ICYMARE

International Conference for
YOUNG Marine Researchers

BOOK OF ABSTRACTS

ICYMARE 2021 ONLINE EVENT
21–24 SEPTEMBER 2021

ICYMARE
International Conference for
YOUNG Marine Researchers

THE BREMEN SOCIETY FOR
NATURAL SCIENCES from 1864

eco
environment coastal & offshore

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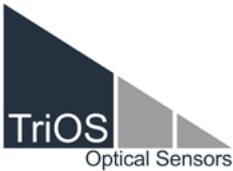
virtual ICYMARE 2021

21 - 24 September 2021

Book of Abstracts

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OPEN ACCESS

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MARINE SCIENTISTS

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The Bremen Society for Natural Sciences

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 society and the Übersee-Museum

The collections of the Museum Society and the Bremen Society for Natural Science grew constantly over the years. The latter society took care for these collections. Together with the Historical Society, a commission was founded with the aim to strategically grew the collections and to found a museum for presenting the collections. After some negotiations regarding care-taking costs, the City of Bremen took over the collections and the subsequent costs to care for them. The rooms at the time were not sufficient any more. At an industrial exhibition in 1890, the idea of a museum was raised. In 1896, the "City Museum of Natural History, Ethnology and Trade", today Übersee-Museum (directly translated: "Overseas Museum") was founded. The first director of the museum, Hugo Schauinsland, was also the Chairman of the Bremen Society for Natural Sciences for a short time. Still today, employees of the museum are also at the same time involved in the society. Furthermore, the society organized exhibits for the museum, e.g., a replica of a dinosaur skeleton or the skeleton of a Megaloceros (prehistoric giant deer). Scientifically more important are the zoological and botanical collections which have been and will be the basis of taxonomical, systematical, biogeographical, floristic, and faunistic research.

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.

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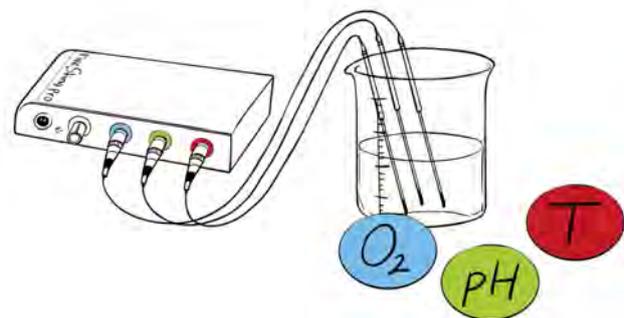
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Virtual ICYMARE 2021 - Program

Tuesday 21st September

8⁴⁵	ICEBREAKER	Social Events Room

8⁴⁵ ICEBREAKER — Social Events Room
Join the ICYMARE Pub-Quiz an get to know the other participants while puzzling over marine fun facts!

10³⁰ Coffee break — Main Platform
Take the chance and check out our Welcome video at the main platform — *white box*

10⁴⁵ Session 11 — Main Platform
Sustainable harvesting of seafood – How to explore, predict and evaluate the future of marine food production — Session Room BLUE

— Main Platform

11⁴⁵ Session 8 — Session Room GREEN
From physiology to ecology: what the holobiont concept can teach us about marine organisms and ecosystems — Main Platform

12⁰⁰ Lunch break — Session room YELLOW

12³⁰ Session 5 — Main Platform
Stressed out lives: organismal bottom-up responses to global changes — Session Room BLUE

14⁴⁵ Session 7 — Main Platform
Exceptions make the rule: insights from mixotrophy — Session Room RED

15⁴⁵ Coffee break — Main Platform

16⁰⁰ Project talk — Main Platform
Plastic Pirates - schoolchildren investigate plastic pollution of rivers — Session Room GREEN

16¹⁵ Poster Session

17¹⁵ Session 2
The impacts of climate change over human marine activities and their management

Wednesday 22nd September

9⁰⁰ Session 1 (part 1) — Main Platform
Interdisciplinary Approaches for Sustainable Coastal and Ocean Management — Session Room BLUE

10³⁰ Coffee break

10⁴⁵ Session 1 (part 2) — Main Platform

12⁰⁰ Lunch break — Session Room BLUE

12³⁰ Science Speed Dating — Social Events Room
Try out the fastest way to find a new research partner and speed up your science!

13³⁰ Session 13 — Main Platform
Tropical Marine Ecosystems in the Anthropocene — Session Room GREEN

15⁰⁰ Session 3 — Main Platform
Marine data science — Session room YELLOW

15⁴⁵ Coffee break

16⁰⁰ Session 18 — Main Platform
(Micro)Plastic: environmental distribution, degradation and impact — Session Room BLUE

Thursday 23rd September

8⁴⁵	Session 15 (part 1)	Main Platform
	Change in Polar Regions - Same same, but different?	Session Room BLUE
10³⁰	Coffee break	
10⁴⁵	Session 15 (part 2)	Main Platform
	Change in Polar Regions - Same same, but different?	Session Room BLUE
11³⁰	Session 16	Main Platform
	In a stable relationship: Isotope analysis and marine science	Session Room GREEN
11³⁰	Session 20 (part 1)	Main Platform
	Open Session	Session room YELLOW
12⁰⁰	Lunch break	
12³⁰	ICYMARE Workshops	Workshop rooms
15⁴⁵	Coffee break	
16⁰⁰	Stories	Social Events Room
	Share the story of your journey becoming a scientist with the ICYMARE family	
17⁰⁰	Session 9	Main Platform
	Often overlooked: Understanding and meeting the current challenges of marine invertebrate conservation	Session Room BLUE

Friday 24th September

8⁴⁵	Session 12	Main Platform
	Coastal Wetlands – Muddy is the new trendy	Session Room BLUE
9⁴⁵	Session 20 (part 2)	Main Platform
	Open Session	Session Room GREEN
10³⁰	Coffee break	
10⁴⁵	Session 20 (part 3)	Main Platform
	Open Session	Session Room GREEN
12⁰⁰	Lunch break	
12⁴⁵	Project talk	Main Platform
	GAME – Global approach by modular experiments	Session Room RED
12⁴⁵	Session 20 (part 4)	Main Platform
	Open Session	Session Room GREEN
13⁰⁰	Session 19	Main Platform
	Marine Engineering	Session Room YELLOW
13⁴⁵	Session 4	Main Platform
	Ocean Literacy: linking marine science to education to promote action	Session Room BLUE
15⁰⁰	Coffee break	
15¹⁵	Fireside talk	Main Platform
	Reflections on paths we can take and leading with intention	*white box*
17⁰⁰	Open fireside chat	Main Platform
	Let this event fade away with a drink and have a chat with the awesome early career researcher	*wherever you want*

Workshop

Overcoming obstacles to knowledge co-production for early-career marine researchers

Denis Karcher[1], E. Zoe Walker[2], Lena Rölfer[3], Thanne Walawwe Gedera Fathima Mafaziya Nijamdeen[4], Michael Kriegl[5], Maraja Riechers[6], Xochitl Edua Elias Ilosvay[7]

[1]Australian National Centre for the Public Awareness of Science, Australian National University, Canberra, ACT, Australia, [2]University of Bergen, Norway, [3]Faculty of Sustainability, Leuphana University, Lüneburg, Germany, [4]Systems Ecology and Resource Management Research Unit (SERM), Department of Organism Biology, Universit´e Libre de Bruxelles - ULB, Brussels, Belgium, [5]Leibniz Centre for Tropical Marine Research (ZMT), [6]Social-ecological Systems Institute (SESI), Faculty of Sustainability, Leuphana University Lüneburg, Germany, [7]Centro de Investigación Mariña, Universidade de Vigo, Future Oceans Lab, Vigo, Spain

The vitality of humanity depends on functioning coastal and marine social-ecological systems. Improving the translation of scientific knowledge into tangible action is necessary to achieve more evidence-informed management of coastal and marine systems. Co-produced knowledge and research that includes non-academic stakeholders and practitioners have gained importance for improving the uptake of scientific findings in policy and society (e.g. as acknowledged within the United Nations Decade of Ocean Sciences for Sustainable Development). The recently established Working Group "Anticipating and Transforming Coastal Futures" within the German Committee Future Earth, in particular, aims at developing a new science agenda for achieving sustainable future coasts. This includes exploring potential pathways of coastal and marine science with regard to opportunities and challenges of research approaches that stretch beyond single disciplines and traditional scientific pathways for Early Career Researchers (ECRs). ECRs often face obstacles when using approaches and methodologies for co-producing knowledge, because scientific career paths have traditionally been locked within disciplinary boundaries. Identifying and addressing the challenges inherent to the application of such approaches by ECRs in coastal and marine research is, therefore, fundamental to better support the development of co-produced science and ultimately the utility of science for society. We propose conducting a pre-conference survey within the ICYMARE network, that is specifically targeted at ECRs who have or will co-produce knowledge. Specifically, we will investigate approaches to knowledge co-production with a particular focus on the obstacles faced by ECRs. In addition, we propose a workshop to be held at the ICYMARE conference that will present preliminary survey results and discuss findings with researchers working at the science-policy-society interface. Our overall goal is to identify common personal, institutional, and engagement obstacles to

the co-production of knowledge and discussing ways of mitigating their impact on ECRs future pathways. We welcome everyone at our workshop - wether you have experience with knowledge co-production or not! In case you are planning to conduct, or have already conducted scientific approaches to knowledge co-production, please support us by participating in our short survey prior to the conference: https://survey.leuphana.de/index.php/173974?newtest=Y&lang=en

If you want to take part in this workshop, please register at lena.roelfer@hereon.de

ICYMARE Social Events

To participate in ICYMARE 2021, each of us will be sitting in front of our own computer at home – but this does not stop our community from socially interacting. We will do our best to create a welcoming atmosphere by offering a bunch of social networking events. Any conference participant, presenting or not, is invited to join!

The whole fun will start with our ICEBREAKER on 21st September, prior to the official start of ICYMARE 2021: join the ICYMARE Pub-Quiz and get to know the other participants while puzzling over marine fun facts! The wittiest creature of the Seven Seas shall win!

But that's not all: try out the fastest way to find a new research partner and speed up your science in our Science Speed Dating on 22nd September!

Become a storyteller – share with us your adventures, one-of-a-kind experiments, academic highs and lows or other inspiring, funny and extraordinary Stories on 23rd September!

Please show your interest to participate in the different social events by sending an email including the events you would like to join (IceBreaker, Science Speed Dating, Stories) to networking@icymare.com until the 20th September. This will help us setting up everything.

Feel free to enter our virtual coffee breaks and exchange with other marine scientists and ocean enthusiasts everyday and to join the social events spontaneously.

See you then!

Pub Quiz

Tuesday 21st September 2021, 8^{45} (CEST)

Having fun while testing your marine knowledge? Welcome to ICYMARE Pub Quiz!

Crazy Crustaceans? Fearless Sharks? Yes, that might be your teams' name! Limited places available, ICYMARE participants should show their interest to be part of this challenge and send an email to networking@icymare.com.

Science Speed Dating

Wednesday 22nd September 2021, 12^{30} (CEST)

Meet other young marine researchers in a non-formal environment, and besides presentations or pitches: Science Speed Dating!

We have the ideal networking activity for you. As a conversation starter, prepare a marine or your "Two Truths and One Lie", and guess what your dates are lying about. Limited places available, show us interest to be part of this challenge and send an email to networking@icymare.com.

ICYMARE Stories

What's your Story?

Thursday 23rd September 2021, 16^{00} (CEST)

Enter in ICYMARE Time Machine and share your adventures, one-of-a-kind experiments, academic highs and lows, or whatever you feel worth sharing during the conference. What would you change in those past experiences? What about your academic path? Inspire us and let your 5-minute story be the extra motivation others didn't know they needed!

Any conference participant – presenting or not – can be a storyteller. Grab your chance and apply until 13th of September to networking@icymare.com. Limited places available.

Send us a picture of you, a short biography, and summary (three sentences maximum) of your story and why it is awesome! If you have prepared a PPT presentation or a PDF, you can send it ahead.

Fireside talk

Reflections on paths we can take and leading with intention

Friday 24th September 2021, 15[15] (CEST)

Kristy Deiner [1]

[1] Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Zurich, Switzerland

In a relaxed atmosphere, Kristy Deiner will share her story with the ICYMARE family. She will talk about her journey of becoming a scientist, obstacles she had to negotiate and lessons learned on her way. She will explain her understanding of leading. Moreover, she is going to show us what it means build up a family and an academic career concurrently, while having a non-academic background.

Open fireside chat

Friday 24th September 2021, 17[00] (CEST)

Stay with us a little longer. The conference platform will be available for you as long as you want to network with the #ICYMAREfamily. Let this event fade away with a drink. Talk about the amazing and new research topics presented at ICYMARE 2021. Get in touch with awesome early career researcher all around the world and build up your own research network!

THE FUTURE OF ARCTIC COASTAL ECOSYSTEMS

IDENTIFYING TRANSITIONS IN FJORD SYSTEMS AND ADJACENT COASTAL AREAS

Enable adaptive co-management of social-ecological fjord systems in the Arctic in the face of rapid cryosphere and biodiversity changes

RESEARCH TOPICS

1. Key drivers & data management
2. Biodiversity changes
3. Ecosystem function changes
4. Food provision & livelihoods
5. Nature-based tourism
6. Transdisciplinary synthesis
7. Policy dialogue & outreach

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ICYMARE Workshops

Qualitative analysis of interviews

Sophia Kochalski[1]

[1] University of Santiago de Compostela, Spain

It is essential to understand human behavior and the way people think in order to effectively protect the marine environment and to preserve the benefits that humans derive from the oceans. In this workshop we look practically and theoretically at the analysis of human thoughts based on the qualitative analysis of interviews with fishery stakeholders. We discuss mixed methods, different types of interviews and different ways of analyzing interviews. We will pay particular attention to frequently occurring problems and questions of subjectivity / objectivity and triangulation. Half of the workshop is dedicated to a hands-on exercise during which the participants will be coding and discussing a real-life example. The workshop is suitable for all participants, no prior knowledge of social science methods is needed. There is the possibility to use one participant's own data as example for the workshop, please contact the workshop conductor if this would be of interest for you. All participants are asked to install the free trial version of ATLAS.ti on thei PC prior to the workshop.

If you want to take part in this workshop, please register at Sophia.kochalski@gmail.com

ICYMARE Workshops

From your research abstract to a comic: I cannot draw, but sketch my science!

Marek Muchow[1], Luisa von Albedyll[1]

[1] APECS International, APECS Germany Board

Did you ever wonder how to communicate your scientific research differently?

Researchers get more and more creative with communicating their results away from traditional written articles in journals.

They realized that hand-drawn sketches/comics help to reach and teach a broader audience but also attract your peers' interest to read your work.

Those sketches can work very well when posted online, for example wrapped in a short tweet. Additionally, a lot of researchers started to use their hand-drawn sketches and comic-like pictures in scientific talks.

You wonder why they work so well? Sketching your science from a white sheet of paper will help you to focus on the main message, and choose the most simple way to illustrate it. And remember, a picture is worth a thousand words!

Do you want to learn more about how to sketch your science? This workshop is supposed to give an interactive, step-by-step introduction to the topic. With the help of an expert, we will get to know different methods for breaking down a research result into a comic to tell an understandable story. We will present techniques on how to realize your comic or sketch.

But this is a workshop, and hence after the introduction, it's your time to become active. All workshop participants are encouraged to draw their own sketch or comic based on their own scientific work or a paper they know well. In the last part of the workshop we will talk about the comics and provide feedback.

And don't forget: It is not about perfect drawings, but about simple ways to visualize science for yourself and others.

If you want to take part in this workshop, please register at icymare@apecs-germany.de

ICYMARE Workshops

ICYMARE Workshops

best practice ideas and advice for your Social Media channels

Daniel Kähler

freelance journalist (mainly working for Radio Bremen / ARD, social media and audio editor / author)

This workshop features basic and advanced knowledge on how to set up a smart social media strategy to promote your research or insitution with a journalistic approach. It will give information on which network is best to use for your situation and basic advice on how to create professional content. Furthermore, you will see which devices or softwares can help you. The workshop will give you ideas to adapt for your strategy.

If you want to take part in this workshop, please register at icymare@danielkaehler.de

ICYMARE Workshops

Challenges in Coastal Urban Planning : Sustaianbility Studies on Urban Environmental Management for Coastal Cities and Towns

Kalpana Chaudhari[1], Pasquale De Toro[1], Maria Cerreta[1], Francesca Nocca[1]

[1]Shah and Anchor Kutchhi Engineering College; ISDR,India

The proposed Workshop focusses on Challangesin Urban Coastal Planning so as to provide scientific and rececent adavancement in planning and management of urban cities and towns in marine region.Due to urbanization along coastal region,the problems of urban environment managementare also increased and posed threats for sustanable environment management of cities and towns in marine areas. This workshop will providescientific and techncal knowledge on sustainable urbanisation in marine areas, management of coastal cities and towns, impact asessments of urbanization in coastal region. The experts and researchers from University of Naples-Federico II, Naples ,Italy; Ocean-Knowledge Action Networks of Future Earth and international institutions will make presentations on recent advancements in sustainable urban planning in marine areas as well as case studies on sustainalbe cities and towns along coastal regions etc. The target groups will be students, youth and young professionals working in Marine palnning, management of coastal cities and towns, sustaianble environment management for marine areas etc.

If you want to take part in this workshop, please register at isdrklc@hotmail.com

ICYM*A*RE Workshops

Boosting the impact of your science through effective communication: Learning how to be heard by media, policy makers and stakeholders

Alessandro Cresci[1], Anjali Gopakumar[2], Rebecca Zitoun[3], Paula Kellett[4]

[1]European Marine Board Young Ambassador / Institute of Marine Research, Norway, [2]European Marine Board Young Ambassador / University of Bologna, Italy, [3]European Marine Board Young Ambassador / NIOZ, Netherlands, [4]European Marine Board

Science communication is part of a scientist's everyday life; they write papers and proposals, give talks, educate students, and promote findings to the public. Thus, scientists communicate effectively within a bubble of their peers. Nevertheless, to be successful and impactful, regardless of the field or career path, one must be an effective and engaging communicator to broader, non-scientific audiences. These include media, policymakers, students, and the public. The ability to communicate information (verbally and non-verbally) in a simple, accurate and concise manner is key for science to have an impact on the outside world. Scientists who are good communicators build support for science, promote the understanding of its wider relevance to society, and encourage informed decision-making at all levels, from government to communities to individuals. Effective communication can make science more accessible, diverse, and inclusive. Being able to explain and promote the relevance of ideas and discoveries can also enhance a scientist's ability to secure funding, find a job, write more comprehensible papers, and be a better teacher and mentor to the next generation. When scientists bring science stories to life, science thrives. Nevertheless, this vital life skill is often overlooked, and as a core professional skill, it is unfortunately not always taught to young scientists.This workshop will focus on the importance of good communication to ensure that your science has impact, both for top-down and bottom-up engagement. The session will discuss the basics, principles, and strategies that make communicating to media, policymakers, and stakeholders effective. Invited experts will share techniques, tricks and lessons learnt on how to become an impactful communicator. By introducing the European science-policy landscape and the Ocean Decade, we will show why good communication can make a difference. The workshop will allow attendees to have discussions, ask questions, and participate in breakouts to share ideas.

If you want to take part in this workshop, please register at pkellett@marineboard.eu

ICYMARE Workshops

Tips and tricks for publishing your research – MEPS' perspective

Christine Paetzold[1]

[1] Inter-Research Science Publisher

The scientific publishing process can seem daunting at first. Whether you are preparing your first manuscript submission to a journal, want to try again after having had your work rejected, or just want to learn all about the secrets of successful publishing in MEPS and its sister journals — this workshop will be for you! You will get an overview of how the scientific review process in general works, from choosing the appropriate journal and preparing your submission to challenging a rejection or having your article accepted. I will share my experience from over 10 years as Managing Editor at Inter-Research (the publisher of MEPS), including tips and tricks that will improve your chances of a positive review process outcome. There will be plenty of time for all your questions, including a Q&A session at the end of the workshop.

If you want to take part in this workshop, please register at ICYMARE-workshop@int-res.com

ICYMARE Workshops

Create scientific graphics and visualisations with inkscape

Tim Kiessling[1]

[1] Kiel Science Factory

Graphics are an important communication tool in science, for example as figures in scientific articles, as part of posters and presentations or for effectively communicating your research on social media. With most of the commonly used programs graphic and layouting options are very limited. In this workshop you will learn to use the powerful vector-based program inkscape to create appealing graphics. The program is free to use and open source. We will cover the basics, from navigating inkscape, to improving simple figures, up to importing hand-drawn images that could be the basis for a graphical abstract, logos or a postcard, summarizing your research, to send to your colleagues. We will further briefly touch upon aspects related to scientific graphic design, such as different graphic formats, licensing options and online resources for graphics and photos. For this workshop you will need a computer with inkscape installed (https://inkscape.org/release/inkscape-1.0.2/), a piece of paper, pencil and smartphone/scanner.

If you want to take part in this workshop, please register at kiessling@leibniz-ipn.de

DFG Deutsche Forschungsgemeinschaft

Universität Rostock — Traditio et Innovatio

Priority Program 1158

Antarctic Research

with comparative investigations in Arctic ice areas

More Information:
www.spp-antarktisforschung.de

Background

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

Research Topics

Aetidaeidae sp.
2 mm

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

Prospects

The priority program provides researchers with external funding and 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).

Application

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

SESSION 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Pressures on marine ecosystems are mounting globally, with severe consequences for ecosystems and their associated services. At the same time, the increase in activities in coastal and ocean areas is inevitable. Covering multifaceted and partly poorly understood ecosystems, oblivious to any anthropogenic frontiers, comprehensive regulation and management, up to this day, has proven very difficult. However, there is an increasing awareness of the importance of a sustainable relationship between society and ocean resources. To tackle the challenges posed by the often-conflicting interests between economic activities and ocean conservation, there is an urgent need for integrated approaches. We therefore invite presenters from multiple disciplines including ecology, oceanography, international law, social and political sciences to contribute to our session.

hosted by

Arianna Liconti

Marine Biological Association

Natalie Prinz

University of Waikato, Tauranga, New Zealand

Lena Rölfer

Climate Service Center Germany (GERICS), Helmholtz-Zentrum Hereon, Hamburg, Germany

Clara Antonia Klöcker

Eidgenössisch Technische Hochschule (ETH), Zürich, Switzerland

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Fucus vesiculosus populations on artificial structures have reduced fecundity and are dislodged at greater rates than on natural shores

Paul Brooks [1], Tasman P. Crowe [1], Hannah S. Earp [2], Bryan Thompson [1], Nathan Bourke [1], Ruby George [2], Chloe Piper [2], Pippa J. Moore [2, 3]

[1]UCD Earth Institute and School of Biology and Environmental Science, University College Dublin, [2]Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, [3]School of Natural and Environmental Sciencies, Newcastle University

Keywords: fucoids, ecosystem engineer, ocean sprawl, urbanisation, coastal management

Artificial structures are widespread features of coastal marine environments, but are generally poor surrogates of natural rocky shores. Little is known about the effects of such structures in terms of demographic properties and reproductive potential that may affect the dynamics and long-term viability of populations. Such understanding is particularly important for ecosystem engineer species, such as the intertidal seaweed Fucus vesiculosus. In this study, F. vesiculosus was sampled on eight artificial structures and eight natural shores along the east coast of Ireland and the west coast of Wales. Algal percentage cover, biomass, density of individuals, and growth rate did not differ between artificial and natural shores. Growth and reproductive cycles were consistent with previous studies for this species. While there was considerable variation from site to site, on average, populations on natural shores had higher fecundity during the peak reproductive period in April, and lower rates of dislodgement than on artificial structures. As F. vesiculosus reach peak reproductive output after 24 months, this suggests that individuals may be removed from populations on artificial structures before reaching their full reproductive potential. In this case, this did not influence density, percentage cover, or biomass, which suggests that F. vesiculosus populations on artificial structures may function similarly to those on natural shores if supported by suitable source populations, but potentially may not persist otherwise.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Sediment Profile Imagery (SPI): a tool for environmental impact assessment in shallow coastal environments

João Fernandes [1], Gert Van Hoey [2], Annelies De Backer [2], Jochen Depestele [2], Nene Lefaible [3], Michiel T'jampens [5], Elise Toussaint [6], Jan Vanaverbeke [6], Kris Hostens [2]

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Sediment profile imaging (SPI) allows quick examinations of benthic habitat quality consisting of a wedge-shaped prism with an inverted periscope that penetrates the seafloor reflecting the sediment-water interface (SWI). The SPI camera provides an undisturbed 20 cm, high resolution, cross-sectional profile image which can be analysed for biological, physical, and chemical parameters. Several studies test SPI applicability in different environments, although very few were performed in shallow coastal areas. In this study, we tested SPI derived parameters' performance and applicability for environmental impact assessment (EIA) in the dynamic coastal environment of the Southern North Sea. A total of 600 images were collected based on a control-impact design across 4 EIA cases (dredge disposal, sand extraction, offshore windfarms and fishery (beam trawl & pulse fishery)). Each picture provides several parameters (sediment type, prism penetration, surface reliefs & bedforms, (sub-)surface fauna, sediment apparent redox potential discontinuity depth (aRPD), and % of anoxic surface area). Those parameters form the basis for the benthic indicators: organism sediment index (OSI) and benthic habitat quality (BHQ). The images were analysed using SpiArcBase software, allowing SPI parameters database management. Results indicated sediment classes parameters applicability, and prism penetration depth revealed slight changes in sediment compaction in three out of four cases, except windfarm activity. The surface fauna and % of anoxic sediment surface indicated to be relevant to assess the redox sediment stage and fauna quality in all cases.

In fisheries, a decline in Lanice conchilega is observed after fishery disturbance. The BHQ indicator (adapted from Nilsson & Rosenberg) allowed detection changes due to impacts, whereas the OSI indicator was not sensitive. Our study indicates the value of the SPI derived parameters for EIA purpose in shallow coastal environments by combining information from multiple anthropogenic stressors. SPI's applicability must be seen as a complementary tool to improve the traditional sediment sampling methods.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Ecorisk: Ecosystem risk assessments with R

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Keywords: Ecosystem-based management, R-package, modular framework, Baltic Sea indicators

Marine ecosystems are currently facing a multitude of global and regional challenges such as climate change, fishing, eutrophication, habitat destruction and pollution. Understanding the associated risks to food security and conservation goals requires assessment tools that are adequate across multiple objectives. Such multiple objective risk assessments can better inform and support ecosystem-based management. Current approaches for marine risk assessments range from simple likelihood consequence approaches, productivity-susceptibility analyses, and network models to climate vulnerability assessments. Yet, most approaches are not tailored to handle the combined assessment of a broad spectrum of ecosystem indicators for which time series or information might be limited. Here, we will present the R package 'ecorisk', which implements a new modular qualitative and semiquantitative risk assessment framework. The framework can be used to assess the risk for individual ecosystem indicators, both species-based and aggregated indicators, as well as for the entire ecosystem. It extends already existing approaches from ecological and non-ecological sciences, while including evaluations of uncertainty associated with the risk and modelling approaches for information limited situations. 'Ecorisk' allows a transparent and user-friendly application of this modular framework, which both will be demonstrated using the Baltic Sea as case study. The assessment of the Baltic Sea, using HELCOM indicators, allowed a ranking of threats and the affected indicators, thus helping to guide management decisions.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

O1-4

The meaning of success at the science-policy interface and how to achieve it

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Keywords: Knowledge exchange, impact evaluation, transdisciplinarity, evidence-informed decisions, environmental management

The management of complex ocean and coastal systems requires the integration of best-available knowledge into decision-making processes and practice. Accordingly, calls for scientists, policymakers and other practitioners to interact are plentiful. However, it is hardly articulated what success exactly means for those interactions. Therefore, we reviewed the growing body of literature evaluating science-policy interfaces to elucidate the intended and claimed outcomes of knowledge exchange (KE) processes as well as the evidence used to evaluate research outcomes and impact. Reviewed KE processes commonly aimed, claimed and referred to evidence regarding the usability of knowledge and social outcomes. They also aimed for deeper policy/economic/societal impacts as well as the actual use of scientific knowledge within decision-making processes. Those additional goals were seldom claimed to have been achieved, instead products were commonly claimed to have been produced, and process attributes such as equity, power relations and transparency were commonly used for evidencing impact. Hence, success of KE at the interface of environmental science and policy comes in diverse forms, and studies' aims and claims may mismatch. This suggests a need to better align the goals with evaluation measures to plan for, facilitate, and appreciate the diverse impacts of knowledge exchange processes. Based on this review and experiences from successful examples at the marine science-policy interface, we generate some understanding and guidance on how to improve the use of marine science in decision-making processes, and build capacities to engage more effectively.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Social networks and mangrove forest management: A case study from the Northern Province of Sri Lanka

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The sustainable management of complex social-ecological systems needs the understanding of changes and transformations of the natural environment. Similarly, the establishment of flexible governing institutes with proper management is also imperative. The coordination and collaboration between various departments may foster the increment of ecosystem functions and services. Still, research on collaborative stakeholder networks and their linkages with sustainable mangrove management strategies is lacking. Through social network analysis, we analyzed the mangrove management stakeholders' perspectives and their informal and formal relationships in the Northern Province of Sri Lanka. Questionnaire surveys were carried out with 19 different stakeholders who were closely related to mangrove management. Our findings indicated that the government departments mandated to conserve mangroves were not only formally appointed key stakeholders but were also perceived as central by other stakeholders in the reality of day-to-day mangrove management. There was a lesser representation of private organizations, despite existing mangrove resource extraction. Communication barriers, lack of awareness regarding the importance of mangroves, and shortages in staff and resources for conservation were highlighted as major constraints that need to be addressed in future mangrove management initiatives.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

A participatory modeling approach to analyze stakeholder perceptions of aquaculture as a social-ecological sytem

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Keywords: Social-ecological systems, fuzzy cognitive mapping, aquaculture, Indonesia, environmental governance

While scientists and policymakers are increasingly recognizing the value in applying a holistic social-ecological systems (SES) perspective to natural resource governance problems, there are continued calls for research methods which more explicitly explore SESs as complex systems, and research designs which better integrate local stakeholder perspectives. Here I present a planned PhD project which applies fuzzy cognitive mapping (FCM), a participatory modeling approach which addresses both of these gaps, to the case context of aquaculture, a sector which remains critically understudied from the SES perspective despite being the fastest growing food production sector globally. Fuzzy cognitive mapping is a method by which stakeholders serve as local SES experts, creating structured quantitative models representing their knowledge and perceptions (or "mental models") of a given system, and has been applied to an increasing array of environmental governance contexts. Through my research, I will apply FCM alongside Elinor Ostrom's social-ecological systems framework to the rapidly expanding aquaculture sector in Nusa Tenggara Barat, Indonesia. I assess how local stakeholders perceive aquaculture as a social-ecological system, and explore how differences in mental models across diverse groups of stakeholders connected to aquaculture, including fish farmers, policymakers, developmental organizations, and researchers might represent areas of consensus or conflict within local aquaculture governance and development.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

Mangrove ecosystem functions, goods, and services in Southern and North-western Sri Lanka; insight towards Ethnobiology and mangrove conservation

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Keywords: Ethnobiology, Mangroves, Ecosystem services, Sri Lanka, Multiple use

Mangrove ecosystems provide valuable services to human communities and local communities typically use direct and indirect services provided. Through this study we determined mangrove species utilization, described the exploitation of mangrove across geographical locations, highlighted the relationship between mangrove use and existential believes, and assessed the importance of mangrove ecosystem in relation to fishery-related activities. The study focused on coastal communities around six mangrove forests in southern and north-western Sri Lanka (Rekawa, Garanduwa, Koggala, Dewata, Chilaw, Gin, and Puttalam). An ethnobiological survey was carried out in households (n = 197) in sixteen villages of these regions. The results indicated that communities sustain their livelihoods with multiple mangrove-dependent income-generating activities among which fishing (21.3%) was the major occupation. Fruit juice produced from Sonneratia sp. and Acrostichum aureum young leaves constituted valuable edible products from mangrove in both regions. The use of mangrove dead wood as alternative source of fuel was also frequent for Rhizophora mucronata and Lumnitzera racemosa. Other uses of mangrove such as wood for construction, chemical and medicinal properties were reported to a lesser extent. Regarding the use of mangrove resources, there was a significant difference across regions with less overall usage in north-western Sri Lankan mangroves compared to the Southern region. NGO-induced mangrove conservation and

successful mangrove restoration projects were prevalent in the north-western province. Overall, awareness of forestry-related regulations within communities was high, although most respondents were not optimistic about the future of the mangroves of Sri Lanka.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

A method to quantify trophic controls along the trophic levels through food-web modelling approach

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Keywords: Mixed trophic impact, bottom-up controls, keystone species,, Northern Ionian Sea, top-down controls

The identification of top-down and bottom-up controls in marine food webs represent an important challenge in the marine ecology research. In fact, the quantification of trophic controls played by species could be useful to understand the ecosystem structure and functioning. A method to quantify trophic controls played by consumers at scale of integer Trophic Level (TL) has been developed through a food-web modelling approach. In particular, the Mixed Trophic Impact (MTI) estimated by a mass-balance model developed for the Gulf of Taranto (GoT, Northern Ionian Sea, Central Mediterranean Sea) has been used to identify the trophic controls played by keystone species/groups on other living groups. MTI quantifies direct and indirect trophic impacts between an impacting group i and an impacted group j through the elements of the MTI matrix (mij). Positive/negative values of mij indicate the increase/decrease of biomass of the impacted group j due to a slight increase of biomass of the impacting group i, respectively. In the analysis, positive and negative impacts of the main keystone groups were used to estimate impacts at the level of discrete TLs, by weighting the impact of each group by the proportion of flows of group j belonging to integer TLs. Thus, a representation of the trophic controls played by the main keystone groups in the GoT food web was provided analysing their bottom-up, wasp-waist and top-down controls. Meso-Microzooplankton and Macrobenthic invertebrates played bottom-up controls with positive impacts up to the TL (V) of the GoT food web. Benthopelagic shrimps and small pelagic fishes played wasp-waist controls impacting the FGs within TLs (III) and (IV). Bathyal squids and the striped dolphin showed top-down controls activating trophic cascades.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

O1-9

Cumulative Impacts Assessment (CIA) on marine and coastal ecosystems: A review and future directions for integrated management of marine and coastal ecosystems

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Keywords: Cumulative impact assessment, Marine and coastal ecosystems, Machine learning, Complex inter-relations, Ecosystem services

Cumulative impacts increasingly threaten marine and coastal ecosystems. The growing interplay between climate change hazards and human-induced pressures from land-based and maritime activities are exacerbating environmental risks, resulting in severe water quality degradation, biodiversity loss, and decline in the provisioning of ecosystem services for human well-being. To address these issues, the research community has started designing and testing different methodological approaches and tools that apply cumulative impact appraisal schemes for a sound evaluation of the complex interactions and dynamics among multiple pressures affecting marine and coastal ecosystems.

Through an iterative scientometric and systematic review, this study provides a state of the art of these methods, giving a specific emphasis to the identification of cutting-edge approaches exploring and modelling inter-relations among climatic and anthropogenic pressures, vulnerability and resilience of marine coastal ecosystems to these pressures, and the resulting changes in the ecosystem services flow. Despite recent advances in computer sciences and the rising availability of big data for environmental monitoring and management, this review revealed a limited implementation of advanced complex system methods for cumulative risk assessment. Moreover, only recently experts have started integrating ecosystem services flow into cumulative impact appraisal frameworks, as generally assessments endpoint within the overall evaluation process (changes in the bundle of ES against cumulative impacts). The present two-tiered review also highlighted a lack of integrated approaches and complex tools able to frame, explain, and model spatio-temporal dynamics of marine coastal ecosystems' response to multiple pressures, as required under relevant EU legislation (e.g., Water Framework and Marine Strategy Framework Directives). Progress in understanding cumulative impacts, exploiting the functionalities of more sophisticated machine learning-based approaches (e.g., big data integration), will support decision-makers in the achievement of environmental and sustainability targets.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

O1-10

Transdisciplinary coastal research in the Global South: a systematic literature review

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Keywords: Literature review, transdisciplinarity, coastal research, Global South

The integrity of coastal ecosystems is the basis for the provision of ecosystem services as well as the formation of values and practices of coastal communities. However, global changes like climate change, pollution, ecosystem destruction and biodiversity loss threaten the integrity of such coastal socio-ecological systems, especially in the Global South. Due to the complex causes and impacts of sustainability problems within these regions, there is a need to generate socially robust knowledge that drives novel solutions to coastal problems which are salient, credible, and legitimate by incorporating context dependent and diverse knowledge systems into the solution process- an aim that transdisciplinary research claims to facilitate and address. To gain an overview on the current practice of transdisciplinary research in coastal regions of the Global South, a systematic literature review was conducted. This research is part of the DKN Future Earth working group 'Anticipating and transforming future coasts' (https://www.dkn-futureearth.org/activities/working_groups/088413/index.php.en). A special focus was put on assessing the inclusiveness of transdisciplinary approaches with regards to the integration of knowledge systems, diverse interests and internal power dynamics and understanding the way in which this research engages with the concepts of the coastal futures and anticipation. For this, we analysed the articles according to a framework of different approaches for anticipatory governance developed, considering diverse conceptions of the future, actions in the present and ultimate aims. Moreover, we highlight how transdisciplinarity was defined by the case studies, enablers and hurdles of coproduction of knowledge, methods used and who was involved in the process to what extent. Our presentation will give insights about participation and anticipation on research to help to conduct further research in this field, promoting tools and methods fitting for the certain case. Insights on participatory involvement and anticipatory governance shed light on current challenges and opportunities of transdisciplinary research.

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

The pential for a mesopelagic fishery by the current large scale Danish pelagic fishery; comparing economics and fishery dynamics

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Keywords: Catch and effort dynamics, fisheries economics, potential mesopelagic fishery, economic break even point, pelagic fishery dynamics

Mesopelagic fish species represent a large unexploited resource for the fishing industry and the fish meal, oil, nutraceutical and pharmaceutical production. However, thorough investigation on ecological sustainability and socio-economic viability are fundamental prerequisites for potential exploitation. We explored the economic viability of a potential mesopelagic fishery investigating minimum catch rates, under the assumption of previous assessments of biological sustainability of such exploitation. We analysed fishery data from the North-East Atlantic fisheries of the Danish large pelagic fleet from 2015 to 2019 and compared and combined the fishing dynamics and cost structures with data from interviews of pelagic producer organization representatives to develop scenarios of profitability. The results show full year-round fleet occupation with the ongoing fisheries, exposing the need of switching from existing activities, or investing into new vessels for conducting potential mesopelagic fishery. Economic analyses revealed that the minimum revenue to break even (zero profit) by trip varies among métiers between 60'000 to 200'000 euro, with a strong positive correlation with vessel sizes. High profitability was discovered for herring, Atlantic mackerel and blue whiting fisheries while low profitability was observed for the Norway pout fishery. Different scenarios of mesopelagic profitability were investigated and compared to current economic dynamics. A high break-even revenue per trip was forecasted due to the increased perceived costs for fuel, modifications of gears and on-board processing methods and potential new vessel investments. High profitability may be reached if the catches exceed 220-1060 tonnes per trip depending on costs and vessel storage capacity. If the conservation methods are improved from current refrigerated sea water, fishing trips could last longer than 5 days,

being the major limiting economic factor for potential mesopelagic fishery. Future investigations on resource abundance, fishing rights, storage and conservation methods will be essential to test the robustness of the scenarios analyzed in this study

Session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

P1-1

CORAL3D. A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with waste from the marble industry.

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Keywords: Invertebrates, biodiversity, habitat, climate change, circular economy

Mediterranean scleractinian corals are heavily affected by the acidification of waters caused by climate change, as it influences the precipitation of calcium carbonate through which they build their skeletons. Moreover, they are exposed to bleaching, ripping out of colonies, burying, emerging diseases, chemical pollution and fishing gears impact. The main objective of CORAL3D project is the design of an artificial reef for the settlement of Mediterranean coral species in the Marine Reserve of Cabo Tiñoso (Region of Murcia, Spain). This action not only creates a habitat for corals, but also benefits other species which are intrinsically dependent. Furthermore, the circular economy concept is applied so, to manufacture the artificial reef, a block of waste limestone and the Computer Numerical Control printing technology were used. For this purpose, the stone block was digitized, and softwares were used to create different types of reef structures. Finally, one was selected according to these design criteria: to provide shelter and to offer a suitable substrate and slopes for coral colonization. Corals that will settle on the reef are being collected around the marine reserve, from the sea bottoms, when they have fallen from rocky walls. Then, they are being transferred to a coral aquarium for maintenance. Once the reef is anchored, the corals will be placed on the structure. On the other hand, an experimental hydrodynamic study was performed to find the best location for the reef anchorage. Clod cards made of plaster of Paris situated at different heights along metal structures were used to estimate the currents at different ubications. As a conclusion of the study, a good location was found at a depth of about 25m, characterized by the absence of meadow or rocky habitats, where it is believed that the reef will offer potential conditions for the development of corals.

SESSION 2) The Impacts of Climate Change over Human Marine Activities and their Management

The upcoming release of the Sixth IPCC Report in 2022 will shed new light on the progress science has made in understanding the effects of climate change over marine ecosystems. However, how severe will marine natural capital be affected, and how will climate change impact the future managing cost of our ecosystems? To answer these questions, a mixed approach between natural, and social sciences, is required. So, if you have researched about climate change effects over marine ecosystems, their social and economic consequences, and/or the upcoming challenges marine management will face, this session is for you!

Dieu Anh Dinh

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Identification of marine heatwaves in the Archipelago Sea and experimental testing of their impacts on the non-indigenous Harris mud crab

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In conjunction with climate change, marine heatwaves (MHWs) are expected to become more frequent and increase in intensity and duration. Despite the rapid warming of sea surface temperature (SST) observed in and projected for the Baltic Sea compared to other large waterbodies, not many experimental studies have examined the impact of MHWs in this area. This study consists of one modelling and one experimental section. In the modelling part, metrics of MHWs in the Archipelago Sea were identified and analysed by applying the software package "heatwaveR", on two SST datasets from Seili, Finland. For the experimental part, impacts of simulated MHWs were tested on the non-indigenous mud crab, Rhithropanopeus harrisii. Measured response variables were feeding and growth. The treatments were designed based on metrics retrieved from the climatological SST data assessed in the modelling section. The treatments represented a present average MHW, a MHW of increased amplitude and a future MHW scenario of a high amplitude. R. harrisii recently entered the Archipelago Sea with an expanding distribution range, which may be driven by its relatively high tolerance to environmental stress in comparison to many native species. Thus, the study hypothesized that R. harrisii would tolerate the benign heatwave treatment but may suffer from intense heat stress experienced in the applied future heatwave scenarios. The mean SST (both summer and annual) in the Archipelago Sea has increased over the last 52 years (0.4 and 0.5°C per decade respectively), and so has the frequency of MHWs. The latter may mainly be driven by an increase in mean SST in the region. There was no significant difference between the treatments in feeding rates or growth over the 36-day long experimental period. Hence, R. harrisii tolerates extreme temperatures that are associated with both present and future MHWs in the Archipelago Sea.

Session 2) The impacts of climate change over human marine activities and their management

Spatio-temporal dynamics of fish in the face of climate change: Application of species distribution models in the Baltic Sea

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Keywords: Baltic International Trawl Survey, Catch per unit effort, Generalized linear and additive models, Vulnerability assessment, Species range shift

Climate change is steadily becoming one of the biggest threats mankind has ever seen. An ever-rising number of evidences shows that marine habitats, species survival and ultimately ecosystem functioning could be severely and negatively affected by the projected changes. As a result, ecosystem services that the human population relies on are likely to be substantially disrupted. Among others, the provision of nutrition through fishing practices is likely to be impacted by the advancing effects of increasing water temperatures. Such developments have already been seen across the world. A prominent example is the Baltic Sea. Historically challenged with overfishing and eutrophication as evident from several strong shifts in ecosystem state, this semi-enclosed large body of brackish water is becoming increasingly threatened by rising temperatures, growing hypoxia, acidification and projected changes in salinity. These pressures are likely to result in large-scale spatial redistributions and changes in the abundance of fish species. As a consequence, ecosystem functioning and fisheries dependent on the Baltic Sea will be impacted. Understanding and predicting the spatio-temporal dynamics of species abundances as a response to the projected climatic changes is, thus, crucial for the sustainable management of socio-ecological marine systems. The effective tools for this are species distribution models (SDMs), which use computer algorithms to predict the distribution of a species in space and time using environmental data. Here, we develop ensemble SDMs based on trawl survey data for a set of fish species that are of particular commercial interest to the fisheries operating in the Baltic Sea. We investigate climate related drivers of past dynamics covering the last 3 decades and predict future range changes for the chosen species. The results of our study are highly relevant for climate vulnerability assessments and could effectively inform management efforts that will need to be taken in the coming years.

Session 2) The impacts of climate change over human marine activities and their management

O2-3

Climate adaptation pathways and the role of social-ecological networks in small-scale fisheries

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Keywords: Adaptation, Climate Change, Network structures, Small-Scale Fisheries, Social-Ecological Systems

Climate change is expected to have increased negative impacts on marine ecosystems worldwide which will threaten the livelihoods and wellbeing of the millions of people who depend on them. We urgently need to understand how people dependent on marine resources will behave under such impacts, and the factors that may facilitate responses that enable a sustainable future. In this paper, we first empirically examine the adaptation pathways that fishers follow when they face a set of hypothetical impact scenarios over their fisheries resources. Second, we empirically test the role of five social-ecological network structures - bonding, bridging, linking, ties with informal leaders and ties with marine resources - on fisher's stated intended responses to the set of climate impact scenarios. We achieve this by drawing on social-ecological network and sociodemographic data collected via face-to-face semi-structured interviews with 404 small-scale commercial fishers from 9 Galician communities, Spain. Our results provide novel empirical evidence that fishers generally intend to follow a 'remain (business-as-usual) – adapt – transform – exit (the fishery)' pathway when faced with increasing climate impacts. Next, we use a set of multinomial multilevel logit mixed-effect models that help to demonstrate that trust-based bonding ties (ties among fishers within social groups) and ties to informal leaders are associated with a 'business-as-usual' strategy. In contrast, communicative bonding ties are associated with adaptive responses, while communicative bridging ties (ties between fishers from different social groups) are associated with transformative and exit strategies. Our findings provide key empirical insight that broaden our understanding of the intricate relationship between social networks and adaptive behavior which is likely to have relevance for small-scale fisheries and potentially other environmental systems worldwide. This research highlights the key role of social ties and structures in climate change adaptation of social-ecological systems.

Session 2) The impacts of climate change over human marine activities and their management

O2-4

Vulnerability analysis of the Western Baltic Fisheries

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Keywords: Fisheries management, Baltic Sea, Vulnerability, Climate Change, Adaptive Capacity ,

Many economies and communities are dependent on fisheries for nutrition, income and also social cultural. Climate change and its associated impacts are altering the productivity of aquatic ecosystems and thus for example the distribution of target fish species important for coastal fisheries. Additionally, the fisheries sector is already facing multiple drivers of change such as shifts in market access, management frameworks and demographics (i.e., high age of fishers and lack of young fishers). To examine these changes in detail, this work focuses explicitly on the example of the western Baltic Sea and its small-scale fisheries. A vulnerability analysis regarding the small-scale fisheries of the Baltic Sea was carried out focusing on the near-coast districts located in Schleswig-Holstein and Mecklenburg-Vorpommern. This analysis is based on freely available fishery (e.g., landings by area, number of fishing boats) and socio-economic data (e.g., GDP and tourist overnight stays). The overall situation will be evaluated, including expert opinions on specific indicators, as well as an algorithm-based analysis. The comprehensive analysis shows that fisheries are distributed differently in the coastal regions being more adaptable near tourist hotspots with direct marketing having a positive effect. The proximity of producer organizations is also likely to have a positive impact through the infrastructure provided. The aim is to investigate which regions of the western Baltic fisheries are particularly vulnerable to the changing of (climate) conditions and which are most adaptive. To be able to make a statement about the local vulnerability, results are transformed into an index, which will be further evaluated cartographically using the program ArcGis. Conclusions regarding local management approaches are to be drawn to point out to the policy that fishery management best be applied locally in order to safeguard the fish stocks, the resident fisheries sector and its culture and tradition.

SESSION 3) Marine Data Science

Marine sciences face technological progress leading to bigger data sets that become increasingly challenging to be analyzed. We collect samples, count indicators, observe patterns and draw conclusions. We handle huge and diverse data and learn from very sparse. Hence, applying Software Engineering and Data management principles is fundamental for our research. For our session, we are searching for your personal experience in collecting, processing, analyzing or interpreting marine data. Building on your contribution, our session shall create a broad insight into the necessity and diversity of data science in marine sciences leading to hints at best practices in this.

hosted by

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Session 3) Marine data science

A study on whole-transcriptomes of two Polychaeta for discovering novel bioproducts with potential biotechnological applications

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Keywords: Annelida, marine bioprospecting, marine environment, RNA-Seq, toxins

The tremendous marine biodiversity relates with the ocean's almost limitless source of bioactives with potential therapeutic applications, including toxins. These biomolecules, many of which proteinaceous, are part of venoms and poisons and can interact with specific molecular targets aiming to impair specific physiological and metabolic pathways in the recipient organism. Recent discoveries on marine venoms, together with the first approved drug developed from a neurotoxic conotoxin, point toward high value of invertebrates as source of novel bioreactives. Polychaeta, in particular, hold an astounding biodiversity, albeit little explored for biotechnological purposes despite growing evidence of venom secretion. This work focused on Glycera alba and Hediste diversicolor, two species with distinct predatory behaviour and morphoanatomy suspected to secrete toxins. To unravel novel toxins, comparative transcriptomics based on RNA-Seq was performed between the species and between different organs, with emphasis on the proboscis, an eversible pharynx used for feeding and sensing. Altogether, Glycera alba and Hediste diversicolor assembled transcriptomes yielded 3075(0.64%) and 3122(1.62%) differentially-expressed genes in the proboscis that rendered 976 and 1893 homology-matched proteins against Swiss-Prot, respectively. Glycera alba's proboscis was found to secrete cysteine-rich venom proteins that can act as immobilisers, along with several enzymes that are known permeabilising and diffusing agents(e.g. zinc-dependent metallopeptidases and chitinases). Conserved domains like CAP, CUB and Kazal also reflected the common signature of venoms. On the other hand, Hediste diversicolor's proboscis secretes mostly digestive and permeabilising enzymes together with a few CRISPs, whereas the skin may secrete toxins, allergens and, potentially, interesting secondary metabolites. These results show Glycera alba's proboscis as a source of bioactives that may interfere with specific mammalian targets, for instance, ion channels of the nervous system. Conversely, isolating metabolites from Hediste will require

dedicated metabolomics approaches whose choice may be facilitated by the retrieval of enzymatic networks from the worm's whole-transcriptomes.

Session 3) Marine data science

O3-2

Monitoring Marine Wildlife and Ecosystem Biodiversity with Artificial Intelligence and Computer Vision: Opportunities and Challenges

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Keywords: Machine learning, climate change, ethics, conservation, mammals

As climate change accelerates and humans continue to encroach on habitats, wildlife and marine biodiversity continue to be under threat. Deep learning and computer vision tools have proven to be a key tool in confronting this growing crisis and aiding in the conservation of wildlife and biodiversity. For example, the use of artificial neural networks to identify, classify, and semantically segment marine mammals and fish in imagery has enabled automated monitoring of individuals and trends in populations in species. These technologies aid in the allocation of resources and personnel as part of more targeted conservation strategies. In addition, automated strategies that are enhanced by such technologies inform governments and policymakers in crafting policy to promote biodiversity and protect areas that are crucial for endangered species. However, as with the rise of any new technologies, there are issues in regards to artificial intelligence that must be taken into account, especially by policymakers. For example, the availability and requirements of high-powered computing that is often necessary for the implementation and deployment of large-scale deep learning-based frameworks can be a challenge, especially in developing countries and underserved and isolated regions. Furthermore, data privacy and security, especially in regards to crowdsourced data that is often utilized for machine learning and the curtain of "big" datasets. Another example is the bias in machine learning algorithms that can result in skewed results or misguided conclusions from the predictions that are outputted. Therefore, while deep learning-based computer vision solutions are promising as a method for preserving biodiversity, there are also issues that must be addressed by those involved in governance.

Session 3) Marine data science

Automated plankton classification - a dynamic optimization procedure

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Keywords: Deep Learning, Convolutional Neural Network, Dataset Shift, FlowCam

With recent advances in Machine Learning techniques based on Deep Neural Networks (DNNs), automated plankton image classification is becoming increasingly popular within the marine ecological sciences. Yet, while the most advanced methods can achieve human-level performance on the classification of everyday images, plankton image data possess properties that allow only a limited degree of automatization.Due to spatial and temporal variability in the plankton communities, field samples may contain life-stages or taxa unknown to a trained DNN. Manual validation of the classification results and regular model adjustment are thus required, hindering the complete automatization of the process. However, model modification requires hard-to-acquire knowledge of Deep Learning techniques and related programming skills. Therefore we propose a "dynamic optimization cycle" (DOC) for plankton classification, a highly efficient and simple procedure combining machine learning and manual validation for ongoing model improvement and adaptation.The key component of this DOC is a desktop application with graphical user interface (GUI) on top of a baseline Deep Learning algorithm. This GUI can be used for image classification and model re-training on manually validated images without further Deep Learning knowledge or experience in coding being required. This way, the algorithm is constantly improved and updated, progressively reducing time for manual validation in the process. The proposed DOC allows a more rapid and effective classification of dynamic plankton communities from different ecosystems, while accounting for spatial-temporal variability, an issue that may be of increasing importance due to climate-change effects. Fluctuations in plankton structure may help to explain food web dynamics and make better projections of the impacts of environmental change on the dynamics higher trophic levels such as fish populations.

Session 3) Marine data science

Variability in Carcinus maenas fecundity along lagoons and estuaries of the Portuguese Coast

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Keywords: **Reproductive patterns, Morphological parameters, European green crab, Regional differences, Atlantic coast**

Fecundity allows evaluation of the reproductive potential of species, being directly related to the females' biological characteristics and depending on their body size. Although *Carcinus maenas* as a species is widely studied, research focusing on fecundity is still scarce.The main objective of this study was to evaluate size-fecundity relationships across different lagoons and estuaries along the Portuguese coast to understand how the local environment affects reproductive patterns. Between 2019 and 2020, ovigerous females were collected from the Southern (Ria Formosa and Ria de Alvor), Central (Rio Sado) and Northern regions (Ria de Aveiro) of Portugal, and the fecundity of each female was estimated through the gravimetry method. Morphometric relationships (Carapace Width - Egg counting; Egg counting - Egg Weight; Body Wet Weight - Egg Weight) were inferred from 180 egg-bearing females with a carapace width between 26.96 and 61.25 mm. A positive correlation between fecundity and the morphological parameters was observed. Significant differences in fecundity were found among all systems, from north to south Portugal, varying between 22121 and 408538 eggs per female. Furthermore, a regional gradient was observed across regions, with lower temperature estuaries (Ria de Aveiro) displaying an increase in fecundity. The fecundity in Sado estuary was also affected by salinity. Fecundity varied significantly across regions due to hydrodynamic, temperature and salinity differences among systems.

Session 3) Marine data science

Where the big Ships go to Sleep, Idenifying Lay Offs based on positional Data

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Keywords: AIS, Hotspots, Shipping, Networks, Lay-Off

So called Lay Offs are a practise by shipowners to put a ship on roadside in order to stabalize freight rates. These ships can be put to sleep for elongated times sometimes until their recativation becomes infeasble. Only manned by a skeleton crew they are waiting for better times. Most recogizable it takes place around the outer harbour limits of singapore, we asked ourself how we can detect this phenomenon on a global scale and how it is related to the shipping network. The Method used is an analysis of so called Automated Identification Systems (AIS) Data. AIS is originally a system for the prevention of Ship collision it containes a vast amount of position data, as well as information about class speed and destination. The Problem is that this data is not publicly available on a global scale. We settled for a freely available dataset provided by the US American Coastguard for the waters surrounding the United States. The work is a proove of concept for the method rather than a global analysis. I filtered the data for ships of the types, Tanker, Bulkfreighter and Container vessel and made sure they are located outside of harbours. In the next step the programmed algorythm analyses position and speed data, keeping only vessels that did not move above a certain speed or away from the starting position of the day. The results show that container vessels behave very differently to tankers or bulk freighters. There deinitively seems to exist a relation between oil price and stationary ships. At the same time when compareing the identified areas of lay off to their position or centrality in gloabal shipping networks is hinted towards, a fact that closes the loop as Singapore is the most central port within the network.

SESSION 4) Ocean Literacy: Linking Marine Science to Education to promote Action

Does your research relate with Ocean Literacy or outreach activities? Then we need you in the conversation! Developing science that is solution driven, inclusive and socially relevant is at the center of the Ocean Science Decade goals (2021-2030). By bringing scientists, educators and citizenship together, Ocean Literacy has become one of the key pillars to achieve this aim. This session seeks to bring together those doing research in marine education and outreach to reflect and find best practices in Ocean Literacy.

hosted by

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Session 4) Ocean Literacy: linking marine science to education to promote action

The Youth4Ocean Forum, a free platform for young Ocean Changemakers

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Keywords: Ocean Literacy, Youth, forum, Changemakers , initiative

The ocean is a source of life for human beings. It gives us food, oxygen and energy. It is home to many species and acts as climate regulator. Understanding how we influence the ocean and how the ocean influences us is at the core of ocean literacy. This understanding allows us to make responsible consumer choices to better protect our ocean and to use the opportunities it offers in a sustainable manner. The European Ocean Coalition (EU4Ocean) connects diverse organisations and people that contribute to ocean literacy and the sustainable management of the ocean. Supported by the Directorate General for Maritime Affairs and Fisheries of the European Commission, this bottom-up inclusive initiative offers a dynamic topic-oriented working environment that stimulates collaboration, exchange of practices and dialogue across the many different target groups leading to the creation of new ocean literacy partnerships and innovative actions, co-designed by organisations and the youth. The coalition is made up of three components: an EU4Ocean Platform for organisations and individuals engaged in ocean literacy initiatives, a Youth4Ocean Forum and a Network of European Blue Schools. The Youth4Ocean Forum assembles young ocean changemakers. It is a free platform for people between 16 and 30 years old. Their common goal is to tackle the climate crisis, fight marine pollution, ensure food security and shape their future with a healthy ocean. Therefore, the Youth4Ocean Forum provides young people with the opportunities to speak up for their generation in front of European institutions, share their ideas and connect with like-minded young people and experts all over Europe. It empowers the youth to solve challenges facing the ocean such as e.g. food security by helping them to develop and promote their individual projects and obtain accreditation of EU Young Ocean Advocates.

Session 4) Ocean Literacy: linking marine science to education to promote action

Building (scientific) knowledge by building bridges between land and sea

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Keywords: analogies, playing, critical thinking, reading habits, outdoors

Knowledge on the ocean is still quite scarce among society. One of the target groups with which to work on reversing the situation are school students. When looking at formal curricula, the ocean is not explicitly included at the primary school level which, together with the fact that humans are terrestrial animals and therefore tend to illustrate with and include more terrestrial examples when trespassing knowledge, may lead towards an under-inclusion and insufficient knowledge about the ocean among youngsters. If we are to educate critical thinkers and citizens compromised with the natural and social world we should understand the importance of the ocean in the planet and over humankind, and our relations with it, and therefore increase knowledge about it. We have therefore developed several didactic materials which try to bring closer knowledge on the ocean by using analogies or similarities with better-known and easier to access terrestrial environments. These materials have been used both in primary and secondary schools, and also in science fairs for the general public and seem to stimulate this "knowing and wanting to know" the ocean. We will present both a board game and an illustrated album which are currently distributed either in public libraries and/or public educational resources centers, and which are also available (and open-access) online through the website of the Education&Outreach project El mar a fons. The examples provided to the date have been gathered through years of talking both to scientists, students and the general public; the materials are thus open-ended and nourish out of feedback from users. The also may be used in outdoor education opportunities, which we reckon crucial in establishing deeper and more solid relationships with nature.

Session 4) Ocean Literacy: linking marine science to education to promote action

"L'Oceà a casa" (The Ocean at Home): discovering the ocean from home during COVID-19 lockdown

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Keywords: Ocean literacy, lockdown, scientific eduation, marine education, outreach

How to literate about the ocean from home? During the COVID-19 lockdown, educational resources were needed to ease the lack of onsite education. To help filling this gap, the Institute of Marine Sciences (Institut de Ciències del Mar, ICM) from the Spanish National Research Council (CSIC) created the initiative "L'Oceà a Casa" (The Ocean at home), an online blog to gather educational content and resources that families could follow from home, oriented to children from 4 to 10 years old. The initiative consisted of an online blog with a total of 15 daily entries covering different aspects of the Ocean, ensuring the representation of all the different Ocean Literacy principles and aligned with Sustainable Development Goals. This resulted from a bottom-up collective effort of more than 28 experts from the ICM-CSIC, and also the close collaboration of an illustrator and a documentarist. As a result, more than 20 original contents, including videos, activities, games and seminars were developed. "L'Oceà a Casa" reached more than 5 thousand visits in a month and reached a wide audience, including readers of the daily contents and attendants to the online seminars. Data were collected by online tools (web, newsletter and social networks analytics) and opinions were collected by survey with the main aim of collecting information for educational research purposes and improvement. This session will describe the ICM's experience with Ocean Literacy and will give a summary of the main conclusions derived by "L'Oceà a Casa" and best practices that could inspire the development of OL initiatives in other institutions.

Session 4) Ocean Literacy: linking marine science to education to promote action

Combining ocean and climate literacy through online participatory simulation

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Keywords: ocean literacy, climate change literacy, participatory simulation, complexity, online

In October 2020 and May 2021, the Inter- Oceans-Climate School (IOCS), of the Ocean Open University (OOP), organized two experimental online participatory simulations to help people understand the complexities of the ocean-climate nexus. The theme of the first one was "The Mediterranean and climate change: Impacts, people, action", and the second was "The Trilogy of Ocean, Coast & Climate: The Urgency & Exigency of Literacy". Both sessions were official event of the UN Decade of Ocean Science for Sustainable Development. Our overarching goal was to help participants to become better ocean-climate-literate stakeholders. Each session consisted of a priming activity, a large-scale, open-ended, goal-guided, data-driven open participatory simulation, which was fully debriefed. Sessions ran over three days, using a visio-conference platform, allowing oral and written interaction among participants. They came from places as far away as Barbados, Belarus, Brazil, France, India, Italy, Iran, Netherlands, Spain, Thailand, Tunisia, UK. Educational background was varied: BSc, MSc, PhD, MBA, Engineering, BA in Hospitality. A detailed, online feedback form two weeks after the event collected participants' opinions, including: "It was a wonderful experience.", "I felt very good with all the participants.", "When I describe the experience to friends I always say that it was something really useful for my personal and professional growth.", "It was a very enriching experience for me to meet all these people with different training and knowledge, coming from different countries.", "Enriching moments, so much more to discover.", "What a great experience! I felt happy, engaged and surrounded by beautiful minds." Both schools were a great success. We believe that this approach could serve as an example for other ocean education institutions. In our talk, we will outline the content areas covered and the pedagogical principles. We will also provide highlights of participants' feedback after the event.

Session 4) Ocean Literacy: linking marine science to education to promote action

O4-5

Capacity-building of marine research institutions for the improvement of ocean literacy

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Keywords: Ocean Literacy, capacity-building, marine research institutions, marine education, outreach

Ocean Literacy (OL) is defined as an understanding of how the ocean influences you and how you influence the ocean. It also pursues the goal of people being able to make informed and responsible decisions related to the ocean. These decisions need to be based in the most updated knowledge as possible and in accordance to the processes and traits of the ocean in the context of constant global and local changes. A strong coordination and collaboration among key stakeholders is crucial for keeping all the parts updated and oriented to sustainable development. One of the most important actors in this transfer processes are marine research institutions, including marine research centers and faculties or units at universities dedicated to the production of marine knowledge. The response to the answers and inquiries of the public based on scientific rigor are crucial and of paramount importance in a context were fake news and pseudoscientific contents are widely and quickly spread around. The Capacity-building (C-B) of marine research institutions, understood as the capacity of an institution in terms of resources and other elements of organization, requires also a reflection on the performance of Ocean Literacy activities. C-B is a central aspect to be considered in order to set specific strategies for achieving both the OL goals and SDG's. C-B requires both resources and adequate global and local capacity to use such resources effectively.This review draws upon a wide range of sources in order to better understand C-B of marine research institutions in terms of the production and capacity for OL purposes. The sources include published literature and data, surveys and discussions among practitioners in the OL field. The effort compares and reflects on marine research institutions of different countries in terms of C-B for OL purposes. The main goal of the study is to provide a conceptual framework of the resources used and needed for the correct development of education and outreach

activities in these institutions. It also reflects on the pathways and methodologies chosen, kind of activities and profile of the personnel involved in those activities.

Session 4) Ocean Literacy: linking marine science to education to promote action

Reaching society through a specialized communication program: the case of the Marine Observatory of Climate Change in the Canary Islands, the OMACC-PF.

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Keywords: ocean acidification, CO2 vent, science communication, visual thinking, Observatorio Marino de Cambio Climático - Punta de Fuencaliente OMACC-PF

Ocean acidification constitutes one of the primary consequences of anthropogenic climate change, generating multiple negative effects in the marine realm. Although great advances have been made on ocean acidification research in the last decade, there are still many relevant gaps. In this sense, the acidic sublittoral volcanic vents located at 'Punta de Fuencaliente' (Canary Islands) constitute an unequalled and promising natural lab, being hitherto the only one found within the Atlantic subtropical biogeographic region. With an annual variation of CO2 emission between 459-988 µatm and of pH between 7.4-8.07, its values range within those that will be reached in the next 30-80 years, according to the IPCC projections, thus meaning a window to future ocean. Accordingly, a marine observatory of climate change associated to these vents has been recently established in the lighthouse of Fuencaliente, the OMACC-PF. Research conducted at the OMACC-PF is providing and will provide a glimpse of the potential synergies among environmental factors, and changes produced on species interactions andadaptive capacity under acidification. This will enable making projections of utmost utility to identify the roadmap on mitigation and adaptation to climate change. Yet, in order to involve and mobilize society accordingly, including local and regional stakeholders and global visitors, this research needs to be approached and made accessible to non-specialized audiences. To that end, we are developing a thorough communication program associated to the OMACC-PF based on visual thinking. This program includes (i) a permanent exhibition, covering its characteristics, relevance, and the work developed on it so far, (ii) an introductory animation to ocean acidification, as well as (iii) the integration of its visual

identity. Across the whole program, the use of visuals, allows translating complex concepts into more comprehensible contents. Hereafter, assessment on the usefulness of the developed materials to reach society will be conducted.

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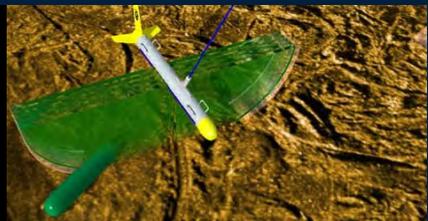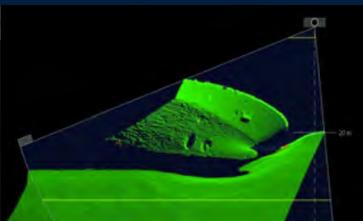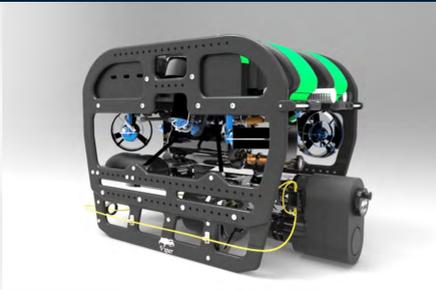
SESSION 5) Stressed out Lives: Organismal Bottom-up Responses to Global Changes

Global changes prompted by anthropogenic activities – including climate change, pollution, and bioinvasions – are crucial research topics due to their detrimental impacts in the different coastal and marine ecosystems. This special session invites ICYMARE 2021 BERLIN participants to present their findings addressing the effects of global changes on marine organisms. Mechanisms of stress and further damage will be preferred, specifically responses at lower levels of biological organization such as the less studied molecular and biochemical markers.

hosted by

Inês Morão

Politécnico de Leiria | MARE - Marine and Environmental Sciences Centre, Peniche, Portugal and Faculty of Sciences - University of Lisbon, Portugal

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Session 5) Stressed out lives: organismal bottom-up responses to global changes

O5-1

Establishing the green-lipped mussel (Perna canaliculus) as a bioindicator species for environmental contaminants using molecular biomarkers

Camille G Baettig [1,2], Andrew Barrick [2], Martin Zirngibl [2], Kirsty F Smith [2], Gavin Lear [1], Louis A Tremblay [1,2]

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Keywords: RT-qPCR, Gene expression, Green-lipped mussel, Ecotoxicology, Copper

In New Zealand (NZ) there is a desire to use endemic species for ecotoxicological hazard assessments, for example the green-lipped mussel (*Perna canaliculus*), rather than internationally standardized species for the characterization of environmental hazards. Due to NZ historically having low levels of contamination relative to the rest of the world, sublethal endpoints or biomarkers may be necessary to predict potential environmental impact before it occurs at higher levels of biological organization. The aim of this research was to develop and validate RT-qPCR primers for *P. canaliculus*, targeting a suite of genes for various mechanistic responses (oxidative stress, xenobiotic transfer, membrane transportation, DNA response/repair, and endocrine disruption). *Perna canaliculus* was exposed (48h) to two well studied reference contaminants, benzo[a]pyrene and copper, known to induce sublethal responses in other bivalves. 48 mussels (3 individuals x 4 contaminant concentrations x 4 replicates per condition) were randomly selected, pooled in 3 L jars, and were exposed to 4 test conditions of Cu and B[a]P separately: natural sea water, 25 µg/L, 50 µg/L, and 100 µg/L. As B[a]P was solubilized using 0.1% dimethyl sulfoxide (DMSO) an additional test condition (4 replicates) was also added to investigate effects of DMSO on gene expression. The results of the present study found modulation of oxidative stress, xenobiotic transfer, and genotoxicity genes which is consistent with previous results reported for other mussel species. Membrane transport genes were modulated after exposure to both Cu and B[a]P, suggesting that these chemicals may have other mechanisms of toxicity that have not been fully investigated. Additionally, this was the first experiment to implement gene expression for *P. canaliculus* in an ecotoxicological context and successfully developed 11 novel biomarkers for the species. Furthermore, these results demonstrate the potential of *P. canaliculus* to be used as an indicator species for environmental risk assessment monitoring studies.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

Consecutive marine heatwaves decrease the performance of the common starfish *A*sterias rubens by accumulation of thermal stress

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Keywords: climate change, environmental fluctuation, extreme events, thermal stress, Baltic Sea

Global climate change fosters the occurrence of extreme events such as marine heatwaves. According to projections, heatwaves are expected to increase in frequency, duration, and intensity and likely cause ecosystem wide effects by exceeding thermal tolerances of many species. Shallow coastal areas and marginal seas, like the Baltic Sea, are particularly affected by increasing ocean temperatures and thermal fluctuations. Yet, few studies test the effects of thermal fluctuation. The effects of marine heatwaves on the performance (feeding rate, growth, and activity) of the common starfish Asterias rubens were assessed. A. rubens is one of the main predators of the highly abundant blue mussel Mytilus sp. and thus, controls the distribution and abundance of Mytilus sp. In the 55-days lasting mesocosm experiment, 12 individuals per treatment were subjected to either Seasonality (summer temperature profile), one heatwave with current intensity (temperatures above 21 °C for 14 days) during two different time periods of the experiment (1st or 2nd heatwave) or a treatment with the combination of the two heatwaves (1st and 2nd heatwave). The heatwaves were nonlethal to starfish, but reduced their feeding, growth, and activity during exposure. The direct succession of two heatwaves amplified these effects. A. rubens was able to recover, but starfish subjected to both 1st and 2nd heatwave showed a delay in recovery and were overall lighter at the end of the experiment. The present study indicates that A. rubens accumulates thermal stress upon exposure to consecutive heatwaves without recovery phases in-between. Due to the performance impairment of A. rubens a predator release on blue mussels can be expected. Along with global warming, the described effects may intensify and cause impacts on the ecosystem level. Though, this could be counteracted if starfish acclimate or adapt, or other (invasive) species take over the main predation of blue mussels.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

O5-3

Unraveling the ecological role of the harmful algae *Heterosigma akashiwo* under variable estuarine conditions

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Keywords: HAB, allelopathy, raphidophyte, bottom-up, coastal ecosystems

Harmful algae blooms (HABs) are increasing worldwide and have severe adverse effects on ecosystems, local economies, and ultimately in human health. Recurrent HAB events in multiple South African estuaries have been attributed to *Heterosigma akashiwo*, a harmful raphidophyte species. Since estuarine ecosystems are characterized by highly variable temperature and salinity regimes, which are driving phytoplankton bloom dynamics, this study aims to investigate the ecological role of *Heterosigma akashiwo* in terms of competition and grazing under variable estuarine conditions. To address this research gap, full-factorial laboratory experiments with two naturally relevant levels of salinity (15, 30) and temperature (16 °C, 22 °C) have been conducted. In monoculture, *Heterosigma akashiwo* was promoted at high temperature versus low salinity conditions while its naturally co-occurring competitor *Heterocapsa rotundata* proliferated at the contrary low temperature versus high salinity conditions. In competition, *Heterosigma akashiwo* was superior to *Heterocapsa rotundata* at high temperature irrespective of the salinity regime, while at low temperature, *Heterosigma akashiwo* only dominated *Heterocapsa rotundata* at low salinity and was significantly suppressed in the high salinity versus low temperature treatment. As a next step, the estuarine grazers Acartia tonsa and Brachionus plicatilis were added to the same experimental design to test for consumer mortality, grazing rates and species-specific sensitivity to the harmful algae. The most negative effects on primary consumers were found in the Heterosigma akashiwo monocultures, where especially the high temperature level in combination with low salinity led to high mortality rates. However, the presence of non-harmful prey significantly alleviated the harmful effects of *Heterosigma akashiwo* on the studied grazers. Thus, present results provide a mechanistic understanding on the competitiveness of this HAB species, coupled to adverse effects on primary consumers, upon exposure to estuarine temperature and salinity regimes.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

O5-4

The causes and effects of chemical contamination and drivers of oxidative stress in a wide-ranging seabird

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Keywords: North Atlantic, Chemical contaminants, Stress biomarkers, Habitat use, GPS tracking

Multidisciplinary approaches are essential to diligently assess environmental health status of ecosystems. In this study, year-round chemical elements' exposure and impacts were assessed on the wide-ranging Cory's shearwater Calonectris borealis breeding in Berlenga Island, offshore Portugal, North Atlantic Ocean. The aim was to identify potential contamination and oxidative stress sources associated with trophic ecology, habitat and spatial use, and foraging patterns. A set of 20 chemical elements were quantified, along with oxidative stress biomarkers, stable isotope analyses, and GPS tracking data. Birds presented higher accumulation to some non-essential elements along the year (i.e. arsenic, As; cadmium, Cd; mercury, Hg; lead, Pb; and strontium, Sr), in concentrations similar or surpassing other procellariform seabird populations all over the world. No significant differences were found for any of the elements between different periods within the breeding season, with exception of Hg. However, a Principal Component Analysis taking into consideration a group of elements showed differences between pre-laying and chick-rearing periods, with overall higher concentrations in the former. Individuals spending more time engaging in an intensive search for food, and in more coastal environments, presented overall higher element concentrations, and particularly Hg. Contrary to expectations, no relationships were found between chemical elements and oxidative stress. On the other hand, spatial use and foraging patterns of Cory's shearwaters influenced their oxidative stress responses. Our results highlight the need for multidisciplinary approaches to deepen the understanding of the large-scale vulnerability

of bioindicators such as seabirds and, by extension, the overall environmental health of ecosystems in which they rely.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

Physiological signatures of coral stress under combined ocean warming and predation pressure

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Keywords: Ocean warming, predation, coral reefs, molecular biomarkers, physiology

Coral reef ecosystems face severe threats due to global change. Although these systems display some level of adaptability to disruptive events, increasing ocean warming has been a major driver of coral reef bleaching and mortality. Coupled to other biotic pressures, corals' ability for acclimatization and adaptation may become compromised in the long run. Here, we tested the combined effects of gradual warming and predation pressure (by simulating wounds inflicted by fish) in six species of Scleractinia corals' cellular stress responses (heat shock protein Hsp70, total ubiquitin Ub, and total antioxidant capacity TAC), physiological health (integrated biomarker response index, IBR), bleaching and mortality. Preliminary results show significant main and interactive effects of species (*Acropora tenuis*, *Echinopora lamellosa*, *Montipora capricornis* brown and green morphotypes, *Galaxea fascicularis*, *Psammocora contigua* and *Turbinaria reniformis*), temperatures (26° C vs 30° C vs 32° C) and predation pressure (wound vs no wound), in all the dependent tested variables. Overall, of the six species used in this study, only three (G. fascicularis, P. contigua and T. reniformis, mostly slow-growing corals) survived the worst temperature scenario (32° C) combined with predation pressure, suggesting that morphology may be an important trait determining coral tolerance to stress. At 30° C, Hsp70 and Ub were induced in most species in comparison to control, but TAC was only induced at 32° C. Predation by itself only induced cellular stress responses in the three most tolerant species that also survived the high temperature treatment. IBRs increased mainly when high temperature was combined with predation, suggesting poorer health, and indicating that physiological processes were induced by temperature and wound

lesions to cope with protein unfolding, denaturation, oxidative stress and tissue damage. Moreover, the combination of high temperature and predation pressure seems to have synergistic effects for corals, accelerating bleaching processes and mortality.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

Sex-specific thermal tolerance limits and cellular stress responses of the ditch shrimp *Palaemon varians* under the combined effects of temperature and salinity

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Keywords: Global warming, Shallow marine environments, Critical Thermal maximum, Stress biomarkers, Intraspecific variability

As global temperatures continue to rise due to global change, marine heatwaves (MHW) are also becoming more frequent and intense, impacting biodiversity. Organisms inhabiting shallow marine environments, such as the ditch shrimp *Palaemon varians*, are expected to be the most affected by rising temperatures. Thus, addressing species' thermal ecology and climate extinction risk is crucial to foster climate-smart conservation of shallow water ecosystems. Here, we estimated upper thermal tolerance limits (Critical Thermal Maximum, CTmax) of *P. varians* and further tested the combined effects of salinity (20 and 40) and temperature (20 vs 23 or 26 ºC) in stress biomarker levels in the muscle of shrimps over a month (day 7, 14, 21 and 28). Females displayed lower CTmax than males, which may have been associated to their higher size and energetic investment in offspring. Overall, smaller individuals were more resistant to elevated temperature, a pattern already described in other studies. The average CTmax value of *P. varians* recorded in a southern Europe population (Portugal) was 37.3 ˚C, which is greater than the CTmax values recorded for northern populations (UK 31 ºC and France 36 ºC). This clinal variation may indicate some level of local adaptation in tolerance limits. However, shrimps still have a large thermal safety margin, as the highest recorded temperature in their natural environment was 30 ˚C. Multivariate analysis of biomarker data showed that temperature and exposure time had a significant effect on stress biomarkers, as opposed to salinity, with no major interactions being detected between factors. These findings indicate that the increase in the frequency and duration of MHW may cause stress on shrimps. If temperature increasing rate continues, species from shallow marine environments may experience

shifts in their physiological performance and population dynamics, along with metabolic changes and a potential prevalence of smaller-bodied organisms.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

The effect of parental thermal environment on maternal investment and offspring performance

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Global warming is characterised by the overall increase in both global sea surface temperatures, and in the frequency and intensity of thermal extremes. Recent work suggests that changes in temperature variation will have greater impact than changes to its mean, yet most studies focus on the effect of constant, elevated temperatures, with the effects of increased environmental stochasticity on the life histories of aquatic animals largely unknown. Our study documents the effect of constant (15, 20, or 25 °C) and fluctuating (between 15 and 25 °C) parental thermal environments on fitness-related traits, measured as maternal investment (egg size) and offspring performance (cardiac function), in a wild population of the brackishwater amphipod *Gammarus chevreuxi*. The parental thermal environment did not affect maternal investment, irrespectively of the thermal regime. However, mothers acclimated to constant, elevated temperatures, produced offspring with lower heart rates than those from mothers acclimated to control conditions. Interestingly, the heart rate of offspring from mothers exposed to fluctuating environments was intermediate. We discuss the adaptive significance of the observed bradycardia in offspring from mothers exposed to elevated temperatures, and conclude that aquatic animals which experience thermal fluctuations in their natural environment may be able to adopt mechanisms in response to environmental thermal variance that minimise negative effects on their fitness. This is supported by previous studies suggesting that ectotherms exposed to regularly reoccurring thermal stress experience greater selection for reversible plastic traits, potentially leading to physiological acclimation to thermal fluctuations.

Session 5) Stressed out lives: organismal bottom-up responses to global changes

O5-8

Combined effects of light intensity and temperature on cellular stress response and physiological performance of the soft coral *Sarcophyton cf glaucum*

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Keywords: Coral holobiont, marine heatwaves, oxidative stress, photoacclimation, biomarkers

Marine heatwaves (MHW) are threatening tropical coral reef ecosystems, leading to mass bleaching events worldwide. Temperature and irradiance are two critical factors shaping the health of photosynthetic corals by modulating the photo-oxidative status of the holobiont. Understanding the physiological and molecular responses of less studied species, such as tropical soft corals, in the face of environmental change can be helpful for their conservation. Here, we evaluated the physiological performance and cellular stress responses of the soft coral *Sarcophyton glaucum* under different global change scenarios. Corals were exposed to different light intensities (high light, low light, 662 and 253 µmol m-2.s-1) for 30 days (time-point 1) and a subsequent MHW simulation was carried out for 10 days (control 26°C vs 32°C) (time-point 2). Subsequently, corals were returned to control temperature and allowed to recover for 30 days (time-point 3). Coral fragments were sampled at each of these time-points and physiological parameters - maximum quantum yield of photosystem II (Fv/Fm), a measurement of photosynthetic activity, dark-level fluorescence (Fo), as a proxy of chlorophyll a content, and stress-related biomarkers (total protein, superoxide dismutase, glutathione-S-transferase, catalase, lipid peroxidation, and ubiquitin) - were assessed in the holobiont. Corals were sensitive to shifts in light intensity, as both yield and chlorophyll a significantly decreased under high light intensity. After MHW simulation, most stress biomarkers activity/levels increased, while yield decreased. Therefore, their photosynthetic activity is shaped by both light intensity and temperature. After recovery, all parameters (except yield) returned to their control state. Although temperature had stronger effects on these organisms than light, overall corals were able to recover from the stress imposed. Also, the combination of both tested

factors does not seem to induce synergistic effects on corals contrary to what could be initially expected.

O5-9

GAME 2021: Influence of artificial lighting at night (ALAN) on food consumption rates and activity patterns in marine benthic herbivores

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Keywords: Light pollution, Sea urchins, Paracentrotus lividus, Anthropogenic impact, Global approach

Light pollution is an emerging anthropogenic stressor in coastal ecosystems. Currently, 22% of the world's coastlines are affected by artificial light at night (ALAN) and the exposure to night lighting is expected to become more widespread as human coastal populations are predicted to double by 2060. Since artificial light in urbanized coastal areas became omnipresent, a comprehensive understanding of light pollution effects on benthic species and ecosystems is still lacking. To assess the potential influence of ALAN on the grazing behavior of the sea urchin Paracentrotus lividus, we conducted two laboratory experiments in Vigo, Spain, between June and September 2021. The two subsequent experiments used the same experimental design and set-up, but applied ALAN intensities that differed by one order of magnitude (i.e. 30 lux and 3 lux). The sea urchins (n = 18) were exposed to ALAN emitted by LED lights (eco+ LED strip SKY 6500 K) from sunset to sunrise and were acclimated to these conditions for 14 days prior to assessing their performance. Another group of sea urchins experienced a natural day/night cycle. P. lividus individuals in both groups were fed with artificial algae pellets (Ulva spp.) throughout the acclimation, but were starved 4 days prior to assessing the response variables. We measured food consumption rates and documented the behavior of each grazer individual using time-lapse photography during a 24 h interval. This is one of the first studies to address the influence of ALAN on the behavior of a marine benthic grazer and we hope to get insights into whether this form of pollution has the potential to interfere with key processes in marine benthic ecosystems such as the top-down control that is exerted by grazers.

SESSION 6) Fantastic Microbes and where to find them: Integrating "-omics" Approaches to understand Life

Fantastic microbes and where to find them: we invite researchers using the latest -omic technologies to assess the microbial biodiversity of our oceans to present their results. Understanding how marine microbes function and relate to each other has been a primary goal of taxonomists, ecologists and evolutionary biologists for centuries. Therein, high-throughput sequencing technologies have become an everyday research tool to resolve these various questions. But regardless of the increasing availability of sequencing data, deciphering the code of life remains a challenge. Therefore, emphasize your individual approaches to access the wide range of eco-evolutionary 'omics of marine species to elucidate life.

hosted by

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Session 6) Fantastic microbes and where to find them: Integrating "-omics" approaches to understand life

Littorinid-associated microbiomes revealed by 16S metabarcoding

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Keywords: Littorina, cryptic species, metabarkoding, microbiome, 16S

Gut symbionts provide indispensable contributions to normal development, metabolism, immunity, reproduction, etc. of their vertebrate and invertebrate hosts. Gut microbiome is a highly specific symbiotic community. Its composition is shaped by many factors, including hosts diet, host immune competence and competition between hosted bacteria. Analysis of the microbiomes associated with species of recent divergence allows to assess the level of microbiome conservatism during evolution. Marine intertidal molluscs Littorina (subgenus Neritrema) inhabiting North Atlantic shores are the complex of young and closely related species. Taxonomic analysis of bacterial communities associated with such organisms may facilitate identification of the microbiota functional role in littorines and their speciation. In this project we assessed bacterial communities associated with a set of closely related Littorina species. Three types of samples were taken from four sites on the coasts of North and Norwegian seas: environmental biofilms from substrates, snail mantle fragment and distal gut fragment. Microbal composition was analyzed via metabarcoding (16s-rDNA fragments sequencing using NGS technology), followed by OTU identification in SILVA database. In this research the microbiomes associated with Littorina from the North Atlantic were described for the first time. Microbiome interspecific and geographic variability was assessed and main factors determining the composition of microbiomes were identified. Common species markers were not found, however OTU markers were found for individual sites in each of the regions. This phenomenon indicates a high geographic heterogeneity of environmental microbiomes and the due differences in host-associated microbiomes. Our data on the diversity and major species of environmental and host-associated microbiomes correlate with the recent results on American litorinids. This study was supported by the Russian Foundation for Basic Research grant 19-04-00392 and RSF grant 19-14-00321 (PI A. Granovitch).

SESSION 7) Exceptions make the Rule: Insights from Mixotrophy

We are what we eat. This phrase can also apply to many marine organisms, which can often eat besides performing photosynthesis or they can even use other organisms for their own benefit. Darwin had already questioned the plant and animal dichotomy, now it is clear that mixotrophy is a critical factor when it comes to understanding ecosystem functioning. Increased attention on mixotrophy now show that mixotrophy might be the rule rather than the exception. If you study mixotrophy and try to unveil the mysteries of trophic interactions of marine organisms, we welcome you to apply for this session and share the news with other young scientists.

hosted by

Konstantinos Anestis

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Sorbonne University, Station Biologique de Roscoff, France

Session 7) Exceptions make the rule: insights from mixotrophy

O7-1

Revising our understanding of plankton succession in temperate oceans under the mixoplankton paradigm

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Keywords: Protist Plankton, Mixotrophy, Mixoplankton Paradigm, Temperate Ocean, Plankton Succession

Planktonic protists perform a crucial role in making Earth habitable for all life forms and make a critical contribution to marine biogeochemical processes. Traditionally, these protists have been divided into two functional groups comprising the 'plant-like' photo-autotrophic phytoplankton and the 'animal-like' phago-heterotrophic protozooplankton; here, we refer to this as the traditional paradigm in marine ecology. However, there has been growing recognition that a significant proportion of marine planktonic protists are actually capable both of phototrophy and phagotrophy in the one cell; these protists have been termed "mixoplankton". This study reappraises plankton succession under the new mixoplankton paradigm through reference to the Station L4 phytoplankton time-series dataset (www.westernchannel observatory.org). This weekly time-series, set up in 1992, holds one of the most established datasets of marine planktonic protists globally. For the first time, the protist functional groups at this location, consisting of 282 different taxa, were reclassified according to the mixoplankton paradigm. The aim was to assess the impact of this new paradigm compared to the traditional paradigm on plankton dominance, seasonality, and succession under different nutrient and temperature conditions. We detected statistically different results when comparing an analysis according to the mixoplankton versus the traditional paradigm in terms of both abundance and biomass. Principal component analysis demonstrated that mixoplankton biomass is dominant in summer seasons, most prominently in July and August when overall plankton biomass is greatest. Additionally, 3D polynomial graphs indicate a complex array of driving factors leading to this mixoplankton dominance that develop above threshold values of ecosystem maturity and temperature. Therefore, this study, using the most extensive data set available, demonstrates the importance of being cognizant of the mixoplankton paradigm in any consideration of plankton dynamics. Results from the analyses of the L4 data set under the mixoplankton paradigm will be presented.

Fantastic Beasts: Mixoplankton spatial variability and succession in The North Sea revelaed by metabarcoding

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Protist plankton engaging photo- and phago- mixotrophy (mixoplankton) are common and important members of the global plankton community. Based upon the origin of their chloroplasts in an eco-physiological context, two main types are considered: constitutive-mixoplankton (CM) and non-constitutive mixoplankton (NCM). Regardless of their significance, little attention has been paid to the characterization, diversity and temporal succession of these two major mixoplankton types. We performed Illumina MiSeq metabarcoding of V4-18S rRNA in 155 samples from the Southern and Northern North Sea covering a > 1 year time-series and a broad latitudinal area. Contextual environmental data: nutrients, T°, chlorophyll-a, and PAR were collected and evaluated for their influences over community changes. Dataset revealed that Dinophyta and Ciliophora were the major mixoplankton contributors. Data showed a significance of CM over the time-series, accounting for a high proportion (33.6%) of the reads, against the low contribution of NCM (2.31%). CM dinoflagellates *Heterocapsa rotundata* and *Karlodinium veneficum* dominated, especially in spring-summer. Non-significant differences were found in NNS between surface and deep chlorophyll maximum communities. Time-series revealed that PAR and phosphate availabilities ($p < 0.01$) were influencing most the observed diversity. Overall, the metabarcoding approach allowed to depict with high resolution the composition of the whole protistan community in the North Sea and outlined the weight of mixoplankton within.

Session 7) Exceptions make the rule: insights from mixotrophy

Biomass dynamics of mixotrophic ciliate Mesodinium rubrum on the effect of prey concentration

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Keywords: Mesodinium rubrum, cryptophyte, mixotrophy, photosynthetic growth, nutrient uptake

Mesodinium rubrum is a cosmopolitan ciliate that relies on phototrophy and preys on cryptophytes to sequester plastids and other organelles. However, little research has been conducted to unravel the role that prey play in the growth and nutrition of *M. rubrum*. In this experiment, we set up 5 different proportional mix culture groups (*M. rubrum* and its prey, *Teleaulax amphioxeia*), and 6 single culture groups with the corresponding density as control. Cell count, C, N, and P elements were used as research variables. The study showed that a higher prey concentration resulted in a longer exponential growth period and a higher population density of ciliate. Meanwhile, within the proportions range we set, the growth rate of Mesodinium reached the threshold(0.15 d-1) at low prey concentration and the ingestion rate was still undersaturated. According to the nutrition analysis results, although low prey concentration groups contained less particulate carbon and nitrogen, they could uptake more nitrogen from the medium and fix more carbon. So, it is suggested that limited prey concentration promotes photosynthetic efficiency and nutrient absorption of *M. rubrum*. It is founded that the mix-culture process led to the conversion of the main form of dissolved inorganic nitrogen from nitrate to ammonia. And the lack of nitrate-nitrogen in the medium was a limiting factor for ciliate photosynthesis, even in the presence of abundant prey. Dissolved inorganic phosphorus in the medium was absorbed and utilized by the ciliates during feeding and division, but the absorption was no longer observed when this process ceased.

SESSION 8) From Physiology to Ecology: What the Holobiont Concept can teach us about Marine Organisms and Ecosystems

In the last twenty years, a new and revolutionary concept has made its way to research: the holobiont. From coral reefs to the deep-sea, symbiotic relationships and host-microbiome interactions are omnipresent and central to the health of marine ecosystems. The development of modern technologies such as '-omics' approaches and imaging constitute exciting opportunities to unveil the complex mechanisms supporting these relationships. This session aims to learn from the diversity of holobiont studies. Are you working on a holobiont model? On the microbiome? On symbiosis? From physiology to ecology topics, we are looking forward to hearing from you!

hosted by

Maud Micha

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O8-1

Microbiome diversity is uncoupled from the biodiversity–functioning relationship in marine phytoplankton

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Keywords: diatoms, biodiversity-productivity, holobiont, interdomain interactions, bacteria-algae interactions

Diatoms play an important role in the global carbon cycle and marine food webs. The surface and immediate surrounding of a diatom cell is colonized by bacterial communities, which constitute the host's microbiome. The composition of the microbiome is highly specific to different diatom species and may vary among conspecific strains or geographic origins. Mutualistic interactions between diatom hosts and their distinct microbiome benefit diatom growth and fitness. On the other hand, antagonistic effects both within and across the taxonomic domains can impact bacterial and host communities. The dynamics of the communal microbiome during an encounter of different diatom species or conspecific strains have not been explored. Increased plant and microbial diversity improve plant productivity in terrestrial ecosystems. It remains unclear, however, whether the productivity of diatoms and the diversity of their associated bacterial communities are similarly linked. In a laboratory experiment, we artificially increased intra- and interspecific diatom diversity in a gradient from monoculture to polyculture using three distinct geographical strains of three different diatom species. Diatom growth and productivity were recorded and differences in the composition and diversity of the associated microbiomes in diatom mono- and polycultures were determined. Differences in bacterial community composition based on amplicon sequence variants (ASV) in the attached and the free-living bacterial fractions were assessed by sequencing the hypervariable regions V4 and V5 of the 16S rRNA gene. In monocultures, we observed distinct species-specific patterns in ASV composition of both fractions regardless of the host's geographic origin. Contrary to our expectations, bacterial diversity did not generally increase with host diversity in diatom polycultures. Diatom productivity was positively associated with diatom diversity, but not with bacterial taxonomic diversity. Overall, our results imply that complex

interdomain interactions rather than mere diversity effects govern bacterial and diatom community dynamics.

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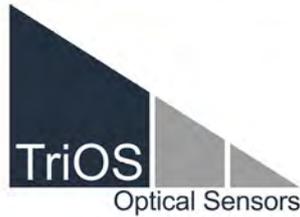
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Quality management

SESSION 9) Often overlooked: Understanding the Ecological Importance of Marine Invertebrates

Marine invertebrates are key players in the global oceans that provide important ecosystem services, so this session topic encompasses all the different research regarding the study of invertebrates. We welcome abstracts of studies conducted on marine invertebrates in every field, from genetics to biophysical interactions to biomedical research. Submissions should focus on the diverse roles that marine invertebrates play and the effects they face from environmental stressors. We hope to receive submissions on a range of original research topics that will ultimately contribute to the ongoing conversation of the importance of invertebrates in marine ecosystems around the world.

hosted by

Emily Chen

Recent Erasmus Mundus Graduate, Marine Biology Research Group, Ghent University, Belgium

O9-1

Supporting the "centre-periphery hypothesis": lower recruitment and reproductive effort in northern than in central populations of the stalked barnacle *Pollicipes pollicipes*

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Keywords: Distributional range, phenology, recruitment, reproduction, stalked barnacle

Understanding large-scale spatial and temporal patterns of marine populations is a central goal in ecology, that has received renewed attention in the context of climate change. However, very few studies explore the large-scale dynamics of populations using standardized protocols and during the same time frames. In this study, we present a comparison of the phenology and annual intensity of reproduction and recruitment for the intertidal stalked barnacle *Pollicipes pollicipes* over an European scale (France, Spain and Portugal), and describe their potential linkages with environmental variables. Differences in the phenology and annual intensity of both reproduction and recruitment were found within regions, mainly between northern (Brittany) and central populations (Asturias, Galicia and SW Portugal), although differences within Iberian populations were also detected. The lower population performance of this species close to its northern limit supports the "centre–periphery hypothesis". Brittany had a less intense annual reproductive effort and a shorter reproduction season (3 months) than central populations (5 months), as well as low recruitment. In Iberia, the recruitment patterns of *P. pollicipes* were opposite to the reproductive ones, since despite the higher annual reproduction

intensity in Galicia (which included the absence of a non-breeding season), a lower annual recruitment intensity was observed there. Our results suggest that air and sea surface temperature, and chlorophyll-a might explain the variability in reproduction and recruitment patterns of *P. pollicipes* found, while no relationship with upwelling was inferred. In the face of large-scale environmental issues like climate change, scaling up ecological studies becomes increasingly important to enhance the resilience of marine populations.

O9-2

Patterns of biodiversity on newly restored mussel beds

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Keywords: Restoration, shellfish, ecosystem services, green-lipped mussel, ecosystem engineers

Natural green-lipped mussel (*Perna canaliculus*) populations are scarcely found in places where they once flourished throughout New Zealand, although they are vital ecosystem engineers for our oceans. Mussels provide habitats for many other animals and are important juvenile fish nurseries. While restoration efforts have been attempted on mussels worldwide, there is still a lack of understanding of the patterns of biodiversity that occur in the early stages of a restored green-lipped mussel bed. An effort to test the patterns of biodiversity on a newly restored mussel bed began after mussels were deployed to the seafloor. In January 2020 we transplanted three tonnes of cultured adult mussels into four locations in the inner Pelorus Sound in the Marlborough Sounds. We analysed biodiversity differences over time by identifying infauna communities, pelagic fish, and larger conspicuous fauna within the mussel matrices. These mussels will continue to be monitored for an additional year and the results of this study will give us insight into how restored mussels provide habitats and effect biodiversity in the Marlborough Sounds of New Zealand. As well as its relevance locally, this study more broadly provides insight on one of the ecosystem services mussels can provide and can help to increase the understanding future restoration efforts.

Session 9) Often Overlooked: Understanding the Ecological Importance of Marine Invertebrates

"Habitat suitability of the red squat lobster in the Northern Humboldt Current"

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Keywords: distribution modelling, Pleuroncodes monodon, Northern Humboldt current system, SPDE, INLA

The Northern Humboldt Current System (NHCS) is well-known for being the most productive Eastern Boundary Upwelling System in terms of secondary production, mainly associated with small pelagic fish. Since the mid of 1990s, the red squat lobster (Pleuroncodes monodon; henceforth RSL) steeply increased its biomass and became after Peruvian anchovy (Engraulis ringens), the species with the second-highest biomass in the pelagic community of the NHCS. Despite its greater biomass and its key ecological role as prey of multiple species, studies on several aspects of its life history, population dynamics and habitat suitability are still limited. Hence, we aim to explore the spatial and temporal distribution and the main drivers of RSL in the NHCS. Data collected from acoustic scientific surveys (2001-2019) during summers and springs were used to explore the spatiotemporal patterns. Environmental (temperature, salinity, thermal fronts and chlorophyll) and geographic covariates (distance to coast and bathymetry) were proposed as the predictors of the probability of presence/absence of RSL and modelled using a generalized linear mixed model including space and time as random effects under a Bayesian approach. Our preliminary results suggest that distance to the coast, surface temperature and bathymetry play a significant role in the horizontal structuration of RSL habitat. Moreover, spatial structures with a range of ~70 km in spring and ~60 km in summer support the use of models including a spatial component and indicates an expansion of the potential habitat during colder months. On the other hand, the low value of temporal correlation suggests that the distribution of red squad lobster do not have temporal dependence. A more accurate prediction of RSL habitat could improve its management but also the management of other species preying and competing with RSL.

Session 9) Often Overlooked: Understanding the Ecological Importance of Marine Invertebrates

New insights into seasonal and stage- specific physiology of *Salpa thompsoni*

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Keywords: Salpa thompsoni, Gene expression, Southern Ocean, Life cycle, RNA-seq

The pelagic tunicate *Salpa thompsoni* and Antarctic krill *Euphausia superba* are the dominating grazers in the Southern Ocean (SO). Long term observations show a southward shift in the distribution of both species, which may be a consequence of climate change. In addition, there has been a notable decrease in krill abundance in certain areas where salp abundances are increasing. Unlike krill, salps were historically considered a trophic dead end and of no economic value. However, they have recently been attracting attention because of their contribution towards carbon sequestration and their ability to outcompete other grazers with their tremendous filtering capacity. Salps are known to grow rapidly under favorable environmental conditions due to short generation times of their chain-forming sexual (aggregate) and asexual (solitary) life stages, and can form massive blooms. A shift in dominance from Antarctic krill to salps may therefore have major implications for the functionality of the Antarctic pelagic ecosystem. This study examines seasonal gene expression profiles in *Salpa thompsoni* during winter and late summer for both reproductive stages. Preliminary results indicate differential responses of several physiological processes between seasons. In addition, a large majority of genes showed an upregulation in solitaries compared to aggregates in winter, indicating a stage-specific overwintering strategy. Our data provide the first insights into the seasonal and stage- specific physiology of salps. These data will not only contribute to a more comprehensive understanding of the response of salps to changing environmental conditions but also help us predict how this species might respond to climate change.

Session 9) Often Overlooked: Understanding the Ecological Importance of Marine Invertebrates

Foraging Ecology of *Homarus americanus*, the American Lobster

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Keywords: Baited Underwater Video, Behavior, Alternative Baits, Fishery, Diurnal Cycle

The American lobster, *Homarus americanus*, is a benthic marine predator of both ecological and economic importance. Found in the Northwestern Atlantic, *H. americanus* is a generalist omnivore that feeds at more than one trophic level, with natural fodder consisting of a variety of vertebrate, invertebrate, and macroalgal species. This diet is also subsidized substantially by bait from the lobster fishery which introduces baited traps into the benthic ecosystem. The influence of the lobster fishery and natural lobster foraging ecology is of interest to both fishers and academics alike. Currently, the majority of lobster foraging behavior was observed under laboratory settings, which are known to influence the behavior of *H. americanus*. Using Baited Underwater Video Tripods (BUVT) we intend to investigate the natural foraging behavior of *H. americanus* in the field in relation to native fodder, commercial bait, and alternative bait options to determine the responses of lobsters to different prey items, as well as factors that affect lobster foraging responses. BUVTs allow for observation of how lobsters interact both with bait and conspecifics to expand our understanding of the foraging behavior of lobsters as well as allow us to test baits which may lead to increased sustainability within the lobster fishery.

Session 9)Often overlooked: Understanding and meeting the current challenges of marine invertebrate conservation

O9-6

Sea slugs of South-east Pelion (Greece)

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Keywords: Sea slugs, Nudibranchs, mt. Pelion, Greece

Sea slugs belong to Heterobranchia subclass of the Gastropoda have the interest of naturalists since the 18th century. There are numerous published works written to spread the knowledge of these molluscs in all marine regions worldwide, however this is the first study for this region which still remains unexplored of its biodiversity. Here, in this research there are the results for the region of the coast of South-east Pelion. We recorded 104 observations for 16 species, of which, 16 species have been found and identified to the lowest taxonomic level, belonging to 2 orders: 2 Aplysiida, 16 Nudibranchia and 1 superorder: 2 Sacoglossa, including one alien species, Bursatella leachii, and 15 observations have identified to Nudibranchia order and they are nudibranchs eggs. All the species have been recorded in central Greece, and especially in the South-east area of Pelion in different locations. That study is an in-depth research, first and unique from this region that reveals the sea slugs occurrence in the area.

Session 9) Often Overlooked: Understanding the Ecological Importance of Marine Invertebrates

Reproduction and feeding of the sea star *Asterina fimbriata* in Patagonia, Argentina

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Keywords: Argentine Sea, Brooding, Echinoderms, Stable isotope, e-DNA metabarcoding

Sea stars (Asteroidea) inhabit from intertidal zones to greater depths. They can reproduce both sexual and asexually, and exhibit many reproductive strategies. Some species present direct development and their youngs are brood, an interesting uncommon reproductive mode, as a derived reproductive strategy. Asteroidea represents worldwide the most diverse class of echinoderm and is the most representative in Argentine waters. At present, the information about the biology and ecology of some sea stars is practically unknown. The present project aims to study the reproduction and feeding of *Asterina fimbriata*, a small brooding species that spans along the Patagonian coasts. Samples will be taken monthly during two years at Camarones Bay (44°S-65°W). In preliminary samplings we have observed some individuals of A. fimbriata with an arched body posture, while brooding embryos masses on its oral surface. Whether those individuals are females or if they are not able to ingest food during the brooding period (as occurs in Anasterias minuta, another sea star of this region) it's uncertain. To unveil this, we will study the existence of a reproductive cycle and its relation with different environmental variables. We will also analyze the developmental stages of its offspring. We will determine the reproductive effort and the relationship between fecundity and parent size, and also describe their diet through a stable isotope and e-DNA metabarcoding techniques. We will evaluate the feeding behavior of adults and the possible influences of water temperature. Furthermore, we will estimate the energetic cost of the adult females throughout the reproductive cycle and estimate the ecological role of this species in the environment. This project will provide new knowledge about the biology of this species, expanding the information to promote the conservation of invertebrate biodiversity in the Southwestern Atlantic.

Distribution and abundance of the crinoid *Antedon mediterranea* in La Spezia Gulf in relation with environmental parameters

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Keywords: Antedon mediterranea, crinoid, ecological factors

Antedon mediterranea (Lamarck, 1816) is a crinoid endemic of the Mediterranean Sea, where it has a geographically wide but localized distribution, reaching very high population densities where environmental conditions are optimal. Its ecology is far from being completely clarified. *A. mediterranea* is a passive filter-feeder, moderately lucifuge and benthic species normally distributed between 10 and 100 m of depth. Nevertheless, in the Gulf of La Spezia (Ligurian Sea), a large population unexpectedly inhabits the surface waters in a side bay along floating piers. In this work we monitored and evaluated the distribution and abundance of this crinoid between December 2018 and December 2019, along with the major environmental parameters likely influencing the presence of this echinoderm, namely nitrate, nitrite, phosphate, dissolved oxygen, zooplankton density, zooplankton biomass, sedimentation rate, composition of the sediment and community composition Four stations were selected inside the gulf, two in which the species was present, and two in which it was absent. Both distribution and density of *A. mediterranea* appeared mainly related to the trophic level of the station. In particular the density of this species was related to that of zooplankton. A fish farm of Sparus aurata, close to the station with the highest density of *A. mediterranea*, can explain its unexpected presence close to the surface and in highly-urbanized areas, due to the higher local food availability for the presence of digested and undigested remains. Further studies considering longer periods and taking into consideration both natural and anthropic factors, can help better understand the ecology of this crinoid in the Mediterranean Sea.

How about plasticity? Native and invasive crabs exposed to a new generation pesticide

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Keywords: Pollution, Bioinvasions, Sulfoxaflor, Carcinus maenas, Hemigrapsus takanoi

Crustaceans are amongst the most reported invaders of coastal habitats, and predatory brachyuran crabs one of the most successful marine invasive groups. They hold high tolerance to abiotic stress and their adaptation mechanisms prompt their invasive conspicuousness. Besides human-mediated introduction vectors, the success of coastal bioinvasions is influenced by ecosystem disturbances such as climate change or the introduction of runoff pollutants. Sulfoxaflor is a new generation insecticide active ingredient, effective on neonicotinoid-resistant pests in agriculture. Toxic to pollinators, its application has been controversial, with the product being banned and re-approved in the US, and regulated to several European countries. Few studies address its toxicity to non-target organisms, and the ones comparing responses in species of different ecological status are non-existent. Therefore, in this study, coastal crab species were exposed to this new generation pesticide: native (*Carcinus maenas*) and invasive (*Hemigrapsus takanoi*). The organisms were individually exposed (N=10) to six sub-lethal concentrations, in a semi-static exposure, at 19°C, during 7 days. The aim was to address their plasticity - as alterations in behavioural and physiological responses (feed intake, motricity, and oxygen consumption) - and assess potential interspecific competitive advantages under pollution scenarios. Current realistic effects of new generation and emergent pesticides on non-target and native versus invasive species can and should be pinpointed. Such approaches promote informed and effective regulation measures, while also helping to unravel the underlying mechanisms for bioinvasions success under global change scenarios.

P9-4

Effects of the trematodes *Microphallus pygmaeus* (Digenea, Microphallidae) on the physiological processes in mollusks of the genus Littorina (Gastropoda, Littorinidae)

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Keywords: Parasitology, trematoda, periwinkles, metabolomics, proteomics

Parasite infection inevitably affects the physiological processes in the host's organism. These effects can be as non-adaptive (side effects of the infection) as well as adaptive, when the parasite changes the phenotype and behavior of the host in such a way as to increase the likelihood of successful infection of the next host in the life cycle. For example, changes in the shell shape and locomotion, and parasitic castration have been shown in periwinkles (Mollusca, Littorinidae) due to trematode infection. Such changes in the host physiology help the parasite to infect its final hosts (sea birds) and maintain its circulation in the ecosystems of the sea coasts. Here, we analyzed the composition of metabolites and proteins in the tissues of infected by trematodes and healthy snails of two species (*Littorina saxatilis, L. obtusata*) to characterize the molecular mechanisms which may underlie these transformations of the host phenotype. The metabolites of periwinkles were analyzed using gas chromatography mass spectrometry (GC-MS/MS); two-dimensional difference gel electrophoresis (2D-DIGE) was used for protein analysis. Significant changes in both the metabolome and proteome were registered in the infected snails. The revealed changes in the abundance and composition of «energy» metabolites (lactate, succinate, malate), as well as free amino acids (methionine, valine, proline, etc.), fatty acids and their esters imply a significant shift in the catabolism and anabolism in the organism of the infected host. A low abundance of sterols (precursors of sex hormones) may indicate the effect of the parasite on the reproductive system of the host, including the phenomenon of parasitic castration. Thus, a significant and profound effect of trematodes on the physiology of marine molluscs has been shown. This study was supported by grant from the Russian Foundation for Basic Research (19-04-00392).

Session 9) Often Overlooked: Understanding the Ecological Importance of Marine Invertebrates

Gene expression analysis in *Littorina saxatilis*, infected and non-infected by trematodes *Microphallus piriformes*

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Keywords: Host-parasite interactions, transcriptomic analysis, Littorina saxatilis, Microfallus piriformes

The parasite effects on its host organism are complex and different. The infestation by trematodes of Littorina snails, the intermediate hosts, can lead to severe changes in the host physiology through parasitic castration and replacing of the hepatopancreas tissue by the local hemipopulations of trematodes. Our study aimed at revealing transcriptomic changes in the organism of *Littorina saxatilis*, infected by trematodes *Microphallus piriformes* compared to uninfected individuals. Snails were collected from natural populations at three distant geographical locations: Chupa Bay (White Sea), Kola Bay and Dalnye Zelentsy (Barents Sea). Molluscs were acclimated to the standard aquarium conditions for two weeks. Total RNA was extracted from tissues not damaged by parasites, and the libraries for the Illumina NovaSeq sequencing were prepared. The expression levels of the transcripts were estimated using Salmon based on de novo reference assembly. Gene expression analysis showed a higher variance in transcriptomic profiles among infected molluscs than healthy ones. Differentially expressed transcripts were established using the sPLS-DA method. Several annotated transcripts coding for proteins of diverse housekeeping functions such as translation, proteins processing, DNA repair and nuclear transport were identified. This indicates great functional changes in an infected snail organism. Additionally, we have found differences in the expression level of the endochitinase-A-like-enzyme, which is known to be involved in biomineralization processes and possibly can explain shifts in the infected snails shell shapes. Other differentially expressed transcripts are the TMEM208 (autophagy negative regulator) and sulfotransferase (sulphating of gonad hormones), which are possibly responsible for decreasing the titre of sex hormones and the reproductive system degeneration after infection. Hence, our study provides molecular background for parasitic castration phenomena, changes in shell shape and significant infection-driven functional shifts in a

SESSION 11) Sustainable harvesting of Seafood - How to explore, predict and evaluate the Future of Marine Food Production

Seafood production remains a significant human activity in the marine realm and is a vital source of income and protein for millions. Yet, human use as well as climate change are continuously altering the oceans. Those changes will also affect the economic conditions for seafood production. In order to adapt, new strategies need to be developed and implemented, a process for which marine sciences are crucial. All marine researchers developing models, evaluating or implementing management strategies, or using innovative research approaches are encouraged to join our session. We aim to balance method presentation and strategic discussions.

hosted by

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Session 11) Sustainable harvesting of seafood - How to explore, predict and evaluate the future of marine food production

Migration under light stress? – Chloroplast relocation movement under different irradiances in sea grapes (*Caulerpa lentillifera*)

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Keywords: Sea grapes, light stress acclimation, chloroplast relocation

Sea grapes (*Caulerpa lentillifera*) are green algae of high economic potential due to various nutritional benefits like high antioxidative activities. The thallus of *C. lentillifera* consists of stem-like, horizontal stolons and edible erected fronds with vesiculate ramuli. Sea grapes are mainly consumed in Asia, where cultivation of the light-sensitive seaweed takes place at ~50 µmol photons m-2 s-1. Light stress can be used to trigger the production of secondary metabolites, causing increased antioxidative potentials and total phenolic contents. However, high irradiance treatments were observed to induce decoloration events, possibly due to chloroplast relocation movement within the siphonous algae. With intent to acquire a strategy balancing antioxidant contents and decoloration for an economic application, it was investigated if the exposure to different irradiances (50, 100, 200, 400, 600 µmol photons m-2 s-1) for 21 days may cause chloroplast relocation, presuming that algal color is an important factor to customers' decision. To track potential chloroplast movement, chlorophyll concentrations of frond tips, frond bases and stolons of algae from each radiation treatment were analyzed and algal color was quantified using a MATLAB macro of Winters et al. (2009). First results indicate that stolons generally have a higher total chlorophyll content (TCC) compared to fronds, but under 50 µmol photons m-2 s-1 for 21 days the total TCC (mean ± SD) of stolon (0.18 ± 0.07 mg g-1 fresh weight, FW) and frond tip (0.10 ± 0.05 mg g-1 FW) did not differ significantly. In contrast, under high light stress (600 µmol photons m-2 s-1) stolons showed higher TCCs (0.21 ± 0.10 mg g-1 FW) compared to frond base (0.06 ± 0.06 mg g-1 FW) and tip (0.04 ± 0.05 mg g-1 FW).This trend might indicate a chloroplast redistribution from frond tips to stolons as a possible light stress acclimation, minimizing photodamage.

O11-2

Understanding connectivity of scallop populations in the Scottish waters to inform marine management

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King scallop (*Pecten maximus*, L.) is a sedentary species that occurs in patches on the seabed known as "scallop grounds". Scallops reproduce by broadcast spawning and their fertilized eggs develop into a pelagic larval stage that is dispersed on tidal currents and it is influenced by local abiotic factors. Scallop fisheries are of substantial social and economic relevance in Scotland, landing around 10.000 tonnes and totalling almost £23 million in 2015, according to the Marine Scotland report of 2016. However, despite their commercial importance, to date little is known about their population structure and how different grounds are interconnected within Scottish waters. Thus, understanding the connectivity between different scallop grounds is an important aspect in a sustainable exploitation perspective, informing the appropriate spatial scale at which to manage the fishery and delineating fine-spatial management units. Indeed, overfishing of critical scallop grounds could potentially undermine the connectivity between scallop grounds, thereby leaving the population more vulnerable to stock collapse. Here, we illustrate and discuss the future steps of the project in order to determine the connectivity of patches of scallops in Scottish waters, examining their population structure, parental and geographic origins with a combination of approaches. Using contemporary genomic analysis, we will examine different cohorts within discrete scallop grounds to infer their genetic population and parental origins. Using isotopic signatures at different points in the scallop shell, we will determine scallop age, and use water temperature and shell chemistry signatures to investigate their geographic origins. The aim of this study is to combine cutting-edge

genomic and biogeochemical analysis to mapping scallop populations in Scottish waters, informing the appropriate spatial scale for a sustainable management of the fishery in a complex changing environment.

Session 11) Sustainable harvesting of seafood - How to explore, predict and evaluate the future of marine food production

Management of North Sea cod (Gadus morhua L.) under future climate change

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World-wide fish stocks are suffering of the compound effects of overfishing and climate change. However, the demand for seafood is expected to increase and climate-change effects are expected to become more prevalent, hence there is a growing need for assessments of future opportunities for sustainable exploitation of living marine resources. Here, we performed long-term climate scenario based population projections for the North Sea cod stock, a valuable living resource supporting fisheries from multiple European countries. We accounted for the typical structural uncertainties in the population model and its sensitivity to different climate scenarios by employing the strategic concept of Decision-Making under Deep Uncertainty (DMDU) to assess our projections. We generated a large pool of projections, sampling from the uncertainty ranges especially in the so-called stock recruitment relationship of North Sea cod and testing candidate management policies under different future climates. We then compared the risk of policies to fail sustainability objectives with potential profits and identified risk-profit trade-offs of the fish stock. We found that North Sea cod can be harvested at ca. 40kt catch or a harvest rate of ca. 8 % while not exceeding 50 % risk of unsustainable fishing. These levels of exploitation return a profit of 80-100 million Euros per year, which is lower than peak profits during the 1970s and 80s, but according to the level of the last two decades. Our study shows that North Sea cod can indeed be harvested in a sustainable and viable manner, even during future climate change.

Session 11) Sustainable harvesting of seafood - How to explore, predict and evaluate the future of marine food production

Ecological Footprint of Fishing: A device to structure sustainable production in Algerian fisheries

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Keywords: Fishing Footprin, Algerian Fishery, SNBE, Sustainable Fishing, Algerian Coast

With more than 1200 kilometers of coastline, 9.5 million hectares of fishing area, and over thirty ports of various categories sheltering 1. 862 vessels in 2012, the Algerian fishing industry has been able to create an economic activity worthy of the attention it has received (FAO, 2013). The Algerian government pursued a strategy to promote fishing through the implementation of quality management tools, infrastructures, acquisition of fishing equipment and staff training (Yahaou, 2016).Despite its production potential, Algeria ranks fourth in the Mediterranean area, where it represented an average of 9% of productivity from 2014 to 2016 (FAO, 2018), the country fails to reach its maximum available biomass capacity, which is estimated to be over 200 000 tons (Yahaou, 2016). Illustrated by Wiefels in 2014 the marine catches in Algeria fell sharply between 2006 and 2013.Therefore the National Strategy for Blue Economy for 2030, which aims primarily to enhance productivity, must consider the market demand from a continuously growing population that is projected to attend 55.7 million inhabitants in 2075 with a consumption rate of 20 kg per capita per year. As well as, the biological capacity of its marine areas to provide the resources.A monitoring device for the different factors in the fishing sector is required to estimate the demand, restructure the production and provide insight on restoring the stocks biomass. We estimated that over 42513 gha are required to sustain the fishing activity of Tipaza, a coastal city of Algeria for 52410 tons of seafood in 2015. The purpose of this paper is to present the EF of fishing activity as a method to gather local data on the materials and energy flows associated with fishing activity. As well as a reliable tool to establish production thresholds to reduce the strain on an already declining biomass.

Session 11) Sustainable harvesting of seafood - How to explore, predict and evaluate the future of marine food production

"Investigating methods to increase tetraspore release and vegetative growth of the red seaweed *Palmaria palmata*"

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Keywords: dulse, seaweed aquaculture, biomass growth, spore release, proliferations

Edible macroalgae are widely distributed around the globe and are known for their exceptional nutritional and physiological characteristics, which make them very useful in diverse industries, such as the cosmetic, pharmaceutical or food industries. *Palmaria palmata* (Linnaeus) (Weber and Mohr, 1805), commonly known as dulse, is a red alga that accounts for 8-35% of protein (dry weight), vitamins and eicosapentaenoic acid, making it a healthy plant-based food item. It is a resource traditionally harvested from the wild, but the growing commercial demand is inducing intense pressure on the feral populations. Therefore, more research on efficient big scale cultivation of this species is needed. Previous studies have shown a low rate of tetraspore release and germination, with high spore mortality, leading to a low cultivation success. Our project aims to investigate if a trigger for tetraspore release, comparing different environmental factors, such as dessication, longer dark phases than per usual and aireation. The second objective is to explore where do the new vegetative proliferations appear in a specific section of the tissue or if it is a random process. Lastly our goal is to investigate whether biomass exposed to purple light has a higher growth rate compared to that exposed to a wide spectrum lamp and, likewise, what is the optimal light intensity for *Palmaria palmata* to grow in a faster fashion.

Drivers of spatio-temporal fishing dynamics in the southern North Sea: the case of three German fishing fleets

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Knowing the drivers of fisheries is crucial to assess reactions to changes in management and mitigate potential negative consequences. A growing body of research focuses on the behavior of fishers, but studies using empirical methods to identify drivers of fishers are still rare. We focus on the southern North Sea, a highly used shelf sea that will undergo several changes in the coming decades due to expanding offshore wind farms, climate change, and Brexit. We extracted spatio-temporal fishing effort from logbook and vessel monitoring system (VMS) data for the main German fleets operating in the southern North Sea, i.e. the brown shrimp, flatfish, and mixed demersal fleet. We used boosted regression trees (BRT) to analyze fishing hours in response to environmental, economic, and socio-cultural parameters and tested qualities of BRT predictions for various temporal and spatial scales. Our results show that most significant drivers are environmental variables, however, in terms of average importance economic parameters were equally relevant. Bottom temperature, salinity, distance to port, bathymetry, wind speed, and wave height were significant drivers for all three fleets. The brown shrimp fishery was the only fleet with significant resource and fuel price, as well as the information whether it was a work day. Future predictions were most reliable for the coastal brown shrimp fleet, but monthly aggregated values achieved good performance for all fleets up to 30km buffers around fished areas. Incorporating larger spatial areas into the model revealed potential alternative fishing grounds. This result may help to assess displacement effects of fisheries due to new restrictions. Overall, our findings show that fishing dynamics are driven by complex interactions between environmental and economic variables, and that state-of-the-art modelling approaches, such as BRTs, are able to predict fishing effort.

SESSION 12) Coastal Wetlands - Muddy is the new trendy

Coastal wetlands are important resources for communities relying on marine environment. They are a buffer zone between oceans and terrestrial ecosystems, supplying unique ecological functions such as carbon sequestration and nitrogen removal. The provisioning and cultural services delivered contributes to the socioeconomics of coastal populations. While mangrove, saltmarsh and seagrass are valued as one of the most precious ecosystems in the world, they are also the most endangered with a global cover loss estimated around 25-50% over the past 50-100 years. We welcome in this session any studies related to coastal wetlands to improve our knowledge on these important ecosystems.

hosted by

Charles Cadier

Australian Rivers Institute, Griffith University, Brisbane, Australia

Naima Iram

Australian Rivers Institute, Griffith University, Brisbane, Australia

Destruction of Mangrove and Lagoon Ecosystem Caused by Shrimp Farming in the Pambala–Chilaw Lagoon Complex, Sri Lanka

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Keywords: Mangrove ecosystem, Shrimp farming, Land use/cover changes, Remote sensing and GIS, Ecosystem services

In Sri Lanka, mangrove vegetation and lagoons located in the North-Western coast have experienced high level of degradation since the introduction of shrimp farming in the 1980s. Within the Pambala-Chilaw lagoon complex, this study sought to assess the areal changes in mangrove vegetation and shrimp farms. The levels of physicochemical parameters of the Chilaw lagoon in response to shrimp farm effluent discharge was also assessed. Aerial (1973) and satellite (2020) images were geoprocessed and classified to assess the land use/cover changes in the Chilaw lagoon area. Physicochemical parameters (nitrates, phosphates, pH and conductivity) were also measured in water and sediments from the Chilaw lagoon as well as sediments from its fringe mangrove vegetation. It was observed that mangrove vegetation decreased in areal extent by 45% of which majority (92%) was attributed to shrimp farming. Statisitically significant differences ($p < 0.05$) were observed for levels of physicochemical parameters recorded in water samples collected along vertical (3 depths) and horizontal (3 zones) gradients of the Chilaw lagoon. The highest records of physicochemical parameters in water samples were from the lowest depth. High levels of pH (pH > 9) recorded in water samples were evidenced by the observation of algal blooms and limited fish catch in the lagoon over the years. Moreover, high levels of pH (6.70 – 7.99) and conductivity (583 – 6850 µs/cm) recorded in mangrove sediments can be indicative of abiotic stress on mangrove seedlings, affecting the entire mangrove ecosystem. A strong correlation between nitrates and phosphates

observed in sediments from mangrove vegetation (r2 = 0.94) and lagoon (r2 = 0.98) revealed a common pollution source; shrimp farms. The high level of water and sediment pollution and the current exponentially lower areal ratio (1:1) between mangrove and shrimp farms consequently poses a critical ecological issue of immediate concern.

Session 12) Coastal Wetlands - Muddy is the new trendy

Assessment of Blue Carbon Stocks Including Mangroves, Seagrasses and Salt marshes in Puttalam Northwest Sri Lanka

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Keywords: Tropical Wetlands, Climate change, Carbon sequestration, Organic Carbon, Vegetative Biomass

Blue carbon is the carbon stored in coastal and marine ecosystems and are reputed to be large store houses of carbon compared with terrestrial ecosystems. The objective of this study was to assess the carbon storage capacities of mangroves, seagrasses and salt marshes in Puttalam Lagoon associated areas in Low Country Dry Zone of Sri Lanka. In the mangroves, belt transects were laid from the shore towards the land. Nested circular plots having 7m radius were established, large trees were sampled for diameter. Small trees (<3 cm dbh) were sampled in 2m radius. Litter, pneumatophores and seedlings were sampled in plots of 30 x 30cm area. Species specific allometric equations were used in the assessment of biomass. In the seagrass beds and salt marshes belt transects were set up parallel to the beach (along the coastline) and 1 x 1m plots were sampled along this. In each plot, the species composition and the number of plants/species were recorded. Few plants were uprooted and taken to the laboratory for further analysis. In case of all three ecosystem types, soil samples were taken from the core to represent the following depths; 0-30 and 30-60, 60-90. The organic carbon was analysed using Loss on Ignition method. Mangroves comprised of Rhizophora mucronata and Avicennia marina while sea grasses dominated by Enhalus acoroides. The salt marshes comprised of two species ie. Suaeda vera, and Salicornia brachiata. Total ecosystem carbon content of planted mangroves was 320.47 Mg C/ha; natural mangroves 596 Mg C/ha, seagrasses 236.76 Mg C/ha and salt marshes 197.16 Mg C/ha. In all these ecosystems the contributions of soil organic carbon was significantly higher than plant component – mangroves – 64%, seagrasses and salt marshes 99%. In mangroves aboveground: below carbon content was 72:28 for the natural mangroves.

O12-3

Combined effects of global and local stressors on mangroves, salt marshes and seagrass beds: a literature review

Cristina Seijo [1,2], Catarina Fonseca [2,]3, Andrea Z. Botelho [4,5], Gema Casal [6], Cindy C. Cornet [7], Simon Cragg [8], Elisa Furlan [9,10], Artur Gil [2,11], Jean-Philippe Maréchal [12], Bethan C. O'Leary [13,14], Rémy Simide [15], Ewan Trégarot [7], Matthijs van der Geest [16], Silvia de Juan [17]

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Keywords: coastal wetlands, climate change, stressors, pressures, resilience

Coastal wetlands such as mangroves, salt marshes and seagrass beds occupy a unique position at the land-sea interface and are vitally important to human prosperity and well-being. While those ecosystems provide a wide range of services, including food, coastal protection and climate change regulation, their ability to cope with the effects of climate change is compromised by widespread and growing anthropogenic pressures. Understanding the combined effects of global and local stressors on coastal wetlands is exceedingly challenging because of the inherent complexity of these ecosystems and the variability of stressors across space and time. To identify the current state of knowledge on combined effects of multiple stressors and ecological thresholds in three key coastal ecosystems, namely mangroves, salt marshes and seagrass beds, and their associated ecological thresholds, a systematic literature review was conducted on this topic. The

search string comprised a set of common search terms combined with more specific search terms relevant to each ecosystem. Searches were restricted to English language and geographically to the North Atlantic, Mediterranean and Caribbean. A total of 1848 records were retrieved and screened for relevance, first by title and abstract and then at the full-text level. This resulted in 466 relevant studies, of which 126 focused on mangroves, 127 on salt marshes, and 213 on seagrass beds. Preliminary analyses indicate that changes in salinity associated with sea-level rise and changes in seawater and air temperature associated with global warming are among the key stressors across all coastal wetlands. Those stressors directly related to climate change should be considered in the design and implementation of risk assessment frameworks if intended to be scientifically sound and informative to drive coastal wetland management and adaptation pathways.

Coastal erosion reduction by seagrass: not all species are equal

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Coastal erosion exacerbated by climate change and development is increasing the risk of flooding to coastal areas globally. Seagrass meadows can indirectly reduce coastal erosion by stabilising sediment on the seafloor and, in some cases, form sea cliffs if sediment surrounding the meadow is eroded. There is evidence that seagrass can reduce erosion on the seafloor yet, the stabilisation of seagrass-formed cliffs has not been tested. Existing studies have investigated the effects of seagrass, whose below-ground biomass form dense root mats on the seafloor but not considered alternate root structures or erosion of sea cliffs. This study applied the methods used to investigate cliff erosion rates in saltmarsh, to *Enhalus acoroides*, a species that does not form dense root mats, to discern if it can still stabilise sediment. Seagrass and sediment cores from Xincun Bay, China, were transplanted into a purpose-built frame, exposing one side of the core to waves within a flume to mimic wave exposure experienced by sea cliffs in the field. The effect of cliff height was tested for five depths over a one-hour experiment duration. Seagrass presence did not have a significant effect on erosion, but the cores with seagrass generally persisted longer, regardless of cliff height, than the sediment cores. These results suggest that non-dense root-mat-forming seagrasses may not provide the equivalent sediment stabilisation as other species.

Plant selection for Floating Treatment Wetlands in Brackish Waters

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Keywords: Water quality, remediation, toxicology, marine pollution, contaminants

Coastal ecosystems, including brackish water bodies (i.e., wetlands, saltmarshes, estuaries, mangroves, and coastal lagoons) provide critical ecosystem services that support both human and environmental health. Increasingly, anthropogenic activities impair water quality in brackish ecosystems. Changes in land use often result in increased velocity and volume of stormwater runoff paired with the increased presence of nutrients, metals, plastic, and organic-based contaminants that affect water quality. Mitigation of contaminants in brackish waters is critical. Floating treatment wetlands (FTWs) are a remediation technology that uses vegetation to improve water quality, that has been proven effective and studied mostly in freshwater systems. However, FTWs application in systems with fluctuating salinity, such as brackish waters, still requires further investigation. Our goal is to determine the plant species suitable for use in FTWs deployed in brackish water ecosystems with fluctuating salinity. This experiment will evaluate the performance of four plant species (Distichlis spicata, Juncus roemerianus, Spartina alterniflora, and Spartina patens) grown under three different salinity levels (0.5 ppt, 5 ppt, and 18 ppt). The results will inform the selection of plant species to use in future contaminant remediation experiments with FTWs and provide background information for the application of FTWs as a remediation technology in brackish water bodies.

SESSION 13) Tropical Marine Ecosystems in the Anthropocene

Tropical coastal ecosystems such as coral reefs, seagrass meadows and mangrove forests provide the resources and ecosystem services upon which humans vitally depend. These ecosystems, however, are under threat due to the increasing pressure caused by anthropogenic impacts like overfishing, pollution and climate change. In this session, we invite contributions from natural and social sciences that advance our knowledge on the challenges that these valuable ecosystems face. We are interested in studies presenting solutions for their sustainable management in harmony with societal needs and particularly invite you to use innovative methods to present your research.

hosted by

Xochitl Édua Elías Ilosvay

Centor de Investigación Mariña, Universidade de Vigo, Future Oceans Lab

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Session 13) Tropical Marine Ecosystems in the Anthropocene

O13-1

Left out in the cold: does cold water bleaching pose a threat to (sub)tropical coral reefs?

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Keywords: Sea surface temperature (SST), temperature anomaly, cold spot (CS), climatology, remote sensing

Water temperatures on coral reefs are increasing globally, resulting in frequent bleaching events, threatening coral reef survival. However, since the 1970s cold water events reaching the lower temperature threshold of corals resulting in bleaching and mortality have been observed, yet remain vastly understudied. Therefore, this study aimed to investigate spatial and temporal variation in cold water temperature anomalies on (sub)tropical coral reefs (-35–35°N). Firstly, we identified coral reef ecoregions that commonly experience low sea surface temperatures (SST). Secondly, we analyzed the annual percentage of reefs experiencing cold stress over the past 33 years. A minimum Monthly Mean (mMM) SST climatology was developed (spanning 1987–2020) as a baseline. To identify ecoregions with low SST, mMM temperatures were compared among 150 ecoregions. The baseline mMM was subtracted from daily SST to calculate temperature anomalies, called Cold Spots (CS). To analyze temporal variation, the percentage of reefs experiencing cold stress (CS≤-1°C) was calculated per year. mMM temperatures ranged from 13.1–29.5°C globally. The Galapagos Islands ecoregion contained lower mMM temperatures compared to other equatorial ecoregions, likely due to frequent upwelling. Five ecoregions had an exceptionally wide range in mMM (>6°C): North and central Red Sea, Persian Gulf, Taiwan and coastal China, North-west Hawaii, Bahamas and Florida Keys. The subtropical climate at these ecoregions in the Northern hemisphere likely explains the wide variation in mMM. Cold water bleaching events are most likely to occur in these ecoregions containing exceptional mMM temperatures. Globally the percentage of reefs experiencing cold stress significantly decreased over the past 33 years (P<0.001**, R2=0.77), suggesting that global warming diminishes cold stress on reefs. Cold stress is expected to coincide with heat stress on subtropical coral reefs, cumulatively threatening corals dispersing pole-ward to refugia under future climate scenarios with extremer weather patterns.

O13-2

Impact of phosphate eutrophication on the susceptibility of the pulsating soft coral *Xenia umbellata* to ocean warming

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Keywords: Soft Corals, Local Stressor, Global Stressor, Warming , Phosphate

Coral reefs are in decline because of the simultaneous occurrence of global factors like ocean warming and more local factors like eutrophication. Research so far focused on the impact of either global or local factors on corals but did rarely consider combined effects. Additionally, previous studies concentrated on hard corals, but rather neglected soft corals, despite their increasing occurrence in coral reefs. Further, studies found that hard corals were more susceptible to ocean warming when exposed to high N:P ratios, because corals experienced phosphate starvation. We thus investigated the combined effects of phosphate (P) eutrophication and ocean warming on the cosmopolitan Indo-Pacific soft coral *Xenia umbellata*. We hypothesize that P in contrast to nitrate (N) eutrophication increases the resilience of soft corals to ocean warming. To test our hypothesis, a five-week manipulation laboratory experiment with first P eutrophication (1, 2, 8 µM PO_4 addition) and then ocean warming (stepwise temperature increases from 26 to 32 °C) was conducted. During this experiment, we measured survival, growth, colouration, pulsation rate, oxygen fluxes, and analyzed stable isotope composition for d15N and d13C to investigate ecophysiological changes in the corals with their associated zooxanthellae and microbes. Phosphate eutrophication alone had no significant effect. Warming led to a significant decrease of cellular chlorophyll a concentrations in colonies without phosphate eutrophication. Additionally, all colonies showed a significant decrease in d15N at the end of the warming phase, regardless of their phosphate treatment. The combined effect led to colonies having higher densities of zooxanthellae compared to their baseline values and significantly increased pulsation rates up to 30 °C.P eutrophication seems to enhance the resilience of *Xenia umbellata* colonies towards ocean warming by enabling them to increase pulsation rates. This, in turn, could further increase their competitive dominance on future reefs, changing ecosystem functions.

O13-3

Interconnectivity of water quality with biodiversity and ecosystem function in impacted marine environments

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Keywords: Anthropogenic impact, subtidal ecosystem, water quality gradient, urban pollution, standardized assay

Coastal marine environments act as an integral part of human society by providing numerous functions and services. However, in an urban, densely populated area such as Hong Kong, the water quality of its surrounding marine environment has been substantially reduced due to anthropogenic disturbance and pollution, which in turn devastated biodiversity and ecosystem function. In this study, we investigated the interconnectivity of eight water quality parameters (temperature, dissolved oxygen, salinity, turbidity, inorganic nitrogen, total nitrogen, chlorophyll α, fecal coliform), alongside fish and sea urchin biodiversity with ecosystem function of seven localities within Hong Kong. These functions were quantified using standardized, reproducible methods, such as squidpops, which were dried squid mantles tethered on bamboo rods for measuring predation rate, and tea bags to simulate organic material for measuring decomposition rate. We found that the ecosystem function and biodiversity of each site had significant correlation with several water quality parameters. In addition, we found additional connections between fish composition and predation rates, as well as sea urchin abundance and herbivory rates. Nevertheless, the association of each variable to multiple different water quality parameters suggests a more complicated and nuanced relationship than previously thought. Overall, our study provides a baseline for characterizing and assessing the functionality of marine environments using standardized methods, though subsequent studies are necessary to further assess the effects of each parameter toward biodiversity and ecosystem function.

Session 13) Tropical Marine Ecosystems in the Anthropocene

Effects of artificial provisioning on feeding behaviour, nutrition and physiology of coral reef fish

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Keywords: Supplementary feeding, diving tourism, chemical pollutants, biomarkers, histopathology

Artificial provisioning in coral reef systems to attract fish and thereby enhance visitor satisfaction is a common practice in many tropical diving tourism destinations, yet, impacts on smaller fish species remain largely unclear. Besides inducing changes in feeding behaviour, the inadequate food may also affect nutrition, metabolism and health. Additionally, compounds in sunscreen may affect the physiological status of native species. Here, we conducted feeding experiments (artemia vs artemia+bread vs bread) including the UV-filter octocrylene as a nested factor (control vs DMSO vs DMSO+octocrylene) on two coral reef species, Neoglyphidodon melas and Chromis viridis. Aiming to understand the extent to which satiation after bread feeding influences natural feeding rates, we quantified feeding rates (bites/minute) by visual count. We also sampled liver and muscle tissue to analyse biomarkers associated with nutrition and stress (total proteins, total lipids, total glycogen and glucose, total energy as well as lipid peroxidation and total antioxidant capacity). Finally, we conducted histopathological analysis of fish liver to assess tissue health. Preliminary results suggest that satiation may lead to lower ingestion rates of natural food subsequent to artificial feeding events. The findings also suggest the occurance of elevated glucose and glycogen levels especially in muscle tissue of fish fed with mixed and bread diets compared to the control. Moreover, fish exposed to octocrylene displayed an increasing trend in total antioxidant capacity, suggesting induction of antioxidants to cope with physiological stress induced by the UV-filter especially in fish that were also fed on bread diets. We observed changes in fat

vacuolation, eosinophilia as well as necrotic and apoptotic foci with consequent hyperaemia and melanomacrophage aggregates in fish exposed to these stressors, suggesting tissue injury and inflammation in hepatic parenchyma and pancreatic acini. This suggests that the combination of chemical pollution and poor nutrition may affect fish health.

Diet composition and feeding habits of two small-pelagic fish species targeted by shallow water fisheries in the Visayan Sea, Philippines

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Keywords: Visayan Sea, Diet composition, Sardines, Stomach Content Analysis, Plankton

The Visayan Sea is a marine inland area located in the west central Philippines. In this area, sardine fishery activities play an essential role in the national production and in the domestic consumption as sardines are a key source of protein in the Philippine central region. Coastal waters support most of the fishery activities, and, in fact, this activity has reported an impact on the reduction of the stocks in the latest 20 years. Necessary information to understand the ecological role and trophic interaction of the sardines in the Visayan Sea is necessary to address stock depletion issues. This study concerns Stomach Content Analysis (SCA) to identify the food types that are part of the diet of the most common species *S. gibbosa* and *S. lemuru* sampled by commercial ring nets from 2017 to 2019 from a shallow fishing ground of Concepcion province, west coastal waters of the Visayan Sea. Based on examined stomachs (N = 132) fifty different food types were identified in total. According to their diet composition, both sardine species were fed mainly on phytoplankton (27 types) and zooplankton (11 types) categories suggesting both species are omnivorous planktonic feeders. Close to full overlap in their diets were found, a sign of high prey density on the environment and possible competitive interaction. The most common food items in both diets were diatoms and copepods. However, multivariate analysis shows significant differences (P-value: 0.001, PERMANOVA routine) between diets if abundance were compared. These differences in abundance proportions were observed along the different size classes mainly for phytoplankton for *S. lemuru* and for zooplankton for *S. gibbosa*. In *S. gibbosa* feeding intensity was higher (0.906 ± 0.4) with a dominance on calanoid copepods, crustaceans like ostracods, luciferids, decapod zoea, and benthic associated organisms, like nematodes and flatworms. Meanwhile, *S. lemuru* showed a general lower feeding intensity (0.641 ± 0.2), with diets based on harpacticoid and cyclopoid copepods, diatoms and dinoflagellates. This study reveals inter specific differences in the feeding behaviors, between particulate-feeding and filter-feeding, with *S. gibbosa* being preferably a particulate feeder with a wide diet spectrum of zooplankton

groups and benthic organisms, while *S. lemuru* rather filter feeds on a wide spectrum of food items but particularly on phytoplankton species.

Session 13) Tropical Marine Ecosystems in the Anthropocene

How potential field methods can help to simulate trade-offs in fish movement behaviour in fragmented seascapes

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Keywords: Individual based modelling, potential fields, habitat fragmentation, connectivity, fish bioenergetics

In nature, fish are seldom evenly distributed across a heterogeneous seascape like coral reef systems and their space use patterns will largely result from the interactions between individual movement behaviour and the characteristics of the surrounding environment. When foraging, herbivorous parrotfishes, for instance, are constraint by habitat characteristics like the food availability and different levels of predation risk. As parrotfish play an important role in structuring benthic communities, the resulting spatial distribution of the fish population can strongly influence community composition and ecosystem resilience. Motivated by the need to limit model biases due to over-simplified movement patterns we aim at a more realistic representation of fish movements and their decision-making process. In a novel approach, we combine individual-based modelling (IBM) with potential field methods, in which environments are represented as fields of repellent and attracting forces.In our model, the biotic components represented are individual parrotfishes, food availability and predation risk, while abiotic factors include the diel cycle as well as the underlying habitat structure of a coral reef system. By coupling the fish's bioenergetics with a navigation capacity using the potential field we provide a mechanistic basis for better understanding and predicting how changes in the habitat structure and fragmentation may cause shifts in population dynamics and space utilization.Model results indicate that movement patterns and the resulting spatial distributions of the population are more irregularly distributed among coral reef patches the more the coral reef habitat becomes fragmented and reduced. On the individual level, the process of reproduction seems most susceptible to changes in habitat configuration and composition. Based on our findings we believe that the integration of potential field methods into IBMs is a promising strategy to represent the complexity of dynamic decision-making of animals in applied models.

SESSION 15) Change in Polar Regions – Same same, but different?

Both polar regions are frequently in the focus of public interest. Likewise, scientific observations and research in those regions are crucial due to their vulnerability to changing environmental conditions. While both polar systems are affected by climate change, the extend and fashion of such impacts may vary significantly between the regions, making comprehensive conclusions difficult. This session aims to feature and integrate research from both poles and calls for contributions in ecology, oceanography, glaciology, climatology, social sciences and all other polar-related fields.

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Session 15) Change in Polar Regions - Same same, but different?

Benthic element cycling on the Antarctic shelf and its potential control by sea ice cover

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Antarctic shelf regions are potential carbon and nutrient cycling hotspots where rapid climatic changes are projected to affect seasonal sea ice cover, water column stratification, and thus surface primary production and associated fluxes of organic carbon to the seafloor. Here, we report on surface sediment oxygen profiles and respective fluxes in combination with pore water profiles of dissolved iron (DFe) and phosphate (PO_4^{3-}) from 7 stations along a 400 mile transect with variable sea ice cover and water column stratification from the East Antarctic Peninsula to the west of South Orkney Islands. Our results show that sea ice concentrations and stratification of the upper water column decreased across the transect. We defined a marginal sea ice index of 5-35% sea ice cover which was positively correlated with the benthic carbon mineralization rate. C-mineralization rates increased gradually between the heavy ice-covered station and the marginal sea ice stations from 1.1 to 7.3 mmol C m-2 d-1, respectively. The rates decreased again to 1.8 mmol C m-2 d-1 at the ice-free station, likely attributed to a deeper water column mixed layer depth, which decreases primary production and thus organic carbon export to the sediment. Iron cycling in the sediment was elevated at the marginal sea ice stations where Fe-reduction led to DFe fluxes in the pore water of up to 0.379 mmol DFe m-2 d-1, while moderate (0.068 mmol DFe m-2 d-1) and negligible fluxes were observed at ice-free and ice-covered stations, respectively. In pore waters, concentrations of DFe and PO_4^{3-} were significantly correlated with almost identical flux ratios of 0.33 mol PO_4^{3-} per mol DFe for most of the stations, indicating a strong control of the iron cycling on the phosphate release to the water column. The high benthic DFe and PO_4^{3-} fluxes highlight the importance of sediments underlying the marginal ice zone as source for limiting nutrients to the shelf waters.

Session 15) Change in Polar Regions – Same same, but different?

O15-2

Phytoplankton species composition is governed by both iron and manganese limitation in the Drake Passage

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Keywords: Southern Ocean, Trace elements, Co-limitation, phytoplankton, communities

The Southern Ocean (SO) stores over 40% of anthropogenically derived CO_2 and is the world's largest High-Nutrient Low-Chlorophyll (HNLC) region, where the scarcity of trace metals such as iron (Fe) drives SO phytoplankton composition and biomass build up. As dissolved manganese (dMn) concentrations in the Atlantic sector of the SO are very low (0.04 nM), it was hypothesized that phytoplankton growth may not be limited by Fe only, but also by Mn availability. Our Fe-Mn bottle amendment experiments with two natural phytoplankton communities of the Drake Passage show that only some members of the phytoplankton community were Fe-Mn co-limited, including the biogeochemical important diatom group *Fragilariopsis* and one subgroup of picoeukaryotes. On the other hand, growth of the ecologically relevant haptophyte *Phaeocystis antarctica* was significantly inhibited when Mn was added alone. Hence, Fe-Mn availability is a key factor for shaping SO phytoplankton community structure with important implications for the efficiency of the biological carbon pump.

Session 15) Change in Polar Regions - Same same, but different?

Antarctic meiofauna is most abundant in regions with seasonal sea-ice cover

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Keywords: Benthic ecosystems, Climate change, Community composition, Sea-ice cover, Southern Ocean

The Antarctic marine ecosystem is altering due to global warming. Changing sea-ice cover and duration impact the ecosystem and benthic communities which depend on sinking food from the water column. We studied how different sea-ice cover concentrations affect the composition of meiofauna communities in the Weddell Sea. During *RV Polarstern* expedition PS118 to the North-Western Weddell Sea, sediment samples for meiofaunal analysis were taken with the Multicorer (MUC). Three stations were chosen based on differences in sea-ice cover and similarity of sediment grain size. Meiofauna higher taxa such as Nematoda and Copepoda were extracted from the sediment samples and counted. Our results indicate that 9-year sea-ice cover influences the abundance and composition of meiofauna most and that Antarctic meiofauna is most abundant in regions with seasonal sea-ice cover. On the investigated small regional scale, the relationship between environmental factors that impact food availability at the sea floor and the composition of meiofauna communities resembles the situation observed on a larger scale in the Weddell Sea. The strong correlation between sea-ice cover and meiofauna abundance and composition on two different geographical scales in the Weddell Sea stresses the importance of assessing the effects of climate change on the Antarctic marine ecosystem.

O15-4

Long term changes at Southern Ocean squid ecology - What we know?

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Long-term studies of pelagic nekton in the Southern Ocean and their responses to ongoing environmental change are rare. We used stable isotope ratios measured in squid beaks recovered from diet samples of wandering albatrosses *Diomedea exulans*, and assessed decadal variation (from 1976 to 2016) in the habitat ($\delta 13C$) and trophic level ($\delta 15N$) of five important Southern Ocean squid species in relation to indices of environmental conditions—Southern Oscillation Index (SOI) and Southern Annular Mode (SAM). Based on $\delta 13C$ values, corrected for the Suess effect, habitat had changed over the last 50 years for *Taonius notalia*, *Gonatus antarcticus*, *Galiteuthis glacialis* and *Histioteuthis atlantica* but not *Moroteuthopsis longimana*. By comparison, mean $\delta 15N$ values were similar across decades for all five species, suggesting minimal changes in trophic levels. Both SAM and SOI have increased in strength and frequency over the study period but, of the five species, only in *Taonius notalia* did these indices correlate with, $\delta 13C$ and $\delta 15N$ values, indicating direct relationships between environmental conditions, habitat and trophic level. The five cephalopod species therefore changed their habitats with changing environmental conditions over the last 50 years but maintained similar trophic levels. Hence, cephalopods are likely to remain important prey for top predators in Southern Ocean food webs, despite ongoing climate change.

Session 15) Change in Polar Regions - Same same, but different?

Brown seaweeds in the Arctic: Mechanisms of acclimation to combined abiotic drivers

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Keywords: Kelp, Interactive effects, Temperature, Salinity, Stressors

Polar regions are facing rapid temperature increase and consequential changes in the marine environment. For instance, glacier and sea ice melting, and enhanced terrestrial freshwater discharge can result in hyposaline conditions in stratified fjord systems. When combined, changing abiotic drivers might have strong impacts on marine organisms, such as primary producers. The boreal-temperate kelp *Saccharina latissima* and the Arctic endemic kelp *Laminaria solidungula* are important foundation species in Arctic shallow-water coastal ecosystems. We conducted different short-term experiments to reveal interacting effects of temperature increase and other drivers related to climate change, e.g. hyposalinity, on the physiological and biochemical status of Arctic kelps. Therefore, we monitored various physiological parameters over time, such as photosynthetic performance (maximum quantum yield of photosystem II; Fv/Fm). Additionally, biochemical response variables were analyzed, for instance mannitol, which acts as compatible solute under osmotic stress or C:N ratio indicative of the cellular nutrient status. We found large variations in susceptibility between the species and between acclimation processes. When different abiotic factors are combined they can reveal neutral, additive or antagonistic effects on the kelp species. Thus, we demonstrate the complexity of understanding interactive physiological effects of multiple changing environmental factors and the ecological consequences for kelp species.

An introduction to East Greenland's functional structure: An epibenthic community assessment and their associated traits and drivers

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Keywords: Ecosystem functioning, Benthos, Arctic, Traits, Diversity

Arctic marine environments are the most impacted by climate warming with temperatures increasing at rates of more than two times faster than any other ecosystem on Earth. As a result, ramifications to the physico-chemcial structure of the water column are having impacts on endemic biodiversity and are altering important ecological functions and services, such as carbon sequestration, Arctic food web interactions, nutrient recycling, and commercial fish stocks. With limited knowledge of the functional structure of the East Greenland coast, this study uses the biological trait approach (BTA) to assess spatial changes of the eipbenthic communities relating to sea-ice (East Greenland Fjord systems) and open-water (continental slope), and aims to determine the key drivers in community structure by assessing taxa relatedness (taxonomy), traits, and environmental covariates using the Hierarchical Modelling of Species Communities (HMSC) analysis. Here we show clear spatial patterns in functional diversity and functional trait groups across the East Greenland shelf with the highest species and functional diversity on the shelf and the lowest on the slope. Additionally, we reveal that key drivers of species composition and their traits are not from a single covariant, but due to a unique combination of environmental covariates including depth, oxygen, turbidity, and chlorophyll a. As melting glaciers add terrestrial input into the water column and cause scouring to the seafloor, the later three key drivers are expected to increase in variability across time and space, and thus, alter biological communities and their ecological functional roles. Switching functional groups from biological community structure may mean a reduction in ecosystem services which could consequentially unbalance the Arctic carbon budget and commercial fisheries. Therefore, further research into Arctic functional trait groups and their response to climate change are important when considering ecosystem effects, especially when focusing on future management and conservation strategies of Arctic ecosystems.

Session 15) Change in Polar Regions - Same same, but different?

Linking phenological shift of jellyfish *Aglantha digitale* with the Atlantification of the European Arctic

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Keywords: Climate change, Gelatinous zooplankton, Fram Strait, Arctic Ocean, Medusae

The Arctic Ocean experiences climate change induced warming that reshapes its ecosystems. As a result of increased volume and temperature of the Atlantic Water (AW) inflow through the Fram Strait, the European Arctic acquires more Atlantic features. Such a transition, referred to as Atlantification, also pertains to the biotic components of the Arctic ecosystems. The environmental transition has already led not only to the poleward range expansion of boreal taxa but also altered species' phenology –timing of recurring biological events. In order to better understand the potential future of the European Arctic's pelagic ecosystems, we monitored the population state of one of the most abundant zooplanktonic species locally, the hydromedusae *Aglantha digitale*, throughout 12 consecutive years (2003-2014). Our results show, that during that time the population size of *A. digitale* in the epipelagic zone (0-200 m) of the European Arctic has decreased. Aided with the study of the hydrology of the monitored system and statistical modelling, we documented a shift in the population structure of *A. digitale* between AW anomalously "warm" and "cold" years. Altogether, our results suggest that the increasing temperature of the AW leads to either accelerated reproduction of *A. digitale* and/or a second reproductive cycle occurring in the southern part of Fram Strait. Additionally, demographic structure of *A. digitale* across the investigated area indicated a potential connectivity of the local populations, with the northern one originating (at least partially) in the south. Being the first of its kind, our study highlights the negative ecological consequences of the intensifying Atlantification and points to the need to include gelatinous animals in plankton time series.

Session 15) Change in Polar Regions - Same same, but different?

Genetic connectivity of the widespread hydrozoan *Aglantha digitale* from temperate to central Arctic regions

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Keywords: Hydrozoa, COI, Genetic diversity, Arctic

Climate change proceeding at unprecedented pace is currently redistributing life on Earth. In the Arctic region, climate change is acting more rapidly than elsewhere on this planet, and has dramatically altered sea ice thickness and extent. However, for many Arctic taxa, the distribution ranges and population connectivity have remained undocumented. This is particularly so for Arctic gelatinous zooplankton, of which the diversity, abundances and role in the food web are understudied. The hydromedusa *Aglantha digitale* is highly abundant in the Arctic Ocean, and characterized by a widespread distribution, ranging from temperate waters to the central Arctic. Its distribution in the water column has been linked to the presence of Atlantic water masses, which renders it a likely candidate to benefit from the ongoing "Atlantification" of the Arctic. Despite its ubiquity and abundance, its genetic diversity remains unknown, and it is unclear whether this species is composed of different geographic lineages throughout its distribution range. To compare the genetic diversity and assess the phylogeography of *A. digitale*, we collected samples from several recent international cruises. Geographic populations from temperate waters, sub-Arctic Greenland, Svalbard and the central Arctic are compared based on sequences of the mitochondrial cytochrome c oxidase subunit I (COI). A better understanding of the distribution and connectivity will help to predict potential range shifts of *A. digitale* in an "Atlantified" Arctic.

Trophic ecology of Arctic gelatinous zooplankton

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Keywords: Jellyfish, DNA metabarcoding, Biomarkers, Diet analyses, Food web

Gelatinous zooplankton (GZP), comprising ctenophores, cnidarians, and tunicates, gained more interest in recent years. During favourable conditions, GZP is known to rapidly increase in biomass and several dominant species are able to exploit the zooplankton standing stock. Since GZP biomass may increase with ongoing warming in the Arctic Ocean, similar to elsewhere in the World Ocean, it is likely that GZP range shifts will take place concomitant with the Atlantification of the Arctic. Thus, it is crucial to gain knowledge about their role in the Arctic marine food web. Because of GZP having low nutritional values, they were considered to be a "trophic dead end", until modern methods like video logging, biomarkers, and molecular diet studies introduced a paradigm shift regarding the role of jellyfish as prey for different fish and seabird species worldwide. In this project, we will use DNA metabarcoding to reveal the role of GZP in the diet of Arctic and sub-Arctic fish species. Additionally, the role of so-called "jellyfalls" as a carbon source for the Arctic deep-sea benthic communities will be investigated by applying DNA metabarcoding on the stomach contents of scavenging benthic amphipods. The role of GZP as predators in the Arctic Ocean during different seasons will also be investigated. To do so, DNA metabarcoding of the gastric pouch of dominant GZP species in the Arctic Ocean will be performed, to detect, amongst others, predation on ichthyoplankton. Additionally, biomarkers will be used to determine the trophic position of GZP in the Arctic marine food web and to reveal the role of the ice-algal pathway in the diet of GZP. The obtained data will reveal which fish species may be competitors of predators on jellyfish and, hence, will contribute to improve food web models of the Arctic marine ecosystem, currently neglecting the role of GZP.

Modelling of Arctic gelatinous zooplankton distribution and abundance based on data from pelagic video transects in Fram Strait

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

Global warming in the Arctic region causes alterations in the composition and structure of marine communities. Such changes are particularly pronounced in the transitional zones such as Fram Strait where the increased inflow of warm Atlantic waters accelerates this process. In other ecoregions of the world's oceans, warming has caused an increase in the biomass of gelatinous zooplankton (or jellies). Jellies are versatile predators in diverse marine ecosystems. Despite the potential impact of jelly communities on the Arctic food webs, their ecological roles have been poorly studied. We hypothesise that the Arctic pelagic community consists of a significant component of gelatinous fauna, some of which are expanding from the North Atlantic. To test this hypothesis, we obtained baseline data on vertical distribution and diversity of Arctic jellies using towed camera video transects during expeditions to the HAUSGARTEN LTER in Fram Strait in 2019, 2020 and 2021. The data include the abundance of 17 groups of gelatinous zooplankton, among which the most abundant were the hydrozoan family of Rhopalonematidae, mainly consisting of *Aglantha* and *Rhopalonema*, and the siphonophore suborders Physonectae and Calycophorae. Based on the obtained abundance data, we fitted bayesian joint species distribution models (JSDMs) to understand current patterns of species distributions at different depth layers and to provide predictive insights into community assembly processes. Variance partitioning over the explanatory variables showed that depth and temperature explained a substantial amount of variation for most of the taxa. The trained models were later coupled with climate change scenarios, which allowed us to forecast spatial niche range shifts in ecosystems.

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Session 15) Change in Polar Regions – Same same, but different?

P15-1

Acclimation responses to irradiance and temperature in the brown seaweed *Desmarestia aculeata* (Desmarestiales, Phaeophyceae) in Arctic fjords

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Keywords: Desmarestia aculeata, Arctic, Temperature, Irradiance

The Arctic currently experiences large amplitudes of change in temperature and radiation regime due to global warming and sea ice decline. The resultant increase in irradiance entering the water column influences the photosynthetic activity of benthic and pelagic primary producers. The implications for the Arctic algal flora have only been studied for a limited number of species. The subtidal brown alga *Desmarestia aculeata* populates the cold-temperate coasts of the North Atlantic, reaching as far as the polar zone, and is commonly found forming extensive meadows. In order to assess their acclimation potential, we collected *D. aculeata* in Kongsfjorden, Svalbard (78.9°N, 11.9°E), during the arctic summer and exposed the specimens to a combined irradiation(50 and 500 µmol photons m-2s-1) and temperature (0, 4 and 8°C) experiment for 21 days. Photosynthetic parameters (F_v/F_m, electron transport efficiency (α), maximum relative electron transport rate (rETRmax), saturation point (Ek)) as well as biochemical characteristics (pigmentsand antioxidant concentration) were assessed. Photosynthetic parameters were affected by high irradiance, with Fv/Fm, α, rETRmax and Ek tending to decrease with high light. In general, pigment concentration (Chl *a*, Chl *c2*, Fucoxanthin and β-Carotene) also tended to decrease in high light, while the temperature factor did not induce significant differences. The antioxidative potential increased with higher irradiance and temperature, while phlorotannin concentration increased at 0 and 8°C with high light, showing significant differences between treatments. Our study shows the mechanisms this subtidal species applies to effectively respond to increased temperature and irradiance. Hence, the increase of ice-free zones, and, consequently, the increase of irradiance and temperature in the water column, may affect the ecophysiology of this species in the Arctic zone..

Arctic vs sub-Arctic pelagic amphipods: DNA reveals a different history and a different future in the face of climate change

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Keywords: Phylogeography, Genetic diversity, Demographic history, mtCOI gene, Themisto

Rapid warming in the Arctic is drastically impacting marine ecosystems, affecting species diversity, distribution, and food web structure. Pelagic Themisto amphipods are dominant in the Arctic zooplankton community and represent a key link between secondary producers and higher trophic levels. Two co-existing species dominate in the region: *Themisto libellula*, considered a true Arctic species and *Themisto abyssorum*, a sub-Arctic, boreal species. Many aspects of the ecology and genetic structure of these two species are not well studied, despite their high biomass, importance in the food web and the fact that they are already being affected by rapid climate change. We tested both species for levels of genetic diversity, patterns of spatial genetic structure and demographic history in the Greenland shelf, Fram Strait, and Svalbard. This was achieved using variation on the mitochondrial cytochrome c oxidase subunit 1 gene (mtCOI). These data revealed strikingly different levels of mtCOI diversity: low levels in *T. libellula* contrasted with higher diversity in *T. abyssorum*. No spatial genetic structure was found, and high levels of connectivity and evidence of historic demographic expansion were exhibited by both species. The diversity and demographic signatures are likely explained by glaciation events impacting population sizes during the last glacial maximum. High population connectivity is likely due to current-induced mixing among Themisto populations. The observed low genetic diversity, in combination with its cold adaptions, could cause *T. libellula* to be more susceptible to the Atlantification of the Arctic. In contrast, high diversity likely increases adaptive potential in *T. abyssorum* which, combined with its Atlantic affinity, could lead to it benefitting from warming trends. This study provides new data on the phylogeography of two ecologically important species, which can contribute to predicting how zooplankton communities, species interactions and food web structure will manifest in the Arctic as a result of climate change.

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SESSION 16) In a stable Relationship: Isotope Analysis and Marine Science

Nature has given us a gift in that some elements come in a heavy and a lighter form and paying attention to this difference can help us reveal invisible or hidden processes. Stable isotope analysis has almost endless possible applications in marine science: from nutrient uptake of sea grass over tracking sponge mucus to constructing food webs for whole ecosystems. We want to hear how you apply this technique in your research! If mixing model or isotope labelling, anything is welcome – and if you MUST work with radioisotopes, that's fine too!

hosted by

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Session 16) In a stable relationship: Isotope analysis and marine science

From warm to cold waters: habitat and trophic ecology of Southern Ocean squids throughout their life cycle

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Keywords: Ontogenetic changes, Antarctica, Cephalopods, Stable isotopes, South Pacific

The Southern Ocean surrounds Antarctica and presents unique extreme conditions, e. g. cold waters and formation of sea-ice in the winter, and the strongest current in the world, the Antarctic Circumpolar Current (ACC). The unique system of oceanic fronts of the ACC divides the Southern Ocean in two distinctive water masses, the Antarctic and Subantarctic waters, and it is isolated from the other oceans by the Subtropical front. Evolving in this isolated-extreme environment, the Southern Ocean is home of more than 8800 species, from which ~97% are endemic. Cephalopods play a major role in this ecosystem, linking the lower trophic levels to the top predators such as fish, seals, whales, albatrosses, and penguins. However, very little is known about the dynamics in the habitat and trophic ecology during the different stages of their life cycle. Stable isotopic analyses of carbon ($\delta13C$) and nitrogen ($\delta15N$) have been applied to study the distribution, habitat and trophic ecology of cephalopods, providing valuable information on the ecological role of these organisms. Here, we applied the stable isotopic method in two specific sections of squids' lower beaks [i.e. the tip of the rostrum (juvenile) and wing (adult stage)], to study the ontogenetic changes in habitat and trophic ecology of 10 Southern Ocean squid species. Higher $\delta13C$ values in early life stages than in adults suggest that the studied species tend to move southwards during their life cycle. Furthermore, our results support oceanic fronts as important habitat for these organisms. With climate change, it is hypothesised that adults may move southwards, possible impacting top predators living in northern islands. Overall, $\delta15N$ values revealed an increase in the trophic position from juveniles to adults in

all species, suggesting different feeding strategies between species and life-stages (zooplanktivorous, piscivorous and omnivorous)..

SESSION 18) (Micro)Plastic: Environmental Distribution, Degradation and Impact

Scientists, policy makers and the general public worldwide share the attention of the (micro)plastics invading the aquatic and non-aquatic realms. There is a broad spectrum of research interest and foci of (micro)plastics ranging from the environmental distribution analysis and determination of polymer biodegradation, to various exposure experiments testing the bioavailability and consequential effects of (micro)plastics in the organisms following ingestion. Are you trying to the fill in the knowledge gaps or uncertainties of (micro)plastic pollution or the interaction with marine biota? We kindly encourage you to share your innovative ideas, improved methodologies, and novel results with fellow young researchers.

hosted by

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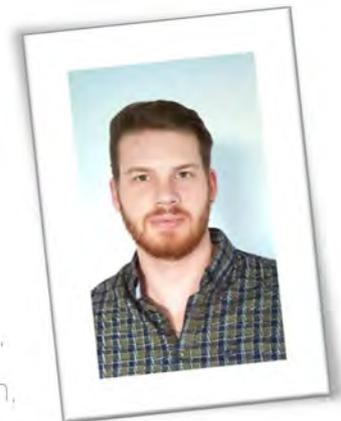
Session 18) (Micro)Plastic: environmental distribution, degradation and impact

O18-1

Plasticrusts – a novel plastic debris type on marine rocky shores

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Keywords: Macroplastic, Fourier-transform infrared spectroscopy (FTIR), Atlantic Ocean, Mediterranean Sea, Anthropocene

Although marine plastic pollution has been investigated intensively over the last 50 years, novel forms of plastic debris keep appearing worldwide. For instance, plasticrusts are a novel form of plastic debris that has only recently been reported for the first time from rocky intertidal habitats in Madeira island (Atlantic Ocean) and Giglio island (Mediterranean Sea) in 2019 and 2020, respectively. Plasticrusts are plastic crusts encrusting intertidal rocks that are likely generated by sea waves flushing plastic debris across rugose rocky surfaces. To date, Fourier-transform infrared (FTIR) spectroscopy indicated that the blue plasticrusts from Madeira and Giglio consisted of polyethylene (PE) which is used in various everyday products. However, due to the recency of these reports, the current knowledge on the sources and the generation of such plasticrusts is still limited. In this presentation, we report novel findings that resulted from plasticrust field surveys in Madeira and Giglio. In Madeira, we collected blue plasticrusts and blue plastic debris items such as bags, barrel pieces, bottle caps, crate pieces, cutlery and pens. Furthermore, we observed the generation of green plasticrusts from a thick green plastic rope caught between intertidal rocks. At the lab, we analysed all materials from Madeira and all previously collected blue plasticrust materials from Giglio using FTIR. We found (i) that all blue plasticrust materials from Madeira and Giglio consisted of high-density polyethylene (HDPE), (ii) that the blue plastic bags consisted of low-density polyethylene (LDPE), (iii) that all other blue plastic debris items consisted of HDPE, and (iv) that the green plasticrust and the plastic rope material consisted of polypropylene (PP). Overall, our study identified potential plasticrust sources and corroborated the notion that plasticrusts are generated by waves scouring plastic debris across rugose rocks.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Two new forms of plastic debris from the Seto Inland Sea, Japan

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Keywords: Plastiglomerates, Pyroplastic, Fourier-transform infrared spectroscopy (FTIR), Microplastics, Environmental monitoring

Several novel forms of plastic debris, including plastiglomerates and pyroplastics, have recently been reported from coastlines worldwide. While plastiglomerates (discovered in Hawaii) consist of plastics firmly melted together with rocks, pyroplastic (reported from the United Kingdom and Italy) is melted plastic with a rock-like appearance. Due to its relatively low density, pyroplastic floats in water. However, field records of such novel forms of plastic debris are still scarce. Furthermore, it is unclear whether the formation of plastiglomerates and pyroplastics influences the pathway of melted plastic debris through the environment. Here, we present the first record of plastiglomerates and pyroplastics from the Seto Inland Sea. During recent biodiversity surveys, one of us (SF) discovered one plastiglomerate and three pyroplastics along the Ariho River estuary in Sanyo-Onoda City, Yamaguchi Prefecture, Japan. The plastiglomerate was detected in the sandy intertidal zone and consisted of plastic firmly melted to a solid pebble. All pyroplastics were found along the high tide strandline. Subsequent observations in Japan confirmed that all pyroplastics floated in water and that all pyroplastics were relatively fragile and easily degraded into microplastic (plastic < 5 mm). To identify the plastiglomerate and pyroplastic polymer types, Fourier-transform infrared (FTIR) spectroscopy is currently being conducted in Germany. Our findings highlight that plastiglomerates and pyroplastics are two different pathways for melted plastic debris through the environment. While solid plastiglomerates may enhance the sequestration of plastic debris into the geological record via river sedimentation, fragile pyroplastic being washed-ashore by waves may accelerate the degradation of plastic debris into microplastic. Therefore, we recommend that future research should monitor these new forms of plastic debris under natural field conditions.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Microplastic Abundance on the Coastal Beaches of Northern Sri Lanka

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Keywords: Density separation, fragments, marine litter, plastic pellets, recreational

Sri Lanka is a paradise for beautiful beaches and an aesthetic hotspot for beach visitors nationally and internationally. However, the presence of marine litter and Microplastics (MPs) has contaminated the beaches. MPs are synthetic organic polymers with a size dimension of < 5 mm that are ubiquitous and have a negative impact on the marine ecosystem. Since there is a lack of information on MPs in the Northern coast, the present study investigated the abundance and composition of MPs (1- 5 mm) at three coastal beaches in the Jaffna peninsula: Charty beach, Pointpedro and Mathagal. Sand samples were collected monthly using a randomized quadrate sampling (0.25 m2) approach from August 2020 to January 2021. The sand samples were dried, sieved, and then subjected to sodium chloride density separation. A stereo microscope and a hot needle test were used to identify the MPs. MPs were counted, weighed and categorized into six groups as fragments, films, fibers, foams, robe and filaments, and pellets. The R software was used for statistical analysis. The overall mean abundance of MPs in Charty beach (10.00±17.12 MPs/m2), Pointpedro (116.44±111.56 MPs/m2), and Mathagal (33.11±43.36 MPs/m2) was significantly different ($p < 0.05$), according to the Kruskal-Wallis test. The fragments were the most abundant group on each beach and a large amount was recorded in Pointpedro. This shows that secondary MPs are more prevalent on the beaches surveyed, and the presence of plastic pellets indicates that primary MPs are present as well. The identified potential sources for the occurrence of MPs are fishing and related activities, recreational and tourism and domestic littering practices. This research is first studied the abundance of MPs on beaches in Northern Sri Lanka, which will be a baseline for future research in this emerging field.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Microplastic load and polymer type composition in North Sea, Mediterranean and Atlantic rocky intertidal snails

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Keywords: Micro-Fourier-transform infrared (μFTIR) spectroscopy, Decadal monitoring, Bioindicator, Paint chips, Baseline

Microplastics (plastics < 5 mm, MPs) have been documented in marine habitats worldwide. Due to their small size, MPs are readily ingested by numerous pelagic and benthic animals. However, compared to the constantly increasing knowledge on MPs in oceanic, estuarine and sandy habitats, information on MPs from rocky intertidal habitats is relatively limited. This is surprising since rocky shores constitute one third of the global shoreline. Therefore, we examined 24 water samples and 130 snails (i.e., common herbivorous topshells) collected from wave-sheltered and wave-exposed rocky intertidal habitats in Helgoland island (North Sea), Cap Ferrat and Giglio island (Mediterranean Sea) and Madeira island (Atlantic Ocean) in 2019/2020 for MPs. Additionally, we examined snails collected from the same habitats in Helgoland, Cap Ferrat and Giglio in 2007-2009. For our examinations, we used micro-Fourier-transform infrared spectroscopy (μFTIR). In total, we performed 112 μFTIR measurements on the water samples and 250 μFTIR measurements on the snails. We detected 24 MPs (six polymer types) in the water and 50 MPs (nine polymer types) in the snails. Water MP load (2.4 ± 0.8 MPs / L water; mean ± SE) and polymer composition were similar across locations and wave-exposure. Likewise, snail MP load (1.0 ± 0.2 MPs / g snail wet weight) and polymer composition were similar across locations, wave-exposure and time. Interestingly, 21 % of the water MPs and 52 % of the snail MPs consisted of paint chips. Furthermore, we detected a significant positive relationship between water and snail MP loads. Overall, our results indicate (i) that MPs are common in rocky intertidal habitats, (ii) that paints constitute a major MP source in such habitats, and (iii) that snails are fine-tuned MP bioindicators. In addition, our results (iv) provide a baseline to examine future MP dynamics in rocky intertidal systems. .

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

O18-5

Detection of microplastics in maldivian coral reef invertebrates

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Keywords: Marine Environment, Microplastics, Coral reefs, Pollution, FTIR Spectroscopy

Coral reefs are one of the most productive and biodiverse ecosystems in the ocean. Nowadays these ecosystems are threatened by different stressors, among which pollution by plastic. It has been noticed that the global surface load of plastic is well below that expected from input rates and that there is an important gap of plastic debris smaller than 1 mm. Corals and sponges could be important players in the removal of microplastics, since they screen huge volumes of water, through suspension-feeding. There is evidence of plastic ingestion by corals, even if in almost all the performed studies the ingestion rate is potentially altered, not providing alternative food. Adhesion of microplastic to reef surfaces is a possible mechanism of plastic removal. In this study we optimize and apply methods to detect microplastics in coral reef invertebrates, combining optical and spectroscopic techniques. Analyses were carried out on 22 scleractinian corals sampled in the water surrounding Magoodhoo island, Faafu Atoll, Maldives and on a total of 7 sponges collected from Magoodhoo island and Thudufushi island, South Ari Atoll, Maldives. We have detected microplastics, from various synthetic polymers, with size range between 134-25 μm, both in corals and sponges. This study shows that microplastic pollution already represents an important stressor also in remote areas like the Maldives.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Accumulation of microplastics at different trophic levels in selected coastal water bodies in Sri Lanka: Insight towards potential impacts to human health

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Keywords: microplastics, lagoon, food web, bio-concentration

The continuous increase in synthetic plastic production, combined with poor plastic waste management, has resulted in an increased dumping of plastics into our aqueous environment. As a result, microplastics, which are defined as plastic particles of less than 5 mm in size, are produced and persist in both seawater and freshwater environments. Microplastics as a new form of emerging pollutant in Sri Lanka has piqued the interest of public and government officials. This study is focused on the Kalametiya lagoon area in the Southern Province of Sri Lanka. Objectives of this study are a) to examine the level of accumulation of microplastics at different trophic levels in selected coastal water bodies, b) to assess the tropic level transfer of micro plastics, and c) to determine whether the existing amounts of micro plastics in fishes (large fishes) are higher than the risk levels to humans. For this, water, sediment, and lagoon dwelling fish samples were collected from the Kalamatiya lagoon. Forty-five water and sediment samples along with 25 fish samples representing the lagoon were collected. The water samples were checked for the presence of microplastics and analysed using stereo microscopic techniques after digestion of the organic matter in the samples using oxidative reduction and tissue lysis. Microplastics were observed in water samples in the preliminary observation. This is an ongoing study, and the future directions would be to identify and evaluate the accumulation of plastics in each trophic level as a bio concentration factor.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Investigation of the aquatic hazard potential of bioplastics by ecotoxicological studies with *Daphnia magna*

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Keywords: bioassay, biopolymers, leaching of pollutants, acute and chronic toxicity

Biodegradable plastic materials are important to contribute to worldwide plastic pollution reduction. Nevertheless, entering of bioplastics in the aquatic environment may result in degradation and leaching of accompanying and metabolite compounds like bisphenol A, phthalates and polycyclic aromatic hydrocarbons. Such persistent—and in particular hydrophobic—organic pollutants (HOCs) can have significant changes on ecological diversity, leading to ecosystem function losses. Since the release of HOCs from bioplastics in the aquatic environment and their ecotoxicological impacts are still sparsely researched, biotests of bioplastic materials based on poly(lactic acid) (PLA), poly(1,4-butylene succinate) (PBS) and Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) were performed in this study. Acute and chronic leaching and contact tests with the crustacean *Daphnia magna* according to OECD202 and OECD211 were performed. The bioplastic concentration for all performed tests was maximum 10 g plastic in 1 L test medium. For chemical validation the test media were analysed by gas chromatography-mass spectroscopy (GC-MS).In acute contact and leaching tests with *D.magna* no immobilisation was observed after 48 hours for PLA, PBS, and PHBV, respectively. During chronic contact tests, a significant poor offspring for all materials compared to the negative control was observed. In chronic PLA leaching tests, all adult daphnids died between day 7 and day 17 and no offspring was observed. GC-MS analysis of the material showed a contamination of PLA with 2-methylnaphthalene, which could be the cause of daphnia mortality. Chronic PBS leaching tests had the highest amount of offspring with 27 neonates in 21 days and the daphnids had a significant higher growth rate which indicate endocrine effects.The results of this study showed that the tested bioplastics have chronic but no acute toxicity to aquatic organisms. Since bioplastics remain long in the aquatic environment till degradation, the investigation of chronic effects to organisms contribute to the knowledge of bioplastic hazard potential.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

O18-8

Effects of bio-based microplastics on the hatching of *A*rtemia nauplii

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Keywords: Brine shrimp, early developmental stages, anthropogenic impact, pollution

Effects of bio-based microplastics on the hatching of Artemia nauplii Microplastic derived from conventional petroleum-based materials poses an emerging threat for organisms in aquatic systems. Therefore, bioplastics made from renewable resources or bio¬degradable materials are thought to be less detrimental to the environment than petro- plastics. However, investigations on the effects of bioplastics on marine invertebrates are scarce. Particularly, knowledge on the effects on early developmental stages is lacking. We tested the effects of bio-based microplastics, additives that might leach out of the plastics, and different temperatures on the hatching success of the brine shrimp Artemia persimilis. Per attempt, 10-40 eggs were exposed for 24 hours in 12-well cell culture plates to particulate bioplastic suspended in seawater. The eggs and the bioplastic particle sank down and formed a layer at the bottom of the wells. In the second experiment, the eggs were suspended in seawater, which has before contained bioplastic granules for one or seven days. In total, four bio-based plastics and two petroleum-based plastics were tested at 22 ˚C, 24˚ C and 26˚ C.

O18-9

Exploring PAEs contamination in "Reef Framework Builders": soft and hard corals

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Keywords: Microplastics, Phthalates, SPME, LC-MS, Corals

The study aims to determine in coral samples the contamination of phthalates and their metabolites, throughout the use of the solid-phase micro-extraction (SPME) coupled with analyses performed with the Liquid-chromatography and Mass spectrometry (LC-MS) instrument.The corals were hard and soft corals, coming from very different sampling environment, respectively the Maldivian reef and the Genoa Aquarium. For hard corals we took into consideration the species Porites lutea, Pavona varians, and Pocillopora verrucosa. Instead for soft corals we sampled the species Coelogorgia Palmosa, Sinularia sp., Sarcophyton sp, and Lobophytum sp.The Phthalates that were considered were butyl benzyl phthalate (BBP or BBzP), dibutyl phthalate (DBP), di-2-ethyl hexyl phthalate (DEHP) and dimethyl phthalate (DMP), diethyl phthalate (DEP), associated with the plastic pollution in the marine environment; and also 3 metabolites of PAEs were taken into consideration and researched in the coral samples, monoethylexyl phthalate or MEHP (monoester of DEHP), monobutyl phthalate or MBP (monoester of DBP) and mono benzyl phthalate or MBP (monoester of BBP).The SPME fiber is a powerful technique that allows the extraction of contaminants from samples regardless of the volume or mass of the sample itself, and also, since it is a non-invasive method, it is possible to use it for in vivo measurement (Bio-SPME). In addition to the fiber, the use of the LC-MS instrument for analyzing the contaminants extracted by the fiber from the sample, allows the determination of the specific contaminant with a concentration up to part per trillion (ppt) with an high resolution.Thus, the coupling of the two instruments enabled us to perform high-resolution analyses of our samples, and gave us the chance to compare the concentration of contaminants in different coral species. Moreover, we implemented the method steps to reach the maximum resolution and the minimum contamination, since the phthalates are ubiquitous in all the environments, persistent and this makes easy the contamination of samples from external sources.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Development of a novel technological approach for the removal of microplastics from water using organosilanes

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Keywords: Microplastics, Microplastics removal, Agglomertaion, Organosilnes, Aquatic pollution

Microplastics (MP) are a global environmental problem, especially in aquatic environments. To stop inputs of MP from point sources as municipal or industrial wastewater treatment plants, there is a need for a cheap and effective method for the removal of MP from water. Other fields of application are MP sensitive water using process as sea salt extraction or sea water desalination. Here we present a novel process of removing MP from waters using organosilanes. When added to water containing MP, organosilanes can attach to the sruface of the MP and collect it in large agglomerates. Due to a subsequent water induced sol-gel-process, the microplastics gets chemically bound and fixed in a 3-dimensional hybrid silica network. This physical-chemical process allows the formation of large agglomerates, which float on the water and can be easily removed. Recent studies showed that the organic groups of the organosilanes have a major impact on the reaction and removal behavior. Additionally the effect of different water temperatures and water compositions on the removal process was investigated. Possible residues of the organosilanes remaining in the water after the fixation process were monitored using ICP-OES and DOC measurements. As MP encompasses a multitude of different types of polymers with different properties and surface properties, the used organosilanes need to be specifically adapted to certain polymer types. The high diversity and adaptability of organosilanes gives this relatively new and little researched approach a high potential. First pilot plant tests show that process has a high capability to be applied in technical scale.

All that glitters is not plastic – difficulties of microplastics identification in zooplankton samples and digital tools to overcome them

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Keywords: Microplastic litter, Sample treatment, Nile Red, Image analysis, Biota

Microplastic (MP) litter in marine ecosystems is of growing scientific and civil concern due to the ubiquitous distribution of this anthropogenic pollutant and its bioavailability for organisms at the base of the food web. Understanding distributional patterns of MP abundance is crucial to evaluate the actual environmental implications. Meanwhile, zooplankton samples are preferable to use in MP identification if the research aims to study the potential for MP encounter, uptake and trophic transfer by marine organisms. However, the lack of standardized identification and quantification techniques impedes a thorough assessment as well as comparisons between study cites. In order to overcome this problem, novel, simple and resource-saving methods are developed. At first glance, the combination of Nile Red staining with fluorescence microscopy offers an effective and inexpensive technique applicable for various types of environmental samples, including biological. However, the disadvantage of the method is that Nile Red stains MP particles and organic matter alike, therefore requiring effective preceding digestion of organic matter. Practice shows that digestion with a strong base (such as potassium hydroxide) is able to remove most of the organic material, but works insufficiently for zooplankton samples containing many chitinous remains. Image processing tools, in turn, can fix the issue of insufficient digestion and co-staining of biological material at the very end of data processing. Trainable Weka Segmentation is a plugin of Fiji software that uses machine learning algorithms to produce a segmentation based on pixel classification. By using the differences in pixel contrast, intensity and texture and depending on the area selected for separation, the model divides the image into 2 or more segments. Like that, it is possible to remove areas of organic material from the image and hence to avoid the issue of MP overestimation even in the case of unsuccessful digestion treatment for zooplankton samples.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Conventional vs. biodegradable microplastics - effects of different plastic types on the digestive enzyme activities of the Atlantic ditch shrimp Palaemon varians

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Keywords: crustacea, digestive enzymes, bioplastics, polylactide, pollution

Microplastics accumulate in the oceans and threaten marine biota in multiple ways. One approach to reduce the negative impacts of the global plastic consumption is the gradual replacement of petroleum-based plastics by biodegradable plastics, such as polylactide. Yet, little is known about the pathways of biodegradable plastic particles in the environment and their impacts on different organisms. This study investigates the effects of biodegradable and conventional microplastics on the digestive enzyme activities of the marine invertebrate Palaemon varians. In an eight-day feeding experiment, the shrimp were exposed to four different food treatments. All shrimp received 5 mg of plant-based food flakes, mixed with 1 mg of either biodegradable plastic particles, conventional microplastics or a natural silicate powder. The control group was fed with flake food only. Subsequently, the midgut glands of the animals were dissected, and the protein content of the organs was determined. The enzymatic activities of six different digestive enzymes in the midgut gland were measured and analysed for differences between the treatments. It was possible to detect the different plastic particles in the digestive organs of the shrimp and thus to prove their ingestion. However, the food supplements did not affect the shrimp. The enzymatic activities showed similar patterns in all feeding groups, and no considerable differences between the treatments could be observed. Neither the conventional nor the biodegradable microplastics resulted in visible biochemical reactions. Apparently, plastic particles did not influence P. varians when they were ingested in combination with a sufficient amount of high-quality food, as no evidence for an enzymatic response to the microplastic uptake could be found. Overall, neither the ingestion of biodegradable nor conventional microplastics had any considerable effects on the digestive enzyme activities of P. varians.

Session 18) (Micro)Plastic: environmental distribution, degradation and impact

Occurrence of microplastics in commercial mid-trophic level fishes along the Portuguese coast

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Keywords: North Atlantic, stable isotopes, stress biomarkers, sardines, mackerels

The use of plastics has been increasing dramatically in the last decades, and consequently plastics and microplastics have been considered emergent contaminants in aquatic environments. The occurrence of microplastics has been reported in several marine species worldwide, however species from mid-trophic chains have not been extensively studied. This study aims to contribute to an overall assessment of the environmental impacts of microplastics in a community of small pelagic fish in the North Atlantic. The presence of microplastics was analysed in sardines (*Sardina pilchardus*) and mackerels (*Scomber* spp. and *Trachurus trachurus*) sampled along the Portuguese coast. Biochemical stress assessments and stable isotope analyses were also performed. The presence of plastic pieces in the stomachs of 29% of the sampled fishes is particularly concerning, as these small pelagic fish from mid-trophic levels compose a significant part of the diet of humans and other top predators. The most common type of plastic was fibres, followed by fragments, and in terms of colour, blue and transparent plastics were the most common. No differences were found in the number of plastics among species. However, *S. pilchardus* presented significantly larger sized pieces than the mackerel species. Even so, no clear evidence of direct relationships between the occurrence of microplastics and the isotopic niches or oxidative damage levels of fish was found. This study highlights the importance of multidisciplinary approaches, including stable isotopes and oxidative stress biomarkers as complementary tools in microplastic contamination assessment of the marine mid-trophic chains.

SESSION 19) Marine Engineering

The use of technology in the marine science is inevitable and spans all fields of research. From the obvious use of technology in the marine energy sector or special measuring technologies to measure the ice thickness to the use of cameras to track particles in the water column. Furthermore, the usage and development of technology is a major part of the marine research. This Session invites young researchers, engineers or undergraduate students to share their work as a part of the interdisciplinary field of marine engineering. However, they used special equipment or developed new devices or methods to explore the marine sector.

hosted by

Jan Boelmann

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O19-1

Development of an autonomous, multifunctional sampler

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Keywords: sampler, microplastic, plankton, multimethod sampler, autonomous

Development of an autonomous mulifunctional sampler – especially for plankton – with requirements: Usable even in rough seas • Separate, tightly closing, chilled & preserving sampler-bottles• Highly reliable, robust & water proof design• Autonomous unattended operation and easy to maintain• Scalable configuration

O19-2

Computationally Extended Depth of Field for Microscopy On-The-Go

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Keywords: Image Processing, Deblurring, Underwater Photography, Marine Imaging

In microscopy, a large magnification is necessary to resolve small details, which in turn results in a small depth-of-field (DOF).In stationary lab microscopes focal stacking is used to solve the small DOF problem. A focal stack is a sequence of images taken at different depth layers in the scene. The images are then combined to produce an image where everything is in focus. However, this requires a scene that is static throughout the acquisition time that can take seconds. Thus, it is not suitable for scenarios where the objects or the microscope is moving, e.g., underwater or in the field. One-shot imaging can be used to overcome this problem. This is achieved by scanning over the organism in the same way as in focal stacking but while keeping the shutter open. Then, information from many layers of the object is saved in one image, significantly shortening the acquisition time.The one-shot image is blurry as it contains many superimposed focal planes. Previously, it was deblurred using strict assumptions on the optical system which limited it to a relatively small range. In this research we are using a deep neural network that enables a more flexible setup and a larger DOF. The network is trained using data simulated with 44 point spread functions calculated in an optical simulation of our system, i.e., does not require real world ground-truth data. We show results of dynamic scenes (e.g. coral polyps, insects) where the DOF was increased over 44 times with only a small increase in time.

O19-3

Robotic Infrared Vision: Enabling operation in fog and low-light environments

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Keywords: Thermal Imaging, Remote Robotic Application, Sensoric Perception, Thermal Vision in Fog, Search and Rescue

Robots advance further in the scientific and industrial work field and support or even replace humans in dangerous environments. Still these high-end machines tend to struggle with unexpected obstacles and have not reached the degree of flexibility which would allow for full autonomous operation modes. To enhance flexibility robots need a larger and broader set of sensors and a better implementation of these in the decision-making process.The scenario discussed in this paper is the operation of robots in fog or smoke, circumstances which set an end to many autonomous operations and are still hard to manage even for humans. To increase the observational capacity the legged robot discussed in this thesis was equipped with a thermal camera which was integrated into the controlling unit to achieve maneuverability in environments which would not have been accessible before. To understand the significance of thermal imaging in low-light environments, fog or smoke, the physical background for the extinction of light in this environment will be discussed. The devices chosen for this setup (i.e. the robot and the thermal camera) will be discussed on the basis of the parameters of greatest importance of each. The computer which was needed as an interface between the both will be addressed in this context and especially the software developed for it. The performance of the system will be discussed on the basis of a field test in fog. Proving, that the implemented system enhanced the situational awareness of the operator and allowed for operation under circumstances which would have not been possible without the thermal capacity. The system proved to be capable of detecting a person in an environment with high fog density. It was further able to approach the person in an obstacle filled environment and therefore gather more detailed information about the scene.

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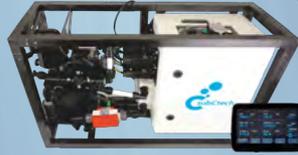
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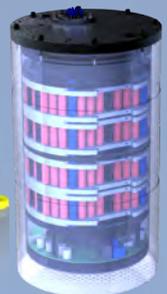
SESSION 20) Open Session

Marine Sciences are a vast and diverse field of research with a lot of different topics to be covered. No conference is able to represent all topics with a separate session. The Open Session aims to summarize contributions of young marine scientists from all research fields which do not feel to fit into one of the other sessions.

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"Moving target": how multiple stressors can alter tipping points

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Keywords: Benthic organisms, Stressor interaction, Eutrophication, Salinity variation

Human activities trigger both gradual and sudden changes in natural environments, creating stressors for resident organisms. Two scenarios have been associated with the increase in human impacts on natural ecosystems: 1) non-additive effects generated by a spatio-temporal superposition of multiple stressors and 2) tipping points emerging along anthropogenically altered environmental gradients. While these two scenarios have been investigated individually, very few studies have focused on tipping points in the context of multiple stressors – especially in aquatic environments - thus hindering understanding of the combined occurrence of non-additive effects and tipping points. We carried out a laboratory mesocosm experiment to identify the impact of a saltwater intrusion on a simplified freshwater benthic community exposed to a nutrient enrichment gradient. Our objective was to 1) identify the effect of individual and combined stressors on responses at multiple levels of the biological hierarchy, 2) understand how a tipping point along an environmental gradient can be altered by the presence of a second stressor, and 3) identify evidence for changes in the interactions of stressors along an environmental gradient. Our results show that tipping points can shift to lower levels across an environmental gradient in the presence of additional stressors. We also identified a switch in stressor interaction along the environmental gradient created through nutrient enrichment. Ultimately, these and forthcoming results will allow us to better understand and predict the consequences of combined environmental stressors generated by human activities in aquatic ecosystems.

Marine Tropical Sponge in Indonesia: *A* potent source for [preliminary] ecological chemical defences and anti-infective agents

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Keywords: porifera, palatability, agar diffusion assay, MIC, antiviral

This study aimed to investigate the ecological and pharmaceutical bioactivities of Indonesian marine sponges. Twenty-nine marine sponges extracted with Methanol: Ethyl acetate (1:1) then evaluated for fish feeding deterrence and agar diffusion assay against 14 environmental bacteria. Inhibition assay against clinical microbial and Hepatitis C Virus (HCV) was also conducted to investigate their pharmaceutical activities. Most crude extracts were active to deter generalist fish Canthigaster solandri, while selective low to moderate inhibition zones showed against environmental bacteria. In the pharmaceutical assay, inhibition activity against HCV in the liver cells was possessed in less than 40% of crude extracts. In contrast, lower inhibition activities have occurred against clinical microbial. We found no positive correlation in every assay but the ecological ones. Hyrtios sp, Theonella sp, Ocenapia sagitaria and Darwinella suberea showed the broadest activities on every assay, while most other extracts showed various selective ones. Although further investigation was necessary through isolation and structure elucidation,

high deterrence activity of the extracts in our study was contributed to the lack of ecological bioactivity information in Indonesia.

O20-3

In depth characterization of the polar lipidome of the commercial shrimp Pandalus borealis

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Keywords: Lipidomics, Phospholipids, Fatty acids, Liquid-chromatography, Mass spectrometry

Polar lipids are the most abundant class of lipids in several marine organisms. Among these, phospholipids (PL) have attracted substantial attention do to their importance as a source of essential fatty acids and because they enable high bioavailability of omega fatty acids than triglycerides. While the Northern shrimp Pandalus borealis is one of the most important shrimp fisheries of the North Atlantic, our current understanding of the polar lipidome of this species is extremely limited. In order to fill this important paucity, we provide here a detailed characterization of the polar lipidome of P. borealis abdominal muscle, the edible part of the shrimps, which was achieved using a state of the art high-resolution liquid-chromatography mass spectrometry HILIC-(LC-MS and MS/MS) approach. The identification of molecular species was based on the assignment of the molecular ions observed in LC–MS spectra, their typical retention time, mass accuracy, and LC–MS/MS spectra interpretation. This allowed to confirm the identity of the polar head group and the fatty acyl chains. Our results showed that the muscle of P. borealis displayed a mean total lipid extract of 71.4 ± 9.2 mg g-1 of dry weight, of which 31.7 ± 4.7 mg g-1 of dry weight were PL content. Moreover, a total of 275 lipid species (m/z), were identified distributed over nine PL classes: PC – phosphatidylcholine; LPC –

lysophosphatidylcholine; PE - phosphatidylethanolamine; LPE – lysophosphatidylethanolamine; SM - sphingomyelin; CL - cardiolipin; PG – phosphatidylglycerol and PI – phosphatidylinositol. The top three most abundant lipid classes were PC, PE and PI, and the three most abundant lipid species were PC(34:1), PC(38:6) and PE(38:6), featuring different molecular lipid species (combinations of fatty acyl chains). The characterization of the lipidome of this commercially important shrimp species has the potential to contribute to the development of new value-added applications in food technology and nutrition.

Mackerel species in Madeira, Portugal: a look at their diet and trophic position

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Keywords: copepods, diet, mackerels, stable isotopes, stomach contents

The Atlantic chub mackerel *Scomber colias* and the blue jack mackerel *Trachurus picturatus* are two abundant species in the Macaronesia region which includes the archipelago of Madeira, Portugal. Both are key species in the trophic web, being important prey for several local top predators, such as seabirds and marine mammals. Nonetheless, little is known about their feeding ecology in oceanic environments. In this study, the authors describe the seasonal variation in the diet of *S. colias* and *T. picturatus* in the oceanic region of Madeira throughout a year. Visual inspection of stomach contents revealed that *S. colias* fed on a broader range of prey groups than *T. picturatus*, but for both species, zooplankton (particularly calanoid copepods) and fish were the most important food items. The diet of *S. colias* included a higher proportion of fish, namely Atlantic saury Scomberesox saurus and *S. colias*, than that of *T. picturatus*, that included mostly the longspine snipefish Macroramphosus scolopax.*T. picturatus* consumed a higher proportion of decapods and other copepods. Seasonal variation was found in the diet of both species, with zooplanktonic species being more important in colder months (February to April) for *S. colias* and during warm months (May to October) for *T. picturatus*. Their diet in other seasons was dominated by fish. Although they consume similar prey, carbon and nitrogen

stable isotope analysis of muscle of *S. colias* and *T. picturatus* showed little overlap in their diets, and *T. picturatus* showed higher δ15N and a narrower isotopic niche.

O20-5

Structure of the Ambulatory Flaps of Paintpot Cuttlefish (*Metasepia tullbergi*) for Walking

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Keywords: ambulatory flap, locomotion, Metasepia tullbergi, paintpot cuttlefish, skin papillae

Metasepia cuttlefish have a very unique locomotion mode. They prefer to walk (amble) on the seafloor than swim. During ambling, they use a pair of ambulatory flaps as hind legs like quadrupeds. The existing study described that the ambulatory flaps were muscular; however, no one proved the actual structure of the flaps. Since clarifying the structure of ambulatory flaps is important for understanding their unique locomotion, we observed the histological morphology of the ambulatory flaps of Paintpot cuttlefish (*Metasepia tullbergi*) and their ambling locomotion. We found that the ambulatory flaps were not fully muscular as previously believed. The ambulatory flaps were skin papillae. Histological observations indicated that the skin had collagen connective tissue and specific papillae muscles (dermal erector muscles and retractor muscles) forming skin papillae. Behavioral observations showed that the ambulatory flaps changed these shapes from erecting to shrinking. The existence of skin papillae can explain this shape-changing of the flaps since skin papillae can change their size and shape. This study showed the unique locomotion strategy that they walk on the seafloor using skin papillae, where other benthic cephalopods use them only for camouflage purposes. We suggest that Metasepia cuttlefish adapt in distinct environments by this locomotive uniqueness.

O20-6

Comparison of underwater 360° video monitoring and diver-based visual census using Reef Check methods in the Red Sea, Egypt.A pilot study

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Keywords: Video monitoring, 360˚ video, Coral Reef, Insta360 One X, Reef Check

Video imagery collection for a permanent and reviewable record is used more frequently for marine monitoring. In the pilot study at hand, the time efficiency and the assemblage of reef structures in the Red Sea around Dahab, Egypt, were compared between 360˚ Video Monitoring (360VM) and Diver-based Visual Census (DVC) method following the Reef Check Protocol.The following aspects of underwater monitoring with Insta360 One X were tested and improved over the course of five test-dives: tilt of 360 camera; camera movement over the transect; capture of full width of the transect; vertical distance of the camera to the transect and the seafloor. The video files were analysed using Insta360 Studio 2019. The time needed for 360VM and DVC was measured for data collection and data analysis. The DVC method needed significantly more time than 360VM in all surveys. Abundance, and species richness differed significantly between methods for fish and invertebrate surveys. The substrate data did not show significant differences between methods. Factors such as agility, colours, size, behaviour and shape of organisms strongly affected their detectability in the 360˚ video analysis.

Detective work to identify the unknown from the seafloor: a new Anobothrus species (Polychaeta, Ampharetidae) from the Southern Ocean described with combined techniques

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Keywords: Anobothrus konstantini sp. nov., Antarctic Peninsula and Filchner Trough, ecology, micro-CT and SEM analysis, taxonomy

Despite extensive sampling and new identification methods, many benthic species of the Southern Ocean are still unknown. Here we present a detailed description of a new Ampharetidae (Polychaeta) species, Anobothrus sp. nov. from the Weddell Sea including its detailed habitat description. The identification process was challenging and resembled detective work. Since not all diagnostic characters were visible with established techniques (light microscopy and scanning electron microscopy), we included micro-computed tomography (micro-CT) for the first time for a species description of Anobothrus. Using light microscope and scanning electron microscope, we identified the following diagnostic characters: presence of a circular glandular band on segment 6; an elongated ridge between notopodia on segment 12 and modified notochaetae on this segment; sixteen thoracic, two intermediate and ten abdominal segments. The micro-CT images provided information on the shape of the prostomium (Ampharete-type) and the arrangement of branchiae (four pairs in two rows, without a gap). This method helps to detect diagnostic features that are difficult to recognize in poorly preserved or small individuals. In addition, this study presents a detailed habitat description for the new Anobothrus species based on the measured environmental parameters at collection sites (chlorophyll a content, organic matter content, chloroplastic pigment equivalents, grain size). The combination of taxonomic and ecological studies provides the essential basis for modelling habitat and species distribution, an important tool for management and species conservation of the Southern Ocean ecosystem.

Molecular assessment of Ulva (Ulvophyceae, Chlorophyta) diversity in Vietnam reveals marked differences with traditional understanding of species diversity

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Keywords: Ulva, molecular diversity, sepecies delimitation, Vietnam

The green algal genus Ulva occurs in marine and freshwater environments, and is important both from an ecological and economic perspective. Because morphological species identification and delimitation in the genus is problematic, the application of molecular data is becoming standard. However, information about genetic diversity of tropical Ulva species is limited. In this study we explored the gap between traditional and molecular understanding of Ulva diversity in Vietnam employing three commonly used genetic markers, ITS, rbcL, and tufA. Three single locus species delimitation methods including GMYC, ABGD, and PTP, complemented with morphological information, were used to assist species delimitation, leading to the identification of 19 species. The Ulva species identified in this study disclosed a diversity which largely differs from the species hitherto known from Vietnam based on morphological data. Only four species, *U. lactuca*, *U. reticulata, U. spinulosa, and U. flexuosa*, are congruent with our traditional understanding of Ulva diversity. Seven species, *U. ohnoi, U. tepida, U. chaugulii, U. kraftiorum, U. meridionalis, U. limnetica*, and *U. aragoënsis*, are recorded for the first time from Vietnam. For eight species, a name could not be assigned with certainty. A comparison with recent studies showed that Vietnam shared similar species with adjacent countries, including Japan, China, and Australia. Our study emphasizes the importance of molecular data in assessments of Ulva diversity, especially in the tropics, to provide better insight in global diversity patterns of its species.

Session 20) Open Session

Factors shaping microbial community structure and dissolved organic matter composition during austral spring in the San Jorge Gulf

Joanna Paczkowska [1,2], Gabriela Noemi Williams [1], Augusto César Crespi-Abril [1,2], Flavio Emilio Paparazzo [1,2], Antonella De Cian [1,2], Juan Pablo Pisoni [1,2], Sonia Brugel [3], Agneta Andersson [3], Rodrigo Javier Gonçalves [1,2]

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Keywords: Coastal processes, marine phytoplankton, Patagonia

Marine biological productivity depends on phytoplankton and heterotrophic bacterial interactions, influencing the energy and carbon transfer to higher trophic levels including fish, birds and marine mammals. The aim of this project was to study major factors governing the microbial food web and dissolved organic matter characterization in the San Jorge Gulf, the largest basin of the Patagonian Shelf. San José Gulf campaign was carried out during austral spring 2017. Surface water samples were collected for biological (chlorophyll a, microbial abundances) and chemical analyses (dissolved inorganic nutrients, colored dissolved organic matter (CDOM), humic substances). Moreover, the Simpson stability parameter was calculated to estimate water mixing condition based on CTD data. A clear district of the stratified waters observed mostly in the central part of the Gulf from the well-mixed coastal areas was observed. Stratified waters were characterized by higher small phytoplankton (pico- and nanophytoplankton), heterotrophic bacteria, nanoflagellates abundances and the relative contribution of protein-like (C1) compound. Lower temperature and higher wind speed observed in southern coastal area extending over the South Bank and southern edge of the Gulf contributed to well mixed water conditions likely supporting larger phytoplankton cells growth. Additionally, higher biological index (BIX), the relative contribution of humic-like (C4) compound and humic substance concentrations were recorded. Northern coastal waters were characterized by higher salinity, the relative contribution of humic-like (C2, C3) compounds and humification index (HIX).

Coccolithophores of the Last Interglacial (MIS 5e): an Opportunity to Observe a World 2°C Warmer

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Keywords: Climate change, Marine carbon cycle, Paleoecology, Calcifying marine phytoplankton, Micropaleontology

The effects of anthropogenic carbon dioxide (CO2) emissions on climate change are increasingly evident. A rapid rate of change, and unprecedented environmental and social impacts, make the need for precise and accurate predictions of the future consequences of climate change increasingly important. Experiments on living organisms provide useful data regarding the potential response to future climate scenarios; however, monospecific cultures alone are limited in their ability to account for the high complexity of ecosystems. In contrast, the fossil record provides valuable information on how organisms respond to climate change within an ecosystem context. Paleontological data when combined with culture-derived data can improve predictions of the state of biodiversity in the future under varying climate change scenarios. Coccolithophores are particularly sensitive to climate change making them excellent climate proxies. These calcifying marine phytoplankton play a key role in the ocean carbon cycle at various timescales providing pivotal information on the oceans' capacity towards CO2 buffering. In this study, the results of CO2-controlled coccolithophore cultures were compared to fossil coccolithophore communities from Site U1501 of the International Ocean Discovery Program (IODP) Expedition 368 to the South China Sea. Helicosphaera carteri cultures were grown under warming scenarios predicted by the Intergovernmental Panel on Climate Change (IPCC). The coccolithophore content of paleontological samples belonging to Marine Isotope Stage 5 (130-70 ky), a geological interval considered as an analogue for modern warming, were analyzed. Finally, findings from the paleontological data and culture experiments were compared with models of future climate scenarios. This comparison will be useful for understanding the potential effects of anthropogenic climate change on oceanic primary producers like coccolithophore

New Antarctic Loxosomella (Loxosomatidae, Entoprocta) from the Weddell Sea is recorded from only one station

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Keywords: Benthic communities, meiofauna, Entoprocta, new species, Southern Ocean

Entoprocta (Goblet Worms) are small benthic marine and limnic animals that are found nearly all over the world. These sessile, filter-feeding organisms have a long stalk and a tentacle-bearing membrane that surrounds their mouth and anus. Some groups are colonial, others are solitary and mostly commensals on sponges, polychaetes or echinoderms. Only few species show an interstitial lifestyle and are of meiofaunal size (32 µm – 1mm). During RV Polarstern expedition PS118 to the North-Western Weddell Sea, sediment samples for meiofaunal analysis were taken with the Multicorer (MUC). Meiofauna was extracted from cores of three continental shelf stations and higher taxa were counted. Three MUC-cores from one of these stations contained 27 specimens of a new species of Loxosomella (Loxosomatidae). To date, only three other species of Loxosomella are reported from the Antarctic. The found species is new to science since it has a y-shaped cell row on its dorsal side and a long stalk. Compared to other species of Loxosomella, the new species is smaller (approx. 0.5 mm) and carries larger larvae in its atrium. It is yet unknown if this species is free living and sediment dwelling or if it inhabits tubes of other benthic taxa such as polychaeta. Most astonishingly, Loxosomatidae were not found at all in meiofauna samples from two previous expeditions to the Weddell Sea shelf.

Venomous weever fishes: a painful sting with biotechnological potential? *A study on venom production, delivery and toxin characterization in Echiichthys vipera*

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Keywords: Trachinidae, Venomous, Marine toxins, Histology, Proteomics

Biotoxins are powerful chemical compounds that evolved in multiple marine animal lineages as defence or predation strategies. These bioproducts have great biotechnological potential because many are proteins that can interact with specific molecular targets in the recipient organisms, interfering in cell signalling, cell cycle and survival, plus metabolic and physiological pathways. For these reasons, Blue Biotechnology is increasingly focusing these bioresources. Despite the promises for application in drug development, characterising marine toxins is a challenging endeavour that ultimately results in a few approved pharmaceuticals. This study aimed primarily at investigating toxins from the weever fish *Echiichthys vipera*, a venomous teleost abundant along the coast of Portugal and compare the venomous secretions between dorsal and opercular spines and between males and females. For this purpose, fish were surveyed to identify and describe the venom apparatus, which was followed by LC-MS based shotgun proteomics to comparatively characterize the cocktail of toxins, permeabilising enzymes and other substances that make up venom. Histological analyses of the different types of spines and soft rays revealed cavities, or ducts, inside the venomous spines, as opposed to non-venomous rays, which are lined by glandular tissue. These results are compatible with venom secretion and delivery through injection. Besides microanatomy, dorsal spines, opercular spines and soft rays possess distinct proteomic signatures, visible in SDS-PAGE gels and following MS. Most importantly, dorsal and opercular spines do not possess the same toxin signatures, among which cytolytic proteins similar to those of Scorpionidae appear to form the majority. Indeed, some toxins seem to be specific of dorsal spines. The

results also suggest differences between males and females. These findings, which are being validated toxicologically, suggest that weever fish venom is complex and modulated by intrinsic variables such as sex and type of spine, rendering this species a most promising target for bioprospecting.

The biotechnological potential of marine bio-reactives: Exploring novel toxins from the Polychaeta *Glycera alba*

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As the largest and most ancient habitat on earth, the marine environment has an immense biodiversity that can become an almost endless span of novel bioproducts. Of which, only a few have already been synthesized in vitro and commercialised as approved drugs. Venom-derived drugs have shown to be a viable alternative to the expensive and time-consuming process that is the design of synthetic pharmaceuticals. Due to long-term coevolution between predator and prey, proteins with strong activity towards specific targets of recipient organisms were recruited into venoms and poisons, which are cocktails of toxins, enzymes, and other substances. Some Polychaeta, a large class of biodiverse and ubiquitous invertebrates, are known to secrete toxins for predation and defence. The present study focused on *Glycera alba*, a common Glyceridae from the Portuguese estuarine intertidal, whose congenerics, G. tridactyla and G. dibranchiate, are known to be venomous. As the first attempt to screen for potential proteinaceous toxins, we extracted and fractionated total protein from the worm's proboscis and body wall. The structures were compared, due to histological confirmation of the presence of venom glands in the former, which are bound to reservoir-like structures and ducts connecting to hollow jaws. The protein fractions obtained by ultrafiltration and SDS-PAGE disclosed intricate proteomes with important differences between the two organs that can be associated to toxins and permeabilising agents, among other bio-reactives. However, LC-MS/MS-based proteomics did not entirely resolve the proteomes' complexity for this low-genomic annotation organism. The fractions that yielded the most important differences between the two organs, particularly those of higher molecular weight, are now being tested for toxicity using mussel gill tissue as ex vivo model. Altogether, the encouraging findings

show that venomous annelids can be important sources of bio-reactives, albeit illustrating the challenges of surveying organisms whose genomes and metabolism are poorly understood.

Changes in the light spectrum alter the pigment composition and growth of marine phytoplankton communities.

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Keywords: Light colour, water depth, pigments

Light is a fundamental resource for primary producers. Its intensity and quality influence the in aquatic system living phytoplankton. In the water column, the spectral range of light shifts due to the absorption of water molecules and the presence of light-absorbing substances. To use specific wavelengths more efficiently, phytoplankton can produce pigments in taxon-specific combinations. In this study, we focused on the effect of light spectra (light colour) on marine phytoplankton communities. During a research cruise in the Balearic sea, we performed an experiment using phytoplankton communities from 10 different water depths and incubated them under four different light colour treatments. We used the wavelength ranges of the red, green or blue part of the light spectrum, and as control the full light spectrum. Communities from all water depths showed the highest pigment concentration, growth rate and pigment diversity under blue light, and lowest under green light conditions. Pigment composition was also significantly affected by the different light colour where green light communities showed the most differences to other light colour treatments. Furthermore, we observed significant effects of light and water depth in combination on the pigment concentration. In blue light, communities from 80 m water depth contained most pigments, while in other light treatments samples from 45 m had the highest concentrations. Our results support our hypothesis that light quality has an impact on phytoplankton communities in terms of changes in pigment composition and growth. This study highlight, that light spectrum shifts may lead to changes in phytoplankton community structures and subsequently affect higher trophic levels.

Assessment of ovarian asymmetry and endpoint of reproductive toxicity in harbour porpoise (*Phocoeana phocoena*) and common dolphin (*Delphinus delphis*)

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Keywords: Ecotoxicology, persistent organic pollutants-POPs, Histology, Ovarian asymmetry, Endpoint reproductive toxicity

Marine mammals are sentinels of ocean and human health, being top predators with long spans that present with chronic diseases, developmental disorders, and reproductive failure, as well as accumulation of lipophilic contaminants in their subdermal blubber layer. Previous studies have observed that a combination of stressors, including pollutants, nutritional and immune, could be the cause of the decline in reproductive health in small cetaceans in Irish and British waters. However, work in this regard is hindered due to the lack of evaluation of potential reproductive toxicity endpoints, resulting from a lack of understanding of normal ovarian form and function within small cetaceans. Ovarian follicular counting (oocyte quantification) has been identified as an endpoint marker for the assessment of female reproductive toxicity in humans and other mammals, where the effects of contaminants are assessed against the number of primordial and primary follicles and their potential for causing premature reproductive senescence. To undertake this approach, qualitative and quantitative evaluation of "normal" follicular counts is required, particularly in small cetacean species that exhibit marked ovarian asymmetry, such as the harbour porpoise (*Phocoena phocoena*). As little is known on whether asymmetrical ovarian function is present at birth or develops later in life.Using histological analysis and image acquisition and analysis software to investigate ovarian form and function on a set of stranded neonatal and juvenile harbour porpoise and common dolphin (*Delphinus delphis*) ovaries this study will evaluate (1) ovarian asymmetry in these species and (2) methods for quantifying ovarian follicular numbers that could be used as an endpoint for assessments of chemically-induced ovarian toxicity in small cetacean studies.

Planktonic Net Community Production and Respiration Rates in Narragansett Bay, Rhode Island

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Keywords: phytoplankton, primary production, oxygen, coastal, temperate

Net community production (NCP) and net community respiration (NCR) reflect key processes in the global carbon cycle and continued monitoring is essential for balancing local and regional carbon budgets in large-scale ecosystem models. The net rate of organic carbon production in the surface ocean is largely a balance between phytoplankton photosynthesis (gross primary production, GPP) and microbial respiration (net community respiration, NCR). In Narragansett Bay (Rhode Island, USA), and elsewhere, these rates are poorly characterized in terms of their magnitude and variability. As oxygen is a necessary by-product of marine primary production, changes in oxygen concentrations reflect the balance between photosynthesis and respiration for natural plankton communities. To better understand the variability of primary production in Narragansett Bay, natural seawater samples were collected twice weekly during Summer 2021 and incubated in bottles equipped with optical oxygen sensors under controlled light and temperature conditions. These samples were collected in conjunction with the long-term Narragansett Bay Plankton Time Series, which provides environmental and phytoplankton community data. Measuring oxygen concentrations every minute for 24 hours allowed us to track the decrease in oxygen levels in the dark period and the corresponding increase in oxygen levels during the light period. Net community production rates in Narragansett Bay were 15.1 ± 9.6 µmol O_2 L-1 day-1 (Mean ± SD) and net community respiration rates were -19.8 ± 7.2 µmol O_2 L-1 day-1 (Mean ± SD). These results suggest that the ecosystem in Narragansett Bay is net autotrophic for the summer months. We anticipate measuring seasonal variation in the production and respiration rates and identifying the environmental factors responsible for driving these rates. Our results show that the high-resolution monitoring of oxygen concentrations in lab incubation experiments is an effective tool to estimate production and respiration rates in a highly-productive, coastal temperate location.

Effects of Organic Matter Cycling on Rare Earth Element behaviour in seawater during a phytoplankton spring bloom

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Keywords: metal microbe interaction , organic metal complexation, mesocosm, biogeochemical modelling, coastal North Sea

Rare Earth Elements (REE) show nutrient-like vertical profiles in the open ocean water column, even though there is no evidence for active uptake by organisms. Certain organisms can however interact with REE via sorption processes. Phytoplankton thereby shows higher affinities for light REE (LREE) over the heavy REE (HREE); bacterial surfaces show higher affinities for HREE over LREE. Additionally, in terrestrial systems organic matter (OM) was found to control REE speciation with increasing relevance for HREE. In the marine environment, the influence of OM on the overall REE distribution is mostly considered insignificant and thus is largely overlooked. With respect to the mentioned research findings, this assumption is highly questionable. Aim of this study therefore is to evaluate the effect of OM cycling on REE concentration patterns in the marine water column. We analysed the distribution of dissolved REE during an artificially induced, mesocosm based, phytoplankton spring bloom. Measurement in high temporal resolution in one enclosed seawater mass enabled the investigation of REE in close association to the OM cycling. We observed temporal patterns in dissolved REE concentrations that we can link to variations in the OM pool. Two bio-associated shuttles possibly transfer REE between the particulate and the dissolved phase. The phytoplankton-shuttle is characterized by adsorption on the particulate OM; the heterotrophic-shuttle is characterized by desorption processes through heterotrophic activity. The strength of these shuttles decreases with atomic number. Simulations of organic complexation of REE, modelled via PHREEQC, revealed high relevance of organic ligands for HREE and only small effects on LREE. Organic complexes act as buffers against adsorption being opponent to the phytoplankton-shuttle. Our findings show that biological productivity and

associated OM cycling influences REE abundances in seawater. An aspect that should be considered when interpreting past and present REE distributions.

Incubation Experiment of TRANSLATES (Trace Gases in Selected Aquaculture Sites in Southern Portugal)

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Keywords: Aquaculture, Trace gas biogeochemistry, Sensors, Nitric oxide, Carbon monoxide

Our research aims to observe the potential impact of aquaculture on the nitrogen cycle, on deoxygenation, and the production and consumption of climate relevant trace gases such as nitric oxide, carbon monoxide, nitrous oxide, and methane. On 18 May 2021, we collected effluent waters in 3.5L glass bottles from the aquaculture facility of Estação Piloto de Piscicultura em Olhão (EPPO) in Portugal. The collected samples were then transferred to an area exposed to ambient light conditions with constant flow of water (to minimize temperature fluctuations) at the CCMAR in the Universidade do Algarve. Bottles were incubated in incubation vessels under conditions of light and dark to interrogate the impact of UV on photochemical pathways of NO and CO. A further set of incubations were poisoned with sodium azide to prevent microbial production of nitric oxide. Aside from trace gases concentration, ancillary parameters such as nutrient, O_2, pH, marker pigments, CDOM, flow cytometry were determined at the start and end of the incubation. To measure pH, dissolved oxygen, and temperature, we used a lab bench Firesting Pro multi-analyte meter provided by PyroScience GmbH. Using this sensor, we observed an 89% increase of oxygen concentration (398.96 ±1.03 µmol/L from 210.43±1.88 µmol/L) after 48 hours of incubation in light incubation. Using a Micromac 1000 Portable Analyzer Systea, we also noted that ammonium, nitrate, and nitrite were consumed (below detection limit) while phosphate concentration decreased by about 86% in light incubations after 48 hours. This may probably be attributed to photosynthetic activity of phytoplanktons which consumes nutrients and produces oxygen. We observed that after 24 and 48 hours incubation, pH decreased by 0.20 to 0.50 pH unit from initial pH 8.00. This experiment showed the capability of the lab-bench Firesting Pro multi-analyte meter in measuring dissolved oxygen, pH, and temperature for biogeochemistry incubation experiments.

Ecotrophic effects on freshwater zooplankton and its composition due to a changing diet during growth of marine juvenile sticklebacks of the three-spined stickleback *Gasterosteus aculeatus* (Linnaeus, 1758)

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Recent studies have examined in more detail the trophic position of the three-spined stickleback *Gasterosteus aculeatus* within the ecosystem of freshwater bodies such as rivers or lakes. These studies suggest that stickleback ecotype divergence can drive eco-evolutionary changes in zooplankton communities and ecosystems within one generation. While some work has focused more on the ecotrophic effects of top-down regulations based on the diet of adult sticklebacks in freshwater, the current study looks more closely at the effect of changing diets in growing juvenile sticklebacks from two ecotypes. These are the marine and the freshwater ecotypes, both of which can be found in sympatry in temperate regions along marine, estuarine, and riverine environments, with the marine ecotype migrating from marine habitats to freshwater bodies only for reproduction. Thus, marine juvenile sticklebacks are expected to change their diet during growth to meet their nutritional and energy requirements for migrating back to the marine environment. However, the resulting ecological impact on zooplanktonic communities as a result of differential foraging behavior of growing juvenile sticklebacks has not yet been investigated. For this purpose, this study aimed to detect changes on zooplankton communities by using DNA metabarcoding as a result of foraging strategies correlated with fish growth and ecotype. The data potentially suggest that the influence of migratory behavior of juvenile sticklebacks of the marine ecotype on their environment, and in particular on zooplankton as their primary food source and its composition, may be more relevant to eco-evolutionary changes than previously thought. Therefore, subsequent quantitative analysis of zooplanktonic communities could provide insight into whether significant changes in their diversity have occurred. The results should lead to a better understanding of the migratory behavior and associated changes in zooplankton community composition and assessment of the ecological impact of the marine stickleback ecotype on its environment.

Extractive activities and regulations of kelp in southern Peru during the 21st century

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Due to their appliances in different industries, kelp has been getting more attention, and with this, their extraction has been made into a more common practice within small coastal populations. In southern Peru, where there are kelp forests, the species targeted for extraction are *Macrocystis pyrifera*, *Lessonia berteroana* and *L. nigrescens*. Artisanal fishermen are constantly monitored by the state, whom imposes regulations for a sustainable exploitation. Nevertheless, the general population is not aware of the damage kelp ecosystems suffer due to excesive gathering of algae. Because some of the small towns depend on this as a primary economical activity, the main purpose of this work is to answer if the norms that the state rules control effectively the extraction of kelp or not by analyzing studies about the effect of the extraction, and reports of the Peruvian sea institute (IMARPE), while comparing their results with decretes and resolutions given by the Ministry of Production (PRODUCE) during the years 2009-2017. In conclusion, even though the regulations help parcially control the extraction when applied, there is still a need for better enforcement, and because of irregulations and inconsistencies on the regulations of some species, all the efforts are in vain. Something that should be noted is that due to the income this activity generates, sometimes authorities showtolerance to the informality, making extraction control even more complex. A solution that should be applied is the promotion of educational campains and co-management in small coastal towns.

The Seaweed Resources of Peru: current status and future perspectives

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Keywords: Taxonomy, Biodiversity, Molecular studies, Seaweed uses, Peruvian seaweed exports

The coast of Peru (3.5–18°S) is one of the most productive marine areas in the world. A systematic review of taxonomic and biodiversity studies allowed us to update the seaweed checklist of the country, which reports a total of 260 specific/intraspecific taxa. Rhodophyta shows the highest number of taxa (185 species), followed by Chlorophyta (41 species) and Phaeophyceae (34 species). Since 2012, an increase in molecular studies has been reported mostly in Rhodophyta, while Chlorophyta and Phaeophyceae have lagged far behind. Utilization of seaweed resources has been based on artisanal collection from natural beds. These are mainly consumed fresh or salt-dried (*Chondracanthus chamissoi* and Porphyra/Pyropia species), or exported for polysaccharide extraction (Lessonia berteroana, Lessonia trabeculata, Macrocystis pyrifera). Although some regulations for brown seaweed extraction exist, overexploitation is a constant threat that must be addressed. Seaweed exports during the last 25 years went from 194 to 33 950 metric tons (175 times increase). Brown seaweeds (L. berteroana, L. trabeculata and M. pyrifera) represented 97% of the exports. The top four destination countries were China (90.3%), Chile (4.1%), France (1.4%) and USA (1.2%). Biomass from seaweed farms accounts, at most, for only 4% of the total annual landings, and there is a decreasing trend on seaweed aquaculture production since 2012. However, some cultivation projects for *C. chamissoi* and Porphyra/Pyropia species are currently being undertaken. In addition, recent studies have started to explore new uses of commercial and non-commercial seaweeds. Uncovering the Peruvian seaweed diversity and establishing well sustained culture and management projects are essential for utilizing and preserving the seaweed resources of Peru.

An investigation on the biotechnological potential of the gastropod *Nucella lapillus*: On the search for cysteine-rich toxins and other proteins

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Keywords: Marine biotechnology, Molluscs, Bioprospecting, Bioactives, Proteome

Cysteine-rich secretory proteins (CRISPs) are highly bioactive natural products, bearing potential biotechnological and biomedical applications, from anti-oxidants to biocides, and can be found in a wide range of organisms, with emphasis on venom-secreting animals. Still, little is known about CRISPs in marine invertebrates, despite their immense biodiversity and relevance for the bioprospecting for novel natural products. These proteins can play an important role in many organs, from digestive enzymes to toxins involved in prying and chemical defense against predators, intraspecific competition and even the reproductive processes. Even though venoms, such as those secreted by marine cone snails, contain some of the best-studied cysteine-rich toxins, and indeed already giving rise to approved painkiller drugs (conotoxins and conopeptides are known neurotoxins), most marine invertebrate venoms remain uncharacterized and their individual components unidentified. *Nucella lapillus* (L. 1758) is a common gastropod in W Europe that is suspected to secrete immobiliser toxins that likely associate with cysteine-rich proteins. The present work aimed at comparing the secretion, presence and bioreactivity of cysteine-rich proteins between foot, peribuccal gland mass, digestive gland and gonads. The findings demonstrate that the perioral mass holds salivary glands, which are structurally compatible with the secretion of enzymes and toxins, as revealed by histological analysis. It was also shown that the peribuccal mass contains the greatest amount and diversity of proteins, with similarities to proteome of the foot. Proteins from the glandular mass ranging from 20 to 40 kDa are be compatible with the proteins under study. In turn, isolating proteins from digestive gland and gonads revealed more problematic, in large part due to the presence of peptidases in the previous. As protein

extracts from the peribuccal gland mass are currently being tested for toxicity and bio-reactivity, the results indicate that this organ is a promising target for bioprospecting.

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