



ICYMARE

International Conference for
YOUNG Marine Researchers

BOOK OF ABSTRACTS

ICYMARE 2023 OLDENBURG

18–22 SEPTEMBER 2023



ICYMARE
International Conference for
YOUNG Marine Researchers

WVW
THE BREMEN SOCIETY FOR
NATURAL SCIENCES from 1864

www.icymare.com

ICYMARE 2023 OLDENBURG

Book of Abstracts

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Content

Welcoming Words	4
About ICYMARE	6
Organization Team	9
Oldenburg	11
Venues & Directions	15
Useful Information	20
Session Overview	22
Tuesday, 19 th September	26
Wednesday, 20 th September	98
Thursday, 21 st September	174
Friday, 22 nd September	202

Welcome to ICYMARE 2023 OLDENBURG

We are happy to welcome all of you to the 2023 edition of the "International Conference for Young MARine REsearchers" – ICYMARE. We are happy that we can come together in-person for a meeting in Oldenburg. 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 2023 OLDENBURG 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 2023 OLDENBURG possible.

We are most thankful for you presenters. Without you, organizing a conference would not make any sense. We warmly welcome you in Oldenburg and hope that you will have an amazing time at ICYMARE 2023 OLDENBURG. 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 2023 OLDENBURG organization team

The German Marine Research Alliance (Deutsche Allianz Meeresforschung, DAM) connects university and non-university marine research institutions across Germany. In collaboration with strategic partners and stakeholders, DAM strengthens the sustainable use of the coasts, seas, and oceans.

DAM supports the training and networking of young researchers and technicians in marine sciences by sponsoring this year's ICYMARE Poster Session.



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.



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:

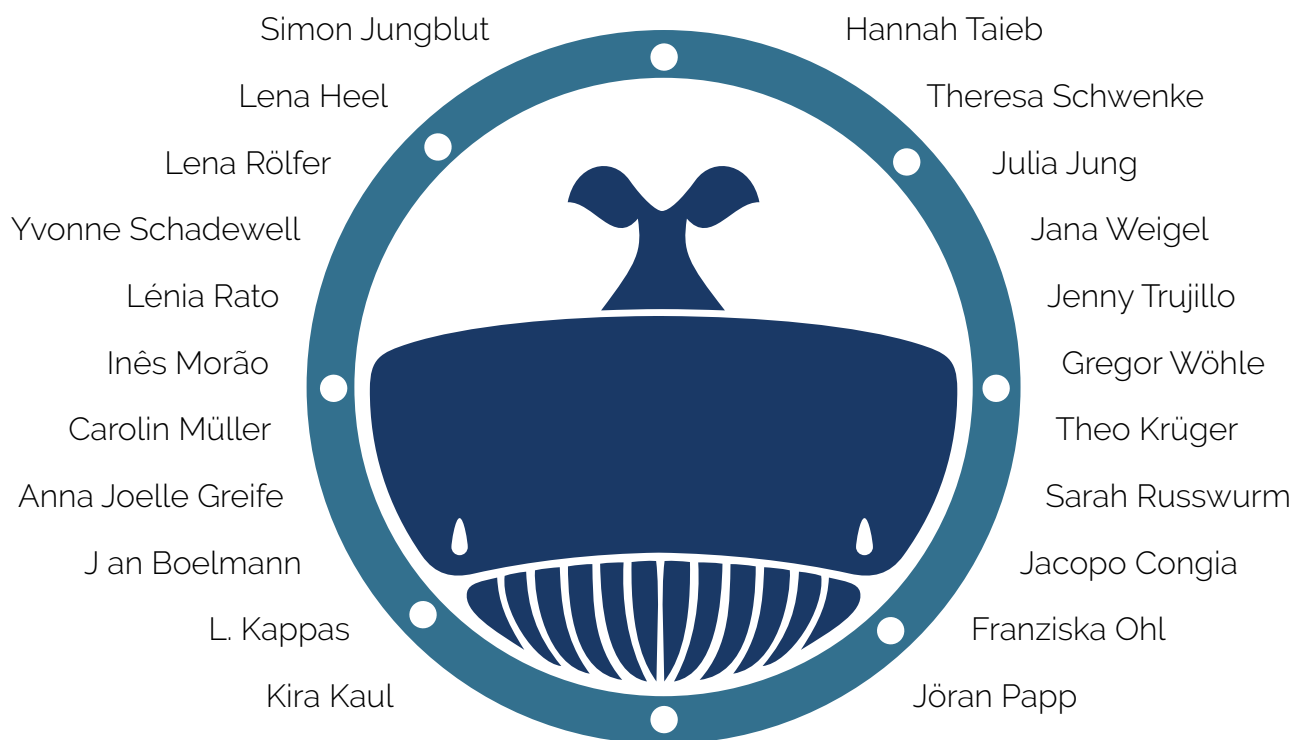
- ICYMARE is an annual on-site conference for young marine researchers with changing locations and hosting support.
- ICYMARE is an opportunity to build your network of young marine researchers in a professional as well as easy-to-talk-to atmosphere.
- ICYMARE offers you the chance to engage in our community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



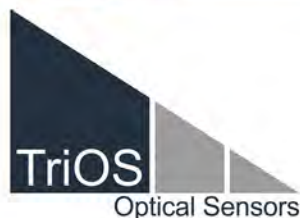
Organization Team

Our team consists of motivated people with a background in marine sciences who organize the conference for you on voluntary basis. If you want to join our team or help with the organization beforehand or at the days of the actual ICYMARE conference on-site in Oldenburg please contact: hello@icymare.com

The ICYMARE 2023 OLDENBURG Team



Thanks to all of you – you are great!



High-End Measurement Technology - Made in Germany

Since 1998 TriOS Mess- und Datentechnik GmbH is active in developing and producing optical measurement devices for water analysis. TriOS devices are in use worldwide thanks to an international sales network. The core competences of the company are spectrometer applications and fluorescence measurement. TriOS offers hyper-spectral sensors for online measurement of Nitrate, Nitrite and organic compounds and is market leader in the area of oil in water monitoring

OUR PRODUCTS

RAMSES

RAMSES radiometers are spectral imaging radiometers to measure radiance, irradiance, or scalar irradiance in the UV, VIS and UV/VIS ranges. Thanks to their ultra small size and weight as well as very low power consumption, they are especially suitable for hand-held and autonomous applications in remote places, like the Arctic or Antarctica.

OPUS

OPUS is the new generation of spectral sensors for on-line measurement of nitrogen and carbon compounds. Through the analysis of a full spectrum, OPUS is able to deliver reliable readings for NO₃-N, NO₂-N, organic ingredients (CODEq, BODEq, DOCEq, TOCEq), and a number of other parameters.

VIPER

VIPER measures hyperspectral attenuation and transmission coefficients, enabling detailed determination of multiple parameters at the same time. Typical applications for VIPER are water quality monitoring, color measurements of aqueous solutions or quality monitoring of drinking water.

AND MANY MORE...

OUR ACTIVITIES

Research and cooperation with partners

Development of new Sensors

Production on company site in Rastede

Assembly of optics and Electronics in Rastede

Field Testing of Sensors

Worldwide operation and cooperation

Quality management

Oldenburg

ICYMARE 2023 OLDENBURG will take place in Oldenburg from 18th to 22nd of September 2023!

We are happy to be hosted by the Institute for Chemistry and Biology of the Marine Environment of the Carl-von-Ossietzky University Oldenburg for the conference and the State Museum for Nature and Man in Oldenburg for the icebreaker. Everybody is welcome to join us – no matter if you would like to present your work, a poster or just come and listen to the inspiring conference program.

Welcome to the city of Oldenburg

Oldenburg (in Lower Saxony) is located in the northern part of Germany, approximately 50 km west of Bremen and around 90 km east of the Dutch border. It's a city that beautifully combines its historical past with modern elements. The city features cobblestone streets that wind through its historic district, showcasing its medieval heritage through well-preserved buildings. Overlooking the busy Markt square is the imposing Oldenburg Castle, a symbol of the city's history.

The Carl von Ossietzky University of Oldenburg adds a vibrant international touch, attracting students as well as scientists and contributing to the cultural scene. Amidst the city's hustle, green oases like the Schlossgarten offer peaceful spaces. The welcoming locals (Oldenburg has roughly 170'000 inhabitants) frequent cozy cafes and squares, fostering connections across generations and nationalities. Oldenburg truly captures the essence of Lower Saxony's charm in various ways. during the conference.



0 5 min



Pedestrian zone

Tourist Information

long-distance coach

Car park

Coach parking

Barrier-free parking spaces

Barrier-free WC
Oldenburg-Info im Lappan | Schlosshöfe
Schlaues Haus | Schloss Oldenburg

Barrier-free parking in the multistorey car park
Parkhaus am Waffenplatz | Waffenplatz 4, 26122 OL
Schlosshöfe Parkhaus | Mühlenstraße, 26122 OL
Parkhaus Heiligengeist-Höfe | Heiligengeist-Höfe, 26121 OL

- 1 Lappan (1467/68)**
The striking Gothic bell tower, which once belonged to the Heiligen-Geist-Spital (Holy Spirit Hospital) (1350/1355), was one of the few buildings to survive the town fire of 1676 unscathed. Its Renaissance roof was added in 1709.
- 2 Haus Graf Anton Günther (1682)**
Count Anton Günther of Oldenburg reigned in Oldenburg from 1603 onwards. The former merchant's house with its neo-Renaissance façade, redesigned in 1894, depicts the count on his favourite horse "Kranich", the Crane.
- 3 Degodehaus (1502)**
The house survived the town fire of 1676 and today is the last remaining medieval patrician house. The interior features a remarkable painted wooden ceiling from the 17th century.
- 4 Altes Rathaus (1888)**
Since 1888 this Town Hall has taken the place of the Renaissance town hall which was built in 1635 and demolished in 1886. It is still the seat of the Lord Mayor today. Its special feature is its triangular shape with stylistic elements of the neo-Gothic and neo-Renaissance periods.
- 5 St. Lamberti-Kirche (13.Jh./15.Jh. / modification 18./19.Jh.)**
Built between 1155 and 1234 as a Romanesque hall church, the church was remodelled several times. Today the exterior does not reflect the classicist rotunda of the interior.
- 6 Schlosswache (1839)**
A classicist building that once belonged to the Oldenburg Schlossfreiheit, a classicist ensemble with Kavaliershaus (Cavalier's House) and Marstall (Stables). The military changing of the guard was a tradition in Oldenburg until the abdication of the Grand Duke (1918). Today, the Landessparkasse zu Oldenburg (founded in 1786) is located in and attached to the Schlosswache. The former Ersparungscasse is considered to be the oldest still existing savings bank in the world.
- 7 Schloss (1607)**
Built on a medieval moated castle („Aldenburg“), which was first mentioned in a document in 1108. The present building dates largely from the early 17th century. Built by Count Anton Günther in the Renaissance style as a residence. Duke Peter Friedrich Ludwig had the interior redesigned in a classicist style in the 18th century. Since 1923 it has been part of the State Museum of Art and Cultural History.
- 8 Prinzenpalais (1826)**
This classicist building served as a residence, initially for the Russian grandchildren of Duke Peter Friedrich Ludwig, later for the Grand Duke Nikolaus Friedrich Peter. Since 2003 it has been part of the Landesmuseum für Kunst und Kulturgeschichte (State Museum of Art and Cultural History) and houses the Galerie Neue Meister (New Masters' Gallery) with an excellent collection of paintings and sculptures from the Classical Modern period.
- 9 Landesmuseum Natur und Mensch (1836)**
The museum moved to its present location in 1879. It houses one of the oldest natural history collections in Germany. The permanent exhibition is characterised by an interdisciplinary approach, an artistic presentation as well as its insights into modern research. It is founded on the rich landscape of North-West Germany.
- 10 Augusteum (1867) / Kunstverein (1843)**
The Augusteum is part of the Landesmuseum für Kunst u. Kulturgeschichte (State Museum of Art and Cultural History). Built in the style of a Florentine palace, it houses one of the most traditional collections of Italian, Dutch, French and German painting from the 15th century to the 18th century. The Kunstverein is adjacent to the Augusteum. Established in 1843, it is one of the oldest in Germany. It is dedicated to promoting contemporary culture. Some 100 years after its foundation, it built and moved into this contemporary exhibition hall.
- 11 Elisabeth-Anna-Palais (1894/1896) / Schlossgarten (1814)**
Renaissance style was commissioned by the last Grand Duke as a new residence for the family. It was named after his wife Elisabeth Anna of Prussia. After the abdication, it became state property and served as a residence. The National Socialists used the rooms as a venue for weddings of party members. After the end of the war, the occupying forces used the house as a casino. When they no longer needed the building, the Social Court moved in when it was established in 1954. The adjacent Palace Garden is an 18-hectare historic park in the style of an English landscaped garden. It was laid out between 1804 and 1819 by order of Duke Peter Friedrich Ludwig by the court gardener of the time, Julius Friedrich Wilhelm Bosse.
- 12 Pulverturm (16. Jh.)**
As the last surviving building, the Powder Tower is a reminder of Oldenburg's former city fortifications. It actually only served to store weapon ammunition under the Danes in the years 1667 to 1773. In the 19th century it was used as a storeroom for the Palace kitchens. Since 1996 the Powder Tower has been used for cultural purposes.
- 13 Oldenburgisches Staatstheater (1893)**
This imposing building has an impressive classicist columned porch and a neo-baroque interior in the so-called "Grosses Haus" (Great House). The "Kleines Haus" (Small House) is located in the modern annex.
- 14 Kulturzentrum PFL (Peter Friedrich Ludwigs Hospital) (1838/41)**
This building, designed in the late classicist style, was erected as a hospital. After the municipal clinics moved out in 1984, the listed complex was restored and redesigned for cultural purposes.
- 15 Edith-Russ-Haus für Medienkunst (2000)**
The EDITH-RUSS-HAUS gallery was founded due to an endowment of the Oldenburg senior teacher Edith Maria Russ. With its focus on new media art, it is a special feature in northern Germany.
- 16 Stadtmuseum (1915) / Horst-Janssen-Museum (2000)**
The Stadtmuseum was founded by the art and history collector Theodor Francksen. With the partial demolition of the building planned from March 2021, the museum will leave its current location by autumn 2023 and lead a nomadic existence with its exhibitions being shown at various places throughout the city. The Horst Janssen Museum is dedicated to the visual arts on paper. It is named after the draughtsman, etcher, woodcutter, poster artist, illustrator, author and graphic artist Horst Janssen (1929 to 1995), who grew up and is buried in Oldenburg. The permanent exhibition focuses on the many facets of his artistic talent.
- 17 Computer-Museum e.V. (2009)**
Personal computers, arcade machines, game consoles and pinball machines from the 1970s, 80s and 90s are not only on show but can be used for a hands-on experience. The chronologically structured exhibition includes icons from the years 1972 to 1998.
- 18 Bahnhofsgebäude (1915)**
Railway transport began in the capital of the Grand Duchy of Oldenburg in 1867. In the beginning there was only a goods shed which served as a station. The first actual railway station was built in 1879. The building had to be demolished and in 1915 the main station was opened in its present form. The architecture of this impressive station building can be classed as belonging to the contemporary reform style, but its details also show the influence of Heimatschutz architecture and Art Nouveau. Only the waiting room still evidences its former glory.



Public toilets

Keep your eyes open for this sign in the city centre. Various tourism partners offer visitors toilet facilities free of charge. For example at the Oldenburg Tourist Information in the Lappan Bell Tower.

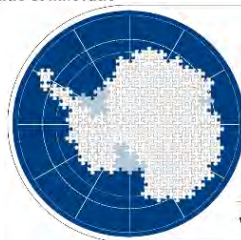
Oldenburg-Info im Lappan

Lange Strasse 3 | 26122 Oldenburg
Mon - Fri 10.00 - 18.00
Sat 10.00 - 16.00
Phone: +49 441 - 36 16 13 66



Tourismus & Marketing

Oldenburg i.o.



DFG PRIORITY PROGRAMME 1158

ANTARCTIC RESEARCH

with comparative investigations in Arctic ice areas

Funded disciplines

- ✓ Biology
- ✓ Physics/Chemistry
- ✓ Geoscience

Application process

- Once a year
- Closing date 1st week of November
- Obligatory presentation of new project idea at the coordination workshop in September of application year



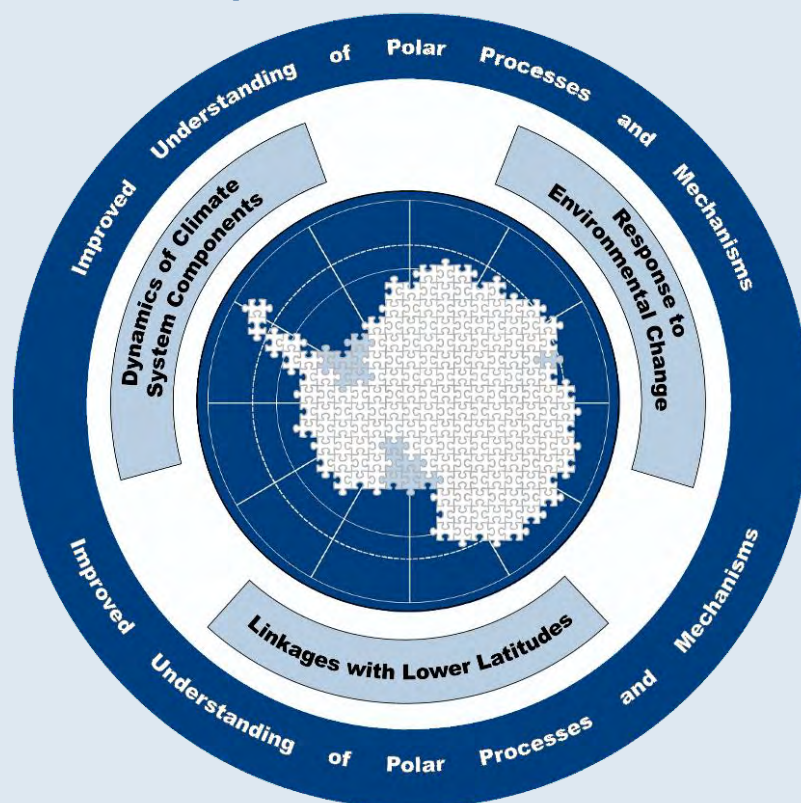
- 3 years funding for PhD (67%)
- 2 years funding for Postdoc

Further information

www.spp-antarktisforschung.de



Research topics



Prospects

- DFG priority program facilitates resources required for expeditions from the Alfred Wegener Institute in Bremerhaven (AWI), the Federal Institute for Geosciences and Natural Resources in Hannover (BGR) and the German Aerospace Centre in Cologne (DLR).

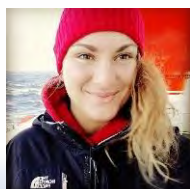


Get in contact with us

spp-antarktisforschung@uni-rostock.de



Prof. Ulf Karsten



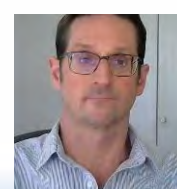
Dr. Julia Ehrlich



Dr. Angelika Graiff



Dr. Petra Quillfeldt



Prof. Tilmann Harder

Venues & Directions

Conference Venue:

Carl von Ossietzky University Oldenburg



The Carl von Ossietzky University Oldenburg, often referred to as the University of Oldenburg, is a renowned public research university. Established in 1973, the university has rapidly gained recognition for its interdisciplinary approach to education and research. In terms of campuses and facilities, the University of Oldenburg has multiple sites that cater to its diverse academic offerings, the two main campuses are:

Haarentor Campus (blue rectangle on map next page): This is the main campus of the university, located closer to the heart of Oldenburg (green circle on map next page). It houses the majority of the university's departments and facilities, including lecture halls, research centres, and administrative offices.

Wechloy Campus (orange rectangle on map next page): Situated a few kilometres away from the city centre close by a scenic nature conservation area (Naturschutzgebiet Haarenniederung), the Wechloy Campus is known for its focus on natural sciences and engineering. It includes laboratories, research facilities, and specialized departments. ICYMARE 2023 will convene at Wechloy Campus at building W32.

(Downloadable full map of Campus Wechloy here: uol.de/mediapool/lageplaene/TSC_Campus_Wechloy.pdf?v=1652450705).



Campus Wechloy can be reached directly via bus line 306 "Universität". If you disembark the bus at the very last stop "Carl-von-Ossietzky-Straße", you are standing right in front of the main building of the Faculty of Mathematics and Natural sciences. Via the main entrance, you enter the broad hallway, called Ringebene, on which the biggest lecture halls are situated. Additionally bus line 310 "Wehnen/Famila-Center" stops close by and you can easily walk to the campus. With the installation of a new train station in 2015 "Oldenburg-Wechloy", you can reach the campus also via train and a short walk.

Bus fares (overview):

Single ticket: 2.70 Euro (valid for 90 minutes after voiding to travel)

Set of four tickets: 8.80 Euro

1-day-ticket (one to max. five persons): 7.30 – 19.30 Euro

7-day-ticket: 20 Euro

All fares:

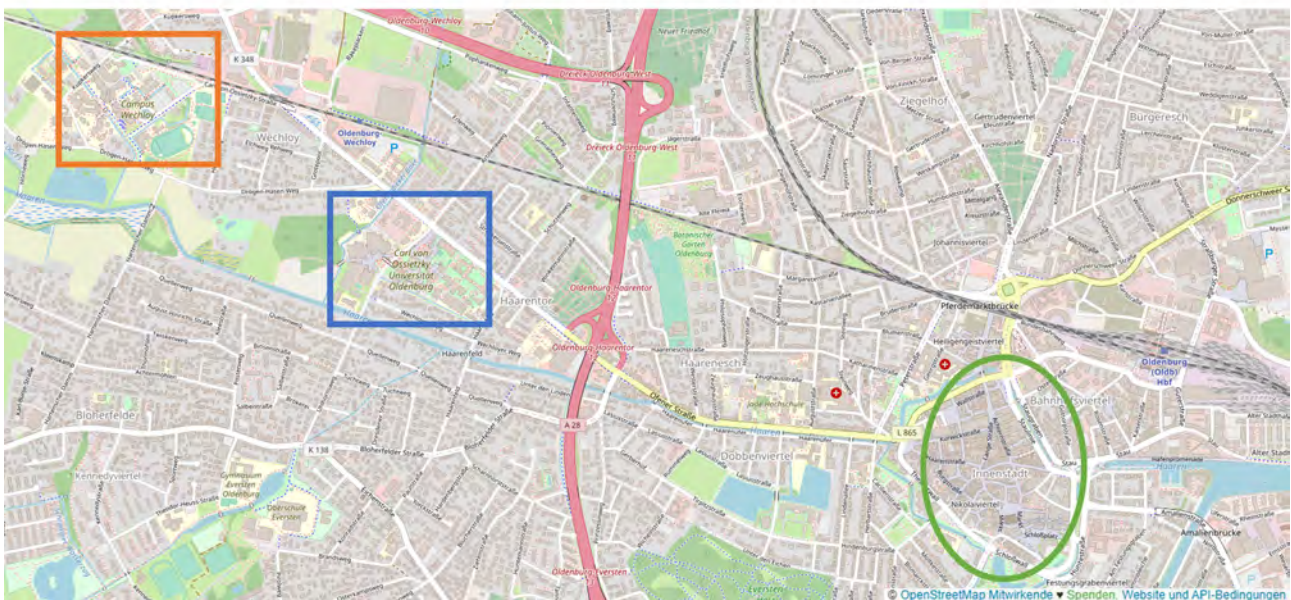
https://www.vwg.de/documents/uebersicht_tickets_2023_2_1672996576.pdf

Bus system map:

<https://www.vwg.de/documents/vwg-netzplan-2023.pdf>

Tickets can be bought either directly on the bus, digitally using DB Navigator app or from ticket vending machines at several bus stops in the city centre.

Moreover, the Campus features a big parking to the right side of the street with parking free of charge (Carl-von-Ossietzky-Straße 9 – 11, 26129 Oldenburg).



Icebreaker Venue:

**The State Museum for Nature and Man
(Landesmuseum für Natur und Mensch)**

On Monday, 18th September 2023 at 6pm we will kick off the conference with our legendary ICYBREAKER.

Join us at the State Museum for Nature and Man Oldenburg with free drinks and finger food. Get to know the ICYMARE Team and the other participants during Human bingo, where the first ten to complete it will have the opportunity to receive a prize.

The museum can be reached from the bus stops "ZOB" or "Hauptbahnhof Süd" the bus line 315 as well as VBN buses line 270, 280 and 289 go to the bus stop "Staatsarchiv" directly in front of the museum. Unfortunately, these buses only run once an hour. The bus stop "Am Schlossplatz" is served by many different bus lines. From there it is about a 5 minute walk to the museum. You can also get on the bus directly in front of Oldenburg main station (bus stop Hauptbahnhof-Süd). All bus lines stop at the "Lappan" in the center of Oldenburg, there you can change buses.

Address

The State Museum for Nature and Man
Damm 38-44
26135 Oldenburg
Germany



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DNA-Barcoding

Precise taxonomic identification of single specimens

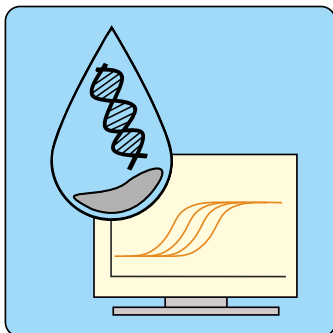
Animals, plants, algae, fungi, eggs, larvae, parts of organisms



DNA-Metabarcoding

**Complete taxonomic assessment of bulk samples
using next-generation sequencing techniques**

Zooplankton, phytoplankton, benthos, stomach contents, faeces



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**Fast and precise detection of single target species from
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eDNA-Metabarcoding

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samples**

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Useful Information

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 2023 OLDENBURG 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. Or send an email to support@icymare.com.

Mobile Phones

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

WiFi Information

The Carl-von-Ossietzky University Oldenburg is member of the eduroam network. So all participants should be able to access the internet with their normal accounts. If you don't have an account at the eduroam network, we will provide you access to the WiFi.

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

Our Portfolio of Top Quality Aquatic Science Journals

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Progress Series

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of Aquatic
Organisms

AME

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Microbial
Ecology

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Fully OA

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Session Overview



SESSION OVERVIEW

1 Data Science

1. **Ecological modelling of marine communities: where we are and where we are going**
Hosted by Livia Oliveira and Silvia Malagoli
2. **Assessment of climate change impacts affecting coastal and transitional environments leveraging machine learning approaches**
Hosted by Maria Katherina Dal Barco and Federica Zennaro
3. **Applications of machine learning in marine sciences.**
Hosted by Hameed Moqadam and Patricia Schöntag

2 Biogeochemical Processes

1. **Biogeochemical cycles under pressure: Past, present, and future changes**
Hosted by Melina Knoke and Rieke Schaefer
2. **Impacts of Climate Change on Biogeochemical Processes in Polar Regions**
Hosted by Claudia Schmidt and Chantal Mears
3. **Physical, biogeochemical as well as microbiological processes and their interactions in coastal ecosystems**
Hosted by Magali Roberts and Felix Auer

3 Marine Social Science

1. **Marine Governance and Conservation**
Hosted by Wiebke Homes and Jana Stahl
2. **What options do we have? Integrated scenarios for shaping the future of our oceans**
Hosted by Jonathan Heimer
3. **Blue carbon: law, policy, and science**
Hosted by Eva Sinemus and Federica Catonini
4. **Identifying spatial opportunities for NbS design and implementation in marine-coastal areas**
Hosted by Elena Allegri and Cengiz Arslan

4 Marine Ecology

1. **Dinoflagellates: From (paleo-)environmental reconstructions to modern ecology and harmful algal blooms**
Hosted by Runa Reuter
2. **The Future Ocean Biological Carbon Pump**
Hosted by Kea Witting
3. **Marine megafauna in the Anthropocene: threats, challenges, and perspectives**
Hosted by Ramona Mattmueller and Svenja Woehle
4. **Animal telemetry from freshwater to the oceans**
Hosted by Arc'hantael Labrière and Lotte Pohl
5. **Effects of Host-Microbiome Interactions - from Single Cell Physiology to Ecosystem Impacts**
Hosted by Marrit Jacob and Alessandra Kronschnabel
6. **Interactions and stressors in benthic communities: predicting future changes and advancing behavioral ecology**
Hosted by Lola Nader
7. **Migration of marine life and its importance to conservation**
Hosted by Walter Pisco Limones
8. **Tropical coastal ecology: biodiversity, research and conservation**
Hosted by Roman Petrochenko and Vadim Merkin

5 OMICs

1. **Utilizing DNA metabarcoding methods to overcome challenges in studying marine organisms**
Hosted by Annkathrin Dischereit and Ayla Murray
2. **Ocean Farming: Innovation at the Omics Level**
Hosted by Justin Tierney

6 Open Session

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Tuesday
19th September 2023



Program - Tuesday, 19th September

07:00	Registration & Welcome coffee	
08:30	Welcome words	
08:45	Keynote speech and plenary discussion	
	Supporting the career development of Young Marine Researchers Murat Eren Helmholtz Institute for Functional Marine Biodiversity (HIFMB) <i>Lecture Hall</i>	
09:45	<i>Breakfast break</i>	
10:00	Polls	
	<i>Lecture Hall</i>	
10:30	Group photo	
10:45	<i>Coffee break</i>	
11:15	Session 2.2 Impacts of Climate Change on Biogeochemical Processes in Polar Regions <i>Lecture Hall</i>	Session 1.1 Ecological modelling of marine communities: where we are and where we are going <i>Seminar room A</i>
12:30	<i>Lunch break (self organized)</i>	
13:15	Round table Topic: (Un)Toxic working environments <i>Foyer</i>	
14:00	Session 2.1 Biogeochemical cycles under pressure: Past, present, and future changes <i>Lecture Hall</i>	Session 1.3 Applications of machine learning in marine sciences <i>Seminar room A</i>
15:00		Session 3.4 Identifying spatial opportunities for NbS design and implementation in marine-coastal areas <i>Seminar room A</i>
15:30	<i>Coffee break</i>	
16:00	Session 6.0 A Open Session <i>Lecture Hall</i>	Session 4.1 Dinoflagellates: From (paleo-) environmental reconstructions to modern ecology and harmful algal blooms <i>Seminar room A</i>
17:00	Poster session <i>Foyer</i> Join the relaxing atmosphere during the Poster Session, grab a drink and take the chance to talk to other young scientists about their research. It will be a great evening with delicious food, inspiring chats and probably new friends.	

Keynote & Plenary Discussion

SUPPORTING THE CAREER DEVELOPMENT OF YOUNG MARINE RESEARCHERS

Speaker: Murat Eren, Helmholtz Institute for Functional Marine Biodiversity (HIFMB)

Moderation: Simon Jungblut

The Oxford Learner's Dictionary defines a 'mentor' as 'an experienced person who advises and helps somebody with less experience over a period of time'. While it sounds straight forward enough, effective mentorship is extremely difficult, even though it is arguably one of the most critical endeavours in science. The purpose of this talk is to help early-career researchers recognize the role of mentors in science and their likely impact on their careers and wellbeing, and help them identify ways by which they make informed decisions regarding what to expect and look for in their next mentors.

Session 2.1
Impacts of Climate
Change on Biogeochemical
Processes in Polar Regions



Impacts of Climate Change on Biogeochemical Processes in Polar Regions

hosted by Claudia Schmidt & Chantal Mears

Tuesday, 19th September 2023, 11:15 – 12:30, Lecture Hall

Polar regions are particularly vulnerable to increasing anthropogenic and climate change impacts, causing repercussions on ice cover, hydrography, water chemistry and pollution levels of water, air and sediment. With continued exposure to stressors, concern arises that these perturbations could potentially lead to irreversible consequences on the functionality of polar ecosystems. To further understanding within these multifaceted, albeit sensitive areas, we invite contributions that shed light on the complex relationships between multiple stressors and changes in biogeochemical cycles of Arctic and Antarctic regions. Here, we aim to focus on how carbon sequestration or other ecosystem services change, across multiple time scales ranging from paleo-oceanography to seasonal cycles.

11:15 – 11:30, Lecture Hall

The role of Subantarctic Pacific dust provenance changes in Pleistocene climate transitions

Kiruba Krishnamurthy

Marine Isotope Geochemistry, Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany

11:30 – 11:45, Lecture Hall

Dissecting temperature responses on multiple functional traits in Arctic key phytoplankton species

Linda Rehder

Alfred-Wegener-Institut

11:45 – 12:00, Lecture Hall

Decadal Trends in Arctic Biogenic Aerosol Precursors

Moritz Zeising

Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Bremerhaven, Germany

12:00 – 12:30, Lecture Hall

Microbial utilization of ancient carbon and its potential impacts of the global carbon cycle

Manuel Ruben

Alfred Wegener Institute, Helmholtz Centre for Polar- and Marine-Research, Am Handelshafen 12, 27570 Bremerhaven, Germany and University of Bremen, Bibliothekstraße 1, 28359 Bremen Germany

The role of Subantarctic Pacific dust provenance changes in Pleistocene climate transitions

Kiruba Krishnamurthy¹, Torben Struve¹, Jack Longman², Chandranath Basak³, Isuri U Kapuge³, Frank Lamy⁴, Gisela Winckler⁵, Katharina Pahnke¹

¹Marine Isotope Geochemistry, Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany.; ²Department of Geography and Environmental Sciences, Northumbria University Newcastle, UK; ³Department of Earth Sciences, University of Delaware, USA; ⁴Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Bremerhaven, Germany.; ⁵Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York 10964, USA.

Keywords: Southern Ocean, dust transport, Southern Hemisphere westerly winds, glacial- interglacial climate, iron fluxes

Atmospheric mineral dust is an important component in the global climate system. Dust influences the Earth's radiative budget and supplies micronutrients to remote marine and terrestrial environments. Due to the large distances from continental source regions, the primary productivity in the Southern Ocean is limited by iron (Fe) supply. Increased airborne Fe supply by mineral dust can reduce this limitation and promotes primary productivity, sequestration of atmospheric CO₂ in the deep ocean, and a reduction in global atmospheric temperatures. This mechanistic link between Southern Ocean dust deposition, primary productivity, atmospheric CO₂ and temperature has been identified as a powerful amplifier of global cooling during glacial intervals. The magnitude of this positive feedback is dependent on the total amount and partial (Fe) solubility of the dust deposited in the surface ocean, which are related to the rock composition (mineralogy) in the source region as well as dust transport distance and conditions (organic complexation, (photo)chemical reactions, pH variations, and particle sorting). However, relatively little is known about dust provenance and transport in the Southern Hemisphere over the glacial-interglacial cycles of the mid- to late Pleistocene. Therefore, we use the geochemical fingerprint of the dust fraction from marine sediments of Sites U1540 and U1541 collected during IODP Expedition 383 in the Subantarctic Zone of the Central South Pacific. Our data constrain the contribution of individual dust source regions to the dust-climate feedbacks in the Southern Ocean during Pleistocene climate transitions, thus providing reference datasets for future climate modelling studies.

Dissecting temperature responses on multiple functional traits in Arctic key phytoplankton species

Linda Rehder^{1,2}, Sebastian Rokitta¹, Clara Hoppe¹, Levke Jasper^{1,3}, Isabelle Buschmann^{1,4}, Björn Rost^{1,2}

¹Alfred-Wegener-Institut, ²Universität Bremen; ³Carl von Ossietzky Universität Oldenburg;

⁴Ludwig-Maximilian-Universität München

Keywords: Primary production, Physiology, Carbon cycling, Global warming

In the Arctic, one of the fastest changing regions, phytoplankton experience changes in environmental conditions, of which temperature is pivotal in many aspects. Rising temperatures accelerate biophysical and biochemical processes, so that a 15-90% stimulation of biological rates under different IPCC temperature scenarios is predicted. However, stimulation in the individual processes involved in phytoplankton physiology is only observed below specific thermal optima. Above those, warming impacts physiology and compromises vital functions. We hypothesized that organismic temperature responses originate from diverging physiological processes, which likely result in metabolic mismatches beyond thermal optima. To test this, we assessed temperature responses of multiple functional traits (e.g. growth, production, elemental and pigment quota) in a selection of Arctic phytoplankton species. Our results show that thermal scopes differed in both, the width of the thermal niches and the shapes of their performance curves. While cellular growth typically followed an optimum curve, carbon quotas exhibited either U- or bell-shaped behavior. We assume the interplay between cell division rates and net carbon uptake as the main control for these trait specific differences among taxa. Currently, we are looking into underlying physiological processes (e.g. photosynthetic and respiratory O₂ and CO₂ fluxes) to determine metabolic bottlenecks under future temperature scenarios to improve our understanding about detrimental temperature effects.

Decadal Trends in Arctic Biogenic Aerosol Precursors

Moritz Zeising¹, Laurent Oziel¹, Judith Hauck¹, Bernd Heinold², Svetlana Losa¹, Silke Thoms¹, Manuela van Pinxteren², Sebastian Zeppenfeld², Astrid Bracher^{1,3}, Moritz Zeising, Laurent Oziel, Judith Hauck, Bernd Heinold, Svetlana Losa, Silke Thoms, Manuela van Pinxteren, Sebastian Zeppenfeld, Astrid Bracher

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Keywords: arctic ocean, biogeochemical model, phytoplankton, particle aggregation, biogenic aerosols

A large source of uncertainty surrounding the quantification of Arctic warming originates from clouds and the impacts they have on the atmospheric radiative budget. Aerosols can affect cloud properties, especially in the Arctic realm, where biogenic aerosols of local production are particularly important as other, remote sources are scarce. To explore the production rates and trends of the aerosol precursors in the upper ocean, we implemented two additional carbon variables in the process description of a coupled ocean biogeochemical model, namely dissolved carboxylic acid containing polysaccharides (PCHO) and transparent exopolymer particles (TEP). As a natural process, phytoplankton can excrete excessive carbon as PCHO and in other forms of dissolved organic carbon, which happens mainly under nutrient stress during and after a phytoplankton bloom. In a subsequent process, PCHO can aggregate to form TEP. Containing this more detailed description, our model setup proves reliable with respect to in-situ and remote-sensing observations of key quantities such as Total Chlorophyll a, PCHO or TEP. The simulation results in highest concentration of TEP on the continental shelves and in the marginal ice zone, where phytoplankton blooms are most intense. Over the simulated period of 1990-2019, significant increasing trends of TEP are identified in the Amerasian Basin, the Canadian Archipelago, and the Kara Sea, while significant decreasing trends are found in the eastern Fram Strait, the Barents Sea, and parts of the Eurasian Basin. We attribute these opposing trends to regional differences in primary production and nutrient availability. With our model results, we provide valuable data on biogenic aerosol precursors for the Arctic realm, on which Earth Systems Models can build upon to improve the understanding of aerosol feedbacks and cloud properties within in the Arctic climate.

Microbial utilization of ancient carbon and its potential impacts of the global carbon cycle

Manuel Ruben^{1,2}, Florence Schubotz^{2,3}, Jens Hefter¹, Hanna Marchant^{3,4}, Matthias Wietz^{1,4}, Walter Geibert¹, Martin Butzin^{1,3}, Troben Gentz¹, Hendrik Grotheer^{1,3}, Matthias Forwick⁵, Withold Szczuciski⁶, Valier Galy⁷, Jens Strauss⁸, Gesine Mollenhauer^{1,2,3}

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Keywords: carbon cycle, radiocarbon, microbes, arctic, remineralization

Ancient organic carbon is generally seen as biologically inert and thus bypasses the active carbon cycle, as it was synthesized, degraded, and deposited thousands to millions of years ago. However, since the turn of the century, several studies have challenged this view, indicating a more complex situation of its bioavailability. Thus, suggesting that, by biological utilizations, the previously locked-up (fossil) carbon reemerges into the active carbon cycle. While this process certainly affects the carbon cycle over geological time scales, its influence on decade-to-century time scales is still up for debate. Nevertheless, anthropogenic climate change is expected to enhance the erosion of ancient carbon deposits through processes like permafrost thawing or increased glacial erosion. Therefore, increasing the accessibility of the contained ancient carbon to today's microbes in downstream ecosystems. Based on marine case studies downstream from glaciers and permafrost soils, concepts and possible sources for ancient carbon utilization will be presented to raise awareness for this crucial but often overlooked detail in the carbon cycle. We here present evidence from compound specific radiocarbon analysis, indicating today's microbes to utilize ancient carbon up to $55 \pm 6\%$ and $88 \pm 12\%$, in glacial sedimentary deposits and the water column adjacent to coastal permafrost erosion, respectively. This is a point of concern as, by unlocking ancient deposits, microbes' metabolic tendencies facilitate in the production of two potent greenhouse gases CO₂ and CH₄, potentially resulting in a positive feedback loop.

Session 1.1
Ecological modelling of
marine communities:
where we are and where
we are going



Ecological modelling of marine communities: where we are and where we are going

hosted by Livia Oliveira & Silvia Malagoli

Tuesday, 19th September 2023, 11:15 – 12:30, Seminar room A

Marine ecosystems host an enormous variety of marine communities, many of which are crucial to Earth's and our well-being. From theory to management applications, models allow us to disentangle underlying natural mechanisms governing these communities, to make predictions and to inform conservation policies. As such, ecosystem models are a fundamental tool in marine sciences. In this session we invite abstracts presenting state-of-the-art modelling techniques that aim to understand ecological communities at any trophic level, with possible management applications or even data descriptors.

11:15 – 11:30, Seminar room A

The power of unknowns: How generalized modeling uses massively parallel math to unlock insights into uncertain systems

Jana Chiara Massing

Helmholtz Institute for Functional Marine Biodiversity at the University of Oldenburg (HIFMB), Oldenburg, Germany

11:30 – 11:45, Seminar room A

How High Can You Go? A novel approach for height measurements of Corals and Sponges using Stereovideo data

Katharina Paetz

Carl-von-Ossietzky Universität Oldenburg

11:45 – 12:00, Seminar room A

Using hydroacoustic and environmental data to model the vertical distribution of alike clupeid species herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) in the Baltic Sea

Maria Golovaneva

Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany

12:00 – 12:15, Seminar room A

Simulating the ecological dynamics of a phytoplankton community using an eco- evolutionary model with three traits

Paula Peñalver Pereira

Spanish Institute of Oceanography (IEO Gijón - CSIC); The Ocean Globe Laboratory (oglab)

The power of unknowns: How generalized modeling uses massively parallel math to unlock insights into uncertain systems

Jana C. Massing¹, Thilo Gross¹

¹Helmholtz Institute for Functional Marine Biodiversity at the University of Oldenburg (HIFMB), Oldenburg, Germany

Keywords: generalized modeling, nonlinear dynamics, biological networks, stability, bifurcation

Ecological communities are fascinating due to their complexity: Not only do they harbor a multitude of different species; these different species also interact in diverse and complex ways. This poses a major challenge for understanding these systems and predicting their future behavior. Due to the complexity of real-world systems, every function that we use to describe a process in a system is always an approximation of reality. Due to the many uncertainties in these systems, it is desirable to obtain results that are independent of specific functional forms. This is the idea of generalized modeling (GM): Capturing the structure of a system without restricting it to specific functional forms enables us to analyze a whole class of systems in parallel. GM thereby enables analytical insights and highly efficient numerical investigation of uncertain systems. In the past, GM has been applied in more than 50 publications in diverse areas of Science, Engineering, Mathematics and Medicine. For example, GM could reveal factors that impact food web stability and help identify susceptible species to perturbations and species that have the strongest impact on the dynamics of the system. Also, GM enables combining complex social and ecological models and is used in studies of metabolism to identify for example major contributors to metabolic network stability. In summary, GM offers an alternative approach for formulating dynamical models to gain insights into the dynamics and bifurcations of uncertain systems.

How High Can You Go? A novel approach for height measurements of Corals and Sponges using Stereovideo data

Katharina Paetz¹, Claude Spencer², Brooke Gibbons², Tim Langlois²

¹Carl-von-Ossietzky Universität Oldenburg; ²UWA Oceans Institute, The University of Western Australia

Keywords: stereo video, generalized additive model (gam), spatial prediction, height measurement, benthic invertebrates

Sessile invertebrates, such as sponges and corals, provide crucial habitats for a variety of species, including fish and invertebrates. The growth of these sessile organisms can be influenced by a variety of factors, such as nutrient availability, tidal flow, or substrate type. Studying how these factors impact the height of sessile invertebrates can give an insight in habitat complexity and the associated organisms. In this study we investigated the impact of different seascape metrics (depth, slope, latitude and detrended bathymetry) on the height of the sessile invertebrate community. We used a drop camera system with a stereo video approach to measure individuals. For analysis, we assigned invertebrates to one of six height classes (10-20 cm, 20-40 cm, 40-60 cm, 60-100 cm, >100cm and Unknown) and spatially predicted the best model for each class. We used a generalized additive model (GAM) and full sub-set multiple model selection process. Our results suggest that different factors can present best model fits for different height classes. We found detrended bathymetry as well as latitude to result in high AIC score models for all height classes. Mapping of the best fit models indicated an increased abundance in the area of the paleo shoreline off the coast of Western Australia for some height classes, highlighting the importance of bathymetry for habitat complexity. With this study, we successfully established a novel workflow to annotate the height of sessile benthic invertebrates, which can be applied in both small and large scale, providing valuable information for marine park planning and conservation.

Using hydroacoustic and environmental data to model the vertical distribution of alike clupeid species herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) in the Baltic Sea

Maria Golovaneva¹, Sven Gastauer², Daniel Stepputtis¹, Stefanie Haase¹

¹Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany; ²Thünen Institute of Sea Fisheries, Bremerhaven, Germany; ²Scripps Institution of Oceanography, University of California, San Diego, CA, United States

Keywords: vertical distribution modelling, small pelagic fish, ecological niche, acoustic backscatter disaggregation, generalised additive models

Understanding the current state of a stock is important for efficient fisheries management. Fisheries-independent acoustic surveys are common and powerful instruments for stock assessments of pelagic species, however, they provide an ecosystem snapshot and might not reflect the temporal dynamics. Using extensive acoustic data collected by commercial vessels could become a valuable addition to routine stock assessment surveys and enable a clearer understanding of species distribution in spatial and especially temporal dimensions. To better resolve the distribution of key Baltic pelagic species sprat and herring, we established a collaboration with a commercial fishing vessel that collects acoustic measurements during its fishing season. However, commercial vessels either do not perform trawl sampling like ferries or present a highly directed sampling regime like fishing vessels. Therefore, it remains a challenge to disaggregate acoustic densities of similar acoustic targets, like sprat and herring, from commercial acoustic records. Our study aims to support the disaggregation of acoustic backscatter from the two clupeid species when only limited biological sampling data is available. We are constructing a model of Baltic sprat and herring distributions in the water column depending on environmental parameters such as temperature, salinity, oxygen and chlorophyll-a concentration. We use acoustic and environmental data obtained during annual surveys in May and October, potentially complemented by data collected by our partner fishing vessel during its operations in late winter- early spring. We aim to model fish distributions within the main Baltic Sea basins during the daytime when fish are mostly aggregated into schools. We hypothesize that there are seasonal and spatial effects on environmental preferences of sprat and herring, and that species composition within fish schools affects their vertical position and shape. In perspective, we intend to use the predicted sprat and herring vertical distributions to facilitate the disaggregation of their acoustic backscatter when trawl samples are limited.

Simulating the ecological dynamics of a phytoplankton community using an eco- evolutionary model with three traits

Paula Peñalver Pereira^{1,3}, Guillaume Le Gland^{2,3}, Antoine Guche¹, Sergio M. Vallina^{2,3}

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³The Ocean Globe Laboratory (oglab)

Keywords: Modelling, Diversity, Evolution

Diversity controls the adaptive capacity of ecosystems. Therefore, understanding what mechanisms make some ecosystems more diverse than others is key to assess their response to future environmental changes. In this study, we simulate the dynamics of a phytoplankton community and three of its functional traits (cell size, optimal temperature and optimal irradiance for growth) using the eco-evolutionary model SPEAD (Simulating Plankton Evolution with Adaptive Dynamics). SPEAD uses an aggregate approach whereby the state variables of the model are the statistical moments of the traits, i.e., total phytoplankton biomass, mean trait values, trait variances (used as a proxy for diversity), and inter-trait covariances. We then couple SPEAD to a vertically-resolved physical forcing scenario that simulates conditions in the Sargasso Sea, and validate its bulk properties with observations from BATS (Bermuda Atlantic Time-series Studies). Competitive exclusion tends to reduce diversity over time as a result of simplification in models. To counter this effect, we tested two different diversity-sustaining schemes: "trait diffusion" (TD), where diversity is sustained by random mutations, and "Kill-The-Winner" (KTW), where zooplankton grazes preferentially upon the most abundant species. We compare and discuss the realism of both mechanisms. We show that diversity is also maintained and structured by the seasonal succession of stratification and mixing of the euphotic layer. The simulated means and variances of the functional traits have different distributions over depth and time, which we can relate to physical and ecological drivers.

Session 2.1
Biogeochemical cycles
under pressure: Past,
present, and future changes



Biogeochemical cycles under pressure: Past, present, and future changes

hosted by Melina Knoke & Rieke Schaefer

Tuesday, 19th September 2023, 14:00 – 15:30, Lecture Hall

Marine biogeochemical cycles range from the surface and deep ocean to marine sediments. Anthropogenic pressures on marine biogeochemistry are increasing, including rising temperature, eutrophication and ocean acidification. To understand anthropogenic global impacts on the open ocean, an understanding of past and present biogeochemical cycles is essential to predict changes in our oceans, marine life and organic matter. Approaches and methods for monitoring biogeochemical cycles include, for example, modelling approaches or in situ measurements. We welcome studies improving our understanding of interactions and changes to marine biogeochemical cycles in the global oceans as well as their monitoring.

14:00 – 14:15, Lecture Hall

Brown algal fucoidan secretion around the globe

Inga Hellige

University of Bremen, Faculty of Biology and Chemistry, Marum Centre for Marine Environmental Sciences, Germany and Max-Planck Institute for Marine Microbiology, Germany

14:15 – 14:30, Lecture Hall

The ocean's warm breath - ocean heat and carbon storage under net-negative emissions

Svenja Frey

Carl von Ossietzky University Oldenburg (Germany) and GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany)

14:30 – 14:45, Lecture Hall

Connecting the molecular composition and radiocarbon age of dissolved organic matter in the Mauritanian sub-region of the Canary Upwelling System

Fenna Alfke

Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University of Oldenburg, Oldenburg, Germany

14:45 – 15:00, Lecture Hall

Dissolved neodymium isotopes in the Tasman Sea: impact of water mass mixing and non-conservative modifications

Martin Zander

ICBM, Institute for Chemistry and Biology of the Marine Environment, Carl-von-Ossietzky-Universität Oldenburg

15:00 – 15:15, Lecture Hall

Experimental evaluation of the formation and stability of dissolved organic sulfur

Wiebke Freund

Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University of Oldenburg, Oldenburg, Germany

Brown algal fucoïdan secretion around the globe

Inga Hellige^{1,2}, Hagen Buck-Wiese^{1,2}, Margot Bligh^{1,2}, Carol Arnosti⁴, Sherif Ghobrial⁴, Camilla Gustafsson⁵, Mohammed Kajee⁶, Chad Lloyd⁴, Mark Rothman⁶, Beatriz Salgado Murillo⁷, Evie Wieters⁷, Lydia White⁵, Jan-Hendrik Hehemann^{1,2}

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⁶University of Cape Town, South Africa; ⁷Estación Costera de Investigaciones Marinas, Chile

Keywords: Brown algae, Fucoïdan, Carbon sequestration, Glycans, Carbon cycle

Brown algae annually convert gigatons of carbon dioxide into complex polysaccharides. Significant quantities of fixed carbon dioxide are invested into the secretion of complex polysaccharide fucoïdan approaching the amount of carbon they store in biomass. Fucoïdan forming a mucilaginous substance serves as a defense mechanism against microbes. Challenging to degrade for bacteria, fucoïdan can accumulate and persist for centuries in marine sediments, forming a possible carbon sink. The rates of fucoïdan secretion and degradation by associated microbiomes remain unknown across different species of brown algae from different oceans. We quantify fucoïdan secretion and degradation rates for *Lessonia trabeculata* in the South Pacific Ocean, *Ecklonia maxima* in the South Atlantic Ocean, *Sargassum fluitans* in the North Atlantic Ocean and *Fucus vesiculosus* in the Baltic Sea during incubations in tanks for four weeks using a multi-targeted approach. The combination of monosaccharide quantification using HPAEC-PAD, with highly specific antibody binding give us an insight into fucoïdan concentrations over time. The results indicated high fucoïdan secretion rates across the tested species. Additionally, preliminary findings showed that fucoïdan persisted against microbial consumption during the initial degradation kinetic within weeks after secretion. These findings suggest that fucoïdan secretion is a common feature among brown algae. Initial persistence against consumption by bacteria are in line with fucoïdan being a potential pathway for carbon sequestration around the globe.

The ocean's warm breath - ocean heat and carbon storage under net-negative emissions

Svenja Frey^{1,2}, Ivy Frenger², Wolfgang Koeve²

¹Carl von Ossietzky University Oldenburg (Germany); ²GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany)

Keywords: Deep convection event, Climate reversibility, Ocean heat and carbon storage

The ocean has absorbed a significant fraction of anthropogenic CO₂ emissions and most of the associated excess heat accumulating in the Earth system. This results in dampening the effects of anthropogenic climate change. The timescale of heat and carbon storage in the ocean is uncertain, making their response to long-term trends and physical drivers a topic of interest, particularly if we enter a phase of net-negative emissions. Here, we use an idealized climate change simulation with the University of Victoria (UVic) Earth System Model to investigate the ocean heat and carbon storage response to slow reversibility scenarios that include net-negative emissions. The model is of intermediate complexity, allowing for the centennial to millennial-scale climate simulations used in the research. My results show a prominent heat release from the ocean in Antarctic waters under global cooling, leading to substantial global warming of circa 0.5 °C. This heat release during net-negative emissions is independent of atmospheric CO₂ forcing and disrupts the otherwise near-linear relationship between cumulative anthropogenic CO₂ emissions and surface temperature (TCRE). As the source of the released heat, we identified a deep convection event (DCE) in the Antarctic Ocean that brings up previously accumulated heat from the deep ocean. As next steps, we aim to narrow down the mechanism that triggers DCE and explore the impacts the DCE has on the carbon stored in the ocean. My findings have implications concerning ambitious emission mitigation pathways that include net-negative emissions, and the potential goal of returning to pre-industrial atmospheric CO₂ concentrations - as surprises might await.

Connecting the molecular composition and radiocarbon age of dissolved organic matter in the Mauritanian sub-region of the Canary Upwelling System

Fenna Alfke¹, Hendrik Grotheer^{2,3}, Thorsten Dittmar^{1,4}, Michael Seidel¹

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Keywords: Dissolved organic matter, Canary Upwelling System, Carbon cycle

Marine dissolved organic matter (DOM) is one of the largest active global carbon pools. Its average radiocarbon age of several thousand years suggests that it resists degradation for multiple oceanic mixing cycles. Potential DOM removal processes such as adsorption processes onto sinking particles and the formation of particles (POM) could significantly alter the oceanic carbon pools but are still not fully understood. The Canary Upwelling System (CUS) on the West- African North Atlantic coast is one of the major global eastern boundary upwelling systems (EBUS). It is characterized by high productivity through upwelling and Saharan dust deposition. The main source of oceanic DOM is primary production and release from particulate organic matter (POM) in the surface ocean. Sinking particles can transport POM into deeper water layers via the biological carbon pump, possibly releasing DOM. We hypothesize the presence of three distinguishable DOM pools consisting of surface, nearshore, and aged deep-sea DOM. For our study, samples were taken along a shelf-to-open-ocean transect off the coast of Mauritania at the CUS, to study the molecular composition of solid phase extracted (SPE) DOM via ultrahigh-resolution mass spectrometry (FT-ICR-MS) in combination with the radiocarbon analysis of SPE-DOM. Our results reveal offshore trends of molecular properties and radiocarbon SPE-DOM signatures that can be related to surface DOM from recent primary production and the inflow of North Atlantic Deep Water, respectively. Nearshore samples at the CUS, however, were characterized by a more pronounced vertical homogeneity. Through our analytical approach we are currently aiming at deciphering the contributions of deep-sea DOM from upwelling, input of DOM from recent primary production, and DOM released from suspended particles.

Dissolved neodymium isotopes in the Tasman Sea: impact of water mass mixing and non-conservative modifications

Martin Zander¹, Katharina Pahnke¹, Torben Struve¹, Frank Lamy²

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Keywords: Palaeoceanography, Holocene, Southwest Pacific, Ocean Circulation

The global overturning circulation plays an important role in global climate change and knowledge of past ocean circulation changes is therefore key to a better understanding of the Earth's climate system and its variability. To reconstruct past ocean circulation, independent circulation proxies are required. Neodymium (Nd) isotopes are widely used for this purpose but require rigorous testing on a site-by-site basis. The Tasman Sea is located at the interface between the Pacific and the Southern Ocean, which are characterized by water masses with pronounced differences in their Nd isotope signatures. Therefore, the Tasman Sea is an ideal study area for investigating changes in the water mass exchange between the Pacific and Southern Ocean during past glacial-interglacial cycles using Nd isotopes. Here we measured dissolved Nd isotopes (expressed as ϵ_{Nd}) in the water column of the eastern Tasman Sea on samples collected during R/V Sonne expedition SO290. Our seawater Nd isotope results show a wide range of ϵ_{Nd} values from -8.6 to -2.1 along a North-South transect in the eastern Tasman Sea. We ascribe the observed variations primarily to the mixing of water masses from the Pacific and Southern Ocean. We will quantify the degree of non-conservative effects on the Nd isotope distribution in the study area using multi-parameter water mass analysis and isotope mixing calculations. Additionally, the seawater data will be compared with ϵ_{Nd} extracted from authigenic phases in sediment core-tops to investigate the seawater integrity of this proxy at our sampling locations for reconstructions of past ocean circulation changes using long sediment cores.

Experimental evaluation of the formation and stability of dissolved organic sulfur

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

Marine dissolved organic matter (DOM) stores 660 Pg carbon globally. A part of the DOM, so-called recalcitrant DOM (RDOM), is stable on millennial timescales. Thus, RDOM contributes to oceanic carbon storage. Dissolved organic sulfur (DOS) may contribute to the marine RDOM pool and is generally derived from primary production with significant contributions of DOS produced by abiotic incorporation of sulfide into DOM under sulfidic conditions ("sulfurization"). DOS is discharged from anoxic environments such as intertidal flat sediments. We aim to answer how the benthic sulfur cycle affects the formation of sulfurized DOM and the stability of DOS in the context of carbon storage. Therefore, we conducted experiments to mimic the sulfurization of DOM under anoxic conditions and different seasonal settings, i.e., incubation temperatures. Moreover, we incubated sulfurized DOM to evaluate the stability of the produced DOS upon discharge into the water column, including photochemical and oxic microbial degradation. Our biogeochemical analyses include quantifying dissolved organic carbon (DOC) and DOS as well as ultra-high resolution mass spectrometry (FT-ICR-MS) to identify molecular changes in the DOM composition. First results reveal a rapid sulfurization of DOM at 20°C reaching C/S ratios comparable to sulfidic German Wadden Sea sediments within 30 minutes of incubation. The DOM C/S ratios further decrease after 48 hours, reaching a threshold ratio of 13 after three weeks of incubation. This C/S ratio corresponds to values detected in several thousand-year-old sulfidic deep sub-surface sediment suggesting this to be an upper limit of complete DOM sulfurization. Our ongoing analyses aim to yield broadly applicable DOM sulfur incorporation and degradation rates. Ultimately, our results will contribute to ocean biogeochemical models to predict future changes in the oceanic DOS pool and to estimate its carbon sequestration potential in a changing ocean.

Session 1.3
***Applications of machine
learning in marine sciences***



Applications of machine learning in marine sciences

hosted by Hameed Moqadam & Patricia Schöntag

Tuesday, 19th September 2023, 14:00 – 14:45, Seminar room A

With the improvements in computing power and the abundance of already existing data, machine learning has been increasingly applied in a variety of scientific fields. While traditional physical modelling has been proven effective, in marine and earth system sciences there is still much potential in exploiting data-driven methods in order to gain faster and deeper insights from the already existing data and make the most out of new measurements. We would like to invite colleagues using data science, machine learning, data assimilation, and data mining to present their research explaining and forecasting the complex relations on marine ecosystems.

14:00 – 14:15, Seminar room A

Improving oceanic mesoscale eddy parameterization using high-resolution simulations and Machine Learning

Rajka Juhrbrandt

Alfred-Wegener-Institute, Bremerhaven, Germany

14:15 – 14:30, Seminar room A

In the face of global warming: Composition and variability of the Decapod larvae communities in a south Iberian estuary

Marta Monteiro

CESAM Centre for Environmental and Marine Studies and Department of Biology, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal and MARE / ARNET, School of Tourism and Maritime Technology, Polytechnic of Leiria, 2520-630 Peniche, Portugal

14:30 – 14:45, Seminar room A

Characterizing the benthic community structure of coral reefs in Palau using drone derived orthophotomosaics with a semiautomated and manual approach

Viktoria Sturm

Institute of Geography, Johannes-Gutenberg University of Mainz

Improving oceanic mesoscale eddy parameterization using high-resolution simulations and Machine Learning

Rajka Juhrebandt^{1,2}, Stephan Juricke^{1,2}, Thomas Jung^{1,3}, Peter Zaspel²

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Keywords: Neural networks, coarse-graining, ocean modelling, Gent-McWilliams

Climate models are a crucial tool for predicting future climate states, which has become more important than ever in the ongoing climate crisis. However, limited computing power and resources restrict their spatial and temporal resolutions. Therefore, climate models cannot represent all processes in ocean and atmosphere. Modellers estimate the effects unresolved processes have on the resolved processes. One such structure are turbulent mesoscale eddies in the ocean. It is known from observations that eddies carry a large amount of kinetic energy and play a significant role in transport of tracers such as temperature and salinity as well as in heat uptake from the atmosphere. It is crucial that eddies and their effects on the processes mentioned above are represented accurately in climate models. To better estimate these effects in low-resolution simulations, high-resolution simulations can be used to constrain the parameters necessary for the estimates. However, tuning these parameters can be subjective and time-consuming. In this project, Machine Learning methods will be used to facilitate and speed up this process using high-resolution data from the FESOM2 ocean model. At low resolutions, FESOM2 estimates the effects of the unresolved eddies using the Gent-McWilliams (GM) parameterization containing a GM coefficient. Using a coarse-graining approach, a framework including Bayesian Neural Networks will be developed to calculate a predictor for this coefficient as well as its variability. Maps of the GM coefficient for multiple setups with increasing complexity and data volume will be created. This presentation shows preliminary results of the project.

In the face of global warming: Composition and variability of the Decapod larvae communities in a south Iberian estuary

Marta Monteiro^{1,2}, Joana Cruz³, Ulisses Azeiteiro¹, Sónia Cotrim Marques², Vânia Baptista³, Maria Alexandra Teodósio³

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Keywords: Climate Change, Meroplankton, Extreme Climatic Events, Guadiana Estuary, Crustaceans

Climate change poses a severe threat to planktonic populations, with added risk for meroplanktonic assemblages, which may compromise recruitment into adult stages, mostly used as food resources. The present study aims to investigate the influence of the current and predicted environmental scenarios on the interannual abundance of decapod larvae assemblages in the Guadiana estuary (Portugal). A zooplanktonic sampling program was conducted on a single station at the estuary entrance, from 2014 - 2022. These assemblages are dominated by *Upogebia* spp., followed by *Diogenes pugilator*, *Panopeus africanus*, *Afropinnotheres monodi*, and *Polybius henslowii* species. Structural equation modeling results reveal the strong influence of varying water temperatures and salinity, while chlorophyll-a concentrations, river runoff and the large-scale climatic mode North Atlantic Oscillation (NAO) revealed no effect on these assemblages' abundances. Overall, the whole community and the main species showed a positive linear trend with increased salinity. While the effect of increasing temperatures was species-specific. Under the current climatic scenario, water temperature seems to be more important in predicting seasonal variation of the assemblages' abundances, with marked seasonality during Spring and Summer. On an interannual basis, no significant difference was observed in abundance nor in species composition found between warm and cold years for the current period. However, predictive models used to investigate future scenarios, RCP 2.6 and RCP 8.5, where temperature is expected to increase by 2°C and 4.3°C until 2100, suggests an alteration in assemblages' composition, where the abundances of *D. pugilator*, the second most abundant species, tend to decrease abruptly. Reported evidence along with the high connectivity of the region with the Mediterranean Sea, where extreme climatic events and invasion by alien species is increasingly more frequent, also connected with changes in freshwater discharges, will likely trigger significant alterations in species dominance and abundance, with clear ecological and socio-economic implications.

Characterizing the benthic community structure of coral reefs in Palau using drone derived orthophotomosaics with a semi-automated and manual approach

Viktoria Sturm¹, Sonia Bejarano², Pia Lewin², Elisa Casella², Annabell Klinke², Mattia Ghilardi², Timo Willershäuser¹

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Keywords: QGIS, CoralNet, photogrammetry

Mapping coral reef environments is a challenging task which is promoted by modern technologies of remote sensing. High resolution imagery is required to assess the cover of the biotic and abiotic components of coral reefs. A remotely piloted aircraft system i.e., drone, was used to obtain small-scale imagery of different reefs in Palau that were transformed into orthophotomosaics. Randomized points were set on the orthorectified photomosaics to classify them according to nine benthic classes. The classification was conducted using a manual approach with the software QGIS and a semi-automated method using the website CoralNet. The assessment of the benthic structure usually requires cost-intensive technologies and complex algorithms. In this study two methods characterized the benthic community structure in a simple, cost-effective and feasible manner to provide numerical and geographical data. The manual classification process of 1200 points with QGIS endured six hours whereas CoralNet enabled a semi-automated online annotation with a time consumption of four hours. The open-source applications neither required costly sensors, nor the development of specific algorithms. The numerical and geographical data obtained from either QGIS or CoralNet can, depending on the research aims, be used to develop statistical analyses or habitat maps. The characterization of the coral cover and community structure estimates the status quo of the reef, enables comparisons throughout the regions or detects changes. This knowledge is essential for marine spatial planning purposes or the conservation of coral reefs that are currently endangered by anthropogenic impacts.

Session 3.4
Identifying spatial opportunities for NbS design and implementation in marine-coastal areas



Identifying spatial opportunities for NbS design and implementation in marine-coastal areas

hosted by Elena Allegri & Cengiz Arslan

Tuesday, 19th September 2023, 15:00 – 15:30, Seminar room A

Societies are facing ever-growing number of challenges for human health and wellbeing due to biodiversity loss, climate change impacts, and unsustainable economic and social development. Nature-based Solutions (NBS) have emerged as an important component of the overall response to these challenges. However, policymakers, practitioners, and scientists need to better understand how to identify spatial opportunities in a transdisciplinary manner for targeting effective NBS in marine-coastal ecosystems. This session invites presentations on methods, approaches, and applications from various fields of studies that identify opportunities for the design and implementation of marine-coastal NBS and for the prioritization of suitable areas for NBS application.

15:00 – 15:15, Seminar room A

Machine Learning as a key digital tool for shaping environmental change processes and posing the basis for spatial restoration actions

Federica Zennaro

Ca' Foscari University of Venice and Centro Euro Mediterraneo sui Cambiamenti Climatici (CMCC)

15:15 – 15:30, Seminar room A

Small-scale, big picture: Understanding the socio-economic and spatial dependency of small-scale fleets on marine resources

Marissa Levinson

International Master of Science in Marine Biological Resources (IMBRSea) Ghent University, 9000 Ghent, Belgium and INDUROT, Universidad de Oviedo, Oviedo, Spain

Machine Learning as a key digital tool for shaping environmental change processes and posing the basis for spatial restoration actions

Federica Zennaro^{1,2}, Elisa Furlan^{1,2}, Angelica Bianconi², Vuong Phan^{1,2}, Sebastiano Vascon¹, Andrea Critto¹, Antonio Marcomini^{1,2}

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The increasing availability of geospatial big data, mostly originating from diverse sources and presented in heterogeneous formats, is successfully exploited by Machine Learning (ML) algorithms across several environmental applications, such as the prediction of extreme events and natural hazards, water quality monitoring, weather forecasting and climate change (CC) risk assessment. Within Venezia 2021 and the H2020 MaCoBioS projects, the potential of these models was fully leveraged to analyse environmental dynamics underpinning natural systems' response to CC and human-made pressures. As regards Venezia2021 project, ML and numerical models were hybridized, exploiting capabilities of both approaches to model water quality (WQ) dynamics in the Venice lagoon, under a baseline and mid and far future CC scenarios. Random Forest (RF) algorithm was used to assimilate historical WQ data (i.e., water temperature, salinity and dissolved oxygen) and spatio-temporal information (i.e., monitoring station and acquisition date of WQ data), and to predict changes in chlorophyll-a (Chl-a) conditions. In particular, through a hybrid ML- Biogeochemical framework, this study allowed for a better understanding of the eutrophication issue over the last ten years (2008-2019), and to detect potential critical conditions under future CC scenarios (2050, 2100). Overall, a decreasing trend for the lowest Chl-a values (below 0.85 µg/L, the first quartile) was observed, with an opposite rising trend for the highest ones (above 2.78 µg/L, the fourth quartile). On the seasonal level, summer remains the season reaching the highest Chl-a values in all scenarios, although in 2100 a strong increase in Chl-a is also expected during spring, as a consequence of the prospected anticipated optimal conditions for algal proliferation (e.g., a temperature around 25°C, abundant light, and stable wind conditions), due to climate change. Concerning the MaCoBioS project, the cumulative impacts of both human and CC-related pressures, affecting seagrasses condition in the Mediterranean Sea, was assessed using a RF model. Data collected from different open-source platforms for the 2017 baseline scenario (e.g., data from Copernicus Marine Service) was used to train, validate and test the model. Moreover, future scenario analysis was performed by integrating projections from the CMCC-MedCORDEX model, including sea surface temperature and salinity under 2050 and 2100 timeframes. The results of the analysis showed that the ecological condition and service capacity of seagrass meadows are mainly threatened by human pressures (e.g., distance from main urban areas as proxy of coastal development), as well as by changes in nutrient concentration and sea surface temperature. This aligns with results from the scenario analysis, highlighting a decrease in seagrass coverage and related services capacity, in both 2050 and 2100 timeframes. In the described applications, ML models provide useful predictive insights on possible future conditions of water bodies and aquatic ecosystems in response to multiple pressures, supporting the identification of spatial hotspots for design and applying spatial restoration actions as effective strategy to accelerate the recovery of biological communities at local scale threatened by climate change.

Small-scale, big picture: Understanding the socio-economic and spatial dependency of small-scale fleets on marine resources

Marissa Levinson^{1,2}, Laura García de la Fuente², Arturo Colina Vuelta²

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Keywords: small-scale fisheries, fisheries management, indicators, socioeconomy, multidisciplinary approach

In recent years, a growing interest has emerged in addressing knowledge gaps that exist between the interplay of socioeconomic factors and spatial interactions in the context of small-scale fisheries (SSF). This is particularly challenging given the limited availability of accurate and long-term data in SSF, which often closely engages with other stakeholders in nearshore regions. Many key decisions for conserving marine resources and valuable habitats involve displacing or altering the SSF activities, causing adverse economic and social consequences. Thus, concepts such as resource dependency, or the link between a fleet and its fishing grounds, become increasingly important. This study focuses on quantifying and mapping indicators representing socio-economic dependence and spatial connections in a small-scale fishery using socio-economic variables, to discuss their relevant level of application (fishery, port, vessel) and utility to support decision-making in marine spatial planning at different scales. The case study of this paper is the artisanal common octopus (*Octopus vulgaris*) fishery in Asturias, a region of Northwest Spain, that holds an economic, social, and cultural value for local communities. Current management efforts, such as the Octopus Management Plan (OMP) put into effect in 2000, have aimed at increasing the economic viability and sustainability of the fishery. However, there is a considerable knowledge gap about spatial and socio-economic dependencies on this fishery and fishing grounds in the region. Indices, such as essentiality, were calculated by integrating economic sales and GPS information. The study's outcomes can be incorporated into integrated resource management approaches and provide essential knowledge to cope with increasing challenges (i.e., climate change, MPAs declaration and management, marine spatial planning, licensing new activities such as offshore energy and aquaculture, generational loss of fleets). This work will also inform sustainability efforts of the fishery and the fishing communities who rely on it about strategic areas of importance.

Session 6.0 *A* **Open Session**



Open Session

hosted by Theo Krüger & Jöran Paap

Tuesday, 19th September 2023, 16:00 – 16:30, Lecture Hall

If you think your research does not fit into any of our other sessions, please feel free to submit your abstract to the open session!

16:00 – 16:15, Lecture Hall

Sea spray hygroscopicity in synergy with atmospheric aerosol.

Arindam Mazumdar

University of Milano-Bicocca

16:15 – 16:30, Lecture Hall

Fucus virsoides: metabolic rates of a glacial relict in a changing scenario

Martina Mulas

National Institute of Oceanography and Applied Geophysics - OGS, via Beirut 2,
34151, Trieste, Italy

Sea spray hygroscopicity in synergy with atmospheric aerosol.

Arindam Mazumdar¹, Niccolo Losi¹, Luca Ferrero¹

¹University of Milano-Bicocca

Keywords: cloud formation, climate change, humidification and dehumidification, cloud condensation nuclei

Currently atmospheric greenhouse gases and aerosols are causing global warming. Marine aerosols from sea sprays are the largest source of aerosols. On the one hand, aerosols scatter sunlight and absorb solar radiation which leads to positive radiative forcing. On the other hand aerosols also act as condensation nuclei, which are the cloud seeds promoting cloud formation. Clouds reflect incoming solar radiation and generate cooling, this leads to aerosols having an indirect effect of negative radiative forcing. Our study analyses hygroscopicity aspect of marine aerosols and its role affecting cloud formation. Chemical analysis and hygroscopicity experiments were performed on samples collected during two oceanographic cruises, EUREC4A and AREX. This enabled us to understand the behaviour of aerosols during humidification and dehumidification process. Results from the chemical analysis have been fitted to an extended Aerosol Thermodynamics Model (AIM) to forecast Cloud Condensation Nuclei (CCN) behaviour and their growth in the atmosphere. Measurements from the humidification and dehumidification experiment suggest that for the oceanographic cruise EUREC4A average deliquescence relative humidity (DRH) is 74% when the aerosols convert into the liquid phase, while during dehumidification the average crystallization relative humidity (CRH) is 54% thus, indicating the beginning the crystallization phase. In case of AREX average deliquescence relative humidity (DRH) is 76% when the aerosols convert into the liquid phase, while during dehumidification the average crystallization relative humidity (CRH) is 52%. Also the mass hygroscopicity growth factor in the condensation/evaporation fits with an exponential function. The experimental model and AIM are similar, implying AIM can be applied for other relevant datasets. Thus, the sea spray hygroscopicity of marine aerosols is found to have synergy with atmospheric aerosol, influencing cloud condensation nuclei and cloud formation. Past research and our work shows that aerosols can have both positive and negative radiative forcing and it influences climate change.

***Fucus virsoides*: metabolic rates of a glacial relict in a changing scenario**

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Keywords: *Fucus virsoides*, endemism, intertidal, primary productivity, Fucales

Fucus virsoides J. Agardh is a glacial relict endemic to the northern Adriatic and the only representative of the genus in the Mediterranean. Once widespread in the region from the Venice lagoon to Montenegro, this tidal species has experienced a significant decline in recent decades due to multiple stressors such as pollution, habitat disturbance and climate change. Mainly due to the decrease in phosphorus loading in its main freshwater source and the implementation of Italian legislation, the N/P ratio in the area has increased and it is now considered oligotrophic. In the Gulf of Trieste, the last population of *F. virsoides* has so far been recorded in Marina Julia (Gorizia, Italy), where it is exposed to a whole range of extreme conditions. The only studies that looked at the metabolic rates of the species were carried out in Rovinj (Croatia) and date back to the 70-80s. By querying the EMODnet database for different nutrient conditions in the region, we selected different N/P ratios to which we exposed thalli. In a two-week experiment, we recorded the metabolic rates of *F. virsoides* every four days under both light and dark conditions using photorepirometry techniques.

Session 4.1
Dinoflagellates: From
(paleo-) environmental
reconstructions to modern
ecology and harmful algae
blooms



Dinoflagellates: From (paleo-)environmental reconstructions to modern ecology and harmful algal blooms

hosted by Runa Reuter

Tuesday, 19th September 2023, 16:00 – 16:30, Seminar room A

Dinoflagellates are amongst the major primary producers in the ocean. Some dinoflagellates are known to produce highly resistant and preservable resting cysts making them important research targets for (but not limited to) (paleo-)environmental reconstructions, biostratigraphy, and the study of marine organic matter decomposition. This session aims to bring together marine early career researchers from different disciplines, studying living or fossil dinoflagellates, providing a forum to discuss the latest advances of their studies. Contributions regarding all aspects of dinoflagellate research, from modern settings to the geological past, are invited. Presentations covering novel or unconventional approaches or ideas are particularly encouraged.

16:00 – 16:15, Seminar room A

New insights on the molecular composition and taphonomy of organic-walled dinoflagellate cysts: implications for ecological, eco-evolutionary and affinity studies

Pjort Meyvisch

Department of Geology, Ghent University, Ghent, Belgium

16:15 – 16:30, Seminar room A

Environmental factors influencing the dinoflagellate cysts production and their preservation in the bottom sediment in the upwelling region off Cape Blanc, Mauritania: a comparison of sediment trap with down-core sediment cyst record

Surya Eldo Virma Roza

MARUM - Center for Marine Environmental Sciences, University of Bremen

New insights on the molecular composition and taphonomy of organic-walled dinoflagellate cysts: implications for ecological, eco-evolutionary and affinity studies

Pjotr Meyvisch¹, Hanne François¹, Kenneth N. Mertens², Gerard J. M. Versteegh³, Pieter R. Gurdebeke⁴, Vera Pospelova⁵, Henk Vrielinck⁶, Stephen Louwye¹

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Keywords: Fourier transform infrared spectroscopy, dinosporin, organic geo(chemistry), biomacromolecules, molecular preservation

Over the last 60 years, the microscopic, resistant, organic-walled resting cysts of dinoflagellates (dinocysts) have proven to be useful tools in (paleo)environmental and (paleo)ecological reconstructions, as well as in Meso- and Cenozoic biostratigraphy. A large part of their scientific value originates from the fact that they thrive in a wide range of aquatic environments, and that both modern and fossilized forms occur, essentially making them well-suited target organisms for a plethora of biological and/or geological studies. Most of such studies rely on these cysts' morphological characteristics (used in morphotaxonomy), although the last few decades have seen a gradual increase in molecular approaches to not only characterize the composition of the enigmatic, resistant material that makes up their walls (i.e., dinosporin), but also to discover whether variability in dinosporin can be used as a (paleo)environmental and/or (paleo)ecological proxy. Results of these efforts have for example revealed that dinosporin is a heavily cross-linked carbohydrate, somewhat similar to cellulose, and that the diet of dinoflagellates is reflected in their cyst wall composition. Over the last few years, considerable improvements have been made in the application of a spectrochemical method using infrared light (i.e., Fourier transform infrared spectroscopy) which allows the robust macromolecular characterization of individual dinocysts. This state-of-the-art methodology was used to systematically analyze a large selection of modern and fossil dinocysts; the results are presented in this talk and include new insights on: (i) the molecular diversity of dinosporin and its possible associated ecological origins, (ii) the molecular changes occurring in dinosporin upon burial and diagenesis in sediments and rocks (i.e., molecular taphonomy), and (iii) the implications of these taphonomical effects for eco-evolutionary dinocyst studies, as well as for the usage of molecular geochemistry over morphotaxonomy of organic-walled palynomorphs (i.e., usually microscopic, resistant, fossilized remains of organisms) in the light of affinity studies.

Environmental factors influencing the dinoflagellate cysts production and their preservation in the bottom sediment in the upwelling region off Cape Blanc, Mauritania: a comparison of sediment trap with down-core sediment cyst record

Surya Eldo V. Roza¹, Gerard J. M. Versteegh², Karin A. F. Zonneveld^{1,3}, Hendrik Wolschke⁴, Iria García-Moreiras^{5,6}, Fangzhu Wu⁷, Gunner Gerds⁷

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Keywords: Dinoflagellate cysts, upwelling, Northwest Africa, sediment trap, down-core

Dinoflagellates are one of the most important primary producers in marine ecosystems. Many living dinoflagellate species produce organic-walled cysts during their sexual reproduction. Dinoflagellate cysts are well-preserved in the sediment leading to their common usage as a proxy to investigate past marine ecosystems. Understanding the environmental factors that drive cyst production is essential to interpret the cyst record from the sediment archive. One question of interest in paleoceanography is how well the sediment cyst record reflects the local productivity and upper water conditions. To answer this question, we have conducted a comparison study at the upwelling region off Cape Blanc, Mauritania where the primary producers are supported by nutrients coming mainly from the coastal upwelling and the Saharan dust. We have collected 18 years (2003 - 2020) of dinoflagellate cysts' export flux using a sediment trap, which was compared with an undisturbed sediment core from the vicinity area of the trap. The core was subsampled per 3 mm to produce a high-resolution cyst record. The selected samples were dated with ²¹⁰Pb and the result indicated a sedimentation rate of ca. 3 years per sample, therefore, the upper 1.8 cm of the sediment core coincided with the period covered by the sediment trap. The cyst associations recorded in the sediment trap and sediment core were dominated by heterotrophic cyst taxa with *Brigantedinium* spp. as the most common species. However, its relative abundance fell by almost half in the sediment cyst association. Consequently, other species increased their relative abundance, particularly phototrophic cyst taxa whose relative abundance doubled in the down-core record. Our preliminary results indicated that certain alterations occurred in the cyst association after being deposited in the bottom sediment. Further investigation of the core features (e.g., oxygen concentration and bioturbation) will be applied to identify the cause of this alteration.

Poster Session



Phytoplankton groups distribution in the Atlantic Ocean derived from a synergistic product from OLCI and TROPOMI measurements

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Keywords: satellites, microorganisms

Phytoplankton play a crucial role in the global carbon cycle, not only because they are the key source of primary production in the marine ecosystem and a major driver of biogeochemical cycling. In fact, they are an essential component of the biological carbon pump and are also significant producers of oxygen and fatty acids. Different phytoplankton groups have specific functions and thus play different roles in the biogeochemical cycle and for the marine food web. Information on phytoplankton groups (PFTs) can be obtained from satellite observations such as the Ocean and Land Colour Instrument (OLCI) on board of Sentinel-3 as well as the TROPospheric Monitoring Instrument (TROPOMI) on board the Copernicus Sentinel-5 Precursor satellite. Here, the chlorophyll-a concentration for two main phytoplankton functional types (diatoms and cyanobacteria) are derived by combining retrievals from space-borne measurements at a high spatial resolution by the empirical algorithm (OC-PFT) applied to OLCI data with data retrieved from TROPOMI at measurements high spectral resolution by an analytical method (DOAS). We will present preliminary results of global distribution PFTs as well as discuss their temporal variability over selected biogeochemical provinces.

Impact of melting glaciers on role of Greenland's fjords as carbon sinks

Marius Buydens¹, Ulrike Braeckman¹, Ann Vanreusel¹, Karline Soetaert², Lorenz Meire³

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Keywords: Benthic-pelagic coupling, Sediment oxygen consumption, Mineralization, Subarctic fjord, Nutrient sediment profile

Greenland exhibits two major types of glaciers: those whose outlet extends into the sea (marine-terminating glaciers; MTG) and those ending on land (land-terminating glaciers; LTG). These different glacier types induce a different hydrology within their respective fjords which seems to bring about important differences regarding primary productivity. As such, research has suggested that fjords with MTGs promote higher phytoplankton biomass through upwelling of meltwater coming from the base of the gletsjer and thereby entraining nutrients towards the sea surface. As climate change progresses, the question is also rising whether the higher primary productivity at MTG-dominated fjord systems is translated to the benthic ecosystems and if this means that eventually less carbon will be buried in Greenlandic fjord sediments as MTGs shift to LTGs. To investigate the benthic-pelagic coupling and to test the hypothesis of MTG fjord systems sustaining higher benthic biomass and burying significantly more carbon in their sediments, a MTG-characterized fjord system, Nuup Kangerlua (Godthabsfjord), and a LTG-fed fjord, Ameralik Fjord, were sampled. Benthic organisms were collected to compare biodiversity and biomass of micro-, meio-, and macrobenthic communities as well as Pb-210, granulometry, porosity, pigments, C:N, stable isotopes and metal concentrations throughout sediment profiles. In addition, sediment community oxygen consumption rates and nutrient, alkalinity and DIC fluxes were measured to assess the mineralization potential and carbon burial across and between the two fjord systems.

A record of changing geochemistry through the PETM

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Keywords: Large Igneous Province, Global warming, paleoclimate

Volcanic eruptions can have both short-term and long-term effects on the Earth's climate. Episodes of intense volcanic activity and Large Igneous Province (LIP) emplacement have been linked with both climatic warming and cooling. One such period of intense volcanism was during the breakup of the North Atlantic and the emplacement of the North Atlantic Igneous Province (NAIP) between 60 -45 million years ago (Ma). NAIP emplacement occurred in line with a period of rapid global warming known as the Paleocene-Eocene Thermal Maximum (PETM). However, because of the short duration of the PETM (~200 ka) compared to NAIP volcanism (several Ma), the contribution of NAIP volcanism to these environmental changes is unclear. The PETM is particularly interesting because it offers a case study from the geological record with numerous parallels to the current global warming driven by anthropogenic greenhouse gas emissions. The period was associated with, significant addition of ¹³C depleted carbon into the ocean-atmosphere system, which lead to global warming and ocean acidification, rise in sea surface temperature by 5°C, global expansion of oxygen minimum zones, local photic zone euxinia, sea level rise, migration of species, and an enhanced hydrological cycle. This project is entirely based on sediment samples collected from the mid-Norwegian margin during IODP Expedition 396, and this work focusses on a number of themes relating to the role large-scale volcanic eruptions play in controlling climate change. Here we present initial results from a project to identify how sediment geochemistry changed across the PETM. Primarily XRF and ICP-MS analysis of sediments are used to attain a full record of the changing chemistry through the period and target elements will be used to reconstruct enhanced chemical weathering (K, Zr, Ti, Mg), redox conditions (Fe, Cu, Co, Zn), paleo productivity (Ca, Si, P, Ba).

Interaction of Organic and Inorganic Matter in Coastal Environments: Sediments as Sources and Sinks for Trace Metals and Dissolved Organic Matter

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Keywords: Metal oxide, organic complex, coastal North Sea, bio-cycling processes, benthic-pelagic coupling

In coastal oceans, trace metals can be transported via organic or inorganic carrier phases from the water column to sediments where they are trapped, recycled and/or (re-)introduced to the water column via benthic-pelagic coupling. Also, in the shallow Wadden Sea of the Southern North Sea, these processes shape the composition of the organic and inorganic matter pools of the water column. However, whether a sediment acts as source or sink depends on the interplay of several factors, for instance sediment type and prevailing redox-conditions. Constraining trace metal budgets in coastal ecosystems such as the Wadden Sea therefore still is a major challenge because composition and properties of sediments are highly variable. The aim of our study was to identify source and sink potentials of different sediments for dissolved organic matter (DOM), and trace metals (manganese, iron and thallium). We performed incubation experiments suspending three distinct sediment types in seawater: sands, surface- and bottom Wadden Sea sediment. We monitored changes of DOM, particulate organic matter and trace metals over 14 days. The initial resuspension of both Wadden Sea sediments significantly increased dissolved manganese (dMn) and iron (dFe) concentrations in the overlying seawater. However, dMn and dFe decreased in the bottom Wadden Sea sediment treatment over time, while concentrations increased in the surface sediment treatment. Dissolved Tl concentrations decreased in both Wadden Sea treatments but increased in the sand treatments, while dFe and dMn concentrations did not change in the sand treatments. Our data suggest that the observed trace metal dynamics are driven by the interplay of redox processes and organic matter content. These findings contribute to our ongoing compilation of trace metal and organic matter time series data and provide important insights into processes determining sink and source behavior of these chemical species in different types of coastal sediments.

A stitch in time saves nine: lessons for preventing research fatigue in marine stakeholders

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Keywords: consultation fatigue, non-engagement, over-researched communities, participatory research, stakeholder engagement

The interest and willingness of marine scientists to involve stakeholders in research and governance has increased over the past decade. Consequently, marine stakeholder groups are increasingly asked to engage with scientific issues. Young marine scientists delving into stakeholder engagement should be wary as to avoid inducing research fatigue in their study participants. This study aims to provide early career marine researchers with a foundational understanding of research fatigue and how it may be prevented or diminished. Research fatigue occurs when a person or group becomes weary of participating in research processes and are therefore hesitant or unwilling to take part in further research. Drivers of research fatigue vary but are overall related to the methodological misuse of participation. Severe research fatigue threatens future research and management actions involving stakeholders by increasing nonparticipation, risking the collection of poor-quality data, and undermining trust towards researchers, among others. It also raises ethical concerns, given that research fatigue is a negative state of mind that associated with exhaustion, apathy and frustration. Research fatigue has been given some (limited) attention in some fields of study but has been poorly studied in marine social sciences. To better understand the contexts in which research fatigue occurs and how it can be minimised, prominent articles regarding research fatigue from bioethics, public health, sociology and corporate communications literature were examined for knowledge useful to marine social sciences. Lessons from across disciplinary boundaries can help marine researchers avoid fatigue by: (1) administering caution over which type of participation should be applied to a given scientific activity; (2) raising awareness of how that participation can affect the underlying drivers of research fatigue; and (3) providing practical recommendations about designing and applying participation methods. Such take-away messages can help those applying young marine scientists execute their research without exhausting their stakeholders goodwill.

Expert Stakeholder's Perceptions and Attitudes Towards Mangrove Management: A Case Study from Sri Lanka

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Keywords: Wetland, Governance, Participatory Approaches, Conservation, Natural Resource Management

Sri Lanka stands out as the world's first country to formally conserve its mangrove forests through policies irrespective of land ownership. The Sri Lankan government declared complete protection of its mangroves in the year 2020. Our study focused on delineating expert opinions regarding mangrove management policies and conservation in Sri Lanka. We conducted a questionnaire survey (August 2021 - April 2023) involving 76 respondents representing 25 different stakeholder groups, comprising government, non-government, and private organizations across all five coastal provinces in Sri Lanka. A significant majority of stakeholders (90%) acknowledged the crucial importance of mangroves as an ecosystem. However, despite the Sri Lankan government's formal mangrove conservation policies, only 28% of the respondents knew that all mangrove forests are fully protected by law in Sri Lanka. In contrast, 38% thought that mangroves were not formally protected, while 34% were unsure. Moreover, the majority of respondents (72%) either lacked knowledge or believed that the protection of mangrove forests in Sri Lanka was incomplete, highlighting the need for further education and awareness-raising on the topic. We believe that there must be a distinction made between the formal protection on paper, and the actual conservation of all mangroves. While encroachment of mangroves is prohibited in Sri Lanka, with strict policies in place for the felling of mangroves, only 70% of the respondents believed that the felling ban by the government was effective. Nonetheless, Sri Lanka continues to develop mangrove management policies, although mutual policy learning amongst stakeholders, or improvement of the overall mangrove management and conservation interests, has not been substantial. In conclusion, implementing effective mangrove management policies, by

including all stakeholders, is just as critical as policy establishment, and further education and awareness, and enforcement are necessary to bridge the policy implementation gap.

O₂ and nitric oxide dynamic in coral (*Galaxea*) gastric cavity microenvironment

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Keywords: coral gastric cavity, microenvironment, nitrogen cycling, denitrification

The gastric cavity of corals plays a vital role in various essential functions such as coral feeding, excretion, defense against pathogens, and the uptake/release of symbionts. However, limited studies have been conducted on the coral gastric cavity due to the technical challenges in measuring the physico-chemical microenvironment and microsampling of its contents. In this study, we utilized electrochemical microsensors to investigate the chemical conditions within the gastric cavity of *Galaxea* corals and to uncover the biological activities of both the coral host and its symbiotic microbes, with a specific focus on anaerobic respiration processes. We performed depth profile measurements through coral's mouth and reaching the bottom of the gastric cavity. Under irradiance with light, the O₂ concentration was found to increase to 320~405 mol L⁻¹, as a result of photosynthesis. In the absence of light, the O₂ concentration decreased, and the microenvironment within the gastric cavity became anoxic (0 mol L⁻¹). During the dark incubation, we continuously monitored the O₂ concentration over time and observed several periods of fluctuation and increase, which suggests the occurrence of water exchange between the coral gastric cavity and the surrounding seawater. Within this anoxic gastric cavity, we detected the presence of nitric oxide (NO), the highest recorded concentration of NO reached 48 nmol L⁻¹. NO is a signal molecule which was found produced during heat stress and related to the coral-symbiont interaction, and NO is also the intermediate product of denitrification. Further studies should focus on verifying the source of NO in gastric cavity and understanding the effect of NO on coral-symbiont interaction. With this research we described the spatial and temporal dynamic of O₂ within the coral gastric cavity, and we detected the production of NO, which sheds light on understanding the characterisation and the role of this important microenvironment.

Effects of temperature and hypoxia on catalase levels of a sedentary benthic fish

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Keywords: Stress, Climate change, Fish, Catalasa, Hypoxia

Temperature and oxygen are two of the most affected environmental variables in our age of climate. The changes in these variables can have a plethora of effects on marine biota, and understanding them is of outmost importance to address this issue. We simulated climate change scenarios, to evaluate the effects of high temperature, hypoxia and a combination of both, on the liver levels of catalase activity in *Hallobatrachus dactylopterus*. We used a condition index to estimate the welfare of the fish in each treatment and correlate it with the levels of catalase determined in the laboratory. The two environmental drivers studied showed effects on the catalase of this species after the course of 30 days of exposure. The most affected treatment was the combination of both hypoxia and high temperature, which showed that fish had increased levels of catalase activities in their livers. Fish on the other three treatments (i.e. only hypoxia, only high temperature and control) had equal levels of catalase activity, statistically. The condition index on the affected treatment was the lowest, but not statistically different from both the high temperature or the hypoxia treatments. Only the control treatment showed a statistically higher condition index.

Effects of food and microplastics on digestive enzyme activities of blue mussels *Mytilus edulis* and their endo-parasites *Mytilicola* sp.

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Keywords: Parasites, Food web, Algae, Starvation, Microplastics

Endo-parasites are widespread in marine organisms. Often, the nutrition of endo-parasites decisively depends on the qualitative and quantitative food uptake of their host. However, they have rarely been considered in the context of the pollution of the oceans with microplastics, which are ingested by a great variety of host organisms. In the south east North Sea, the blue mussel *Mytilus edulis* hosts two endo-parasitic copepods, *Mytilicola intestinalis* and *Mytilicola orientalis*. Previous studies showed that these species differentially feed either on the food ingested by their host or on the intestine tissue of the mussel. Twelve infected mussels each were exposed for five days to one of three different treatments: starvation, fed with suspended microalgae, fed with microplastics. After the experiments, the digestive tissue of the mussels was dissected and the parasites were isolated. The activities of six digestive enzymes were measured in the mussel tissue and in entire individuals of the parasites using fluorescent substrates. Enzyme activities of the mussels did not vary between the food treatments. Similarly, the food treatment had no effect on the enzyme activities of *M. intestinalis* whereas *M. orientalis* had clearly elevated enzyme activities when the host was starving. The two parasites responded differently to variations in the qualitative and quantitative food supply of their host suggesting differential use of food resources available to the endo-parasites. Apparently, microplastics had no effect on the activity of digestive enzymes of *M. edulis* and its endo-parasites. The reactions of the digestive enzymes of the mussels and parasites were significantly different.

Physiological and behavioural responses of the snail *Faunus ater* to temperature, salinity and tidal regime

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Keywords: gastropod, climate change, mangrove ecosystem, coastal ecosystem, stress response

The inter-related effects of climate change are impacting coastal and mangrove ecosystems on multiple levels. Species that dwell in the intertidal zone are directly affected by increasing temperatures, fluctuating salinity and inundation times. The gastropod *Faunus ater* is widely distributed and locally abundant in mangrove ecosystems along the coastlines of the Indo-West Pacific, but their ecology and response to climate change is not well known. This study assessed the physiological and behavioural response of *F. ater* in a fully crossed experimental design using temperature, salinity and tidal regime as proxies for climate change. The results show that food consumption and respiration were increased at higher temperature, coinciding with the metabolic theory. The response of moving behaviour to single treatment factors, as well as their interactions, displayed more complex patterns that implied specific trade-off behaviours. The catalase activity (CAT) and lipid peroxidation (LPO) gave more insight and revealed the accumulation of LPO and CAT in medium-stress treatments. These results suggest that *F. ater* is dealing with low to medium stress through the activation of their antioxidant defence and uses behavioural protection through hermitization and habitat evasion during times of increased stress.

Temperature-dependent grazing on kelp by the green sea urchin *Strongylocentrotus droebachiensis*

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Keywords: Digestive physiology, Grazing activity, Climate change, Temperature performance, Ecosystem function loss

Extreme grazing events by sea urchins have left formerly dense kelp forest communities completely barren all along the Norwegian coast, creating a new alternative-stable state, the so-called sea urchin barrens. Two sea urchin species of the family Strongylocentrotidae present as main grazers a key species in the Porsangerfjord, Northern Norway. In 2022, the kelp forest shows sea urchin abundances of $20 \pm 10 \text{ Ind m}^{-2}$, whereas in the neighboring sea urchin barren $147 \pm 54 \text{ Ind m}^{-2}$ were observed. Individuals from the kelp forest as well as from the barren had full guts, containing mainly pieces of brown algae, although the origin of the algae consumed by sea urchins from the barren is not completely clear. The theoretical algae wet mass that would be grazed by both species per day accounts for $28 \text{ g} \cdot \text{m}^{-2}$ (kelp) and $48 \text{ g} \cdot \text{m}^{-2}$ (barren) as calculated from sea urchin density and grazing rates obtained from in-situ grazing experiments. In a temperature-controlled experiment, conducted with the main representative, *Strongylocentrotus droebachiensis* (Müller, 1977), grazing rates increased steadily from 2 to 10°C, but decrease at higher temperatures and ceases completely at the thermal limit of 22 °C. This suggests that grazing pressure on kelp communities is influenced by temperature. With ongoing Arctic warming and increasing marine heatwaves (MHW) intensity and frequency, grazing pressure on kelp will likely increase, as will physiological challenges on benthic primary consumers. Investigations on the metabolic performance of *S. droebachiensis* by ¹H NMR analyses will complement the findings on the feeding behavior of this species in the face of climate change in order to study the implications of Arctic warming on benthic primary consumers and the consequences for their ecosystem as well as ecosystem functioning.

Diet spectra of several fish species in South Greenland waters revealed through DNA metabarcoding: the role of gelatinous zooplankton as prey

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Keywords: jellyfish, COI, 18s rDNA, food web

Gelatinous zooplankton (GZP) occur in all oceans ranging from polar to tropic regions, occupy all depths and can rapidly form large populations with high biomasses. Yet they have been largely overlooked as a food source for higher trophic levels. The high water content and fragility result in quick digestion of gelatinous prey, which is potentially why only a small number were recorded using conventional stomach analysis methods. Here, the advantages of molecular diet analysis come into play: DNA metabarcoding allows to identify short DNA fragments even from heavily degraded tissues. Over recent years, it allowed the detection of many different predators of GZP that were previously not considered as potential jelly consumers. This study uses a multi-marker approach combining 18S rDNA and Cytochrome c oxidase I (COI) to identify prey items in the stomachs of common Southern Greenlandic fish species, several of which are commercially exploited: Atlantic cod (*Gadus morhua*), redfish (*Sebastes* sp.), wolffish (*Anarhichas* sp.), greater silver smelt (*Argentina silus*) and plaice (*Hippoglossoides platessoides*). A special focus could be placed on *A. silus*, of which the stomachs were recorded as empty during visual assessment prior to the DNA extraction, but up to 100% of the detected reads could be assigned to GZP in the metabarcoding analysis. Overall, the results indicate that GZP predation is prevalent in all fish species studied and is detectable with both genes, COI and 18S. This makes it the first study to demonstrate the role of GZP as prey for Greenland fish communities.

Ostracod's assemblages revealed by integrating DNA barcoding and morphology from North Sea

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Keywords: meiobenthos, Ostracoda, DNA identification, COI gene

Crustaceans from class Ostracoda (also called seed shrimps) are an important ecological group of meiobenthic organisms (body size range: 30-1000 µm). Ostracods are a food source for demersal fish and small macro-benthic invertebrates, and data about their diversity and abundances can be used for biomonitoring of the environment. The majority of recent investigations of ostracods are mainly focused on fossil assemblages, while the data concerning their diversity and ecological role in the food webs are fragmentary. DNA barcoding of the Cytochrome c oxidase subunit I (COI) as a frequently used approach is proven to be a reliable method for species delimitation of different groups of metazoans. This study provides the preliminary insights into the diversity and abundance of meiobenthic ostracods in the south part of the North Sea using morphological identifications and genetic variabilities of a ~680 bp fragment of the COI gene. So far, our results revealed that ostracods are less abundant with lower diversity compare to other meiofauna groups. Genetical analyses of the ostracod specimens from the studied area revealed the presence of 9 different genotypes (species) mainly with low abundances and occurrence of singletons. The highest abundance of ostracods (14 individuals) was reported at St. 28 (sandy biotope) with distinct genetic clusters into 4 different species. The preliminary morphological identification of ostracod specimens from this study has shown that, so far, all analyzed specimens belong to the order Podocopida. The most abundant species were recorded from families Loxoconchidae, Leptocytheridae and Xestoleberidae. Further studies of the diversity and distribution of ostracods using reverse taxonomical approach integrating both molecular and morphological analyzes will provide better understanding of the ecological features of these crustaceans and their role in benthic ecosystems food webs.

Halimeda incrassata: a tropical seaweed in the Mediterranean Sea

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Keywords: Tropicalization, *Halimeda incrassata*, Invasive seaweed, Mediterranean Sea, Light

The arrival and expansion of tropical invasive species have been increasing in the Mediterranean Sea for several decades. *Halimeda incrassata* is a tropical seaweed first detected in 2011 on the coast of Mallorca (Balearic Islands, NW Mediterranean), growing in shallow sandy bottoms. It is a calcareous rhizophytic seaweed that has the potential to transform ecological communities in Mediterranean ecosystems. Studying the growth and calcification capacity of *H. incrassata* at different irradiance levels provides information about the means by which it was introduced and the possible future expansion. In this study, an in situ experiment was conducted manipulating light levels to assess its resistance capacity to different light availabilities. This work found that *H. incrassata* is very resistant to reductions of light availability, whereby its ability to generate biomass and carbon content is not significantly altered by light reductions of more than 60% over a period of 10 weeks. These results have relevant implications about its expansion capacity, since it has the potential to invade greater depths, interfering in habitats of other species such as *Posidonia oceanica* or *Cymodocea nodosa*, as well as altering the calcareous component of the substrates by releasing inorganic carbon.

Combining sensor nodes for automated acquisition of marine data

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Keywords: Sensor integration, automated sensing, data merging, environmental monitoring

Environmental monitoring programs carried out by expeditions on research vessels are expensive and only allow measurements for discrete times and locations. The attempt to get a higher resolution of data on an environment needs flexible and automated data acquisition techniques. To be able to base decisions on marine data, information on where, when and how it was acquired is needed as necessary context information. The process should be automated so that data acquisition by nonprofessional operators is possible. For a geospatial positioning of subsurface hydrological data, the position of the sensors has to be provided in coordinates and depth. This makes it necessary to have at least two different sensing nodes. In the attempt to combine these the synchronisation between nodes is essential. We present a system that connects multiple nodes wireless and provides the infrastructure to synchronize, handle and store their data. Sensing nodes that acquire measurements in water connect multiple sensors with a variety of parameters in hardware directly. Nodes in the air gather information with sensors and APIs to give context information on the measurements. Mobile connectivity makes it possible to transfer the data to land for near real time visualization and evaluation. The approach shows how decentralized automated units can complement monitoring programs in a variety of stationary and mobile use cases on ships of opportunity or in citizen science. Remote visualization of results of multiple deployed units makes a fast evaluation and reaction based on measured data possible.

Data Train - The Cross-disciplinary Training in Research Data Management and Data Science

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Keywords: Data skills, Data analysis, Big data, Fair data, Interdisciplinary education

Data-driven science is important for answering pressing research questions of our time. Global warming, pollution, massive extinction of species and the impact on human health as well as the socio-economic consequences of the COVID-19 pandemic are just a few recent examples. In times of digitalization, sound research data management (RDM) and data science-related skills, such as data formatting/handling, -analysis, -visualization and -deposition following the FAIR data principles, are indispensable for making research efficient and applicable for our society. However, there is a significant deficit of these skills among PhD students across many disciplines, including marine researchers. Qualified persons in RDM and data science are missing to foster innovative technologies. Gaps in the University curricula still exist, while the needs for various scientific disciplines are on the one hand very specific but on the other hand with many synergies. Using these synergy effects and responding to this massive demand, the U Bremen Research Alliance, with the support of the Federal State of Bremen, has established the cross-institutional and cross-disciplinary training program "Data Train - Training in Research Data Management and Data Science" for doctoral researchers from member institutions. Data Train pursues the mission of strengthening the competencies in data literacy, data management, and data science, while offering doctoral researchers a platform to build an interdisciplinary and interinstitutional network. The program is associated with the German National Research Data Infrastructure (NFDI). NFDI consortia represented in Bremen (NFDI4Health, NFDI4Biodiversity, KonsortSWD, NFDI4Ing, NFDI4DataScience, NFDI4Earth, NFDI-MatWerk, NFDI4Microbiota, NFDI4Memory) participate in the development and operation of the training courses, which started in 2021 and now take place annually. The cross-institutional and cross-disciplinary training model covers the entire data value chain and makes an important contribution to data literacy training, which is beneficial for all kinds of scientific fields as well as for society and economy.

Labile or stable? Assessing organic matter recalcitrance - case study on Malaysian mangrove sediments

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Keywords: blue carbon, carbon sequestration, loss on ignition, thermal stability

Mangrove forests and other coastal vegetated ecosystems sequester and store large amounts of organic carbon in their biomass and their sediments. In recent decades, their integrity and extent have been compromised and reduced by numerous human activities. As a result, the global capacity to mitigate climate change through blue carbon storage in coastal vegetated ecosystems has declined dramatically. For concrete actions to reverse this trend it is not only crucial to have better knowledge of the quantity but also stability of the stored organic matter (OM; containing the organic carbon). The present research aims to enhance the understanding of sediment OM, notably by quantifying OM fractions of distinct stability. Here we present a case study from peninsular Malaysia, where we collected 50 cm-deep sediment cores in three different regions at the west and east coast. By applying a stepwise combustion method, we provide first insights into OM quality with regard to thermal stability as a proxy for recalcitrance against decay. We will present 1) regional organic matter characteristics, and 2) possible differences of OM recalcitrance levels across sediment depth. Novel insights into organic matter stability will deepen our understanding of long-term organic matter storage in mangrove ecosystems and thereby their potential as climate change-mitigators. This knowledge will further inform regional and global management of coastal vegetated ecosystems and potential carbon offset schemes.

Detection and relative quantification of the European eel populations in rivers of Asturias (Spain) using eDNA.

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Keywords: *Anguilla anguilla*, environmental DNA, qPCR, specific marker, freshwater life monitoring

The European eel (*Anguilla anguilla*) is a species classified as critically endangered by the International Union for Conservation of Nature (IUCN). To protect current eel populations and to promote their recovery, it is essential to develop efficient monitoring methods free of associated mortality, especially in the case of vulnerable populations. That is why environmental DNA is gaining importance globally, as it allows sensitive and non-invasive monitoring of aquatic species. In this work, the presence of European eel in two Asturian rivers is determined. In addition, a quantitative approach is applied in order to correlate the environmental DNA with the biomass of eels obtained by electric fishing. To do this, eDNA is recovered from water samples by filtration, extracted, and amplified by real-time PCR (qPCR). With this methodology, eels have been detected in 69,56% (16/23) of the analysed sampling points, and in 91,66% (11/12) of those points for which the presence of this species is known. In addition, it has been possible to establish a correlation between the amount of DNA and eel biomass including a correction for river hydrography developing a marker with predictive value, which was validated with eDNA of other river. These results show that the methodology used has great potential for non-invasive monitoring of the species, especially in rivers with low density of eels where electric fishing loses efficiency.

What approach can we use to study benthos on plastic substrates?

Iryna Kapshyna^{1,2}, Olena Uzun^{1,2}, Valentyn Portianko¹, Olena Bondarenko¹, Anastasiia Snigirova¹

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Keywords: biofilm, meiofauna, macrofauna, marine litter, Black Sea

Plastic pollution in the environment has become a new habitat for marine biota. Despite the increase in research of biofouling on plastics, methodological approaches to studies of the whole benthic community and on plastic substrates are largely unknown. Thus, the aim of this research is to represent the methodology for the complex analysis of biofouling communities (from microalgae to meio- and macrofauna) on the plastic surfaces. The complex experimental evaluation of the colonization of plastic substrates was made for the first time in the Black Sea. The three types of constructions were designed to study marine biofouling. The experiments were carried out at various exposures (1-10 months) in situ in the north-western Black Sea coastal area. In total, 28 genera of microalgae, 13 major groups of meiobenthos and 36 species of macrofauna were found on plastic during the experiments. The main component of the microalgae biofilm was represented by the complex of *Cocconeis* species. The higher taxa of meiofauna such as Nematoda, Harpacticoida (Copepoda), Polychaeta, Bivalvia, Cirripedia and Amphipoda made the greatest contribution to the biomass and density of the meiobenthos community. The main component of the density and biomass of macrofauna was formed by Bivalvia (*Mytilaster lineatus*, *Mytilus galloprovincialis*) and Crustacea (*Amphibalanus improvisus*). Although the methodology of experiments needs to be improved and unified, the results of this study could be used as a part of monitoring marine litter components. The present and further studies will allow estimation of biofouling growth (intensity, structure, biodiversity) on new types of substrates and their impact on benthic habitats. The obtained data make an important contribution to the development of national standards for Descriptor 10 of the Marine Strategy of Ukraine and understanding the ecological status of marine environment.

Contextualising marine measurements by linking various data sources

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Keywords: Environmental monitoring, Internet-of-things, Data contextualisation

Effort required to obtain marine measurement data is immense. Sensors of various shapes and sizes are deployed stationary or at different locations in certain time intervals as data sources. This leads to data sets which differ in spatial and temporal resolution and in complexity. Since many characteristics of the marine environment influence each other, additional parameters should be collected as context datasets. The aim of this research is to evaluate the opportunities of third-party data sources and their implementation by using methods from the internet-of-things (IoT) approach. Hereby, each data source is designated as an object that can be connected within a network. As a first step an analysis of possible data sources in the region of Rostock, Germany, was carried out and applicable data sources were selected. Then a modular, self-developed sensor system was deployed at one station for a longer period of time and measured and transmitted data automatically. At the same time the selected third-party data sources were combined to provide contextual data. With the use of Application Programming Interfaces (APIs) and tools of the IoT-approach the implementation and near-real-time data visualisation could be carried out. This allows users to track changes and make quick initial assessments with taking the context data into account. During the process of data alignment standard vocabularies and naming conventions are taken into account. In summary the integration of additional, external data sources as context data simplifies the process of data contextualisation immensely, which is why measuring systems for marine environmental monitoring should provide such communication interfaces. At the same time, there is an obligation to correctly indicate the source and owner of a data set and the way it was created.

Floating Sediment Traps - closing a gap: Detailed representation of trophic interactions and estimation of carbon sequestration potential in marine high productivity regions

Luisa Meiritz^{1,2}, Niko Lahajnar², Tim Rixen^{2,3}

¹GEOMAR Helmholtz Center for Ocean Research, Kiel; ²Universität Hamburg, Institute of Geology, Working Group Marine Biogeochemistry, Hamburg; ³Leibniz-Centre for Tropical Marine Research, Bremen

Keywords: upwelling systems, energy transfer, particulate matter flux, floating sediment traps

Highly productive regions in the world's oceans, such as eastern boundary upwelling systems (EBUS), cover only a few percent of the ocean surface. Socio-economically, however, they contribute significantly to the food supply of large populations. Due to their high biological productivity, these areas have a major impact on the marine carbon cycle. The complex EBUS are also affected by impacts of ongoing anthropogenic climate change such as upwelling-induced temperature changes, coastal acidification and deoxygenation and are also subject to ecosystem pressures from overfishing, making it difficult to fully grasp these systems. To better understand the functioning of these systems, floating sediment traps are deployed in the water column and sample the active and passive particle transport at various depths. After microscopic and biological determination of the particles, these samples provide the opportunity to perform numerous biogeochemical analyses such as flowcam analyses, statistical surveys and nutrient analyses on different particle groups, abundance determinations, eDNA sampling, and estimates of organic/inorganic carbon and particle flux. As a practical example, we show here our recent work from the Benguela Upwelling System (BUS) obtained from the TRAFFIC project (Trophic TRANSfer eFFICIency in the Benguela Current). Over the last three years, 16 floating sediment systems have been deployed here. With data acquired from the southern (sBUS) and northern (nBUS) part, changes in particle flux fluctuations have been detected and quantified. The data show significant interseasonal differences and changes in particle flux. In austral winter, particle transport in the sBUS is with up to 48,000 mg m⁻² d⁻¹ almost five times greater than in austral summer. Compared to the nBUS, the sBUS shows higher rates of particle transport in every season. In conclusion, the interdisciplinary scope of the floating systems closes a previously existing gap between the disciplines of marine biology, biogeochemistry, oceanography and environmental modelling.

Sex differences in sand goby feeding ecology during breeding season

Cindy Meyer¹, Katja Heubel¹, Sabine Schückel², Ulrike Schückel²

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Keywords: food web, feeding ecology, paternal care, gobiidae, stomach content

Having a comprehension of how feeding ecology differs between sexes during specific times of the year is essential to the advancement of ecosystem research. However, this topic is relatively unexplored. In order to uncover these differences during breeding season in sand gobies, fish were captured in the Amrum Bank region of the German North Sea during and after breeding season in 2019, 2020 and 2021. All individuals were dissected and measured. The stomach contents were weighed and prey items identified. Our aim was to (i) reveal the trophic role of the sand goby by identifying its prey, (ii) to study seasonal variation in its feeding ecology, and (iii) to look into potential dietary differences between males and females. We show that sex and season affect the diet of *P. minutus*. There were no dietary differences between males and females in the autumn. In May, during the breeding season, males have less food in their stomachs and a different selection of taxa in their diet. The effects on the feeding ecology could be caused by different behaviour and feeding opportunities of female and male sand gobies during reproduction and male parental care. This study is among the first studies addressing gender-specific differences in the diet. We confirm that *P. minutus* is a second consumer which suggests its important role in the coastal marine food web and conclude that it is time for ecosystem research to start considering sex differences.

Algal sulfated fucan: a global carbon sink

Aman Akeerath Mundanatt¹, Silvia Vidal-Melgosa¹, Jan-Hendrik Hehemann¹

¹MARUM - Center for Marine Environmental Science, University of Bremen, Bremen, Germany, Max Planck Institute for Marine Microbiology, Bremen, Germany

Keywords: Algal polysaccharides, Carbon sequestration, Sediment

Brown algae and diatoms produce and exude complex polysaccharides called algal sulfated fucans that resist microbial degradation. These anionic polysaccharides can assemble into gel-like transparent exopolymer particles and eventually aggregate into larger sinking particles. Sulfated fucans may limit the microbial remineralization of the sinking particles and promote carbon transport to the sediment. However, their significance in global carbon cycling processes is relatively unknown. Monoclonal antibody-based methods like enzyme-linked immunosorbent assay can semi-quantitatively detect specific epitopes on the sulfated fucans. We probed for sulfated fucans in sediment samples from the Black Sea, the Mediterranean Sea, the Bransfield Strait, and the South Pacific. We detected sulfated fucans in samples including 11.8 ka and 125 ka old sediment, showing their potential to trap carbon for millennia. Unknown concentrations of sulfated fucan in sediments underscore the requirement for quantitative measurements and establish their contribution to carbon sequestration and cycling.

Mariculture affects microbial biofilm community structure and its coral settlement induction capacity

Blaire M. Padayhag¹, Michael Angelou L. Nada¹, Jake Ivan P. Baquiran¹, Marilou P. Sison-Mangus², Maria Lourdes San Diego-McGlone¹, Patrick C. Cabaitan¹, Cecilia Conaco¹

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Keywords: Nutrient enrichment, settlement cues, coral settlement, 16S rRNA, 18S rRNA

Coral larval settlement is a complex process that relies on settlement cues such as those elicited by microbial biofilms. Changes in reef environmental conditions, including nutrient enrichment from mariculture, may cause changes in biofilm communities, which, in turn, can affect coral larval settlement. To determine how a nutrient gradient from mariculture activity affects biofilm development and subsequent coral larval settlement, biofilm communities were developed on glass slides for 4, 7, 11, and 15 days at four sites with increasing distance from a mariculture zone. Biofilms farthest from mariculture influence elicited greater settlement of *Acropora tenuis* larvae. Characterization of the prokaryotic and eukaryotic communities by 16S and 18S rRNA sequencing revealed a greater proportion of crustose coralline algae (CCA) and gammaproteobacterial taxa in the biofilms developed at sites farthest from the mariculture, whereas no CCA and a greater proportion of cyanobacteria were found on biofilms closer to the mariculture zone. These findings suggest that nutrient enrichment due to mariculture activities alters the composition of biofilm-associated microbiome at nearby reef sites and indirectly causes poor coral larval settlement.

The NFDI4Earth Academy - Your training network to bridge Earth System and Data Science

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³MARUM - Center for Marine Environmental Sciences, University of Bremen; German Federation for Biological Data (GFBio e.V.); ⁴Deutsche Allianz Meeresforschung

Keywords: PhDs & PostDocs, Data science, Interdisciplinary research, Collaboration, Community

The NFDI4Earth Academy is a network of doctoral and post-doctoral scientists, interested in bridging Earth System and Data Sciences beyond institutional borders. The research networks Geo.X, Geoverbund ABC/J, and the German Marine Research Alliance (DAM) offer an open science and learning environment. The Academy covers specialized training courses and facilitates collaborations within the NFDI4Earth consortium with access to all NFDI4Earth innovations and services. Academy fellows advance their research projects by exploring and integrating new methods, connecting with like-minded scientists, and developing skills and a mindset for open and data-driven science across disciplinary boundaries. Our two-year Academy program offers a unique approach to traditional graduate school curricula. We prioritise peer-mentoring and flexible event structures to meet our fellows' specific training needs. Fellows can, with our support, organize additional events and access external training opportunities.

Our first cohort of 39 fellows from 24 institutions in Germany is on the verge of completing a fruitful first year. The call for our second cohort will open on October 16, 2023, with the program scheduled to commence in June 2024.

Meiobenthos in different habitats of the Snake Island marine protected area (Black Sea)

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Keywords: MPA, benthic habitats, EUNIS, rocky shores

The nearshore aquatic zone of the Snake Island, located in the north-western Black Sea shelf, is a marine protected area (MPA) with fragmentary data on meiobenthic taxa biodiversity. The first comparative analysis of the meiobenthos assemblages in different habitats according to the EUNIS classification of the Snake Island was made. Meiobenthos was studied in the three habitats: Exposed Black Sea upper infralittoral rock with turf of Corallinales (MB142), Mytilid dominated Black Sea exposed upper infralittoral rock with foliose algae (no fucales) (MB143) and Black Sea infralittoral sands and muddy sands without macroalgae (MB542). Total, 5 permanent groups and 5 temporary higher meiobenthos taxa were registered in the different habitats. The highest density and biomass means ($190655 \pm 23004 \text{ ind.}\cdot\text{m}^{-2}$ and $3170.90 \pm 412.15 \text{ mg}\cdot\text{m}^{-2}$ respectively) of meiobenthos were at MB143 habitat, formed by *Mytilus galloprovincialis* with foliose algae. The results of nMDS and cluster analyses showed meiofauna assemblages of both MB142 and MB143 differ from the MB542 habitat (significance confirmed by the ANOSIM pairwise test). SIMPER analyses showed that Bivalvia and Ostracoda made the biggest percentage contribution to these dissimilarities between habitats. Thus, the meiobenthos assemblages at the different habitats of the Snake Island MPA were similar to the other regions of the Black Sea with some unique features (e.g. relatively lower total meiobenthos density, high percentage of ostracods on the algal substrate, etc.). Further studies of peculiarities of meiobenthic taxa in other MPAs might lead to estimate patterns of the meiobenthos formation and for their possibility of use in biomonitoring.

Project HotMess: Investigating the impacts of temperature and pollution on global intertidal ecosystems

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¹University of Oxford; ²Oxford Brookes University

Keywords: Multiple Stressors, Nutrient Pollution, Climate Change, Global Coastlines, International Collaboration

Understanding the effects of multiple stressors is imperative for the prediction, management, and mitigation of impacts. The combined effects of stressors may be more insidious than their more predictable individual effects, and so more research is necessary to disentangle their outcomes. Multiple stressor impacts on marine ecosystems, particularly intertidal, are vastly understudied. This is despite the vast range of ecosystem services and functions they provide; such as serving as early indicators of change, and as exporters of energy across the aquatic-terrestrial interface. The goal of Project HotMess is to explore intertidal community composition shifts under changes in temperature and pollution at a global scale. To do this, passively warmed settlement plates shall be constructed and placed along global coastlines at different proximities to a nutrient pollution source, and community composition shall be analysed over one year. This shall allow nutrient pollution and increased temperature to be evaluated independently and interactively. The experiment shall be installed in 28 coastal countries (across all 7 continents), to determine whether biogeographic climate variables influence the effects of these stressors. Climate data shall be gathered from all sites accordingly. This experiment was first installed in Brighton (UK), in September 2022. Analysis shall include community composition shifts, as well as food web analysis throughout the summer period. Preliminary results due in June 2023. The experiment has also most recently been installed across nine Southern hemisphere countries between March-April 2023. A further 18 replicates are set to be installed across Northern hemisphere countries in September 2023. Community composition of standardised functional groups shall be investigated for these sites. Project HotMess shall disentangle complex community ecology responses across the globe, and encourage global collaboration and representation across multiple research themes. This project has the potential to initiate and pave the way for further research in a vastly understudied field.

Development of dissolved organic matter in the sea surface microlayer during an algal bloom: a mesocosm study

Jasper Zöbelein¹, Hannelore Waska¹, Thorsten Dittmar¹

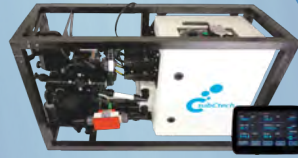
¹Marine Geochemistry, University Oldenburg

Keywords: air-sea interface

The sea surface microlayer (SML) covers most of the ocean's surface. This thin layer measures between 1 to 1000 μm and is formed by a complex mixture of solved and aggregated carbohydrates, lipids, proteins, and a variety of diverse surface-active organic compounds. As an aggregate-enriched environment which is highly irradiated by ultraviolet light, the SML is a unique biome sheltering distinct microbial communities. This leads to the SML featuring distinct physicochemical properties compared to the underlying water. With its high concentration of surface-active substances, the SML modulates the air-sea exchange processes of gases, heat, light, and momentum. As part of the project Biogeochemical processes and Air-sea exchange in the Sea-Surface microlayer (BASS), we characterize dissolved organic matter (DOM) in the SML and its influence on the inorganic carbon cycle. We aim to understand the organic matter composition of the SML and underlying water. A major goal is to understand the reasons for the strong spatial and temporal heterogeneity of SML-DOM and the conditions under which it becomes an interface which is chemically distinct from the underlying water. By that, we will elucidate the role SML-DOM is playing in the air-sea gas exchange, carbonate chemistry, and ecosystem functioning of associated organisms. During a mesocosm study in summer 2023, an algal bloom was induced at the Sea Surface Facility (SURF), Wilhelmshaven. The goal was to study the formation and decay of the SML. First results show a distinct enrichment of the SML with dissolved organic carbon (DOC). Ultrahigh-resolution mass spectrometry will further reveal molecular patterns which are linked to SML properties, such as alkalinity and CO_2 equilibration. The first results will be discussed in the contribution.



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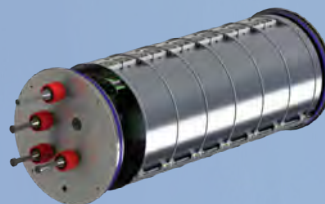
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Wednesday
20th September 2023



Program - Wednesday, 20th September

07:30	Registration & Welcome coffee	
08:30	Keynote speech ECOP Germany: Building a network, sharing knowledge & empowering young professionals for the UN Ocean Decade Sandra Ketelhake, Early Career Ocean Professionals (ECOPs) programme <i>Lecture Hall</i>	
09:30	<i>Breakfast break</i>	
09:45	Session 2.3 A Physical, biogeochemical as well as microbiological processes and their interactions in coastal ecosystems <i>Lecture Hall</i>	Session 4.8 A Tropical coastal ecology: biodiversity, research and conservation <i>Seminar room A</i>
10:45	<i>Coffee break</i>	
11:15	Session 2.3 B Physical, biogeochemical as well as microbiological processes and their interactions in coastal ecosystems <i>Lecture Hall</i>	Session 4.8 B Tropical coastal ecology: biodiversity, research and conservation <i>Seminar room A</i>
12:30	<i>Lunch break (self organized)</i>	
13:15	Round table Topic: Scientific diving <i>Foyer</i>	ECOP Networking Meeting Sandra Ketelhake, Simon Jungblut <i>Info table</i>
14:00	Session 2.3 C Physical, biogeochemical as well as microbiological processes and their interactions in coastal ecosystems <i>Lecture Hall</i>	
15:30	<i>Coffee break</i>	
16:00	Session 6.0 B Open Session <i>Lecture Hall</i>	Session 3.1 Marine Governance and Conservation <i>Seminar room A</i>
17:15	<i>Joint pizza orderings</i>	
18:00	Science speed meeting <i>Seminar room A</i> Interact with fellow young marine researchers in a relaxed setting beyond formal presentations or pitches: join us for the Science Speed Meeting! To initiate a conversation, you can introduce yourself and share your academic and career journey, your passions, or even pose a fun question like: "If you were a marine species, which one would you be and why?" Our team will be there to help you get started.	

Keynote & Plenary Discussion

ECOP GERMANY: BUILDING A NETWORK, SHARING KNOWLEDGE & EMPOWERING YOUNG PROFESSIONALS FOR THE UN OCEAN DECADE

Speaker: Sandra Ketelhake, Early Career Ocean Professionals (ECOPs) programme; GEOMAR Helmholtz Centre for Ocean Research Kiel

Moderation: Simon Jungblut

The United Nations Ocean Decade (2021 - 2030) is a crucial moment to prepare and connect a generation of professionals motivated to take the lead in addressing multiple ocean challenges. Since the First Global Planning Meeting of the Decade, Early Career Ocean Professionals (ECOPs) have been an integral part of the Decade. The international ECOP Programme elevates and strengthens the diverse perspectives of new generations of ocean professionals through a collective voice, ensuring that knowledge is transferred between experienced professionals and ECOPs to promote ocean sustainability for "The Ocean We Want". With ECOP Germany, we aim to channel efforts and build opportunities, while creating a network that leverages the synergies with ongoing initiatives. ECOP Germany is just gaining momentum and we welcome every German or resident that self-identifies as being early in their career in any ocean-related field (research, education, government, industry, NGO, etc.) to join our national network. In this keynote, we will present the overall vision & mission of the international ECOP Programme, focussing on ideas we have for ECOP Germany, and show some national initiatives that contribute to knowledge sharing and offer opportunities for exchange.

Session 2.3
Physical, biogeochemical
as well as microbiological
processes and their
interactions in coastal
ecosystems



Physical, biogeochemical as well as microbiological processes and their interactions in coastal ecosystems

hosted by Magali Roberts & Felix Auer

Wednesday, 20th September 2023, 09:45 – 15:15, Lecture Hall

Coastal ecosystems are major transition zones at the land-sea interface where physical changes strongly influence biogeochemical and microbiological processes. Coastal systems are subject to different gradients, redox and freshwater-saltwater, as well as strong hydro- and morphodynamics, tides and waves. Those gradients and dynamics have an impact on flow and transport patterns, biogeochemical reactions and microbiological habitats. Investigating how these interactions can affect coastal ecosystems requires interdisciplinary research. In our session, we aim to bring together young scientists from different backgrounds to present their work addressing physical, biogeochemical or microbiological processes and their interactions in coastal ecosystems.

09:45 – 10:00, Lecture Hall

Do coastal environments function as important reaction interfaces for new technology metals?

Corinna Mori

Research Group for Marine Isotope Geochemistry Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Oldenburg, Germany

10:00 – 10:15, Lecture Hall

Molecular fingerprints of dissolved organic matter in porewater of German coastal vegetated ecosystems

Darya Baiko

Institute for the Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany

10:15 – 10:30, Lecture Hall

Depositional processes and controlling factors for the preservation of particulate organic matter in the Helgoland Mud Area, SE German Bight

Daniel Müller

Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany and Faculty of Geosciences, University of Bremen, Bremen, Germany

10:30 – 10:45, Lecture Hall

Effects of Burrowing Mud Lobsters (Thalassina) on Carbon Fluxes in Malaysian Mangroves

Moritz Nusser

Leibniz Centre for Marine Tropical Research (ZMT) and University of Bremen

11:15 – 11:30, Lecture Hall

Trends in temperature, heat fluxes, phytoplankton blooms and sea level in the 21st century - time series analysis for the German Wadden Sea (Spiekeroog)

Ronja Schwenkler

University of Oldenburg, Marine Sensor Systems and Technical University Braunschweig, Institute for Geosystems and Bioindication

11:30 – 11:45, Lecture Hall

Longstanding hard coastal protection structures in tidally dominated areas: its impact on the sedimentology (Harle inlet, Southern North Sea)

Anna-Lena Geßner

Carl von Ossietzky Universität Oldenburg, ICBM

11:45 – 12:00, Lecture Hall

On the intertidal morphology and sedimentology of Spiekeroog Island, German Bight: Insights from DynaDeep joint project

Jairo Cueto

Coastal Geology and Sedimentology Group, Institute of Geosciences, Christian-Albrechts-Universität zu Kiel

12:00 – 12:15, Lecture Hall

Spatio-temporal variability of redox conditions in the deep subterranean estuary of a high energy beach

Magali Roberts

Marine Isotope Geochemistry, Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany

12:15 – 12:30, Lecture Hall

PHYSICAL AND BIOGEOCHEMICAL INFLUENCES ON OXYGEN DYNAMICS IN THE BEACH SEAWATER INFILTRATION ZONE

Felix Auer

Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Am Handelshafen 12, 27570, Bremerhaven, Germany

14:15 – 14:30, Lecture Hall

Iron and dissolved organic matter coupling at redox interfaces in high energy subterranean estuaries

Kojo Amaoko

Research Group for Marine Geochemistry (ICBM-MPI Bridging Group), Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany

14:30 – 14:45, Lecture Hall

Differential transformation of freshwater and seawater dissolved organic matter by subterranean estuary microbial community

Grace Abarike

Research Group for Marine Geochemistry, Institute for Chemistry and Biology of the Marine Environment (ICBM-MPI Bridging Group), University of Oldenburg, Oldenburg, Germany

14:45 – 15:00, Lecture Hall

Microbial communities in the subterranean estuary of Spiekeroog beach

Simone Brick

Carl-von-Ossietzky-Universität Oldenburg

15:00 – 15:15, Lecture Hall

Exploring the Complex Interactions between Physical, Biogeochemical, and Microbiological Processes in Coastal Ecosystems: Implications for Sustainability and Management

Edward Kusewa

St. Pauls University

Do coastal environments function as important reaction interfaces for new technology metals?

Corinna Mori¹, Maren Striebel², Katharina Pahnke¹

¹Research Group for Marine Isotope Geochemistry Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Oldenburg, Germany; ²Research Group for Planktology Institute for Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Oldenburg, Germany

Keywords: metal-organic complexation, mesocosm study, rare earth elements, phytoplankton blooms, benthic-pelagic coupling

The assimilation of rare earth elements (REE) in agriculture, industry, and medicine has led to their increased anthropogenic introduction to coastal environments, where they can become potentially harmful for the ecosystem, depending on their respective function. Previous studies indicate that, contrary to the current state of the art, changes in REE concentration patterns are associated with organic matter (OM) cycling. The main objective of our study was to determine the imprint of intense OM-cycling on REE patterns in coastal ocean compartments. We conducted an indoor mesocosm experiment where we incubated a naturally composed North Sea phytoplankton community over a duration of 42 days. The exchange between the 600 L seawater body and the underlying sediment reservoir was ensured by the implementation of a diurnal tidal cycle. Over the course of the experiment, we monitored REE concentrations, the temporal changes in bloom composition (via marker pigments), macronutrients, dissolved and particulate OM, as well as selected trace metals (Mn, Fe). Our results reveal significant shifts in REE patterns over the course of the experiment, which was characterized by three distinct phytoplankton bloom peaks. After an incubation time of 35 days, we induced a suspension event. This intense exchange between the benthic and pelagic environment not only initialized the third bloom peak but also significantly altered the REE pattern. First results indicate that the changes in REE concentrations are not only linked to changes in biomass itself, but also depend on the phytoplankton bloom stage, the composition of the community as well as the associated dissolved organic matter pool. The dynamics in the growth and degradation of the phytoplankton bloom and the associated adsorption and desorption of REEs to and from organic carrier phases resulted in shifts in the fractionation of light REE, relative to heavy REE.

Molecular fingerprints of dissolved organic matter in porewater of German coastal vegetated ecosystems

Dariya Baiko¹, Lea Benecke¹, Thorsten Dittmar^{1,2}, Michael Seidel¹

¹Institute for the Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg, Germany; ²Helmholtz Institute for Functional Marine Biodiversity (HIFMB), University of Oldenburg, Germany

Keywords: salt marsh, seagrass, blue carbon

Coastal vegetated ecosystems (CVEs) are among the most productive habitats on the planet. In Germany, CVEs are represented by salt marshes and seagrass meadows along the coasts of the North and Baltic Seas. Both salt marshes and seagrasses can export a substantial portion of their photosynthetically fixed material into porewater in form of dissolved organic matter (DOM). DOM constitutes a complex mixture of compounds that plays a major role in biogeochemical cycles, especially at the land-sea interface. With the help of ultrahigh-resolution mass spectrometry (FT-ICR-MS), patterns of DOM compositions can be observed. We aim to identify the CVE-specific molecular fingerprints to assess the carbon sequestration potential of the different CVEs. Porewater samples from CVE in the German Wadden Sea as well as at the Baltic Sea coast were collected. At each location, salt marshes and seagrass meadows were sampled in addition to an unvegetated area in direct vicinity to both vegetated ecosystems. Elevated concentrations of dissolved organic carbon (DOC) in vegetated sediments suggest accumulation of organic matter in these ecosystems. Similarly high DOC levels in adjacent unvegetated sediments at some locations indicate a possible transport of DOM from vegetated areas, which is relevant for estimating of the carbon sequestration potential of these CVEs. Despite the substantially different environmental settings in the North Sea and the Baltic Sea, we expect to find comparable DOM patterns between two coasts that are CVE-specific.

Depositional processes and controlling factors for the preservation of particulate organic matter in the Helgoland Mud Area, SE German Bight

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Keywords: Sediment dynamic, ²¹⁰Pb dating, bioturbation, POC dynamic, POC budget

Fine-grained coastal and marine sediments are the largest permanent sink for carbon on our planet. The Helgoland Mud Area (HMA) is the main depocenter for such sediments in the German Bight, North Sea. It is located at water depths between 11 and 27 m, with a sediment thickness up to 29 m and covers an area of about 500 km² southeast off the island of Helgoland. We aim to assess depositional processes and to quantify the long-term carbon storage within the sediments using it as a model area. Complementing existing estimates of sedimentation rates, we have determined new sedimentation/accumulation rates based on ²¹⁰Pbxs and ¹³⁷Cs activities for the upper ~30 cm of the sediments at high spatial and vertical resolution. Our results on sedimentation rates for the last ~200 years range from <0.5 to ~10 mm yr⁻¹ with the highest rates in the southern and central part of the HMA. Particulate organic carbon (POC) contents typically amount to 1 to 2 wt% within the uppermost ~30 cm of the sediments, with highest total organic carbon (TOC) contents at sites with highest sedimentation rates. In addition, we determined the source of the degraded POC based on dissolved inorganic carbon (DIC) concentrations in the pore water and its stable carbon isotope composition of DIC using Miller-Tans plot analysis. These analyses revealed that the origin, availability and reactivity of POC show a sharp boundary in the study area between POC from marine origin in the north-west and POC from terrestrial sources in the south and east. Based on our comprehensive dataset, we will identify different depositional/geochemical provinces in the HMA and assess the impact of disturbances including anthropogenic activities on long-term POC burial.

Effects of Burrowing Mud Lobsters (*Thalassina*) on Carbon Fluxes in Malaysian Mangroves

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Keywords: mangroves, burrowing macrofauna, bioturbation, blue carbon, sediment carbon dynamics

Studies on effects of the burrowing macrofauna on carbon fluxes often focus on only a single flux pathway, e.g., the vertical efflux of gaseous carbon dioxide into the atmosphere, or the horizontal efflux of dissolved organic and inorganic carbon into tidal creeks. Improving the understanding of multiple pathways simultaneously can help to understand carbon dynamics in mangrove forests and therefore lead to more accurate estimates of carbon budgets. This study aims to provide a multifaceted insight of the effects of mud lobster burrows on vertical and horizontal fluxes of inorganic and organic carbon. Mud lobsters (*Thalassina*) in the Indo-West Pacific dig burrows of several meters in depth and create mounds of filtered mud at the sediment surface that can substantially change the topography of the mangrove forest floor. We hypothesize: 1) *Thalassina* changes organic matter by digestion and redistributes it from deeper layers to the surface. 2) Bioturbation by *Thalassina* leads to deeper penetration of oxygen into the sediment, creating a change in microbial communities from anaerobic to aerobic and generates an efflux of carbon dioxide to the atmosphere via aerobic respiration. 3) Dissolved organic and inorganic carbon that has accumulated in water inside the burrow gets washed out into the ocean by the tidal pump of the porewater. To differentiate physical from biological effects of the burrows, we conducted an exclusion experiment with artificial burrows and compared those with natural burrows and bulk sediment. To test our hypotheses, we measured the content and recalcitrance of organic matter in the burrow wall sediment, analysed the microbial community metabolism, quantified CO₂ effluxes from the burrows, and measured the DOC and DIC concentrations in the sediment pore water across tidal cycles. Our results reveal a higher CO₂ efflux from mound sediment compared to bulk sediment, indicating the influence of *Thalassina* in enhancing the vertical efflux through the construction of their mounds.

Trends in temperature, heat fluxes, phytoplankton blooms and sea level in the 21st century - time series analysis for the German Wadden Sea (Spiekeroog)

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Keywords: climate change, heat budget, algae bloom, sea level rise, correlation analysis

The ocean influences the climate system by absorbing heat. Air and water temperatures are increasing, impacting both marine ecosystems and coastal communities and causing changes in local climate and sea level rise, which will impact the unique ecosystem Wadden Sea. Current trends in heat budget, temperature and sea level are still unknown for the Spiekeroog area. Therefore, the aim of this study was to calculate a heat budget for the last 20 years based on data from the time series station Spiekeroog and analyze trends in temperature and sea level. It was further investigated if an impact on the intensity, length and starting point of the phytoplankton bloom can be observed by inferring a proxy for the bloom intensity from remote sensing reflectance data. Water temperature increased significantly, while the air temperature did not increase. Between 2013 and 2021, the net short wave radiation was on average 120 W/m^2 , net long wave radiation was -45 W/m^2 , latent heat flux was -88 W/m^2 and sensible heat flux -9 W/m^2 . The mean annual heat balance was -4 W/m^2 , indicating a negative heat flux directed from the atmosphere to the ocean. There was a positive trend in the annual heat balance between 2008 and 2022. The maximum phytoplankton bloom intensity increased (correlation with time 0.54), but the trend was not significant (p-value: 0.07). The day of the year of the maximum bloom intensity and the length of the bloom period did not change over the period. Mean sea level showed a positive trend. To sum up, rates of water temperature and sea level rise increased, but no significant impact on the phytoplankton bloom could be found so far.

Longstanding hard coastal protection structures in tidally dominated areas: its impact on the sedimentology (Harle inlet, Southern North Sea)

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Keywords: Coastal protection measures, tidal inlet, sedimentological facies, marine environment, Wadden Sea

Coastal erosion and flood protection present significant global challenges. Hard coastal protection measures are implemented in high-risk areas, providing immediate results. In general, groynes are used worldwide to protect coastal areas and regulate currents. Especially in the North Sea, where tidal currents prevail, their impact on the flow dynamics and sediment characteristics is less studied. The aim of this study is to analyze how longstanding coastal protection measures affect sedimentology, especially in a high dynamic system such as a tidal inlet. The East Frisian Islands in Northern Germany are under the influence of an erosive eastward littoral drift. On the island of Wangerooge, one longstanding groyne extends about 1.4 kilometers into the "Harle" inlet between Spiekeroog and Wangerooge and significantly reduces the exchange area between the North Sea and the Wadden Sea. As a result, it can be assumed that the flow dynamics are significantly altered and the sediment transport is strongly affected, resulting in a modification of sediment transport and morphology. By conducting sedimentological grain size analysis with following semi-quantitative component analysis, the characteristics of the surface sediments are detected. Statistical analysis discriminated seven different facies types assigned to three realms. In combination with multibeam data from literature, the facies have been extended to a facies map. The results indicate a higher grain size distribution in the main channels and the formation of a sandbar which separates the main channels in the inlet. Also, the identification of erosion and deposition areas indicates the impact of the altered current pattern of circulation eddies and mixing shear zones. A comparison with an almost unaffected inlet of the East Frisian Islands emphasizes the longstanding impacts of coastal protection measures.

On the intertidal morphology and sedimentology of Spiekeroog Island, German Bight: Insights from DynaDeep joint project

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Keywords: Morphology, morphodynamics, hydrodynamics, numerical modeling, sedimentology

Coastal zones are one of the most dynamic environments on planet Earth. Waves, tides, currents, and wind are constantly reshaping the beach's features and creating a dynamic equilibrium. The intertidal zone, in particular, experiences morphological changes on various time scales, potentially influencing biogeochemical processes from the surface to the deep subsurface. We are focused on investigating the contribution and interaction of hydrodynamic and aeolian drivers in generating morphological and sedimentological fluctuations within the intertidal zone, specifically examining the time scale of tidal cycles. The Spiekeroog island in the German North Sea has been selected as the study area within the frame of the DynaDeep joint project. Over a period from December 2021 to December 2023, 3- and 2-day field campaigns were conducted at a frequency of six weeks. High-resolution drone topographic surveys were employed to monitor the morphological evolution of a 500x500 m beach area on Spiekeroog Island. Additionally, sediment samples were collected throughout the study period from a cross-shore arrangement spanning from the dune tops to the low-water line. To further comprehend the intermediate morphological states and sediment sorting between surveys, numerical modeling was employed, complementing the field campaign data. This study provides valuable insights into the complex dynamics of coastal morphology and sedimentology in the intertidal zone, contributing to a better understanding of these vital coastal ecosystems.

Spatio-temporal variability of redox conditions in the deep subterranean estuary of a high energy beach

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Keywords: Subterranean estuary, Redox, Flow, Spatio-temporal

Subterranean estuaries (STE) of high energy beaches are sites of intense carbon, nutrient and trace metal cycling. The coarse-grained sediments with a high permeability allow advective pore water flow with high transport rates. The advective flow is controlled by the inland hydraulic gradient, density variations of the different matrices (fresh and saline water) and oceanic forces (tides, waves). Organic matter (OM), introduced by seawater circulation is recycled by microbial degradation, which results in nutrient production and release into coastal seawater. Due to seasonal shifts in phytoplankton bloom intensity and composition, OM input and turnover are expected to be seasonally and spatially variable over an annual cycle. In addition, beach surface topography variations lead to transient flow conditions and therefore a spatio-temporally changing groundwater composition in the subsurface of high energy beaches. While shifts in redox-state of the shallow beach area (<1m) have been characterized in previous studies, little is known about the shifts in the deeper parts of the beach. To investigate these changes, salinity, the redox indicators, oxygen, manganese, iron, nitrite, nitrate, and ammonium as well as phosphorus were monitored along a cross-shore transect of the Spiekeroog Island STE down to 24 m below the sediment surface over several months. First results showed that the saline circulation within the STE reached even deeper than 24 m in the intertidal zone. Oxic groundwater and higher OM degradation rates were found down to depths of 12 m in the duneward part of the beach. Below and towards the low water line manganese and iron reducing conditions predominated. Temporal changes mainly occurred in the upper part above ~12 m and conditions were more stable below, at least in the supratidal area. In the intertidal zone, changing groundwater composition indicates spatio-temporally variable freshwater discharge zones.

PHYSICAL AND BIOGEOCHEMICAL INFLUENCES ON OXYGEN DYNAMICS IN THE BEACH SEAWATER INFILTRATION ZONE

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Keywords: Subterranean Estuary, Beach Aquifer, Oxygen Consumption, Oxygen Dynamics, Reactive Transport Modelling

Sand beaches mark a highly dynamic land-ocean transition, affected by waves, tides, storms and associated morphodynamics. At the beach face, tidally driven seawater infiltration creates a high input of electron acceptors such as oxygen (O₂) and organic matter (OM) into the upper saline plume of the beach aquifer. In the beach sands, O₂ consumption by bacteria is controlled by the availability of labile organic matter, with the retention of fresh particulate OM in the upper sand layers. The availability of OM and O₂ in turn is influenced by both seasonal input and morphodynamics. Thus, physical processes drive the dynamics of O₂ input and consumption in the beach and assume a highly variable redox zonation. Within the interdisciplinary research project DynaDeep, we investigated O₂ dynamics down to 1 m depth along a sampling transect in the infiltration zone on Spiekeroog beach (Germany). We conducted a two-monthly, year-long sampling campaign including measurements of sedimentary O₂ consumption rates, grain size distributions and organic carbon contents as well as in-situ measurements of O₂ concentrations. In summer, O₂ consumption rates were up to 90 $\mu\text{mol} \cdot \text{h}^{-1} \cdot \text{l}^{-1}$ with a 10-fold decrease within the first decimeters, indicating an efficient retention of reactive POM. Due to morphodynamics, this reactive layer was occasionally buried to greater depths, causing secondary peaks of rates. In winter, the rates in the retention layer significantly declined by a factor of 6. Together with the increased solubility of O₂ at winter temperatures, this led to an increase in O₂ concentrations in the deeper layers. First continuous measurements of O₂ indicated a tidal influence on O₂ concentrations, which fluctuated up to 50 $\mu\text{mol} \cdot \text{l}^{-1}$ in a summer tidal cycle. We employed a reactive-transport model to interpret our results and explore the repercussions of our findings for the deeper subsurface.

Iron and dissolved organic matter coupling at redox interfaces in high energy subterranean estuaries

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Keywords: carbon cycle, trace metals, humic substances, redox boundaries, Subterranean estuary

Subterranean estuaries (STEs) beneath high-energy beaches act as biogeochemical reactors, altering the chemical composition of fresh meteoric groundwater and intruding seawater. At redox interfaces of STEs, Fe (III) (oxy) hydroxides can form and scavenge specific fractions of dissolved organic matter (DOM). However, Fe-DOM coupling in high-energy STEs is not well understood. Our research aims to elucidate spatio-temporal dynamics of Fe-DOM coupling in an STE of a high-energy beach in the North Sea, Germany, and its impact on DOM concentrations and mass fluxes. Groundwater samples were taken from three wells at various beach locations: close to the dune base (ML1), near the high-water line (ML2), and near the low water line (ML3). We immediately filtered and acidified the samples, and collected replicates left to oxygenate for 24 hours to assess Fe-DOM coagulation. Analysis included dissolved organic carbon (DOC) concentrations, humic-like/terrestrial DOM components (CDOM), and DOM molecular composition. First results show that ML3 anoxic groundwater had the highest concentrations of DOC and CDOM, indicating deep freshwater upflow from the islands' lens at the low water line. DOC concentrations in all STE groundwater samples were lower than those in seawater, suggesting the STE is a net sink for organic carbon. CDOM results from the Fe-DOM precipitation experiment revealed that Fe scavenges 5% to 20% of CDOM in the anoxic groundwater, and the removal appears to be spatially and seasonally dependent. Molecular DOM data will be reported in the scope of the presentation to characterize iron-coagulating fractions. Overall, our study sheds light on the previously underexplored relationship between Fe and DOM coagulation in high-energy STEs at redox interfaces, demonstrating the significance of temporal and seasonal dynamics affecting coagulation on a quantitative and qualitative level.

Differential transformation of freshwater and seawater dissolved organic matter by subterranean estuary microbial community

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Keywords: dissolved organic matter, flow through reactor, recirculating advective flow, subterranean estuary, groundwater

Subterranean estuaries (STEs) are active biogeochemical zones of the coastal ecosystem, where fresh groundwater mixes with recirculating seawater. In STEs of high-energy beaches, the dynamic porewater advection causes changing redox conditions, affecting the dissolved organic matter (DOM) composition and its transformation by microbial communities. However, the DOM composition and its molecular level processing by microbial communities is still poorly understood because of the complexity of both counterparts. We performed flow-through reactor (FTR) experiments to investigate how the DOM from different sources is transformed by the microbial communities. We used sediment and groundwater from the STE of a high-energy beach on Spiekeroog Island. Beach sediments were incubated for 13 days in FTRs with groundwater samples of low (~1.6) and high salinities (~29.1) as marine and terrestrial endmember, respectively, under recirculating advective flow. The FTRs ran under oxic conditions and the outer parts of the sediment columns and the porewater reservoir were exposed to light. Porewater samples were taken daily and analysed for the dissolved organic carbon concentration (DOC). Samples for molecular characterization of DOM from start and end of the incubation were isolated through solid phase extraction and analysed via ultrahigh-resolution Fourier-transform ion cyclotron resonance mass spectrometry. Over the course of the incubation, DOC concentrations increased, indicating organic matter production, presumably by primary production as oxygen concentrations also increased. The DOM composition of the pore water samples was highly diverse, with thousands of different molecular formulae detected in each of the endmembers. The low salinity pore water had a more terrestrial DOM signature with a higher proportion of aromatic compounds compared to the DOM in the high salinity porewater. By comparing the molecular composition of DOM at the start and end of the incubations, we will elucidate whether and how the different DOM composition affected their turnover by the microbial communities.

Microbial communities in the subterranean estuary of Spiekeroog beach

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Keywords: Subterranean estuary, microbial community, high energy beach, biogeochemical reactor, freshwater lens

Microbial communities in the subsurface of coastal areas play an important role in global nutrient cycling. In the subterranean estuary (STE) of the East Frisian Island Spiekeroog, discharging water from the freshwater lens and seawater mix and undergo biogeochemical transformations. Together with a changing morphology of this high energy beach, this leads to dynamic conditions regarding salinity, nutrient availability and redox zonation, which makes the STE a very specific habitat for microorganisms. The DynaDeep project is an interdisciplinary project which aims to gain a deeper understanding of the processes in this STE and its role as biogeochemical reactor. One aim of the project is to identify the microbial communities and their metabolic function and response to environmental changes in this habitat. In the upper meter of the beach, the sediment-attached fraction of microorganisms is quite uniform and composed of generalists that occur at varying sampling sites and depth at different seasons. However, little is known so far about the microbial communities in deeper layers as well as the fraction of free-living microbes. For both fractions we observed a distinct decrease in microbial cell numbers within the upper 24 m of the STE. Additionally, we found that the composition and abundance of the free-living community differs notably from the attached community, for example by the relatively high abundance of Nanoarchaeota in the porewater.

Exploring the Complex Interactions between Physical, Biogeochemical, and Microbiological Processes in Coastal Ecosystems: Implications for Sustainability and Management

Edward Kusewa¹, Eric Ogott¹

¹St.Pauls University

Keywords: Coastal ecosystems, Physical processes, Biogeochemical processes, Microbiological processes

Coastal ecosystems are dynamic and complex systems that are shaped by a range of physical, biogeochemical, and microbiological processes. These processes are tightly interconnected and play critical roles in the functioning and sustainability of coastal ecosystems. Understanding the complex interactions between these processes is crucial for effective management and conservation of coastal ecosystems. The aim of this research was to explore the complex interactions between physical, biogeochemical, and microbiological processes in coastal ecosystems and their implications for sustainability and management. To achieve this aim, we conducted a comprehensive review of the current state of knowledge on these processes, including their underlying mechanisms, spatial and temporal dynamics, and responses to anthropogenic disturbances. We used a combination of systematic literature reviews, meta-analyses, and modeling approaches to synthesize existing knowledge and identify key knowledge gaps and research priorities. Our analyses revealed that physical processes such as tidal currents, wave action, and sediment transport play critical roles in shaping biogeochemical and microbiological processes in coastal ecosystems. For example, they can influence nutrient and carbon cycling, oxygenation, and microbial community composition and diversity. We also found that biogeochemical processes, such as nutrient cycling, primary production, and organic matter decomposition, are tightly linked to microbial processes, including microbial respiration, decomposition, and symbiosis. These processes are strongly influenced by external factors such as climate change, eutrophication, and pollution, which can alter their dynamics and lead to ecological shifts and ecosystem degradation. Our research highlights the need for interdisciplinary approaches that integrate physical, biogeochemical, and microbiological processes in coastal ecosystem research and management. It also underscores the importance of understanding the complex feedbacks and interactions between these processes and their sensitivity to external disturbances. In conclusion, our study provides valuable insights into the complex interactions between physical, biogeochemical, and microbiological processes in coastal ecosystems and their implications for sustainability and management. It emphasizes the importance of taking a holistic and interdisciplinary approach to coastal ecosystem research and management, which is critical for maintaining the health and resilience of these vital ecosystems.

Session 4.8
Tropical coastal ecology:
biodiversity, research and
conservation



Tropical coastal ecology: biodiversity, research and conservation

hosted by Roman Petrochenko & Vadim Merkin

Wednesday, 20th September 2023, 09:45 – 12:00, Seminar room A

Tropical ecosystems are seriously affected by modern environmental changes, but coastal ecosystems are doubly suppressed both due to terrestrial and marine pollution and global warming. Thus, they need to be prospected and protected as ones of the most diverse ecosystems on the Earth. We are looking for new researches in the field of coastal tropical biodiversity, new methods and approaches for coastal ecosystems to have more rational research, conservation and usage. If you have some new ways to improve our knowledge of tropical coastal ecosystems or contribute to further conservation, please be sure to send us your abstracts!

09:45 – 10:00, Seminar room A

Scaling marine restoration through industry-research partnerships: Tourism-led coral reef rehabilitation on Australia's Great Barrier Reef

Rachael Isabella Scott

University of Technology Sydney, Sydney Australia

10:00 – 10:15, Seminar room A

Protecting the Sea Living Fossil: Frontier Social Conservation Action and Research of Horseshoe Crabs in Indonesia

Rizky Eko Muliawan

Sahabat Belangkas Nusantara

10:15 – 10:30, Seminar room A

Coalescent-based species delimitation using multilocus data of Red Sea haplosclerids

Joëlle van der Sprong

Department of Earth and Environmental Sciences, Palaeontology and Geobiology,
Ludwig-Maximilians-Universität München, Munich, Germany

10:30 – 10:45, Seminar room A

Deciphering the potential of hydrogen-enriched seawater to boost coral holobiont health

Malte Ostendarp

Department of Marine Ecology, Faculty of Biology and Chemistry (FB 2), University of Bremen, 28359 Bremen, Germany

11:15 – 11:30, Seminar room A

Physiological and behavioural responses of the snail *Faunus ater* to temperature, salinity and tidal regime

Max Lambrecht

Carl von Ossietzky University of Oldenburg, Oldenburg, Germany and Institute for Chemistry and Biology of the Marine Environment (ICBM), Wilhelmshaven, Germany

11:30 – 11:45, Seminar room A

Population genetics and functional ecology of mangroves across the Galápagos archipelago

Tobias Poprick

Leibniz Centre for Tropical Marine Research (ZMT), Bremen, Germany and Faculty 2 Biology/Chemistry, University of Bremen, Bremen, Germany

11:45 – 12:00, Seminar room A

The effect of shipwrecks as artificial reef structures on fish assemblages in Colombo, Sri Lanka

Anjleen Hannak

Bremen University & ZMT, Bremen, Germany

Scaling marine restoration through industry-research partnerships: Tourism-led coral reef rehabilitation on Australia's Great Barrier Reef

Rachael Scott¹, David J. Suggett², Emma F. Camp¹, Christine Roper¹, Paige Strudwick¹, Lorna Howlett¹, Gemma Gilette¹, John Edmondson¹

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Keywords: coral reefs, marine restoration, marine stakeholders, tourism industry, Great Barrier Reef

The UN Decades on Ecosystem Restoration and Ocean Science for Sustainable Development (2021-2030) have sharpened global focus on marine restoration, catalysing new partnerships geared toward stemming declines in ocean health to conserve the ocean's vital ecosystem services. Coral restoration approaches for targeted local-scale site intervention are increasingly being adopted around the globe as a means to support the resilience of coral reef ecosystems and their dependent coastal communities to ongoing and intensifying global and local-scale pressures. Following catastrophic losses of coral populations on Australia's Great Barrier Reef, a novel tourism industry-research partnership was conceived to build capacity for reef stakeholders to assist the recovery of hard coral cover at sites regularly accessed during regular tourism operations. Here we describe how the staged implementation of coral propagation activity resulted in new cost-effective means to grow and re-plant coral, which in turn evolved into a coordinated, industry-driven entity, the Coral Nurture Program. Since its inception in 2018, the Coral Nurture Program has expanded activity to the two major tourism hubs on the Great Barrier Reef, resulting in installation of >120 coral nurseries and out-planting of 80,000 corals over 30 sites from >2000 people hours. These efforts have been underpinned by coupled, co-conceived research, aimed at understanding factors spanning coral biology to reef ecology aimed at optimising the growth and survivorship of restored coral populations. We discuss the importance of stakeholder-led restoration, and how this model provides a framework for other coastal restoration activities that are rapidly establishing worldwide.

Protecting the Sea Living Fossil: Frontier Social Conservation Action and Research of Horseshoe Crabs in Indonesia

Rizky Eko Muliawan¹, Hanifa Miranda Itfetriani Haryo Putri³, Naila Khuril Aini⁴, Rafly Zhulkifly Karael Sundah⁵

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⁵University of Diponegoro

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 characteristics. In-situ measurement of sediment and water 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.

Coalescent-based species delimitation using multilocus data of Red Sea haplosclerids

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Keywords: Porifera, Haplosclerida, species delimitation, ultraconserved elements, target capture

The unambiguous identification of species is indispensable for biodiversity assessment and a better appreciation of their roles in ecosystems. However, methods for reliable species identification in many important marine invertebrate taxa are still deficient. This is especially true for difficult-to-identify marine demosponges of the order Haplosclerida, a species-rich group of sponges, especially on coral reefs. Due to the paucity of diagnostic morphological traits, Haplosclerida are also the most challenging in terms of species discovery, delimitation, and identification. Molecular taxonomy is equally difficult because the single-gene markers applied so far provide insufficient resolution. Hence, new multi-marker approaches are necessary. To this end, we developed a target enrichment-based multilocus species delimitation assay (MSDA) for Haplosclerida. This MSDA consists of 20,000 enrichment probes targeting genome-wide loci and was tested on freshly collected sponge material from the Red Sea and much older type material from museum collections. The total number of loci recovered from each specimen ranged between 118 and 1158 (mean: 550 +/- 276 SD). We demonstrate, how this genome-wide information opens new avenues in biodiversity research, as these data can be used for model-based species delimitation, identification and discovery. Such application of MSDA approaches will lead to improvements in taxonomic revisions and subsequent interpretations of biological and ecological observations for applied research.

Deciphering the potential of hydrogen-enriched seawater to boost coral holobiont health

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Keywords: coral bleaching, coral physiology, antioxidant, *Acropora hemprichii*, *Pocillopora verrucosa*

Currently, many coral reefs worldwide are threatened by climate change, particularly ocean warming. To further prevent the rapid decline of these highly valuable ecosystems, an investment into climate change mitigation measures is urgently needed. Therefore, this study aimed to identify the potential of hydrogen-enriched seawater to promote coral physiology and overall holobiont health potentially counteracting coral bleaching and mortality. We propose that molecular hydrogen may offer a promising approach to prevent coral bleaching since several studies demonstrated the potential of molecular hydrogen as a strong antioxidant and competitive inhibitor of the nitrogenase enzyme complex. Hence, molecular hydrogen could not only promote the degradation of harmful reactive oxygen species (ROS), but also reduce nitrogen fixation rates to maintain the nitrogen-limited state of the coral holobiont. To examine the short-term effect of hydrogen-enriched seawater (0.5 ppm) lasting for 48 h, we analyzed and compared the physiological responses, particularly bleaching-related parameters, of commonly distributed hard corals *Acropora hemprichii* and *Pocillopora verrucosa* from the Central Red Sea between ambient (26°C) and high water temperatures (32°C). Preliminary results on oxygen fluxes indicate no detectable effect of hydrogen on coral physiology under heat stress. This presentation will present the results of several more response parameters like survival, chlorophyll a, photosynthetic efficiency, symbiont cell density and denitrification, particularly related to bleaching and nitrogen cycling, in order to assess the potential of hydrogen addition to increase the resilience of corals to ocean warming.

Physiological and behavioural responses of the snail *Faunus ater* to temperature, salinity and tidal regime

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Keywords: gastropod, climate change, mangrove ecosystem, coastal ecosystem, stress response

The inter-related effects of climate change are impacting coastal and mangrove ecosystems on multiple levels. Species that dwell in the intertidal zone are directly affected by increasing temperatures, fluctuating salinity and inundation times. The gastropod *Faunus ater* is widely distributed and locally abundant in mangrove ecosystems along the coastlines of the Indo-West Pacific, but their ecology and response to climate change is not well known. This study assessed the physiological and behavioural response of *F. ater* in a fully crossed experimental design using temperature, salinity and tidal regime as proxies for climate change. The results show that food consumption and respiration were increased at higher temperature, coinciding with the metabolic theory. The response of moving behaviour to single treatment factors, as well as their interactions, displayed more complex patterns that implied specific trade-off behaviours. The catalase activity (CAT) and lipid peroxidation (LPO) gave more insight and revealed the accumulation of LPO and CAT in medium-stress treatments. These results suggest that *F. ater* is dealing with low to medium stress through the activation of their antioxidant defense and uses behavioural protection through hermitization and habitat evasion during times of increased stress.

Population genetics and functional ecology of mangroves across the Galápagos archipelago

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Keywords: gene drift, adaptation, connectivity, functional traits, ddRad-seq

Genetic diversity is an essential component of biodiversity, driving the resilience or the evolutionary potential of species to adapt to changing environmental conditions. Determining spatial patterns of genetic variation contributes to a better understanding of those factors that affect local genetic diversity and gene flow, thereby better informing conservation or restoration actions to maintain or restore connectivity across populations. Studies on population genetics of mangrove plant species still remain scarce. The Galapagos archipelago, under strict protection since 1952, provides a unique opportunity to study patterns of intraspecific genetic variation of mangrove species in an environment with minimal anthropogenic impact, where the major forces at play consist of natural processes. While the spatial distribution and extent of mangrove ecosystems has been thoroughly reassessed in 2019, patterns of genetic diversity within and between mangrove forests and the connectivity among those still remain unknown. This study addresses this knowledge gap for the three major mangrove species of the Galapagos: *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa*, within and across the eight islands identified as harboring mangroves. The sampling scheme will target both fringe and land-locked mangrove forests, to evaluate the effects of the geomorphic setting. Combining molecular data generated through double-digest restriction site-associated DNA sequencing (ddRADseq) technique, plant functional trait data and environmental parameters, this project will shed light on genetic diversity within and across islands and potential local adaptation of mangroves in the Galapagos. This information will help assess what populations might be at risk under future environmental change, and thereby could inform management actions to increase their adaptation potential and resilience. We will present here our global approach and results, focusing on the plant functional trait datasets and preliminary results for molecular data collected for the three mangrove species.

The effect of shipwrecks as artificial reef structures on fish assemblages in Colombo, Sri Lanka

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Keywords: fisheries management, biological value, marine habitat loss, marine habitat conservation

The application of artificial reefs as a tool for fisheries management and habitat restoration is a common practice, with shipwrecks being recognized for their role as accidental habitats for marine communities. To evaluate the effects of these structures on fish aggregation, a pilot study was developed as part of the first efforts to quantify the fish assemblages on shipwrecks in Colombo, Sri Lanka. A unique feature of Sri Lanka is the high concentration of shipwrecks around the island's coastline. Historically important wrecks are protected for their archaeological value, while the available literature on their biological and socio-economic role in coastal communities remains limited. This puts the wrecks at risk of salvaging activity for their scrap metal value. To investigate these marine habitats, diver-operated video transects were conducted on three shipwrecks and three sandstone reefs, with the natural reefs functioning as the control sites for this study. The pilot study provided an opportunity to test a new, non-destructive approach for fish surveys. The analysis of the species composition presented commercially valuable and common indicator species on the shipwrecks. A total of 35 Genera from 20 Families were identified. Preliminary results of this pilot study suggest that the concentrated habitat area of the shipwrecks, in comparison to the wider available space on natural reefs, yielded larger aggregations of schooling species (*Lutjanus* and *Pterocaesio*). Shipwrecks allow for targeted fishing of species while their structure restricts the use of destructive net fishing techniques for larger catch sizes. Their structural complexity may be a determining factor in their function as artificial reefs for species recruitment, however further research is required to investigate this relationship. Future research will focus on the secondary productivity of economically valuable species on shipwrecks and the improvement of survey methodology on the complex topography of wrecks.

Session 6.0

Open Session



Open Session

hosted by Theo Krüger & Jöran Paap

Wednesday, 20th September 2023, 16:00 – 17:15, Lecture Hall

If you think your research does not fit into any of our other sessions, please feel free to submit your abstract to the open session!

16:00 – 16:15, Lecture Hall

Changes in faunal community dynamics before and after major volcanic ash deposition at the ABE vent field, Lau Basin (Kingdom of Tonga)

Livia Brunner

Department of Ocean Systems, Royal Netherlands Institute for Sea Research, Texel, Netherlands

16:15 – 16:30, Lecture Hall

Social structure of Taiwanese humpback dolphin (*Sousa chinensis taiwanensis*) off the western coast of Taiwan

Hui-Yo Kuo

Institute of Marine Ecology and Conservation, National Sun Yat-sen University, Taiwan

16:30 – 16:45, Lecture Hall

Complementarity of morphological and molecular tools in zooplankton monitoring at the Berlengas Biosphere Reserve, Portugal

Marco Simões

MARE / ARNET, Polytechnic of Leiria; Faculty of Sciences of the University of Porto, Portugal and CIIMAR - Interdisciplinary Centre of Marine and Environmental Research, Matosinhos, Porto

16:45 – 17:00, Lecture Hall

Biotic and abiotic drivers of barnacle (*Semibalanus balanoides*) recruitment onto a sub-Arctic intertidal rocky shore.

Marta Prieto

UiT- The Arctic University of Norway, Tromsø, Norway

17:00 – 17:15, Lecture Hall

The Efficacy of Ocean Farming: From Omics to Economy

Justin Tierney

S2AquaCoLab

Changes in faunal community dynamics before and after major volcanic ash deposition at the ABE vent field, Lau Basin (Kingdom of Tonga)

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Keywords: hydrothermal, megafauna, macrofauna, meiofauna, disturbance

Deep-sea hydrothermal vents are ephemeral and highly productive ecosystems that are found to be rich in metals. In the Lau Basin, the ABE vent field comprises areas of diffuse hydrothermal venting that are characterized by the three vent endemic megafaunal foundation species *Alviniconcha* spp., *Ifremeria nautiliei* and *Bathymodiolus septemdierum*. Here, we study the composition and temporal dynamics of meio-, macro-, and megafauna. This includes samples collected in 2009 and in 2022, the later obtained right after the eruption of the close-by submarine volcano Hunga Tonga-Hunga Ha'apai, north of the island Tonga, had covered the ABE vent field with volcanic ash. When comparing the three different vent habitats in 2009, the megafauna was similar in abundance and body size. The associated macrofauna, was significantly lower in abundance and species richness in the *Alviniconcha* habitat, which experienced higher temperatures and higher sulphide concentrations compared to the *Ifremeria* and *Bathymodiolus* habitat. In 2022, only a few patches of mussels had survived the ash coverage and could be studied. While in 2009, 22 macrofaunal species were identified in the *Bathymodiolus* habitat, in 2022 only 9 species were found. The natural disturbance by the ash coverage as observed in the ABE vent field is in some ways comparable to the plume impacts that deep-sea mining might have on the ecosystem. It is therefore important to keep studying the ABE vent field in the imminent future to better understand the resilience and recovery of the fauna.

Social structure of Taiwanese humpback dolphin (*Sousa chinensis taiwanensis*) off the western coast of Taiwan

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Keywords: Taiwanese humpback dolphin, *Sousa chinensis taiwanensis*, social structure, photo-identification, half weight index

The sub-species Taiwanese humpback dolphin (*Sousa chinensis taiwanensis*) only occurs in the western waters of Taiwan. The IUCN Red List classifies this sub-species as Critically Endangered (CR) due to their small population size (<80 individuals) and heavily impacted habitat from anthropogenic activities. Many research and conservation projects have focused on this population but still much is to be discovered on their ecology. Previous studies suggested the Taiwanese humpback dolphin exhibits a fusion-fission society, where they gather randomly for purposes like foraging and socializing. Due to their small population size and restricted habitat, it is presumed that a subtle social structure has developed within this subspecies. This study aims to understand their social structure in detail and then further explore the relation between social structure and habitat use. A hypothesis on the presence of non-random association between individuals of this subspecies was developed and tested by examining the structure of group composition and group dominant behaviour. Between 2018-2021, high-quality imagery was used for photo identification to categorise individuals. Out of the identified individuals, 60% (n=33) were included in the analysis based on sightings of more than 3 times during boat surveys in a single year. The social structure was analysed by half weight association indices, their habitat preference was determined by line-based kernel density estimation and the association between individuals will be analysed by standardized lagged association rate analysis. The analyses are undergoing, and it is expected to obtain evidence supporting non-random association formed social structure in this population.

Complementarity of morphological and molecular tools in zooplankton monitoring at the Berlengas Biosphere Reserve, Portugal

Marco Simões^{1,2,3}, Sónia Cotrim Marques¹, Cátia Costa¹, Maria da Luz Calado⁴, Jorge Lobo-Arteaga^{5,6}, Cátia Bartiloti^{5,6}, Maria Campos⁴, Sérgio Miguel Leandro⁴, Agostinho Antunes^{2,3}

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Keywords: zooplankton, metabarcoding, morphology, species richness, non-indigenous species

Zooplankton plays a fundamental role in marine ecosystems, contributing substantially to the biogeochemical cycling and as food source for commercially important fish and marine mammals. Therefore, zooplankton monitoring is a prerequisite for the management of such ecosystem. The application of molecular tools, including environmental-DNA (eDNA) metabarcoding, has proved to be a helpful tool in monitoring marine ecosystems. The aim of this work was to compare the results of molecular and morphological methods in zooplankton taxonomic classification and assess its complementarity. Four plankton samples collected vertically with a WP2 net (200 µm) at the Berlengas Biosphere Reserve were subjected to classic taxonomic identification and DNA extraction. Additionally, four 1L-water samples collected at the same moment were subjected to filtration (0.22 µm) and eDNA extraction. All samples were then subjected to High-Throughput Sequencing, targeting the 18S rRNA and COI genes. Sequencing results showed differences in species richness among samples, and overall higher values than the morphological approach. Comparison of the molecular results revealed that zooplankton bulk samples metabarcoding presented a higher species richness than the eDNA samples. However, some species were only detected through eDNA (e.g.: *Harpacticus sp.*). Species richness was also different between genes, with COI detecting more species than 18S rRNA. It was also possible to detect DNA sequences of Non-Indigenous Species (NIS) in the analysis of zooplankton samples, e.g., *Balanus trigonus*, which has not been reported previously at Berlengas. This work highlights the importance of using several identification approaches to effectively monitoring marine ecosystems, including the early detection of new NIS.

Biotic and abiotic drivers of barnacle (*Semibalanus balanoides*) recruitment onto a sub- Arctic intertidal rocky shore.

Marta Prieto¹, Markus Molis¹

¹UiT- The Arctic University of Norway, Tromsø, Norway

Keywords: coastal ecology, interactions, whiplash, desiccation, bulldozing

Arctic near-shore ecosystems are highly understudied and stressed environments that play a major role in biogeochemical cycling. Furthermore, the Arctic region has extreme environmental conditions which are expected to be strongly modified by climate change. Coastal experiments performed in temperate regions showed, for instance, that barnacle (*Semibalanus balanoides*) settlement and recruitment are negatively affected by seaweed canopy whiplash and limpet bulldozing and vary over small spatial scale with shore height due to strong desiccation gradients. However, canopies can also benefit both limpets and barnacles, providing a microclimate with reduced desiccation effects. The empirical evidence of those studies from temperate regions, may, however, not be applicable to the Arctic intertidal. This study focusses on the limpet-seaweed-barnacle interactions in the Arctic intertidal zone for which information on species interactions is extremely limited. Here, I report on: (1) the effect of shore height on barnacle (*S. balanoides*) settlement success and recruit density in relation to the effect of seaweed (*Ascophyllum nodosum*) canopy presence and (2) the separate and combined effects of the presence of seaweed (*A. nodosum*) canopy and limpets (*Patella vulgata*), on the density of barnacle cyprids, recruits and adults. The results showed that barnacle cyprids and recruits were highly negatively affected by desiccation, being merely present at high-shore zones. Moreover, seaweed-canopy had a large negative effect on barnacle density while the limpet effect was relatively small. The combined effects of canopy whiplash and limpet bulldozing suggest an additive effect on barnacle density. These results indicate that the presence of an algal canopy does not enhance limpet performance (e.g., grazing activity) to add extra pressure on barnacle survival. This study shows that the functional role of intertidal organisms such as canopy-forming macroalgae may be expressed differently in high latitudinal intertidal communities than what could be inferred from studies done on temperate zone.

The Efficacy of Ocean Farming: From Omics to Economy

Justin Tierney¹, Catia Marques

¹S2AquaCoLab

Keywords: Aquaculture, Biotechnology, Blue Economy, Food Production, Sustainability

Omics-based tools have the potential to revolutionize ocean farming by providing a comprehensive understanding of biological systems at the molecular level. This talk aims to showcase the latest advancements in omics-based tools and their applications in addressing challenges in ocean farming such as disease management, environmental monitoring, and improving the efficiency of aquaculture production. Questions surrounding the efficacy of aquaculture in the blue economy will also be introduced and discussed.

Session 3.1

Marine Governance and Conservation



Marine Governance and Conservation

hosted by Wiebke Homes

Wednesday, 20th September 2023, 16:00 – 17:15, Seminar room A

Human dimensions have traditionally been lacking in marine and coastal science and policy. However, as anthropogenic pressures on the marine ecosystem continue to increase, there is a growing need to consider the multifaceted relationships between people and oceans to develop effective conservation and management measures. In our session, we are looking forward to discussing how governance structures, formal and informal institutions, and other social processes drive the evolution and choice of different conservation approaches. We are excited to receive abstracts that apply methods and approaches from social and political sciences to local, regional, or national marine governance and conservation issues.

16:00 – 16:15, Seminar room A

The legal regulation hurdles of the exploitation of marine genetic resources beyond national jurisdiction

Mariam Mgeladze

Ankara University National Center for the Sea and Maritime Law (DEHUKAM)

16:15 – 16:30, Seminar room A

Using Leverage Points to identify the transformation potential of interventions: An example of the South Pacific atoll of Ouvéa

Lilly Baumann

16:30 – 16:45, Seminar room A

High Seas Treaty in confrontation with Climate Change

Nastaran Sadeghi Gandom Abad

International Law Department, Faculty of Law, Central Tehran Branch, Islamic Azad University, Tehran, Iran

16:45 – 17:00, Seminar room A

Governance of Marine Protected Areas for the conservation of the harbour porpoise in the (German) North Sea

Wiebke Homes

Leibniz Centre for Tropical Marine Research (ZMT)

17:00 – 17:15, Seminar room A

Social Outcomes of Marine Spatial Management Measures

Gideon Kweku Enimah

Brunel University London, Dept of Biosciences, UB8, 3PH, UK

The legal regulation hurdles of the exploitation of marine genetic resources beyond national jurisdiction

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Keywords: MGRs; Exploitations; International Law; BBNJ.

Marine genetic resources (MGRs) have promising economic and social potential in various aspects of human life. The global market demand for MGRs straightens business corporation's interest to invest in the exploration and exploitation of such resources. It is considered, that the MGRs and the information attached to such materials will enable global society to open new future innovations, which will lead to significant discoveries. The exploration of MGRs could lead to habitat destruction, overexploitation of resources, and pollution. Those impacts can interact and accumulate over time, and lead to irreversible damage to the marine environment. As the deep seabed ecosystems appear sensitive and exploration in international waters may affect the marine ecosystem, the relevant legal framework shall be developed for the protection and preservation of the environment, where all interests are maintained in a balanced, uniform, and coherent way. Access to MGRs beyond the national jurisdiction is a very complex matter from maritime environmental protection and sustainable development perspective. Therefore, the present paper explores the international legal framework of the International Convention on the Law of the Sea, 1982, the Convention on Biological Diversity, the International Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction, and the intellectual property rights agreements applicable to the exploitation of MGRs beyond national jurisdiction. It analyses the legal hurdles of the definition of marine genetic resources, the regimes of protection of the maritime environment, and intellectual property rights over the MGRs. As for methodology, complex and various databases are analyzed. The paper concludes with the results that the international governance of MGRs beyond national jurisdiction is a very complex and still progressing subject. The exploration of MGRs beyond the national jurisdiction requires a more coordinated and coherent system of legal regulations and decision-making processes.

Using Leverage Points to identify the transformation potential of interventions: An example of the South Pacific atoll of Ouvéa

Lilly Baumann, Marjan Braun, Maraja Riechers, Paulina Heeg, Alexandre Ganachaud

Keywords: social-ecological systems, South Pacific, New Caledonia, Leverage Points

Coastal social-ecological systems in the South Pacific are facing severe sustainability challenges. These include the negative impacts of climate change, such as rising sea levels, higher sea surface temperatures, and an increase in extreme weather events. In addition, natural resources and biodiversity are under pressure from human stressors such as overfishing, pollution, and erosion. Addressing these challenges and moving toward more sustainable trajectories will require system transformations that may be induced through well-placed interventions. Based on a systematic literature review and expert interviews on sustainability interventions in New Caledonia we classify efforts by their transformative potential. This classification is built on the Leverage Points perspective as based on Meadows (1999) and Abson et al. (2017). We focus on a specific case study to test our lessons learnt through the literature review with expert interviews from local to the South Pacific - regional scale. The interviews have been conducted from November 2022 to January 2023. Ouvéa a small, low-lying island northeast of the main island of New Caledonia was chosen as a case study. The analysis shows a diverse picture on the proposed interventions regarding their transformative potential, interlinkages, and challenges for implementation as perceived by the interviewed experts. Furthermore, the study provides insights into the social-ecological system of Ouvéa and common sustainability challenges faced by low-lying atoll islands in the South Pacific. The research underscores the importance of adapting interventions to the local context, prioritizing participatory management, and incorporating indigenous knowledge in order to effectively implement interventions and prevent maladaptation.

High Seas Treaty in confrontation with Climate Change

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Keywords: High Seas Treaty, BBNJ, Marine Protected Area, Areas Beyond National Jurisdiction, International Environmental Law

The last effort of the international community in confrontation with the increasing reduction of biodiversity, especially in the seas, finally resulted in the conclusion of a new treaty according to Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction (2023). The purpose of this research is to examine the compliance of the rules contained in this treaty with international legal measures in dealing with climate change and to evaluate its effects on the increasing consequences of climate change. The method of this research is descriptive-analytical, and the method of collecting information is the library method. Out of the four specialized parts of this treaty, "Measures such as Area-based Management Tools, including Marine Protected Areas" and "Environmental Impact Assessments (EIA)" play a significant role in protecting the marine environment and climate resilience. MPAs can be influential in protecting biodiversity against the harmful effects of climate change by creating protected areas like those on land. Also, EIA help to identify and manage vulnerable areas and species. As a result, it should be noted, the sufficient role of the oceans in the carbon cycle and the adjustment of climate conditions is undeniable. Meanwhile, the negative effects of climate change threaten biodiversity in the oceans, the health of marine areas, and food security in the world. The authors believe that the cooperative approach can be seen throughout this treaty and it is undeniable. Actually, the High Seas Treaty has tried to cover various dimensions regarding biodiversity conservation in confrontation with the effects and consequences of climate change but the effectiveness of the rules of this treaty, especially in climate resilience, depends on the cooperation of international actors in the implementation of the rules of this document and especially the adherence to the common but differentiated responsibility principle.

Governance of Marine Protected Areas for the conservation of the harbour porpoise in the (German) North Sea

Wiebke Homes¹

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Keywords: Biodiversity, Ostrom, Socio-ecological systems, MPAG

Marine mammals are embedded in complex socio-ecological systems and in the North Sea they are under extreme anthropogenic pressure from fishing, maritime transport, the construction of offshore wind parks, habitat destruction and resource extraction. The increasing industrialization of the North Sea profoundly changes environmental conditions and challenges current processes of marine spatial planning. This results in trade-offs between conservation and use, and particularly impacts marine predators with large migratory routes. For example, fishing is allowed in Marine Protected Areas (MPAs) in the German North Sea. Although special protection in form of a Whale Sanctuary is in place for the only endemic whale species in the North Sea, the harbour porpoise (*Phocoena Phocoena*), its abundance herein is declining and their distribution shifting, which necessitates the urgent need for a transformative shift towards more dynamic and innovative governance arrangements for effective conservation. This research therefore first assesses current governance structures in MPAs and the Whale Sanctuary in the German North Sea and how these have evolved politically using an analytical framework that combines both the Institutional Analysis and Development and the Socio-Ecological Systems framework. A question this study addresses is why both protected areas do not effectively fulfill their function as key regulatory instrument for harbour porpoise conservation. Finally, institutional and governance challenges that would need to be overcome for a future establishment of mobile MPAs are examined in the particular context of the North Sea. This study contributes to the wider academic debate on how to best shape effective marine predator conservation for ecosystem-based, adaptive and sustainable management.

Social Outcomes of Marine Spatial Management Measures

Gideon Kweku Enimah¹, Nibedita Mukherjee², Bethan C. O'Leary³, Sandra L. Dorning⁴, Bryce D Stewart⁵, Emma Mckinley⁶, Prue F.E Addison⁷, Chris William⁸, Griffin Carpenter, David Righton, Katherine L Yates

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Keywords: MPA, Compliance, Governance, Tourism, Economics

The protection of marine ecosystems is critical for achieving Sustainable Development Goal 14. Marine protected areas (MPAs), fishery closures and marine spatial plans are some of the spatial management measures used to manage marine ecosystems. However, the effectiveness of these measures remains largely understudied from a social perspective. Here, we build upon the systematic map on marine management effectiveness created by O'Leary et al. 2022 and specifically analyse the social outcomes. The results showed that these measures increased fishing yield in 80 studies. In 100 studies, majority of the stakeholders (fishers, recreational fishers, and tourists) supported the restrictions. There was increase in tourism and tourism revenues in the MPAs. The MPAs lead to a displacement of efforts by fishers to other areas of the coastal zones not under restriction, as seen in Channel Islands State Marine Reserve network. Fleet performance decreased in Arrabida Marine Protected Areas and increased in Lyme Bay MPA. Compliance was a major issue in the MPAs in several studies depending on the level of engagement before the restrictions were imposed. Conflicts were common in the MPAs as found in 67 studies, as stakeholders had different views on their impacts. Communities did not always share the views of the implementing authorities on the effectiveness of the MPAs. While some of the stakeholders viewed the MPAs as good for the environment, others thought the MPAs have deprived them of their traditional fishing areas. There were employment increases in the National Marine Park of Alonissos primarily due to the increase in tourism. Overall, MPAs with better management practices and community engagement had greater success than those with poor management.

Poster Session



Phytoplankton groups distribution in the Atlantic Ocean derived from a synergistic product from OLCI and TROPOMI measurements

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Keywords: satellites, microorganisms

Phytoplankton play a crucial role in the global carbon cycle, not only because they are the key source of primary production in the marine ecosystem and a major driver of biogeochemical cycling. In fact, they are an essential component of the biological carbon pump and are also significant producers of oxygen and fatty acids. Different phytoplankton groups have specific functions and thus play different roles in the biogeochemical cycle and for the marine food web. Information on phytoplankton groups (PFTs) can be obtained from satellite observations such as the Ocean and Land Colour Instrument (OLCI) on board of Sentinel-3 as well as the TROPospheric Monitoring Instrument (TROPOMI) on board the Copernicus Sentinel-5 Precursor satellite. Here, the chlorophyll-a concentration for two main phytoplankton functional types (diatoms and cyanobacteria) are derived by combining retrievals from space-borne measurements at a high spatial resolution by the empirical algorithm (OC-PFT) applied to OLCI data with data retrieved from TROPOMI at measurements high spectral resolution by an analytical method (DOAS). We will present preliminary results of global distribution PFTs as well as discuss their temporal variability over selected biogeochemical provinces.

Impact of melting glaciers on role of Greenland's fjords as carbon sinks

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Keywords: Benthic-pelagic coupling, Sediment oxygen consumption, Mineralization, Subarctic fjord, Nutrient sediment profile

Greenland exhibits two major types of glaciers: those whose outlet extends into the sea (marine-terminating glaciers; MTG) and those ending on land (land-terminating glaciers; LTG). These different glacier types induce a different hydrology within their respective fjords which seems to bring about important differences regarding primary productivity. As such, research has suggested that fjords with MTGs promote higher phytoplankton biomass through upwelling of meltwater coming from the base of the gletsjer and thereby entraining nutrients towards the sea surface. As climate change progresses, the question is also rising whether the higher primary productivity at MTG-dominated fjord systems is translated to the benthic ecosystems and if this means that eventually less carbon will be buried in Greenlandic fjord sediments as MTGs shift to LTGs. To investigate the benthic-pelagic coupling and to test the hypothesis of MTG fjord systems sustaining higher benthic biomass and burying significantly more carbon in their sediments, a MTG-characterized fjord system, Nuup Kangerlua (Godthabsfjord), and a LTG-fed fjord, Ameralik Fjord, were sampled. Benthic organisms were collected to compare biodiversity and biomass of micro-, meio-, and macrobenthic communities as well as Pb-210, granulometry, porosity, pigments, C:N, stable isotopes and metal concentrations throughout sediment profiles. In addition, sediment community oxygen consumption rates and nutrient, alkalinity and DIC fluxes were measured to assess the mineralization potential and carbon burial across and between the two fjord systems.

A record of changing geochemistry through the PETM

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Keywords: Large Igneous Province, Global warming, paleoclimate

Volcanic eruptions can have both short-term and long-term effects on the Earth's climate. Episodes of intense volcanic activity and Large Igneous Province (LIP) emplacement have been linked with both climatic warming and cooling. One such period of intense volcanism was during the breakup of the North Atlantic and the emplacement of the North Atlantic Igneous Province (NAIP) between 60 -45 million years ago (Ma). NAIP emplacement occurred in line with a period of rapid global warming known as the Paleocene-Eocene Thermal Maximum (PETM). However, because of the short duration of the PETM (~200 ka) compared to NAIP volcanism (several Ma), the contribution of NAIP volcanism to these environmental changes is unclear. The PETM is particularly interesting because it offers a case study from the geological record with numerous parallels to the current global warming driven by anthropogenic greenhouse gas emissions. The period was associated with, significant addition of ¹³C depleted carbon into the ocean-atmosphere system, which lead to global warming and ocean acidification, rise in sea surface temperature by 5°C, global expansion of oxygen minimum zones, local photic zone euxinia, sea level rise, migration of species, and an enhanced hydrological cycle. This project is entirely based on sediment samples collected from the mid-Norwegian margin during IODP Expedition 396, and this work focusses on a number of themes relating to the role large-scale volcanic eruptions play in controlling climate change. Here we present initial results from a project to identify how sediment geochemistry changed across the PETM. Primarily XRF and ICP-MS analysis of sediments are used to attain a full record of the changing chemistry through the period and target elements will be used to reconstruct enhanced chemical weathering (K, Zr, Ti, Mg), redox conditions (Fe, Cu, Co, Zn), paleo productivity (Ca, Si, P, Ba).

Interaction of Organic and Inorganic Matter in Coastal Environments: Sediments as Sources and Sinks for Trace Metals and Dissolved Organic Matter

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Keywords: Metal oxide, organic complex, coastal North Sea, bio-cycling processes, benthic-pelagic coupling

In coastal oceans, trace metals can be transported via organic or inorganic carrier phases from the water column to sediments where they are trapped, recycled and/or (re-)introduced to the water column via benthic-pelagic coupling. Also, in the shallow Wadden Sea of the Southern North Sea, these processes shape the composition of the organic and inorganic matter pools of the water column. However, whether a sediment acts as source or sink depends on the interplay of several factors, for instance sediment type and prevailing redox-conditions. Constraining trace metal budgets in coastal ecosystems such as the Wadden Sea therefore still is a major challenge because composition and properties of sediments are highly variable. The aim of our study was to identify source and sink potentials of different sediments for dissolved organic matter (DOM), and trace metals (manganese, iron and thallium). We performed incubation experiments suspending three distinct sediment types in seawater: sands, surface- and bottom Wadden Sea sediment. We monitored changes of DOM, particulate organic matter and trace metals over 14 days. The initial resuspension of both Wadden Sea sediments significantly increased dissolved manganese (dMn) and iron (dFe) concentrations in the overlying seawater. However, dMn and dFe decreased in the bottom Wadden Sea sediment treatment over time, while concentrations increased in the surface sediment treatment. Dissolved Tl concentrations decreased in both Wadden Sea treatments but increased in the sand treatments, while dFe and dMn concentrations did not change in the sand treatments. Our data suggest that the observed trace metal dynamics are driven by the interplay of redox processes and organic matter content. These findings contribute to our ongoing compilation of trace metal and organic matter time series data and provide important insights into processes determining sink and source behavior of these chemical species in different types of coastal sediments.

A stitch in time saves nine: lessons for preventing research fatigue in marine stakeholders

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Keywords: consultation fatigue, non-engagement, over-researched communities, participatory research, stakeholder engagement

The interest and willingness of marine scientists to involve stakeholders in research and governance has increased over the past decade. Consequently, marine stakeholder groups are increasingly asked to engage with scientific issues. Young marine scientists delving into stakeholder engagement should be wary as to avoid inducing research fatigue in their study participants. This study aims to provide early career marine researchers with a foundational understanding of research fatigue and how it may be prevented or diminished. Research fatigue occurs when a person or group becomes weary of participating in research processes and are therefore hesitant or unwilling to take part in further research. Drivers of research fatigue vary but are overall related to the methodological misuse of participation. Severe research fatigue threatens future research and management actions involving stakeholders by increasing nonparticipation, risking the collection of poor-quality data, and undermining trust towards researchers, among others. It also raises ethical concerns, given that research fatigue is a negative state of mind that associated with exhaustion, apathy and frustration. Research fatigue has been given some (limited) attention in some fields of study but has been poorly studied in marine social sciences. To better understand the contexts in which research fatigue occurs and how it can be minimised, prominent articles regarding research fatigue from bioethics, public health, sociology and corporate communications literature were examined for knowledge useful to marine social sciences. Lessons from across disciplinary boundaries can help marine researchers avoid fatigue by: (1) administering caution over which type of participation should be applied to a given scientific activity; (2) raising awareness of how that participation can affect the underlying drivers of research fatigue; and (3) providing practical recommendations about designing and applying participation methods. Such take-away messages can help those applying young marine scientists execute their research without exhausting their stakeholders goodwill.

Expert Stakeholder's Perceptions and Attitudes Towards Mangrove Management: A Case Study from Sri Lanka

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Keywords: Wetland, Governance, Participatory Approaches, Conservation, Natural Resource Management

Sri Lanka stands out as the world's first country to formally conserve its mangrove forests through policies irrespective of land ownership. The Sri Lankan government declared complete protection of its mangroves in the year 2020. Our study focused on delineating expert opinions regarding mangrove management policies and conservation in Sri Lanka. We conducted a questionnaire survey (August 2021 - April 2023) involving 76 respondents representing 25 different stakeholder groups, comprising government, non-government, and private organizations across all five coastal provinces in Sri Lanka. A significant majority of stakeholders (90%) acknowledged the crucial importance of mangroves as an ecosystem. However, despite the Sri Lankan government's formal mangrove conservation policies, only 28% of the respondents knew that all mangrove forests are fully protected by law in Sri Lanka. In contrast, 38% thought that mangroves were not formally protected, while 34% were unsure. Moreover, the majority of respondents (72%) either lacked knowledge or believed that the protection of mangrove forests in Sri Lanka was incomplete, highlighting the need for further education and awareness-raising on the topic. We believe that there must be a distinction made between the formal protection on paper, and the actual conservation of all mangroves. While encroachment of mangroves is prohibited in Sri Lanka, with strict policies in place for the felling of mangroves, only 70% of the respondents believed that the felling ban by the government was effective. Nonetheless, Sri Lanka continues to develop mangrove management policies, although mutual policy learning amongst stakeholders, or improvement of the overall mangrove management and conservation interests, has not been substantial. In conclusion, implementing effective mangrove management policies, by

including all stakeholders, is just as critical as policy establishment, and further education and awareness, and enforcement are necessary to bridge the policy implementation gap.

O₂ and nitric oxide dynamic in coral (*Galaxea*) gastric cavity microenvironment

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Keywords: coral gastric cavity, microenvironment, nitrogen cycling, denitrification

The gastric cavity of corals plays a vital role in various essential functions such as coral feeding, excretion, defense against pathogens, and the uptake/release of symbionts. However, limited studies have been conducted on the coral gastric cavity due to the technical challenges in measuring the physico-chemical microenvironment and microsampling of its contents. In this study, we utilized electrochemical microsensors to investigate the chemical conditions within the gastric cavity of *Galaxea* corals and to uncover the biological activities of both the coral host and its symbiotic microbes, with a specific focus on anaerobic respiration processes. We performed depth profile measurements through coral's mouth and reaching the bottom of the gastric cavity. Under irradiance with light, the O₂ concentration was found to increase to 320~405 mol L⁻¹, as a result of photosynthesis. In the absence of light, the O₂ concentration decreased, and the microenvironment within the gastric cavity became anoxic (0 mol L⁻¹). During the dark incubation, we continuously monitored the O₂ concentration over time and observed several periods of fluctuation and increase, which suggests the occurrence of water exchange between the coral gastric cavity and the surrounding seawater. Within this anoxic gastric cavity, we detected the presence of nitric oxide (NO), the highest recorded concentration of NO reached 48 nmol L⁻¹. NO is a signal molecule which was found produced during heat stress and related to the coral-symbiont interaction, and NO is also the intermediate product of denitrification. Further studies should focus on verifying the source of NO in gastric cavity and understanding the effect of NO on coral-symbiont interaction. With this research we described the spatial and temporal dynamic of O₂ within the coral gastric cavity, and we detected the production of NO, which sheds light on understanding the characterisation and the role of this important microenvironment.

Effects of temperature and hypoxia on catalase levels of a sedentary benthic fish

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Keywords: Stress, Climate change, Fish, Catalasa, Hypoxia

Temperature and oxygen are two of the most affected environmental variables in our age of climate. The changes in these variables can have a plethora of effects on marine biota, and understanding them is of outmost importance to address this issue. We simulated climate change scenarios, to evaluate the effects of high temperature, hypoxia and a combination of both, on the liver levels of catalase activity in *Hallobatrachus dactylopterus*. We used a condition index to estimate the welfare of the fish in each treatment and correlate it with the levels of catalase determined in the laboratory. The two environmental drivers studied showed effects on the catalase of this species after the course of 30 days of exposure. The most affected treatment was the combination of both hypoxia and high temperature, which showed that fish had increased levels of catalase activities in their livers. Fish on the other three treatments (i.e. only hypoxia, only high temperature and control) had equal levels of catalase activity, statistically. The condition index on the affected treatment was the lowest, but not statistically different from both the high temperature or the hypoxia treatments. Only the control treatment showed a statistically higher condition index.

Effects of food and microplastics on digestive enzyme activities of blue mussels *Mytilus edulis* and their endo-parasites *Mytilicola* sp.

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Keywords: Parasites, Food web, Algae, Starvation, Microplastics

Endo-parasites are widespread in marine organisms. Often, the nutrition of endo-parasites decisively depends on the qualitative and quantitative food uptake of their host. However, they have rarely been considered in the context of the pollution of the oceans with microplastics, which are ingested by a great variety of host organisms. In the south east North Sea, the blue mussel *Mytilus edulis* hosts two endo-parasitic copepods, *Mytilicola intestinalis* and *Mytilicola orientalis*. Previous studies showed that these species differentially feed either on the food ingested by their host or on the intestine tissue of the mussel. Twelve infected mussels each were exposed for five days to one of three different treatments: starvation, fed with suspended microalgae, fed with microplastics. After the experiments, the digestive tissue of the mussels was dissected and the parasites were isolated. The activities of six digestive enzymes were measured in the mussel tissue and in entire individuals of the parasites using fluorescent substrates. Enzyme activities of the mussels did not vary between the food treatments. Similarly, the food treatment had no effect on the enzyme activities of *M. intestinalis* whereas *M. orientalis* had clearly elevated enzyme activities when the host was starving. The two parasites responded differently to variations in the qualitative and quantitative food supply of their host suggesting differential use of food resources available to the endo-parasites. Apparently, microplastics had no effect on the activity of digestive enzymes of *M. edulis* and its endo-parasites. The reactions of the digestive enzymes of the mussels and parasites were significantly different.

Physiological and behavioural responses of the snail *Faunus ater* to temperature, salinity and tidal regime

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Keywords: gastropod, climate change, mangrove ecosystem, coastal ecosystem, stress response

The inter-related effects of climate change are impacting coastal and mangrove ecosystems on multiple levels. Species that dwell in the intertidal zone are directly affected by increasing temperatures, fluctuating salinity and inundation times. The gastropod *Faunus ater* is widely distributed and locally abundant in mangrove ecosystems along the coastlines of the Indo-West Pacific, but their ecology and response to climate change is not well known. This study assessed the physiological and behavioural response of *F. ater* in a fully crossed experimental design using temperature, salinity and tidal regime as proxies for climate change. The results show that food consumption and respiration were increased at higher temperature, coinciding with the metabolic theory. The response of moving behaviour to single treatment factors, as well as their interactions, displayed more complex patterns that implied specific trade-off behaviours. The catalase activity (CAT) and lipid peroxidation (LPO) gave more insight and revealed the accumulation of LPO and CAT in medium-stress treatments. These results suggest that *F. ater* is dealing with low to medium stress through the activation of their antioxidant defence and uses behavioural protection through hermitization and habitat evasion during times of increased stress.

Temperature-dependent grazing on kelp by the green sea urchin *Strongylocentrotus droebachiensis*

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Keywords: Digestive physiology, Grazing activity, Climate change, Temperature performance, Ecosystem function loss

Extreme grazing events by sea urchins have left formerly dense kelp forest communities completely barren all along the Norwegian coast, creating a new alternative-stable state, the so-called sea urchin barrens. Two sea urchin species of the family Strongylocentrotidae present as main grazers a key species in the Porsangerfjord, Northern Norway. In 2022, the kelp forest shows sea urchin abundances of $20 \pm 10 \text{ Ind m}^{-2}$, whereas in the neighboring sea urchin barren $147 \pm 54 \text{ Ind m}^{-2}$ were observed. Individuals from the kelp forest as well as from the barren had full guts, containing mainly pieces of brown algae, although the origin of the algae consumed by sea urchins from the barren is not completely clear. The theoretical algae wet mass that would be grazed by both species per day accounts for $28 \text{ g} \cdot \text{m}^{-2}$ (kelp) and $48 \text{ g} \cdot \text{m}^{-2}$ (barren) as calculated from sea urchin density and grazing rates obtained from in-situ grazing experiments. In a temperature-controlled experiment, conducted with the main representative, *Strongylocentrotus droebachiensis* (Müller, 1977), grazing rates increased steadily from 2 to 10°C, but decrease at higher temperatures and ceases completely at the thermal limit of 22 °C. This suggests that grazing pressure on kelp communities is influenced by temperature. With ongoing Arctic warming and increasing marine heatwaves (MHW) intensity and frequency, grazing pressure on kelp will likely increase, as will physiological challenges on benthic primary consumers. Investigations on the metabolic performance of *S. droebachiensis* by ¹H NMR analyses will complement the findings on the feeding behavior of this species in the face of climate change in order to study the implications of Arctic warming on benthic primary consumers and the consequences for their ecosystem as well as ecosystem functioning.

Diet spectra of several fish species in South Greenland waters revealed through DNA metabarcoding: the role of gelatinous zooplankton as prey

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Keywords: jellyfish, COI, 18s rDNA, food web

Gelatinous zooplankton (GZP) occur in all oceans ranging from polar to tropic regions, occupy all depths and can rapidly form large populations with high biomasses. Yet they have been largely overlooked as a food source for higher trophic levels. The high water content and fragility result in quick digestion of gelatinous prey, which is potentially why only a small number were recorded using conventional stomach analysis methods. Here, the advantages of molecular diet analysis come into play: DNA metabarcoding allows to identify short DNA fragments even from heavily degraded tissues. Over recent years, it allowed the detection of many different predators of GZP that were previously not considered as potential jelly consumers. This study uses a multi-marker approach combining 18S rDNA and Cytochrome c oxidase I (COI) to identify prey items in the stomachs of common Southern Greenlandic fish species, several of which are commercially exploited: Atlantic cod (*Gadus morhua*), redfish (*Sebastes* sp.), wolffish (*Anarhichas* sp.), greater silver smelt (*Argentina silus*) and plaice (*Hippoglossoides platessoides*). A special focus could be placed on *A. silus*, of which the stomachs were recorded as empty during visual assessment prior to the DNA extraction, but up to 100% of the detected reads could be assigned to GZP in the metabarcoding analysis. Overall, the results indicate that GZP predation is prevalent in all fish species studied and is detectable with both genes, COI and 18S. This makes it the first study to demonstrate the role of GZP as prey for Greenland fish communities.

Ostracod's assemblages revealed by integrating DNA barcoding and morphology from North Sea

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Keywords: meiobenthos, Ostracoda, DNA identification, COI gene

Crustaceans from class Ostracoda (also called seed shrimps) are an important ecological group of meiobenthic organisms (body size range: 30-1000 µm). Ostracods are a food source for demersal fish and small macro-benthic invertebrates, and data about their diversity and abundances can be used for biomonitoring of the environment. The majority of recent investigations of ostracods are mainly focused on fossil assemblages, while the data concerning their diversity and ecological role in the food webs are fragmentary. DNA barcoding of the Cytochrome c oxidase subunit I (COI) as a frequently used approach is proven to be a reliable method for species delimitation of different groups of metazoans. This study provides the preliminary insights into the diversity and abundance of meiobenthic ostracods in the south part of the North Sea using morphological identifications and genetic variabilities of a ~680 bp fragment of the COI gene. So far, our results revealed that ostracods are less abundant with lower diversity compare to other meiofauna groups. Genetical analyses of the ostracod specimens from the studied area revealed the presence of 9 different genotypes (species) mainly with low abundances and occurrence of singletons. The highest abundance of ostracods (14 individuals) was reported at St. 28 (sandy biotope) with distinct genetic clusters into 4 different species. The preliminary morphological identification of ostracod specimens from this study has shown that, so far, all analyzed specimens belong to the order Podocopida. The most abundant species were recorded from families Loxoconchidae, Leptocytheridae and Xestoleberidae. Further studies of the diversity and distribution of ostracods using reverse taxonomical approach integrating both molecular and morphological analyzes will provide better understanding of the ecological features of these crustaceans and their role in benthic ecosystems food webs.

Halimeda incrassata: a tropical seaweed in the Mediterranean Sea

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Keywords: Tropicalization, *Halimeda incrassata*, Invasive seaweed, Mediterranean Sea, Light

The arrival and expansion of tropical invasive species have been increasing in the Mediterranean Sea for several decades. *Halimeda incrassata* is a tropical seaweed first detected in 2011 on the coast of Mallorca (Balearic Islands, NW Mediterranean), growing in shallow sandy bottoms. It is a calcareous rhizophytic seaweed that has the potential to transform ecological communities in Mediterranean ecosystems. Studying the growth and calcification capacity of *H. incrassata* at different irradiance levels provides information about the means by which it was introduced and the possible future expansion. In this study, an in situ experiment was conducted manipulating light levels to assess its resistance capacity to different light availabilities. This work found that *H. incrassata* is very resistant to reductions of light availability, whereby its ability to generate biomass and carbon content is not significantly altered by light reductions of more than 60% over a period of 10 weeks. These results have relevant implications about its expansion capacity, since it has the potential to invade greater depths, interfering in habitats of other species such as *Posidonia oceanica* or *Cymodocea nodosa*, as well as altering the calcareous component of the substrates by releasing inorganic carbon.

Combining sensor nodes for automated acquisition of marine data

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Keywords: Sensor integration, automated sensing, data merging, environmental monitoring

Environmental monitoring programs carried out by expeditions on research vessels are expensive and only allow measurements for discrete times and locations. The attempt to get a higher resolution of data on an environment needs flexible and automated data acquisition techniques. To be able to base decisions on marine data, information on where, when and how it was acquired is needed as necessary context information. The process should be automated so that data acquisition by nonprofessional operators is possible. For a geospatial positioning of subsurface hydrological data, the position of the sensors has to be provided in coordinates and depth. This makes it necessary to have at least two different sensing nodes. In the attempt to combine these the synchronisation between nodes is essential. We present a system that connects multiple nodes wireless and provides the infrastructure to synchronize, handle and store their data. Sensing nodes that acquire measurements in water connect multiple sensors with a variety of parameters in hardware directly. Nodes in the air gather information with sensors and APIs to give context information on the measurements. Mobile connectivity makes it possible to transfer the data to land for near real time visualization and evaluation. The approach shows how decentralized automated units can complement monitoring programs in a variety of stationary and mobile use cases on ships of opportunity or in citizen science. Remote visualization of results of multiple deployed units makes a fast evaluation and reaction based on measured data possible.

Data Train - The Cross-disciplinary Training in Research Data Management and Data Science

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Keywords: Data skills, Data analysis, Big data, Fair data, Interdisciplinary education

Data-driven science is important for answering pressing research questions of our time. Global warming, pollution, massive extinction of species and the impact on human health as well as the socio-economic consequences of the COVID-19 pandemic are just a few recent examples. In times of digitalization, sound research data management (RDM) and data science-related skills, such as data formatting/handling, -analysis, -visualization and -deposition following the FAIR data principles, are indispensable for making research efficient and applicable for our society. However, there is a significant deficit of these skills among PhD students across many disciplines, including marine researchers. Qualified persons in RDM and data science are missing to foster innovative technologies. Gaps in the University curricula still exist, while the needs for various scientific disciplines are on the one hand very specific but on the other hand with many synergies. Using these synergy effects and responding to this massive demand, the U Bremen Research Alliance, with the support of the Federal State of Bremen, has established the cross-institutional and cross-disciplinary training program "Data Train - Training in Research Data Management and Data Science" for doctoral researchers from member institutions. Data Train pursues the mission of strengthening the competencies in data literacy, data management, and data science, while offering doctoral researchers a platform to build an interdisciplinary and interinstitutional network. The program is associated with the German National Research Data Infrastructure (NFDI). NFDI consortia represented in Bremen (NFDI4Health, NFDI4Biodiversity, KonsortSWD, NFDI4Ing, NFDI4DataScience, NFDI4Earth, NFDI-MatWerk, NFDI4Microbiota, NFDI4Memory) participate in the development and operation of the training courses, which started in 2021 and now take place annually. The cross-institutional and cross-disciplinary training model covers the entire data value chain and makes an important contribution to data literacy training, which is beneficial for all kinds of scientific fields as well as for society and economy.

Labile or stable? Assessing organic matter recalcitrance - case study on Malaysian mangrove sediments

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Keywords: blue carbon, carbon sequestration, loss on ignition, thermal stability

Mangrove forests and other coastal vegetated ecosystems sequester and store large amounts of organic carbon in their biomass and their sediments. In recent decades, their integrity and extent have been compromised and reduced by numerous human activities. As a result, the global capacity to mitigate climate change through blue carbon storage in coastal vegetated ecosystems has declined dramatically. For concrete actions to reverse this trend it is not only crucial to have better knowledge of the quantity but also stability of the stored organic matter (OM; containing the organic carbon). The present research aims to enhance the understanding of sediment OM, notably by quantifying OM fractions of distinct stability. Here we present a case study from peninsular Malaysia, where we collected 50 cm-deep sediment cores in three different regions at the west and east coast. By applying a stepwise combustion method, we provide first insights into OM quality with regard to thermal stability as a proxy for recalcitrance against decay. We will present 1) regional organic matter characteristics, and 2) possible differences of OM recalcitrance levels across sediment depth. Novel insights into organic matter stability will deepen our understanding of long-term organic matter storage in mangrove ecosystems and thereby their potential as climate change-mitigators. This knowledge will further inform regional and global management of coastal vegetated ecosystems and potential carbon offset schemes.

Detection and relative quantification of the European eel populations in rivers of Asturias (Spain) using eDNA.

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Keywords: *Anguilla anguilla*, environmental DNA, qPCR, specific marker, freshwater life monitoring

The European eel (*Anguilla anguilla*) is a species classified as critically endangered by the International Union for Conservation of Nature (IUCN). To protect current eel populations and to promote their recovery, it is essential to develop efficient monitoring methods free of associated mortality, especially in the case of vulnerable populations. That is why environmental DNA is gaining importance globally, as it allows sensitive and non-invasive monitoring of aquatic species. In this work, the presence of European eel in two Asturian rivers is determined. In addition, a quantitative approach is applied in order to correlate the environmental DNA with the biomass of eels obtained by electric fishing. To do this, eDNA is recovered from water samples by filtration, extracted, and amplified by real-time PCR (qPCR). With this methodology, eels have been detected in 69,56% (16/23) of the analysed sampling points, and in 91,66% (11/12) of those points for which the presence of this species is known. In addition, it has been possible to establish a correlation between the amount of DNA and eel biomass including a correction for river hydrography developing a marker with predictive value, which was validated with eDNA of other river. These results show that the methodology used has great potential for non-invasive monitoring of the species, especially in rivers with low density of eels where electric fishing loses efficiency.

What approach can we use to study benthos on plastic substrates?

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Keywords: biofilm, meiofauna, macrofauna, marine litter, Black Sea

Plastic pollution in the environment has become a new habitat for marine biota. Despite the increase in research of biofouling on plastics, methodological approaches to studies of the whole benthic community and on plastic substrates are largely unknown. Thus, the aim of this research is to represent the methodology for the complex analysis of biofouling communities (from microalgae to meio- and macrofauna) on the plastic surfaces. The complex experimental evaluation of the colonization of plastic substrates was made for the first time in the Black Sea. The three types of constructions were designed to study marine biofouling. The experiments were carried out at various exposures (1-10 months) in situ in the north-western Black Sea coastal area. In total, 28 genera of microalgae, 13 major groups of meiobenthos and 36 species of macrofauna were found on plastic during the experiments. The main component of the microalgae biofilm was represented by the complex of *Cocconeis* species. The higher taxa of meiofauna such as Nematoda, Harpacticoida (Copepoda), Polychaeta, Bivalvia, Cirripedia and Amphipoda made the greatest contribution to the biomass and density of the meiobenthos community. The main component of the density and biomass of macrofauna was formed by Bivalvia (*Mytilaster lineatus*, *Mytilus galloprovincialis*) and Crustacea (*Amphibalanus improvisus*). Although the methodology of experiments needs to be improved and unified, the results of this study could be used as a part of monitoring marine litter components. The present and further studies will allow estimation of biofouling growth (intensity, structure, biodiversity) on new types of substrates and their impact on benthic habitats. The obtained data make an important contribution to the development of national standards for Descriptor 10 of the Marine Strategy of Ukraine and understanding the ecological status of marine environment.

Contextualising marine measurements by linking various data sources

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Keywords: Environmental monitoring, Internet-of-things, Data contextualisation

Effort required to obtain marine measurement data is immense. Sensors of various shapes and sizes are deployed stationary or at different locations in certain time intervals as data sources. This leads to data sets which differ in spatial and temporal resolution and in complexity. Since many characteristics of the marine environment influence each other, additional parameters should be collected as context datasets. The aim of this research is to evaluate the opportunities of third-party data sources and their implementation by using methods from the internet-of-things (IoT) approach. Hereby, each data source is designated as an object that can be connected within a network. As a first step an analysis of possible data sources in the region of Rostock, Germany, was carried out and applicable data sources were selected. Then a modular, self-developed sensor system was deployed at one station for a longer period of time and measured and transmitted data automatically. At the same time the selected third-party data sources were combined to provide contextual data. With the use of Application Programming Interfaces (APIs) and tools of the IoT-approach the implementation and near-real-time data visualisation could be carried out. This allows users to track changes and make quick initial assessments with taking the context data into account. During the process of data alignment standard vocabularies and naming conventions are taken into account. In summary the integration of additional, external data sources as context data simplifies the process of data contextualisation immensely, which is why measuring systems for marine environmental monitoring should provide such communication interfaces. At the same time, there is an obligation to correctly indicate the source and owner of a data set and the way it was created.

Floating Sediment Traps - closing a gap: Detailed representation of trophic interactions and estimation of carbon sequestration potential in marine high productivity regions

Luisa Meiritz^{1,2}, Niko Lahajnar², Tim Rixen^{2,3}

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Keywords: upwelling systems, energy transfer, particulate matter flux, floating sediment traps

Highly productive regions in the world's oceans, such as eastern boundary upwelling systems (EBUS), cover only a few percent of the ocean surface. Socio-economically, however, they contribute significantly to the food supply of large populations. Due to their high biological productivity, these areas have a major impact on the marine carbon cycle. The complex EBUS are also affected by impacts of ongoing anthropogenic climate change such as upwelling-induced temperature changes, coastal acidification and deoxygenation and are also subject to ecosystem pressures from overfishing, making it difficult to fully grasp these systems. To better understand the functioning of these systems, floating sediment traps are deployed in the water column and sample the active and passive particle transport at various depths. After microscopic and biological determination of the particles, these samples provide the opportunity to perform numerous biogeochemical analyses such as flowcam analyses, statistical surveys and nutrient analyses on different particle groups, abundance determinations, eDNA sampling, and estimates of organic/inorganic carbon and particle flux. As a practical example, we show here our recent work from the Benguela Upwelling System (BUS) obtained from the TRAFFIC project (Trophic TRANSfer eFFICIency in the Benguela Current). Over the last three years, 16 floating sediment systems have been deployed here. With data acquired from the southern (sBUS) and northern (nBUS) part, changes in particle flux fluctuations have been detected and quantified. The data show significant interseasonal differences and changes in particle flux. In austral winter, particle transport in the sBUS is with up to 48,000 mg m⁻² d⁻¹ almost five times greater than in austral summer. Compared to the nBUS, the sBUS shows higher rates of particle transport in every season. In conclusion, the interdisciplinary scope of the floating systems closes a previously existing gap between the disciplines of marine biology, biogeochemistry, oceanography and environmental modelling.

Sex differences in sand goby feeding ecology during breeding season

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Keywords: food web, feeding ecology, paternal care, gobiidae, stomach content

Having a comprehension of how feeding ecology differs between sexes during specific times of the year is essential to the advancement of ecosystem research. However, this topic is relatively unexplored. In order to uncover these differences during breeding season in sand gobies, fish were captured in the Amrum Bank region of the German North Sea during and after breeding season in 2019, 2020 and 2021. All individuals were dissected and measured. The stomach contents were weighed and prey items identified. Our aim was to (i) reveal the trophic role of the sand goby by identifying its prey, (ii) to study seasonal variation in its feeding ecology, and (iii) to look into potential dietary differences between males and females. We show that sex and season affect the diet of *P. minutus*. There were no dietary differences between males and females in the autumn. In May, during the breeding season, males have less food in their stomachs and a different selection of taxa in their diet. The effects on the feeding ecology could be caused by different behaviour and feeding opportunities of female and male sand gobies during reproduction and male parental care. This study is among the first studies addressing gender-specific differences in the diet. We confirm that *P. minutus* is a second consumer which suggests its important role in the coastal marine food web and conclude that it is time for ecosystem research to start considering sex differences.

Algal sulfated fucan: a global carbon sink

Aman Akeerath Mundanatt¹, Silvia Vidal-Melgosa¹, Jan-Hendrik Hehemann¹

¹MARUM - Center for Marine Environmental Science, University of Bremen, Bremen, Germany, Max Planck Institute for Marine Microbiology, Bremen, Germany

Keywords: Algal polysaccharides, Carbon sequestration, Sediment

Brown algae and diatoms produce and exude complex polysaccharides called algal sulfated fucans that resist microbial degradation. These anionic polysaccharides can assemble into gel-like transparent exopolymer particles and eventually aggregate into larger sinking particles. Sulfated fucans may limit the microbial remineralization of the sinking particles and promote carbon transport to the sediment. However, their significance in global carbon cycling processes is relatively unknown. Monoclonal antibody-based methods like enzyme-linked immunosorbent assay can semi-quantitatively detect specific epitopes on the sulfated fucans. We probed for sulfated fucans in sediment samples from the Black Sea, the Mediterranean Sea, the Bransfield Strait, and the South Pacific. We detected sulfated fucans in samples including 11.8 ka and 125 ka old sediment, showing their potential to trap carbon for millennia. Unknown concentrations of sulfated fucan in sediments underscore the requirement for quantitative measurements and establish their contribution to carbon sequestration and cycling.

Mariculture affects microbial biofilm community structure and its coral settlement induction capacity

Blaire M. Padayhag¹, Michael Angelou L. Nada¹, Jake Ivan P. Baquiran¹, Marilou P. Sison-Mangus², Maria Lourdes San Diego-McGlone¹, Patrick C. Cabaitan¹, Cecilia Conaco¹

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Keywords: Nutrient enrichment, settlement cues, coral settlement, 16S rRNA, 18S rRNA

Coral larval settlement is a complex process that relies on settlement cues such as those elicited by microbial biofilms. Changes in reef environmental conditions, including nutrient enrichment from mariculture, may cause changes in biofilm communities, which, in turn, can affect coral larval settlement. To determine how a nutrient gradient from mariculture activity affects biofilm development and subsequent coral larval settlement, biofilm communities were developed on glass slides for 4, 7, 11, and 15 days at four sites with increasing distance from a mariculture zone. Biofilms farthest from mariculture influence elicited greater settlement of *Acropora tenuis* larvae. Characterization of the prokaryotic and eukaryotic communities by 16S and 18S rRNA sequencing revealed a greater proportion of crustose coralline algae (CCA) and gammaproteobacterial taxa in the biofilms developed at sites farthest from the mariculture, whereas no CCA and a greater proportion of cyanobacteria were found on biofilms closer to the mariculture zone. These findings suggest that nutrient enrichment due to mariculture activities alters the composition of biofilm-associated microbiome at nearby reef sites and indirectly causes poor coral larval settlement.

The NFDI4Earth Academy - Your training network to bridge Earth System and Data Science

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Keywords: PhDs & PostDocs, Data science, Interdisciplinary research, Collaboration, Community

The NFDI4Earth Academy is a network of doctoral and post-doctoral scientists, interested in bridging Earth System and Data Sciences beyond institutional borders. The research networks Geo.X, Geoverbund ABC/J, and the German Marine Research Alliance (DAM) offer an open science and learning environment. The Academy covers specialized training courses and facilitates collaborations within the NFDI4Earth consortium with access to all NFDI4Earth innovations and services. Academy fellows advance their research projects by exploring and integrating new methods, connecting with like-minded scientists, and developing skills and a mindset for open and data-driven science across disciplinary boundaries. Our two-year Academy program offers a unique approach to traditional graduate school curricula. We prioritise peer-mentoring and flexible event structures to meet our fellows' specific training needs. Fellows can, with our support, organize additional events and access external training opportunities.

Our first cohort of 39 fellows from 24 institutions in Germany is on the verge of completing a fruitful first year. The call for our second cohort will open on October 16, 2023, with the program scheduled to commence in June 2024.

Meiobenthos in different habitats of the Snake Island marine protected area (Black Sea)

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Keywords: MPA, benthic habitats, EUNIS, rocky shores

The nearshore aquatic zone of the Snake Island, located in the north-western Black Sea shelf, is a marine protected area (MPA) with fragmentary data on meiobenthic taxa biodiversity. The first comparative analysis of the meiobenthos assemblages in different habitats according to the EUNIS classification of the Snake Island was made. Meiobenthos was studied in the three habitats: Exposed Black Sea upper infralittoral rock with turf of Corallinales (MB142), Mytilid dominated Black Sea exposed upper infralittoral rock with foliose algae (no fucales) (MB143) and Black Sea infralittoral sands and muddy sands without macroalgae (MB542). Total, 5 permanent groups and 5 temporary higher meiobenthos taxa were registered in the different habitats. The highest density and biomass means ($190655 \pm 23004 \text{ ind.}\cdot\text{m}^{-2}$ and $3170.90 \pm 412.15 \text{ mg}\cdot\text{m}^{-2}$ respectively) of meiobenthos were at MB143 habitat, formed by *Mytilus galloprovincialis* with foliose algae. The results of nMDS and cluster analyses showed meiofauna assemblages of both MB142 and MB143 differ from the MB542 habitat (significance confirmed by the ANOSIM pairwise test). SIMPER analyses showed that Bivalvia and Ostracoda made the biggest percentage contribution to these dissimilarities between habitats. Thus, the meiobenthos assemblages at the different habitats of the Snake Island MPA were similar to the other regions of the Black Sea with some unique features (e.g. relatively lower total meiobenthos density, high percentage of ostracods on the algal substrate, etc.). Further studies of peculiarities of meiobenthic taxa in other MPAs might lead to estimate patterns of the meiobenthos formation and for their possibility of use in biomonitoring.

Project HotMess: Investigating the impacts of temperature and pollution on global intertidal ecosystems

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¹University of Oxford; ²Oxford Brookes University

Keywords: Multiple Stressors, Nutrient Pollution, Climate Change, Global Coastlines, International Collaboration

Understanding the effects of multiple stressors is imperative for the prediction, management, and mitigation of impacts. The combined effects of stressors may be more insidious than their more predictable individual effects, and so more research is necessary to disentangle their outcomes. Multiple stressor impacts on marine ecosystems, particularly intertidal, are vastly understudied. This is despite the vast range of ecosystem services and functions they provide; such as serving as early indicators of change, and as exporters of energy across the aquatic-terrestrial interface. The goal of Project HotMess is to explore intertidal community composition shifts under changes in temperature and pollution at a global scale. To do this, passively warmed settlement plates shall be constructed and placed along global coastlines at different proximities to a nutrient pollution source, and community composition shall be analysed over one year. This shall allow nutrient pollution and increased temperature to be evaluated independently and interactively. The experiment shall be installed in 28 coastal countries (across all 7 continents), to determine whether biogeographic climate variables influence the effects of these stressors. Climate data shall be gathered from all sites accordingly. This experiment was first installed in Brighton (UK), in September 2022. Analysis shall include community composition shifts, as well as food web analysis throughout the summer period. Preliminary results due in June 2023. The experiment has also most recently been installed across nine Southern hemisphere countries between March-April 2023. A further 18 replicates are set to be installed across Northern hemisphere countries in September 2023. Community composition of standardised functional groups shall be investigated for these sites. Project HotMess shall disentangle complex community ecology responses across the globe, and encourage global collaboration and representation across multiple research themes. This project has the potential to initiate and pave the way for further research in a vastly understudied field.

Development of dissolved organic matter in the sea surface microlayer during an algal bloom: a mesocosm study

Jasper Zöbelein¹, Hannelore Waska¹, Thorsten Dittmar¹

¹Marine Geochemistry, University Oldenburg

Keywords: air-sea interface

The sea surface microlayer (SML) covers most of the ocean's surface. This thin layer measures between 1 to 1000 μm and is formed by a complex mixture of solved and aggregated carbohydrates, lipids, proteins, and a variety of diverse surface-active organic compounds. As an aggregate-enriched environment which is highly irradiated by ultraviolet light, the SML is a unique biome sheltering distinct microbial communities. This leads to the SML featuring distinct physicochemical properties compared to the underlying water. With its high concentration of surface-active substances, the SML modulates the air-sea exchange processes of gases, heat, light, and momentum. As part of the project Biogeochemical processes and Air-sea exchange in the Sea-Surface microlayer (BASS), we characterize dissolved organic matter (DOM) in the SML and its influence on the inorganic carbon cycle. We aim to understand the organic matter composition of the SML and underlying water. A major goal is to understand the reasons for the strong spatial and temporal heterogeneity of SML-DOM and the conditions under which it becomes an interface which is chemically distinct from the underlying water. By that, we will elucidate the role SML-DOM is playing in the air-sea gas exchange, carbonate chemistry, and ecosystem functioning of associated organisms. During a mesocosm study in summer 2023, an algal bloom was induced at the Sea Surface Facility (SURF), Wilhelmshaven. The goal was to study the formation and decay of the SML. First results show a distinct enrichment of the SML with dissolved organic carbon (DOC). Ultrahigh-resolution mass spectrometry will further reveal molecular patterns which are linked to SML properties, such as alkalinity and CO_2 equilibration. The first results will be discussed in the contribution.

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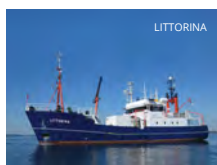
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BRIESE RESEARCH closely cooperates with the following research institutes:



Thursday
21st September 2023



Program - Thursday, 21st September

07:30	Registration & Welcome coffee	
08:30	Keynote speech	
	Equity at a crossroads: Inclusivity and justice in marine policy, research, and in our lives and careers Marie Fujitani, Leibniz Centre for Tropical Marine Research; Institute for Geography, University of Bremen <i>Lecture Hall</i>	
09:30	<i>Breakfast break</i>	
09:45	Session 3.2 A What options do we have? Integrated scenarios for shaping the future of our oceans <i>Lecture Hall</i>	Session 4.2 A The Future Ocean Biological Carbon Pump <i>Seminar room A</i>
10:45	<i>Coffee break</i>	
11:15	Session 3.2 B What options do we have? Integrated scenarios for shaping the future of our oceans <i>Lecture Hall</i>	Session 4.2 B The Future Ocean Biological Carbon Pump <i>Seminar room A</i>
12:30	<i>Lunch break (self organized)</i>	
13:15	Round table Topic: Mental health <i>Foyer</i>	NFDI4Earth Academy Info Table Melina Knoke & Carolin Müller <i>Info table</i>
14:00	Workshops	
	The foundation of measurements: metrology Rieke Schäfer, Physikalisch-Technische Bundesanstalt <i>Lecture Hall</i>	
	What is Organisms Democracy Baltic Sea and who will speak for the Chinese Mitten Crab? Georg Reinhardt, Organisms Democracy NGO and artists collective Club Real <i>Seminar room C</i>	
	Diversity in science - no brainer or long way to go? Sam Schwickert, Spielköpfe <i>Seminar room B</i>	
	The importance of stupidity in science Yvonne & Caro, ICYMARE <i>Seminar room A</i>	
	Exkursion	
	Museum of Natural Science Oldenburg Franziska Ohl <i>Main Entrance</i>	
18:00		
20:00	Bar hopping evening Get to know the beautiful city of Oldenburg by hopping from bar to bar	

Keynote & Plenary Discussion

EQUITY AT A CROSSROADS: INCLUSIVITY AND JUSTICE IN MARINE POLICY, RESEARCH, AND IN OUR LIVES AND CAREERS

Speaker: Marie Fujitani, Leibniz Centre for Tropical Marine Research; Institute for Geography, University of Bremen

Moderation: Julia Jung

Three prominent themes in academic discourse recently have centred on equity – equity in policy processes and outcomes, equity in research practice and collaborations, and issues of equity in academic careers. These themes in the marine sciences bridge environmental sustainability and social justice and have shared principles of inclusivity, representation, and participation. Equity in policy, research, and academic career development can lead to more robust and sustainable outcomes through more diverse inputs and outputs, dismantling systemic barriers, amplifying underrepresented voices, and fostering an environment where all individuals can thrive and contribute meaningfully. This is absolutely necessary to achieve a sustainable future for our oceans and the communities that depend on them. In this keynote, I explore the overlaps between these parallel concepts of equity, their best practices and benefits, and the challenges and their intersections, drawing on my own experience in international sustainable development research, policy, and as a mother in an academic career path.

Session 3.2
What options do we have?
Integrated scenarios for
shaping the future of our
oceans



What options do we have? Integrated scenarios for shaping the future of our oceans

hosted by Jonathan Heimer

Thursday, 21st September 2023, 09:45 – 12:00, Lecture Hall

Under human pressure, the oceans are changing at a rapid pace. To map future pathways on a local or global scale, science-based scenarios can be a powerful tool. They make scientific knowledge tangible and help communities adapt and shape their ocean-related futures based on options for action. Whether you are working on ocean assessment, modelling, building coastal oceans in collaboration with local communities, or any other area of work related to the ocean of the future, we invite you to contribute your expertise and share your experiences.

09:45 – 10:00, Lecture Hall

The potential for regional economic development on German coasts through sustainable use of Coastal Vegetated Ecosystems

Sarah Rabe

University of Hamburg

10:00 – 10:15, Lecture Hall

Profiles of priority projects in order to develop mitigation measures to reduce the loss of mangroves in the Colombian Pacific

Jenny Paola Trujilo Ortigoza

10:15 – 10:30, Lecture Hall

Fishing for Climate Resiliency: A participatory approach to develop adaptation measures to cope with climate change

Miguel Pinto

Centro de Ciências Do Mar (CCMAR), Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal

10:30 – 10:45, Lecture Hall

The crab fishery in Portugal - Rebuilding the past, assessing the present and planning the future

João Monteiro

CCMAR - Algarve Centre of Marine Sciences, Universidade do Algarve

11:15 – 11:30, Lecture Hall

Flow in Stasis: Data-driven analysis of immobilities in marine transport

Ole Müller

Helmholtz-Institute for Functional Marine Biodiversity (HIFMB), Oldenburg, Germany

11:30 – 11:45, Lecture Hall

"From Sea to Street": The role of murals in shaping our images of the future ocean

Sophia Kochalski

CRETUS, Universidade de Santiago de Compostela, Spain

The potential for regional economic development on German coasts through sustainable use of Coastal Vegetated Ecosystems

Sarah Rabe¹

¹University of Hamburg

Keywords: coastal vegetated ecosystems, blue carbon, regional economy, coastal population

Healthy Coastal Vegetated Ecosystems (CVEs) are essential for coastal inhabitants since they provide numerous ecosystem services that benefit the well-being of coastal communities. In Germany these coastal ecosystems are saltmarshes, seagrasses and macroalgae, all of which contribute not only to coastal protection, but have their potential for carbon sequestration. Globally, however, coastal ecosystems are declining at rates of up to 7% per year. Conserving, restoring and possibly expanding CVEs can contribute to negative Greenhouse Gas (GHG) emissions but the local coastal population needs to acknowledge these potentials, respect their value, and even see their economic potential. The result of a recent population survey documented that German coastal population connote something positive with saltmarshes and seagrasses - as belonging to their homeland - while macroalgae is more ambiguous. Nonetheless, there is still a wide knowledge gap about CVEs and their advantages, especially in respect to the economic use of these ecosystems, e.g., as carbon sequester through carbon crediting and at the same time making use of the surplus biomass for local production. Using the method of Future Search Workshops, together with local entrepreneurs, nature conservatists and politicians, we intend to develop a strategy for a so-called blue carbon economy for German coastal communities. The presentation shows first results from the workshops in Schleswig-Holstein and Lower Saxony, on the actor's perspectives and demands, the constraints and the differences between the two federal states and the potential for regional economic development on German coasts through sustainable use of Coastal Vegetated Ecosystems.

Profiles of priority projects in order to develop mitigation measures to reduce the loss of mangroves in the Colombian Pacific

Jenny Paola Trujillo Ortigoza, Martha Lucia Palacios Peñaranda, Elizabeth Patiño Correa, Rafael Contreras Rengifo, Juan Carlos Mejia Renteria

Keywords: mangrove, Pacific, deforestation, climate change, mitigation measures

The mangrove is a marine-coastal ecosystem, they are extremely resilient ecosystems that can act as indicators of environmental change given their unique characteristics. The Mangrove ecosystem has been suffering different natural and anthropogenic pressures, the latter being those actions that directly and indirectly accelerate the natural effects and affect these ecosystems in a greater percentage. Mangrove forest subsists along the Pacific coast of Colombia has been estimated at a reduction of 57%, the mangrove area in 2011 was 213,857 hectares compared to 501,300 hectares in 1960. In order to postulate projects to reduce the loss of the mangroves in the Colombian Pacific areas, is highly necessary to do an environmental characterization of those areas, after doing an evaluation of their current conditions which can identify the principal issues. From the impacts identified, it could develop different environmental measures that lead to reducing, mitigating, correcting, or compensating for the loss of mangroves and the ecosystem services they offer for the study area. For instance, four specific prioritized projects will contribute to the management of the different impacts that could be identified in a Pacific: 1) Publicize the project through the participation of citizens. 2) Propose measures to reduce the loss of mangroves in the municipality of Colombian Pacific. 3) Execute measures to reduce the loss of mangroves in the municipality of Colombian Pacific. 4) Design monitoring and maintenance programs for the implemented measures to reduce the loss of mangroves in the municipality of Colombian Pacific. Prioritizing projects to manage the loss of the mangrove ecosystem and the ecosystem services that it offers for the study area, involving the community and authorities, and identifying the principal resources necessary for development efficiency each project prioritizes.

Fishing for climate resiliency: A participatory approach to develop adaptation measures to cope with climate change

Miguel Pinto¹, Marta Albo-Puigserver^{1,2}, Juan Bueno-Pardo³, Romane Thiebault¹, Maria Alexandra Teodósio¹, Francisco Leitão¹

¹Centro de Ciências Do Mar (CCMAR), Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal.; ²Centro Oceanográfico de Baleares, Instituto Español de Oceanografía (IEOCSIC), Ecosystem Oceanography Group, 07015 Palma, Spain.; ³Centro de Investigación Mariña (CIM), Universidade de Vigo, Future Oceans Lab, Campus Lagoas Marcosende, 36310 Vigo, Spain

Keywords: climate adaptation, fisheries management, governance, vulnerability, resiliency

The Portuguese fisheries is a complex eco-socio-economic system and a cultural cornerstone of the country. As climate change threatens to unbalance this delicate system it becomes necessary to develop adaptation plans to reduce its vulnerability. Our objectives were to 1) review and assess climate change adaptation plans in Portugal, 2) develop a participatory approach that includes fishing communities' input in the development of adaptation plans, 3) advance with a list of measures for different communities regarding adaptation based on scientific data and fishers' contributions. The literature review of adaptation of climate change documents revealed that plans at the national scale scarcely mentioned fisheries and, a complete lack of possible adaptation measures, specific to the sector. In regional and local documents, while fisheries are mentioned more often, adaptation measures are still lacking. The participatory approach consisted of a series of workshops with fisheries stakeholders and was complemented by field surveys/inquiries to fishers along the main ports of the Portuguese coast. This approach demonstrated that ecological measures, such as temporary fishing closures or minimum landing sizes were well accepted by the attending stakeholders and, in contrast, marine protected areas (MPAs) were not well accepted by the attending stakeholders who argue that the fishing community has little contribution for MPA decisions and regulation processes. Institutional measures (i.e., subsidies reduction and landing obligations) were, in general, the less accepted. Despite regional differences, fishers demonstrate a clear willingness to integrate management and decision-making processes in co-management-like plans between the stakeholders (i.e., fishers, scientists, environmentalists, industrialists, etc.). We expect this multiple participatory approach to 1) increase the knowledge and environmental awareness of fishers regarding climate change and 2) provide scientific backing to develop adaptation measures to cope with climate change, aiming to help fisheries managers adapt to potential future challenges.

The crab fishery in Portugal - Rebuilding the past, assessing the present and planning the future

João N. Monteiro¹, Rubén Roa-Ureta¹, Andreia Ovelheiro¹, Maria Alexandra Teodósio¹, Francisco Leitão¹

¹CCMAR - Algarve Centre of Marine Sciences, Universidade do Algarve

Keywords: *Carcinus maenas*, Artisanal fishery, Estuarine fishery, Socio-economic assessment, Stock assessment

Small-scale fisheries exhibit great variation between geographic areas, not only due to different biological and environmental conditions, but also due to a variation on the socio-economic, and historical contexts. Information on harvesting and fishery of small crabs along Portuguese estuarine communities, and their dependence on this fishery is scarce. An integrated study was implemented to characterize crab estuarine fisheries through the Portuguese coast. In this study, a socio-economic assessment of crab (*Carcinus maenas*) fishing was carried out and the exploitation status was determined. The results show that the crab fishery in Portugal is of local importance since the 60s, involving a large number of fishers specifically for this species. While in the first years the crab was exported to Spain for fishing companies, in the last two decades it has gained importance as bait for other fishing activities, such as octopus and sport fishing. Nowadays, a reduced number of families are involved in crab fisheries, which is their main source of income, being mainly carried out by men with advanced age. The systems with the largest catches are Ria de Aveiro and Sado river. They present distinct fishery characteristics and prices at which crab is sold range between 1 and 2 Euro/Kg. For the period between 1989 to 2020, stock assessment analysis revealed that the yearly landings never exceeded the exploitation sustainable status on both systems. This study highlights that the small-scale crab fishery in the Portuguese systems has been socioeconomically important along the last decades. This study highlights that the small-scale crab fishery in the Portuguese systems has been socioeconomically important over the last few decades. However, nowadays, it has reduced importance due to the absence of regulatory measures. With changes in these regulations, it could be an alternative to other estuarine fisheries and potentially becoming an important estuarine fishery in the Portuguese systems.

Flow in Stasis: Data-driven analysis of immobilities in marine transport

Ole J. Müller^{1,2,3}, Thilo Gross^{1,2,3}

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Keywords: Mobilities, Shipping, Positional Data, AIS

Humans built ships for marine mobility, but ships are sometimes observed to remain stationary for prolonged times. This contradiction opens questions on the influences that drive ships to become immobile. Marine transportation is a global scale infrastructure with large ecological impacts and strong political and economic ties. The sector needs to be understood and incorporated into our models of future oceans. Current research on marine transportation is mainly concerned with the movement of vessels and less with their stationarity. Here we analyze positional data to uncover temporal and spatial patterns of immobility. The data set covers the United States waters pre- and post- Covid 19 pandemic. We found that for the US marine immobility is strongly driven by tankers. Moreover, the probability that a cargo ship regains mobility on the next day is independent of the time it has remained stationary before. Hot-spot areas for ship immobility are located close to central places in the global shipping network, such as Galveston or Los Angeles. There is a regular seasonal pattern of immobility in shipping that was disrupted by the Covid 19 pandemic. Despite the significant disruptions we did not detect evidence for a deliberate immobility response in US waters. Our study demonstrates how big data from automated sources can be used to uncover major patterns in (im)mobility. The identified patterns open up discussions into the influences on global shipping that drive immobility. A deeper understanding of the reactions the shipping sector employs to deal with crisis, and the factors driving these reactions will help to provide more robust scenarios of the future ocean.

"From Sea to Street": The role of murals in shaping our images of the future ocean

Sophia Kochalski¹, Ignacio Gianelli¹, Katina Roumbedakis¹, Baiba Pruse², Marien Helmus², Marta Dievina³, Tanja Straka⁴, Natali Lazzari¹, Sebastian Villasante¹

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⁴Technische Universität Berlin, Germany

Keywords: Citizen science, Street art, Urban youth, Public perception, Ocean stewardship

The ocean is essential for life on earth, but is facing severe challenges, including pollution, overfishing, and climate change. Research shows that living at the coast and exposure to the ocean, especially as a child, strengthen one's connection with the ocean and encourages ocean stewardship. In inland and urban areas, such direct interactions are more infrequent, so that mediated interactions, e.g., through books, movies, documentaries, photos, science education and journalism, become more important. Murals, a specific form of street art, have become more common in many European cities in recent years and are promoted via art festivals and city marketing. They can evoke emotion, teach, inspire, motivate, remind, explain, and shape future human-environment relationships, particularly in inland and urban areas. The project "From Sea to Street" is a citizen science initiative collecting murals and the stories and emotions they evoke in four European countries (Germany, Spain, the Netherlands, and Latvia). We will highlight the importance and potential of murals for ocean conservation from a scientific and transdisciplinary point of view and present our Citizen Science campaign, in which the whole ICYMARE family is invited to participate.

Session 4.2
The Future Ocean
Biological Carbon Pump



The future ocean biological carbon pump

hosted by Kea Witting

Thursday, 21st September 2023, 09:45 – 12:00, Seminar room A

In a changing ocean, assessing possible scenarios for the Biological Carbon Pump (BCP) locally and globally becomes more important than ever. With rising atmospheric carbon dioxide, ecosystem structures are likely altered which results in alterations in the BCPs carbon export potential. Detangling pathways of the BCP on ecosystem scales still poses a challenge. Harmonizing in situ observation methods with classical approaches across research institutes could help solve this problem. This session invites contributions on changing pathways of the BCP and future indications they can hold. Example studies using various techniques to investigate BCP dynamics are welcome.

09:45 – 10:00, Seminar room A

Understanding carbon cycling across coastal soft sediments: the contribution of macrofauna to community respiration

Eva Karin Rohlfer

10:00 – 10:15, Seminar room A

A first estimate of the effect of offshore wind farms on sedimentary organic carbon stocks

Knut Heinatz

Institute of Marine Ecosystem and Fishery Science, Marine Ecosystem Dynamics, Universität Hamburg, Hamburg, Germany and Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia

10:15 – 10:30, Seminar room A

Quantifying the bioavailability of coastal iron sources from South Georgia to natural phytoplankton communities

Jasmin Stimpfle

Alfred-Wegener-Institut

10:30 – 10:45, Seminar room A

Effects of seasonal changes in phytoplankton biodiversity on the carbon cycle

Catharina Uth

Tvärminne Zoological Station, University of Helsinki, Hanko, Finland

11:15 – 11:30, Seminar room A

Effects of climate change induced dominance shifts in zooplankton community composition on the carbon cycle

Tjardo Stoffers

Tvärminne Zoological Station, University of Helsinki, Hanko, Finland

11:30 – 11:45, Seminar room A

Shit happens - Fecal pellet production of copepods as part of the passive carbon flux

Hanna Stegemann

BreMarE - Bremen Marine Ecology, Marine Zoology, Universität Bremen, Bremen, Germany

11:45 – 12:00, Seminar room A

Influence of the Amazon River Plume on particles and zooplankton distribution in the Tropical Atlantic

Claudeilton de Santana

GEOMAR Helmholtz Center for Ocean Research Kiel and Christian-Albrechts-Universität zu Kiel

Understanding carbon cycling across coastal soft sediments: the contribution of macrofauna to community respiration

Eva Karin Rohlfer, Anna Villnäs^{1,2}, Camilla Gustafsson, Laura Kauppi, Joanna Norkko, Alf Norkko

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²Baltic Sea Centre, Stockholm University, Stockholm, Sweden

Keywords: infauna, biodiversity, carbon fluxes, coastal ecosystems, seafloor

Coastal ecosystems are biodiversity and carbon cycling hotspots and are inhabited by productive, diverse communities with intense carbon recycling potential. Links between biodiversity and carbon cycling are poorly understood and, despite their key role in ecosystem functioning, macrofauna is often overlooked. Seafloor flux measurements linked to infauna data over large scales are scarce and thus assessing the contribution of macrofaunal metrics to carbon cycling is difficult. In this study, we combined data measuring seafloor respiration over environmental gradients in the Finnish archipelago together with faunal abundance and biomass data to study the faunal contribution to respiration across different habitat types and seasons. We show that the contribution of fauna in shallow habitats is more prominent in sandy habitats compared to habitats with higher organic matter content, while total seafloor respiration is the highest in muddy habitats. Total seafloor respiration was lower in shallow sandy habitats (depth: 3 m) compared to deeper habitats (depth: 10 & 33 m), but varied seasonally for all depths. We found that seasonality in faunal respiration decreased with depth. We documented the highest faunal contribution in the winter months when total seafloor respiration was generally low as well as in late summer when total seafloor respiration decreased and faunal respiration was relatively high. Taxa that contributed the most to faunal respiration were large-bodied bivalves and polychaetes *Macoma balthica*, *Mya arenaria*, *Marenzelleria* spp., *Hediste diversicolor*, and abundant snails, such as *Hydrobia* spp. The contribution of microbial respiration to total respiration increased with depth, organic matter content, and warmer temperatures. Our results highlight that those variables which offset the carbon sink capacity are dependent on habitat type, biodiversity, and seasons. Moreover, biodiversity elements such as macrofauna are important to consider when assessing carbon cycling potential, especially considering how climate change and other human pressures are influencing biodiversity.

A first estimate of the effect of offshore wind farms on sedimentary organic carbon stocks

Knut Heinatz^{1,2}, Maike Iris Esther Scheffold

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Keywords: environmental impacts, sediment disturbance, wind park, offshore wind turbine (OWT) monopile

Offshore wind farms (OWFs) can increase the transfer and stock of organic carbon (OC) in the surrounding sediments during their operational phase, while their construction and decommissioning release carbon. To answer the question whether sediments of OWFs trap more OC than they release, we estimate the net carbon effect over the entire life cycle (construction, operational and decommissioning phases) of OWFs in the Southern North Sea. Based on existing studies we compare the increased OC flux due to the colonization of organisms at the foundations of wind turbines and the OC loss due to sediment-disturbing activities during construction and decommissioning. Our results show that the areal intensity of carbon release in the disturbed areas is about 43.5 times higher than that of carbon trapping in the entire area of the OWFs. However, since the disturbed areas only account for about $0.50 \pm 0.06\%$ of the total area of the OWFs, in absolute terms about 4.6 ± 1.4 times more carbon is trapped in the sediment of the OWFs than is released. Due to limited data availability and the resulting need for extensive assumptions, our estimates only represent orders of magnitude. We therefore provide sensitivity estimates that define the limits of our calculations in terms of disturbance depth, remineralisation ratio, scour protection measures and heterogenous OC contents. In addition, we identify shortcomings of our extrapolation. Further research, especially more advanced impact assessments of construction and decommissioning processes must follow to improve the understanding of impacts of OWFs on sedimentary OC.

Quantifying the bioavailability of coastal iron sources from South Georgia to natural phytoplankton communities

Jasmin Stimpfle¹, Florian Koch¹, Berenice Ebner¹, Scarlett Trimborn¹

¹Alfred-Wegener-Institut

Keywords: Southern Ocean, iron limitation, phytoplankton productivity, biological carbon pump

In vast regions of the Southern Ocean, Phytoplankton productivity is limited by the micronutrient iron (Fe). Besides concentrations of Fe in seawater, the bioavailability i.e., the Fe chemical species that can be acquired by phytoplankton governs primary production and consequently biological sequestration of carbon dioxide. The sources of Fe that fuel extensive open ocean phytoplankton blooms downstream of the island South Georgia (Atlantic sector of the Southern Ocean) are poorly known. To investigate the bioavailability of five coastal sources of Fe (Groundwater, coastal water and glacial meltwater from 3 different locations), we conducted incubation experiments with natural phytoplankton communities during the Polarstern expedition Island Impact (2022), using a radioactive tracer (⁵⁵Fe). Our results show that the selected Fe sources are not equally taken up by phytoplankton and stimulate productivity differently. Further, we will assess the ecological relevance of each source in the ecosystem by tracing their isotopic signature and modelling nutrient fluxes and water masses around the island of South Georgia.

Effects of seasonal changes in phytoplankton biodiversity on the carbon cycle

Catharina Uth¹, Eero Asmala², Aleksandra Lewandowska¹

¹Tvärminne Zoological Station, University of Helsinki, Hanko, Finland; ²Geological Survey Finland (GTK)

Keywords: carbon cycle, phytoplankton, biodiversity, seasonal changes

The seasonal change in environmental conditions favors different groups of phytoplankton species resulting in community shifts and varying carbon dynamics. However, anthropogenic effects on the seasonal cycle alter the composition and diversity of phytoplankton communities, which can have a cascading impact on carbon flows and storages in coastal ecosystems. Our study focuses on the effect of phytoplankton community seasonal change on the carbon cycle in the Baltic Sea. We collected samples roughly every other week, for one year, from two stations in the coastal Gulf of Finland to follow the changes in phytoplankton composition and evenness and estimate the pelagic carbon stock. In addition, we deployed sediment traps every season to assess carbon export to the seafloor. The spring phytoplankton community was dominated by diatom species (95%), which potentially results in higher carbon transport to the seafloor due to their high sinking velocity. The summer and autumn communities consisted mainly of cyanobacteria (63%) which can form high biomass, but have low sinking potential allowing for higher carbon emission to the atmosphere. The highest POC/PON ratio occurred during February (9.6 mol/mol) and lowest values were measured in November (2.1 mol/mol), suggesting the highest carbon accumulation in the water column in spring. Overall, our study emphasizes the importance of phytoplankton community composition to the carbon cycle dynamics and highlights the need for seasonal monitoring to fully understand the carbon transport from pelagic communities in coastal areas.

Effects of climate change induced dominance shifts in zooplankton community composition on the carbon cycle

Tjardo Stoffers¹, Louise Forsblom², Aleksandra Lewandowska¹, Maiju Lehtiniemi²

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Keywords: community change, time series, zooplankton, carbon pump

Anthropogenically induced climate change has affected the marine environment by ocean warming, acidification, changed nutrient loads and changed salinities. Due to its long water exchange time, shallow depth and low salinity, the effects in the Baltic Sea happen earlier and stronger than in other seas. For instance, the Baltic Sea has already faced temperature and salinity fluctuations that most other seas will only experience in the future. These changes alter zooplankton communities in terms of community composition or functional diversity with a reported shift towards smaller organisms and a loss of zooplankton biomass. Ultimately, changes in zooplankton community composition can alter the functioning of the biological carbon pump in terms of carbon uptake, transport and export as the potential decrease in zooplankton size could weaken the transport of organic material to the seafloor. In this study, zooplankton data from the long-term monitoring site Tvaerminne Storfjaerden in the Gulf of Finland, northern Baltic Sea, spanning 55 years, are analysed to identify changes in zooplankton community composition and model future developments. The results show a decline in the abundance of larger zooplankton species and a concurrent increase of smaller zooplankton species due to rising temperatures and decreasing salinity. Based on these results experiments will be conducted to identify direct (e.g., respiration rates, carbon export in form of excretion and CH₄) as well as indirect effects (e.g., grazing pressure) of the changed community structure on the carbon cycle.

Shit happens - Fecal pellet production of copepods as part of the passive carbon flux

Hanna Stegeman¹, Maya Bode-Dalby¹, Niko Lahajnar², Bettina Martin³, Morten Iversen⁴, Holger Auel¹

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Keywords: mesozooplankton, organic matter transformation, carbon export, egestion rate, elemental analysis

Mesozooplankton is a major component of the ocean's biological carbon pump, respiring CO₂, transforming organic matter, recycling nutrients in the surface ocean and exporting carbon to the deep sea. This study focused on copepods as key mesozooplankton organisms in the Benguela Current Upwelling System (BUS) to analyse species-specific contributions to the passive carbon flux via the production of compact, fast-sinking fecal pellets (FP) that efficiently export particulate organic carbon (POC) to depths below the epipelagic. FP production rates, volume, carbon and nitrogen content were measured in individual and bulk incubation experiments, and FP sinking rates were calculated based on their dimensions. From seven tested species, *Neocalanus tonsus* showed the highest FP production rate, followed by *Calanus agulhensis* and *Chiridius cf. gracilis*. Within a copepod body length range of 2-6 mm, FP length, as a proxy of FP carbon content, was independent of copepod size, as in situ FP sizes and production rates rather reflected different physiological adaptations and feeding strategies, but also the current feeding status. Overall, *Calanoides natalis* was identified as the most important contributor to the POC flux in the BUS due to its high abundance. Digestion efficiency, i.e., the difference between the C:N ratio of FPs and food, varied in all species, with most showing higher N than C absorption, resulting in a high FP C:N ratio. Therefore, the copepod species composition could influence the strength and efficiency of the biological carbon pump, as a high FP C:N ratio would promote C export and efficient N recycling. Ultimately, in situ FP characteristics and production rates of key species are needed to validate biogeochemical models, but species-specific contributions to the POC flux are difficult to predict, and monitoring of environmental parameters and more detailed studies that consider diurnal cycles are required.

Influence of the Amazon River Plume on particles and zooplankton distribution in the Tropical Atlantic

Claudeilton S. de Santana^{1,2}, Rainer Kiko¹, Helena Hauss³,

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³NORCE Norwegian Research Centre;

Keywords: ZooScan, Underwater Vision Profiler, land-ocean continuum, biological carbon pump, Western tropical Atlantic

The Amazon River Plume (ARP) is the largest freshwater input in the world's ocean and causes a huge enrichment in the planktonic production in Western tropical Atlantic. However, particle and zooplankton studies in this region are still scarce, especially regarding biomass distribution and carbon fluxes. Thus, this study aims to quantitatively investigate the horizontal and vertical distribution of zooplankton and particles in terms of abundance, biovolume and biomass along the ARP continuum: inner shelf waters, outer plume, and oceanic waters. Zooplankton samples were obtained along the ARP through multinet and bongo hauls in two different seasons in the context of the Camadas Finas III and N-Amazon projects, during and without the ARP retroflexion period. Profiles of in-situ images were also obtained using an Underwater Vision Profiler (UVP5) during N-Amazon. Net samples were digitalized with a ZooScan, and the obtained images were analyzed using the software ZooProcess and the Ecotaxa web application. Statistical analyses were conducted to compare the ARP distribution zones, physical-chemical parameters obtained through CTD, and to infer ecological interpretations. Preliminary results showed significant differences between the biomass values from the inner shelf ($66919.01 \pm 61612.58 \text{ mgC m}^3$) and outer plume zones ($318583.5 \pm 366847.5 \text{ mgC m}^3$) as well from the outer plume and shelf break samples not influenced by the ARP ($190978.9 \pm 417883.6 \text{ mgC m}^3$). In general, mean values for abundance (ind/ m^3) and biovolume (mm^3/m^3) were also higher in the areas influenced by the ARP than areas without its influence, while horizontal carbon fluxes ($\text{mgC m}^{-2}\text{s}^{-1}$) increased in a costal-oceanic gradient along the ARP continuum. Furthermore, these general trends highlight the importance of the Amazon coastal areas as a source of planktonic organisms to open ocean.

Workshops



Workshops

What is Organisms Democracy Baltic Sea and who will speak for the Chinese Mitten Crab?

Georg Reinhardt

Organisms Democracy NGO and artists collective Club Real

Keywords: multispecies society, political ecology, organisms rights, parliament of species, science goes public

How can marine biology research be brought closer to the public? How can we involve more people in the dramatic stories that take place and come alive for marine biologists in the data and charts? Maybe with a theatre performance staging political discussion between different species of the Baltic Sea? Or maybe we can even ask the audience to take the perspective of a Chinese mitten crab and argue on its behalf.

We would like to offer a perspective how performing art, and participatory practices can help translate important research results to the larger public and get your perspective and opinion on how Organisms Democracy Baltic Sea should continue. We would like to discuss with you how science could and should be part of a „democracy of all species“.

What are the challenges for a multi species coexistence amidst climate crisis and ongoing human colonisation of the ecosystem Baltic Sea? Should humans share political power and involve other species in decisions on marine ecosystems? What is Organisms Democracy and could it be a chance for the Baltic Sea?

Organisms Democracy is a cultural and political practise that has been developed by the artists group Club Real with citizens representing more than human species in different ecosystems in Germany, Austria and Sweden. In our Workshop at ICYMARE we would like to ask questions, explore possibilities, and create alliances for a possible Organisms Democracy Baltic Sea.

Workshops

Diversity in science - no brainer or long way to go?

Samantha Schwickert

Spielköpfe, Bach und Fischer GbR

Keywords: equality, feminism, sustainability, sustainable management, diversity

Science aspires to be neutral, inclusive, and egalitarian. This is also important in the marine sciences, where the sustainable management and use of resources needs to consider the voices of different disciplines as well as societal stakeholders. However, who actually has access to the scientific system? Do we all truly have the same opportunities within this system? What are privileges, and how do they influence social inequality and even "neutral" science? During our workshop, we aim to discuss and visualize these questions to better understand the significance and impact of privileges. We will explore mechanisms of social inclusion and exclusion and engage in conversations about subconscious stereotypes, e.g., gender, race, and age. Through playful and interactive activities, we will uncover the inequalities that exist, particularly within the scientific system, and why it is crucial to reflect upon our own privileges if we want to achieve diversity and equality in science. Thus, the workshop is targeted at everyone within the ICYMARE community and beyond, who is open to discuss and reflect on this topic in a safer space. Sam Schwickert studied physics and sustainability science before she co-founded Spielköpfe, a social start-up dealing with gender-equality and anti-discrimination.

Workshops

The foundation of measurements: metrology

Rieke Schäfer

Physikalisch-Technische Bundesanstalt

Keywords: traceability, measurement uncertainty, sensor data

Measurements play a central role in marine sciences. A huge number of variables, such as temperature, pressure, pH and many others, are constantly measured around the world. But have you ever considered how we actually know if measurements across the globe are comparable? Or do you know how to calculate how much to trust each measurement? Both are important questions and they are the core of what metrology does. Metrology is the science of measurements, not to be confused with meteorology - the science of weather. Metrology is all about understanding measurements better and ensuring that we can compare the things we measure. How much can we trust the result we get? How well do we know all the factors that influence our measurement? Answering these questions gives us an idea of the uncertainty associated with the values we get. A part of this is to ensure traceability which is a direct connection to SI-base units for every measurement. This connection ensures that two measurements of the same unit can be compared within their uncertainty. In this workshop, we want to explore the concepts of metrology and how they are or could be implemented in your work. I will briefly present the key concepts of metrology, give you an overview why these are important, and explain how traceability is achieved. Our example case will be seawater pH measurements, on which I am currently working as part of the SapHTies project. Then we will discuss your examples and questions. Together, we can think about your measurements and how they are embedded in the overall landscape of measurements. This will highlight the potential of rigorous application of metrology to have more trustworthy results.

Workshops

The importance of stupidity in science

Yvonne Schadewell & Carolin Müller

ICYMARE

Keywords: empowerment, uncertainty, mental health, imposter syndrome




Ever felt insecure about your professional knowledge, competencies, and skills? Ever reached that point at which you felt like instantly quitting what you are doing as you are eventually not the right person to do that course, that degree, that job? Well, we've all been there and, most certainly, so have your supervisors (back in those days... and maybe still now). While we do not promise to offer a solution to our shared imposter syndrome, we warmly invite you to exchange your stories with us. We believe that accepting that feeling stupid once in a while may even advance you as a scientist and researcher. We also believe that this feeling can even be used in your own favour! Interested how? Then don't hesitate and join us and embrace stupidity with us! Expected Workshop Outcomes: Best-case scenario: we learn from each other methods and tools how to overcome these challenging episodes by accepting that stupidity is part of our professional and private life. Worst case scenario: a sorrow shared is a sorrow halved!

One-Device Solutions in the Lab and ...



... Underwater



pH (total scale) 
ultra-trace O₂ 
(high speed) O₂ 



Friday
22nd September 2023



Program - Friday, 22nd September

07:30	Registration & Welcome coffee	
08:30	Keynote speech and plenary discussion Gender(ed) aspects in interdisciplinary marine sciences, island studies and knowledge exchange - a (not so) scientific biography Annette Breckwoldt, Leibniz Centre for Tropical Marine Research <i>Lecture Hall</i>	
09:30	<i>Breakfast break</i>	
09:45	Session 4.5 Effects of Host-Microbiome Interactions - from Single Cell Physiology to Ecosystem Impacts <i>Lecture Hall</i>	Session 4.3 A Marine megafauna in the Anthropocene: threats, challenges, and perspectives <i>Seminar room A</i>
10:45	<i>Coffee break</i>	
11:15	Session 4.4 Animal telemetry from freshwater to the oceans <i>Lecture Hall</i>	Session 4.3 B Marine megafauna in the Anthropocene: threats, challenges, and perspectives <i>Seminar room A</i>
		Session 6.0 C Open Session <i>Seminar room A</i>
12:30	<i>Lunch break (self organized)</i>	
13:15	Round table Topic: Job applications Foyer	
14:00	Session 4.6 A Interactions and stressors in benthic communities: predicting future changes and advancing behavioral ecology <i>Lecture Hall</i>	Session 5.1 Utilizing DNA metabarcoding methods to overcome challenges in studying marine organisms <i>Seminar room A</i>
15:30	<i>Coffee break</i>	
16:00	Session 4.6 B Interactions and stressors in benthic communities: predicting future changes and advancing behavioral ecology <i>Lecture Hall</i>	Session 6.0 D Open Session <i>Seminar room B</i>
17:15	Farewell Best talk/poster awards & Project pitches <i>Lecture Hall</i>	
20:00	Post Conference Party <i>Foyer</i> The grand closing party! We will celebrate a full week of fantastic science, networking and inspiration! Don't miss this great party with dancing & drinks rounding up an exciting conference week.	

Keynote & Plenary Discussion

GENDER(ED) ASPECTS IN INTERDISCIPLINARY MARINE SCIENCES, ISLAND STUDIES AND KNOWLEDGE EXCHANGE - A (NOT SO) SCIENTIFIC BIOGRAPHY

Speaker: Annette Breckwoldt, Leibniz Centre for Tropical Marine Research

Moderation: Lena Rölfer

On this last morning of the week, let me take you on a short (non-linear) biographic journey from island to island, from lesson to lesson. As a marine biology graduate, island nerd and UN consultant, I started to understand the unique challenges and opportunities faced by small islands and their communities. Aspects such as environmental sustainability, economic development, cultural preservation, and social resilience, were all of a sudden hard to consider separately, and fed directly into my interdisciplinary curiosity. Islands somehow remained (the) one steady feature of my work. Now it combines natural and social science approaches to support the participatory, inter- and transdisciplinary integration of academic and ecosystem user knowledge on coastal marine resources and their various functions. Glimpses of what happened 'on the side' – becoming a supervisor, octopus mum, board member, tropical researcher on Iceland, and equal opportunity representative – will accompany my (not so) scientific love token.

Session 4.5
Effects of Host-Microbiome
Interactions - from Single
Cell Physiology to
Ecosystem Impacts



Effects of Host-Microbiome Interactions - from Single Cell Physiology to Ecosystem Impacts

hosted by Marrit Jacob & Alessandra Kronschnabel

Friday, 22nd September 2023, 09:45 – 10:30, Lecture Hall

Host-bacteria interactions occur in all ecosystems and affect the physiology of the interacting partners. These interactions can be beneficial, neutral, or harmful for one or both partners and may have cascading effects on ecological communities. The recognition and chemical communication between interacting partners are often mediated through the exchange of metabolites. In the marine realm, the exact processes behind these cross-kingdom interactions are largely unknown. This session invites studies exploring the mechanisms involved in host-microbiome interactions and their small- and large-scale effects on single cells, populations, ecological communities, and ecosystems.

09:45 – 10:00, Lecture Hall

Immunity: an essential force for animal-microbe crosstalk

Angela Marulanda-Gomez

Research Unit Marine Symbioses, GEOMAR Helmholtz Centre for Ocean Research
Kiel, Germany

10:00 – 10:15, Lecture Hall

Positive effects of probiotics on two common Red Sea hard corals under short-term heat stress

Mareike de Breuyn

Marine Ecology Department, Faculty of Biology and Chemistry, University of
Bremen, 28359 Bremen, Germany

10:15 – 10:30, Lecture Hall

The trials and errors of adapting chemical methods to diatom-bacteria systems

Leila Patzelt

Leipzig University and University of Bremen

Immunity: an essential force for animal-microbe crosstalk

Angela M. Marulanda-Gomez¹, Kristina Bayer¹, Martha Ribes², Lucia Pita², Ute Hentschel¹

¹Research Unit Marine Symbioses, GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany;

²Institut de Ciències del Mar - CSIC, Spain

Keywords: Sponges, phagocytosis, immune receptors, Fluorescence activated cell sorting, RNA- Seq

Animal-microbe symbioses rely on a fine-tuned crosstalk between animal hosts and associated microbes. Underlying mechanisms controlling the specificity of these interactions remain largely unknown. Cumulative evidence identified immunity as the driving force for microbial recognition, tolerance, and homeostasis within animal holobionts. Early branching metazoans provide an opportunity to investigate the onset and conserved mechanism of host-microbe interactions in “higher” animal groups. Sponges (phylum Porifera) are basal metazoans that feed on water column microbes and at the same time establish symbiotic associations with some of them. Yet, it is still unclear how sponges recognize and differentiate between food to digest, symbionts to incorporate, and pathogens to eliminate. I will present two study cases to illustrate the approaches we have adopted to elucidate this sponge-microbe recognition: (1) RNA-Seq differential gene expression analysis as a method for characterizing immune-related genes involved in the response of sponges upon exposure to either seawater or symbiont microbial consortia. The molecular response of sponges to each microbial consortia suggests the host can recognize these bacteria as “non-self” and “self” and supports the presence of a hallmark of innate immunity in sponges. The differential expression of NLR-like genes indicates that these receptors play a role in microbial sensing. (2) an in-vivo phagocytosis assay coupling sponge incubations with sponge cell (host) dissociation and fluorescence-activated cell sorting (FACS) for quantifying the incorporation of different types of particles (e.g., microalgae, bacteria, and fluorescent beads) into sponge cells. Phagocytosis was found to be a fast process (contact to digestion within 1h) and to depend on particle type as well as particle concentration. Applied molecular and cellular approaches demonstrated their potential to elucidate mechanisms of microbial discrimination in sponges. Adapting these approaches to other early evolutionary metazoans could aid in unraveling the general role of immunity in animal-microbe interactions.

Positive effects of probiotics on two common Red Sea hard corals under short-term heat stress

Mareike de Breuyn¹, Malte Ostendarp¹, Yusuf C. El-Khaled^{1,2}, Neus Garcias-Bonet², Andr s F. Novoa³, Susana Carvalho², Raquel S. Peixoto², Christian Wild¹

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Keywords: Beneficial microorganisms for corals, coral holobiont, microbiome manipulation, *Acropora hemprichii*, *Pocillopora verrucosa*

The treatment with coral probiotics, i.e. beneficial microorganisms for corals (BMCs), is a novel approach where native coral-specific microbes are applied to corals to strengthen their fitness under stressful conditions. Probiotics have been shown effective in reducing coral bleaching and mortality under long-term heat stress experiments, but whether probiotics can protect corals in short-term acute heat stress is still unknown. This study aimed to evaluate the effect of probiotics on two common Red Sea Scleractinia (*Acropora hemprichii* cf. and *Pocillopora verrucosa*) under short-term heat stress. We allocated 12 coral fragments per species to each treatment at ambient (26 °C) and increased temperature (32 °C) for 48 h with half of the fragments treated with BMCs and the remaining used as control (no addition). To understand the holobiont functioning of *A. hemprichii* cf. and *P. verrucosa*, we assessed: 1) host survival; 2) primary production; 3) Symbiodiniaceae cell densities by flow cytometry; 4) chlorophyll a and c2 concentrations by UV-spectrophotometry; 5) photosynthetic efficiency by pulse amplitude modulation fluorometry; and 6) denitrification by an acetylene reduction assay. BMCs had a positive effect on coral holobionts of *A. hemprichii* cf., allowing it to maintain its functions under heat stress comparable to non-stress conditions, while they did not affect *P. verrucosa*. Remarkably, Symbiodiniaceae cells were extremely dense for heat-stressed *A. hemprichii* cf. when inoculated with BMCs, being 12 - 13 times higher when compared to untreated fragments at 32 °C. Inoculated *A. hemprichii* cf. at 32 °C further showed fully intact primary production and photosynthesis reaching efficiency levels 4 - 5 times greater than their untreated conspecifics. Our first results suggest that coral mortality may be reduced even over short-time scales by treating fragments with BMCs 2h before extreme heat stress. Heat waves are becoming more intense and frequent, and the application of probiotics or BMCs could be used as novel management strategies to effectively mitigate coral bleaching.

The trials and errors of adapting chemical methods to diatom-bacteria systems

Leila Patzelt^{1,2}, Tilmann Harder^{2,3}, Jennifer Bergemann², Alessandra Kronschnabel^{2,3}, Hannah Drewes², Ulf Bickmeyer³

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Keywords: *Thalassiosira*, fluorescence labelling, extracellular polysaccharides, ROS, nitric oxide

Diatoms are responsible for up to a quarter of global oxygen production and are the most abundant form of microalgae in the world's oceans. Diatoms and bacteria likely exchange a number of molecules including basic nutrients, metabolites, vitamins, and toxins, which affect how both partners thrive. However, interactions and selective processes between diatoms and bacteria are still largely uncharted. Within this work, marine bacteria and the diatom *Thalassiosira rotula*, isolated from Helgoland, Germany, were examined as potential interaction partners to gather insight into diatom-bacteria interactions. Chemical and fluorescent methods previously used on other systems were adapted to marine diatoms. By using saccharide-binding fluorescently labelled lectins, it was confirmed that *T. rotula* are surrounded by mannose or glucose-containing sugars, likely as exopolysaccharides, which might be able to sustain bacterial growth. This project also aimed to develop high-throughput screening methods to observe the chemical response of *T. rotula* when co-cultured with different bacteria. The stress response chemicals ROS and NO (measured indirectly through NO₂-), were quantified by an absorbance and a fluorescence dye-staining reaction. The extracellular nitrite production was assessed by the Griess assay, but the axenic *T. rotula* did not produce sufficient nitrite (LOD: 0.65 µM). This method was, however, found to be a valuable and fast tool in assessing the nitrate-reducing capacity of bacteria. The ROS-staining dye DCF-DA was shown to permeate the cell membrane and to fluoresce in specific organelles. The ROS response of *T. rotula* to an encounter with marine bacteria showed inconclusive results but yielded potential for future investigations. While navigating unsuccessful experiments, these methods led to a number of unexpected discoveries. This talk shares insight on adapting three chemical methods by navigating false positives, false negatives, and other trials to further understand the diatom-bacteria system.

Session 4.3
Marine megafauna in
the *Anthropocene*:
threats, challenges,
and perspectives



Marine megafauna in the Anthropocene: threats, challenges, and perspectives

hosted by Ramona Mattmueller & Svenja Woehle

Friday, 22nd September 2023, 09:45 – 12:15, Seminar room A

Despite conservation efforts, marine megafauna is challenged by increasing threats: chemical and plastic pollution, ghost nets, increasing noise levels, fishing, tourism, oil spills, and habitat changes caused by anthropogenic climate change, to name a few. These anthropogenic threats alter the acoustic space, (acoustic) behaviour, energetics, and physiology of these species, including impacts on potential populations such as genetic bottlenecks, increasing mortality, or displacement from important foraging or breeding areas, as well as other impacts on the biodiversity of marine megafauna. This session aims to bring together current knowledge on marine megafauna ecology and methods for studying and protecting these elusive species.

09:45 – 10:00, Seminar room A

Effects of tourism on whale shark behavior

Mariana Arguero Tejeda

Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional (CICIMAR - IPN)

10:00 – 10:15, Seminar room A

Causes and Consequences of Individualized Foraging Behaviour in an Endangered Marine Predator

Svenja Stoehr

Bielefeld University

10:15 – 10:30, Seminar room A

Decomposition of trait variability in a decreasing marine mammal population

Ane Liv Berthelsen

The Hoffman Lab, Department of Animal Behaviour, Bielefeld University

10:30 – 10:45, Seminar room A

Prevalence of morbillivirus, herpesvirus and influenza virus in Fin whales (*Balaenoptera physalus*) in the waters around Chañaral Island

Christina Aldana

IMBRsea, Panthalassa NGO and Ghent University

11:15 – 11:30, Seminar room A

Baleen whales in a changing Arctic Ocean – Investigating acoustic occurrence and habitat usage of endemic and seasonally migrating species

Marlene Meister

Alfred Wegener Institute, Bremerhaven

11:30 – 11:45, Seminar room A

Defining the Unknown: Exploring spatio-temporal patterns and characteristics of an unknown sound signal discovered in acoustic recordings from the Southern Ocean

Mercedes Chumbley

Alfred Wegener Institute for Polar and Marine Research, University of Bremen

Effects of tourism on whale shark behavior

Mariana de Jesus Arguero Tejeda, Dr. Rogelio González Armas¹, Dr. Darren Whitehead², Dr. Felipe Galván Magaña¹, Dr. Héctor Villalobos Ortiz¹

¹CICIMAR – IPN; ²Shark Research Mexico

Keywords: accelerometer, elasmobranch, shark, swimming dynamics, Animal tracking

The whale shark (*Rhincodon typus*) is the most popular species of shark for ecotourism worldwide. It is the largest fish in the world and easily recognizable by the pattern of white spots on its skin. The species' docile and calm behavior, combined with its charismatic appeal to tourists, explains its popularity in ecotourism. However, there is limited knowledge about the acceleration and propulsion forces related to its swimming, as well as its behavior and evasive turns when tourists are present. To gain insight into these areas, an unprecedented fine-scale analysis will be conducted to understand the effects of human interactions on the whale shark's swimming behavior during ecotourism. It is hypothesized that interactions with tourists cause avoidance behavior in the whale shark, which increases its energetic cost. Therefore, this study aims to provide accurate numerical information on the whale shark's behavior to ensure good practices or adapt guidelines for ecotourism in the Bay of La Paz, Mexico. To record the necessary variables of swimming dynamics, non-invasive sensors called accelerometers will be placed on the whale shark's dorsal fin. These variables include acceleration, heading based on the Earth's magnetic field, and pressure. The Euler rotation angles will be calculated from these variables to indicate changes in direction of the animal. The acceleration will be divided into static and dynamic acceleration, and the "global dynamic acceleration of the body" will be obtained from the latter, which is necessary to calculate the energy expenditure. Some of the analyses will be conducted using the TagTools and AnimalTrack packages in R-Studio. By understanding the swimming behavior of the whale shark both with and without tourists present, this study will contribute to maintaining good ecotourism practices and guidelines in the Bay of La Paz, Mexico.

Causes and Consequences of Individualized Foraging Behaviour in an Endangered Marine Predator

Svenja Stoehr¹, Alexandra Childs¹, Jonas F. L. Schwarz¹, Oliver Krüger¹

¹Bielefeld University

Keywords: animal behaviour, individualization, marine mammal, life history, El Niño

Specialisations in foraging behaviour have been described for many species, however our knowledge about their causes as well as consequences remains mostly hypothetical. Strong stability of individual foraging strategies in particular could entail consequences not only for an individual but an entire populations` ability to cope with environmental change. In this study, we combined biologging data of 53 adult Galapagos sea lion females (*Zalophus worlebaeki*) with a newly developed morphological proxy to classify individuals as benthic and pelagic foragers and demonstrate a temporal stability of foraging strategies at a hitherto undescribed extent. With 20 years of monitoring data, including information on early life, development and reproductive success, we could utilise detailed life-history data to help understand the development as well as consequences of stable foraging polymorphisms in these animals. When investigating potential causes, we focused on the significance of environmental conditions and early social environments, factors that are strongly affected by climate change and the ongoing population decline, respectively. To study the consequences of these strong specializations for females, we compared the reproductive success of benthic and pelagic foragers over two decades and thus under different environmental conditions. This allowed us to identify an environment-dependent fitness trade-off, where the reproductive success of pelagic foragers is initially higher but strongly negatively affected by increasing sea surface temperature, while the reproductive success of benthic foragers is lower but unaffected by environmental change. With this study, we could therefore not only demonstrate how environmental conditions, and changes thereof, could lead to individualization in foraging behaviour, but how this in return creates a partial buffer effect against climate change in an endangered marine predator.

Decomposition of trait variability in a decreasing marine mammal population

Ane Liv Berthelsen¹, Rebecca Nagel², Anneke Paijmans¹, Joseph Hoffman¹

¹The Hoffman Lab, Department of Animal Behaviour, Bielefeld University; ²University of St. Andrews

Keywords: marine mammal, genomics, heredity, individualization

Variation in wild populations is shaped by genetic and environmental aspects specific to the individual, but little is known about how strongly these factors contribute to individual trait variation and how they interrelate. We investigated a broad range of intrinsic and extrinsic factors potentially affecting individual trait variation in Antarctic fur seals, *Arctocephalus gazella*. The species was brought to near extinction due to sealing in the 18th and 19th century, rebounded and now face the challenges inflicted by climate change. We collected biometric, endocrinological, genetic, immunologic, and movement data from a total of 100 mother-pup pairs at two adjacent breeding colonies with a fourfold difference in density during two consecutive breeding seasons. The first season was, coincidentally, a year of very low food availability. Individual investigation of these traits has revealed substantial impact of environmental and genetic variability on individual trait variation. Utilizing a Bayesian modelling framework, the proportion of variance in a phenotypic trait explained by additive and non-additive traits was investigated and used to estimate heritability of time-variant co-variants. We hypothesized that 1) the intrinsic and extrinsic factors can explain a considerable proportion of the observed variation, and that 2) the proportion explained by additive effects estimated using respectively microsatellites and SNPs are comparable. Elucidating intricate multi-trait complexes have important implications for understanding and managing wild populations in a changing world.

Prevalence of morbillivirus, herpesvirus and influenza virus in Fin whales (*Balaenoptera physalus*) in the waters around Chañaral Island.

Cristina Aldana^{1,2,3}, Frederick Toro^{2,4}

¹IMBRsea; ²Panthalassa NGO; ³Ghent University; ⁴Santo Tomas University

Keywords: Virome, Cetaceans, Conservation

Fin whales (*Balaenoptera physalus*) are present from temperate to subpolar waters of the world. However, they migrate to higher latitudes for feeding and return to low latitudes for breeding and calving. One of the feeding sites is located in north-central Chile. Specifically, near four Islands located in the Humboldt Current System. Fin whales are listed as an endangered species and face threats including ship strikes, entanglement in fishing gears, hunting, climate change, pollution, recreational, commercial use of preferred habitat, and increased ocean noise. While rarely considered as a major driver of population decline or cause of extinction, pathogens have been implicated in various mass mortalities, being nowadays seen as a serious threat to wildlife conservation. On marine mammals, health problems associated with emerging diseases, especially those of viral origin given their high degree of mutation, remain a concern. The aim of this project is the study of the prevalence of morbillivirus, herpesvirus, and influenza viruses in Fin whales. Sampling took place in Chañaral del Aceituno, one of the four islands forming the feeding site in the Humboldt Current System. Blow sampling has been used to determine respiratory virome and was collected non-invasively using a 5m pole with a petri plaque attached to its end. Virus prevalence was detected using DNA extraction and PCR amplification. Our results show that any animal was infected by herpesvirus or morbillivirus, whereas influenza was present in 18.18% of the samples. This study shows non-invasive techniques to assess cetaceans' health, and the importance of the virome analysis for wildlife conservation. Moreover, the presence of influenza virus on fin whales, raises concern on the impact of this disease on Chilean wildlife.

Baleen whales in a changing Arctic Ocean - Investigating acoustic occurrence and habitat usage of endemic and seasonally migrating species

Marlene Meister¹, Dr. Karolin Thomisch¹

¹Alfred Wegener Institute, Bremerhaven

Keywords: bioacoustics, marine mammals, Fram Strait, blue whales, vocalizations

The Arctic Ocean's baleen whales face severe environmental changes due to climate change, including rising water temperatures, sea-ice retreat, and altered plankton bloom occurrences. These factors are likely to affect habitat suitability for the Arctic endemic bowhead whale (*Balaena mysticetus*), as well as seasonally migrating baleen whale species, such as blue (*Balaenoptera musculus*), fin (*B. physalus*), and sei whales (*B. borealis*), causing northward distributional range shifts and changes in migratory behaviors. Secondary effects could exacerbate stress on marine mammals through increased interspecific competition, orca (*Orcinus orca*) predation, and human activities in previously inaccessible Arctic Ocean areas. To investigate impacts of climate change on endemic and seasonally migrating baleen whale species, passive acoustic monitoring data collected between 2012 and 2022 in eastern and central Fram Strait are analyzed. For this purpose, a combination of manual and automatic detection methods is applied to assess acoustic presence patterns of different species. Preliminary results on blue whale acoustic presence suggest vocalizations to primarily occur from July to October. Notably, an unanticipated early onset of calling activity in May 2019 might suggest a potential temporal shift towards earlier calling times in recent years. However, due to limitations in data availability, a comparison of phenological patterns across different years could not be performed so far. In January 2017 and February 2021, vocalizations were discovered on a few consecutive days indicating that individual blue whales either remained in or migrated into Fram Strait during winter. Further analyses are ongoing to derive detailed information on environmental impacts on blue whale acoustic presence. The findings offer critical information on baleen whale (acoustic) occurrence and habitat usage, necessary to monitor and mitigate anthropogenic and climate-change related threats to marine life in an already vulnerable ecosystem and for developing effective conservation strategies in the face of the rapidly changing Arctic environment.

Defining the Unknown: Exploring spatio-temporal patterns and characteristics of an unknown sound signal discovered in acoustic recordings from the Southern Ocean

Mercedes Chumbley¹, Dr. Ilse van Opzeeland²

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Keywords: Marine bioacoustics, Passive acoustic monitoring, Soundscape, Antarctic Weddell Sea, Unidentified underwater sound sources

Sound is an important source of information for life underwater and forms the basis for communication in many aquatic species. Attributing acoustic signals to species often requires visual confirmation, which in polar regions is challenged by the logistic constraints of accessing and working in ice covered areas. The objective of this study was to characterize an unknown underwater sound signal and to define its spatial and temporal occurrences and patterns aiming to obtain cues for the identification of its source. The sound has appeared at 4 stations along the Greenwich Meridian, as well as off the coast of Namibia. The unknown sound had been recorded repeatedly across the Antarctic Weddell Sea and consists of a sequence of broadband pulses that continues over periods up to 21.8hrs. By audio-visually screening spectrograms from year-round hydrophone data from these stations, results revealed that the signal was present during the months of February and March in the years of 2011-2013. The presence of the signal in these recordings in multiple years suggests a consistent seasonality in its occurrence. Ongoing work focuses on defining the signal's acoustic characteristics such as bout duration, interval length and peak frequency. By combining the results from these analyses with information on the timing of behavior from different species, this project hopes to contribute to an eventual identification of the sound source.

Session 4.4
**Animal telemetry from
freshwater to the oceans**



Animal telemetry from freshwater to the oceans

hosted by Arc'hantael Labrière and Lotte Pohl

Friday, 22nd September 2023, 11:15 – 12:15, Seminar room A

Aquatic telemetry is becoming a common technique using animal-borne tags to study movement on various scales or even intra- and inter-specific interactions. By quantifying animal movement remotely, management decisions involving fisheries, protected areas and conservation can be greatly improved. Telemetry helps to complete knowledge gaps of the tagged species by detecting individuals without having to capture them. It also provides fundamental knowledge on endangered or invasive species, including large-scale animal migrations. This session aims to bring together current telemetry research across a diversity of taxonomic groups as well as spatio-temporal scales.

11:15 – 11:30, Lecture Hall

Thelma Biotel - Open Protocol in telemetry and recent innovations

Hilde Johannesen

Thelma Biotel

11:30 – 11:45, Lecture Hall

Movement of the starry smooth-hound shark *Mustelus asterias* in the North Sea

Lotte Pohl

Flanders Marine Institute

11:45 – 12:00, Lecture Hall

I'm loving' it! High site fidelity of cod outside the spawning season to an artificial reef in the western Baltic Sea

Carl J. F. Bukowski

Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany

12:00 – 12:15, Lecture Hall

Spawning migration and behaviour of twaite shads (*Alosa fallax*) in the Scheldt estuary, Belgium

Arc'hantael Labrière

IMBRSea, INBO - Research Institute for Nature and Forest in Flanders and Gent University, Belgium

Thelma Biotel - Open Protocol in telemetry and recent innovations

Hilde Johannesen¹

¹Thelma Biotel

Keywords: Acoustic Telemetry, Open Protocol, Collaboration, Technology, Innovation

In 2019, a set of open, acoustic transmit protocols was officially handed over to the research community. The main idea behind Open Protocol (OP) was to develop a shared open collaboration opportunity across all interested manufacturers. This allows for the creation of networks worldwide, where transmitters and receivers from separate manufacturers can work together. OP promotes healthy competition, flexibility in equipment selection, and innovation by opening acoustic telemetry networks to different sensor and transmitter manufacturers, fostering new solutions for future research. With an increase in tagging projects and the continuous deployment of thousands of acoustic receivers all over Europe and the world, OP has been developed with the intention of collecting as much data as possible on the tagged species. Because of the migratory nature of some of these species, the collaboration between manufacturers and scientists worldwide is essential for proper research. Thelma Biotel leads in integrating tiny sensors into compact transmitters and digital receivers. Notable highlights include the mortality sensor that detects changes in status between alive and dead. The upcoming Tesla tag will monitor electromagnetic field exposure, particularly in wind farms. Our equipment is delivered with a future-proof choice of open protocol, including the new Open Protocol Digital, allowing for transmit intervals down to seconds. Thelma Biotel is dedicated to uniting a collaborative mindset with high-quality technological equipment developed in partnership with frontline scientists. Amid continuous advancements and innovations in acoustic telemetry, cross-manufacturer collaboration is essential to fully capitalize on this technology's present and future capabilities. Thelma Biotel will present the opportunities and challenges associated with open protocol in acoustic telemetry research, as well as current and future innovations within the field.

Movement of the starry smooth-hound shark *Mustelus asterias* in the North Sea

Lotte Pohl ¹, Carlota Muñiz¹, Niels Brevé^{2,3}, Jan Reubens ¹

¹Flanders Marine Institute; ²Wageningen University and Research; ³Sportvisserij Nederland

Keywords: Acoustic telemetry, Acoustic Data Storage Tags, North Sea, *Mustelus asterias*

To successfully manage fish populations, knowledge on distribution and movements is necessary. Acoustic telemetry investigates animal movements within the spatial range of acoustic receivers, while archival Data Storage Tags (DSTs) continuously log temperature and pressure allowing to infer animal trajectories through geolocation modelling. Recently, these two technologies were merged into a single tag: the Acoustic Data Storage Tag (ADST), which combines the benefits of both technologies. Elasmobranchs are especially vulnerable to threats from climate change and anthropogenic pressure due to late sexual maturity and low fecundity. This makes them a high priority group for conducting movement ecology studies. The starry smooth-hound shark *Mustelus asterias* (Cloquet 1819) is a widely distributed elasmobranch in the Northeast Atlantic Ocean. Its population is currently stable but fishing pressure on the species might increase following the protection of the spiny dogfish *Squalus acanthias*. Crucial habitats for mating or pupping are not clearly identified yet, and previous studies on *Mustelus asterias* suggest a difference in circannual migration patterns dependent on sex and life stage. During 2018 and 2019, 30 individuals of *M. asterias* were tagged with ADSTs in the Scheldt estuary (Dutch Southern North Sea). Acoustic detections were obtained from the permanent network of acoustic receivers deployed in the Belgian Part of the North Sea and the Westerscheldt as part of LifeWatch. Twenty individuals were detected in the acoustic network, and 8 of the tags were recovered. Three of the recovered tags were detected by acoustic receivers. Two of the recovered tags logged information for >1 year, one of which was in a female, and the other in a male *Mustelus asterias*. Their modelled trajectories show a sex bias in winter habitat with the male migrating north into the Southern North Sea, and the female migrating south into the English Channel which goes in line with previous studies. Pressure and temperature data (where available, i.e., the tags have been recovered) will be used in combination with the acoustic detections to infer differences between sex and life stages in habitat use and location. Relevant environmental variables such as temperature and food availability, and anthropogenic sea use such as through Offshore Wind Farms and fishing vessels will be consulted to infer explanations for potential differences found. Further results on movements within the Southern part of the North Sea will be discussed.

I'm loving' it! High site fidelity of cod outside the spawning season to an artificial reef in the western Baltic Sea

Carl J. F. Bukowski¹, Bodo Dolk², Olaf Krüger², Thomas Mohr³, Steffen Schulz³, Thomas Lorenz², Stefanie Haase¹, Gerd- Michael Arndt³, Malte Dorow³, Uwe Krumme¹

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Keywords: Western Baltic Cod, acoustic telemetry, artificial reefs, site fidelity, tagging

Cod show site fidelity to spawning grounds, but the level of site fidelity to discrete locations outside the spawning season is largely unknown. The level of site fidelity can be an important metric in planning of protected areas and fisheries management. We used acoustic telemetry to assess site fidelity of cod to an artificial reef in a protected shallow-water area near Nienhagen (Germany) from 2012-2014. A total of 96 cod were caught, tagged with acoustic transmitters and released sequentially over a period of 1.5 years. 40 cod were resident and remained >100 days at the reef (mean = 240d; range 107- 485d), 56 cod stayed on average 26.4d (range: 1 - 98d) post-release before they were not detected anymore. In the pre-spawning-period 2012/13 (winter), 13 out of 42 present cod remained at the reef while 29 left, of which 17 returned in spring, likely post-spawning, to stay at the reef over summer. Over the whole period, 8 cod were caught by the fisheries, resulting in 8.3% fishing mortality, whereas natural mortality remains unknown. Our results show surprisingly long residencies for individual cod to an artificial reef structure in the Western Baltic Sea. We are currently investigating whether similar behaviour occurs on a natural slope with sandy and rocky bottom in the Bay of Lübeck using acoustic telemetry. Comparisons of the results from the Nienhagen study versus the ongoing study help to understand site fidelity of cod outside the spawning season and provide first insights into dissimilarities in site fidelity between artificial reefs and natural habitats.

Spawning migration and behaviour of twaite shads (*Alosa fallax*) in the Scheldt estuary, Belgium

Arc'hantael Labriere^{1,2,3}, Pieterjan Verhelst², Stijn Bruneel^{2,3}, Tom Moens³

¹IMBRSea; ²INBO - Research Institute for Nature and Forest in Flanders; ³Gent University, Belgium

Keywords: acoustic telemetry, anadromous, fish movement ecology

Twaite shads (*Alosa fallax*) are encountered from Morocco to Iceland, including in the Baltic Sea. Most populations are anadromous, as adults live at sea and migrate to estuaries and rivers to reproduce. They spawn more than once in their lifetime and spawning events usually occur at night-time in spring or early summer depending on the area. Juveniles then migrate seaward in the surface layer later in the year. Significant declines were seen in the species populations in Europe due to water pollution, overfishing, habitat destruction and river fragmentation through the development of weirs and dams. As such, twaite shads were added to Annexes II and V of the EC Habitat Directive (Council Directive 92/43/EEC) and to the Appendix III of the Bern Convention (ETS No. 104). The species is also listed as 'endangered' (EN) in the IUCN Red list in Flanders. It was considered as extinct in Belgium due to poor water quality especially in the River Scheldt, however its population seems to be recovering following improved water management. Here the behaviour and migration of adult twaite shads was investigated during the spawning period in the River Scheldt using acoustic telemetry, following successful internal tagging since 2019. After providing fundamental knowledge on the species, environmental variables (time of the day, water temperature, tidal cycle, salinity, dissolved oxygen, sediment concentration, water velocity) were linked to their migration. It improves our understanding of the ecology and behaviour of this sensitive species to better target and assist appropriate management and conservation efforts.

Session 6.0

Open Session



Open Session

hosted by Theo Krüger & Jöran Paap

Friday, 22nd September 2023, 12:00 – 12:30 & 16:00 – 16:45, Seminar room A

If you think your research does not fit into any of our other sessions, please feel free to submit your abstract to the open session!

12:00 – 12:15, Seminar room A

Are persistent organic pollutants (POPs) affecting egg quality from female green (*Chelonia mydas*) sea turtles?

Inês Morão

MARE - Marine and Environmental Sciences Centre, ESTM, Politécnico de Leiria, Portugal and Faculdade de Ciências & CESAM, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal

12:15 – 12:30, Seminar room A

Understanding biofilm assemblages on aquatic plastics and their potential as a dating tool for plastic pollution

Skylah Reis

University of Cambridge

16:00 – 16:15, Seminar room A

Biodiversity, trophic position, and nutritional ecology of Euphausiid species in the Benguela Upwelling System

Tine Jordan

University of Bremen, Bremen Marine Ecology (BreMarE), Marine Zoology

16:15 – 16:30, Seminar room A

The diet of three Arctic amphipod species during the Polar Night based on DNA metabarcoding

Ann-Kathrin Dischereit

Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research

16:30 – 16:45, Seminar room A

Genetic and morphological diversity of the genus *Pontostratiotes* in the North Atlantic

Fanny Sieler

University of Hamburg

Are persistent organic pollutants (POPs) affecting egg quality from female green (*Chelonia mydas*) sea turtles?

Inês Morão¹, Tiago Simões², Roger B. Casado², Sara Vieira^{3,4}, Juan Muñoz-Arnanz⁵, Begoña Jiménez⁵, Marco F.L. Lemos¹, Sara C. Novais¹

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

Due to their complex life cycle, their diets and migratory behaviors, marine turtles tend to accumulate Persistent Organic Pollutants (POPs) in their tissues. POPs have global distribution and are known to accumulate in the environment and to be harmful to wildlife. Few studies have been made to understand POPs effects in sea turtles' tissues that may influence their overall health and their eggs quality. It is known that embryos are sensitive to POPs and due to the threatened status of such iconic marine species, it is important to evaluate this maternal transference and how a proper embryo development may be affected by such contaminant loads. The egg mass in sea turtles is mostly represented by the yolk, highly rich in lipids. As metabolic and signaling mediators, yolk fatty acids (FAs) are essential for embryo development and post-hatch activity. *Chelonia mydas* is the most common species nesting in the São Tomé and Príncipe archipelago. Studies about the possible effects of POPs in these females or in their eggs are still lacking. Thus, the aim of this study was to determine the levels of different POPs, both in the blood of nesting females and in their eggs, to infer about maternal transference, and to evaluate if such contamination could be associated with differences in the morphology and quality of their eggs. The egg yolk polar fraction (phospholipids) was more affected by the POPs levels. Results indicated that with higher levels of some persistent pesticides, lower amounts of essential FAs were observed. A maternal transference phenomenon was also evidenced for all the contaminants analysed and the dichlorodiphenyltrichloroethanes (DDT's) represented the highest percentual transference. This study provided valuable information about the current POPs levels in female green sea turtles and in their eggs indicating their widespread presence and threat for future sea turtle populations.

Understanding biofilm assemblages on aquatic plastics and their potential as a dating tool for plastic pollution

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Keywords: biofilms, plastics, microbiology, diatoms, Plastisphere, Riverine

The microbial and macrofouling communities that live on plastic pollution have recently gained much attention in the marine ecosystem. Communities including pathogen-transmitting bacteria, invasive species, and even coastal macrofauna have been found to live on plastics in the middle of the ocean. However, the communities living on freshwater and estuarine plastics have largely been left out of the spotlight. This work, done in collaboration with the University of Cambridge, UK, was an experimental approach to better understanding the biofilm communities of plastics along a salinity gradient. As seen in the marine environment, biofilm communities have pathogenic (plastics can carry unique bacteria from the surrounding water), ecological (biofilms both produce and cycle organic matter), and physical significance (biofilms can increase the density of plastic and cause it to sink into the benthos). For this project, our specific research question asked whether or not biofilm communities could act as a dating tool for freshwater plastic pollution as biofilm communities have distinct phases over time in the marine environment. Plastic coupons were incubated in the River Great Ouse (UK) for 21 days at various salinity points. Using spectrophotometry and SEM analysis we quantified biofilm abundance and characterized the biofilm communities. We found that environmental parameters played the largest role in determining the biofilm but plastic type was also significant. There was the greatest abundance of biofilm on plastics incubated in freshwater and of the plastic types, polypropylene wet wipes, harbored the most diatoms. As the interaction between environmental factors, plastic type and length of incubation played a role in biofilm development, no model could be developed for using biofilm as a means of dating plastic pollution. Nonetheless, this work provides critical insight into the microbial ecology of freshwater and estuarine plastic pollution and acts as a step towards understanding the holistic impacts of plastic on our aquatic environments.

Biodiversity, trophic position, and nutritional ecology of *Euphausiid* species in the Benguela Upwelling System

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Keywords: zooplankton, fatty Acids, trophic position, food web, diel vertical migration

Biodiversity, feeding ecology and vertical migration behaviour of lantern shrimp (krill, Euphausiacea) were studied in the Benguela Current coastal upwelling region (BUS) off Namibia and South Africa. Due to their high biomass, their physiological plasticity, and their position as a link between primary production and higher trophic levels euphausiids occupy a key position in the BUS. Knowledge about the variability of distribution, abundance, life-history strategies as well as food spectrum and migration behavior of euphausiids, is useful to enable statements about the influence of environmental changes on their functioning within the energy transfer in the BUS. In total, 15 species were identified. *Euphausia hanseni* and *Nematoscelis megalops* dominated in the northern BUS off Namibia, whereas *Euphausia lucens* and *Euphausia similis* prevailed in the southern BUS off South Africa. Biodiversity increased from the coast to oceanic waters, and it was higher in the northern BUS than in the southern BUS. Functional groups within the Euphausiacea were characterised by different vertical migration behaviour and food preferences (analysed via fatty acids and stable isotopes). *E. hanseni* and *Euphausia recurva* were migratory species that feed mainly herbivorously. In contrast, *E. lucens* was a non-migratory species that fed omnivorously. *N. megalops* and species of the genus *Stylocheiron* were also non-migratory and tended to feed carnivorously. This study shows that the ecological role of krill is more complex than just linking primary production and higher trophic levels. For realistic food-web models in BUS, these functional groups within the taxonomical order of krill should be considered. Abstract for oral presentation.

The diet of three Arctic amphipod species during the Polar Night based on DNA metabarcoding

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Keywords: DNA metabarcoding, gelatinous zooplankton, Amphipoda, Kongsfjorden, Polar Night

The Atlantification of the Arctic leads to enhanced warming and sea-ice loss. This is particularly noticeable in the high-Arctic Kongsfjorden, on the west coast of Spitsbergen, due to its direct connection to the West-Spitsbergen Current (WSC). As the fjord has been well studied over the last decades, it serves as a sentinel for ongoing climate-change driven changes. The Atlantification can also be witnessed from a biological perspective, as boreal species are shifting their distributions poleward and are advected into the Arctic fjord systems. Particularly in winter time, warmer temperatures allow boreal species to survive and establish new populations. In this study, we focused on the role of GZP in the diets of two benthic scavenging amphipod species (*Anonyx sarsi* and *Orchomenella minuta*) and one free-swimming pelagic amphipod (*Gammarus setosus*) by applying DNA metabarcoding to their stomach contents. Our aim was to investigate their diet in the Polar Night, and the role of jellyfish predation, or feeding on jellyfish carcasses. As gelatinous zooplankton are thriving in winter time, we wanted to verify their role as major food source. For *G. setosus*, DNA metabarcoding revealed a diet consisting mainly of scyphozoans (*Cyanea spp.*), different hydrozoan species (incl. the siphonophore *Nanomia cara*) and, in lower read abundances, ctenophores (*Bolinopsis infundibulum*). For the scavenging amphipod species *Anonyx* and *Orchomenella*, gelatinous zooplankton made up a minor share of their diet. The majority of reads detected belonged to polychaetes and different fish species such as *Liparis fabricii* and polar cod (*Boreogadus saida*). We were also able to show that the diets of the benthic-pelagic scavenging amphipods overlap, suggesting potential competition for food sources. Future studies using DNA metabarcoding could further reveal the so far neglected role of gelatinous zooplankton in the Arctic food web.

Genetic and morphological diversity of the genus *Pontostratiotes* in the North Atlantic

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Keywords: IceAGE expeditions, hyperbenthic copepod, CLSM, COI, *Aegisthidae*

The family *Aegisthidae* (Giesbrecht, 1893) is known as a typical faunal component of deep-sea hyperbenthic waters that gradually colonized other marine environments. Among its members, the copepod genus *Pontostratiotes* (Brady, 1883) has shown to be a highly successful and adapted group to deep-sea environments. Within this genus, the most recent species description has been published over a decade ago. Recently, efforts have been made to unravel the phylogenetic relationship of the family *Aegisthidae*, but the existing species and available DNA sequences of *Pontostratiotes* have not yet been phylogenetically reviewed. In this study, samples taken during multiple expeditions covering the North Atlantic (IceAGE, IceAGE 3, IceDivA, IceDivA 2) including individuals of *Pontostratiotes* have been analyzed. The gene fragment mitochondrial cytochrome oxidase c subunit I (COI) was used to create a phylogenetic tree including the acquired specimen and already existing sequences. In addition, specimens of the clusters established within the tree have been morphologically analyzed, documented by means of confocal laser scanning microscopy (CLSM), and compared to the existing species descriptions. This combined approach is then used to assign the specimen to valid species and discover potential new species. Nine phylogenetically distinct lineages have been recovered, four of them being new species to science. A discussion on the diversity and geographical patterns of the *Pontostratiotes* species are included.

Session 5.1
Utilizing DNA metabarcoding
methods to overcome
challenges in studying
marine organisms



Utilizing DNA metabarcoding methods to overcome challenges in studying marine organisms

hosted by Annkathrin Dischereit & Ayla Murray

Friday, 22nd September 2023, 14:00 – 15:15, Seminar room A

DNA metabarcoding is a promising tool in marine research with a wide range of applications. It is used to supplement or replace traditional methods such as net catches and visual surveys as well as being employed in trophic and microbiome studies. In this session we welcome all studies using DNA metabarcoding to investigate biodiversity, rare or invasive species detection, monitoring, or diet spectra in marine environments. We also welcome all studies in closely related fields including bioinformatics or OMICs.

14:00 – 14:15, Seminar room A

The importance of restriction enzyme selection for genome reduction in conservation genomics

Ainhoa Lopez Rivero

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14:15 – 14:30, Seminar room A

Quantifying TRUE fish abundance using Bayesian joint models combining eDNA and bottom trawl observation

Gledis Guri

Norwegian Institute of Marine Research, Framsenteret, Tromsø, Norway and Dept. of Arctic and Marine Biology, UiT The Arctic University of Norway, Tromsø, Norway

14:30 – 14:45, Seminar room A

The importance of DNA reference libraries for metabarcoding biodiversity assessments

Luisa Düsedau

Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research, Am Handelshafen 12, 27570 Bremerhaven, Germany and Marine Botany, BreMarE - Bremen Marine Ecology, University of Bremen, Germany

14:45 – 15:00, Seminar room A

Sandy-beach meiofauna communities are impacted by coastal protection measure

Iryna Kapshyna

Senckenberg am Meer Wilhelmshaven, Germany; 1Institute of Marine Biology of the NAS of Ukraine

15:00 – 15:15, Seminar room A

Implementing eDNA metabarcoding to investigate gelatinous zooplankton biodiversity and community composition in a rapidly changing Arctic

Ayla Murray

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The importance of restriction enzyme selection for genome reduction in conservation genomics

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Keywords: reference genome, GBS, Gene Ontology, non-model organisms

Conservation genomic studies in non-model organisms generally rely on genome reduction techniques based on restriction enzymes and bioinformatic tools to process the data. Although the fraction of the sequenced genome is expected to be randomly located, the genome reduction might depend on the recognition site of the restriction enzyme used. Here, we evaluate the distribution and functional composition of loci obtained after the Genotyping-by-sequencing (GBS) genome reduction technique with two restriction enzymes (EcoT22I and ApeKI). To do so, we compared data from two endemic fish species (*Symphodus ocellatus* and *Symphodus tinca*, EcoT22I enzyme) and two ecosystem engineer sea urchins (*Paracentrotus lividus* and *Arbacia lixula*, ApeKI enzyme). In short, we mapped the data to the phylogenetically closest reference genome available (*Labrus bergylta* for fish and *Strongylocentrotus purpuratus* for sea urchins) and we classified the loci as exonic, intronic, or intergenic, and we studied the functionality of the loci by using Gene Ontology (GO) terms. We also simulated the effect of using both enzymes in the two reference genomes. In both datasets, we detected an enrichment towards exonic or intergenic regions depending on the restriction enzyme used, and we did not detect differences between total loci and candidate loci for adaptation. Most of the functions assigned to the mapped loci were shared between the four species and involved a myriad of general functions. Our results highlight the importance of restriction enzyme selection and the need for high-quality annotated genomes in conservation genomic studies.

Quantifying TRUE fish abundance using Bayesian joint models combining eDNA and bottom trawl observation

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Keywords: Bayesian joint model framework, eDNA, fisheries, quantification, marine ecosystems

Quantifying the abundance, diversity, and distribution of fish species is a critical aspect of understanding and managing marine ecosystems. In recent years, there has been growing interest in the use of molecular tools, such as environmental DNA (eDNA), for quantifying fish abundance and biodiversity assessment. However, there are still challenges with using eDNA, such as the inability to infer absolute quantification of eDNA concentration. In this study we developed a Bayesian joint model framework modelling the true fish community concentration from which both eDNA and trawl catch data derive from. Our study provides empirically driven knowledge on biological parameters responsible (DNA shedding, degradation, dilution, transport, recovery rate and isolation efficiency) linking the measured DNA concentration to the fish population abundance estimated by trawl data. Moreover, we found that our model robustly quantified the fish population abundance using only eDNA data indicating the reliability of eDNA-based fish population assessments. These findings have broad implications for the use of eDNA in marine ecosystem management and conservation efforts.

The importance of DNA reference libraries for metabarcoding biodiversity assessments

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Keywords: Arctic, Macroalgae, DNA barcoding, Seaweeds, Cryptic species

Traditional biodiversity studies are based on morpho-anatomical identification tools and misidentifications are common. This results in an underestimation of biodiversity and incomplete information about species distributions. Metabarcoding can be a powerful method to reveal hidden species, which might be overlooked in classical field monitoring. Besides its logistical advantages, correct species identification in metabarcoding datasets is only successful when reliable DNA barcode reference libraries exist. In this context, Arctic macroalgae are one of the many examples of genetically highly understudied groups. Moreover, molecular work on macroalgae is difficult as each lineage (red, green, and brown) requires specific markers for DNA barcoding and the resolution achieved with universal metabarcoding primers is often not sufficient. To better document expected biodiversity changes in habitats, especially those subjected to severe ongoing climate change, it is therefore essential to genetically verify morpho-anatomical species and document inherent cryptic diversity. This will provide the needed baseline knowledge for monitoring and modern metabarcoding studies. We investigated macroalgal biodiversity in two Arctic fjord systems at different stages of cryosphere loss, namely Kongsfjorden on Svalbard which is surrounded by glaciers, while Porsangerfjorden in Northern Norway is ice-free and characterized by a sub-Arctic to cold-temperate climate. In two expeditions (2021 & 2022) we sampled 82 macroalgal taxa from Kongsfjorden and 112 taxa from Porsangerfjorden. We aim to create a novel macroalgal sequence database from these European Arctic locations to facilitate the identification of Arctic macroalgae in the future. Additionally, we tested a newly developed metabarcoding primer pair to detect green algae species in coastal water samples collected along both fjord axes. We propose that a combination of DNA barcoding ground-truthing together with metabarcoding environmental samples is needed to reliably estimate species biodiversity and range shifts in molecular monitoring initiatives as long as barcode libraries remain incomplete.

Sandy-beach meiofauna communities are impacted by coastal protection measure

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Keywords: sand nourishment, interstitial fauna, metabarcoding, Baltic Sea

Sand nourishment is a cost-effective and less invasive coastal protection measure compared to other methods. Therefore, sand nourishment is routinely used for coastal defense in northern Germany. However, it is also a stressor for the sandy beach ecosystems. The impact of sand nourishment on the interstitial animals of non-tidal coasts is largely unknown. Approximately in a 5-year rhythm, large-scale sand nourishments are completed at the beach of the seaside resort Ahrenshoop (Baltic Sea). The last nourishment took place from October 2021 to March 2022. The main aim of our study was to monitor and compare meiofauna communities in the hydrolittoral sandy zone along a 4-km stretch before and after sand nourishment. Meiobenthic communities were analysed incorporating morphological and genetic approaches. Metabarcoding is a massive DNA-barcoding approach suitable for quick biodiversity assessments which is applied to whole communities using bulk samples. In this study, insights are provided by metabarcoding using the V1&V2 hyper-variable region of the 18S rDNA. A reference library with DNA barcodes of *Copepoda* species is incorporated in the metabarcoding analyses to enable monitoring of specific taxa over time. Additionally, individual numbers of higher taxa show that meiofauna communities are influenced by sand nourishment.

Implementing eDNA metabarcoding to investigate gelatinous zooplankton biodiversity and community composition in a rapidly changing Arctic

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Keywords: Jellyfish, Metazoan, NGS Sequencing, Environmental DNA, COI gene

The Arctic is warming four times faster than the global mean and the “Atlantification of the Arctic” via Fram Strait is evident in the increasing changes to both physical and biological processes in the region. Greater understanding of how these changes are impacting local marine biodiversity is crucial for management and mitigation decisions, as well as formulating accurate predictions of future marine ecosystems. Gelatinous zooplankton (GZP) are a highly diverse group of taxa, including cnidarians, ctenophores and pelagic tunicates and can have a wide range of ecosystem impacts. Little is known about GZP diversity and distributions in the Arctic Ocean, and even less about how they are being impacted by climate-related changes. This is because they are notoriously difficult to catch in good condition and are often actively left out of zooplankton surveys, which has led to a lack of reliable and comprehensive baseline datasets, especially in the Arctic Ocean. Here we investigate GZP biodiversity across different systems in the Atlantic side of the Arctic, using eDNA metabarcoding. We compare diversity and distributions in different water masses (Atlantic vs Arctic waters), habitats (pelagic and under-ice environments), regions (coastal fjords and open water systems) and seasons (Polar Day and Polar Night). Cytochrome c oxidase I and 18S rDNA amplicons were sequenced using the Illumina NovaSeq platform and validated with net catch data from the same period and localities where possible. This data represents a valuable contribution to future research on changing GZP biodiversity and community composition, as well as biomonitoring of rare and non-indigenous species in a changing Arctic.

Session 4.6
Interactions and stressors
in benthic communities:
predicting future changes
and advancing behavioral
ecology



The metabolic requirement and feeding plasticity of photosymbiont *Aplysina aerophoba* (Nardo 1843) under tissue regeneration

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Keywords: Porifera, regeneration, nutrient cycling, metabolism, *Aplysina aerophoba*

Upon encounters with grazers or competitors, marine sponges require fast tissue regeneration to avoid chronic wounds, compete for limited space, prevent fouling of exposed spicules, and readjust their size and shape for optimal feeding. During tissue regeneration, resources are required to grow new tissue, which may impact the sponges metabolism and switch resource allocation from a self-sustaining into a net-growth state. This change in the sponge's metabolism may affect the ecological role of the sponge in nutrient cycling. This project addresses the impact of tissue regeneration on the sponge and its microbiome's carbon budget and the cycling of organic matter within the sponge. Therefore, an ex-situ experiment with the Mediterranean sponge *Aplysina aerophoba* was carried out by mechanically damaging the sponges kept in light and dark conditions. During the regeneration period the water inhaled (In) and exhaled (Ex) by the sponge was collected in order to quantify the ingestion or excretion of the compounds of interest (e.g. oxygen, dissolved organic carbon and nitrogen). Pico- and nanoplankton abundances were quantified as control. Respiration and pumping rate measurements were estimated in parallel. The data is currently being processed. We hypothesize that tissue damage will increase sponge metabolic rate and efficiency in DOM ingestion. We also expect that the results will differ between light and dark conditions, with photosymbionts contributing to cover the metabolic demand in light conditions.

The metabolism and carbon balance of benthic communities exposed to extreme climatic events

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Keywords: Macroalgal forests, Climate change, Mediterranean, Shallow reefs, Mesocosms experiment

Macroalgal forests are declining worldwide, as a consequence of local and global anthropogenic perturbations, representing unprecedented threats to the functioning of whole ecosystems and the services they provide. Nonetheless, our understanding of the consequences of climate change on ecosystem functioning is still limited. By means of ex-situ incubations, carried out in mesocosms, we calculated net photosynthesis, respiration, calcification and CaCO₃ dissolution in order to assess the trophic state and carbon balance of NW Mediterranean benthic communities subjected to a simulated heat wave. The heat wave treatment (30.5 °C for 5 consecutive days) was applied to each of three tanks, while three other tanks were used as control. Two experimental trials were carried out, using different benthic communities: the canopy-forming macroalga *E. brachycarpa* for the pristine site and algal turfs for the urban site. Incubations were performed applying transparent and obscured plexiglas domes, each one was equipped with an external pump, to allow the recirculation of water, and an oxygen sensor, to detect the concentration of dissolved O₂ during each incubation. At the beginning and at the end of each 1hour incubation, water samples were taken to determine the initial and final concentration of dissolved inorganic carbon and alkalinity. Finally, benthic assemblages in each incubated area were scraped off the substrate to determine their total biomass and composition. All analyzes are currently in progress and will provide an insight into the effect of extreme climatic events on the functioning of benthic communities on shallow reefs exposed to contrasting human activities.

Temperature increase alters fatty acid composition and has negative effects on reproductive output of the benthic copepod *Microarthridion littorale*

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Keywords: fatty acids, climate change, life-history traits, *Microarthridion littorale*

Copepods are marine invertebrates with a key role at the basis of marine food webs due to their high biomass as well as their elevated fatty acid (FA) content, particularly Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA), two FA which have a well demonstrated role in growth and reproduction in marine organisms. Temperature is a key driver of organism's fitness as well as ecosystem functioning and sea surface temperature is expected to rise under all CO₂ emission scenarios. Thus, understanding how copepods will respond to such changes is crucial given their role in marine food webs. While the majority of research has focused on planktonic copepod species, less is known for benthic species, particularly non-model species. In this study we expose *Microarthridion littorale*, an intertidal benthic copepod to a temperature gradient (12, 15, 18, 21 and 24 °C) current environmental variability as well as future scenarios. Individuals were retrieved from a mudflat in the Westerschelde estuary and cultured at lab conditions. Survival and FA were measured after 18 days of exposure. Growth rates and nauplii production were also measured for each temperature treatment. We have found decreased survival and EPA and DHA relative content with increased temperature as well as increased growth rates and detrimental effects for nauplii production. Benthic copepods are prey for many juvenile fish, any changes in their biomass as well as their FA composition in response to temperature could therefore amplify to higher trophic levels with important consequences for food web functioning.

Will climate change influence the biochemical performance of the bivalve species *Mytilus galloprovincialis* when exposed to antineoplastic drugs?

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Keywords: Anticancer drugs, Bivalves, Climate change, Oxidative stress, Ecotoxicology

Coastal ecosystems currently face exposure to multiple stressors, including climate change-related factors and exposure to emerging contaminants, such as antineoplastic drugs. Antineoplastic drugs are used worldwide in chemotherapy treatments, but their mode of action and low biodegradability make their presence in aquatic ecosystems concerning. These drugs are cytotoxic, teratogenic, mutagenic, genotoxic, and potentially carcinogenic, and have already been detected in aquatic ecosystems. However, their toxicity in non-target organisms, especially under predicted climate change scenarios, is poorly studied. Bivalve species are widely used as bioindicators in ecotoxicological assessment studies and have great socio-economic value in several countries. Thus, this study, aimed to assess the effects of the drugs ifosfamide (IF) and cisplatin (CDDP) in the mussel species *Mytilus galloprovincialis*, under actual and foreseen warming conditions. Organisms were exposed for 28 days to different concentrations of IF (10, 100, and 500 ng/L) and CDDP (10, 100, 1000 ng/L) at control ($17 \pm 1.0^\circ\text{C}$) and increased ($21 \pm 1.0^\circ\text{C}$) temperatures. Biochemical responses related to metabolic capacity, energy reserves, oxidative stress, and neurotoxicity were assessed. The results showed that the organisms were able to maintain their metabolic capacity and avoid cell damage when exposed to IF conditions, regardless of the temperature tested. Contrarily, CDDP exposure caused an increase in the metabolic capacity at both temperatures. Under the warming scenario, although there was activation of antioxidant enzymes, cell damage was observed at the two highest concentrations (100, 1000 ng/L). Overall, the present findings indicate that temperature magnified the impacts of CDDP on *M. galloprovincialis*, reinforcing the need for antineoplastic monitoring programs in coastal ecosystems.

Biochemical and histopathological alterations induced by praseodymium and europium in the mussel species *Mytilus galloprovincialis*

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Keywords: Praseodymium, Europium, Mussels, Biochemical alterations, Histopathology

The global effort to achieve carbon neutrality led to the increase demand for renewable energy technologies and their raw materials, namely rare earth elements (REEs). These are critical elements due to their high economic importance and the risk associated with their supply. However, the rise of REE-based technologies led to increase amounts of electronic waste (e-waste), and the incorrect disposal as well as the inefficient recycling strategies have resulted in higher concentrations of REEs in the aquatic environment. Praseodymium (Pr) and europium (Eu) are two REEs with potential environmental risks, however their effects on organisms are almost unknown. Therefore, the aim of this study was to assess the biochemical and histopathological effects of different concentrations of Pr and Eu in the mussel species *Mytilus galloprovincialis*. Mussels exposed to all concentrations of Pr activated defence mechanisms, such as antioxidant and detoxification enzymes. However, the mechanisms were not sufficient to prevent cellular damage, leading to higher protein carbonylation (PC) levels. On the other hand, mussels exposed to Eu only activated defence mechanisms at the highest concentration, which was not enough to avoid cellular damage, with higher levels of lipid peroxidation (LPO) and PC. Cellular damage (LPO and PC levels) was also evident at the lower concentrations of Eu, due to the limited defence capacity. Regarding histopathology, Pr induced higher injuries than Eu, which can be associated with the higher accumulation of this element. This study highlights that both elements were toxic to this species, even at the lowest concentration tested, which may eventually impact their growth and survival.

Metabolic responses of Mediterranean corals to inorganic iron enrichment

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Keywords: coral physiology, metabolic plasticity, energetics, nutrient bioavailability

Mediterranean corals live in habitats with naturally high fluctuations in seawater temperature and nutrient availability. The nutritional status of corals is linked to the uptake of several micronutrients, which support cellular metabolism and growth. Among these, iron is a fundamental micronutrient for respiratory and photosynthetic processes. Although the role of iron has been identified in microalgal endosymbionts as a cofactor for biochemical pathways in photosystems I, II, and the electron transport rate chain, the response of coral holobionts to elevated iron conditions was not investigated yet. To address this gap, we used high-resolution optical and microsensing technologies to quantify the effects of inorganic iron enrichment (ranging from 20 to 100 nM) on the metabolic performance of the Mediterranean corals *Cladocora caespitosa* and *Oculina patagonica*. Respiration and photosynthesis were monitored in single polyps using respirometry chambers, and reduced energetic productivity (P:R ratio) under elevated iron conditions suggested a significant impact on coral ecophysiology. Furthermore, the use of microsensors revealed anoxic conditions in coral gastric cavities, indicating oxygen depletion with increasing iron concentrations. These results enable novel insight into how increasing exposure to inorganic nutrients, such as iron, affects Mediterranean corals and can help predict the consequences of climate change on the Mediterranean Sea in the short and long term.

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such as aquaculture, marine biotechnology, marine energy, and deep-sea mining growing rapidly under a new era characterized by rapid growth of a blue, ocean-based economy. The sustainability of the blue economy is closely dependent on our knowledge about how to mitigate the impacts of the multiple pressures on the ocean ecosystem associated with the increased scale and diversification of industry operations in the ocean and global human pressures on the environment.

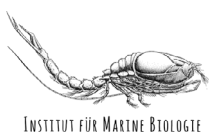
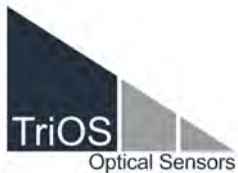
Therefore, Frontiers in Marine Science particularly welcomes the communication of research outcomes addressing ocean-based solutions for the emerging challenges, including improved forecasting and observational capacities, understanding biodiversity and ecosystem problems, locally and globally, effective management strategies to maintain ocean health, and an improved capacity to sustainably derive resources from the oceans.



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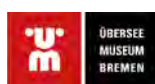
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