethylene (C-PE), polypropylene (C-PP), polyethylene terephthalate (C-PET), polymethyl methacrylate (C-PMMA) and polyvinyl chloride (C-PVC). In addition, car and truck tire wear particles (CTT & TTT) were analyzed in SML for the first time. MP were present in all samples and all fjords. Concentrations reached up to 28 µg total MP/L water sample. The most prominent MP types were CPMMA, C-PVC and CTT. CTT and C-PE showed an overall enrichment in the SML, while CPVC and C PMMA were enriched in the underlying water masses. Other quantified polymer clusters did not show specific enrichment trends. Up to now, not all air samples have been analyzed but already represent a promising data set whose combination with the SML/water data enables innovative insights into vertical distribution of MP in the marine environment.

3.7.P1

Comparing Microplastic Accumulation Trends in Native and Invasive Sea Urchins in the Aegean Sea

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Keywords: Plastic, Invertebrate Ecology, Pollution, Bioaccumulation

Sea urchins are keystone species in many global benthic ecosystems. The concentration of microplastics (MPs) in sea urchin organs was quantified in 120 individuals of 2 different species and from 4 sites across the Greek island Lipsi, with special interest in the differences between the native *Arbacia lixula* and the invasive *Diadema setosum*. Over 93% of MPs observed in both species were fibrous. MP abundance was found to correlate with exposure to open sea and harsh prevailing winds, irrespective of proximity to urban activities. The MP abundance in the invasive species was not found to be significantly dependent on site. Interestingly, the smaller native species contained significantly larger sized MPs than the invasive, possibly as a result of a greater feeding rate in *A. lixula* individuals. Sexually immature urchins may also have a higher feeding rate, giving rise to the negative correlation between gonad index and MPs per individual. The size of MPs ranged from 10µm to 24210µm, heavily skewed towards smaller particles. Few differences in colour were noted between the species and sites. MPs were detected in 100% of the samples with abundance ranging from 19.27 ± 6.77 to 26.83 ± 8.15 items per individual, or 3.55 ± 3.73 to 7.34 ± 10.51 items per gram of wet organ weight. This high value could lead to health risks in East Asia and the Mediterranean, where sea urchin is widely consumed, due to toxins adsorbed to the MPs.

Plasticrusts, plastiglomerate and pyroplastic: New connections among novel plastic forms

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Keywords: Marine plastic pollution, Atlantic Ocean, Madeira, Fourier-transform infrared (FTIR) spectroscopy

Plasticrusts, plastiglomerate and pyroplastic are novel plastic forms that are currently being reported from coastlines worldwide. Plasticrusts are plastics encrusting rocky intertidal habitats, plastiglomerate is melted plastic containing (in)organic material, and pyroplastic is melted plastic with a rock-like appearance. While plasticrusts were suggested to be formed by oceanic waves smashing plastic against intertidal rocks, plastiglomerate and pyroplastic have been related to the (un)intentional burning of plastic in beach campfires and debris incineration fires, respectively. Yet, observations of the plasticrust formation process are missing and it is unknown from which plastic items plasticrusts derive. Also, it is unclear whether plastiglomerate and pyroplastic are related to each other. To address these knowledge gaps, we surveyed rocky intertidal habitats in Madeira Island (Portugal, Atlantic Ocean) for these novel plastic forms and subsequently examined the collected samples macro-, micro- and spectroscopically at the Federal Institute of Hydrology in Koblenz, Germany. We detected green plasticrusts, green maritime rope, blue plastiglomerate and blue pyroplastic. While all green plastics consisted of polypropylene (PP), all blue plastics consisted of polyethylene (PE) and PP. We found that plasticrusts derive from maritime ropes being scoured across raspy rocks in wave-exposed habitats. Moreover, a subsequent lab experiment showed that maritime rope fibers glue together when exposed to simulated summer rock surface temperatures. In combination, these results indicate that waves and temperature contribute to plasticrust formation. Furthermore, we found that the detected plastiglomerate contained a pebble and several pebble-shaped clasts, whereas the detected pyroplastic contained only pebble-shaped clasts. These pebble clasts must have formed during plastiglomerate formation (due to incomplete pyroplastic pebble agglutination) or plastiglomerate degradation (caused by pebble loss of the plastiglomerate). However, regardless of the mechanisms involved, the pebble clasts unequivocally related plastiglomerate to pyroplastic which established the first connection between these two novel plastic forms.

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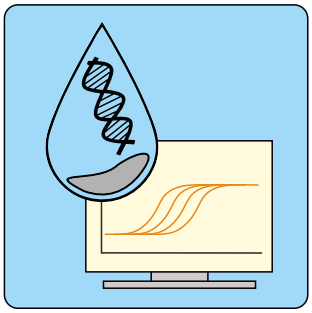

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4) Ecosystem dynamics

1) Interactions between marine species

Jana Vetter

Justus-Liebig-University Giessen,

Oceans harbour a variety of ecosystems inhabited by a wide range of organisms. From competition, over predator-prey to symbiotic relationships, they interact and communicate in multiple ways, forming a complex interaction network. Interactions can occur via direct contact or mediated by the surrounding water. Understanding these relationships and their underlying processes is crucial for conservation efforts. This session wants to bring together lines of research that investigate relationships of organisms on the holobiont, species, or ecosystem level. We look forward to all research that deals with interactions between marine organisms and studies which investigate changes in interactions through anthropogenic stressors.

A Sticky Situation: Copepod-Diatom Interaction in the Context of Oil Spills

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Keywords: Water Soluble Fractions, Fatty Acid Analysis, Harpacticoid copepod, Feeding rate

Oil spills, both large and small leakage, are a frequent disaster in the oceans that continue to this day with no sign of stopping. Studies show that exposure to oil tends to quickly decrease the density of meiofauna estuarine population as a result of both sublethal and directly lethal effects, while the effect and severity of oil exposure on phytoplankton appear to be species-specific. Such differences complicate the determination of how oil spills influence the estuarine food web at large. We investigated how *Platychelipus littoralis*, a resident harpacticoid copepod of the Westerschelde estuary and its prey the benthic diatom *Nitzschia* sp. are affected by the presence of oil, via an oil spill simulation with Diesel Water Soluble Fractions. Specifically, we tested the effect of low and high oil concentrations on copepod fatty acid composition, mortality, egg sack development and feeding rate post-exposure. Diatom growth rate was also measured in response to oil treatments. To focus on the diatom-copepod interaction, the feeding rate experiment was performed combining copepods with diatoms exposed to the different treatments. While we found significant differences in copepod mortality, there were no significant differences in egg sack development, feeding rate, nor diatom growth rate. Fatty acid composition and total content differed significantly among exposure levels, with certain fatty acids becoming predominant within each level. EPA was higher in the control treatment, DHA higher in low concentration, and 16:1n^{-7}, a diatom marker, higher in high oil concentration. Our results suggest that *P. littoralis* is amongst the copepods severely affected by WSF. Nevertheless, *Nitzschia* sp. appears to be among the diatoms unaffected by oil exposure, in turn providing surviving *P. littoralis* with a food source that could potentially offset the acute effects of a spill, thus shedding a light on the effect of oil on the estuarine food web.

Studying species interactions on a microscopic scale – how to map, track, and eavesdrop on super tiny stuff

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Keywords: Holobiont, Diatoms, Algae-bacteria interactions, Phycosphere, Chemical ecology

Species interactions are the core drivers of ecosystem functioning and dynamics. Eukaryotic organisms harbor diverse communities of bacteria and fungi and constitute tiny ecosystems in themselves. The interactions between the host and its associated microbial community have a substantial influence on the host's performance and fitness. The holobiont concept integrates the ecology of the associated microbial community with the ecology of their eukaryotic host and expands on the simplified notion of a single isolated organism. Due to the system's compositional complexity, its spatial dynamics and microscopic scale, species interactions within microalgae holobionts are challenging to assess. An ocean of methods from different fields of research can be applied to study various aspects of holobiont interactions. From starry skies in petri dishes to gold guns and flying molecules, established and emerging methods as well as synergistic interdisciplinary approaches are put in the context of how we can learn to understand what's really going on at the tiny but crucial base of oceanic food webs.

Biodiversity-productivity effects in stony coral assemblages

Jana Vetter[1], André Dietzmann[1], Lisa Hahn[1], Anna Emiglia Lang[1], Maren Ziegler[1]

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Keywords: Coral reef, Biodiversity, Productivity, Physiological response, Stony corals interactions

Coral reefs are the most biodiverse marine ecosystems making them productivity hotspots of ecological and economical significance. Marine heatwaves have led to shifts in stony coral assemblages and loss of biodiversity. As the most important reef-builders, the productivity of stony corals forms the base of a healthy reef ecosystem, but data on productivity of coral species assemblages are scarce and interaction effects among stony corals in shaping their productivity are largely unknown. Here we aimed to investigate the effects of contact-free interactions between various coral species assemblages on their productivity. For this, we conducted 460 incubations with nine stony coral species in isolation and in various species combinations and measured photosynthesis, respiration, and calcification as proxies for productivity. We found that species assemblages consisting of highly productive species in monoculture decreased productivity in polyculture and those consisting of less productive species increased productivity in polyculture. Overall, this resulted in more uniform productivity levels than expected between diverging stony coral assemblages. Our study confirms patterns previously observed in terrestrial ecosystems and implies that universal rules apply to biodiversity-productivity relationships across terrestrial and marine ecosystems alike. Further studies are needed to uncover possible changes in reef productivity due to stony coral biodiversity loss in the future.

Contact-free modulation of coral productivity by sessile reef organisms

Kara Elena Engelhardt[1], Jana Vetter[1], Franziska Wöhrmann-Zipf[1], André Dietzmann[1], Maren Ziegler[1]

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Keywords: Coral reef, Physiological response, Biodiversity, Corals

Biodiversity and ecosystem productivity are closely linked. Coral reefs are the marine ecosystem with the highest biodiversity, which makes them productivity hotspots of ecological and economic importance. Climate change leads to a rapid loss of biodiversity and changes in community composition that affect interactions and productivity of reef organisms. However, the consequences of these changes in community composition for productivity of stony corals and the ecosystems they build are largely unexplored. In this study, we explored the effect of biodiversity-associated stimuli on the productivity of stony corals. First, we subjected three stony coral species to contact-free stimuli from different functional groups (soft corals, macroalgae, and sponges) and monitored their immediate physiological response. Then, we conducted an aquarium experiment in which we subjected five coral species to high and low biodiversity conditions and assessed their productivity after five weeks. All coral species immediately reacted to contact-free stimuli. *Pocillopora verrucosa* increased productivity in response to stimuli by other organisms, Porites rus decreased productivity, and *Stylophora pistillata* maintained stable productivity when compared to the self-conditioned control. While the overall pattern was driven by the investigated coral species, the fine-scale modulation of productivity was also dependent on the stimulating organism. Long-term biodiversity conditions similarly affected productivity of some coral species, albeit in opposing directions to the short-term response in some cases. Our results highlight the potential effects that biodiversity loss in reef ecosystems may have on community composition through indirect modulation of productivity. While the presence of neighbouring reef organisms had immediate and long-term effects on coral productivity, the communication pathways between sessile organism groups that mediate these interactions remain to be investigated.

The diet spectrum of fish in South Greenland waters: the role of gelatinous zooplankton as prey

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Keywords: Jellyfish, Prey analysis, DNA metabarcoding, COI, 18S

Gelatinous zooplankton (GZ) or jellies, consisting of cnidarians ctenophores and tunicates, can reach high biomasses, but so far, have been overlooked as a food source for higher trophic levels. Traditionally, GZ have been seen as trophic "dead-ends" in the food web, as they are rarely observed during visual inspections of predators' stomach contents. This is particularly the case in fishery surveys, which conventionally rely on morphological stomach content analysis. However, high water content and fragility can result in quick digestion of gelatinous prey, meaning only those that were ingested shortly before sampling can be visually recorded. Modern molecular methods, which can detect the DNA of gelatinous species longer after ingestion, are increasingly showing that GZ are part of the diet of numerous animals, including various invertebrate groups, seabirds, turtles and fish. The evaluation of GZ as a potential food source for marine animals is particularly important in context of global warming, as the biomass of GZ is expected to further increase. This study uses DNA metabarcoding (18S and COI) to identify prey items in the stomachs of common Southern Greenlandic fish species, several of which are commercially exploited: *Gadus morhua*, *Sebastes* sp., *Anarhichas* sp., *Argentina silus* and *Hippoglossoides platessoides*. The analysis and comparison of the prey taxa detected with each of the two genes, should yield a comprehensive picture of the prey spectrum of the different fish species, including readily digested and fragile organisms like GZ. The selection of investigated fish species will allow a prey-spectrum assessment of different trophic groups across different habitats: East vs. West Greenland; pelagic vs. demersal fish; juvenile vs. adult.

DNA metabarcoding uncovers prey diversity overlap among tunas and seabirds of Eastern Tropical Atlantic

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Keywords: Diet, Top predators, Tropical ecosystem, Cabo Verde, Atlantic Ocean

Overfishing has been drastically changing food webs in marine ecosystems, and it is pivotal to quantify these changes at the ecosystem level. The study of the ecology of top predators allows to understand the impact of marine food webs' cascading effects due to the decrease of predator populations. This is especially important for ecosystems with a high diversity of top-predators such as the eastern Atlantic marine region. In this work we used DNA metabarcoding to describe the diet of the two most abundant tuna species, highly targeted by fisheries within Cabo Verde and other regions off west Africa, the Skipjack tuna (*Katsuwonus pelamis*) and the Yellowfin tuna (*Thunnus albacares*). We also explored prey diversity overlap between these tuna species and the seabird species breeding in this archipelago that are most likely to share prey preferences and suffer from bycatch, the Brown booby (*Sula leucogaster*) and Cape Verde shearwater (*Calonectris edwardsii*). Overall, the diet of both tuna species was highly diverse, sharing a total of 12 families between the two species. Skipjack tuna diet was dominated by prey from lower trophic levels, such as krill, anchovies and siphonophores, while Yellowfin tuna diet was mainly based on epipelagic fish such as flying and halfbeak fishes. Some of the most abundant prey families detected in Yellowfin tuna diet were shared with both seabird species, resulting on the highest diet overlaps, especially with Brown boobies. These results have implications for the management of tuna fisheries in the Eastern Tropical Atlantic, since a large decrease of both tunas might have cascading effects on both primary and secondary consumer levels. Furthermore, these results provide further evidence that these seabirds may rely on facilitated foraging provided by tuna species and the decrease of these underwater predators may have implications on the viability of tropical seabird populations.

Friend or foe? – Larvae of the invasive Pacific oyster (*Magallana gigas*) trade-off predator and conspecific cues in their decision making for settlement

Sarah Schmidlin[1,2], Yliam Treherne[1], Jan Mees[1,2], Pascal I. Hablützel[1]

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Keywords: Larval Settlement, *Magallana gigas*, Larvae ecology, Settlement cues

Many factors contribute to the successful colonization of new substrates by bivalves. One key factor is settlement preference at the final larval stage. Understanding how ecological cues influence larvae settlement is critical to inform habitat restoration projects, aquaculture, and antifouling efforts. It is well known that larvae of the Pacific oyster are attracted to cues from conspecific adults, which have been shown to originate from shells of dead or living individuals, and waterborne cues released from living individuals. We further know from other benthic organisms, that predator cues reduce settlement propensity. However, in bivalves, these cues have rarely been studied in combination. Here, we investigated the settlement preferences of the Pacific oyster (*Magallana gigas*) when exposed to conspecific and predator cues separately or in combination in an experimental setup. We used a positive cue associated with conspecific shells, a positive cue from water conditioned by live adults and a negative (non-consumptive) cue from kairomones of a main predator, the European green crab (*Carcinus maenas*). We found that predator cues from *C. maenas* significantly decreased settlement propensity, even in the presence of a positive waterborne conspecific cue. Our results suggest that the effects of both types of cues interact in a mainly additive manner. This is first study (to the best of our knowledge) that shows decreased settlement from non-consumptive predator cues for *M. gigas*. Furthermore, we demonstrated that surface bound cues from conspecific shells increased the probability of settlement more strongly than waterborne conspecific cues. In parallel to manual assessment of settlement success trials, we are developing a scalable and low-cost video analysis setup. Specifically, we use Raspberry pi HQ cameras and computers, and particle tracking software. This is an experimental attempt to improve traditional manual observation of larvae settlement as well as complement settlement studies with analysis of larvae behaviors prior to settlement.

Expansion of the harmful dinoflagellate *Alexandrium pseudogonyaulax* in Northern European Waters

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Keywords: Harmful Algae Blooms, Food web interactions, Phycotoxins, Grazing, Long-term Observations

Harmful Algae Blooms (HABs) pose a worldwide ecological problem to marine ecosystems by threatening food webs and marine Fauna, but also an economic problem to aquacultures and the shellfish industry. Toxins produced by microalgae (phycotoxins) can accumulate in the food web and can lead to intoxications in humans. The genus Alexandrium is especially important as it is known to produce a variety of phycotoxins and is distributed worldwide. One of its members the dinoflagellate *A. pseudogonyaulax* has recently (last 15 years) proliferated in Northern European waters, thereby seemingly replacing previously dominating Alexandrium species. *A. pseudogonyaulax* is known to produce the toxin goniodomin A (GDA), however the ecological effects of this substance class are mostly unknown. In addition to goniodomins, *A. pseudogonyaulax* produces a variety of lytic substances that may also exert a negative effect on other members of the phytoplankton community or on higher trophic levels. The influence of these substances on the feeding behaviour, morphological development and hatching rate of the Northern-European copepod *Acartia tonsa* was investigated. In the presence of grazers, the intracellular GDA abundance of *A. pseudogonyaulax* increased by a factor of 4-10 in only 24h. Freshly hatched *A. tonsa* nauplii were not able to develop with a diet consisting only of *A. pseudogonyaulax* and died after four days at the most. In addition, the hatching rate of *A. tonsa* eggs was reduced by approximately 20%. In summary, these findings extend the reported adverse effects of *A. pseudogonyaulax* on other planktonic members and encourage further studies on the interaction between these ecologically important trophic levels.

The diversity of Mollusca from marine lakes in Raja Ampat, West Papua, Indonesia

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Keywords: Species richness, Gastropods, Bivalves, Biodiversity, Benthic

Marine benthic mollusc is one of the most diverse species found in tropical coastal areas. On the other hand, little information exists about their diversity in marine lakes. This study aims to document the species diversity of molluscs that inhabit the marine lakes of Raja Ampat, West Papua, Indonesia. We determined whether the composition of species varied among the lakes and related this variation to the environmental conditions within the lakes. Occurrence data of benthic molluscs species were recorded from 11 lakes using the roving diving survey method. The highest species richness was found in the highest connected lake with 30 species, and the lowest number of species found was in the lowest connected lake with only three species. The recorded species belonged to the classes Gastropoda (46 species, comprised of 33 genera and 22 families), Bivalvia (19 species, consisting of 17 genera and 11 families), and Polyplacophora (1 species). Significant correlations were found between mollusc species richness with connection to the surrounding sea (r-0.77, p-0.006) but not with surface area (r-0.12, p-0.74). The connectivity may determine the number of mollusc species in the lakes, as the degree of connection to the surrounding sea may facilitate the influx of propagule from the coastal area. The nMDS showed the influence of temperature, salinity, and connectivity on mollusc community. The species that could be indicators that specifically seem to thrive in extreme conditions with high temperature and low salinity are Brachidontes sp. and Anodontia sp..

Keeping their cool: the effect of temperature on the bioturbation activity and facilitated ecosystem functions of key Wadden Sea macrofauna

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Keywords: Nutrient cycling, Bioirrigation, Sediment reworking, *Arenicola marina*, *Lanice conchilega*

As anthropogenic influences intensify in coastal ecosystems, it is vital to assess how they can impact bioturbation behaviour of benthic fauna, and ecosystem functions they facilitate. Thus, this study investigated effects of temperature rise on bioturbation behaviours and ecosystem functions of Wadden Sea macrofauna. An experiment utilising single species mesocosm incubations was conducted, measuring bioturbation, sediment stabilisation, and nutrient cycling of four bioturbating species (*Arenicola marina*, *Hediste diversicolor*, *Cerastoderma edule* and *Lanice conchilega*) under 15 and 20 °C. Temperature increases strongly stimulated bioturbation of all species, except *L. conchilega*, while *A. marina* conducted by far the strongest sediment reworking. *Arenicola marina*, *C. edule*, and *H. diversicolor* all destabilized the sediment, yet increased temperature only enhanced sediment destabilization by *A. marina*. Stimulation of benthic nutrient fluxes varied between the bioturbators fauna and was related to behaviour. Again, *A. marina* conducted the strongest nutrient effluxes of NH^{4+}, PO_4^{3-}, and SiO_2, likely due to its strong irrigation activity. Nevertheless, the rise in temperature further increased all species' efflux of SiO_2 and NH^{4+}. Likewise, temperature increased the oxygen consumption of all species relatively by a magnitude of 1, yet *C. edule* and *L. conchilega* cores were much stronger consumers of oxygen than *A. marina* and *H. diversicolor*. Findings here demonstrate that ecosystem functions such as sediment stabilisation and biogeochemical cycling have a clear and direct link to bioturbation by macrofauna. As the strongest bioturbator, *A. marina*, was operating near to its thermal limits, a rise in temperatures beyond 20 °C could pose a threat to its dominant bioturbation. A loss of this sediment reworking will hold ramifications for other ecosystem functions, potentially resulting in accumulation of organic matter within mudflats. Thus, species which show more indifference to the temperature rise, such as *L. conchilega*, could prove vital in maintaining ecosystem functions under upcoming temperature scenarios in the Wadden Sea.

Oxygen consumption in shallow waters of Bay of Gdańsk

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Keywords: Oxygen, In-situ measurement, PyroScience, Consumption, Bay of Gdańsk

The Gulf of Gdańsk is a unique reservoir in the southern part of the Baltic Sea. The specific hydrological and geomorphological conditions influence the development of diverse and relatively rich plant and animal communities. The multi-species underwater meadows shape the richness of benthic and pelagic fauna assemblages. Many types of habitats occur in this area - from the dominant sandy substrate, through coastal reed beds and regenerating Zostera marina underwater meadows, to rocky reefs at the foot of Orłowo Cliff, called oases of biodiversity. Each of these habitats is inhabited by characteristic species that have different oxygen demands. Those benthic habitats are under immense anthropogenic pressure due to the tourist attractiveness of the region. Anthropogenic pressure is particularly evident in summer due to the increased number of tourists, yet its effects are visible throughout the year. It is significant in shaping the structure of the benthic community in each habitat, which directly translates into oxygen demand. Past research has focused on single species oxygen demand under laboratory conditions. In this research, we want to study the consumption of oxygen in the environment (in situ) in a particular habitat. The research conducted will provide preliminary results that can be used as a basis for subsequent scientific projects.

Diet analysis of two hyperiid amphipods in the southern Benguela upwelling system using DNA metabarcoding

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Keywords: *Themisto gaudichaudii*, *Vibilia armata*, Diet spectrum, COI, 18S rDNA

Pelagic hyperiid amphipods represent an important trophic link between the herbivore-omnivore zooplankton community and various higher trophic levels. The two pelagic hyperiid amphipods, *Themisto gaudichaudii* and *Vibilia armata*, are abundant in the southern Benguela upwelling system. *T. gaudichaudii* is recognized as a free-swimming species, while *V. armata* has shown an association with gelatinous zooplankton, particularly during their juvenile stages. So far, morphological identification of prey remains in the stomach contents has been commonly performed to reveal the food items in the diet of hyperiid species. But the stomach content examination technique often overlooked the highly degraded, fragile, and fragmented prey organisms (e.g., gelatinous zooplankton). Thus, the dietary spectra of both species remain poorly understood, especially in the Benguela upwelling system. DNA metabarcoding is an emerging and powerful molecular technique that can be used to investigate diet compositions using DNA fragments available in stomachs or feces. This molecular approach allows prey identification at a high taxonomic resolution to species or genus level, depending on the completeness of the reference database. In this study, we apply DNA metabarcoding to identify the prey composition in the stomachs of *T. gaudichaudii* and *V. armata*, targeting the mitochondrial cytochrome c-oxidase subunit 1 (COI) and the nuclear 18S rDNA regions. Further, we assess variations of prey compositions among the different size categories of each species and different localities in the southern Benguela upwelling system. The outcome of this study provides an insight into the trophic status of the two hyperiids and ultimately contributes to a comprehensive understanding of their ecological role in the southern Benguela food web.

Trophic role of gelatinous zooplankton in the Arctic Marine food web

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Keywords: Jellyfish, Pelagic-benthic coupling, DNA metabarcoding, Benthic scavenging amphipods, Food web

In recent years jellyfish are coming more and more under the spotlight, due to their ability to increase in abundances, often in the shape of large blooms, rather quickly and to impact ecosystem dynamics and energy flow in food webs. In several ecosystems worldwide, a shift from fish or krill to gelatinous organisms in terms of abundance was observed, with potential severe consequences for commercial fisheries as well as for high trophic levels depending on fish or krill as food. Nonetheless, the role of gelatinous organisms as prey is too little understood. Until recently, jellyfish were considered a trophic dead-end, assuming no or little energy transfer to higher trophic levels. However, recent findings with molecular diet studies and in-situ observations demonstrated a regular predation of fish, seabirds and different marine invertebrates on various gelatinous organisms. Gelatinous organisms can also significantly contribute to vertical carbon export, partly in the shape of so-called "jellyfalls", dead gelatinous carcasses sinking to the seafloor. To which extent these "jelly-falls" are utilized by the benthic scavenging community remains understudied. Hence, we aim to reveal the role of "jelly-falls" as a food source for benthopelagic scavenging amphipods in the Arctic marine food web. To do so, we apply DNA metabarcoding targeting a region of the mitochondrial Cytochrome Oxidase I (mtCOI) on the stomach contents of these organisms. Our dataset comprises amphipods collected in a Svalbard fjord while the Polar Night, during which a thriving gelatinous community was present, allowing us to identify the occurrence of gelatinous zooplankton consumed by locally abundant scavenging species.

4) Ecosystem dynamics

2) Coral reefs: past, present, and future

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Coral reefs are the most biodiverse and economically important marine ecosystems worldwide. However, due to anthropogenic pressures, present day reefs are undergoing immense changes in species' abundance and community composition, which are likely to influence future coral generations, the myriad of organisms they support, and the services these ecosystems provide. This session aims to bring together researchers working to elucidate the past, present, and future dynamics and ecology of coral reef regions around the world. We are seeking to incorporate a wide range of techniques at every organizational level from molecular to ecosystem functioning.

Stress-hardening of corals through thermal pre-conditioning

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Keywords: Coral bleaching, Thermal pre-conditioning, Heat stress, Stress tolerance, Environmental priming

Global warming severely affects reef-building corals. In particular, the increased frequency and severity of heatwaves experienced by corals in the last decade challenges their natural acclimatization and adaptation capacities and leads to mass bleaching and mortality on coral reefs worldwide. In this scenario, it is crucial to explore innovative methods and active management techniques that aim to 'assist' evolution and enhance the thermal tolerance of sessile stony corals. This study assessed the heat stress tolerance of six stony coral species (*Acropora muricata, Galaxea fascicularis, Montipora digitata, Pocillopora verrucosa, Porites rus, Stylophora pistillata*) after a 24 day pre-conditioning phase. Specifically, we compared the effects of different stress-hardening methods using distinct temperature profiles. We acclimated coral fragments under three temperature profiles: ambient temperature (26 °C), high stable temperature (29 °C), and high variable temperature (29 ± 1.5 °C with a diel temperature cycle). Following the pre-conditioning phase, corals were exposed to acute thermal stress assays at 35 °C and their physiological response was determined by measuring the photosynthetic efficiency of the symbionts and host tissue coloration as indicator of bleaching. Thermal pre-conditioning at high stable and variable temperatures resulted in increased heat stress tolerance compared to corals from ambient temperatures across species, despite differences in their specific heat stress tolerance. Photosynthetic efficiency declined sharply, plummeting close to zero in corals from stable ambient temperatures, while it remained high in both high temperature pre-conditioning regimes. While the long-term effects of thermal pre-conditioning on stress tolerance remain to be elucidated, our experiment suggests that thermal preconditioning could become a low-cost and sustainable method to actively enhance coral resistance to thermal stress.

Bacterial community dynamics of two coral species in the Andaman Sea (Thailand): Towards linking thermal resistance with microbiome traits

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Keywords: 16S rRNA, Microbiome dynamics, Microbiome-wide association analysis, Manipulation, Probiotics

Microbiome manipulation has been proposed to tackle the coral reef crisis, which is rooted in the excessive thermal stress imposed on reef-building corals by ocean warming. However, developing such microbial interventions, requires a deeper understanding of the microbial roles in thermal resistance of coral holobionts. Microbiome-wide association studies have been used in other holobiont system, such as humans, to help decipher how microbial traits may translate into phenotypic characteristics. To explore the association of coral host-bacteria pairings with known thermal resistance traits, we integrate 16S rRNA data with phenotypic responses to experimental heat stress exposure of two crucial reefbuilding species, *Pocillopora* sp. and *Porites* sp. native to the Andaman Sea off the coast of Thailand. Our analyses reveal the natural species-specific microbiome dynamics of a spatially mostly homogenous pocilloporid microbiome compared to a more variable Porites microbiome that aligns with local environmental conditions of the study sites. Despite the species-specific differences, the proportions of ASVs unique for either heat resistant or sensitive phenotypes were similar in both species, Pocillopora ~10-12% and Porites ~13-14%. We present ASVs unique for the resistant phenotypes, as well as those that were differentially abundant in resistant compared to sensitive corals proposing further investigations into their potential roles for coral thermal resistance. This research pairs metabarcoding with eco-physiological data and its results will be of particular value for future efforts aiming to develop coral probiotics for the conservation of coral reefs.

High molecular weight exudates of hard corals and macroalgae may enhance virus abundance in reef water

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Keywords: Dissolved organic matter (DOM), Bacteria-virus dynamics, Bacterioplankton, Virus-like particles (VLPs), Coral reefs

Corals and macroalgae release dissolved organic matter (DOM) from primary production into surrounding reef water, which can promote bacterial growth. However, little is known about effects of coral and macroalgae exudates on virus dynamics, though viruses outnumber bacteria by at least one order of magnitude, and topdown control through viral lysis can regulate bacteria abundance and nutrient release. To investigate the effects of coral- and algae exudates on bacteria-virus dynamics in undiluted reef water, we used concentrated high molecular weight (HMW)-DOM (i.e., > 1,000 Dalton) from incubations with hard corals, macroalgae, and seawater controls, and added these to reef water in four-day dark incubations. Results revealed that the abundance of viruses-like particles (VLPs) was 28 and 29 % higher with algae and coral exudates, respectively, compared to controls after four days, while no differences were observed after one day. Other parameters (i.e., bacteria abundance, dissolved organic carbon (DOC) concentration, inorganic nutrient concentrations) were not significantly affected by exudates at any time. These results suggest that the effects of HMW-DOM from corals and algae potentially influence viral top-down control on bacterial reef communities.

4.2.P1

Coral community structure around Mitsio archipelagos, northwest Madagascar

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Keywords: Mitsio Archipelagos, Distribution, Genera, Adults, Juveniles

Coral reefs of Mitsio archipelagos is amongst the healthiest and biologically diverse in Madagascar. However, climate change induced stressors such as 1998 and 2016 el nino events and fishery pressure have caused high mortality in scleractinian coral communities. Study was conducted in November 2020 to assess the scleractinian coral community structures in ten stations at the Mitsio archipelagos. At each station, 3 belt-transect of 10m² (10m*1) was laid parallelly to the shore. Every colonies were identified (genera), counted, and assigned into a size categories of 0-5cm, 6-10cm, 11-20cm, 21-40cm, 41-80cm, 81-160cm, 161-320cm. 3388 colonies with 880 juveniles (0-5cm) and 2508 adults (5cm) from 44 genera were recorded. Acropora (26.33%), Porites (15.23%), Dipsastrea (13.11%), Platygyra (10.45%), Galaxea (5.14%), were the most abundant. They present 70.25% of the total colonies. The mean generic richness was 16.63±0.074 genera per 10m². Nosy Fisaka (22.67±2.52 genera per 10m2), and Ankarea (19±4 genera per 10m2) are the richest genera while the lesser number of genera was observed in Nosy Vazoagna (11.33± 1.53 genera per 10m²). The overall mean density of coral assemblage is 11.53±2.62 juveniles colonies per 10m² and 83.6±3.81 adults colonies per 10m². Then, [0-5], [6-10], [11-20] were the most frequent class of size respectively 25.97%, 22.61%, 28.39% of all of the colonies. This frequence was similarly observed in another region of Madagascar. This dominance of small size colony reflects the importance of coral recruitment in replenishment. There is a significant difference in corals distribution among the stations (pvalue=0.01). It is observed that dominant genera are considered resistant corals that ensure the stability of ecosystems and their stress resistance. The high rate of juveniles indicates that there is a contribution of recruitment to population regulation. This information should be the reference for the coral reefs community structure in Madagascar and the western Indian Ocean.

Quantifying the state of the coral reef ecosystem in relation to biophysical benthic and pelagic indicators and biological drivers of change in the Saba National Marine Park, Dutch Caribbean

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Keywords: GCRMN, MPA, Fish-benthos interaction, Trophic cascade, Herbivory

Coral reefs are experiencing large scale degradation. Motivated by the need for regular data monitoring and for quantification of the state and change of benthic and pelagic organisms, the Global Coral Reef Monitoring Network protocol was executed on 18 dive sites in fished and unfished areas around the island of Saba in the Saba National Marine Park (SNMP) in the Dutch Caribbean from March to May 2019. Pictures of the benthos were taken and analysed with the Coral Point Count Excel extension software and fish biomass was calculated through the Bayesian length weight relationship. Although considerably below the Caribbean-wide average, coral cover around the island seems to be slowly recovering from past diseases and hurricane events. Coral species richness positively correlates with reef fish density and Serranidae species richness. As in other parts of the Caribbean, macroalgae in the SNMP are rapidly spreading and increasingly compete for space with habitat-providing gorgonians, sponges and other benthic organisms. In contrast to expectations, fish density and biomass continue to increase, even in zones where fishing is allowed. This might be explained by the higher availability of macroalgae that serve as food for various herbivorous fish species, which in turn are, amongst others, the prey of predatory fish and those higher up in the trophic cascade. However, with the exception of the commercially important fish family Lutjanidae all key fish species have declined in size in recent years. Another finding is the increase of coral diseases. The results indicate the need for further species-specific research in order to identify the factors that are causing the degradation of the reefs in the SNMP. A better understanding of the interactions, ecological roles and functions of benthic and fish communities is essential for the protection of reefs. The results of this study contribute to the adaptive management of the SNMP.

4.2.P3

Efficacy and implementation of coral restoration and rehabilitation as a as a socioecological management tool for coral reefs in the tropical Pacific region

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Keywords: Coral restoration, Coral bleaching, Coral reef management, Pacific Island region, Degree Heating Weeks (DHW)

With increasing rates of coral reef degradation due to human induced activities and climate change; sea surface temperatures, ocean acidification and coral bleaching are increasing. This is destroying coral reefs at a faster rate than it takes for them to recover. In recent years, ecosystem restoration has been integrated into coral reef management practices to remedy the negative effects of human activities on coral reefs. Within the tropical Pacific region, coral gardening and coral nursery/transplantation are commonly used in coral restoration projects. The engagement of the local community is an integral part of this projects. This research aims to investigate the methods used at pilot sites to evaluate their effectiveness and develop future conservation management tools to mitigate against the effects of ocean acidification and coral bleaching. At the end of this research project the following outcomes will be achieved: (1) Improve metrics to predict coral bleaching events within this region; (2) Better understand the effectiveness of the coral restoration methods used, and (3) Better understand the social aspects of the project. Results from this research project can then be used to advise coral reef managers and practitioners on the best coral reef restoration practices within the tropical Pacific region.

4) Ecosystem dynamics

3) Microbial communities in a macrophyte's world – The good, the bad, the ugly

Celina Burkholz

The University of Western Australia

Philipp-Konrad Schätzle

University of Rostock

Marine macrophytes are hosts to individual microbial communities on their leaves, roots, and other compartments of the plant. The relationship between host and microbes is complex, and the host's fitness and performance can either benefit or suffer from this relationship. Additionally, the microbial community can greatly vary with changing environmental conditions and other surrounding factors, which in turn has varying impacts on the host. This session invites scientists to present their findings on the relationship between marine macrophytes and microbial communities and the resulting effects on the host organism and microbiome.

4) Ecosystem dynamics

4) Eco-Physiological effects of climate change in marine animals – Biological studie from the whole animal to its

Nina Krebs

Alfred Wegener Institute (AWI)

“It is not the strongest of the species that survives, not the most intelligent that survive. It is the one that is the most adaptable to change.” (Charles Darwin). Today, the climate is changing fast and all organisms have to adapt to increasing temperature, acidic enriched oceans and lower oxygen level otherwise they will get extinct. What are the strategies and mechanisms of marine animals to cope with climate change? The session will examine this question from the perspective of ecological and physiological mechanisms of marine organisms facing elevated temperature, hypercapnia and/or hypoxia.

Impact of rapid temperature rising on reproducing and non-reproducing polar cod (*Boreogadus saida*)

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Keywords: Magnet resonance imaging (MRI), in vivo experiments, acute warming, 31P-NMR Spectrum, polar fish

Climate change is causing rapid warming of Arctic regions with a great impact on the survival of marine species like polar cod (*Boreogadus saida*). The impact of rising temperatures on polar cod depends on the potential acclimatory or evolutionary adjustments of thermal limits in their most sensitive life stages. Previous studies on acute thermal tolerance suggest that reproducing adults are more vulnerable than non-reproducing adults, however, a deeper understanding of the underlying physiological processes is lacking. A magnetic resonance imaging (MRI) approach was used to measure the physiological performance of unanaesthetised, reproducing and non-reproducing polar cod in vivo during rapid warming. Individual fish were placed in the MR scanner that was continuously perfused with aerated seawater. Inside the MR scanner, 0°C acclimated polar cod were exposed to rising water temperature from 0°C to 8.5°C at a rate of 1.5°C every two hours. A set of specialized MRI techniques was applied to measure physiological performance parameters such as heart rate at different temperatures. Further, we used in vivo 31-P nuclear magnetic resonance (NMR) spectroscopy to monitor the energy status and calculated the intracellular pH. At the end of the experiment fish were sacrificed, lactate blood levels were measured and tissue samples were taken for further analyses.

Goby fish populations in intertidal environments: gene networks and epigenetic regulators modulating energy metabolism in response to seasonal warming and local climate regimes

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Keywords: Goby fish, Marine omics, Molecular biomarkers, Systems biology, Temperature

Molecular mechanisms underpinning stress responses of marine organisms have paramount implications for understanding species' resilience to climate change. This study focused on unravelling gene networks and epigenetic mechanisms contributing to acclimatization and adaptation of the intertidal fish *Pomatoschistus microps* to geographically-constrained seasonal thermal regimes. Fish were sampled in spring vs. summer from populations in different climatic zones (north vs. centre) of the Portuguese coast. Fish livers were dissected and nucleic acids and cytosolic contents were extracted. Whole-transcriptomes and global DNA methylation were analyzed by RNA-Seq and Whole-Genome Bisulfite Sequencing, respectively. Energy biomarkers were also analyzed (e.g., glucose, glycogen, triglycerides, proteins). Goby transcriptomes and epigenomes were assembled and differential expression analysis plus identification of methylated CpG sites/regions were implemented. Functional enrichment and annotation of omics datasets were done using gene ontology tools. Preliminary results indicate that differentially-expressed gene patterns between seasons and latitudes, e.g., related to energy metabolism, may be liked to differential resilience and response to thermal challenge, in accordance with phenotypic traits. In turn, these differences may be, at least in part, regulated by changes in 'global' methylation patterns, similarly to what has been disclosed for similar species. Moreover, energy balance-related biomarkers showed significant differences between seasons and climatic regimes, evidencing that energy reserves generally increase during the warming season and are higher in warmer regimes. Energy use in the summer also differs between thermal regimes and is directed towards growth in fish from warmer areas (centre), whereas in fish from cooler areas (north), is directed towards sexual maturation, evidencing differences in timing of life-

cycle events. We conclude that fish thermal environment modulates plasticity at the molecular level, as well as critical aspects of energy metabolism to cope with different thermal regimes and seasonal temperature fluctuations.

Physiological larval fish models as a powerful tool to understand current and future dynamics of Fish Recruitment

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Keywords: Individual-based model (IBM), Fish recruitment, Climate change, Modelling, Larval physiology

Climate change and increasing human use of the oceans are creating extraordinary challenges for the traditional management of marine resources. Stability of fish populations and their resilience to exploitation is determined to a large extent by the annual recruitment of the young-of-the-year. Recruitment is highly variable and is believed to be primarily driven by mortality of fish early-life stages (ELSs). This mortality is impacted by interacting physical and biological factors that in turn can be altered by climate change and anthropogenic activities. Mathematical modelling, and particular, coupling of models of fish physiology with hydrodynamic and biochemical models like, coupling of fish individual-based models (IBMs) with a hydrodynamic model is often used to simulate the larval drift from spawning areas to nursery grounds to investigate the impact of unfavorable transport on the connectivity of a fish population. The aim of our study is to create an online library of physiological individual-based models (IBMs) of several temperate fish species. Our R-library synthesizes several decades of research and is built on previously published quality controlled larval fish IBMs. Furthermore, we digitize available data from previous field and laboratory studies that can be further utilized for future model development and calibration. We critically review the main components of existing physiological models (foraging routine, growth allocation and metabolic costs) and perform model intercomparing. A proper assessment of model skills is particularly crucial since future conditions may include novel combinations of biotic and abiotic factors, which will require an extrapolation beyond historical field and laboratory observations. We identify most sensitive parameters of the IBMs and discuss existing knowledge gaps with respect to larval adaptive strategies toward future climate changes.

Tissue level effects of season warming and thermal gradient in common gobies: structural and biochemical changes assessed by histopathological screening

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Keywords: Histology, Histochemistry, Intertidal fish, Seasonal warming, Latitudinal thermal gradient

Thermal environment is a major driver of marine species physiology, modulating growth, health and survival. In this study, we aimed to assess tissue-level changes in Pomatoschistus microps in response to seasonal warming and different climatic regions in the portuguese coast: mediterranean w/ warm summer – north-western coast NWC, vs. mediterranean w/ hot summer – southern coast SC, vs. transition region – central-western coast CWC. Fish were collected in Spring vs. Summer from these three climatic regions and whole-body body sections were produced after fixation in Davidson's, dehydration and paraffin-embedding. Histology and histochemical methods were used to differentiate histopathological lesions, maturation stage and key metabolic aspects related to energy storage. Preliminary histopathological screening of organs showed that specimens from different climatic zones displayed differential gonad maturity, with specimens from cooler NWC maturing later in summer, whereas individuals from warmer CWC and SC areas presented mature oocytes in spring, either suggesting asynchronous life cycle events (e.g., spawning) between climatic regions, spatial separation between adults and subadults between local niches or both. Fish from all regions displayed histopathological lesions in kidney, (e.g., diffuse hemorrhage, hyperaemia, and metazoan parasites), whereas biochemical alterations were observed mostly in liver (especially related to glycogen storage and protein expression). Fish from SC also displayed changes in gill microstructure (chlorine cells proliferation and detachment of gill epithelia) not observed in the other populations. Despite the overall low impact of season, significant histopathological alterations were still observed in fish muscle, including increased prevalence of myxozoan-like parasites in summer, suggesting that higher temperature may induce parasitism outbreaks. To conclude, these fish are well-adapted to their local

environment under normal climatic regimes, likely resulting from adaptation to a labile environment subjected to seasonal challenges. Nonetheless, the resistance to factors such as parasites or increased energy demands may still be significantly affected by extreme events.

4) Ecosystem dynamics

5) Marine Forests: an underestimated ecosystem?

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Marine forests characterized by large brown macroalgae, also known as kelp forests, are known for their role as ecosystem engineers. They provide habitat and shelter, food, and protect the coastlines by slowing down waves and currents. Furthermore, kelp forest ecosystems are socio-economically important as they provide jobs and income in many parts of the world. In recent years, kelps have gained more attention as a source of blue carbon. This session welcomes all studies related to kelps and other macroalgae – be it their ecology, physiology, the ecosystem services they provide, or their utilization and restoration efforts

The Helgoland kelp forest - First estimation of summer productivity

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Keywords: Diffuse attenuation coefficient, Kelp, Primary production, Oxygen evolution, Turbid marine system

Kelp forests represent important links in the global marine nutrient and carbon cycle due to their high annual net primary production (NPP) rates. In the southern North Sea, the rocky island of Helgoland (Germany) is a hotspot of biodiversity and provides a unique habitat for kelp forests in a turbid marine system. While quantitative data about biomass distribution exist, NPP estimates are still lacking. For the first time, NPP rates were measured of the biomassdominant kelp species *Laminaria hyperborea* along their depth distribution and along blade gradients during different weather scenarios in summer 2014. Accompanying in situ measurements of photosynthetically active radiation (PAR, 400–700 nm) revealed a highly variable underwater light climate with PAR attenuation coefficients ranging from 0.28 to 0.87 m-1, showing a strong correlation with storm events. There was no depth-dependent change in chlorophyll a content and photosynthesis versus irradiance parameters, indicating a high photoacclimation potential of the species towards incident light. Along the blade gradient, photosynthetic rates normalized to area showed no significant differences in contrast to rates normalized to fresh mass (FM), highlighting the strong difference in anatomic structure along the thallus. Normalization to FM includes changing contents of non photosynthetically but respiratory active inner cell layers along the blade gradient, which leads to large uncertainties in NPP estimations when upscaling to whole thalli. Therefore, calculations of kelp forest productivity should be based on photosynthetic rates normalized to area instead of FM, which was the common procedure in the past. Considering the in-situ *L. hyperborea* leaf area m-2, we calculated a daily summer NPP of 5.9 ±1.6 g C m-2 for the Helgolandic kelp forest, which is comparable to kelp forests along European coastlines. Results also highlight the importance of continuous underwater light measurements as NPP is strongly influenced by highly variable underwater PAR conditions.

Contributions of macrofauna to carbon cycling in Fucus vesiculosus habitats

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Keywords: Macrofauna, Biodiversity, Heterogeneous seafloor, Carbon cycling, *Fucus vesiculosus*

Coastal ecosystems in general and vegetated coastal systems in particular contribute significantly to global carbon sequestration. Benthic macrofauna plays a key role in organic matter processing and benthic-pelagic carbon cycling. However, spatial heterogeneity influences ecosystem features, including biodiversity. Therefore, sampling strategies for heterogeneous habitats need to be applied to estimate the role of benthic macrofauna associated with macroalgae. Here, we used epifauna nets and Kautsky frames by scuba diving to sample and quantify macrofauna associated with hard bottom macroalgae (Fucus vesiculosus) habitats following a sampling protocol for heterogeneous seafloors ("octopus design"). Sheltered (n = 3) and exposed stations (n = 3) were sampled (n = 6 in total) in October 2021 in the Gulf of Finland and analyzed for taxa abundances. In total, 24 epifauna taxa were found. Taxa richness found in exposed stations was slightly lower than in sheltered locations (12.9 ± 2.6 compared to 14.8 ± 3.2). No strong correlation was found between the number of epifaunal taxa and dry weight of algae (r = 0.48) and there was no significant difference in community composition between sheltered and exposed sites (p = 0.057, ANOSIM), however *Gammarus* spp. and Chironomidae were identified as indicator species (p = 0.0048 and p = 0.0367, respectively) for sheltered sites. We could establish full length-weight relationships for four species so far (*Parvicardium hauniense*, *Mytilus* spp., *Gammarus* spp., *Theodoxus fluviatilis*; log-log regression R^2>0.9). Based on those relationships and dry weight mean values measured for size classes in other taxa, biomass and carbon content will be estimated. Furthermore, we will estimate their respiration to make assessments of the faunal contribution to carbon cycling in *F. vesiculosus* habitats.

Microscopic life stages of Arctic kelp differ in their resilience and reproductive output in response to Arctic seasonality

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Keywords: Brown algae, Polar, Light, Seasonality, Resilience

Kelp forests are important habitats in the strongly environmentally and seasonally variable Arctic. There is a critical lack of knowledge about how seasonal conditions and climate change scenarios influence survival and reproduction of kelp early life stages. To better understand the regulation of kelp life cycle processes in this harsh environment we focused on the physiological performance and reproductive success of early life stages in *Alaria esculenta* and *Laminaria digitata* from Kongsfjorden, Spitsbergen. Gametophyte growth and survival during Arctic winter and subsequent sporophyte recruitment under spring conditions were investigated. Winter conditions (2°C, complete darkness) halted gametophyte growth and prevented the onset of gametogenesis in both species. The gametophytes of *L. digitata* but not *A. esculenta* became fertile after returning to spring conditions, suggesting that sporogenesis, sexual reproduction and recruitment in *A. esculenta* must occur successively during summer/autumn while in *L. digitata* a new generation of sporophytes could develop from over-wintering gametophytes. The effects of simulated canopy shading (offering protection against extreme irradiance stress, particularly as sea ice retreats), present-day and projected Arctic summer seawater temperatures, and nutrient levels on gametophyte survival, fertility and sporophyte recruitment success were also investigated in both species. *A. esculenta* gametophytes had greater survival and reproductive success than *L. digitata*, except under very low light (simulating dense canopy). In contrast, shading was required for reproductive success in *L. digitata* gametophytes. Predicted summer temperatures of 9°C reduced sexual reproduction in both species. Interactions observed between these environmental drivers probably reflect species-specific seasonal patterns of survival and reproduction. These differences between kelp species in response to abiotic factors and light levels (simulated canopy shading) suggest that climate change could alter community structure in the Arctic through effects on sexual reproduction and sporophyte recruitment success.

4) Ecosystem dynamics

6) Recent *A*dvances in Tropical Coastal Ecosystem Research

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Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences

Andrew Balashov

MIREA - Russian Technological University, Russia

Tropical coastal ecosystems are an iconic example of rich and complex but vulnerable marine habitat. Complexity and delicacy of linkages between coral reefs, seagrass beds and mangrove forests left the whole system exposed to modern threats, such as global warming, introduction of invasive species, overexploitation and pollution. There is an urgent need to develop old and implement new approaches to research of tropical coastal ecosystems, to support its conservation and rational exploitation. Do You have suggestions on how to fulfil this goal? Then join us and share your vision!

Population genetic structure and connectivity of a marine foundation species (*Halodule wrightii*) inferred from genetic and biophysical methods

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Keywords: Connectivity, Dispersal, Population structure, Seagrasses, *Halodule wrightii*

Marine connectivity studies are essential to provide a framework for analyzing long-term source sink dynamics, as well as determining how species dispersal affects population genetic diversity and structure on large and regional scales. Here we present the first large-scale genetic population and connectivity study of the widespread seagrass species, *Halodule wrightii* in the tropical Atlantic region. We ask whether the genetic, genotypic variation and population structure can be predicted by oceanographic transport or if other factors such biotic transport or rafting explain the observed patterns. Population genetics and physical modelling were used to investigate the dispersal and connectivity of *H. wrightii* in the east and west tropical Atlantic region, by using factorial correspondence analysis, bayesian approaches and biophysical modeling based on particles dispersion simulations and network analysis. Specifically, we used 8 polymorphic microsatellite loci to conduct genotyping on 475 individuals from 19 populations distributed across west Africa, Gulf of Mexico, Caribbean, and Brazil and biophysical model. The genetic data revealed three main genetic clusters 1) West Africa, 2) Gulf of Mexico and 3) Caribbean and Brazil. Moderate to high genotypic diversity was observed in central populations, showing important seed recruitment, but genetic and genotypic diversities were lower at range edges. Genetic data further allowed estimating low levels of gene flow between populations. The biophysical model predicted low connectivity potential, with most virtual particles settling within shorter distances after being released. Likewise, *H. wrightii* population structure and differentiation could be explained by oceanographic distance, but our findings also raise the hypothesis of seed dispersal by biotic vectors such as grazers. Here we also raise the hypothesis of *H. wrightii* seeds/detached shoots being transported by macroalgae rafting structures. Several means of dispersal and propagules transportation are mechanisms that need to be further investigated to understand the connectivity of *H. wrightii*.

Scleractinian coral density and the structure of macrosymbiont community

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Keywords: Symbiosis, Ecology, Pocillopora, Crustaceans, Trapezia

Coral reefs represent a very rich and complex ecosystem. Coral macrosymbionts, viz. polychaetes, molluscs, crabs, shrimps and fish, are an essential component of this ecosystem: while coral colonies provide them with food, shelter, and a spawning place, symbionts themselves protect colonies from predators, remove sediment, bacterial lesions, and fouling algae. The structure of the symbiotic community, its health and resilience may be greatly affected by even seemingly insignificant changes in the environmental parameters, predators and parasites pressure, and parameters of the host colonies. The aim of the present study is to evaluate the impact of one of such factors, the density of coral colonies, on the symbiotic community structure. To do it, 200 small fragments of *Pocillopora verrucosa* colonies were collected, cleaned from symbionts and planted on the metal 1x1,5 m frames elevated 40 cm above the bottom, with densities of 20, 30, 40, 50 and 60 fragments per frame. After 3 months of exposure, fragments were sampled and all macrosymbionts inhabiting them were collected, identified and counted. Examination of collected samples showed that the species richness of the symbiotic community varied from 0 to 14 species per colony, while the amount of symbiotic animals ranged from 0 to 30 individuals per colony. Kruskal-Wallis test was applied to estimate the impact of the coral colonies' density on the symbiotic community structure. We found that density has an impact both on the abundance and species richness of obligate and facultative symbionts, but the direction of this influence is different. With the increase of the host density, species richness and abundance of obligate symbionts significantly increased, while these parameters of facultative symbionts decreased. At the same time, no significant and ordered impact of host density on the species richness and abundance of the whole symbiotic community was observed.

Software for coral health assessment

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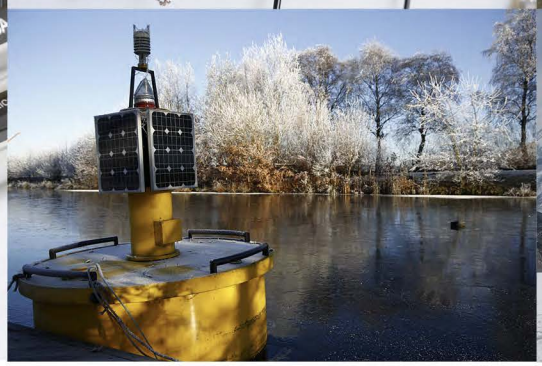
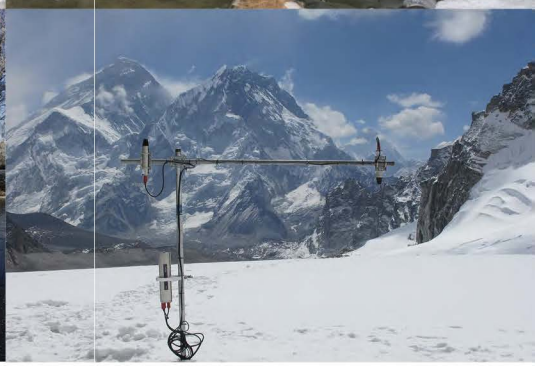
Keywords: Ecology, Bleaching, Health assessment, Colour identification, Dedicated software

Coral reefs are relatively small but extremely rich in biodiversity ecosystems. The basis of the reefs is madreporous corals, forming their skeletons from calcium carbonate, which they extract from the surrounding water. Madrepore corals are colonial animals in close symbiotic relationships with zooxanthellae algae. The presence of zooxanthellae in coral tissues is the main source of coral energy and determines their colour. The influence of external factors of natural and anthropogenic nature can cause the death of these symbionts, leading to colony bleaching. Prolonged bleaching is one of the most common causes of coral death. Thus, accurate identification of coral colouration is a reliable tool for assessment of the coral health. At the same time, the investigation of numerous colonies is a laborious and time-consuming process. To simplify the workflow, a web application for the assessment of coral condition was developed. After uploading the image with the input of initial data, it is saved to the cloud, which allows scientists to work together. The main function is the collection of tools for assessing coral bleaching and measuring the colonies. To evaluate coral bleaching, the user selects a photo in the interface and then chooses the lightest and darkest areas of coral. The result achieved is a bleaching score according to the Coral health monitoring chart. The measurement tool allows calculating the actual size based on data about the grid on which the coral grows. After processing, the application allows the researcher to generate a report table for the selected coral colonies.



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5) An ocean full of numbers

1) Mathematical analysis of marine communities

Ellen Oldenburg

Heinrich-Heine Universität

Communities of various trophic levels are central elements of marine ecosystems. Strongly influenced by the environment, they exhibit pronounced regional and temporal variability. A profound understanding of their dynamics is essential to predict the fate of future marine habitats and to provide a wider range of future scenarios for marine ecosystem functionality and services. Current descriptive analyses alone are insufficient to understand microbiome composition and interactions. For this session, we invite contributions employing statistical, computational, and mathematical approaches to analyse complex dynamic environmental data, aiming at increasing our understanding of complex marine ecosystems and predicting the expected effects of, e.g. global climate change.

Cluster-wise Abundance Forecasting for F4 location around the Fram Strait using Machine Learning

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Keywords: Marine, Time-Series Clustering, Climate Change, AI, Arctic Sea

Climate change can be seen rapidly and drastically at the Arctic Ocean. Characterized by seasonal fluctuations, e.g., in terms of daylight availability, temperature difference and depth of the mixed layer. On these fluctuations, microbial communities are also strongly affected. A data set of mooring, satellite data and sequential data of more than 2k amplicon sequence variants abundances (AVS) and the corresponding environment meta data collected during the years 2016 to 2020 for the F4 location was provided by the Alfred-Wegener-Institute. Our goal in this work is to predict the development of clusters of microbial communities by only including environment data as features. Sufficiently accurate predictions, would provide new opportunities for scenario calculation of climate change in terms of consequences for marine microorganisms. In addition, cost savings can be made e.g., by expensive sequencing. First, we analyzed the abundance dynamics of the AVS by Fourier transform and regression analysis of the time series signals, resulting in elven cluster characterized by their seasonality in 2016. Next, we group the data w.r.t the cluster assignments and calculated the mean leading to a single time-series for each cluster and adding the environment data. Then we split up in train and test data and use a machine learning algorithm for the regression task. For the five seasonal clusters, we were able to give useful predictions with an R2 greater than 0.5; these clusters contain approximately half of the AVS. The remaining clusters with less seasonality we could not make any usable predictions. Naturally, the quality and accuracy of forecasting depends numerous factors. Nevertheless, we were able to predict roughly half of the population developing on cluster bases, using only the environment meta data as features, can be used to bridge the lack of information during measured errors or periods of not reaching the measurement stations.

5.1.2

Modelling the effect of climate change and nutrient saturation on dinoflagellate spring blooms in the Baltic Sea

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Keywords: Computational model, Ordinary differential equations, Environmental parameters, Dinoflagellate blooms, Lotka-Volterra population dynamics

The biological dynamics of marine events still portray a comprehension challenge to modern research. Against the backdrop of climate change and environmental protection, prediction methods become more important. For that reason, ordinary differential equation (ODE) based models equip us with quantitative methods to understand the dynamics of the core components of ecological systems. Accordingly, reductions and mathematical formulations of nature's networks advance our fundamental knowledge of population growth dynamics. Among most widely used formalism are general Lotka Volterra (gLV) equations, that serve as a great point of departure for further analysis of population dynamics. Due to its geological and climatic location, the Baltic Sea ecosystem is particularly sensitive to environmental changes. Above all, eutrophication and climate change repeatedly moved to the focus of attention. As a potential consequence of temperature shift and alternating water stratification, spring phytoplankton blooms transform towards early dinoflagellate blooms. Being part of marine interactions, these impact benthic production as well as secondary consumption patterns. In this work, we model the effects of climate change and nutrient saturation on dinoflagellate spring blooms in the Baltic Sea. By implementing a coarse-grained ODE-based model relying on gLV, we will investigate the environmental sway of several environmental parameters (e.g. temperature, light) in the context of climate change. Moreover, nutrient saturation will be explored as an environmental variable.

Predicting spatio-temporal distributions of Arctic gelatinous zooplankton in Fram Strait in a changing environment

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Keywords: Gelatinous zooplankton, Species distribution models, Fram Strait, The Pelagic In-situ Observation System (PELAGIOS), Ecological forecast

Gelatinous zooplankton are known to play an important role in World Ocean ecosystems. As climate change continues to cause profound environmental shifts in Fram Strait, a key transitional zone between the North Atlantic and the Arctic Ocean, the lack of understanding of how gelatinous zooplankton are affected by these environmental changes creates a significant gap in knowledge about the future state of Arctic ecosystems. In this study, we used in situ observations obtained by the towed underwater camera system PELAGIOS (Pelagic In situ Observation System) to establish one of the first regional baselines of large gelatinous zooplankton diversity and abundance in mesopelagic and bathypelagic zones. Our data included 16 taxa of gelatinous zooplankton, with the most abundant being from the family Rhopalonematidae (*Aglantha digitale* and *Sminthea arctica*) and the suborders Physonectae and Calycophorae. We used a joint species distribution modelling approach to better understand their three-dimensional distribution patterns and assess the environmental drivers of gelatinous community structures. The most significant drivers were temperature and depth. Spatial distribution modelling based on in situ measurements revealed that the highest abundance and diversity of jellyfish are expected at the edges of the West Spitsbergen and East Greenland current systems. The near-future projections indicate that with continued temperature increase, the gelatinous zooplankton community in the Fram Strait will become less diverse but more abundant. Among taxa of the Rhopalonematidae family, we expect the abundance of Aglantha digitale to increase by 2% throughout the water column, while Sminthea arctica will experience a loss of up to 60% by 2050.

Probabilistic approach for the analysis and prevision of Black Sea ecosystems

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Keywords: Uncertainties, Ensemble modelling, Climate projections, Light propagation

Biogeochemical processes are largely described by empirical equations, with parameters that have to be calibrated in each basin on the basis of locally collected observations. These parameters are subject to uncertainties in the modeled biogeochemical variables, the assessment of which has been little documented so far. One method to tackle this problem is to perturb the uncertain parameters in ensemble simulations to obtain statistical information on the model variables. The main objective of my PhD work is to develop an ensemble system for the coupled physical-biogeochemical model NEMO-BAMHBI. Applied to the Black Sea, it aims to evaluate the main sources of uncertainty in the model, of both physical and biogeochemical origin, which have a significant influence on climate and health indicators of the basin. To do so, perturbations will be applied either to external physical forcings or to biogeochemical parameters. Using this system, the objective is to perform climate ensemble projections of the physical and biogeochemical state of the Black Sea on a decadal scale. These projections will focus on features such as the evolution of the Black Sea oxygenated layer. A third line of research will be the evaluation of a reflectance assimilation scheme to reduce uncertainties on biogeochemical variables that arise from the simulation of light propagation in sea water. Therefore, the complete ensemble model will consist of a coupled physical-biogeochemical optical system, with parameters that can be perturbed in each of the components. The added optical model allows a better representation of light propagation in 33 spectral bands, which in turn improves the modeling of photosynthetic processes. The first steps of this work focus on the validation of the coupled system prior to starting the ensemble simulations that will lead to climate projections.

5) An ocean full of numbers

2) Across the seasons: Sea ice in all its facets

Hannah Niehaus

University of Bremen

Linda Thielke

University of Bremen

Sea ice is a very fascinating, but also complex component of the polar climate system. There are numerous linkages between the physical processes of the ice and the other components of the polar climate system. Ice dynamics as well as heat exchange and light transmittance influence the atmosphere, ocean and ecology depending on the season. With a combination of observations, satellite measurements and modelling we can gain a better understanding of the processes related to sea ice in polar regions. This is important especially in a warming climate as the polar climate also influences other parts of the Earth.

Calculating Drag Coefficients from NASA's ICESat-2 Satellite Altimeter

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Keywords: Sea Ice, Roughness, Remote Sensing, Momentum Transfer, Modelling

This talk will cover the first attempt at modelling inter-monthly drag coefficients on a pan-Arctic scale from NASA's new ICESat-2 altimeter satellite. This study aims to identify the short-comings as well as the new possibilities of trying to access drag on such high temporal and spatial scales. This retrieval, once refined, is meant to aid state of the art atmosphere-ocean-sea ice models in better predicting arctic climate.

Assessing SAR Capabilities for Producing Arctic Sea Ice Concentration

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Keywords: Sentinel-1, Sentinel-2, Passive-Microwave, AMSR2, High-resolution

Sea ice concentration (SIC) is an essential climate variable. It provides information about seasonal dynamics in the Arctic and is used for indicating climate change through long term data records. SIC is also a key boundary condition for atmospheric and climatic models, as well as input into sea ice forecasting models needed for safe Arctic operations and weather prediction. Passive Microwave Radiometers (PMR) produce this data due to their ability to measure the emissivity between ice and water but are limited by coarse resolutions of ~5 km when using AMSR2 single band high frequency (89 GHz) algorithms. This means current SIC products are coarser than grid resolutions of sea/ocean models that they are assimilated into (i.e. Barents-2.5 km). Synthetic Aperture Radar (SAR) sea ice algorithms can potentially produce a higher resolution SIC since Sentinel-1 SAR has imaging capabilities of 93×87m when using ground-range detected medium resolution products. SAR application has previously been restricted due to overlapping backscatter signatures of ice types and rough open water. However, the latest SAR sea ice algorithm uses the backscatter incident angle as an ice type class property which can potentially minimise these effects. Therefore, there is a need to determine how the SAR algorithm parameters impact the final SIC produced, with the aim of producing a SAR SIC with a low measurement uncertainty whilst maintaining its high resolution. If handled correctly the SAR SIC has the potential to maintain finer sea ice details that the PMR is unable to resolve. This research achieves this through adjusting SAR algorithm parameters to incrementally coarsen the SIC resolution to minimise the SAR backscatter ambiguities, and consequently reduce measurement uncertainties. To determine the optimal parameters SAR SIC is validated against a SIC derived from 10 m resolution Sentinel-2 multispectral data and assessed against its PMR counterpart.

Remote sensing of melt ponds on Arctic sea ice – impressions from aircraft and helicopter campaigns since 2010

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Keywords: Cryosphere, Optical Imagery, Melt Ponds, Polar Climate

The presence of meltwater ponds on sea ice strongly influences the ice-albedo feedback and thereby polar climate. On a large scale, the areal fraction of melt ponds on Arctic sea ice is determined from satellite-derived products. However, the available products do not have the necessary resolution to represent individual ponds and their usage is often limited by high cloud coverage. Aircraft campaigns can help to fill this gap by providing high resolution observations of the sea ice surface. For the presented project, an existing data set of mostly RGB images of summery Arctic sea ice since 2010 is being analysed with the aim to derive melt pond properties, in particular their geometry and size distribution. The data will be supplemented by in-situ and helicopter-borne measurements of melt ponds in the marginal ice zone during the RV Polarstern expedition to Fram Strait in July and August 2022. Both first results of the ongoing project as well as impressions from the 2022 expedition will be presented here.

Triangular Perspective on the alteration of Sea ice

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Keywords: Antarctica Triangular Perspective, Sea Ice Concentration, Sea Ice Thickness, Ocean Heat Flux, Ocean Circulation

The Arctic regions are losing sea ice, and their oceans are changing rapidly. The consequences of this transition extend to the whole planet. These regions will be profoundly different in the future compared to today, and the degree and nature of that difference will depend strongly on the rate and magnitude of global climate change. On this matter, sea ice has a significant addition and different characteristics compared to its freshwater counterparts such as glaciers. This presentation will cover the several interaction zones of sea ice that exist in polar regions. While Arctic sea ice reveals an overall declining trend in its extent, thickness, and age during the last decades, the sea ice cover of the southern hemisphere has expanded on average. Moreover, the Antarctic-wide slight positive trend is composed of regionally opposing sea ice changes, especially between East and West Antarctica. Although several studies suggest changes in the large-scale atmospheric and oceanic circulation patterns as the main drivers for the increase in Antarctic sea ice extent and the strong regional sea ice variability, the seasonal and inter-annual variability of snow and surface properties and thickness of Antarctic sea ice is rarely studied in this context. More than 80% of the world's ocean remains unexplored and it is difficult to protect what we don't know, while only about 7% of the oceans are designated as marine protected areas. This presentation focuses on the model agreement with observations using various simple metrics that account for sea ice values and the regional distribution of sea ice. In addition, discussing biases in Antarctic sea ice that are common across multiple models as well as some recorded and research data basis drawbacks allow us to see the gap and form future field campaigns and research routes. An improved understanding of the seasonal cycle of dominant sea ice in the Arctic and Antarctic is crucial for future investigations retrieving sea ice variables from recent microwave satellite observations.

Automatic mapping of ice internal stratigraphy

Hameed Moqadam[1,2], Daniel Steinhage[1], Daniela Jensen[1,3], Adalbert Wilhelm[2], Olaf Eisen[1,3]

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Keywords: Ice Stratigraphy, Ground-penetrating radar, Internal reflection, Computer vision

The polar ice sheets of Greenland and Antarctica are an integral part of the climate system. Understanding their history, dynamics and past accumulations rates determines projections of sea level change. This is achieved by studying the internal stratigraphy of ice. Ice englacial stratigraphy is used to assign ages, taken from ice cores, to radar reflections and subsequently connect these known layers over large areas. The mapped stratigraphy is used to model the ice flow and dynamics, paleoclimatological studies, and providing information on basal properties and ice thickness. One of the main methods to investigate these characteristics is radar reflection. Ground-penetrating radar (GPR) have been used as the primary technique to detect internal ice architecture. Internal layer detection has been so far done mostly through a semi-automatic process, which is prone to shortcomings in terms of continuity and layer geometry. Thus, there is the need for more comprehensive and efficient methods. The use of computer vision to perform this task automatically will make a significant difference for layer detection in terms of efficiency and accuracy. In this talk, apart from discussing the motivation for this research, I will provide a brief background on radar system and wave propagation through ice as medium, as well as radar systems. Furthermore, I will present some of the results from classical computer vision methods, and I will discuss an outlook for the convolutional neural network (CNN) approach for mapping the internal stratigraphy.

5) An ocean full of numbers

3) Global warming – endangering lives & coasts

Luciana Villa Castrillón

Universität Hamburg

Emelie Breunig

Universität Hamburg

People of all ages and cultures dream about living within sight of the ocean. Globally, between 50-60% of the world's population live at the coastlines, and relevant infrastructure is positioned there. However, in the last century, the rising sea level led to unprecedented changes. With more frequent extreme weather events such as storm surges, societies at the coast are one of the most vulnerable groups in a changing climate. Is it still possible to stop sea-level rise? To answer that, we invite you to participate in our session and investigate with us the mechanisms of sea-level rise.

5) An ocean full of numbers

4) Of Whirls and Waves: Exploring the Impacts of Small-Scale Motions in the Ocean

Nicolas Dettling

AWI Bremerhaven

Simon Reifenberg

Uni Bremen

Eddies and internal waves are prominent dynamic features transferring energy from the large-scale ocean circulation to small scales, where they can drive intense mixing. They thereby shape the local dynamics and stratification, as well as the transport of passive tracers like nutrients or pollutants. Many questions still remain about the generation, distribution and impact of ocean mixing, requiring innovative approaches from many marine science disciplines. We therefore invite contributions from all researchers interested in describing, observing or modelling small-scale oceanic motions that lead to ocean mixing, and its impacts

Of whirls and waves: Exploring the impacts of small-scale motions in the ocean

Stephan Juricke[1,2]

[1]AWI Bremerhaven; [2]Jacobs University Bremen

Eddies and internal waves are prominent dynamic features transferring energy from the large-scale ocean circulation to small scales, where they can drive intense mixing. They thereby shape the local dynamics and stratification, as well as the transport of passive tracers like nutrients or pollutants. Many questions still remain about the generation, distribution and impact of ocean mixing, requiring innovative approaches from many marine science disciplines. Stephan will give an introduction into the research conducted on the topics related ocean eddies and their numerical modelling at AWI Bremerhaven and Jacobs University Bremen.

Scattering and Refraction of Low-Mode Internal Tides by Interaction with Mesoscale Eddies

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Keywords: Energy-transfer, Internal waves, Tidal frequency, Eddies

Low-mode internal tides in the ocean are generated when barotropic tides interact with seafloor topography. They carry a large part of the internal tide energy and can have varying horizontal wavenumbers and vertical modes. Ocean mesoscale eddies reach horizontal scales of around 100km and timescales in the order of a few weeks and are characterised by high current velocity and density changes. Eddies are three dimensional and also exist in higher depths, which are hard to be measured by in-situ observations and can only be resolved using models. They play an important role in the ocean, since they transport heat etc. in horizontal but also vertical direction. Internal tides propagate to large distances far away from their generation sites, which makes interactions with mesoscale eddies inevitable, since the latter have a similar length scale. These interactions are assumed to alter the vertical mode structure and wavenumbers of low-mode internal tides due to energy transfer from smaller to higher wavenumbers and modes, which in turn are prone to break and cause ocean mixing. Using a high-resolution model, we try to understand the working principle of wave-eddy interactions and their effect on breaking and mixing of internal tides. We focus on the Walvis Ridge region in the southeast Atlantic, since this is where energetic low-mode internal tides at the frequency of the principal lunar semidiurnal constituent (M2) propagate away from the ridge and cross the path of eddies, which take the form of both Agulhas rings and other mesoscale features. The baroclinic tidal velocities, kinetic energy and pressure are investigated using different model resolutions. Likewise, the vertical structure of mesoscale eddies in the same area is studied in order to determine the location and strength of possible interactions.

Quantifying Spectral Energy Transfers in the Eastern South Atlantic using Satellite Data

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Keywords: Spectral Analysis, Inverse Cascade, Satellite Data, Geostrophy, Spectral Slope

Energy cannot be created nor destroyed; it can merely be transferred to different scales. Scott&Wang (2005) showed that in the South Pacific, energy is transferred from mesoscale eddies to large ocean currents (inverse energy cascade). The strength and spectral slope of this energy transfer is not well understood and thus limits the correct parameterisation of energy transfers in climate models. The Eastern South Atlantic (0-10°E, 30 35°S) offers a large dataset (satellite as well as cruise data) containing several high energetic processes, such as tidal beams emanating from the Walvis Ridge as well as eddies in forms of Agulhas rings. The presence of high energetic processes makes the question of where the energy is transferred to, an especially interesting one. Using SSH Data, we will first identify regions with high eddy activity or strong tidal beams. Then, we will calculate the geostrophic velocity of the surface flow, its energy and spectral dependence. By choosing areas outside the tidal/eddy region we can directly compare the less energetic research area of the Scott&Wang paper to our data.

OF WHIRLS AND WAVES: EXPLORING THE IMPACTS OF SMALL-SCALE MOTIONS IN THE OCEAN

5.4.4

The Influence of Topography on Mesoscale Ocean Mixing

Miriam F. Sterl[1,2], Joseph H. LaCasce[3], Sjoerd Groeskamp[1], Michiel L.J. Baatsen[2]

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Keywords: Mixing, Topography, Mesoscale, Eddies, Diffusivity

Mesoscale eddy mixing plays a crucial role in the Earth's climate. In climate models, it is often parameterized via an eddy diffusivity, K. It is known that K can be modulated in the presence of a potential vorticity (PV) gradient, for example that due to the planetary beta effect. The latter can suppress mixing across PV contours. However, the effects of other types of PV gradients, such as topographic slopes, have not been included in analytical expressions for K. We construct a theory for barotropic waves over a topographic slope, to study suppression effects from both planetary and topographic Rossby waves. Furthermore, we describe a new method to calculate K for any location in the ocean, using velocity time series. The resulting expression for the diffusivity yields new insights about the influence of PV gradients and flow velocities on mesoscale mixing, and provides a new way to compute eddy diffusivities.

Spiralling Inverse Method (SIM): A new inverse method to estimate ocean mixing

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Keywords: Inverse methods, Isopycnal diffusivity, Diapycnal diffusivity

Turbulent ocean mixing influences the uptake, transport and storage of carbon, heat and other tracers, therewith affecting our climate. The various mixing processes take place on spatial and temporal scales that range from millimetres to hundreds of kilometres and from seconds to years. This is one of the reasons why ocean mixing is difficult to measure and why direct observations are scarce. Because of the complexity and wide range of scales, mixing is usually included in calculations through parameterizations. But these parameterizations are currently sensible for small changes, changes that can cause large differences in the outcomes of for example climate simulations. This can be improved by constraining the parameterizations through observational based estimates of the mixing strength. One way to obtain these estimates is by using inverse methods to estimate the mixing strength. Here we present the Spiralling Inverse Method (SIM), a new inverse method that provides estimates of the mixing strength. It combines the water mass transformation equation with the thermal wind balance. In this way, it uses widely available observations of temperature and salinity, instead of using the scarce direct observations of the mixing. The temperature and salinity data can easily be obtained from for example a gridded ocean climatology. Not needing a known velocity or stream function in the water column is one of the main advantages of the SIM over other inverse methods that provide estimates of the mixing strength. The SIM will help improve and constrain parameterizations used for climate and ecosystem modelling.

Modulation of a Dissipation Parameterization with time: Mixing over the Reykjanes Ridge

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Keywords: Diapycnal mixing, Dissipation, Internal Tide, Near-Inertial Internal Waves, Irminger Sea

Diapycnal mixing is an important process for the transport of heat and tracers in the ocean. However, it is both difficult to measure and very small in scale which means that it must be parameterized in ocean models. Current parameterizations give information about the spatial variation of mixing, but not about how it varies in time. In this project we use harmonic analysis to extract barotropic tidal velocity for one mooring in the Irminger Current (IC) array. Our aim is to use the barotropic tide to modulate a spatial parameterisation of dissipation and diffusivity with time. We would also like to see how this time-varying parameterization varies across the full mooring array and under the influence of the incoherent baroclinic tide and near-inertial internal waves.

OF WHIRLS AND WAVES: EXPLORING THE IMPACTS OF SMALL-SCALE MOTIONS IN THE OCEAN

5.4.7

Mixing along the Weddell Sea Gravity Current

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Keywords: Energy transfer, Antarctica, Bottom water formation, Mooring, Time series

The Weddell Sea gravity current transports dense water from underneath the Antarctic ice shelves to the open ocean and is the largest contributor to deep water formation in the Southern Hemisphere. Beginning at the formation sites, the dense current starts to mix with the ambient water. The physical properties of the bottom current controlling the further path and depth are therefore dependent on the amount of mixing/entrainment. I analysed velocity and temperature time series from moorings close to the formation sites and more than 1000 km further downstream to estimate the available energy provided by internal waves. Tides strongly influence the Weddell Sea, of which parts are polewards of the critical latitude of the M2 tide, which changes the wave dynamics. By understanding which processes and regions are important, we are able to simulate bottom water formation more realistically in numerical models and assess how vulnerable the mechanism may be to climate change.

OF WHIRLS AND WAVES: EXPLORING THE IMPACTS OF SMALL-SCALE MOTIONS IN THE OCEAN

5.4.8

The Impact of Submesoscale Dynamics on the Air Sea Exchange

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Keywords: Submesoscale, Instability, Parameterization

Feedback mechanisms between atmosphere and ocean have potentially important effects for energy transfers in coupled simulations. Recent studies suggest that small-scale coherent structures associated with submesoscale dynamics in the ocean play an important role on atmosphere-ocean feedbacks. In state-of-the art coupled models these scales cannot be globally resolved, since the computational surplus of the required horizontal resolution would be too high. That motivates the parameterization of submesoscale dynamics, especially with regard to long-time climate simulations. Existing parameterizations however are tested and optimised in idealised or regional setups. If such parameterizations or insufficient parameterizations are used, the model is most likely subject to biases. These types of biases might have a strong impact on the energy consistency. Therefore, this work aims to shed light on the role of submesoscale dynamics on the downward heat and energy transfer in the upper ocean and to investigate how good existing submesoscale dynamic parameterizations capture submesoscale dynamic effects. In order to directly simulate the submesoscale processes in the North Atlantic an ocean-only ICON-Submesoscale-Telescope simulation with a strongly refined grid over the focus region is used. Evaluating the sea surface temperature and the sea surface height with spectral analysis shows an improved model behaviour compared to model runs with 10km horizontal resolution. Preliminary results indicate various types of submesoscale instabilities which are identified by evaluating the local Richardson number. A method is developed to evaluate the correlation between the bulk Richardson number and the vertical buoyancy fluctuation. Subsequently these correlations will be compared to different existing parameterizations.

5.4.P1

Subgrid momentum closures - discussion about deterministic and stochastic components

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Keywords: Parameterization, Eddies, Kinetic Energy

One of the interesting things of numerical simulations is the fact that no matter of grid resolution there will always be the processes that are not resolved. Depending on the scales or sizes of these processes, in the ocean there are common (and less common) parameterizations. I would like to discuss the spectral visualisation of the eddy parameters over the full range of scales and in particular present current work related to the parametrization of the mesoscale eddy range.

Interactions between Mesoscale Eddies and Internal Waves in the South East Atlantic

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Keywords: Internal Tides, Observations, Finestructure Parameterization, Argo Floats, GM Model

Internal waves and mesoscale eddies constitute key components of the ocean energetics and therefore their interaction is crucial to understand for an estimation of the oceans energy cycle. Low mode internal tides can travel over hundreds of kilometres leading to lateral energy transfers. Interactions with mesoscale structures alter the propagation and enhance dissipation of the internal waves and therefore impact ocean mixing. The South East Atlantic ocean is a dynamically active ocean region, with focused internal tide beams emitted by the Walvis Ridge as well as energetic mesoscale eddies originating from the Agulhas Retroflection. This makes the South East Atlantic an ideal location to study eddy- wave interactions by direct observations. We aim to combine the observations with high resolution model simulations to understand energy pathways and provide estimates of energy transfers as a result of the interactions between internal tides and mesoscale eddies. To study the energy and dissipation of internal waves a solid estimation of the background state is of key interest. The broad availability of Argo profiles allows for a spatial map of the internal wave energy, where clear structures are visible with values an order of magnitude higher above ocean ridges compared to the basins. As the finestructure parametrization heavily relies on the GM model we analysed the effect on the internal wave energy of different formulations of the GM76 model. Additional ship based observational data is collected on the SONETT expedition (2.-4.2022) and used to analyse the internal wave field in relation to the mesoscale eddy activity. First measurements show an increase in internal wave activity in the deep parts of the basins, which can not be covered by Argo floats.

5) An ocean full of numbers

5) Variability and Trends in the Major Oceanic Gateways to the Arctic from Large-to Submesoscale

Zerlina Hofmann

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Finn Heukamp

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In our changing climate, polar regions are particularly affected. Sea ice cover in the Arctic is rapidly declining, oceanic heat transport is changing and the Arctic Ocean is becoming subject to novel environmental conditions. A thorough understanding of the large-scale circulation, associated (sub)mesoscale processes such as eddies, fronts or filaments in the ocean, and their impact on heat transport, ice melt, and biology are essential for future projections of Arctic climate. In this session we invite contributions from observational and model studies, studying the processes, mechanisms, and changes of the Arctic Ocean.

Sea-ice derived meltwater stratification slows the biological carbon pump: results from continuous observations

Wilken-Jon von Appen[1], Anya M. Waite[1,2], Antje Boetius[1,3,4], and FRAM team

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The ocean moderates the world's climate through absorption of heat and carbon, but how much carbon the ocean will continue to absorb remains unknown. The North Atlantic Ocean west (Baffin Bay/Labrador Sea) and east (Fram Strait/Greenland Sea) of Greenland features the most intense absorption of anthropogenic carbon globally; the biological carbon pump (BCP) contributes substantially. As Arctic sea-ice melts, the BCP changes, impacting global climate and other critical ocean attributes (e.g. biodiversity). Full understanding requires year-round observations across a range of ice conditions. Here we present such observations: autonomously collected Eulerian continuous 24-month time-series in Fram Strait. We show that, compared to ice unaffected conditions, sea-ice derived meltwater stratification slows the BCP by 4 months, a shift from an export to a retention system, with measurable impacts on benthic communities. This has implications for ecosystem dynamics in the future warmer Arctic where the seasonal ice zone is expected to expand.

Atlantic Water Circulation in Nordic Seas: Role of Large-Scale Atmosphere-Ocean Dynamics and Influence on Sea-Ice Concentration

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Keywords: Atlantic Water, Fram Strait, Greenland Sea

Transport of warm and saline Atlantic Water (AW) to the Arctic Ocean (AO) plays potentially an important role in sea ice variability. In this study we explore the dynamical processes involved in sea ice variability of the Greenland Sea using a coupled ocean-sea ice regional reanalysis system viz. TOPAZ4, based on HYCOM ocean model. Although the AW temperature itself has been warming (consistent with warming global ocean temperature), in recent times its transfer efficiency towards the AO through the Nordic Seas (NS) has undergone significant changes. This ultimately alters the amount of oceanic heat ending up in the AO and thus influences the sea ice concentration. Here complementing the reanalysis data with observations we show that the NS are not only passive conduit of AW anomalies but the coupled atmosphere-ocean dynamics in the Nordic Seas can significantly change the AW characteristics between the entry and exit point of AW in the NS. Further, its implication on the AW heat distribution within the NS and resulting sea ice variability in the Greenland Sea is investigated. The results indicate in a warmer Arctic environment NS circulation may play a more prominent controlling role in the variability of the Arctic climate by influencing deep water formation, sea ice concentration and freshwater budget in this region.

Understanding the Temperature Variability in Fram Strait through the Use of Complementary Observation Datasets

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Keywords: Interpolated Mooring Data, Kriging, Acoustic Data, Ocean Transport, West Spitsbergen Current

Fram Strait provides the only deep-water connection between the Nordic Seas and the Arctic Mediterranean and thus plays a crucial role in the heat transport to the Arctic. We use two types of complementary observational data to study temperature variability and heat transports in Fram Strait: range-depth averaged ocean temperatures collected during the ACOBAR acoustic tomography experiment in central Fram Strait between 2010 and 2012, and point measurements of ocean temperature and currents collected by the AWI/NPI mooring array located at 78.9°N in Fram Strait between 1997 and 2016. Ordinary kriging was used to create a new interpolated product from the AWI/NPI mooring data. It provides a reliable estimation of the temperature anomalies in the gaps between available measurements. The errors made in the calculation of the anomalies were estimated to validate the method. The final product was quality-checked using CTD profiles, and then compared to the acoustic data. The two complementary datasets can provide a new insight to understand the temperature variability in the Fram Strait region, by providing simultaneous information on events happening on the mooring line and on the acoustic paths further south. Satellite observations and models will be used to identify the larger- scale atmospheric and oceanic processes responsible for the anomalies observed in the two datasets and provide hypotheses regarding the differences between acoustic and interpolated mooring data. Preliminary analysis of sea surface height data shows that the wind pattern south of Fram Strait might have a strong influence on the temperature anomalies in Fram Strait and on the recirculation path by strengthening the West Spitsbergen Current.

Subduction as Observed at a Sub-Mesoscale Front in the Marginal Ice Zone in Fram Strait

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Keywords: Physical Oceanography, Frontal Dynamics, Atlantic Water, Polar Water, Observations

The marginal ice zone in Fram Strait is a highly variable environment, in which dense Atlantic Water and lighter Polar Water meet and create numerous mesoscale and sub-mesoscale fronts. Here we present the first results of a front study conducted near the ice edge in central Fram Strait, where Atlantic Water subducted below Polar Water. We posit that the frontal dynamics associated with the sea ice edge also apply beyond, both to the open and the ice-covered ocean in the vicinity. They, in turn, can affect the structure of the marginal ice zone. The study comprises a total of 54 high resolution transects, most of which were oriented across the front. They were taken over the course of a week during July 2020 and include current velocity measurements from a vessel-mounted ADCP. Most of the transects also include either temperature and salinity measurements from an underway CTD, or temperature and salinity measurements and various biogeochemical properties from a TRIAXUS towed vehicle. Additionally, 22 CTD stations were conducted, and 31 surface drifters were deployed. This wealth of measurements gives us the opportunity to follow the temporal and spatial development of the density fronts present at the time. We discuss the dynamics of the frontal development, including the associated geostrophic motion, and the induced secondary ageostrophic circulation with subsequent subduction of Atlantic Water and biological material in a highly stratified region. Beneath the stratified upper ocean, subduction is clearly visible in the biogeochemical properties, and water samples indicate a substantial vertical transport of smaller particles. Surface drifters accumulated in locations of subduction, where sea ice, if present, would likely also accumulate. Our study thus demonstrates the importance of frontal dynamics for the vertical transport of water properties and biological material, and the highly variable development of the marginal ice zone in Fram Strait.

Impact of Cyclonic Wind Anomalies Caused by Massive Winter Sea Ice Retreat in the Barents Sea on Atlantic Water Transport towards the Arctic

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Keywords: Barents Sea Opening Heat Transport, Atlantic Water, Arctic Amplification, Feedbacks, Modelling

One of the fastest changing environments of the Arctic is the Barents Sea (BS), located north of Norway between Svalbard, Franz Josef Land and Novaya Zemlja. We focus on the question whether the observed retreat in sea-ice extent in the BS over the past four decades has enhanced the inflow of warm Atlantic water (AW) into the BS via an ocean-sea-ice-atmosphere feedback contributing to Arctic Amplification. In a set of ocean sensitivity experiments using the sea-ice and ocean model FESOM2.1, we investigate the impact of sea ice-related SLP anomalies and their associated anomalous atmospheric circulation patterns on volume transport through the BSO. The simulations rely on a horizontal grid resolution of approx. 4.5 km in the Arctic and Nordic Seas allowing precise modeling of the BS hydrography and circulation. The model is initially driven with a repeated normal year forcing (CORE1) to isolate the impact of the wind anomalies from high frequency atmospheric variability. After a spin-up phase, the model is perturbed by anomalous cyclones over the BS derived from long term SLP differences in reanalysis datasets associated with the observed sea-ice retreat. The results point indeed to a slight increase in net volume transport into the BS across the BSO. This increase, however, is not caused by an increase in the inflow of AW, but rather a decrease of the outflow of modified AW recirculating back towards Fram Strait. In terms of the feedback, our results indicate that the BS AW inflow is not sensitive to cyclonic wind anomalies caused by the sea-ice retreat. The additional volume and heat transport in the modified AW range may not be sufficient to provide enough heat to melt further sea-ice and hence likely does not close the proposed feedback mechanism in the BS.

Rapid Trends in Barents Sea Opening Heat Transport

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Keywords: Ocean Heat Transport, Sea Ice, Barents Sea

The strong connection between ocean heat transport via the Barents Sea Opening and the recent strong ice decline in the Barents Sea is well established in the literature. The anthropogenic ice decline is superimposed by pronounced internal variability that represents a large source of uncertainty in future climate projections. A notable manifestation of internal variability are periods of rapid ice loss or growth that greatly exceed the anthropogenic trend. These rapid ice change events are associated with large displacements of the sea ice edge which could potentially have both local and remote impacts on the climate system. Using multi-member ensemble simulations from CMIP5 and CMIP6, we show that a majority of rapid sea ice changes are triggered by simultaneous trends in ocean heat transport that shows strong variability on different timescales. Rapid ice change events are a common feature of the future Barents Sea until the region becomes close to ice free. With the sea ice declining in the future, rapid ice changes in the Barents Sea serve as a precursor for future changes in adjacent seas. Along with this could go an increased impact of ocean heat transport via Barents Sea Opening on central Arctic sea ice conditions.

Circulation Changes Derived from CFCs and SF6 along Two Transects in the Arctic Ocean

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Keywords: Transient Tracer, Ventilation, Atlantification, Beaufort Gyre, Decadal Variability

The Arctic is warming stronger and faster than other regions during the climate change. Within this development, the Arctic Ocean's water masses and ventilation processes are changing as well. Transient anthropogenic tracers can be used to track water masses and to investigate ventilation and mixing processes. For these tracers, the atmosphere is the only source to the ocean and they are conservative in the water. In this study, we analyse the tracers CFC-12 (CCl_2F_2, chlorofluorocarbon) and sulfur hexafluoride (SF_6) along two transects in the Canadian Basin of the central Arctic Ocean. Both have been sampled in two decades (T1: 1994 and 2015, T2: 2005 and 2015) with additional hydrographic data for context. We find changes in both tracer concentration and hydrographic properties between the years and transects. High tracer saturations in the upper ocean can be attributed to two different processes: non-linear mixing and wind events. Within the layer of the Atlantic Water, the largest changes in the tracer concentration are found in higher latitudes. These changes might be connected to a change in the (re-)circulation pattern of the Atlantic Water. Further, the time dependent atmospheric concentrations of the tracers are used to determine the age of water bodies. Here, we use the simplest possible approach of age determination to identify the age of the Atlantic Water, assuming no exchange with water masses after it left the surface in Fram Strait. Along the first transect, the tracer age in 2015 is much higher south of 80°N compared to 1994, while the ages are quite similar at higher latitudes. These higher ages indicate an older water mass in 2015, a sign of a possible circulation change maybe connected to the changed size of the Beaufort Gyre.

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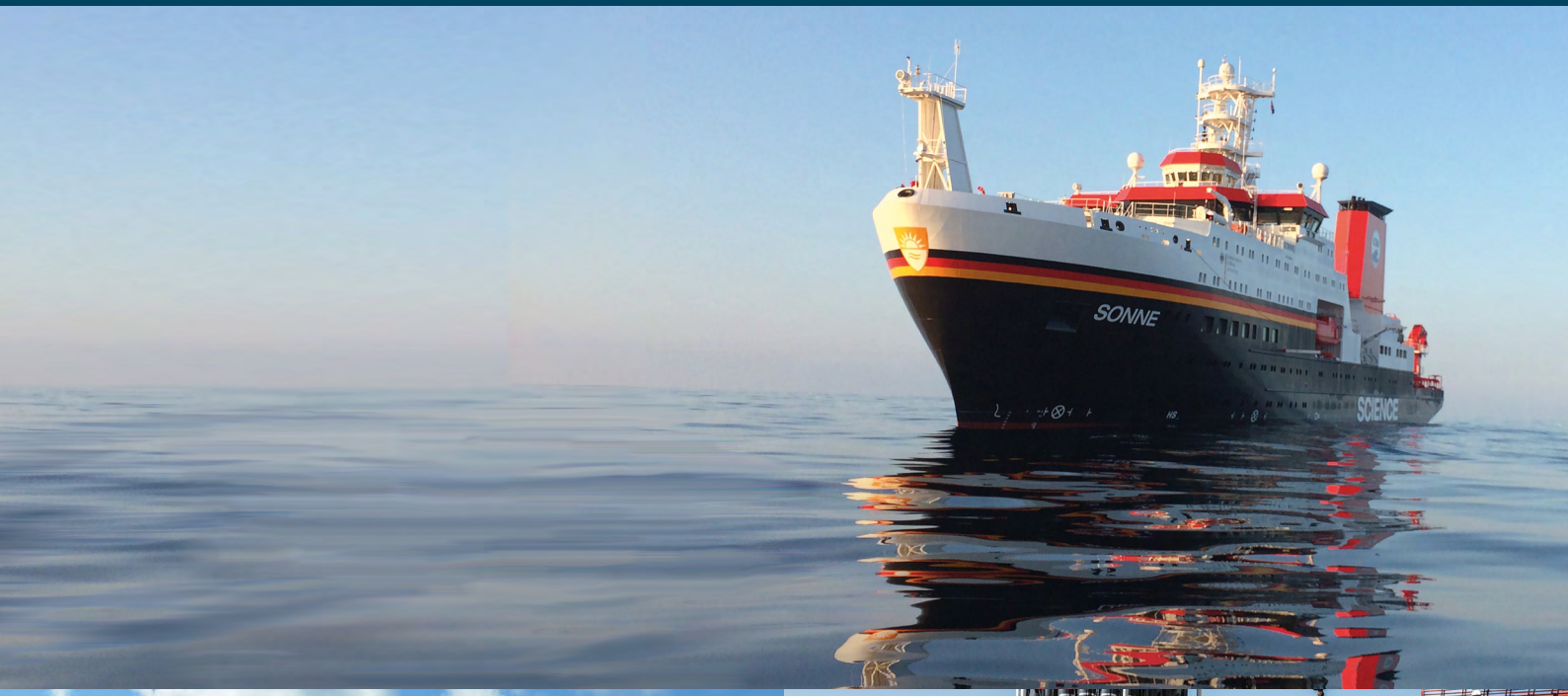

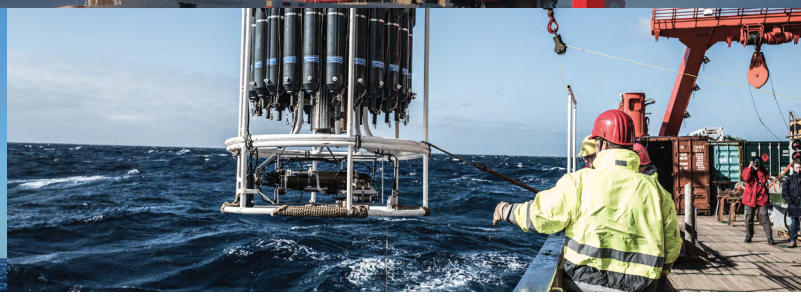

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6) New Technologies

1) Marine biotechnology - *A*n ocean of bioapplications

Cátia Gonçalves

University of Lisbon, Portugal

Inês Moutinho Cabral

University of Lisbon, Portugal

The oceans hold a tremendous biodiversity, withstanding an immense span of natural products that may be translated into multiple biotechnological applications: therapeutical drugs, cosmetics, pesticides, fuels, biomaterials, feed and supplements. They can constitute a safer, cost-effective and more eco-friendly solution than the complex process of producing synthetic compounds. Also, it contributes to shift between deleterious exploitations of the seas towards “green-industry”. Recently, this area has been attracting growing enthusiasm among young marine researchers. Therefore, we kindly encourage ICYMARE participants to contribute and share their research on Marine Biotechnology as we expect to discuss novel approaches, methodology and prospective biotechnological applications.

Advances in the bioprospecting for novel bioreactives from marine invertebrates: Multi-omics and computational strategies

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Keywords: Drug discovery, Polychaeta, Mollusca, Biotechnology, Ecology

Blue biotechnology is one of the pillars of Blue Growth, a strategy introduced by the European Union to ensure sustainable exploitation of marine resources. After a strong initial boost, the real translation into natural products with applications into human health may seem disappointing, however, we must consider that the ocean's vast biodiversity, especially that of marine invertebrates, offer as many opportunities for bioprospecting as it poses challenges. Temperate areas such as SW Europe, which benefits from the Atlantic-Mediterranean interface's high productivity and biodiversity, bare great but little explored potential for the exploration of novel marine bioactives and biomaterials that await discovery and industrial scale-up for various biotechnological applications, including biopharmaceuticals. Enforcing more efficient, industry-directed, bioprospecting from marine invertebrates implies multidisciplinary strategies that enable screening for multiple compounds in single samples, predict their bioactivity by analysing key ecological traits and validate the findings through dedicated bioassays, therefore reducing randomness of discovery. For the purpose, we have been developing methodological pipelines deploying 'omics' and computational strategies as baseline tools for the discovery of novel bioactives from marine annelids, fish, and molluscs, with emphasis on venom-secreting organisms, due to the high potential of biological chemical warfare to interfere with molecular and physiological pathways. These pipelines, which involve proteomics, transcriptomics and even metabolomics, enabled the discovery of novel neurotoxins, anti-inflammatory peptides and fluorescent proteins, plus proteins with proven antiproliferative, antiviral, ion channel permeation and photodynamic properties among others. The discovery of such a vast variety of new substances, compelled us to launch the foundation for a database of marine animal toxins from the Portuguese coast, allocating a compilation of bioreactives with industrial biotechnological potential awaiting translation to industry, therefore contributing for the EU's ambitious goal of leading the Blue Revolution.

Boosting nutrient turnover in Arctic marine oil-degrading biofilms

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Keywords: Bioremediation, Bacteriophages, Arctic, Oil spill, Biofilm

Climate change results in opening of new trans-Arctic shipping routes and exploitation of Arctic oil reserves, increasing the risk of Arctic oil-spills. During an oil-spill, indigenous marine oil-degrading bacteria develop biofilms at the oil-water interface due to the low water solubility of oil and are responsible for degrading a substantial fraction of the spilled oil. During an oil-spill there is a non limiting carbon supply for the oil degrading bacteria. However, nutrient availability can be a limiting factor for oil degradation, particularly during spring and summer when nutrient concentrations become depleted in the water column. Therefore, it is of interest to understand the nutrient turnover in oil-degrading biofilms. Specifically, we hypothesize that bacterial cell lysis, induced by bacteriophage infection, can enhance nutrient turnover providing fresh nutrients for neighboring bacteria in the biofilm. This study investigates the potential for enhancing activity of oil-degrading biofilms by sonication-induced cell lysis as a model for bacteriophage-induced cell lysis. Oil degrading biofilms were cultivated using oil coated probes, mimicking the oil droplets with biofilm observed after an oil-spill. A method for measuring biological activity of the biofilms was established based on oxygen uptake rate (OUR). After a lag phase of 14 days, an OUR of 0.119 µmol O2/cm2/h was observed in untreated biofilms. To quantify the effect of cell lysis, a relationship between release of extracellular DNA and ATP, OUR, and sonication was established. A half-life time of 2.9 min with 20 kHz sonication at 20% amplitude was observed for the planktonic oil-degrading bacteria, Alcanivorax burkomensis. This relationship and OUR will be used to quantify the effect of sonication-induced cell lysis on the activity of oil-degrading biofilms. These results provide unique insights in the role of bacteriophages in nutrient turnover in oil-degrading biofilms, which may result in an innovative biotechnology to enhance natural oil-spill bioremediation using bacteriophage therapy.

Nitrogen and Phosphorus balance of an aquaponic vs hydroponic system with Tilapia and basil

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Keywords: Aquaponics, Nitrogen, Phosphorus, Nutrient sparing, Basil

Aquaponic systems, i.e. the combined production of fish or other aquatic organisms (aquaculture) plants (hydroponics) have been considered a promising approach of nutrient recycling and sustainable food production. However, comparisons of nutrient balances of aquaponic systems vs conventional hydroponic systems are scarce and very difficult to compare between studies due to multiple factors influencing the production parameters. MSc Students participating in the aquaculture course held at the University of applied Sciences Bremen (MSc degree of international studies of technical and applied Biology ISTAB) conducted experimental research comparing potential nitrogen and phosphorus sparing and growth of basil *Ocimum basilicum* in an aquaponic system (with Tilapia) vs a hydroponic system. The two identical indoor farming systems were provided by start-up Greenhub (University of Leipzig - SEPT Competence Centre). In one system, basil was fertilized with a conventional mineral mix. In comparison, the nutrients in the aquaponic system come largely from metabolic products of Tilapia. The aquaponic system was decoupled and fecal waste was removed from the system. At the ICYMARE 2022 MSc students will present their course work on nutrient balances comparing potential nitrogen and phosphorus sparing and growth performance of basil in aquaponics vs hydroponic systems.

6) New Technologies

2) Marine Engineering

Noah Becker

Alfred Wegener Institute Helmholtz center for polar and marine research

Max Anders

Deutsches Zentrum für Luft- und Raumfahrt - Institut zum Schutz maritimer Infrastrukturen

Autonomous and remotely operated vehicles are becoming more influential as research platforms for ocean sciences, the industry, and other applications. This trend emerging from better lasting cells for electrical energy, or the new development of microelectronics and sensors provides an attractive field for young engineers. Apart from a large variety of AUVs and ROVs available on the marked or self-made, there are multiple different approaches to collecting data underwater. In this session, we would also love to learn about your ideas on sensors and systems one can use on such a platform. Professionals, researchers and graduates from different backgrounds get the chance to present their own ideas and involve others in a constructive discussion.

Using a laser distance sensor for volumetric measurements in benthic chambers

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Keywords: Laser triangulation, Optical systems, Benthic flux

In the field of marine biogeochemistry, benthic chambers on landers or other benthic sampler systems can be used to quantify fluxes in the sediment-water interface. For this purpose, it is essential to have an accurate estimation of the water volume contained in the chamber. One possible solution is to include a laser triangulation sensor into a system in the chamber lid, which determines the distance to the sediment. The triangulation sensor is moved by stepper motors to provide a scan of the whole sediment surface area inside the chamber and thus calculates the enclosed water volume. This talk presents the development process and the calibration of such a measurement system.

Prototyping of a Tethered Undersea Kite to Harvest Energy from Low Velocity Currents

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[1]Uni Bremen/DFKI; [2]TU Delft; [3]HS Bremerhaven

Keywords: Ocean Technology, Current Energy, Ocean Energy, Tidal Energy, Tidal Power

The global energy consumption has been on the rise since the last industrial revolution and continues to be. So far the demand could be satisfied by a mixture of conventional and renewable energies. With the global effort to eliminate conventional energies to stop the anthropological climate change, the demand for reliable and predictable renewable energies is growing. Under these circumstances, more attention is drawn towards the development of non-intermittent ocean energy systems. Apart from waves, thermal and salinity gradients, currents are an abundant and reliable ocean energy source. Inspired by state-of-the-art technology, a unique system for current energy, the Current Kite, is presented in the following paper. This tethered undersea kite (TUSK) consist of a wing to which a turbine is attached. The wing drags the turbine through the water in a certain trajectory, sweeping a large area at a relative speed that is several times the actual speed of the underwater current. In the following paper we present the general setup and design of our first and second prototype. The first prototype was built as a proof of concept. It was equipped with active steering and several on board sensors. With the second prototype the aim was to build a more sophisticated system, which would make the active steering redundant and use more efficient, circular flight paths. A wing which would adjust itself in the current and follow the predefined circular path, was designed using numerical simulations. To achieve this circular flight movement without twisting the electrical cable, a swivel and a stress reducer were designed and built to connect the TUSK as well as transfer electrical power to land. In addition the tracking-system was redesigned, communicating by modulation over the power line. This provides a fully autonomous ocean current power plant, which communicates in real time data and has a promising outlook in efficiency, regarding to the state of art.

Development of a SubSea battery manager for Li-ion batteries of the AUV PAUL 3000

Noah Becker[1]

[1]AWI

Keywords: Li-ion battery, Safety, Lifecycle, Resources, Electrochemistry

At present, only a small part of the world's oceans have been explored. But especially in recent years, technology has opened up many opportunities in marine research for both industry and science. More cost effective autonomous and remote-controlled underwater vehicles make it possible to explore the marine environment on a large scale and to collect a large variety of data. But in the case of autonomous underwater vehicles such as crawlers, landers and AUVs, energy is the biggest bottleneck. Although the development of modern batteries and primary storage systems by the automotive and consumer industries is well advanced, rechargeable batteries in particular still have their weaknesses. Maintaining a battery in the form of proper charging, balancing and discharging is crucial for a long service life and safe use. This talk will focus on the development of a portable battery manager for the Li-ion batteries of the AUV PAUL 3000. The maintenance of the batteries is to be improved by combining all maintenance tasks in a portable device for expeditions. This makes the general handling easier and results in a better treatment. In addition, existing methods, in particular recharging, are to be improved by more modern techniques.

6.2.4

Redesign of a portable Launch and Recovery System (LARS) for shallow lakes

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Keywords: LARS, AUV, Trailer, Engineering

Autonomous Underwater Vehicles (AUVs) were developed for the oil and gas industry to perform cost effective and long survey missions to inspect pipelines. In addition to this branch of industry, marine researchers have recognized the advantages of these vehicles. At the Alfred-Wegener Institute (AWI) they are mainly used for benthos mapping in polar regions, accessible only with specially equipped ships. Tests must be carried out to ensure functionality during yearly expeditions. These are performed in a shallow lake near Bremerhaven. Therefore a trailer with a lifting function exists, which cannot be used due to constant development and adjustments of the AUV, which made it longer. To make it usable again, a launch and recovery system was according to the VDI 2222 guideline developed. Its function allows to be launched and recover an AUV over longer distances. In addition, transport on public roads is also made possible via the carrier platform so that the system is fully portable.

7.1.1

Waves of Freedom

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Keywords: Surfing, Capitalism, Human-nature relationship, Anthropology, Visual methods

Waves of Freedom ethnographically researches the interplay between the ocean, humans and capitalist processes in Rainbow Bay, Australia, through wave surfing. The cultural lens of surfing enables to physically get into the perspective of "sea-ing the land" and broaden the terrestrial perception of the ocean as a static and fixed surface beyond social processes which happen on and around it. It explores the everyday life by the sea in order to illustrate the meaning of freedom to a community living in a neoliberal era where the capitalist logic of value has taken over their human nature relationship. The aim is to enhance empathetic forms of understanding the seascape by telling the story of a community whose perception of freedom is based on living with the rhythm of waves. This is important because the understanding of the sea and how we perceive our relationship with it has a relevance to how humans work to conserve or deplete the ocean. The findings are based on embodied ethnographic fieldwork combining participant observation and semi-structured interviews. The results are (re)presented using immersive visual methods mashing up audio recording, photography, and videography. The multifaceted characteristics of the notion of freedom are highlighted, as well as how capitalist processes of commodification and consumption contest this on the one hand, whilst at the same time form the crucial basis of the surfers' freedom. Therefore, this research will give insight into the interplay of freedom and capitalism, and furthermore into the relationship between the land and the sea, thus the culture-nature debate.

7.1.10

Mobilization of petroleum-derived dissolved black carbon in hydrothermal sediments of the Guaymas Basin (Gulf of California)

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Keywords: Dissolved black carbon, Carbon cycle, Hydrothermal sediments, Guaymas Basin

Dissolved organic matter (DOM) constitutes one of the largest organic carbon reservoirs on Earth (662 Pg-C), however, its stability and role in carbon cycles remain enigmatic. Dissolved black carbon (DBC) forms a significant part of recalcitrant oceanic DOM (14 Pg-C). DBC is thought to be mainly formed during the incomplete combustion of biomass and fossil fuels on land, entering the ocean via rivers and aerosols. However, current estimates of the global riverine fluxes of DBC and the residence time of oceanic DBC are unbalanced. In addition, stable carbon isotope measurements suggest a yet unknown marine DBC origin. A potential DBC source could be hydrothermally altered, and petroleum-like DOM. In our study, we hypothesize that hydrothermal sediments of the Guaymas Basin (GB) in the Gulf of California are sources for oceanic DBC. GB is a relatively young, active spreading center where magma intrusions into the sediment thermally alter organic matter (OM). Large amounts of petroleum, hydrocarbons, organic acids, and dissolved inorganic carbon are released from sediments above magmatic intrusions. For our study we received sediment samples from IODP Expedition 385. We performed a hot-water Soxhlet extraction to simulate the hydrothermal mobilization of organic matter from sediments. DBC was quantified in solid-phase extracted DOM using the benzenepolycarboxylic acid method. Our data show that hydrothermal heating leads to the mobilization and potential release of DBC from these OM-rich sediments into the water column with porewater concentrations exceeding reported oceanic DBC concentrations. Our ongoing radiocarbon and molecular DBC analyses will help to further constrain the role of hydrothermally sourced DBC in the oceanic carbon cycle.

7.1.11

Dissolved Organic Sulfur in the North Sea: Is Sulfurization a Mechanism for Recalcitrant Organic Carbon Formation?

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Keywords: Carbon Storage, DOS, FT-ICR-MS, DOM, North Sea

Dissolved organic matter (DOM) is one of the largest organic carbon storages in the marine environment, even exceeding the amount of organic carbon stored in the entire land biomass. Recalcitrant DOM (RDOM) in the ocean resists degradation for several hundred to thousands of years. Recently, abiotic sulfurization of DOM was suggested to increase the stability of DOM by forming RDOM, for example, in sulfidic environments such as intertidal flats. Additionally, dissolved organic sulfur (DOS) may also be derived from primary production and riverine sources. In our study, we explore the main sources and distribution of DOS in the North Sea. North Sea water samples were acquired during a research cruise in June 2021. Furthermore, the German Wadden Sea area, as well as the Weser, Ems and Elbe Rivers, were sampled as potential porewater and anthropogenic DOS sources, respectively. We investigate the molecular composition of solid-phase extracted (SPE) DOM via ultrahigh-resolution mass spectrometry (FT-ICR-MS). We hypothesize that the different DOM sources contain characteristic molecular fingerprints enabling us to identify and trace freshly produced (algal), riverine, and (recalcitrant) intertidal porewater DOS. Our quantitative analysis of (recalcitrant) DOS will further help to constrain the key export pathways and carbon sequestration potential of RDOM in the North Sea and, ultimately, the North Atlantic Ocean.

7.1.12

Unravelling the effects of meio- and macrofauna bioturbation on methanotrophic activity

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Keywords: Methanotrophs, Bioturbation, Community ecology, Sediment, Ebullition

Shallow coastal areas are hotspots for emissions of marine methane (CH_4), which acts as a greenhouse gas in the atmosphere. It is produced in deep anoxic sediments by an array of microorganisms and is oxidized by methanotrophic bacteria and archaea on its way to the sediment surface. This methanotrophic activity is highest in sediment surface layers where oxygen is present. The oxic penetration depth in coastal sediments is shallow and depends on oxygen availability, water stagnation, and benthic infauna activity (bioturbation and bioirrigation). Benthic infauna are meio- and macrofauna that inhabit the sediment surface and re-work the sediment in search of food and shelter. Some animals create and maintain stationary burrows while others continuously create burrows as they move through the sediment. There is limited access to oxygen in sediment surface layers; thus, some animals perform strategies to ventilate their burrows resulting in an influx of oxygen. Some of this introduced oxygen permeates the surrounding sediment, creating a new oxic layer for aerobic microbial activity. Animal activity in the sediment, can therefore alter oxygen availability and possibly influence methanotrophic abundance and activity. However, the effect of bioturbation and bioirrigation on aerobic methanotrophic activity in sediment is still unknown. The goal of this project is to investigate how meio- and macrofauna activity mediates aerobic methane oxidation and the sediment-to-water CH_4 flux to answer the hypothesis that meio- and macrofauna bioturbation influence methanotrophic activity in marine coastal sediment. These results will give a deeper understanding into how meio- and macrofauna influence aerobic methanotrophic activity and CH_4 emissions from marine coastal sediments. The results of this work are important because the coastal ecosystem can be altered and negatively affected by eutrophication and climate change. This can possibly result in an increase of marine CH_4 emissions.

7.1.13

Copepod-mediated effects on the biological carbon pump in the subtropical South Atlantic

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Keywords: Calanoid copepods, Biological Carbon Pump, Active Carbon Flux, Diel Vertical Migration, Subtropical South Atlantic

Zooplankton can transform and transfer organic carbon via various processes, and their communities can affect the intensity and efficiency of the biological carbon pump (BCP). Increasing CO_2 emissions alter the global marine carbon cycle and consequently, the role of zooplankton communities in the BCP. Calanoid copepods are key components of those communities. They are characterised by high taxonomic and functional diversity, making comprehensive studies about their complex role in the BCP challenging. Depth-stratified day and night samples (0-800 m) from the subtropical Southeast Atlantic region influenced by the Benguela Current were analysed with focus on calanoid copepods. Their abundance and biomass distribution, as well as their species specific impact on the passive (fecal pellets) and active (respiratory carbon via DVM) vertical carbon flux were determined. Based on differences in vertical distribution, calanoid species were assigned to four different types of migrant groups, depending on their specific migration ranges (e.g. within the epipelagic, within the mesopelagic and between epi- and mesopelagic zone). Our study aims to address this gap by investigating vertical distribution, community composition, diel vertical migration behaviour and thereby calculating passive and active carbon fluxes of calanoid copepods in the subtropical South Atlantic. This case study shows how different calanoid functional groups impact carbon fluxes in the subtropical South Atlantic. Finally, it demonstrates how detailed zooplankton community analyses, i.e. focusing on important traits such as body size, energetic demands, feeding strategies and diel vertical migration behaviour, can improve pelagic carbon budgets.

Parasitic fungi – Small but powerful vampires of phytoplankton

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Keywords: Chytrids, Fungal parasite, Infection dynamics, Phytoplankton pathogen, Microbial food web

Infecting up to 90% of phytoplankton populations, parasitic fungi can temporarily decimate entire host populations and change prevailing nutrient availabilities. Owing to their inconspicuous nature, aquatic fungal parasites, are largely understudied and little is known about their role in biogeochemical cycling. Here, we aim to provide an insight into the mechanism and dynamics of fungal epidemics in the Baltic Sea as well as in a recently isolated model pathosystem consisting of a dinoflagellate and its fungal parasite. Similar to vampires, parasitic fungi attach externally, grow a root system within the host tissue and eventually siphon nutrients out of the host cell. Within an infection cycle of 2-3 days, host cell content is transformed into millions of zoospores that play an essential role in the microbial food web. With such high potency to infect a phytoplankton population, we propose that fungal parasites lead to fundamental yet cryptic perturbations of microbe driven element and nutrient cycling during phytoplankton blooms in marine systems.

Relationships between metal pollution in female green (*Chelonia mydas*) and hawkbill (*Eretmochelys imbricata*) sea turtles of São Tomé Island and their egg composition

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Keywords: Biomarkers, Marine Turtles, Lipids, Pollution, Reproduction

Metals and metalloids are persistent pollutants and widely distributed in the environment, having harmful effects in diverse organisms. Sea turtles are known to accumulate these pollutants in their tissues and can be considered good indicator species of marine pollution. However, few studies have been made to address how the effects of metal pollution in the female turtles may influence the quality of their eggs, and infer the health of future sea turtles' generations. In sea turtle eggs, the yolk represents the majority of egg mass and it is rich in lipids. Additionally, yolk fatty acids are the major source of energy for embryo development and for the post-hatching activity. Fatty acids are ubiquitous cell constituents with important roles in biological systems, such as metabolic and signalling mediators. These markers have been used in studies with a myriad of organisms, to better understand how pollution affects them. São Tomé Island is an important nesting and feeding ground for five of the seven existing species of sea turtles, including the green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*). The main goal of this study was to evaluate if the contamination by different metal and metalloids in blood of nesting green and hawksbill sea turtles could be associated with differences in the morphology and composition of their eggs and respective compartments (e.g. total fat, weight and dimensions). How the contamination status of the mothers could affect different lipid and fatty acid fractions in the yolk of their eggs were also evaluated in this study. Results indicate that the screened contaminants affect the egg components differently, and in particular the yolk lipid fractions where several alterations in the fatty acid profile were observed. Overall, this study points to some possible effects of metal contamination on the reproductive success of these female turtles by altering egg quality.

Plasticity of native and invasive crabs to a new generation pesticide: an integrative approach

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Keywords: Bioinvasions, Crab, Pollution, Sulfoxaflor, Integrative approaches

Predatory brachyuran crabs are one of the most successful marine invasive groups. They hold tolerance to abiotic stress, and their genetic, life-history, and behavioural adaptation mechanisms prompt their invasive conspicuousness. However, plasticity – and further invasiveness – may be influenced by global change drivers such as climate change or pollution. Sulfoxaflor is a new generation insecticide active ingredient, effective on neonicotinoid-resistant pests in agriculture. However, its application has been controversial, with the product being banned and re-approved in the US, and regulated in several European countries. Few studies address its toxicity to aquatic non target organisms, and the ones comparing responses at several levels of biological organisation regarding "native versus invasive" integrative approaches are non-existent. Therefore, in this study, 10 individuals of each native (*Carcinus maenas*) or invasive crab species (*Hemigrapsus takanoi* and *Hemigrapsus sanguineus*) were exposed to control or one of six sublethal sulfoxaflor concentrations (0, or 0.02 to 0.5 mg i.a./L), in a semi-static procedure at 19°C, over 16 days. Behaviour (motricity), function (feed intake), physiology (oxygen consumption), and biochemical biomarkers of oxidative stress & damage (ROS, SOD, LPO), energy metabolism (ETS, IDH), detoxification (GST), and neuronal activity (AChE) were addressed. This timely approach addressing endpoints of several levels of biological organisation unravels phenotypic plasticity to a new generation pesticide in species with different ecological status. Ultimately, species' specific physiological advantages will allow to infer about mechanisms for bioinvasion success under global change, while promoting further informed and effective regulation measures.

Protecting the sea living fossil: Frontier Social Conservation Action and Research of Horseshoe Crabs in Indonesia

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Keywords: Horseshoe Crab, East Kalimantan, By-catch, Conservation, Community awareness

The study of a nexus between species, environmental conditions and the adjacent ecosystem interactions is predominantly required in order to enlighten the best management and conservation approach toward marine water arthropods species like horseshoe crabs. One of the species (*Tachypleus tridentatus*) is categorized as endangered and the remaining species (*Tachypleus gigas* and *Carcinoscorpius rotundata*) are labelled as data deficient by the International Union for the Conservation of Nature and Natural Resources (IUCN) due to the accidental capture through fishing gear, poaching of adults and eggs, and nesting habitat degradation. Understanding the temporal, spatial and environmental factors influencing the capture of this species is essential to reduce incidental catches. Through research, capacity building, and awareness raising, the project aims to stimulate and promote community collective action for horseshoe crab conservation. We provide the insight into the environmental preferences of horseshoe crabs in East Kalimantan by mapping the field survey measurement aligned with the presence by-catch from gill-nets observing data (5 months on boat observation) from the fishermen with a set of environmental parameter characteristic. In-situ measurement of sediment characteristics (temperature, pH, dissolved oxygen, salinity) was performed. The results provide information on distribution of preferable habitat of each life phase of horseshoe crabs in Balikpapan coast. The temporal by-catch observation reveals that there is a seasonal pattern dominated by Tachypleus gigas (381 catches and 3.46 kg/trip CPUE) during the west monsoon season. In addition, around 11 schools (286 students) were included in a program as a changemaker for future conservationists and 26 fishermen have been trained in basic horseshoe crab research and monitoring protocols. Overall, the findings seemed to assist the horseshoe crab conservation effort for regional management.

Number of primordial follicles in juvenile ringed seals (*Pusa hispida*)

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Keywords: Ringed seal, Primordial follicles, Stereology, Baltic Sea, Greenland

Primordial follicles are important for the reproduction cycle and therefore also for the survival of the whole population of a species. Mammals have a large pool of primordial follicles, and it is thought that this pool represents the total number of oocytes. The aim of the present study was to determine the total primordial follicle number of juvenile ringed seals (*Pusa hispida*) from the Gulf of Bothnia and Greenland. Overall, 52 ovaries from two ringed seal populations (West Greenland (N = 6), Gulf of Bothnia, region in the Baltic Sea (N = 46)) were examined. All ovaries were cut into 2 mm thick slices and every slice was embedded in paraffin. A 5µm thick section was cut out from each tissue block and stained with with haematoxylin-eosin. The mean volume of the follicles and the total volume of primordial follicles per ovary were estimated by stereology and used to calculate the total estimated number of primordial follicles. The median of the total estimated number of primordial follicles seemed to be higher in Baltic individuals than in Greenland individuals (Gulf of Bothnia = 565,657; Greenland Sea = 122,475). This widens the total range of primordial follicles in ringed seals overall and might bear some potential for discussions regarding the influence of endocrine disruptors and environmental influences depending on different regions/populations and their exposure to various factors. Thus, this study provides basic reference data of the number and mean volume of ringed seal primordial follicles.

Effects of TNT from of dumped munitions on fish under the light of climate change

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Keywords: Tumors, Metabolites, Environmental pollution, Flatfish, Immune system

During marine military operations, munition was and is dumped into the ocean via unexploded ordnance, sunken warships and at military practise ranges. Additionally, significant amounts of munition were intentionally dumped into the ocean for disposal after the world wars. Around 1.6 mio tons of conventional munitions have been disposed of in the German North and Baltic Sea alone. The munition has been subjected to corrosion over more than 70 years and leakage of the contained substances (explosives and other munition compounds) occurs. Climate change will most likely further intensify the issue. More frequent extreme weather events will impact marine munition mechanically through waves and currents and facilitate the spread of (toxic) munition compounds. Higher water temperatures and changes in salinity will further facilitate the corrosion. One of the most abundant substances leaking from munitions is the explosive 2,4,6-trinitrotoluene (TNT). It is known to be both acutely toxic in high doses and carcinogenic at low dose chronic exposure in test animals. Another effect of low dose exposure is a reduced reproductive capacity. Many fish around dump sites in Germany have traces of TNT metabolites (45 %), and some also TNT itself (2%), in their bodies. Unpublished data also suggest an increase of liver tumors in flatfish around those dump sites. Finally, the additional stress caused by changing environmental conditions due to climate change may weaken the resistance of fish to cope with the effects of TNT (stress-on stress response). As part of the CONMAR project, my doctoral thesis seeks to conduct a 100-day temperature trial (preference vs upper thermal limit) with sticklebacks to evaluate possible stress on-stress responses of temperature and TNT. Parameters like growth, condition index, organ weights and gonadosomatic index will be considered. The obtained data will be backed by and compared against field sampled flatfish from both Baltic and North Sea.

Measuring the purity of meta-Cresol purple

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Keywords: Total pH, Ocean acidification, pH indicator, Coulometry

With increasing CO_2 concentration in the atmosphere, the oceanic uptake of CO_2 also increases. Raised CO_2 levels change the carbon equilibrium system with impacts on a variety of processes. Overall, the ocean becomes more acidic. To measure and monitor ocean acidification, accurate pH measurements are necessary. The EU-project SapHTies aims to improve spectrophotometric seawater pH measurements. At present, the most used spectrophotometric pH indicator for marine applications is meta-Cresol purple. This indicator will be better characterised over the course of the project. Firstly, primary pH measurements of artificial seawater are done with an electrochemical cell without liquid junction – the Harned cell. Measurements are taken at different salinities and temperatures to cover ranges typical in oceanography. Secondly, the same artificial seawater solutions are doped with meta-Cresol purple to measure its spectrophotometric properties. The characterized indicator can subsequently be used to measure the pH of seawater spectrophotometrically. However, the purity of meta-Cresol purple as well as the kind of impurities vary from batch to batch, which is known to affect spectrophotometric pH measurements significantly. Therefore, the purity of meta-Cresol purple must also be measured. Up to now, there is no adequate measurement method available. Since meta-Cresol purple is an acid, its purity can be measured with low uncertainty in terms of its total acid content by coulometry. It must be considered that impurities can be acids as well. Therefore, another characterization method must be applied that can quantify the proportion of impurities independently from coulometry.

Hydrothermally modified DOM: An analytical perspective on DOM alteration under hydrothermal conditions using radiocarbon dating, FT-ICR-MS, and NMR

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Keywords: Dissolved organic matter, Hydrothermal degradation, FT-ICR-MS, NMR, Radiocarbon Dating

At 660 Gt C, marine dissolved organic matter (DOM) is the largest reservoir of reduced carbon in the ocean. Most of the DOM pool is refractory, remaining in the ocean for thousands of years. By investigating DOM degradation and its alteration by hydrothermal conditions, we aim to clarify the fate of its oldest fraction. Previous field measurements and laboratory replication of hydrothermal conditions suggest that hydrothermal vents can act as a sink for the refractory DOM fraction. Thus understanding hydrothermal vents and their effect on DOM is vital for broadening our knowledge of the global carbon cycle. Solid-phase extracted (SPE) DOM from the Equatorial Pacific Intermediate Water, in a matrix of ultrapure water, was subjected to elevated temperatures (starting at room temperature and ramped up to 300°C) and pressure (400 bar). The hydrothermal experiments removed 50% of the carbon content of SPE-DOM. The remaining DOM fraction presented with increasingly low Δ14C values, indicating the presence of an ancient DOM fraction that is resistant to hydrothermal degradation. Moreover, SPE-DOM characterized by concentration and Δ14C matched a two-component description of background and excess. While the SPE-DOM background is refractory and 14C-depleted, the excess is comparatively high in 14C and degraded when exposed to hydrothermal conditions. Constituents of the background were constrained to ~-650‰ and ~-800‰ Δ14C translating to approximately 8500 to 13000 apparent radiocarbon years. By combining Fourier transform ion cyclotron mass spectrometry (FT-ICR-MS) and Nuclear magnetic resonance (NMR) spectroscopy, molecular characteristics accompanying 14C-depletion were identified. Low oxygen content, decreasing molecular weight, and molecular diversity were characteristic of the DOM background. We found refractory SPE-DOM compounds both removed and unaffected by temperature ramping. Therefore, hydrothermal vents are likely both sinks and sites of preservation for refractory DOM compounds and drivers of the convergence of DOM molecular characteristics.

Influence of hydrothermal heating on the biogeochemistry of dissolved organic matter in Guaymas Basin sediments

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Keywords: Dissolved organic matter, FT-ICR-MS, Hydrothermal sediments, Guaymas Basin, Porewater

Dissolved organic matter (DOM) is one of the largest organic carbon pools on earth containing about 662 Pg-C, and small changes in the dynamics of the oceanic DOM pool may have large influences on the global carbon cycle. DOM in the deep ocean is stable on timescales of thousands of years. A part of this recalcitrant DOM pool consists of dissolved black carbon (DBC). Black carbon is formed during the incomplete combustion of organic matter on land with subsequent transport of DBC to the ocean. Another potential source for pyrogenic DBC may be high-temperature oceanic environments such as hydrothermal systems. However, the influence of hydrothermal systems on the release of recalcitrant DBC to the marine DOM pool is not constrained yet. In our study, we investigate the molecular composition of DOM in porewaters of Guaymas Basin (GB) (Gulf of California) hydrothermal sediments. The GB is a young marginal rift with active seafloor spreading. We hypothesize a change in the molecular composition of the DOM due to hydrothermal heating and a higher relative abundance of DBC in porewater of hydrothermal sediments. We received porewater samples from sediment cores retrieved during IODP expedition 395 in 2019. We characterized the molecular composition of solid-phase extracted (SPE) DOM via Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) and quantified DBC concentrations as benzenepolycarboxylic acids. Our results revealed DOM with lower oxygen content, lower masses and higher aromaticity of the molecular formulae compared to non-hydrothermal settings. The relative abundance of DBC in the porewater increased with depth which may be explained by hydrothermal petroleum generation in the deeper GB sediments. Our study provides insights into how hydrothermal heating impacts the DOM composition in GB with potential consequences for the oceanic carbon cycle pool due to the release of recalcitrant DBC into the water column.

Every scar counts: assessing reproductive succes in female harbour porpoises by using ovarian corpora scars

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Keywords: *Phocoena phocoena*, Corpus luteum, Corpus albicans, Post-mortem investigation, Stranding research

Harbour porpoise (*Phocoena phocoena*) ovary pairs were collected during post-mortem investigation at Utrecht University. Studying the reproductive success of free ranging harbour porpoises is challenging, but ovaries, and more specifically ovarian corpora scars, have been used as a reliable measure of maturity status in small cetaceans. Life history assessment has previously not been routinely conducted; therefore, it is yet unknown what the reproduction cycles and capacity is for harbour porpoises in the southern North Sea. The aim of this study was to show if ovarian corpora scars and ovarian size, in combination with data on age and reproductive status are able to be used as a means for the study of reproductive success in harbour porpoises in the southern North Sea. Ovaries were first weighed and measured and the ovarian corpora scars, corpus luteum (CL) and corpus albicans (CA), were counted macroscopically. The age of harbour porpoises was determined at the Institute of Terrestrial and Aquatic Wildlife (ITAW) of the Veterinary Medicine University of Hannover in Germany and then used in combination with the number of scars counted. Information on reproductive status was obtained during the post-mortem investigations. We found significantly more ovarian corpora scars in older harbour porpoises. Additionally, the reproductive status of harbour porpoises who were both pregnant and lactating were moderately associated to the volume and size of the ovaries. Our results demonstrate that the number of ovarian corpora scars and ovary size increases as the animal matures. Ovarian size is largest for harbour porpoises which were both pregnant and lactating. We argue that ovarian corpora scars can be used more frequently as a measure for reproductive success in harbour porpoises.

Multiscale modelling of biogeochemical fluxes along the Scheldt land-sea continuum

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Keywords: Coastal modelling, Rivers ocean atmosphere interaction, Unstructured-structured grids, Biogeochemical interaction

The multi-scale interactions between river and ocean are poorly understood. With this project, we aim to quantify these multi-scale interactions along the river-estuary-ocean-atmosphere continuum from hourly to multi-annual time scales over the Scheldt-North Sea region. In particular, we will assess how the physical and biogeochemical dynamics of the North Western Continental Shelf (NWCS) (i.e. limited by the 200m isobath) and Southern Bight of the North Sea (SBNS) are influenced by the small-scale variability of the Scheldt river-estuary and the atmosphere. For solving the multiscale interactions along the land sea continuum, we propose to develop an unstructured (finite elements) grid model. Then coupling this model with a structured (finite-differences) grid model, for fully resolving in three dimensions the continuum of scales and processes from a few hundreds of meters up to several tens of kilometers. For the atmosphere, simulations coupling in one way (i.e. the atmosphere forces the ocean with no feedback from the ocean on the atmosphere) and two way (i.e. the ocean feedbacks on the atmosphere) the ocean and atmosphere will be performed in order to assess the impact of particular weather events (e.g. storms, heat wave) on the ocean physics and how oceanic surface conditions feedback on the simulated local wind (e.g. sea breezes). From a biogeochemical point of view, the modelling system developed in this PhD thesis will offer an optimal way to quantify the transfer of organic and inorganic materials (e.g. suspended particulate materials, SPM) from the land to the sea and to track pollution events.

Distribution pattern of Dissolved Black Carbon in the marginal seas of the northwestern Pacific Ocean

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Keywords: SPE acid dependency test, Chemical oceanography, Dissolved Organic Matter, Korean Marginal Seas, Ultrahigh Resolution Mass Spectrometry

Pyrogenetic or black carbon (BC) is ubiquitously produced through incomplete combustion of organic matter in the environment and consists of polycyclic condensed aromatic compounds. The main sources on land are forest fires and anthropogenic fossil fuel burning. A water-soluble fraction of BC, dissolved black carbon (DBC), can enter the world's ocean through rivers, continental runoff, or atmospheric deposition. Through its resistance to microbial degradation, considerable amounts can accumulate in sediments. In surface waters though, BC is rapidly degraded via photooxidation. Through increased industrialization in East Asia, new BC sources are available albeit little is known about the resulting differences in chemical properties of the local seas. Parts of those regions are the Korean Marginal Seas (KMS), namely the East / Japan Sea (EJS), Korea Strait (KS), East China Sea (ECS), and Yellow Sea (YS) from East to West. Through seasonal changes in oceanic currents and highly different end members like the Kuroshio current or Changjiang Diluted Water (CDW) this region has complex water mixing patterns and through various industrial sites many possible DBC sources. To investigate distribution patterns of DBC in the KMS surface water was collected along transects in YS, ECS, and KS, and depth profiles were taken in the EJS. Two types of acids were used for method comparison, to adjust samples to a pH of 2 hydrochloric and nitric acid were used. Different sampling locations and acidification methods were compared using DBC-analysis via UPLC PDA and dissolved organic matter (DOM) molecular composition via FT-ICR-MS. The samples were desalted and concentrated using solid-phase extraction. Both acidification methods showed significant changes on the molecular level, fortunately, BC concentration differed only non-significantly. The KMS data showed significant differences between sampling sites, notably are the higher values in YS compared to EJS.

Between the tide pools: Physiological responses of *Octopus vulgaris* to emersion

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Keywords: Tidepools, Emersion, Common octopus, Metabolism, Oxidative stress

Cephalopods are well known for their cognitive capabilities and unique behavioural repertoires. Still, there are certain life strategies and behaviours that are still not fully understood. For instance, coastal octopuses have been documented (mostly through citizen science and TV documentaries) to occasionally leave water and crawl in intertidal areas. Yet, there is a complete lack of knowledge on the physiological and biochemical basis of this type of behaviour. Within this context, the aim of this thesis was to investigate, for the first time, physiological (routine and maximum metabolic rates and aerobic scope) and biochemical (e.g., antioxidant enzymes activities, heat shock protein and ubiquitin levels, DNA damage, lipid peroxidation) responses in various tissues of the common octopus, *Octopus vulgaris*, to emersion. First, a survey among fishermen from Cascais, Portugal, was conducted, and showed that this type of behaviour is quite frequent in the local tidepool areas. The results also indicated that air exposure followed by resubmersion did not change the maximum metabolic rate and aerobic scope, but elicited a peak in routine oxygen consumption rates. Most biochemical markers revealed no significant differences among emersion/immersion treatments. Our findings showed that *O. vulgaris* was able to tolerate exposure to short-term emersion periods without significant changes in energy expenditure rates, combined with an efficient antioxidant stress-related machinery. These results complement our fundamental knowledge on the biology and ecology of *O. vulgaris*, by giving novel insights into the species' capability to "walk" on land.

7.1.15

Exploring the Role of Blue Economy in Sustainable Development: A Perspective from Pakistan

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Keywords: Blue Growth, Maritime Tourism, Blue Finance, Coastal Communities, SDGs

Being covered by oceans around 71%, Planet Earth is a blue planet. More than three billion people depend on this natural capital for the sustenance of their lives and livelihoods. Given its twin objectives of securing growth and sustainability, the blue economy has become a pivotal policy discourse. This qualitative study aims to explore the role of the blue economy in sustainable development in the contextual settings of Pakistan. Being a bonafide maritime nation and one of the significant littoral states in the Indian Ocean, Pakistan is blessed with immense blue potential that mostly remained untapped. Despite making reasonable efforts, the country is not making headway towards sustainability. Drawing upon Triple Bottom Line Theory, the study adopts an interpretive research paradigm and collects primary data through semi-structured in-depth interviews with the blue economy experts (n-15) selected through non-probability purposive sampling. The researchers performed a thematic analysis of the primary data and discussed the identified themes. The study confirms that the blue economy and sustainable development are compounding, and Pakistan can't afford their mutual exclusivity. While calling attention to several socio-economic, political, institutional, legal, security, and environmental challenges, the study informs that Pakistan's geostrategic location and blue economy potential enable it to turn the tide towards sustainable development. To this effect, the country needs to put in titanic efforts across all spheres to bear out its national and international commitments towards both. The study also contributes to the budding literature on blue economy and sustainable development. With an improved understanding of both phenomena, the study stimulates advanced research and backs the national and international policy discourse. The study also notifies the directions for future research along with limitations and policy implications.

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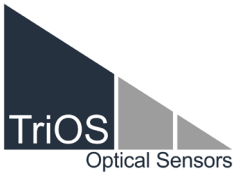

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