ICYMARE

International Conference for
YOUNG Marine Researchers

PROGRAM
BOOK OF ABSTRACTS

University of Bremen, Germany
24 – 27 September 2019

NATURWISSENSCHAFTLICHER VEREIN ZU BREMEN von 1864

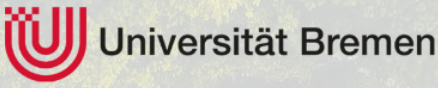
Universität Bremen

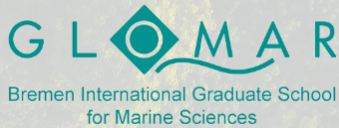
BreMarE
Bremen Marine Ecology
Centre for Research & Education

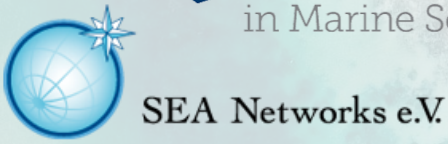
ICRS 2020 BREMEN 14TH INTERNATIONAL CORAL REEF SYMPOSIUM 5-10 JULY 2020

marum
Center for Marine Environmental Sciences

Thanks to all the partners & sponsors of ICYMARE 2019 BREMEN







ICYMARE 2019 BREMEN

24 – 27 September 2019
University of Bremen, Germany

Book of Abstracts

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Cover photograph
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https://www.pexels.com/photo/body-of-water-near-green-mountain-931018/

Published by
Naturwissenschaftlicher Verein zu Bremen
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Contents

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Welcome to ICYMARE 2019 BREMEN

Yes, there is a new fish in the sea! We are so proud to introduce to you the new International Conference for Young MArine REsearchers ~ ICYMARE.

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

What is special about ICYMARE:

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

But most of all: we stay open minded for your ideas and input and our team takes extra care for ICYMARE to get that easy-to-talk-to atmosphere where you can build your network as well as make friends. Our mission at ICYMARE 2019 Bremen is that we are all equals in our research, every opinion matters, you matter, and we respect each other.

ICYMARE 2019 BREMEN will take place with an impressive program of 131 talks and 54 scientific posters. These numbers are even more impressing as this is the very first edition of a new conference series.

We are very grateful to all volunteers, partners & sponsors and session hosts who helped to make ICYMARE 2019 BREMEN possible.

We are most thankful for you presenters. Without you, organizing a conference would not make any sense. We warmly welcome you in Bremen and hope that you will have an amazing time at ICYMARE 2019 BREMEN. We hope that you learn a lot during this conference and that this is a great start to build your own personal professional network.

Welcome as a part of the ICYMARE family!

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Head of ICYMARE Organization Team

Freelance Consultant – Envio Maritime

Dr. Simon Jungblut

ICYMARE Scientific Program and Proceedings

Head of the Association of Marine Sciences at The Bremen Society for Natural Sciences NWV
Marine Ecology, BreMarE – Bremen Marine Ecology, University of Bremen
Functional Ecology, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research

Lena Heel

ICYMARE Homepage and Public Outreach

Marine Ecologist (MSc) & Communication Designer (Dipl)

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ICYMARE 2019 BREMEN Host

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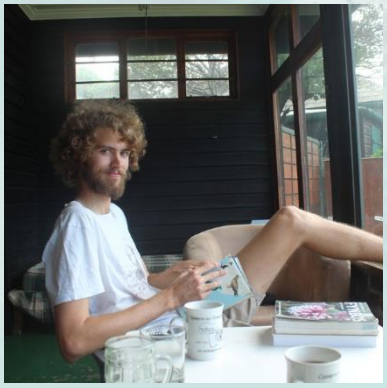

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Want to get involved into the organization and planning of the next ICYMARE?

Please give us your name and mail address at the registration desk.
We are grateful for every single helper!

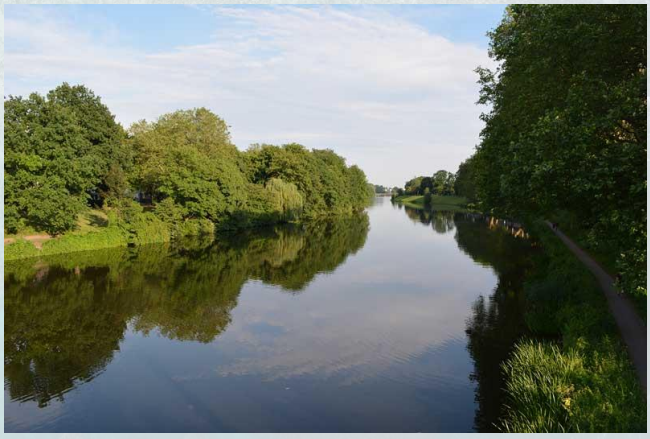
Directions

The Hanseatic city of Bremen

ICYMARE 2019 BREMEN will take place in the wonderful city of Bremen. It has over 550,000 inhabitants and is the bigger one of the two cities that form the federal state of Bremen. The second city is Bremerhaven with over 110,000 inhabitants. Both cities are separated by about 60 km along the river Weser as the dominating aquatic feature of both.

The Bremen Town Musicians, known from the Grimms tale

Historic Town Hall and cathedral at the market square



The Werdersee, a long lake that branches off from the river Weser

As a hanseatic city, Bremen has a long history in import and export trade. Nowadays, Bremen is a city of sciences, especially marine sciences. The bigger area around Bremen is most likely the biggest place in Europe for marine research. The University of Bremen is involved in marine research and additionally, there are some institutes on the campus:

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

Directions

The Hanseatic city of Bremen

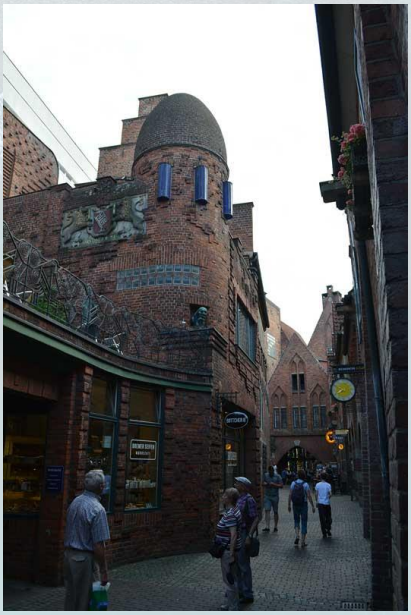
Further marine research institutes are also located in the city of Bremerhaven, so they also belong to the federal state of Bremen:

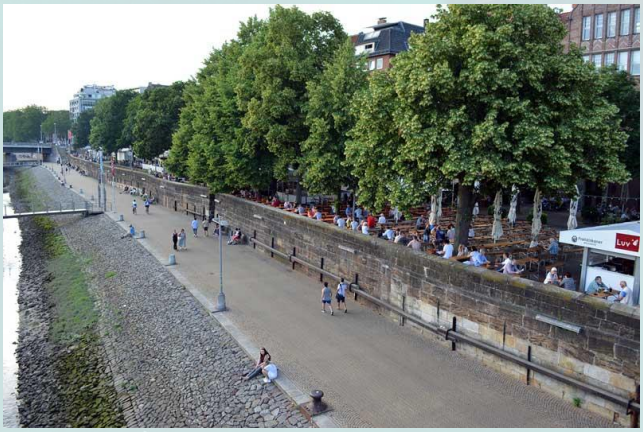
- AWI – Alfred Wegener Institute for Polar and Marine Research
- J. H. v. Thünen Institute of Fisheries Ecology
- J. H. v. Thünen Institute of Sea Fisheries
- University of Applied Sciences Bremerhaven

We are very happy to welcome you in such a marine science-related environment and we are happy to introduce some of the local institutions to you during the conference. In the following, we would like to introduce to you how you can arrive to Bremen and how the public transport in Bremen works. For the general overview of Bremen, check out the interactive city map.

Market square with Schüttinger building

Historic Böttcherstraße





Schlachte, a long street of bars and restaurants along the city center part of the river Weser

Directions

The Hanseatic city of Bremen

You can reach Bremen by several modes of transport:

By Airplane
Bremen has the Bremen Airport Hans Koschnick (code: BRE), which is quite well connected within the European flight schedules. The next bigger airports are Hamburg Airport Helmut Schmidt (code: HAM) or Hannover Airport (code: HAJ) which also connect to overseas. Reaching Bremen from Hamburg or Hannover is easiest and cheapest by regional trains.

By Train
Bremen Main Station is among the 20 biggest train stations in Germany. It is part of the long distance train scheme of Deutsche Bahn as well as of the regional train scheme in northern Germany. Regarding the long distance trains, you can reach Bremen with ICE and IC trains from all over Germany.

If you arriving to Bremen from the airports and cities Hannover or Hamburg or from somewhere within the federal state of Lower Saxony, the “Niedersachsen-Ticket” (“Lower Saxony Ticket”) may be the cheapest option to travel further to Bremen. It costs: 24 Euros for the first person plus 5 Euros each for each further person (up to 5) and is also valid for the city transportation in Hamburg, Hannover, Bremen and many other cities in Lower Saxony.

Bremen
Main Station

By Car
Even if probably not preferred, you can reach Bremen by car via the highways A1 from Hamburg and Osnabrück and via the highway A7/27 from Bremerhaven and Hannover.

Directions

Public transport in Bremen

Bremen is the city of trams. There are nine tramlines and dozens of bus lines all over the city. For you, tramline 6 (Airport to University and back) will be the most important one for you as it connects the airport with the city center, the main station, and the university, where ICYMARE 2019 BREMEN and it´s icebreaker will take place.

Check out the Interactive map of the Bremen public transport

Prices

– Single ride (valid 3 hours in one direction including line changes and breaks, available in the vehicles): 2.80 €

– Day tickets (go back and forth as much as you want, available in the vehicles):
1 person: 8.00 €
2 people: 10.60 €
3 people: 13.20 €
4 people: 15.80 €
5 people: 18.40 €

– 7-day ticket (available in ticket shops): 22.80€

Central tram station in front of the Main Station

Directions

University of Bremen

You can reach the University of Bremen, where the icebreaker and the actual conference of ICYMARE 2019 BREMEN will take place, with tramline 6 that goes to "Universität". You will get off at the station "Universität Zentralbereich" and will find yourself in the middle of the campus at the glass hall. You can go up the stairs on the right in the glass hall or on the left and you are reaching the "Boulevard", the connecting walkway between the most important buildings of the university.

If you take the left-side stairs in driving direction of the tram, you can reach the mensa and the icebreaker venue. If you take the stairs on the right through the glass hall, you will easily reach the conference venues, i.e., the audimax (called "Keksdose") and the SFG-building.

If you arrive by car to the university, signs with "P" on the campus plan indicate parking lots.

Map of the University of Bremen

University of Bremen and Technology Park

Tram station „Universität Zentralbereich" (top) and Boulevard into the direction of the "Keksdose" (left)

Directions

Icebreaker venue

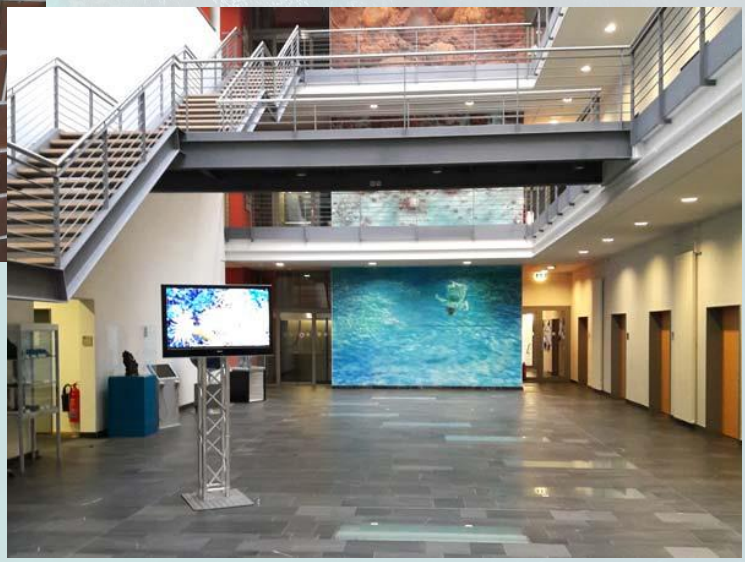
The icebreaker of ICYMARE 2019 BREMEN will take place in the impressive foyer of the Center for Marine Environmental Sciences (MARUM) in Bremen and is supported by GLOMAR – Bremen International Graduate School for Marine Science.

You can reach the MARUM-building by walking to the left end of the Boulevard, past the mensa, go down the stairs and turn right. You walk past the UFT-building on your left and you will reach the MARUM-building.

Start: 24 September 2019, 6.00 pm

Google Maps location of the MARUM

MARUM building, door sign and foyer



Directions

Conference venue

For the conference itself, we are happy to have the audimax of the University of Bremen (called “Keksdose” and indicated with “HS” on the campus plan) for the plenary events and several rooms in the nearby SFG-building. You can reach the audimax by walking to the right end of the Boulevard. For the SFG-building, go down the stairs on the right corner of the audimax-building.

Google Maps location of the audimax building

Google Maps location of the SFG building

Audimax (“Keksdose“)

Entrance of the SFG building

Übersee-Museum Bremen

Free entrance during all conference days

ICYMARE 2019 BREMEN is very happy to have the Übersee-Museum on board as a partner. All participants are given the opportunity to visit the Übersee-Museum **for free** during the days of the conference (24 to 27 September). Just show your name tag at the entrance. The museum is located directly at the main station.

If you want to visit the museum on Tuesday, 24 September, before the icebreaker, please request your name tag at abstract@icymare.com.

ÜBERSEE MUSEUM BREMEN

Google Maps location of the Übersee-Museum

The Übersee-Museum Bremen presents collections focused on ethnology, trade and natural history and connects them to a harmonious experience, which is unique in Europe. Visitors can "travel" to distant continents and discover the fascinating cultures and natural environments with unique exhibits from across the world, masterful animal dioramas and real plants. Some stations also invite to try something out yourself – it's a museum for big and small, and for all senses! Check out the history of the museum and it's connection to the Bremen Society for Natural Sciences.

Conference Information

Registration Desk

In the mornings, the Registration Desk can be found in the foyer of the audimax ("Keksdose"). It will be open every day from 7.30 am onwards. Please drop by upon arrival to register. During the openings in the morning, the registration desk will move into the first floor foyer of the SFG building.

If you find lost items, please bring them to the Registration Desk. It will also act as "Lost and Found".

Uploading Oral Presentations

Please deliver your oral presentations at the Registration Desk well before your session starts. Care will be taken that the presentations will be available on the laptops in the respective rooms when your session starts. You are welcome to provide both, Power- Point presentations and a PDF version as backup.

Poster Set-Up and Poster Session

You can drop your poster roll at the registration desk upon arrival. Please have your name on the roll, we will hang the posters in the coffee break area and will store the rolls in our locked storage room. The posters will be on display during the whole conference in the same area as the coffee breaks and sponsor exhibition takes place.. There will be a Poster Session on Thursday evening, incl. food and drinks.

Mobile Phones

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

WiFi Information

The University of Bremen is member of the eduroam network. Participants who would like to have WiFi during the time of the conference and who do not have an automatic connection via eduroam can get a connection account and password at the registration desk.

Conference Information

Food

There is a restaurant (Café Unique) located in the SFG building, a cafeteria in the GW2 building (opposite of the audimax) and the big mensa at the boulevard with another cafeteria connected to it.

Google Maps location of the Café Unique

Google Maps location of the Cafeteria in the GW2 building

Google Maps location of the Mensa and Cafeteria at the Boulevard

The food delivered by ICYMARE during the icebreaker event, the coffee breaks and the poster session is vegetarian and in many cases vegan.

Certificate of Attendance

Together with your conference bag, you will get a Certificate of Attendance that also serves as a proof for all your efforts regarding the ICYMARE 2019 BREMEN conference. Whether you were a listener, a presenter, a session host, or a helper, you will get such a certificate. All your functions during the conference will be listed. If you contributed a poster or talk, the title and the session of your contribution and the type of contribution (oral/poster) will be mentioned. Likewise, this certificate also acts as proof of payment.

Please check, whether everything is correct. If not, we are happy to fix the errors. Drop by the registration desk to have your certificate fixed.

Conference Information

Group photo

We will take a group photo on Thursday, 5.30 pm, preferably outside. Please meet outside of the SFG building.

Social Media

Do not forget to like and to follow ICYMARE on Social Media. Feel free to tweet and write Facebook posts about the ICYMARE 2019 BREMEN. Don't forget to link the ICYMARE account and feel free to include the hashtag #ICYMARE. Let's work together to let people know about the amazing ICYMARE family.

Facebook

Twitter

Instagram

Be aware: During conferences, many people quickly take a picture of a few slides of your presentation. Either they want to follow up on your research or they would like to share your great talk with fellow scientists and/or friends. Actually not that bad. However, if you are presenting unpublished data or some work in progress it might not be your intention to see your data, your figures and your results on any social media platform.

You can mark those slides that shall be treated confidentially and not shared in the social media world, as well as indicate slides that may be shared. You may use "tweet ok" and "no tweets please - work in progress" icons. Feel free to include them in your presentations to indicate confidential data to the audience.

Tweets Okay!

No Tweets Please
Work in Progress

Program – Wednesday

time	Wednesday, 25 September 2019		
7:30 am Audimax	**Registration & Welcome Coffee**		
8:30 am Audimax	**Opening**		
9:30 am Audimax	**Plenary Discussion**		
10:30 am SFG building	**Coffee Break & Posters**		
11:00 am SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 13 'Winter is Leaving' – Polar Regions in the Age of Climate Change	**Session 2** Share Your Data! New Approaches to Advance Research by Cross-boundary Collaboration and Knowledge Exchange **Session 5** Forensics Meets Ecology – Environmental DNA Offers New Capabilities	**Session 18a** Emerging Technologies in Marine Science
1:00 pm	**Lunch Break**		
2:00 pm SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 11 The Recording Structures of Marine Animals	**Session 20a** Open Session O20-1 – O20-4	**Session 18b** Emerging Technologies in Marine Science
3:00 pm various rooms	**Workshops & Excursions** Coffee break flexible for each group		
7:00 pm Room A	**Movie Screening WIND2WIN**		
9:00 pm Kukoon	**Bar Evening**		

Tap on the event or Session!

Program – Thursday

time	Thursday, 26 September 2019		
7:30 am Audimax	**Registration & Welcome Coffee**		
8:30 am Audimax	**Opening**		
9:00 am SFG building	**Parallel Sessions**		
	Room A	**Room B**	
	Session 12a Functions of Tropical Marine Ecosystems under Environmental Change	**Session 20b** Open Session O20-5 – O20-10	
10:30 am SFG building	**Coffee Break & Posters**		
11:00 am SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 12b Functions of Tropical Marine Ecosystems under Environmental Change	**Session 16a** Biodiversity and Resilience in the Anthropocene	**Session 17** Not as bad as it seems?! Why we need a differentiated evaluation of the impact of marine plastic litter
1:00 pm	**Lunch Break**		
2:00 pm SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 12c Functions of Tropical Marine Ecosystems under Environmental Change	**Session 16b** Biodiversity and Resilience in the Anthropocene	**Session 9** Climate Change as Seen from the Perspective of the Small: Plankton in a Changing Ocean
4:00 pm SFG building	**Coffee Break & Posters**		

Program – Thursday

time	Thursday, 26 September 2019		
4:30 pm SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 4 Living Structures Against Changing Oceans **Session 19** Marine Engineering	**Session 10** They are Among us – Marine Aliens on the Advance	**Session 15** Towards Sustainability in Aquaculture
5:30 pm SFG building	**Group Photo**		
6:00 pm SFG building	**Poster Evening** Food & Drinks		

Program – Friday

time	Friday, 27 September 2019		
7:30 am Audimax	**Registration & Welcome Coffee**		
8:30 am Audimax	**Opening**		
9:00 am Audimax	**Keynote Talk** **Prof. Sheila Heymans** (Executive Director of the European Marine Board)		
10:00 am SFG building	**Parallel Sessions**		
	Room A	**Room B**	
	Session 8 A World of Symbioses! The Wonderful Complexities of Marine Symbioses and Applications for Conservation	**Session 20c** Open Session O20-11 – O20-14	
11:00 am SFG building	**Coffee Break & Posters**		
11:30 am SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 3a Marine Ecosystem Modelling for Social Benefit, Current State and Challenges for Europe	**Session 20d** Open Session O20-15 – O20-17	**Session 7a** Microbial Ecology – How the Smallest Ones Have an Impact on a Global Scale
12:30 pm	**Lunch Break**		

Program – Friday

time	Friday, 27 September 2019		
1:30 pm SFG building	**Parallel Sessions**		
	Room A	**Room B**	**Room C**
	Session 3b Marine Ecosystem Modelling for Social Benefit, Current State and Challenges for Europe	**Session 1** Exploring Social Dimensions of Conservation: Lessons, Experiences and Methodologies	**Session 7b** Microbial Ecology – How the Smallest Ones Have an Impact on a Global Scale **Session 6** Endocrine Disruptors and Model Organisms, Why Do We Need Sentinels in the Marine Realm?
3:30 pm SFG building	**Coffee Break & Posters**		
4:00 pm Audimax	**Project Pitches**		
5:00 pm Audimax	**Awards & Closing**		
	Please do not forget to take your poster from the SFG building!		
8:00 pm Schüttinger	**Post-Conference Clubbing**		

Cyan Planet Virtual Reality Experiences

Coffee & Lunch Breaks, SFG 1st floor foyer

ICYMARE 2019 BREMEN is glad to team up with Cyan Planet. Cyan Planet creates immersive experiences for marine protection and conservation with the help of Virtual Reality. The aim is to create a long-lasting understanding of the ocean's beauty and its destruction, and which efforts and scientific approaches for marine protection are taken. This experience helps to understand that protecting the oceans doesn't mean to conserve just marine species, but ultimately protecting humankind.

Cyan Planet will showcase some of their VR experiences at ICYMARE 2019 BREMEN. During every break you can join them, get VR glasses and dive into an impressive experience. If you want to know more, you can join a workshop on the "Opportunities in using virtual reality technology for marine conservation". Interested people can subscribe at the Registration Desk on Wednesday morning, first come, first serve.

"Come and experience the power and emotional engagement of virtual reality technology at ICYMARE. During breaks, the Cyan Planet team will be there to let you try out VR experiences that let you feel the power of VR technology yourself. Showcased experiences will include "How is the water", the "Seychelles Coral Reef Restoration" and "One Day as a Researcher". More information about the experiences can be found on the Cyan Planet website www.cyanplanet.org"

Cyan Planet

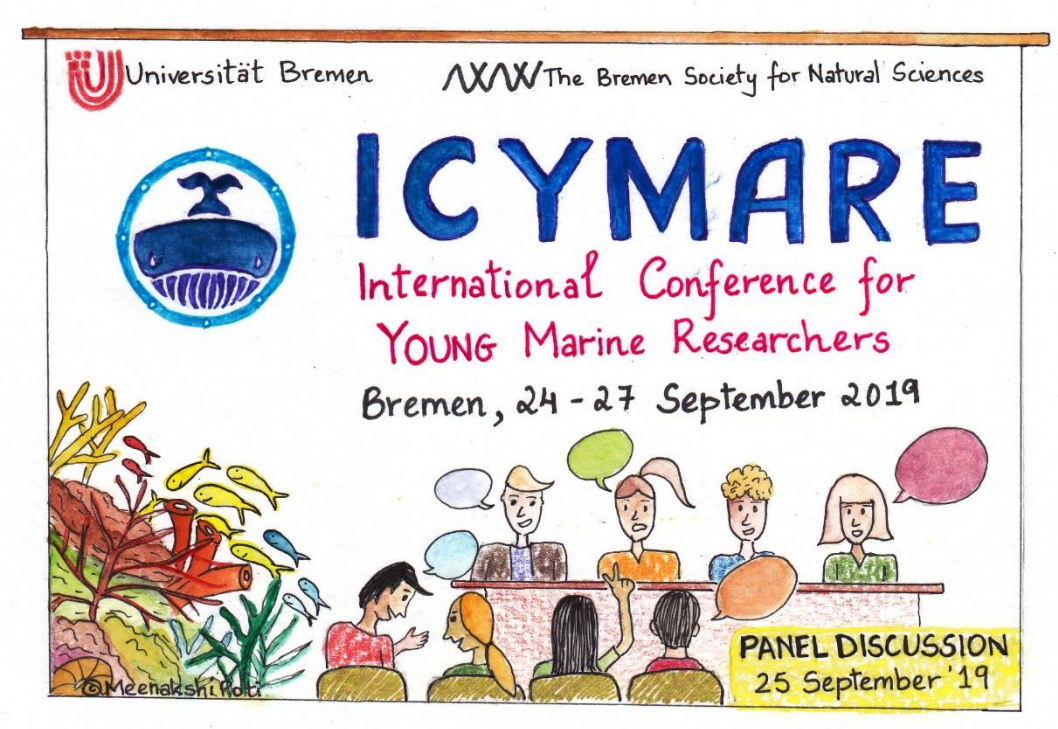
Plenary Discussion Wednesday, 9:30 am

Let's start the ICYMARE 2019 BREMEN with a panel discussion where you are all invited to contribute. Peter Benham, Master student of the IMBRSea program, will, as our moderator, bring together a set of young panelists, who are all dedicated to marine sciences. We will jump right into a question many of us were already wondering about and now we can discuss it with the ICYMARE family:

Should we be more activist? – Examining the current roles & responsibilities of scientists towards society

"How do we measure the impact of our science? Does all science need to have an impact? Who does our research benefit? What kind of topics do we research and how do we best share our results? Exploration, curiosity and the urge to find answers will always be on our horizon and a key driving force for most scientists. However, does the climate crisis and urgency of other current social and ecological problems change our role and as scientists? What is our moral responsibility towards the society we live in in and how can we define this role for ourselves? Come and join us for an open panel discussion to ponder upon these questions and share your thoughts with us at ICYMARE!"

Moderator: Peter Benham
Panelists: Julia Jung, Thomas Sanborn, Julieta Vigliano Relva, Rosa Maria Canedo Apolaya, Justin Tierney



Painting: © Meenakshi Poti – **More illustration samples from Meenakshi**

Workshops & Excursions

Wednesday, from 3:00 pm

Please choose a workshop or excursion and enter your name into one of the lists at the registration desk upon arrival. First come, first serve. Once you entered your name, please stick to your choice unless you have a partner to switch with.

Discover on your own!

During Wednesday afternoon, you may also visit the Übersee-Museum on your own. You do not have to be part of the guided tour there. Gab you name tag and **get free entrance at the Übersee-Museum**.

Workshops & Excursions Wednesday, 3:00 pm

1) Opportunities in using virtual reality technology for marine conservation

Julia Jung (University of Ghent, Belgium) & Cyan Planet

Our workshop will showcase the versatile applications of virtual reality (VR) technology and immersive media production for marine conservation in terms of training, outreach and science communication. During our workshop, participants will get an introduction to VR technology and get to experience the power and emotional engagement of VR for themselves. The workshop will also contain an active outreach component with local high school students, who will also get to experience VR technology. Afterwards, participants will get to explore and see the potential of using VR technology for outreach and science communication by discussing with the students about their experiences. Finally, participants will also be supported to develop storyboards with possible VR applications for their own research, outreach or training.

Max number of participants: 25 scientists and 25 high school students
Room: A **(**SFG 1030)

2) Socialization for Globalization

cross-culture

Dr. Imme Gerke & Dr. Jaques Drolet (IDRG, Bremen)

Globalization requires new social skills. Monoculture provides rules and structure. Multi-culture allows for diversity but lacks structure and stability. Cross-culture is the development of a personal mosaic from the different components of a variety of cultures. It provides the base for mutual understanding, personal responsibility and mutual respect.
Cross-culture Individuals are able to integrate into any culture while preserving their personal view of themselves and of others. They perceive diversity as an invigorating source of opportunity and does not cause them insecurity or defensiveness. Differences are managed in a playful way that allows creativity and self-confidence to grow healthily.

Max number of participants: 20
Room: SFG 2060

3) Data management and manipulation in R: From messy spreadsheets to repeatable code

James G. Hagan (University of Gothenburg, Sweden)

The availability of data in ecology and conservation is constantly increasing. In parallel, new statistical techniques are emerging to analyze these data. As a result, ecology and conservation science are becoming more and more data driven. Given this, an important emerging skill in ecology and conservation is effective data analysis. At the base of effective data analysis is good data management and manipulation skills. Despite this, most young researchers receive little or no training in best practices for data management and manipulation. This workshop aims to change that. What is this workshop about? Firstly, it is not about statistical techniques or data analysis per se. This workshop focuses on how to go from your field notebooks to importing, quality checking and manipulating your data using the R statistical software. We will use worked examples to teach best practice techniques for data management and demonstrate how to manipulate, quality-check and organize data using simple, repeatable code that can then be analyzed effectively. What will you get from this workshop? You will get practical solutions and a best-practice tool kit that will help you manage your data effectively now and in the future. You will get a list of resources that will help you improve your data management and manipulation along with your statistical analyses in R. You will get a set of my own well-annotated R scripts that provide repeatable examples for how to manipulate different forms of data.

Requirements:
1. A laptop (one laptop between two people should be adequate) with R statistical software and R studio installed.
2. Enthusiasm and a can-do attitude! Data science is fun!

Max number of participants: 20
Room: NW2 A 2235

Workshops & Excursions Wednesday, 3:00 pm

4) Academic CV Workshop

Eva M.D. Paulus (University of Groningen, Netherlands)

In this workshop we will discuss the general layout of an academic CV, what to include in it, and some pitfalls. It is interactive so please bring a printed-out version of your own CV or your laptop to edit it right away!

Max number of participants: 20
Room: SFG 2080

5) Best Practice - Science Communication

APECS Germany with Lars Kaleschke (AWI, Bremerhaven), Ulrike Prange (MARUM, University of Bremen), Andreas Vogel (Planetarium Bremen)

You want your science results to be exiting for the public, not only for your lab? In this workshop we will discuss how to effectively reach a broader audience and squeeze science communication outreach into our schedules. Our panel speakers Ulrike Prange (press officer at MARUM, Bremen), Andreas Vogel (director of the Planetarium, Bremen) and Lars Kaleschke (active Scientist @ Twitter, AWI Bremerhaven) will share their insights and methods as professional communicators in science and in museum work. We will have plenty of time to learn from the participants' and APECS' (Association of Polar Early Career Scientists) experiences - and challenges - and discuss best practice tips for early career scientists. While polar outreach is, indeed, cool ;), we explicitly designed this workshop (and the choice of speakers) for all disciplines.

Max number of participants: 20
Room: B (SFG 1020)

Workshops & Excursions Wednesday, 3:00 pm

6) Recording Structures - Novel ageing techniques and the use of "R" and "Shape" for outline analysis

Fedor Lishchenko (A.N. Severtsov Institute of Ecology and Evolution, Laboratory for Ecology and Morphology of Marine Invertebrates, Moscow, Russia), Philip R. Hollyman (British Antarctic Survey, Cambridge, United Kingdom), Jessica Jones (Falkland Islands Fisheries Department, Stanley, Falkland Islands)

Recording structures of marine animals represent a great source of information on the animal's life history and experienced environmental conditions. A wide variety of research methods are routinely applied to the examination of these structures, providing a comprehensive array of data. Unfortunately, such a variety has a significant drawback - it's too easy to get lost in the nuances of the application of methods and the treatment of data.
During the practical part of this workshop, we will demonstrate how some of these methods are applied to the study of inter- and intraspecific morphological variability alongside life-history traits such as age and growth.
For the second part of the workshop, we will discuss the other available methods and possible applications of recording structure use.
Requirements: Participants need to have laptops and to provide email addresses to get the access to Dropbox folder with the required software, in case one wants to work with his own samples, these samples (for otolith-based age determination it could be preserved otoliths, for other activities - photos of samples).

Max number of participants: 25
Room: C (SFG 1010)

7) Excursion: Guided tour through the Übersee-Museum

Dr. Michael Stiller (Übersee-Museum Bremen)

Enjoy a guided tour through the Übersee-Museum given by the Head of the Natural History Department Dr. Stiller.

Max number of participants: 30
Meeting point: 3 pm, SFG Foyer Ground Floor (start of tour 3:30 pm in the museum)

Workshops & Excursions Wednesday, 3:00 pm

8) Excursion: MARUM Center for Marine Environmental Sciences at the University of Bremen - Guided tour incl. sediment core repository

Barbara Donner & Ulrike Prange (MARUM, Bremen)

MARUM produces fundamental scientific knowledge about the role of the ocean and the ocean floor in the total Earth system. The dynamics of the ocean and the ocean floor significantly impact the entire Earth system through the interaction of geological, physical, biological and chemical processes. These influence both the climate and the global carbon cycle, and create unique biological systems.
Come with us on a journey down to the ocean floor and discover the secrets of the deep sea. In our deep-sea cinema we show videos taken by our diving robot at several thousand meters of water depth. A tour through MARUM will give you an overview on deep-sea technologies such as the MARUM-MeBo sea floor drill rig or the remotely operated diving robot MARUM-QUEST. Only the use of these underwater technologies enables research work at MARUM.
MARUM is also home of the Bremen core repository of the International Ocean Discovery Program (IODP) where more than 155 kilometers of cores from the ocean floor are stored.

Max number of participants: 25
Meeting point: 4 pm, SFG Foyer Ground Floor (start of tour 4:30 pm at MARUM)

9) Excursion: Guided tour through the city of Bremen

Join our guided city walk and explore Bremen´s special attractions. Find out about Bremen, its buildings, history and people.

Max number of participants: 25
Meeting point: 3 pm, SFG Foyer Ground Floor (start of tour 4:00 pm in front of the cathedral, city center)

Workshops & Excursions Wednesday, 3:00 pm

10) Excursion: Guided tour through the Leibnitz

In research and education, the Leibniz Centre for Tropical Marine Research (ZMT) in Bremen is dedicated to the better understanding of tropical coastal ecosystems such as mangroves, sea grasses, coral reefs, estuaries and upwelling systems. As an interdisciplinary Leibniz institute, the ZMT conducts research on the structure and functioning of tropical coastal ecosystems and their reaction to natural changes and human interactions. It aims to provide a scientific basis for the protection and sustainable use of these ecosystems. The ZMT works in close cooperation with partners in the tropics, where it supports capacity building and the development of infrastructures in the area of sustainable coastal zone management. The ZMT is a member of the Leibniz Association. Find out more at www.leibniz-zmt.de
Join the guided tour to the facilities of the ZMT. You will get a short overview about the institute's divisions and see the chemical and the biological laboratories as well as the sea water research facilities. Learn about how tropical marine research is conducted in Bremen and find out what is in store for early career researchers at the ZMT Academy. Who knows if your chosen field of work might lead you to ZMT someday?

ZMT
LEIBNIZ CENTRE
for Tropical Marine Research

Max number of participants: 30
Meeting point: 3:00 pm, SFG Foyer Ground Floor
(start of tour 3:30 pm)

11) Excursion: Guided tour through the Max-Planck-Institute for Marine Microbiology (MPI-MM)

Max-Planck-Institut
für Marine Mikrobiologie

During two thirds of the earth's history, microorganisms were the rulers of our planet. They developed an impressive variety of species and metabolic pathways. Even today, microorganisms play a key role in the design of the earth and the climate. At the Max Planck Institute for Marine Microbiology, we are investigating microorganisms in the world's oceans. What role do they play, what are their characteristics and how great is their biodiversity? What is the contribution of microorganisms to the global cycles of carbon, nitrogen, sulfur and iron? What does this mean for our environment and our climate? On a tour of our institute, you get to hear about our mission and selected research projects as well as get a glimpse of our labs and workshops.

Max number of participants: 10
Meeting point: 3 pm, SFG Foyer Ground Floor (start of tour 3:30 pm)

Movie Screening Wednesday, 7:00 pm, Seminar Room A

WIND2WIN

The WIND2WIN Challenge is the first windsurfing challenge in Bulgaria. It took place in September 2018 along the Bulgarian Black sea coast between the villages Durankulak and Rezovo.

Iliyana Stoilova and Yoan Kolew are the athletes who took the challenge and sailed the distance which is equivalent to 300 km in a curved line.

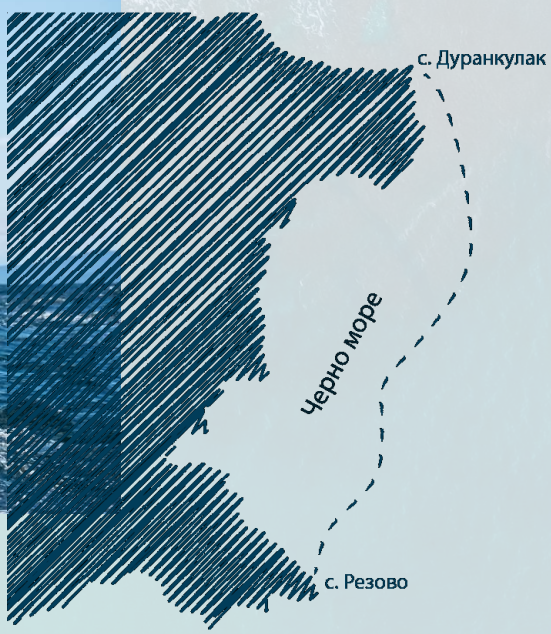
WIND2WIN is an attempt at a rapid maritime journey down the Eastern border of Bulgaria, only with the power of the wind and the human spirit.

The cause of the challenge is to attract the public attention to the plastic pollution problem in the Black Sea.

Velizara Stoilova from the crew will join ICYMARE 2019 BREMEN to bring the movie about this challenge to you. She is happy to answer every question.

Homepage of WIND2WIN

Trailer of the movie



Social Events Wednesday, 9:00pm & Friday, 8:00 pm

Bar Evening on Wednesday, from 9:00 pm on

Let's meet in the Kokoon, a cultural center and meeting place in the Neustadt of Bremen, the part of the city directly opposite of the historic city center.

Enjoy some drinks and music with the ICYMARE family. Some Special prices for certain drinks!

Get out of tram line 6 at the stop "Theater am Leibnizplatz", Just 200 m walk from there!

KUKOON

Google Maps location of the Kukoon

Homepage of Kukoon (in German, sorry)

Post Conference Clubbing on Friday, from 8:00 pm on

After the closing of the conference, we will have another social event. We meet at the Schüttinger, the first tavern brewery of Bremen, which was re-founded in 1990.

Enjoy a quaint and rustic tavern with locally brewed beer next to the old breweing coopers.

From 9:00 pm on, there will be a DJ and a dance floor!

SCHÜTTINGER
ERSTE BREMER GASTHAUSBRAUEREI
ANNO 1990

Google Maps location of the Schüttinger

Homepage of the Schüttinger (in Germany, sorry)

Keynote Talk Friday, 9:00 am, Audimax

Lessons from a circuitous marine science career

Sheila JJ Heymans[1,2*]

[1]European Marine Board, Wandelaarkaai 7, Oostende, 8400, Belgium
[2]Scottish Association for Marine Science, Scottish Marine Institute, Oban, Argyll, PA371QA, UK

*corresponding author: sheymans@marineboard.eu

Keywords: ecosystem modelling; life lessons; mistakes; networking; complementarity

In this talk I will give an overview of my career, describing the decisions I made, the mistakes I made, and how I am navigating the landscape as a female African marine scientist. I will describe some of the work I did, but mostly it will be about my decisions, giving some lessons I have learned over the past 30 year, including the importance of working with people with complimentary skills, of networking, of making difficult decisions, and of picking good students.

European MARINE BOARD
Advancing Seas & Oceans Science

Project Pitches Friday 4:00 pm, Audimax

Time for your ICYMARE project pitch – now it's up to you!

You are running a marine-related blog or you need volunteers for collecting samples, maybe even fellow divers?

PITCH US YOUR PROJECT

Pitch us your project during a max 5 min. speech which you can support with max three simple slides (to be delivered at the registration desk). The best project, voted upon by the audience, will be awarded a financial boost of 200 € provided by the OYSTER network. OYSTER is the early career researcher network of EuroMarine who engage with and aim to support EC marine researchers across Europe and EuroMarine member states.

To participate send us your name and project title to abstract@icymare.com or drop by the registration desk with your short presentation. We only have one hour reserved for project pitch so be quick – slots will be given on a first come first serve basis.

OYSTER
Orienting Young Scientists of EuroMarine

ICYMARE Awards Friday, 5:00 pm, Lecture Hall

ICYMARE 2019 BREMEN will award in total six presentation prices. Three for the best best talks and the three for the best posters of the conference. We are grateful to our partner Springer Nature, who provides us with six book vouchers and we want YOU to decide on the best performances!

SPRINGER NATURE

We all have a feeling what a good talk or poster is all about. In the end, it depends on you. The better prepared you and your contribution are, the better your chances.

How to vote?

In your ICYMARE conference bags, which you will get upon registration, you will find two voting forms. One form is for the talks and one is for the posters. On each list, you will find a list with the presenters name, title and number of all presenters, who are eligible to participate in the voting. You are eligible if you are still Bachelor, Master or PhD candidate.

It cannot be easier: one X on each list. You will find boxes to collect your votes at the registration desk. However keep in mind that you should vote as late as possible to grab an impression of as many talks as possible. Submit you vote until the project pitches the latest!

Best talk, best poster and...

There will be a third box at the registration desk. The third box will collect a piece of paper with your name on it. Springer Nature provides us with one additional voucher to raffle among all people, who gave their votes. For this raffle, please use the paper piece from your conference bag.

All prizes will be awarded during the closing ceremony!

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").

NATURWISSENSCHAFTLICHER
VEREIN ZU BREMEN von 1864

Homepage of the Bremen Society for Natural Sciences

(at the moment only in German, sorry)

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.

ÜBERSEE
MUSEUM
BREMEN

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.

The Bremen Society for Natural Sciences

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.

How to become a member of the Bremen Society for Natural Sciences

International Conference for YOUNG Marine Researchers

25 - 28 August 2020, Hochschule Bremerhaven - Germany

ICYMARE International Conference for YOUNG Marine Researchers

NATURWISSENSCHAFTLICHER VEREIN ZU BREMEN von 1864

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

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To our best knowledge, the ICYMARE conference series is the largest annual conference for early career marine scientists in Europe. It is non-profit oriented and realized with a low budget. The work is done by volunteers and we depend mainly on sponsors. The ICYMARE team is thus extremely grateful for the kind support and collaboration with the following partners, sponsors, and friends.

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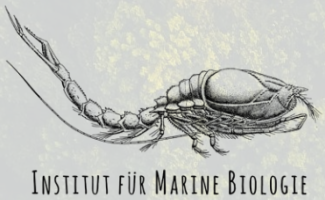

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ICBM

Institute for Chemistry and Biology of the Marine Environment (ICBM)

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OYSTER
Orienting Young Scientists of EuroMarine

Orienting Young Scientists of EuroMarine OYSTER

ÜBERSEE MUSEUM BREMEN

Übersee-Museum Bremen

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More Information:
www.spp-antarktisforschung.de

Background

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

Research Topics

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

Prospects

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

Application

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

www.uebersee-museum.de

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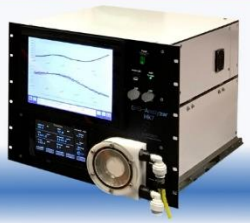

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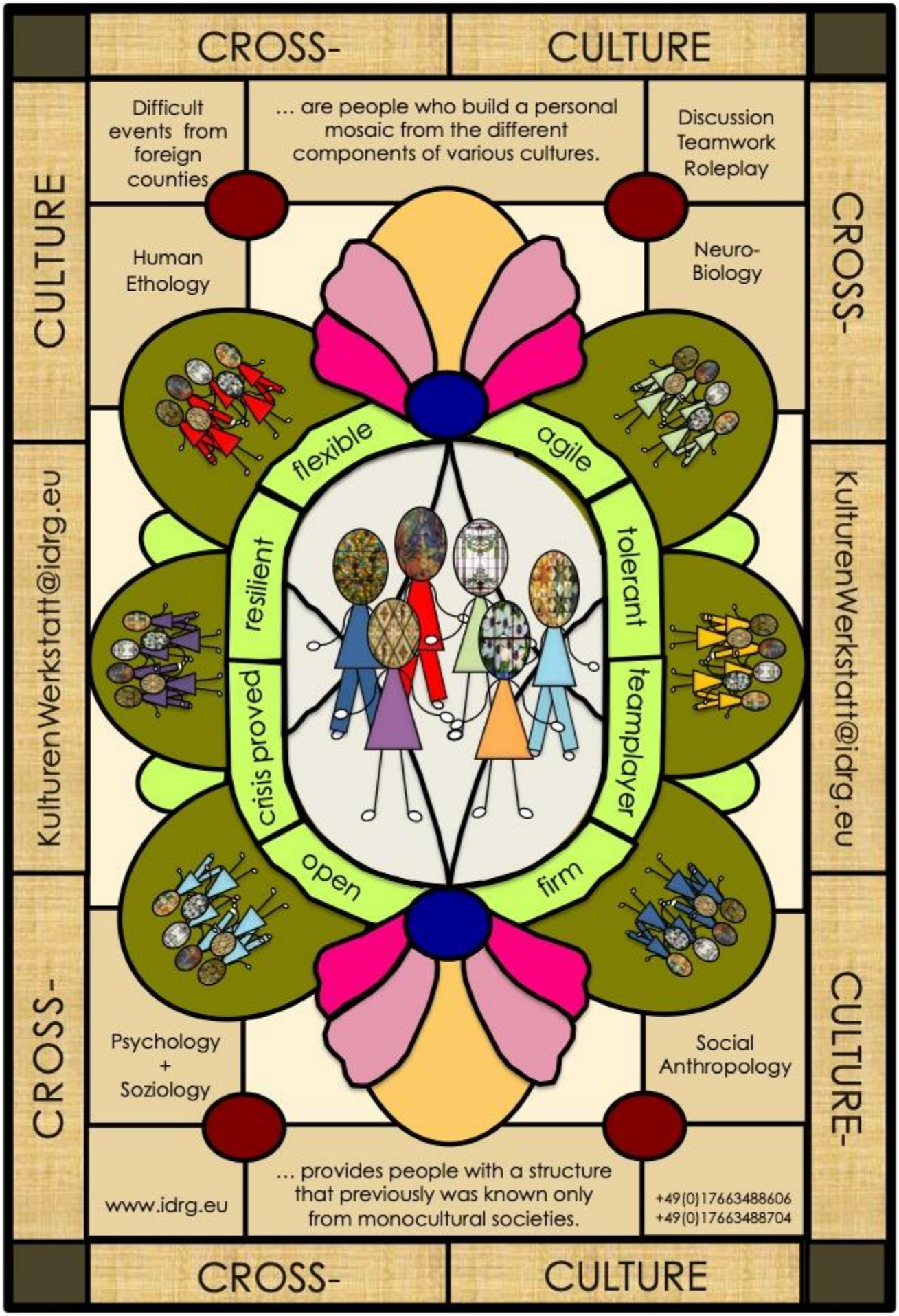
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GAIN

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 773330

Jessica Petereit and Christina Hörterer (AWI)

GAIN aspires to facilitate the paradigm-shift of Eco intensification in European aquaculture to meet the required annual growth in aquatic product volume. This EU-funded project has the dual objective of meeting the increasing production in the industry while ensuring sustainability, health and welfare for both farmed animals and consumers. GAIN is aiming to improve the management of aquaculture farms by alternative feed ingredients, which meet the environmental impact/climate change related sustainability goals and simultaneously increase the welfare of the animals.

Other groups of GAIN are focusing on the use of Big Data for precision aquaculture, innovative re-use and valorisation of by-products and side-streams, analysis and proposals for policy improvements and the evaluation of social considerations.

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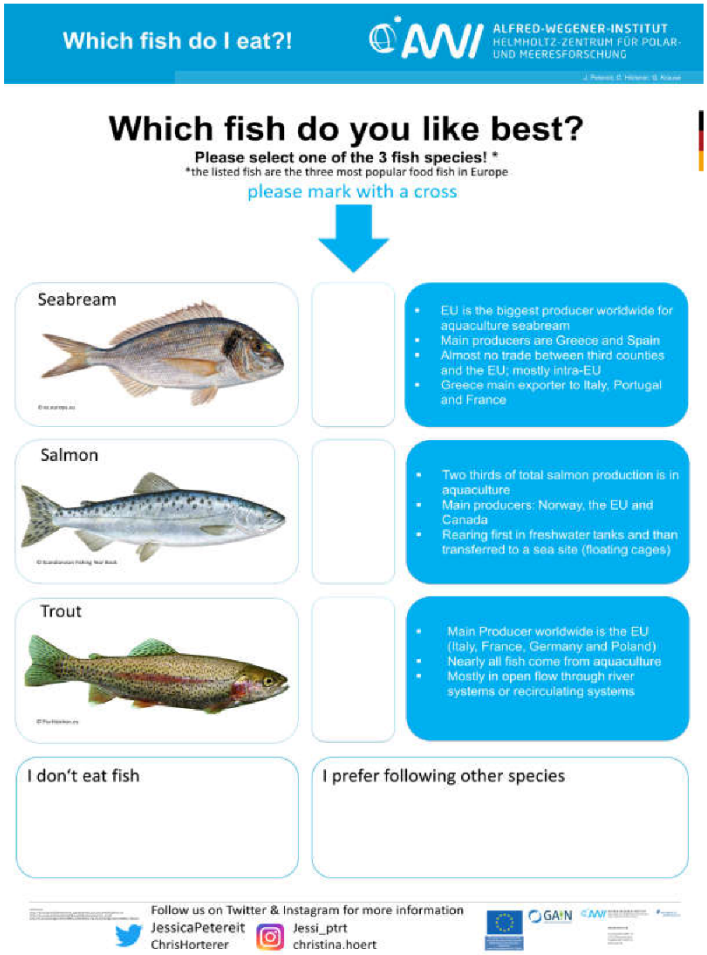

Abstracts of Oral and Poster Presentations

Sessions

Tap to jump to the session!

1) Exploring Social Dimensions of Conservation: Lessons, Experiences and Methodologies

2) Share Your Data! New Approaches to Advance Research by Cross-boundary Collaboration and Knowledge Exchange

3) Marine Ecosystem Modelling for Social Benefit, Current State and Challenges for Europe

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13) 'Winter is Leaving' – Polar Regions in the Age of Climate Change

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Session 1

Exploring Social Dimensions of Conservation: Lessons, Experiences and Methodologies

Call for Abstracts

With the growth of marine conservation both in importance and prevalence, it has become apparent that the success of projects hinges not only on the quality of the science, but on how well it is integrated with the social aspects of its implementation. Embracing this multidimensional approach, we invite participants to share their methodologies and perspectives for working within dynamic social frameworks. We aim to further the continuing conversation that as scientists we have a responsibility not only to our work, but also to the communities we work in.

Session chairs

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O1-1 Oral Presentation

Being utopian and being scientific

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Keywords: Participatory scenarios, models, stories, local ecological knowledge

The development of post-normal science, during the second half of the 20th century, changed the way science was understood; it being no longer seen as a steadily advance in the certainty of our knowledge but rather as coping with uncertainties, complexity and a plurality of legitimate world views. In this context, models can help us understand ecosystem complexity by assessing how system react to internal and external drivers of change, but, among other downsides, they often lack stakeholder participation. For this reason, in recent years, the use of models in combination with scenarios has become increasingly relevant. Participatory scenarios, first developed in the commercial and military context in the 1960s, can capture potential future change by exploring and visualising through narratives, plausible future development pathways that can then be translated into quantitative information. Exploring the future through the construction of what could look like utopian narratives, a priori does not seem very relevant to science. However, thinking about utopias has progressed since Morus' time, from a place that has no place (a *u-topos*), to recognizing the value of the contradictory and incomplete images about the future. Through utopias, values and assumptions can be challenged driving social-ecological change, bridging stakeholders' world views, stimulating innovation and creating an anticipatory adaptation window. In this presentation I will first critically review how scenario planning has been used in the past in marine research and second, I will present how do we plan to use it to study social-ecological tipping points in the Humboldt Current Upwelling System in Peru linking everything with a reflection about utopia.

O1-2 Oral Presentation

Whaling tradition through time – Public perception towards cetaceans along the Cantabrian coast

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Keywords: cetacean conservation, whaling, social perception, Bay of Biscay

Whaling is currently a controversial practice and the focus of a relevant public debate. It represented a very important socio-economic activity in the south Bay of Biscay (North of Spain) from the 12th to the 19th century. Historical records point out the North Atlantic Right Whale (*Eubalaena glacialis*) as the main target species of this activity in the Cantabrian Sea. As a consequence, the North-East Atlantic population of this species was severely depleted. This paper presents a study on public perception of cetaceans and whaling along the Cantabrian coast and evaluates the differences with respect to several non-coastal regions of Spain. A total of 404 random anonymous surveys were conducted in 12 study areas to examine interviewees' knowledge about cetaceans and whaling, as well as their attitudes and willingness to take action in whale and dolphin conservation. Results showed that whaling has a great cultural importance in the Cantabrian coast and this imprint plays a relevant role in citizens' perception. Participants from areas with whaling tradition demonstrated higher knowledge about the history of this activity, but also less opposition to it and less positive attitudes regarding cetacean conservation than respondents from inland provinces. Additionally, we observed that there are other influencing factors, such as gender or age. Despite the existence of a positive correlation between concern regarding cetacean conservation and engagement, our findings indicate that positive attitudes towards the protection of whales and dolphins are not always sufficient for citizens to collaborate for this cause. Therefore, an increase in education programmes to raise awareness about the importance of protecting cetaceans and their environment is recommended.

O1-3 Oral Presentation

Disaggregating the Values for Mangrove Co-benefit by Age, Gender and Level of Education in Vanga, Kenya

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Keywords: Sustainability, livelihood, conservation

Co-benefits approach can offer solutions to sustainability challenges in ecosystem management. Mangroves are endowed with a wide range of co-benefits that are widely untapped into. Competing values for the benefits is one of the prohibiting factors to the realization of the full potential of this approach within the mangrove environment. Vanga being one of the Kenya-Tanzania transboundary sites targeted for the upscaling of carbon crediting, it was necessary to develop an insight into the values for ecosystems co-benefits to improve the impacts of the scheme on conservation and livelihood. Our study adopted a cross-sectional approach employing survey and focus group discussions (FGDs). A total of 377 participants were sampled for the study with 16 FGDs conducted in 4 villages. The study population was disaggregated by age, gender and level of education. Co-benefits were categorized under supporting, cultural and aesthetic, provisioning and regulating. Results show that provisioning co-benefits are the most valued by community members irrespectives of their gender, level of education or age at 83%. 5% value supporting co-benefits while 10% value regulating benefits. Cultural co-benefits were the least valued by only 2% of the community. Community members with no formal education value incentives from payment for ecosystem services (PES) while those with at least a primary school education value rain catchment most. Those with a secondary school education value carbon sequestration most. Women value rain catchment and fish nursery while men value shoreline protection and ocean hazzard barrier. The youths value biodiversity support, fish nursery support and shoreline protection most while the elderly valued incentives and carbon sequetration most. From the results therefore, impacts of gender, education and age comes out clearly with evidences of desperities in values among members from different social standings. These factors should be therefore analysed comprehensively while rolling out conservation projects to avoid a 'tragedy of the commons'.

O1-4 Oral Presentation

Stowaways on my boat? Engaging boat owners with aquatic invasive species using citizen science

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Keywords: Community-based monitoring, public education, invasion vector, round goby

Citizen science is an increasingly popular approach in invasion biology to detect newly introduced species or to track the progression of an invasion. The advantage of citizen science is that gaining scientific knowledge is combined with evoking knowledge and a sense of importance for the investigated topic in the participants. Often, volunteers are recruited from a broad public who are interested in environmental issues. To answer certain questions, however, the pool of volunteers is limited to a specific community. This is the case for questions concerning private boats. Private boats have been identified as one vector that enables saltatory dispersal patterns, where invasive species appear at non-connected locations, sometimes overcoming barriers impossible for them to overcome themselves. To investigate the potential translocation of aquatic invasive species off industrial shipping routes, we engaged with riverine boat owners for a citizen science project. The objectives of this project were 1) to characterize the interiors of motors as potential vector for invasive species to overcome barriers, and 2) to evoke a sense of the importance of this topic in boat owners to promote measures to prevent the unintentional translocation of species. As a flagship species we chose the round goby. The round goby is invasive to freshwater as well as marine systems and therefore a good model for investigating the translocation of invasive species in a range of environments. We present new methods suitable for an uncomplicated sampling of the interior of boat motors, and approaches and pitfalls in engaging with a self-contained community. Presenting the results of the samples collected over the summer, we advocate the worth of actively including the concerned community in projects that have implications for them in a conservation context. Ideally, this project will help to increase the awareness of boat owners to taking action against invasive species.

O1-5 Oral Presentation

A blank area on the map – Molecular identification and shark population dynamics: implications for conservation based on artisanal fishing

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Keywords: Endangered species, Bycatch, Juveniles, Population genetics, Colombia

Coastal ecosystems are highly affected by elevated fishing pressure, targeting a higher number of species in continental waters and being sharks and rays among the most disturbed and harvested species. The increasing demand for shark fins and meat in combination with by-catch captures has led shark populations all over the world to an alarming decline. The Eastern Tropical Pacific (ETP) represents an optimal opportunity to serve as a case study for shark conservation, carrying the potential for worldwide implications. However, the lack of information is still a key problem for the establishment of definitive conservation and management policies. The largest part of elasmobranchs landings from artisanal fisheries are juvenile sharks; captured sharks are landed finless, decapitated, and ready to be processed. These, together with the lack of taxonomic knowledge from fisherman and fisheries control agents, make proper identification a challenging task. Therefore, the use of genetic tools for the identification of the shark species is crucial, due to the high observed abundance of juvenile sharks collected, the presence of cryptic species and important genetic population units that might probe essential for conservation and establishment of baselines for further shark research in the ETP. Here, we present barcoding and genetic diversify results from the mitochondrial NADH2 gene used for the identification of 12 species from shark landings in the Northern Colombian Pacific region (ETP) during the years 2016-2017-2018. Two species are listed under IUCN, *Sphyrna lewini* (21%) is considered Endangered, *Carcharhinus falciformis* (18%) is Vulnerable. Our findings are of great importance, particularly for threatened species, as the genetic diversity results showed low values, indicating possible population decline in this potential nursery area. This study is the baseline for further research in the area aiming for understanding shark population dynamics, connectivity between populations as well as the identification of nursery areas.

O1-6 Oral Presentation

Use of improved energy cooking stoves as a mitigation approach for emissions approach, improving community health and reducing deforestation of the mangrove forest in Gazi Bay, Kenya

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Keywords: Mangrove ecosytems, emission reduction, woodfuel energy, improved cookstoves, SDGs, Gazi bay, Kenya

Biomass is the primary source of energy rural dwellers and urban poor in many developing countries. The main biomass used is firewood. However, the environmental impacts of fuelwood consumption are somewhat neglected by authorities and conservationists, probably because this activity constitutes a chronic disturbance thought to be of a less concern in the face of other major causes of biodiversity loss such as deforestation due to land use changes. However, in area such as Gazi Bay where the research is undertaken, the amount of forest wood harvested for cooking is of concern as it is more than the amount harvested for building. This high demand for wood fuel is coupled with use of traditional stoves (three stones) that are of low energy efficiency. The consequence is use of more wood fuel, increased indoor air pollution, and high pressure on natural mangrove forests that is adjacent to the community. Use of improved cooking stoves has the potential to reduce the consumption of biomass energy by 50%, lower emission of greenhouse gases (GHG) and also decrease indoor pollution. A household survey was carried out in 250 households to determine composition and sources of wood products, the cooking appliances used, community health, and levels of education. Average daily firewood used was measured by measuring firewood weight. The amount of CO and NO were also measured in this houses using passive diffusion tubes. A pilot of improved was also done and the efficiency of the cooking stoves was established. Application of the results in emission reductions as a climate change mitigation, sustainable utilization of mangrove resources for blue carbon trading and improvement of health of the community will be discussed.

O1-7 Oral Presentation

Communicating scientific monitoring data through a public, user-friendly interface: R SHINY app

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Keywords: Scientific communication, MPA, public participation, fisheries, tag-release

Broad communication of scientific findings is challenging. Scientific jargon, restricted access journals and a tendency for scientists to follow traditional formats inhibits the natural flow of information to the general public. This problem is particularly troublesome for so called 'citizen science' programmes that rely on voluntary public participation. In such programmes, information feedback to participants is fundamental as it promotes participation, ensuring continuity. The De Hoop tag-release monitoring programme is one such programme. De Hoop is one of several Marine Protected Areas (MPA) around the South African coast where fishing has been prohibited since 1985. To monitor the status of fish populations and the efficacy of the MPA, the Department of Environmental Affairs (DEA) established the tag-release monitoring programme. Initiated in 1984 it is the longest project of its kind. The programme collects data from two sites within the MPA: Koppie Alleen and Lekkerwater. Each site is sampled three times annually, whereby volunteer anglers catch, tag and release fish, recording vital information which is used to infer population characteristics. This information is of interest to a variety of stakeholders, including the volunteer anglers. Here we present a public, user-friendly R SHINY App platform to distribute findings from the monitoring programme to the general public. The app contains 30 years of fishery-independent data summarised as basic descriptive statistics such as length-frequency, catch-per-unit-effort (CPUE), total catch in numbers and general movement patterns for the most frequently encountered species. These statistics are displayed as custom graphs defined through an interactive interface where the user can choose the species, location and time period of interested. The App does not allow users access to the entire database but aims to promote a general understanding of ecological functioning of the De Hoop MPA and, therefore, its importance in the sustainable management of South African coastal fisheries.

O1-8 Oral Presentation

Lessons learned from the emergence and diversity of marine protected areas (MPAs) in Madagascar and recommendations for MPAs governance

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Keywords: Policy arrangement, Western Indian Ocean, Community-based management, DELPHI, Locally managed marine areas

The protection of marine biodiversity is considered a global priority, as exemplified in the Convention on Biological Diversity's Aichi targets and in Sustainable Development Goal 14. Marine protected areas (MPAs) are considered to be effective conservation and fisheries management tools that generate various ecological and social-economic benefits. MPAs come in all types and sizes, and are managed following different principles, users' needs, and preferences. Madagascar's unique marine biodiversity is currently protected under a range of MPA regimes that emerged comparatively recently, long after the terrestrial protected areas. This study describes the historical outline of the MPA development process in Madagascar and proposes inputs for the future management of MPAs. A policy arrangement approach to structure an iterative Delphi survey was used to analyse how discourse, actors, rules and resources have shaped MPA development in Madagascar. The findings suggest that international initiatives and funding have played a key role in the early days of MPA emergence, while currently co-management between governmental and non-governmental actors shows mixed results regarding conservation effectiveness. Challenges include a better coordination of efforts among various stakeholders, granting a large responsibility to local communities, e.g. in the successful locally managed marine areas (LMMAs), and integrating customary law into the set of regulations for marine conservation and sustainable management in Madagascar.

P1-1 Poster Presentation

Who adapts how? Social networks and innovative production technologies in coastal Bangladesh

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Keywords: social network analysis, climate change, adaptation, social connectivity, innovation

Climate adaptation has become a critical issue in coastal areas, particularly for poor, rural communities dependent on nature-based livelihoods which are directly impacted by climate variability. The adoption of innovative production technologies, such as climate resilient crops or aquaculture techniques, can play a vital role in adapting these livelihoods to climate change. Within these communities, however, certain households may have more access to these innovations than others. In this context, this study examines the relationship between household innovation engagement and social connectivity in a rural farming region in coastal Bangladesh. In this area, a number of innovative technologies have been introduced by government and non-government organizations as adaptations to climate impacts such as salinity intrusion, flooding, and drought. Household innovation engagement and socio-economic traits within two farming communities were collected via questionnaires, and compared with social connectivity data measured through the whole network method of social network analysis (SNA). A "livelihood adaptation network" was mapped, of social ties identified as important for adapting household livelihoods to climate change. It was hypothesized that households with greater social connectivity have increased access to innovative technologies. The role in adaptation of formal ties to external organizations and informal ties to households within the community was explored, as well as the types of social ties involved in livelihood adaptation, including knowledge, money, and labor exchanges. Positive correlations were found between innovation engagement and social connectivity in both study communities, while the relationship between wealth and social connectivity differed between communities, possibly due to differences in community structure and demographics. The analysis demonstrates the power of SNA as an analytical tool to quantitatively identify important actors and map social exchanges, with practical applications in mapping the climate adaptation knowledge flow and as a stakeholder analysis tool.

P1-2 Poster Presentation

Mapping fishing grounds and predatory fish hotspots of Zavora bay, Mozambique - Towards the establishment of a Locally Managed Marine Area (LMMA)

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Keywords: marine protected areas, small scale conservation, GIS, fishing grounds, predatory fish

Mozambique's economy largely depends on fisheries and the tourism industry is fast growing. The menace of over-exploitation and the increasing amount of foreign trawler vessels close to local fishing grounds show an urgent need for proper protection. Marine Protected Areas (MPAs) are an increasingly popular conservation tool. Locally Managed Marine Areas (LMMAs) are MPAs that balance scientific conservation needs and local community values, guiding sustainable exploitation. The goal of this study was to contribute to the very first step towards the increase of coastal protection in Zavora Bay, Inhambane by providing baseline information on predatory fishes. These fish control the food-web in a top-down manner and their removal can have strong repercussions on ecosystem functions. This research analysed biological data of economically important predatory fish in Zavora Bay spanning a time period of three years and correlated their biodiversity with physical and environmental variables. Maps representing local and recreational fishing grounds based on interviews with fishermen were generated by means of a GIS-based approach. We found that diversity of predatory fish was higher in deeper, offshore dive sites than in shallower, coastal sites. Fishing grounds were concentrated around areas where predatory fish biodiversity was highest, and local and recreational fishermen seemed to use different locations. These findings highlight the pressure on predatory fish communities, identifying areas in need of protection. The obtained results will help managers in the decision-making process to allocate a new LMMA in the region and in the communication of these decisions and possible consequences to the local community.

Session 2

Share Your Data! New Approaches to Advance Research by Cross-boundary Collaboration and Knowledge Exchange

Call for Abstracts

Data sharing instead of data storing. We want to emphasize the advantages of merging collected data in times of climate change. Scientists, governments and the public must work together – obtaining an overall understanding of what is happening to the oceans and its biodiversity. This session invites you to discuss your work related to

- Citizens for science: Data-collection on social media and Apps
- Scientific structures – similar and yet so different. How can we find common procedures of data-collection?
- Intergovernmental bureaucracy problems and data protection
- Looking at the bigger picture. Benefit from broader data exchange: projects implemented by cross-boundary collaboration

Session chair

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O2-1 Oral Presentation – Invited Speaker

Crowdsourcing a data collection for Invasive Species Observations

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Keywords: Open Source, Public awareness, Collaboration, Citizen Science

With more than 1000 species from tropical waters already inside the Mediterranean Sea keeping track of their distribution is getting more important than ever. By including divers, sailors and fishermen into the data collection we manage to get a better picture of the dimension as well as raise public awareness for an existing problem. People who interact with the ocean on a daily basis have a better understanding of the changes in the environment and therefore can add valuable insights into the changing factors and inhabitants of any geographic location. With only one dive center a data collection spanning more than 800 dives could be established within 5 months - more than a single researcher could ever do in the same time span! Whilst the data collection is often a collaboration of many parties, the data is usually kept safe. We promote the idea of having all collected data publicly available for other researchers to use. With numerous threats pushing marine environments there is a need to accelerate the research and sharing data is of uttermost importance to speed up this process. Ultimately the truth is: Marine Research is an amazing field full of options and challenges. But if we as researchers want to keep accepting those challenges, we MUST work together to find solutions for existing problems. And quite frankly, we are running low on time to waste. Now more than ever collaboration and the willingness to share data is the key!

O2-2 Oral Presentation

A Multisource Approach to Prioritise Conservation of Gorgonian Forests in Italian Coastal Waters

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Keywords: Web Ecological Knowledge, Citizen Science, Biogeography, Marine Policy, Habitat-forming corals

Gorgonian forests are amongst the most economically and ecologically important elements of Mediterranean subtidal ecosystems. Alongside acting as ecosystem engineers and nursery habitats for a number of benthic and pelagic organisms, gorgonian forests also form beautiful seascapes, of focal attraction for recreational SCUBA-divers. However, the integrity of gorgonian forests , and thus of the entirety of the dependent ecosystem and its services, is threatened by multiple direct and indirect anthropogenic stressors, and mass mortality events have been increasing in frequency and virulence over the past two decades. Despite the number of studies investigating the effect of these stressors and mortalities on gorgonian forests in localized sites and over small time frames, the current and historical state of major habitat-forming gorgonian species along the entirety of the Italian coastline is still unknown. This study filled this gap, supplying the largest and most comprehensive baseline database of seven species of habitat-forming gorgonians in Italian coastal waters. A total of 4773 records ranging from 1984 to 2019 and covering the entirety of the Italian coastline were compiled from four different sources including peer-reviewed and grey literature, citizen science projects, diving questionnaires and the World Wide Web (WWW). Information coming from the WWW included amatorial underwater videos and pictures obtained from Facebook and Youtube, and further confirmed the recently outlined potential of Web Ecological Knowledge in marine research and conservation. Ecological questions over time, space and between Marine Protected Areas boundaries were addressed, and the conservation priorities of gorgonian forests in Italian coastal waters assessed. Results from this study highlight the power and complementarity of multisource approaches in gathering comprehensive, long-term and spatially extended datasets, which are of fundamental importance in providing scientifically-sound evidence to support marine conservation actions in times of global changes and financial hardship.

O2-3 Oral Presentation

Challenges and suggestions to enhance data sharing for a healthier ocean

Linwood H Pendleton[1,2,3,4], Hawthorne Beyer[3], Estradivari[5], Susan O Grose[4], Ove Hoegh-Guldberg[3], Denis B Karcher[4*], Emma Kennedy[3], Lyndon Llewellyn[6], Cecile Nys[4], Aurélie Shapiro[1], Rahul Jain[7], Katarzyna Kuc[7], Terry Leatherland[7], Kira O'Hainnin[7], Guillermo Olmedo[7], Lynette Seow[7], Mick Tarsel[7]

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Keywords: data sharing, knowledge exchange, combinatorial machine, data uploading, ocean conservation.

Ocean ecosystems are declining, yet we have more ocean data, and more data portals, than ever before. Effective sustainable ocean management requires that we make the best possible use of these data and connect data with their users (scientists, conservationists, NGO's, policy-makers, etc.). While tremendous advances have occurred to improve ocean data availability, many data are not shared or hard to find, which wastes time and resources of both data producers and searchers, missing out on the opportunity to effectively use existing knowledge. In the presented study we identify three major challenges to data sharing and use: uploading, aggregating, and navigating. In multi-institutional joint effort we propose a suite of both cultural and technical solutions to overcome these challenges including the use of natural language processing, automatic data translation, data impact factors, and social networks as ways of breaking through described barriers. One way to implement such solutions could be a combinatorial machine that merges both technological and social networking solutions to enhance data sharing and to facilitate researchers to discover, navigate, and download ocean data as well as to connect researchers and data users. Advances in data science, social networking, citizen science and scientific culture provide great hope and opportunity to revolutionize the way we collect and use ocean data, but only if we collaborate, also outside the ocean sector to make the best use of what others have achieved.

O2-4 Oral Presentation

Take care of your clams! Citizen science as promotor of marine resources sustainable use

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Keywords: Citizen science; Data collection; Leisure Fisheries; Science communication

Citizen science is of paramount importance in the data collection era we have now entered. The contribution of citizens to this strictly scientist activity allows scientific community to investigate data they would not have time or funding to collect. A citizen science project took place in the Atlantic French coast to investigate the dynamic of Manilla clam populations (*Ruditapes* sp.). This study was focused on the influence of coastal population leisure and professional fisheries on these dynamics. The objectives of the study were multiple, including the construction of a solid database of their dynamic in the Atlantic coast, the determination of Manilla clam populations health, and the sensitization of volunteer citizens to the challenges of marine resources sustainable use. The results of this 3 years long study will be presented during this talk.

O2-5 Oral Presentation

Genomic tools applied to Marine Megafauna conservation: contributions, challenges and a view towards its implementation in Colombia

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Keywords: Conservation genetics gap, Science-policy interface, Marine policy, Genetic variation

Marine megafauna species (mammals, birds, turtles and elasmobranchs) have important ecological attributes that influence the dynamics of marine ecosystems and are considered as key elements of many conservation strategies. Currently, these species face multiple threats that affect their survival; however, the establishment of effective conservation strategies has been complex due to their wide ranges of dispersal, pelagic habitats and use of diverse ecosystems during different stages of their life cycles. The recent use of Next Generation Sequencing (NGS) tools has permitted, from a genomic scale, a detailed understanding of marine megafauna diversity in terms of population structure, interaction between and within ecosystems, and their capacity of adaptation. Despite its contributions, one of the main challenges for its application is the gap between genetic information and its integration into policies and concrete conservation actions, which could increase with the use of genomic techniques. This study aims to identify the contributions of genomic tools on marine megafauna conservation at a global level through a systematic literature review from 1980 to 2018; and to evaluate the integration of the *genetic diversity* concept in marine policies related to marine megafauna conservation in Colombia, from a qualitative and quantitative textual analysis, as an illustrative case for the assessment of barriers and potential opportunities to bridge the conservation genetics gap. We conclude that genomic tools provide neutral and adaptive information crucial for more accurate management and conservation strategies, as well as new insights and instruments to answer unresolved and novel questions in marine conservation. Additionally, the *genetic diversity* concept is absent in most of the Colombian policy documents analyzed, with a particular concern on local management plans where conservation actions are implemented. We propose strategies to address the barriers found and promote the integral application of new technologies for the conservation of the national marine biodiversity.

P2-1 Poster Presentation

What has Canada caught, and how much is left? Combining catch reconstructions in three oceans with current biomass estimates

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Keywords: Fisheries, Catch, Biomass, Canada, Stock assessment

Canada's marine fisheries occur in three oceans, designated by Pacific, Arctic, and Atlantic Exclusive Economic Zones (EEZs), where management bodies utilize catch records in order to make decisions regarding the future of their fisheries. However, current catch reporting systems and stock assessment processes are flawed, as catch records are missing key fishery components and assessments can use truncated time series that do not represent the full scale of change, known as "shifting baselines". These shortcomings can directly impact the perception of fisheries and influence future management decisions. This research provides a comprehensive catch record for Canadian fish stocks in all three surrounding EEZs from 1950-2017 in order to estimate their current status and provide reference points useful for managers to secure marine resources for the future. Catch reconstructions initially done by the Sea Around Us group and external collaborators, are improved upon and updated to 2017 using methodologies found through the Sea Around Us catch database. Using reconstructions, a new method called Catch Maximum Sustainable Yield (CMSY) allows reference points to be estimated from reconstructed catch series, resilience, and stock status information on data-limited stocks in order to determine the current status of Canadian fisheries. As well, CMSY analysis is used to investigate truncation effects on selected stock assessments that exhibit shortened time series. Concealment of historical trends leads to underestimated sustainable yields and perceptions that stocks are healthier than those assessed with expanded time series. Overall, this research contributes to both enhancing the scope of catch data and provides an approach to assess data-limited stocks, in order to gain better understanding of Canadian fisheries from a historical and managerial perspective.

P2-2 Poster Presentation

Characterization of marine heatwaves on the Asturian coast

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Keywords: Climate change; Satellite-derived SST; In-situ SST; Biodiversity; Ecological impacts

Marine heatwaves are considered one of the most extreme weather phenomena of the oceans, and their increase in frequency and intensity in recent decades is directly related to the global increase in sea surface temperature, one of the many consequences of climate change. In spite of its importance and devastating biological and ecological consequences, the dynamic mechanisms of these events, which seem to be related in many cases to the succession of overlying climate processes, remain unclear to this day. The fact that, until recently, there was no consensus on the definition of marine heatwaves was a major hindrance when aiming to analyze these events. Moreover, the accuracy of satellite datasets when detecting short-term peak events at a local scale has not been fully determined yet and still, their use as water temperature proxies in scientific inquiry is widely generalized. The Asturian coast represents a well-defined transition zone between cold- and warm-temperate waters in the Cantabrian Sea, which makes it an excellent study area to examine these temperature-related processes. In addition, several impacts upon the Asturian marine biodiversity associated with increasing sea surface temperature have been documented, and marine heatwaves most likely have had a role to play in it. Characterizing marine heatwaves is indeed conceptually and methodologically challenging; however, their enormous impacts on biological communities and the goods and services they provide make it necessary to foster research in order to better understand them and prevent their effects in the marine environment.

P2-3 Poster Presentation

Optimization of formation and extraction of antioxidant and antimicrobial activity from macroalgae for a biodegradable packaging

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Keywords: Algae, metabolites, cultivation, light stress

The notion of sustainability and the simultaneous increase in "to-go" products is growing. To combine this, the Mak-Pak project was set up. The aim of this project is to develop a sustainable and biodegradable packaging from macroalgae. During the project, some questions arise like which algae is best suited for this? Under which conditions is the production of antioxidant and antimicrobial metabolites high? And what is the best way to extract the substances? The aim of the work is to determine and combine the optimal growth and extraction conditions for a high content of antioxidant and antimicrobial substances. For the application to the macroalgae packaging as protection aid against microorganisms and lipid oxidation. As first experiment, the brown algae *Fucus spiralis* was tested under different light setting and lighting times in order to test for antioxidant and antimicrobial activity. In a second experiment, different extraction conditions (variation of solvent ratio, time and temperature) with three types of macroalgae (*Fucus serratus, Mastocarpus stellatus, Ulva spp.)* were investigated. Therefore, algae were collected from the North Sea, prepared and cultivated on a laboratory scale. Various radical tests (e.g. ABTS and total phenolic compound) were used to analyze the antioxidant effect of algae extracts. In addition, antimicrobial behavior to *Listeria* sp. and *E. coli* was investigated. In conclusion, an influence of the different light conditions can be seen. Similarly, a change at different temperatures and solvents can be detected during the extraction.

Session 3

Marine Ecosystem Modelling for Social Benefit, Current State and Challenges for Europe

Call for Abstracts

As recognized by the European Marine Board, there is a new era in terms of computational tools and biological-oceanographic data availability which will generate a niche of opportunities for the development of more accurate models and their application to the process of decision-making. Are you already part of this "revolution"? Come and communicate to your fellow young researchers in a story-telling innovative way how you are collaborating to improve Europe's capability to ecosystem modeling. We will address this session with focus on the applicability of our models to generate social well-being and to achieve some of the Sustainable Development Goals.

Session chair

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O3-1 Oral Presentation

Environmental and anthropogenic consequences of climate change in the Baltic Sea

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Keywords: Climate change, Atlantis ecosystem model, holistic mechanistic approach, ecosystem based management, Baltic Sea.

Climate change will affect fish populations and have economic consequences for the fishing industry. To support the process of decision-making in generating environmental and economic well-being, the Baltic Atlantis holistic mechanistic ecosystem model was applied. Climate scenarios included the IPCC climate predictions RCP 4.5 and RCP 8.5 with on top of that three nutrient load scenarios and four Shared Socio-Economic Pathway (SSP) scenarios, with changes in fishery energy efficiency, fuel prices and fish prices. The climate change projections and economic scenarios are used to quantify likely ecosystem changes and fishery consequences important for several pan-Baltic stakeholders. The results indicate an increase or decrease in biomass, both in terms of relative changes in size and distribution and a change in relative costs for six dominant fisheries (Pelagic Trawlers, Small meshed Otterboard Trawlers, Large meshed Otterboard Trawlers, Demersal Seiners/Danish Seiners, Gillnetters and Other - fyke nets, longlines, traps, etc). By integrating the hydrography, the biology covering all trophic levels of the food web, and the economy of fishing activities, we can evaluate and predict relative future climate impacts and likely trends of the main Baltic commercial fish species and fisheries. It is of crucial importance for the future long-term management of the Baltic Sea fisheries and stocks that climate change and integrated impacts of other anthropogenic pressures such as eutrophication and fishing are considered in an ecosystem based approach.

O3-2 Oral Presentation

A statistical model for predicting pesticide risk in waterways draining to the Great Barrier Reef, Australia

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Keywords: ms-PAF, pesticide risk, water quality

Poor water quality associated with land-based runoff is one of the primary pressures impacting the health and resilience of Australia's Great Barrier Reef (GBR) ecosystems. Agriculture is the main source of pollutants such as pesticides delivered to the Reef lagoon. In an effort to halt further decline, the State and Federal governments have set water quality improvement targets under the Reef 2050 Water Quality Improvement Plan (WQIP). The new pesticide target is "*to protect at least 99% of aquatic species at the end of catchments*". The transition from a load-based target for pesticides to an ecosystem risk-based target required a new analytical approach. The GBR Water Quality & Investigations team developed the Pesticide Risk Metric by combining the multi-substance potentially affected fraction (ms-PAF) method with multiple imputation to calculate the toxicity risk of pesticide mixtures to aquatic ecosystems. In order to measure progress towards the WQIP target it was then essential to establish a starting condition (Pesticide Risk Baseline) for both monitored and unmonitored basins. Water quality data from the Catchment Loads Monitoring Program were used to develop statistical models relating Pesticide Risk (% species affected) to landuse, climate and spatial variables at long-term monitoring sites. The modelled relationships were then used to predict pesticide risk at the river basin scale for each of 35 priority basins under the WQIP. Agricultural landuses such as percent sugarcane and percent horticulture were important explanatory variables for pesticide mixture toxicity. Pesticide risk was lowest in basins where conservation and forested grazing were the dominant landuses. The predictive relationships were independently derived for total pesticides, insecticides, photosystem II (PSII) inhibiting herbicides and other herbicides (e.g. synthetic auxins) for prioritisaton of investment and management actions. The Pesticide Risk Baseline and progress towards the reduction target will be reported in upcoming Reef Water Quality report cards.

O3-3 Oral Presentation

A story about time and space – driving an ecosystem model with single species distribution models

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Keywords: Ecospace, southern North Sea, spatial-temporal framework, generalized additive models, model parameterization

Combining spatially explicit ecosystem models with single species distribution models is a promising approach to improve the realism of models used to support spatial fisheries management decisions. Ecopath with Ecosim and its spatial routine Ecospace enables this with the novel spatial-temporal forcing of niche capacity with habitat capacity maps derived from single species distribution models. Thus far, guidelines are lacking on how best to define habitat preferences for inclusion in process-oriented trophic modelling studies. In this work, we demonstrate a procedure for defining habitat capacity maps using a trophodynamic model of the North Sea as a case study. Generalized Additive Models were fit to scientific survey data using differing criteria of habitat preference, which were based on either presence/absence or abundance-weighted criteria. Both approaches, as well as the frequency in which they were updated within Ecospace (biannual, yearly, multi-year, and static), were evaluated against empirical data using a suite of skill assessment metrics. The results suggest that the presence/absence-defined habitat capacity was superior to abundance-weighted criteria. Optimal habitat updating frequency differed for biomass and catch, but variable habitats were generally superior to a static condition. Although the specific settings may differ among systems, the work highlights the influence of habitat preference definitions on modelling performance. In addition, more general (e.g. presence/absence) and less variable (e.g. multi-year or smoothed) definitions of habitat may be required when integrating into models that explicitly account for additional processes relating to habitat, such as the distribution of predator and prey.

O3-4 Oral Presentation

An Ecosystem Model of The Oosterschelde Estuary

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Keywords: mussels; oysters; marine modelling; grazing pressure.

The Oosterschelde is located in the south-western part of the Netherlands, in a region known as the Delta area. It was the former mouth of the Scheldt river, however, decades of high human control and influence ended up transforming it in from an estuary into a tidal bay. Yet, its ecosystem remains highly valuable due to the mussel culture activities taking place in the subtidal areas and its designation as a NATURA-2000 conservation site. The present study developed a 1-D transport-biogeochemical model, which divided the basin into 99 compartments along the longitudinal axis, reproducing the main processes of the pelagic and benthic environments with special emphasis on the phytoplankton-nutrients-bivalve dynamics. The model was calibrated for the period 1996-2005 showing a good fit to data of Chla, DIN and PON. Dynamics in the western zone of the basin was found to be highly influenced by import from the North Sea in terms of primary production, but with the highest local pelagic primary production occurring in the eastern zone. A possible competition for nutrient uptake was detected between the pelagic and benthic primary producers in all zones of the Oosterschelde. The North Sea also influenced nutrient regeneration via the input of substrate, which is remineralised mainly in the western zone, leaving the central and eastern zone mostly dependent on benthic mineralization and transport processes from the western zone to supply their demand. Bivalve filter feeders were shown to exert a high grazing pressure on the phytoplankton. On the regional scale mussels had more impact, but oysters were equally or even more relevant on the scale of a reef. The biomass of the bivalve species experienced a downward trend during the last four years of simulation, which could be an indication of increasing competition for food.

O3-5 Oral Presentation – Invited Speaker

How to use modelling to help value marine ecosystems

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Keywords: ecosystem modelling; ecosystem services; evaluation; policy

Ecosystem models are representations of ecosystems in the same way that Picasso paintings are representations of reality. They are generally not perfect, but you can mostly make out what they are trying to represent. So given that ecosystem models are not perfect and will never be, how do you use them for management? In this talk I will give examples of where my team and I have used ecosystem models to describe what is happening in various marine ecosystem around the world, to show the impact of multiple drivers on these ecosystem, and to showcase how you can use these models to value the ecosystem services they provide. I will describe the use of food web models in the northern Benguela current, the Gulf of Alaska, the Irish Sea and the West Coast of Scotland. Using ecosystem models to value marine ecosystems is still in its infancy but trends are already clear. If we want to manage our ecosystems well we need to value them properly, and understand how our current actions have impacts of the ecosystems of the future.

Session 4

Living Structures Against Changing Oceans

Call for Abstracts

Coastal development has left many nations vulnerable to climate change. Reefs, mangrove forests, seagrass beds, and other biogenic structures protect us from storm events, clean the water, and create habitat. We must restore these biogenic structures to receive these ecosystem services. However, the execution of restoration projects is often difficult. This session will investigate the complexity of applying ecosystem-based solutions to coastal restoration. How can we successfully restore biogenic structures in a myriad of different coastal ecosystems and communities? The goal is to discuss various techniques and methodologies of coastal restoration and how these restoration efforts bring back critical services to coastal communities.

Session chair

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O4-1 Oral Presentation

Dynamic of halieutic and algaculture activities in the village of Andrevo, South-West of Madagascar

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Keywords: Andrevo, small scale fishery, algaculture, holothurie culture, production

Madagascar is an island with more than 5000 km. of coasts and numerous stretches of water, where the sector of fishing takes an important place in the country's economy. Fishing is the principal activity of the *Vezo*, a population in the southwest of Madagascar who are known to participate in small scale fisheries. Seaweed farming and sea cucumber farming also compose an alternate income for the *Vezo* while also decreasing fishery pressure by diversifying sources of income. That is what this research concerns: the dynamic of halieutic and aquatic activities in the village of Andrevo. The main objective is to understand the working of these activities for sustainable development of fisheries and aquaculture in this area. Social and economic research combined with a follow-up study was made by adopting a simple sampling strategy. The field work included two main activities. These included socioeconomic enquiry such as individual interviews, household surveys, and focus groups for the fishers, as well as monitoring of fishing activity which included fishing effort and catch. The people included in study were actors of small fishing and aquaculture activities such as: fishermen, fish and seafood whole sellers, collector, subcollectors, retailers, farmers and consumers, as well as management. On average, 236.3 dugouts (of all gear types) exist per day to do fishing. The average capture by dugout per day was about 7.50 kg. In aquaculture, the alternative to fishing, the production of seaweed varied from 9000 to 70000kg per year and sea cucumber harvesting depended to the quantity of delivered organisms. The insufficiency of material, the increasing scarcity of resources and the fall in prices of products are the major problems which halieutic and aquatic sectors encounter in this village. These problems are due to the use of destructive fishing gear, the monopolization of the market by some sub collectors, and the lack of enforcement of regulations owing to not respecting the local regulation known as "*Dina*".

O4-2 Oral Presentation

First results indicate shelter opportunity as important factor determining fish densities on artificial reefs

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Keywords: Coral Reef Restoration, Bes Islands, Marine Animal Ecology, Ecosystem Response.

Coral cover on Caribbean reefs has declined severely, which resulted in extensive loss of three-dimensional structure (so-called “flattening”) of the reef and a degraded habitat function. On many islands, artificial reefs are being deployed in an attempt to partially restore ecosystem functions by contributing to the three-dimensional structure. Although numerous studies suggest that the performance of artificial reefs vary greatly between different reef types, there are almost no comparative studies available. In the AROSSTA (Artificial Reefs on Saba and Statia) project, we compare the performance of three types of artificial reefs: reef balls™, layered cakes™ and piles of natural basaltic rock. Of each type of artificial reef, four replicates were placed in the waters of Saba and St. Eustatius, Dutch Caribbean. Artificial reef performance, defined as the provision of habitat function for corals and fish, was studied extensively one year after deployment. Layered cake reefs attracted four times more fish than traditional reef ball reefs™, while rock pile reefs had intermediate fish densities. Coral recruit density did not differ between different reef types. We expect that higher grazing intensity on layered cake reefs will result in lower algae cover and subsequently higher survival and growth of the coral recruits.

P4-1 Poster Presentation

Short-term study comparing the Coral Growth and Health between Ocean-Based and Land-Based raised *Acropora* Corals

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Keywords: Restoration, Seychelles, Alkalinity, Photo-acclimation, Phenotypes.

The constant presence of unsustainable anthropogenic activities, partly leading to an era of global climate change, is posing a great threat to coral reefs being home to approximately one third of all known marine species. This extensive degradation of coral reefs poses problems of both economical and environmental significance. Where 60% of the total coral cover is estimated to be lost by 2030, urging for the development of coral restoration programs. Consequently, it is of utmost importance to best understand how the growth and health of Scleractinian corals is controlled for an improved protection and rehabilitation of our natural reefs. The aim of this study was to compare the growth and health between *Acropora muricata* corals propagated in either land-based or ocean-based nurseries, as well as investigate the growth rates between coral fragments and micro-fragments. This was done with the scope to identify limiting factors affecting the growth and health of corals, to allow for optimization of coral propagation techniques/tools used within restoration programs. Two land-based nurseries and one ocean-based nursery were presented in this study, which were constantly monitored from February to May 2019. The results obtained showed a doubled growth rate recorded within the ocean-nursery compared to the land-based nurseries, where all coral fragments showed a greater growth rate and better survival rates compared to the micro-fragments. The coral health/survival rates of the coral fragments were shown to be similar between all nurseries. Moreover, interestingly the factors of alkalinity, wide ranges of seawater temperatures, and the differences exhibited between the various coral phenotypes, all seemed to affect the coral growth and health observed. The findings presented here suggest that both ocean-based and land-based coral propagation techniques, having their own advantages and disadvantages, show promise for future improvements within coral restoration activities needed to combat the changing environment.

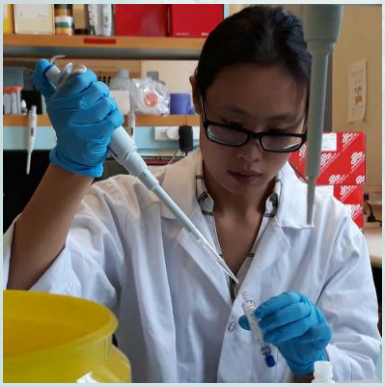
Session 5

Forensics Meets Ecology – Environmental DNA Offers New Capabilities

Call for Abstracts

ICYMARE 2019 BREMEN is pleased to invite the submission of abstracts to a special session on the emerging and promising field of environmental DNA (eDNA). We welcome all research including, but not limited to, methods development of eDNA, ecological discoveries using eDNA, and future directions of the eDNA field. Further, we encourage interdisciplinary studies, combining eDNA with various fields, like modelling, population dynamics, fisheries management and more. This special session is aimed at connecting young researchers across the globe who work with eDNA for networking and collaboration to help map the future of the eDNA field.

Session chairs



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O5-1 Oral Presentation

Diet analyses of seals common in the North Sea and Wadden Sea: a comparison between methods

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Keywords: molecular scatology, diet analyses, *Halichoerus grypus*, *Phoca vitulina*, methodology

Diet is key to understanding an animals' requirements and its role in the ecosystem. In this study we investigated the diet composition of two seal species common in the North Sea and Wadden Sea, the harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*), based on their faecal remains. The methodology used traditionally limits itself to the hard parts recovered from stomach contents, regurgitates and faeces, but it lacks the possibility to detect (parts of) prey eaten without bony structures or hard parts that did not survive digestion. Analysing fragmented DNA of consumed prey that has survived the digestive tract is a non-invasive method that, moreover, may give a better and broader insight into these seals' diets. This study compares both approaches. For this we used existing frozen samples (2011 - 2018) of wild seal faeces collected along the Dutch coast. For the hard-part analyses, faeces samples were washed and remaining hard parts were examined and brought to species level. Prior to DNA extraction, different methods were used to resolve the faeces samples; Ethanol, water and/or freeze-drying and PBS buffer. Ethanol resulted in the fixation of sand particles, which made it difficult to distinguish between particles and hard parts. The Qiagen Fast DNA Stool Kit was used to extract DNA. To identify prey DNA, a ~77 basepair fragment of the 16S mtDNA was used. Since not only fish DNA is targeted, but also other chordate animal species like seals, a blocking primer was added to block (most of) the seal DNA. Next Generation Sequencing was used to sequence all present faeces DNA. By comparing the hard parts with the DNA based analyses we were able to make a (more) complete approach of the diet of harbour and grey seals living in the Wadden Sea and North Sea.

Session 6

Endocrine Disruptors and Model Organisms, Why Do We Need Sentinels in the Marine Realm?

Call for Abstracts

We live in a heavily polluted era, that is not new to anybody since several cases have been well-documented across the world. A growing concern lies in the so-called Endocrine Disruptors (EDs). In brief, EDs may have consequences at different levels, from breeding failure, to cancer development, etc. Model organisms have been used in labs to assess their consequences. Unfortunately, most of the research is made almost exclusively using either freshwater or land organisms. Thus, we welcome any related work that could contribute to enhance our understanding of EDs and potential marine model organisms.

Session chair

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O6-1 Oral Presentation

Biological effects induced by Benzo(a)Pyrene on *Mytilus galloprovincialis* digestive gland cells cultures

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Keywords: Benzo(a)pyrene; Toxicology; Mytilus; cell culture

The development of new technologies has radically changed the way we live and the way we interact with the environment. New anthropogenic activities lead to a gradual increase of aquatic contaminants like the benzo(a)pyrene (BaP), that is a widespread environmental contaminant belonging to the polycyclic aromatic hydrocarbons (PAHs) group. The major sources of BaP are activities involving the combustion of coal, oil, wood, diesel, and petrol. This study aims to asses the cytotoxic and genotoxic effect induced by sublethal concentrations of BaP on short-term digestive gland cell cultures of *Mytilus galloprovincialis*. Cell cultures were tested for vitality in two media, physiological saline, and Leibovitz L-15. Using the physiological saline solution, the 90% threshold was reached after 2 hours. Data demonstrated that in mussel digestive glands cells exposed to BaP, lysosomal membrane stability has been affected even at the lowest concentration of 0.5 ng/mL, highlighting the adverse effects induced by this contaminant on these important structures. To investigate the genotoxic effect, comet assay (single-cell electrophoresis on agar gel) has been performed to evaluate the DNA strand breaks induced by the exposure to benzo(a)pyrene. Data showed how the tail length and intensity are strictly dependent onthe concentration ofBaP, suggesting an increasing number of DNA breaks. The current outcomes demonstrate how the presence of PAH, like BaP, in the marine environment can easily interfere with living organisms. Furthermore, by the use of cell culture of *Mytilus* digestive gland has been obtained a punctual evaluation of the induced damage on these marine organisms by the exposure to the selected PAH.

Session 7

Microbial Ecology – How the Smallest Ones Have an Impact on a Global Scale

Call for Abstracts

Microorganisms might be small but they are everywhere, accounting for more than 90% of ocean biomass. Microbes have an essential impact on all aspects of our planet and its inhabitants. They are providing us with oxygen, driving important global biogeochemical cycles, affecting anthropogenic effects such as pollution and have reshaped our planet throughout its history. No matter if you are working on archaea, bacteria, fungi, viruses or eukaryota, if you are studying single cells or symbiosis, ecological or molecular processes, if your samples come from the water body or the sediments, from the poles or the tropics, … you fit perfectly into this session.

Session chair

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O7-1 Oral Presentation

Improvement of the Biomass Yield and the Total Lipid Content of the Diatom *Skeletonema marinoi* Using Nutrient-rich and Nutrient-limited Conditions

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Keywords: energy crisis, third-generation biofuels, algal biomass, diatom life cycle

Third-generation biofuels, which derive from microalgae, are suggested to be a promising sustainable alternative to petroleum-based fuels. In this study I tested the potential of a local strain of the diatom *Skeletonema marinoi* (RO5AC) for biomass and lipid production. To improve the biomass yield and the total lipid content of this strain I developed three independent experimental setups: (i) a 3-stages setup, (ii) a 2-stages setup, with five days long stage 2, and (iii) a 2-stages setup, with two days long stage 2. In stage 1, identical for all three setups, highest biomass (1.25 gL^{-1}) and lipid content (14.84% of dry weight) were achieved using media 3-4 fold enriched in nitrogen, phosphorus and silica. Besides the effect on biomass and lipid content, media enrichment extended 4-5 days the stationary phase. The biomass reached a peak in the stationary phase, without however affecting the lipid accumulation. In stage 2, the lipid content considerably increased (21 - 23% of dry weight), after two days under nitrogen-limited conditions. The limitation of phosphorus and silica did not affect lipid accumulation. Furthermore, combined nitrogen and phosphorus limitation did not produce an additive effect on lipid accumulation. In stage 3, nutrient starvation did not affect the quantity of the biomass and lipids in the cultures. Finally, I aimed to explore if *S. marinoi*'s cell size affects growth characteristics and lipid content of RO5AC. However, the creation of cell monocultures was not possible, because the cells did not survive after the isolation. The achievement of higher biomass and higher lipid content, using modified media and cultivation in stages, opens new possibilities for the future use of the local diatom *Skeletonema marinoi* for biofuel and biomass production.

O7-2 Oral Presentation

Harmful algae in North Atlantic waters: Distribution and abundance of azaspiracid-producers during a seagoing expedition in summer 2018

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Keywords: Azaspiracid-shellfish-poisoning, quantitative real-time PCR, LC-MS/MS, Amphidomataceae, research survey

The almost globally distributed, marine dinoflagellate genera *Azadinium* and *Amphidoma* (Amphidomataceae) produce a variety of lipophilic phycotoxins known as Azaspiracids (AZA). These toxins are accumulated mostly by filter-feeders like the blue mussel (*Mytilus edulis*) and may lead to the azaspiracid-shellfish-poisoning (AZP) syndrome in humans after consumption of contaminated seafood. With respect to the impacts on human's health, AZA-concentrations above the EU-regulatory limit (0.16 mg AZA Kg^{-1} mussel flesh) go along with closures of shellfish farms and are therefore a threat to the aquaculture industry, as well. Thus, there is a need for a rapid, sensitive and reliable detection and quantification of these microalgae and their toxigenic products. However, this is challenging, as the small-sized cells (12-16 µm) are hardly possible to be identified by traditional light microscopy. Even more challenging, only a few amphidomatacean species produce toxins, and toxigenic and non-toxigenic species can co-occur in the same area. In 2018, a seagoing expedition took place in the North Sea, the English Channel and Irish coastal waters, combining onboard light microscopy, quantitative real-time PCR (qPCR) and liquid-chromatography, coupled with tandem mass-spectrometry (LC-MS/MS), to search for the three azaspiracid-producing species known from the North Atlantic: *Azadinium spinosum*, *Az. poporum* and *Amphidoma languida*. Findings revealed that AZA-producers and respective toxins were widely distributed in the survey area, with high cell densities in the North Sea area and along the Irish coastline. Highlight was a bloom stage of *A. languida* with 1.2×10^5 cells L^{-1}, observed on a central North Sea station. Results of microscopy, molecular and chemical analyses matched well, which increased the confidence about species and toxin detection. This study supports again the recommendation to include toxigenic Amphidomataceans into regular monitoring programs and further demonstrated the advantage of real-time, multi-method approaches to investigate inconspicuous, harmful microalgae species in the field.

O7-3 Oral Presentation

Interactions between free-living and particle-associated microbial communities in an Arctic fjord (Scoresby Sund, East Greenland)

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Keywords: bacteria, aggregate colonization, *in situ* aggregates, Marine Snow Catcher (MSC), free-drifting sediment trap

Carbon export in the ocean is highly dependent on the microbial remineralisation of sinking particulate organic matter. Greenlandic fjords are important carbon sinks and are highly impacted by climate change. The fjord system Scoresby Sund is an ideal model system to investigate bacterial communities under climate change. The study focused on the initial colonization mechanism of sinking aggregates and subsequent interactions between particle-associated and free-living bacterial communities. This was done through the collection of *in situ* aggregates by deploying Marine Snow Catcher (MSC) and free-drifting sediment traps. It is the first study comparing the free-living and aggregate-associated bacterial communities in Scoresby Sund using 16S rDNA sequencing and catalyzed reporter deposition fluorescence *in situ* hybridization (CARD-FISH). Sampling for the free-living (0.2-3 µm filtration) and aggregate-associated bacterial communities took place in summer 2016 in the inner Nordvestfjord and the Outer Scoresby Sund. The aggregate colonization occurred most likely in the chlorophyll maximum layer with the formation of the aggregates. The CARD-FISH cell counts showed similarities in the communities of the free-living bacteria in the chlorophyll maximum layer and the aggregate-associated bacteria collected by the MSC. High Bray-Curtis dissimilarities suggested that, while sinking, little exchange occurred between the free-living bacterial communities and the aggregate-associated bacterial communities collected at depth. Showing high similarities to the aggregate-associated bacterial communities in the surface, the free-living bacterial communities at 1000 m were likely influenced by disaggregated marine snow and detached bacteria from the surface. Therefore, the vertical community connectivity between aggregate-associated bacteria in the surface ocean and free-living bacteria at depth might be dependent on the characteristics of the sinking aggregates. Examination of aggregate dependent vertical connectivity of bacterial communities in Greenlandic fjords can help to predict how aggregates and thus the bacterial communities at depth will change and thereby influence carbon export under future global warming.

O7-4 Oral Presentation

Investigating spatial patterns of variability in bacterial communities inhabiting soils of arid *Avicennia marina* forests

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Keywords: microbial diversity, biogeography, mangrove microbiome

Mangrove forests provide a suite of critical ecosystem services ranging from local to global scales. Soil conditions and associated microorganisms play a fundamental role in maintaining these services, that include nutrient cycling, carbon sequestration and plant growth-promoting properties. Despite its importance, the microbial abundance and function of mangrove soil has received little effort in current research. On the ecotone between the land and the sea, mangrove soils are subject to high variability of geomorphological and ecological conditions that imply a strong distinction of ecological niches. These conditions can diversify the structure and function of the prevalent microbiome. To identify the structure of bacterial communities of mangrove soils, 16S rRNA gene sequencing techniques were applied on samples from arid *Avicennia marina* forests across different spatial scales: (i) at different depths of the soil profile (surface/subsurface); (ii) between two distinct zones within a given forest (seaward/landward); (iii) among forests with varying local hydrodynamic conditions (exposed/sheltered); and (iiii) among forests in different geographic regions (Saudi Arabia and Australia). This study found that the bacterial soil community varied more within each forest than between forests in different countries. Notably, differences between countries became more apparent at the finest taxonomic resolution (ASVs). Bacterial communities from the landward zone of the mangrove forest are more conserved across countries than those from the dynamic seaward zone. Theoretically assigned functions showed high levels of sulfate respiration and chemoheterotrophy as major metabolic pathways. Differences across local factors in the functional traits reflect the within forest variability. The distinct microbial assemblages from the landward zone were associated with high salinity and phosphorus, and nitrogen and larger grain size were associated with the seaward samples. Understanding patterns of microbial communities in mangrove soils is important to predict changes and mitigate anthropogenic pressures on the ecosystem.

O7-5 Oral Presentation

Impact of Deep Sea Mining on Benthic Microbial Communities and Ecosystem Functioning in the Clarion-Clipperton Fracture Zone

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Keywords: Sediment, Manganese Nodules, Material Cycles, Microbial Biodiversity, Anthropogenic Impact

Deep sea sediments are one of the remotest and unexplored ecosystems on Earth. Far from sun light, these ecosystems host conditions extreme for life (e.g. cold temperature, high pressure and limited food availability). However microbes, abundant and active inhabitants of deep-sea, playing a major role in biogeochemical cycles. Knowledge on the microbial diversity and microbially-mediated functions are still limited due to technical challenges of sampling at thousands of meters depth. The rising demand for minerals and metals attracted the attention on the deep sea manganese nodule fields for a long time. Today, development in technology is making deep sea mining efficient and affordable, and licenses for seafloor exploration have already been given by International Seabed Authority to mining companies and states. Thus, baseline studies are crucial to our understanding of nodule field ecosystem functioning and for future mining impact studies. The aim of our study, as a part of international project "MiningImpact 2", is to elucidate diversity, connectivity and function of benthic microbial communities in Clarion-Clipperton Fracture Zone, with specific focus on their role in seafloor material cycles and in the food web. During cruise SO268, interdisciplinary surveys were conducted to characterize seafloor topography, nodule density and geochemistry. Sediment samples and nodules were collected in German and Belgian License Areas, which are 1000 kilometers away from each other and have different environmental setting. Microbial diversity will be investigated by 16S ribosomal RNA gene sequencing, and active microbial taxa and metabolic pathways will be determined applying metagenomic and metatranscriptomic approaches. Results of this study will contribute to better understanding of spatial variability and connectivity of microbial populations, and to elucidate microbially-mediated functions in metals and carbon cycling. This knowledge will constitute the baseline for future deep sea mining impact studies and for development of monitoring and mitigation strategies.

O7-6 Oral Presentation

Phylogeny and metabolic potential of the phylum SAR324

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Keywords: bioinformatics, mixotrophy, comparative genomics, horizontal gene transfer

The bacterial *SAR324* cluster is ubiquitous in the ocean, especially around hydrothermal vents and in the deep sea where it can amount to up to 20% of the whole bacterial community. However, very little is known about the metabolic potential, phylogeny and the influence of *SAR324* on their respective environments. According to a new taxonomy using multiple universal protein-coding genes instead of 16s rRNA, the former *Deltaproteobacteria* cluster *SAR324* is now classified as its own phylum. We managed to construct genomes out of different metagenomic samples, for instance from under the Ross Ice Shelf in the Antarctica. Additionally, we downloaded all publicly available *SAR324* genomes from the genome taxonomy database. After discarding low quality and ident genomes we calculated phylogenetic trees and annotated the remaining 25 genomes to get an overview of their metabolism. The results show that *SAR324* has a very versatile and broad metabolic potential, including many heterotrophic, but also autotrophic pathways. While one, surface associated clade seems to use proteorhodopsin to gain energy from solar radiation, some deep-sea genomes contain the complete Calvin cycle to fix carbon while gaining energy from inorganic chemical reactions. This, in addition to other intriguing genes and pathways for both oxic and anoxic conditions explains the global presence of *SAR324* in the oceans.

O7-7 Oral Presentation

Metagenomics of microbial communities growing on low-density polyethylene as the sole organic carbon source

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Keywords: plastic, biofilm, LDPE, metagenomics

Once in the ocean, plastic pieces are rapidly colonized by microorganisms. It has been suggested that some of these microorganisms are capable of plastic biodegradation. In this study we investigated the potential for low-density polyethylene (LDPE) degradation by three different microbial communities isolated from plastics collected in the North Adriatic Sea. The plastics were incubated in artificial seawater amended with inorganic nutrients and with LDPE as the sole available organic carbon source. Samples were taken after one and two years of incubation for sequencing. Species diversity and richness decreased considerably over time, with two of the communities being composed of about forty species after two years. The third community was composed of six species after one year of incubation and grew very slowly. Sixty-one draft genomes (>50% complete) were recovered from the incubations after one and two years. Several of the organisms enriched in our incubations belonged to taxa related to hydrocarbon degradation, such as *Ketobacter*, *Oceanicola*, *Alcanivorax* and *Rhodobiaceae*. Furthermore, the majority of the recovered genomes harbored genes, such as *alkB,* thought to be involved in polyethylene degradation. Additionally, after two years oxygen consumption measurements were performed to compare respiration rates of the three communities when grown on LDPE and on glass. Microbial communities growing on plastics reached much higher bacterial abundances but lower cell-specific respiration rates than communities growing on glass. This suggests the isolated microbial communities grow more efficiently on plastic than on glass indicating that at least a fraction of the microbial community might be capable of utilizing LDPE as carbon and energy source.

O7-8 Oral Presentation

A Novel Antifreeze Protein Gene Family in an Arctic Diatom, *Melosiraarctica*

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Keywords: psychrophilic polar diatom, ice binding protein, sea ice, lateral gene transfer, genome evolution

Antifreeze proteins (AFPs) provide a solution to the mystery of the intriguing survival strategy of diatoms under extreme polar conditions. We identified a possible new AFP gene family in the Arctic sea ice diatom *Melosira arctica* through genome sequence analysis and phylogenetic studies. Two stable clades of possible AFP sequences from *M. arctica* were found in the AFP family phylogeny tree. One *Melosira* AFP clade groups with other polar sea ice diatoms such as *Fragilariopsis cylindrus* and *Fragilariopsis curta*, the other clusters with psychrophilic bacteria from the polar region, indicating a possible AFP source through lateral gene transfer. An experiment was carried out with *M. arctica* under 5˚C+34psu, 0˚C+34psu, 0˚C+70psu, and -5˚C+70psu conditions and relative growth measured with an Imaging-Pulse-Amplitude-Modulation (IPAM) fluorometer. *M. arctica* was not capable to thrive, but could manage to survive for some time at freezing temperatures and highly saline conditions. The following *M. arctica* AFP ice recrystallization inhibition (IRI) activity detection for gene expression did not exhibit qualitative difference between *M. arctica* and negative controls. In conclusion, the hypothesis of the existence of AFPs, including a novel clade of AFPs, in *M. arctica* cannot be rejected and the AFP genes have different origins within the prokaryotic psychrophilic diversity. Though the predicted typical AFP IRI activity could not be observed, gene expression investigation should be conducted in future studies.

O7-9 Oral Presentation

Human gut bacteria degrade the marine red algal polysaccharide carrageenan

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Keywords: carrageenases, horizontal gene transfer, Bacteroides, polysaccharide utilization loci

Algal polysaccharides in the marine environment provide carbon for microbes that can scavenge these molecules with specialized protein pathways. These polysaccharide degradation pathways are often not restricted to one ecosystem but rather exchanged via horizontal gene transfer. This allows bacteria from different environments to expand their ability to consume new polysaccharides. Human gut bacteria have evolved by gene transfer to degrade marine algal polysaccharides such as porphyran, agar and alginate. Here we show that the human gut bacterium *Bacteroides thetaiotaomicron* evolved to degrade and consume the red algal polysaccharide carrageenan, which is a relatively recent addition in the Westerner's diet. It is used by the food industry as an emulsifying agent, but it remained unknown whether gut bacteria could metabolize this polysaccharide. Our metagenomic data reveals the presence of a cluster of genes in the gram-negative gut bacterium *B. thetaiotaomicron* VPI-3731 that encodes for a multi-protein membrane system to capture, catabolize and consume carrageenan. An upregulation of this carrageenan gene cluster was confirmed with proteomic experiments when *B. thetaiotaomicron* was grown solely on carrageenan. The protein key players involved in the degradative pathway includes a range of transporters, glycoside hydrolases, sulfatases and regulators. We investigated the first step of carrageenan degradation and identified carrageenases that cleave carrageenan in an endo-acting enzymatic pattern. These enzymes initiate the depolymerization of carrageenan into smaller fragments for efficient uptake as we demonstrate by carbohydrate gel electrophoresis and super-resolution microscopy techniques. Since this pathway stems from marine bacteria, the biochemical and microbial mechanism of carrageenan degradation in the gut ecosystem can contribute to the understanding of organic matter degradation in the sea.

P7-1 Poster Presentation

Mixotrophy and the new paradigm for marine plankton research

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Keywords: mixoplankton; microbial ecology; food webs; marine biology; evolution

Ongoing environmental changes driven by either natural or anthropogenic causes have a major impact on the composition of marine planktonic communities. These have given rise to concerns over future proliferation of harmful blooms and subsequent consequences on ecosystem services. A deeper knowledge of the dynamics that shape planktonic communities as we know them is fundamental in order to build up adequate and effective management policies. Planktonic organisms have been traditionally divided into phytoplankton (photosynthetic) and zooplankton (heterotrophic). Mixotrophic plankton are, by definition, single cell organisms able to combine phototrophy and phago-heterotrophy. Here we present the conceptual basis of the new paradigm for plankton studies with the integration of mixotrophy and revision of traditional terminologies. The integration of mixotrophy into ongoing marine research has emerged as pivotal across fieldwork, laboratory experiments and modelling. Studying mixotrophy from an interdisciplinary point of view will enable us to answer ecological questions concerning climate change and marine environment and understand complex evolutionary processes.

P7-2 Poster Presentation

Capturing the diversity of marine heterotrophic protists via single-cell transcriptomics

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Keywords: SC-RNA-seq, taxonomics, heterotrophic diversity, dinoflagellate and ciliate phylogeny, Arctic microbes

The comprehensive and complete taxonomic description of heterotrophic protists is one of the fundamental goals to understand the functioning of marine ecosystems. Improved molecular information on these microbes will help to resolve the scarce knowledge about their part within eco-functional processes in the ocean. New insights into these functional genes of important protists such as ciliates and dinoflagellates will complement the increasing taxonomic complexity and define evolutionary relationships between marine microbial species. Current study proved single-cell transcriptomic sequencing as an efficient method to create a snapshot of expressed genes of unicellular heterotrophs. Focusing on heterotrophic ciliates and dinoflagellates, we sequenced 127 single-cell transcriptomes from 35 field samples taken from Arctic, Subarctic and North Sea waters. From these transcriptomes, we generated multi-gene phylogenies of several dozen genes to decrypt the systematics of heterotrophic taxa within ciliate and dinoflagellate phylogeny, respectively. These approaches will highlight their morphological transitions and facilitate the interpretation of functional genes for these understudied, yet essential groups. Overall, the identification of the functional and phylogenetic diversity of heterotrophic protists is not only critical to understand the processes in the food web, but will provide clues to the system's sensitivity to climate change in the near future.

P7-3 Poster Presentation

Enzymatic kit to detect and quantify the abundant polysaccharide alginate

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Keywords: alginate, algal polysaccharides, CAZymes, enzyme-based method

Studying the mixture and nature of glycans is still a challenging task. The analyses are often cost- and lab-intensive such as mass spectrometry (MS) or nuclear magnetic resonance (NMR). Others provide insights into the monosaccharide composition but lack the information of the 3D-structure, i.e. linkage type, branching, and substitutions (e.g. carboxyl, acetyl or methyl groups) as it is the case with acid hydrolysis of polysaccharides combined with chromatography. Recent studies are using specific carbohydrate active enzymes (CAZymes) to detect and accurate quantify certain polysaccharides in environmental samples. Enzyme-based methods are often less lab- and cost-intensive and still highly accurate. Therefore, it seems of pressing need to develop such techniques for specific glycans. Here we report the first enzymatic-based method to detect and quantify alginate using alginate degrading enzymes from marine bacteria. We also used the enzymes to investigate the monosaccharide composition of different alginates as well as to identify its origin, i.e. algal or bacterial derived. This approach is not only of interest to study alginate and its role in biochemical cycles and food web dynamics in the marine environment but can be also used as biotechnology approach in industry such as waste water treatment where alginate is highly synthesized by mucoid bacteria.

P7-4 Poster Presentation

Unravelling novel hydrocarbon degradation pathways of thermophilic archaea in anoxic deep-sea sediments

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Keywords: ocean-floor dynamics, hydrothermal systems, extremophile metabolism, carbon cycle, sulfur cycle

In anoxic hydrothermally heated and deep-sea sediments, microorganisms encounter a large variety of hydrocarbons as potential energy and carbon sources. Yet, it was believed for a long time that of these compounds, methane is the only one that can be metabolized by thermophilic archaea belonging to the phylum *Euryarcheota*. These methanotrophic archaea (ANME) live in syntrophy with sulfate-reducing bacteria. Recently, it was revealed that other short-chain alkanes such as ethane, propane and butane can also serve as electron donors for several other *Euryarchaeota*. Often, they are syntrophs like ANME and couple to bacterial sulfate reduction. These findings suggest that the knowledge of anaerobic hydrocarbon degradation pathways in deep-sea sediments is not yet complete. The aim of this project is to expand this picture by investigating other potential hydrocarbon electron donors and an alternative electron acceptor. As alternative electron donors, four different sized aromatic compounds are examined. Because these environmentally abundant compounds are recalcitrant and toxic, novel degradation pathways have valuable implications for bioremediation purposes. As alternative electron acceptor, elemental sulfur is tested. Zero-valent sulfur is a promising alternative oxidant to sulfate, since it accumulates in sediments and sulfur reduction likely played a crucial role in biomass production at hydrothermal vents during early evolution of life. As inoculate, we used sediment cores from the Guaymas Basin, a young hydrothermally active spreading center located in the Gulf of California. Anaerobic sediment cultures have been supplied with the above indicated electron donors and acceptor. Different temperature regimes are applied to provide additional information about the temperature-dependency of hydrocarbon degradation and the microbial community composition. Microbial activity and community are monitored using chemical analyses, 'omics approaches, and fluorescence *in situ* hybridization. Since this study is on-going, preliminary results will be presented.

P7-5 Poster Presentation

N_2-assimilation in (hyper)thermophilic marine methanogens

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Keywords: nitrogen cycle, methanogenic archaea, nitrogenase, protein regulators, X-ray crystallography

Hydrogenotrophic methanogens are strictly anaerobic archaea which are astonishingly able to fix N_2, which should not be feasible considering the high-energy required for the process (16 ATPs/N_2 vs 0.5 ATP/formed CH_4), the H_2-partial pressure and high temperature (up to 92˚C) in their natural environment. The nitrogen fixation system observed in methanogens may be the most efficient known yet, if the host growth rates and cell yields are accounted for. The nitrogenase from hydrogenotrophic methanogens is evolutionary distant from characterized homologs, which suggests original structural features (cofactors, catalytic sites, N_2-channels, electron donors and regulatory mechanisms). A combination of *in silico* analysis, anaerobic cultivation, recombinant protein purification, biochemical studies and X-ray crystallography were used to initiate structural and functional investigations of the methanogenic N_2-fixation apparatus and its regulation system. Here we report the impressively fast growth rate of marine methanogen *Methanothermococcus thermolithotrophicus* of 0.348 which is comparable to the *Azotobacter vinelandii* when grown on N_2 (0.340), further optimization and improvement of the diazotrophic culture and findings that diazotrophy in this organism is entirely dependent on molybdenum. Further, structural characterization of N_2-assimilation regulatory proteins belonging to the PII-family (NifI1, 2 complex) was done. The structure of NifI1 was solved *ab initio* by a SIRAS experiment and is revealed to be homotrimeric, consistent with highly conserved homotrimeric organization of PII proteins known so far. NifI2 was modeled *in silico* based on NifI1, revealing complementary surface electrostatic charge profiles and possible ways of complexing with NifI1 and nitrogenase. Our future goal is to structurally characterized each of the proteins of the pathway and elucidate their catalysis, electron donors and modes of regulation, as well as to expand the study to hyperthermophilic model organisms, such as *Methanocaldococcus vulcanius*. Such future discoveries will help answering the fundamental question of ecological impact of nitrogen fixation by methanogens.

P7-6 Poster Presentation

Biochemical and structural characterization of the unconventional sulfate-reduction pathway from a hydrogenotrophic methanogen

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Keywords: sulfur cycle, hydrogenotrophic methanogens, sulfate-assimilation, sulfite-detoxification, structural biology

Hydrogenotrophic methanogens are energy extremophiles that commonly thrive in highly reduced and sulfidic environments and receive sulfur by the direct incorporation of environmental sulfides into proteins. However, since 1986 there is evidence for the presence of a methanogen performing sulfate assimilation – a highly complicated and energy demanding process, which was generally accepted not to be performed in methanogens due to energetic barriers, toxic intermediates and the observed spatial separation of sulfate compounds and methanogenesis. Here we confirm the thermophilic methanogen *Methanothermococcus thermolithotrophicus* as the first known sulfate assimilating archaeon by performing *in silico*, physiological, biochemical as well as structural studies. Comparative genomic analysis revealed the presence of putative enzymes involved in sulfate assimilation in the genome of *M. thermolithotrophicus*. Successful cultivation of the methanogen on a variety of sulfur substrates confirmed and revealed its capability to grow on sulfate and further reduced sulfur-compounds to unexpected high cell densities. The apo crystal structure of the ATP Sulfurylase from *M. thermolithotrophicus* (*Mt*ATPS) - the first enzyme of the sulfate assimilation pathway – was solved at 2.23 Å resolution. Growth experiments of sulfate-adapted *M. thermolithotrophicus* cells show a high tolerance against molybdate, a common ATPS inhibitor and the methanogens' ability to assimilate sulfate at very low concentrations. The presence of the last enzyme in the sulfate assimilation pathway - the assimilatory sulfite reductase – was proven via *M. thermolithotrophicus* ability to tolerate sulfite (up to 2 mM) and enzyme activity assays. Based on *in silico* analysis this enzyme seems to be a yet unknown form of sulfite reductases and might represent an evolutionary ancient enzyme. This work provides insights in how this hydrogenotrophic methanogen performs assimilatory sulfate reduction.

P7-7 Poster Presentation

Impact of depositional regimes on biogeochemical cycling of iron in sediments of the Argentina Continental Margin

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Keywords: microbial Fe reduction, $\delta^{56}Fe$, stable iron isotopes, redox cycling

At the Argentina Continental Margin fundamental interactions between bottom currents, sediment deposition and how these processes control biogeochemical reactions and element cycling including iron can be studied. The focus of my master thesis was to determine (1) the consequences of depositional environments (lower continental slope vs. contourite terrace) on biogeochemical processes and the (2) preservation and diagenetic cycling of solid Fe phases in sediments. Additionally, it was assessed (3) how sedimentary stable Fe isotope signatures ($\delta^{56}Fe$) are affected during early diagenesis. A sequential extraction protocol was applied to determine four reactive Fe phases including Fe carbonates, easily reducible Fe (oxyhydr)oxides, reducible Fe (oxyhydr)oxides and hardly reducible Fe oxides. Purification for sedimentary $\delta^{56}Fe$ signals of Fe carbonates and easily reducible Fe (oxyhydr)oxides followed. The dataset was combined with pore-water data from RV SONNE cruise SO260 and provided stable carbon isotope data. Different extents of the redox zonation and location of the sulfate-methane-transition (SMT) were found. It is suggested that sedimentation rates are low at the lower continental slope with steady state conditions, causing a strong diagenetic overprint of Fe phases unlike the contourite site, where high sedimentation rates are evident and a diagenetic overprint is missing. Fe extraction data indicate that reactive Fe oxides are subject to reductive dissolution at the SMT. Yet significant amounts of reactive Fe oxides are preserved below for deep Fe reduction (potentially through Fe mediated anaerobic oxidation of methane), which is evidenced by dissolved Fe in methanic sediments. The $\delta^{56}Fe$ of reactive Fe phases suggest significant microbial fractionation during deep Fe reduction at the lower continental slope, whereas at the contourite site microbial fractionation is not reflected in $\delta^{56}Fe$. It is concluded that the applicability of $\delta^{56}Fe$ signatures as tracer of microbial Fe reduction might be dependent on the depositional regime (limited in high sedimentation areas).

Session 8

A World of Symbioses! The Wonderful Complexities of Marine Symbioses and Applications for Conservation

Call for Abstracts

Being one of the most common and ancient phenomena, symbioses between different organisms are truly fascinating but not very well understood. Intricate symbioses are ubiquitous. From light harvesting dinoflagellates of cnidarians to anemones housed on pom-pom crabs, and the chemosynthetic bacteria of deep-sea mussels, our oceans are a "World of Symbioses". Adaptive, symbiotic relationships facilitate the success of diverse organisms, across trophic levels, to successfully exploit niches otherwise overcrowded or extreme. Ranging from molecular biology to policy, this session aims to learn from the diversity of marine symbioses, explore its threats, and examines the ramifications for conservation.

Session chairs

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O8-1 Oral Presentation

Light enhanced calcification in bleached corals: investigating the direct and indirect role of light

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Keywords: reef-building corals, circadian rhythm, calcification, menthol bleaching, Galaxea fascicularis

The calcium carbonate skeletons of hard corals build the largest living structures on Earth. These coral reef ecosystems provide a habitat for an estimated third of all marine species. Corals are heavily impacted by climate change, with negative consequences for their capacity to calcify and build their skeletons. Despite its importance, the mechanisms underlying calcification are not fully understood, making predictions of future coral reef scenarios challenging. Generally, calcification is increased under light ("Light Enhanced Calcification"), however the exact role that light plays in this process is still unclear. Corals harbor endosymbiotic unicellular algae, which produce the photosynthetic energy that indirectly fuels calcification. Yet, calcification rates change throughout the day (peak in the afternoon) despite constant illumination. Similarly, blue light enhances calcification even at negative net photosynthetic rates. Therefore, other processes between host and symbionts likely also play a role. To gain a better understanding of the role of light in coral calcification and the complex interplay between the host and symbionts, we compare calcification rates in symbiotic and symbiont-free (chemically bleached) *Galaxea fascicularis* polyps at three times throughout the light-dark cycle. Specifically, we ask 1) whether symbiont-free (bleached) corals are able to calcify? 2) If so, do they calcify more in the light than in the dark? And 3) do they maintain the daily rhythm of calcification? Our results elucidate whether light can directly enhance calcification and whether heterotrophy and coral energy stores are sufficient to sustain calcification in symbiont-free corals (at least in the short term). This knowledge will help to better understand how calcification rates will change in coral reefs under climate change.

O8-2 Oral Presentation

Establishing a Model Organism for Methanotrophic Endosymbionts of Bathymodiolus Mussels

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Keywords: Symbiosis, Methanotrophs, Bathymodiolus, Metabolomics, Model Organism

Bathymodiolus mussels live in the deep sea and rely on symbiotic bacteria which enable them to tap into chemical energy sources from hydrothermal vents or hydrocarbon seeps. Omics disciplines have granted us many insights into the intricate relationship of *Bathymodiolus* mussels and their symbiotic partners yet proving the derived hypotheses is challenging. There is a need for a system which allows manipulative experiments. Since there is no culture of the actual symbionts available, we turned to the free living species *Methyloprofundus sedimenti* which is cultivable. On first glance the lifestyle of an endosymbiont is very different, yet still there is a lot to learn from a comparative approach. By analyzing genomes of methanotrophic symbionts we could identify possible metabolic interactions with the host. Since these pathways are shared with *Methyloprofundus* it is possible to test these inferred traits by controlled incubation experiments followed by mass spectrometry-based analysis of the metabolome. This approach identifies possible substrates as well as excreted metabolites potentially available to the host. In the future we plan to identify metabolic markers linked to environmental conditions which would allow conclusions about the recent history of specimen from the deep sea based on metabolomics data.

O8-3 Oral Presentation

Physiological response of thiotrophic animal symbionts to oxygen

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Keywords: symbiosis, Stilbonematinae, chemoautotrophic bacteria, anoxia

Despite being globally distributed and potentially so abundant as to influence sediment geochemical cycles, we still do not know why marine nematodes (the *Stilbonematinae*) have the unique capacity among animals to engage in monospecific ectosymbioses, i.e. each nematode species is coated by a single phylotype of longitudinally dividing Gammaproteobacteria, *Candidatus* Thiosymbion. It has long been hypothesized that the symbionts associate with the nematodes to exploit their vertical migrations through the redox zone, that is to maximize sulfur-oxidation fueled chemosynthesis by alternatively accessing O_2 (e^- acceptor) in the upper sand and sulfide (e^- donor) in deep, anoxic sand. Here, to test this hypothesis, we analyzed the physiological response of *Ca.* Thiosymbion oneisti to oxygenated and reducing conditions by applying comparative transcriptomics, and a broad range of techniques including NanoSIMS, mass spectrometry and Raman spectroscopy. We show that, in anoxic relative to oxic conditions: (1) Sulfur oxidation and denitrification genes are upregulated together with respiratory chain complexes II, III and V (for ATP synthesis); (2) Intriguingly, chemosynthesis is downregulated; (3) Genes involved in, N fixation, urea uptake and utilization, as well as amino acids, vitamins and cofactor biosynthesis are downregulated; (4) Stress-related genes are downregulated. Based on these results, Ca. Thiosymbion appears to mostly oxidize sulfur when utilizing nitrate as an electron acceptor and, therefore, to optimally exploit O_2-depleted environments for ATP production. However, the energy derived from sulfur oxidation might not be exclusively channeled into chemosynthesis. On the other hand, in superficial sand, the symbiont could employ aerobic metabolism and exploit urea and symbiont diazotrophy for biosynthetic pathways. Collectively, our data suggests that the symbionts do not access superficial sand layers to maximize sulfur oxidation. Instead, we speculate that higher N availability in those upper layers would trigger vitamin, cofactors and amino acid biosynthesis.

O8-4 Oral Presentation – Invited Speaker

Promiscuous and yet selective: Gutless marine worms and their highly diverse microbial symbionts

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Keywords: Marine symbiosis, phylosymbiosis, annelids, chemosynthesis

During recent years, the acknowledgment of symbiosis as an essential player in an organism's ecology and evolution vastly increased, yet little is known about the assembly and maintenance of phylogenetically diverse symbiont communities. In our study, we aim to gain a deeper understanding of symbiont community compositions focusing on one group of marine annelid worms called "gutless oligochaetes". These worms lack a digestive system including not only the gut but also mouth, intestine, anus and additionally, excretory organs such as nephridia. Nevertheless, they flourish in shallow-water marine sediments around the world, gaining their nutrition from mutualistic bacterial symbionts that colonize the worms just below their cuticle. In the first step of our study, we described the phylogenetic diversity of gutless oligochaete symbionts across 178 host individuals, representing 40 different host species from 15 globally distributed sampling location. We identified 37 putative symbiont genera of which up to eight can co-occur in a single host individual. Secondly, we showed that vertical symbiont transmission via the maternal germline as well as biogeography of the hosts only partly explain the similarities and differences that we observe when comparing the symbiont community compositions of different species or different locations. In a third step, we aim to understand the influence of the host nuclear phylogeny on the symbiont community structure and in return understand the role of different symbionts for the diversification of the hosts. Our results provide a first global assessment of symbiont diversity in gutless oligochaetes and highlight the immense potential for symbiont variation even within highly defined, obligate symbiotic systems.

P8-1 Poster Presentation

Differential heat tolerance of corals in the Thai Andaman Sea

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Keywords: bleaching, heat stress, large-amplitude internal waves, temperature fluctuation, thermal tolerance

In recent years, heat waves have driven coral bleaching and unprecedented reef loss. It is suggested that corals living under naturally occurring temperature extremes and fluctuations have a higher stress tolerance. Understanding the survival mechanisms of such corals will be insightful for restoration efforts using 'assisted evolution' approaches that aim at enhancing coral resilience. Reefs in the Andaman Sea off the coast of Thailand are exposed to large-amplitude internal waves (LAIW), which cause remarkable fluctuations of temperature and other parameters. LAIW impact peaks from January-June, but is almost absent from August-January. A previous experiment has shown that during the LAIW peak, *Porites* corals from LAIW exposed reefs performed better under heat stress compared to their conspecifics from protected reefs. Following up on these findings our study investigated 1) whether this differential heat stress tolerance can be extrapolated to other coral species and 2) whether it is persistent throughout the year (e.g., during the absence of LAIW impact). We quantified the stress responses of two coral species, *Pocillopora spp.* and *Porites spp.,* in a high-throughput manner using short-term heat stress assays (24 - 48 h, acute heat stress of 34 °C). Coral fragments from exposed and protected reefs of Racha Island were tested during the two seasons. Measurements of bleaching score (tissue color tone) and photosynthetic efficiency of the dinoflagellate symbionts, demonstrated a milder heat stress response of fragments from the LAIW exposed site compared to those collected in the protected site. The magnitude of bleaching was similar between the coral species, but symbiont performance decreased stronger in *Pocillopora*. Results from the two seasons were consistent. Our study implies that various corals living under LAIW impact have a permanently higher heat tolerance. These results provide a starting point for further exploration of the mechanisms underlying this differential heat tolerance.

P8-2 Poster Presentation

Metabolic Classification of *Methyloprofundus sedimenti* strain WF-1: A Model Organism for Deep Sea Methanotrophic Symbiosis

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Keywords: *Bathymodiolus*, Metabolomics, GC-MS

Many marine organisms live in symbiosis with bacteria. The study of these symbionts is complicated by the lack of cultivation methods outside of the host. One way to work around this problem is to use free-living bacteria that are relatives of the symbionts as model organisms. In this project, we determined metabolic capabilities and physiological changes to the methanotrophic *Methyloprofundus sedimenti* strain WF-1. This free-living bacterium is identical (98% on 16S rRNA gene sequence) with symbiotic intracellular bacteria of *Bathymodiolus* deep-sea mussels. We first compared the genomic capability of both the symbiont and the free-living bacterium. Using mass spectrometry, we then investigated the potential utilization of amino sugars based on a comparison of metabolite quantification and growth. Our metabolomics characterization allowed us to follow up on previously reported observations of an increase in methanol concentration co-occuring with increased transcription of fatty acid desaturase. We tested cultures grown on methane or methanol, which are both environmentally available carbon sources near deep-sea vents, to investigate the effects of each on lipid composition. Assessment of metabolic pathways in WF-1 allows us to make inferences about the niche that endosymbiotic methanotrophs occupy in their deep-sea hosts. Vice versa, a characteristic lipid signature for different carbon sources may help to track environmental conditions for the symbionts. Continued metabolic classification paired with transcriptomics analyses will increase the suitability of WF-1 as a model organism for the understanding of the symbiosis.

Session 9

Climate Change as Seen from the Perspective of the Small: Plankton in a Changing Ocean

Call for Abstracts

Although some people are still in denial, climate change is real and it is happening now. Impacts on the marine environment are vast, including for instance rising sea temperatures and declining sea ice coverages. Plankton is ubiquitous in our oceans. It plays a key role in pelagic processes and directly or indirectly supports most of the marine life. To investigate how climate change is affecting small organisms of the sea is thus crucial to better understand the consequences on the whole ecosystem. This session invites you to share your research results on climate change and its effects on plankton communities.

Session chair

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O9-1 Oral Presentation

Impact of global change on phenotypic trait variability of the diatom *Thalassiosira weissflogii*: A single-cell level approach

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Keywords: multiple driver, food web dynamics, flow cytometry, phenotypic plasticity

As the base of the food web, phytoplankton are directly affected by changes in abiotic parameters and their functional traits, such as growth rate, cell size, and biochemical composition are key drivers of food web dynamics. Since these organisms depend on the phenotypic plasticity of every individual to cope with suboptimal conditions it is crucial to investigate the response of phytoplankton functional traits towards global change at the single-cell level. In this study, the impact of multiple drivers on functional traits of the diatom species *Thalassiosira weissflogii* was assessed. Temperature, CO_2 levels and nitrogen:phosphate (N:P) ratio were chosen based on Intergovernmental Panel on Climate Change (IPCC) predictions and on nutrient regime shifts expected for the end of the century: Ambient (ambient temperature and atmospheric pCO_2; 16 N:P ratio), B2 IPCC scenario (+1.5˚C and 800 ppm CO_2; 25 N:P ratio), and A2 IPCC scenario (+3˚C and 1000 ppm CO_2; 25 N:P ratio). Flow cytometry was used to examine changes in functional traits and intraspecific variability within a clonal culture. In the exponential growth phase, growth rate increased with temperature and pCO_2 whereas there was no significant effect of the initial N:P ratio. Interestingly, when diatom cells were in the stationary phase, the greatest variability in cell size within the population was seen in the ambient treatment. We also observed a correlation between cell size variability and growth rate, with a decrease in variability at higher growth rate, and a strengthening of this correlation by treatment intensity. Cellular lipid content, which was detected via Nile Red staining, decreased from exponential to stationary phase without any difference between treatments. Overall, the results of this study indicate that simultaneous changes in abiotic factors alter functional traits and phenotypic plasticity of diatom cells which may have important consequences for food web dynamics and ecosystem functioning.

O9-2 Oral Presentation

North Sea phytoplankton under global change, a multiple-driver mesocosm approach

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Keywords: phytoplankton communities, global change, North Sea, plankton ecology

Phytoplankton is a major contributor to the total primary production in the North Sea. Yet the structure and functioning of phytoplankton communities are threatened by environmental degradation. Ocean acidification, rising water temperature and changes in nutrient inputs into the North Sea are among the global change processes expected to have the most intense effect on phytoplankton communities in this region. Even though these impacts have been addressed by several studies, previous work have essentially focused on single stressor effects and single species responses. Here, we conducted a mesocosm experiment on North Sea natural phytoplankton communities during the autumn bloom of 2018. We manipulated multiple drivers simultaneously, according to RCP scenarios (Representative Concentration Pathway) developed by the Intergovernmental Panel on Climate Change (IPCC) combined with predicted shifts in N:P ratios: Ambient (ambient temperature and atmospheric ppm CO_2; 16 N:P), RCP 6.0 (+1.5˚C and 800 ppm CO_2; 25 N:P ratio), and RCP 8.5 (+3˚C and 1000 ppm CO_2; 25 N:P ratio). Our results show that phytoplankton autum bloom duration will be shorter under the environmental conditions predicted for 2100 by both scenarios. During bloom, the treatment RCP 8.5 scenario had low-to-moderate primary production and different community composition in comparison to the ambient. The experiment showed that impacts are directly linked to the intensity of environmental change as well. Overall, our work indicates that important shifts in traits and processes within phytoplankton communities are to be expected in the future, if global change mitigation actions do not achieve the goals intended by the 2016 Paris agreement.

O9-3 Oral Presentation

Drivers of long-term changes in ctenophores

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Keywords: Time-space dynamics, Marine Plankton, North Sea, regime shift

Jellyfish regulate abundance of zooplankton and thereby mediate major trophic flows in the marine food web. It's still debated to what extent jellyfish respond to strong pressures by human activities and anthropogenic climate change and how these responses feed-back on the ecosystem. We here investigate multi-scale dynamics in the ctenophore *Pleurobrachia pileus* that feeds on mesozooplankton, mainly copepods, and in turn is preyed on by another ctenophore *Beroe sp.* Changes in *P. pileus* are contrasted to potential drivers using the long-term high resolution time-series at Helgoland Roads. Our study confirms previous studies revealing a significant shift in ctenophore dynamics around 1987. We find that the seasonal cycle both in biomass and population structure is distinctively correlated with changes in temperature, salinity and nutrient levels. For example, winter nutrients correlate with average body size during the bloom; winter biomass increases with winter temperature. In most seasons, *P. pileus* biomass however poorly correlates with food availability. Along the trophic chain, predator-prey dynamics connect the state before and after the blooming period, serving as ecologic memory. Ongoing trait-based modeling of jellyfish dynamics will further inspect underlying mechanistic dependencies and will assess the changing role of jellyfish in coastal marine ecosystems.

O9-4 Oral Presentation

Temperature induced changes in fatty acid dynamics of tropical and temperate harpacticoid copepods

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Keywords: Climate change, Harpacticoid copepods, Fatty acids

Fatty acids, specifically the essential fatty acids (EFAs) such as EPA (20:5ω3), DHA (22:6ω3) and ARA (20:4ω6) are required for important physiological processes in all organisms. Primary producers and some primary consumers like harpacticoid copepods (Crustacea, Copepoda) are the only organisms capable of synthesizing EFAs. Harpacticoid copepods serve as energy vectors of EFAs to higher trophic levels. These copepods are important primary consumers and a major dietary component for organisms such as fish, crustaceans and mollusks. Environmental factors, for instance temperature, is a stressor that drives many physiological responses in organisms and also affects their fatty acid dynamics. In order to understand how global warming might affect EFA availability in the tropical and temperate regions, the tropical copepod *Canthocamptus* sp. (Ecuador) and the temperate copepod *Delavalia palustris* (The Netherlands) were each exposed to three different temperature treatments. The successful thermal acclimation of temperate copepods indicates that marine organisms from these regions could adapt better to global warming. The observed significant decrease of DHA, EPA and ARA in tropical copepods under thermal stress showed global warming can negatively affect EFA concentrations in tropical regions by shifting towards higher saturated fatty acid concentrations in order to compensate for higher metabolic demands. This decrease in EFAs can negatively affect the transfer of energy through the food web and has an impact on organisms at higher trophic levels such as crustaceans, mollusks and fish.

O9-5 Oral Presentation

Diversity and distribution of calanoid copepods in the southeastern Atlantic Ocean

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Keywords: Benguela Current, oxygen minimum zones, small calanoids, diel vertical migration, marine carbon cycle

Copepods play an important role in marine food webs due to their ubiquitous presence in all oceans. They substantially impact the particulate flux and energy transfer. With high-resolution taxonomic analyses we determined the community structure and diversity of calanoid copepods as well as the distribution of the diel vertical migrants in the open southeastern Atlantic Ocean. Zooplankton samples were collected along a transect during research cruise ANT XXIX/1 with RV *Polarstern* in November 2012. Vertical hauls (day and night) were carried out with a multi-net from 800 m to the surface, discrete sampling strata of 100 m each. A total of 102 calanoid species have been identified so far. Calanoid specimens dominated with 61% of the abundance, followed by cyclopoids (29%) and other zooplankton groups (11%). Generally, abundance and biomass of calanoids decreased with increasing depth, with a maximum of 392 ind m^{-3} and 12.1 mg DM m^{-3} for the daytime station. *Acartia* spp. were most abundant in surface layers, whereas *Microcalanus* spp. prevailed above 200 m. *Eucalanus hyalinus* was most important in terms of biomass in each layer but avoided oxygen concentrations below 60 µmol L^{-1}. In these oxygen minimum zones, *Pleuromamma robusta* was the dominant species. Day and night samples were compared to assess the active vertical biomass transport by copepods, their key species and roles in the marine carbon cycle. This study emphasizes the importance of high-resolution analyses as a tool to elucidate community structure in different marine ecosystems. In these habitats certain species may play distinctive roles, thereby affecting trophic interactions and export fluxes in different ways. Such studies reveal previously unknown dynamics of the system. This is essential if we want to find out how copepod communities and their key species will cope with changing environmental conditions and assess the consequences for the entire ecosystem.

O9-6 Oral Presentation

Food web structure and trophic interactions in the Humboldt Current Upwelling System off Peru

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Keywords: Zooplankton, fish production, isotope ratios, fatty acid analysis, anchovy

With a yield of 6.5 Mio. t in Peru and Chile in 2017, the Humboldt Current Upwelling System (HCS) is one of the most productive regions of the world´s oceans in terms of fishery. Fish production is six to ten times higher, compared to the other three Eastern Boundary Upwelling systems (EBUS), in spite of similar hydrographic regimes and comparable primary production rates. Despite the importance of the HCS in ecological and economical terms, little is known about the reasons for the outstanding fish production. Zooplankton is key interlinking phytoplankton with fish, but trophodynamics are not yet well understood and investigated. During the CUSCO (Coastal Upwelling System in a Changing Ocean) project research cruise with RV *Merian* in December/January 2018/2019 we collected numerous samples of dominant food-web components off Peru, especially zooplankton taxa. Via two complementary biomarker approaches (fatty acids, stable isotopes), we determined trophic positions and interactions of key zooplankton species within the HCS food web. We found regional differences in trophic levels of most organisms, with decreasing trophic levels towards the south of the investigation area (up to 2 trophic levels difference). Most copepod species inhabiting the upper water layers seem to occupy lower trophic levels compared to their pendants in the northern Benguela Current Upwelling System (BUS). For example, a mean trophic level of 2.4 was found for the key species *Calanus chilensis* while the corresponding species in the northern BUS, *Calanoides natalis*, exhibited a mean trophic level of 3. Lower trophic levels could possibly explain the higher trophic transfer efficiency in this system. Overall, the stable isotope ratios show that baseline values are essential to calculate appropriate trophic levels. These data contribute to a better understanding of the reasons behind the outstanding fishery yield in the HCS and may help secure its sustainable production.

O9-7 Oral Presentation

Euphausiids the intermediate link: bioindicators in the Eastern South Pacific

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Keywords Euphausiids, Fatty acids, Isotopes, carbon source, trophic position.

Euphausiids are small crustaceans that have a varied diet from herbivory to omnivory. These animals are widely distributed throughout the ocean and they are a key component in the food web of marine pelagic ecosystems because of their importance to transfer energy from primary producer to upper levels. To understand the feeding ecology and energy transfer the use of bioindicators like fatty acids and stable isotopic values of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) are widely used to reveal the interactions between the different groups in the trophic food webs. The aim of this study was to evaluate the composition of 1) fatty acids 2) carbon source ($\delta^{13}C$) and the trophic position ($\delta^{15}N$) in euphausiids along the transect (Caldera - Eastern Island) in the Eastern South Pacific. The samples were collected on the CIMAR 21 spring 2015. The isotopic values exhibit a variation in the carbon source along the transect, with an enrichment from the oceanic zone to the coastal zone. Due to the differences in the primary production, produced by the transition from a eutrophic zone to an oligotrophic zone, the results show that euphausiids have a tendency to omnivory, but in coastal sectors showed a preference for herbivory. This was confirmed by the PUFA/SAFA ratio and the trophic position values of *Euphausia mucronata* and *Stylocheiron* sp., decreasing from the coastal zone to the oceanic zone, with values from 2.7 – 2.4 and 3.5 - 1.5. These values show that *Stylocheiron* sp. has a wider trophic range than *Euphausia mucronate* and therefore, it can feed in a greater prey spectrum. This result shows the adequacy of euphausiids to the different conditions of the transect.

O9-8 Oral Presentation

What's on the menu for krill and salps? The protist community at the West Antarctic Peninsula

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Keywords: Phytoplankton, microzooplankton, high throughput sequencing, pigments, light microscopy

Although the WAP is the most studied region in Antarctica, there are still many gaps in our knowledge on planktonic food web dynamics, especially outside the summer season. Most existing studies focused on members of the classic Antarctic paradigm of a short diatom – krill – top predator food chain, although microbial processes have been shown to be a major pathway in the pelagic food web at the WAP. Microzooplankton, for instance, are dominant grazers in summer and potentially serve as important food source for macrozooplankton, such as krill, when large phytoplankton are less abundant. This link might gain importance as recent warming of surface waters at the WAP is associated with changes in phytoplankton community composition from large diatoms to small cryptophytes, while the dominance of key macrozooplankton grazers is shifting from krill to salps. To better understand and predict the consequences of such changes for the lower trophic food web, a comprehensive understanding of the protist community is imperative. We collected water samples at ten different stations and four different depths around the South Shetland Islands and the Antarctic Peninsula during a cruise in austral autumn (March - May 2018). The samples were analyzed using a broad range of tools, e.g. microscopy, pigment analysis, flow cytometry and high throughput sequencing. Furthermore, dissolved organic carbon and inorganic nutrients were measured in addition to a range of abiotic parameters. Preliminary results indicate significant differences in protist diversity and community composition among stations and sampling sites. While diversity increases with depth, temperature and dissolved nutrient concentrations seem to be important determinants for community composition. By providing a comprehensive picture of the protist distribution over depth and in space, this study will serve as groundwork for investigating the potential consequences of a shift from the predominant krill population to an increasing occurrence of salps.

P9-1 Poster Presentation

The effect of dust on phytoplankton communities of Nuevo Gulf

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Keywords: Wind storms, phytoplankton ecology, Patagonia, Biogeochemical cycles.

Atmospheric dust is a source of micro- and macronutrients to the ocean and plays an important role in shaping marine biogeochemical cycles and possibly in global climate by promoting CO_2 sequestration. Despite Patagonia being the major source of aeolian dust in the southern part of the Atlantic Ocean, responses of plankton communities to dust input have not yet been studied. The aim of our study is to determine the effect of Patagonian dust on coastal phytoplankton communities in field and experimental studies. Biweekly sampling was performed at a fixed station located in front of Puerto Madryn city in Nuevo Gulf to study the dynamics of phytoplankton communities influenced by atmospheric and oceanographic conditions of this coastal system. Additionally, a microcosm incubation was carried out in situ next to the sampling station during the summer period. The aim of the experiment was to determine the response of a natural phytoplankton community to the addition of dust collected during spring of 2018. It was run for 5 days with three treatments (in triplicates): control (without dust addition), low dust concentration ($Dust_L$, 0.2 mg/L) and high dust concentration ($Dust_H$, 1 mg/L). Changes in variables of nutrients (dissolved inorganic phosphorus, dissolved inorganic nitrogen and silicate), chlorophyll a and dissolved organic carbon (DOC) were measured over time. As preliminary results, highest concentrations of nitrate+nitrite and DOC were found in $Dust_H$ treatment, while $Dust_L$ treatment did not significantly differ from the control. $Dust_L$ showed higher concentrations of chlorophyll *a* than $Dust_H$ and the control treatment. As a brief discussion we estimate that atmospheric Patagonian dust adds dissolved macronutrients to the seawater, and there may be other processes as toxicity or grazing that could be negatively affecting the physiology of the phytoplankton community.

P9-2 Poster Presentation

Predicting DMS(P) production in a high carbon dioxide world. - Does algal carbon-utilization provide an answer?

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Keywords: Sulfur cycle, carbon uptake, polar algae, algal physiology, stable isotope incorporation

Climate change is considered a global threat to humankind in our current understanding. A region showing some of the largest measurable changes in surface-ocean temperature is the West Antarctic Peninsula (WAP). Increasing winter temperature of about 6 °C since 1951 has led to a 41 % decrease in mean sea ice cover over the past 50 years. The increasing levels of carbon dioxide result in a lower oceanic pH. It is uncertain how the ecosystem, especially the productive phytoplankton community of the Southern Ocean, will react to these major factors: sea ice retreat and ocean acidification. Here we present an outline of the planned experiments to investigate how the rising levels of CO_2 and the retreat of sea ice will impact the phytoplankton communities in the Southern Ocean. Especially, the physiological mechanisms underlying the sulfur and the carbon cycle will be studied in detail. The focus of the study is on the production of the algal metabolite dimethylsulfoniopropionate (DMSP), its potential coupling to algal carbon uptake mechanisms, and subsequently the production of the climate active gas dimethylsulfide (DMS). The study involves both controlled laboratory and field experiments at the WAP considering environmental factors as temperature, salinity, pH, and light. DMSP-production will be tracked using stable isotope addition experiments and analyzed by Proton Transfer Reaction Mass Spectrometry (PTR-MS) combined with Cavity Ring down spectroscopy to measure isotope ratios of total particulate organic carbon (POC). The carbon uptake mechanism will be studied using an isotopic disequilibrium technique. We hypothesize that the mechanisms that regulate DMSP production are related to the carbon-uptake mechanism of the algae involved. Our results will provide an insight into how the algal sulfur and carbon cycles are linked and how CO_2 and DMS concentrations will develop in the ocean and ultimately in the atmosphere under changing climate conditions.

P9-3 Poster Presentation

Death by downwelling: Changing phenology and larval transport drive wrong-way range shifts

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Keywords: benthic species, climate change, dispersal

Ocean warming has driven some marine species to migrate poleward or to deeper water, following the climate velocity to remain at tolerable temperatures. On the Northwest Atlantic continental shelf, however, many benthic invertebrates' ranges have unexpectedly shifted southward and into shallower, warmer water. We tested whether these "wrong-way" shifts could arise from warming-induced changes in spawning phenology coupled with larval transport. Results showed that larvae spawned earlier in the year encounter more downwelling-favorable winds and river discharge that drive transport onshore and down-shelf. Phenology and transport explained most observed range shifts, whereas climate velocity was a poor predictor. This study reveals a physical mechanism – "death by downwelling" – that counterintuitively pushes benthic species, including commercial shellfish, into warmer regions with higher mortality. These findings oppose trends observed in fish and challenge the generality that marine species are better than terrestrial species at following climate velocity.

P9-4 Poster Presentation

Assessing the role of Cnidaria and Ctenophora in the food web of the Humboldt Upwelling System

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Keywords: climate change, stable isotopes, trophic transfer efficiency, upwelling intensities

The Eastern Boundary Upwelling Systems belong to the most productive marine ecosystems and are probably influenced by climate change. The Humboldt Upwelling System (HUS) off Peru is the biggest of the four EBUS (Canaries, California, Benguela and Humboldt). Despite similar upwelling intensities and primary production rates the fishery yield of the HUS is 8-10 times higher than in other EBUS. This suggests a very efficient trophic transfer. It is unclear what effect climate change will have on the productivity and fishery yield of the HUS. To make a prediction the project CUSCO (Coastal Upwelling Systems in a Changing Ocean) aims at improving knowledge about the factors that determine productivity and trophic transfer efficiency and how they are influenced by upwelling intensities. Data and samples were collected on a cruise with RV Maria S. Merian in December/January 2018/19. During the cruise, large spatial differences in upwelling intensity were detected. The northern regions (8-12°S) were characterized by low upwelling intensities and relatively warm water. In the southern areas (12-16°S) of the Peruvian shelf, however, we encountered moderate upwelling conditions and cold surface water. Part of the CUSCO project is the identification of the food web structure. Gelatinous plankton are often dead ends in the food web and are competitors of small pelagic fish species. Different gelatinous species forming blooms in the northern and southern regions reflect different upwelling regimes. In my master thesis I investigate the abundance, biomass, biodiversity and species composition of Cnidaria and Ctenophora. Here I will present first data of the onshore/offshore and vertical distribution of these organisms. The numerical abundance of both Medusae and Siphonophora parts and species composition were variable along the onshore-offshore transect. To analyse trophic interactions, we are conducting stable isotope measurements of Cnidaria and Ctenophora.

P9-5 Poster Presentation

Assessing the role of anchovy larvae in the food web of the Humboldt Upwelling System

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Keywords: climate change, stable isotopes, trophic transfer efficiency, upwelling intensities

The Eastern Boundary Upwelling Systems (EBUS: Canaries, California, Benguela and Humboldt) belong to the most productive marine ecosystems and are probably influenced by climate change. The fishery yield of the Humboldt Upwelling System (HUS) off Peru is 8-10 times higher than in other EBUS despite similar primary production rates. This suggests a very efficient trophic transfer. The project CUSCO (Coastal Upwelling Systems in a Changing Ocean) aims at improving knowledge about the effect of upwelling intensities on the trophic transfer efficiency along the Peruvian coast. It is unclear how climate change will modify upwelling intensities. To understand the effect of climate change it is important to understand the factors that determine productivity and high trophic transfer efficiency. Here I will present my study design and first data from a cruise with the RV Maria S. Merian in December/January 2018/19. During the cruise, large spatial differences in upwelling intensity were detected. The northern regions (8-12˚S) were characterized by low upwelling intensities and relatively warm water. In the southern areas (12-16˚S) of the Peruvian shelf, however, we encountered moderate upwelling conditions and cold surface water. To analyze trophic interactions, we are conducting stable isotope measurements of anchovy larvae. The Peruvian anchovy, the economically most important fish species of the HUS, was found to have two separate spawning stocks, one in the north and one in the south of Peru, the boundary being 14˚S. First isotope results indicate notable regional differences in $d^{15}N$ values of anchovy larvae. Furthermore larvae in the south were smaller and also located closer to the coast than the ones in the north. These, in turn, suggest differences in the food web structure or different isotope baseline values related to regionally variable upwelling conditions.

Session 10

They are Among us – Marine Aliens on the Advance

Call for Abstracts

Invasive species set a large problem for ecosystems. The enormous amount of ships and their journeys lowered the barrier for alien species in the marine ecosystem. Different guidelines regarding the release of invasive species have been ratified over the world. After 1.5 years, new questions form: is the transport of invasive species decreasing? Do we need better tactics to succeed? Is it maybe already too late, and some ecosystems are unrepairable destroyed? Are new methods for the detection of invasive species invented? We hope with your research, questions can be answered and a new outlook on the future is gained.

Session chairs

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O10-1 Oral Presentation

Evaluating the risk of marine non-indigenous species dispersal by vessel hull fouling in the Galapagos Marine Reserve

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Keywords: automatic identification system (AIS), marine traffic, network analysis, marine spatial planning (MSP), wetted surface area

Marine traffic is the major factor driving marine non-indigenous species (NIS) dispersal, as they may hitchhike in ballast water tanks or attached to vessel hulls. The Galapagos National Park banned ballast water discharge in the Galapagos Marine Reserve (GMR) and made it obligatory to perform regularly hull cleanings and the application antifouling paint. Yet, there are registered marine NIS in the GMR and annual tourist numbers grow every year resulting in a higher risk for new NIS arrivals. This study quantifies the dispersal capacity of marine NIS into and within the GMR on a vessel-resolution. We used a data set of ship movements and vessel characteristics derived from the automatic identification system (AIS) from 2013 to 2016. We used it to develop a marine traffic network for the GMR consisting of nodes (moorings and anchorages) and edges (ship routes). We gathered vessel characteristics and computed vessel-specific wetted surface areas (WSA), a measure for the part of the hull below the water line and a proxy for the ship's dispersal capacity. Monthly aggregates of WSA for each edge served as basis for a mathematical model, which quantified the risk of NIS being transported by hull fouling. We detected 14 first-destinations of vessels arriving in the GMR and identified the 4 ports of Galapagos as the main marine traffic hubs. Vessel number was highest in spring due to private yachts. Furthermore, edge removals revealed essential ship routes for the overall marine traffic connectivity that, if removed, would lower the dispersal capacity of the GMR. These findings imply clear and effective management recommendations for the Galapagos National Park to curb the spread of marine NIS. This is the first study to combine AIS and WSA data to assess the risk of NIS dispersal.

O10-2 Oral Presentation

Otolith shape analysis (OSA) as a tool for population identification of invasive lionfish (Pterois volitans) in the Colombian Caribbean

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Keywords: Otolith shape analysis, invasive lionfish, population structure, Colombian Caribbean

Marine invasions are known as a threat to biodiversity since they can modify the ecology of a region by changing processes, dynamics and composition of a native community. Two marine species are known to be the first marine invasive species in the western north Atlantic, *Pterois volitans* and *P. miles*, their common name is Lionfish, a carnivorous fish native to the Indo-Pacific. Not much about population structure of the invasive species is known, specialy in the southern invaded part. Otolith shape analysis (OSA) is a tool that can help to delineate fish stocks, characterize population movements and detect the natal origin of fish. Therefore, Lionfish samples were obtained in three departments of the Colombian Caribbean: Bolivar, Magdalena and San Andrés. Otoliths of each fish were removed and cleaned, and then photographed with a microstereoscope. Three shape indices and wavelet transform coefficients were obtained with the help of the R package ShapeR, thus shapes were compared among sites. A total of 253 lionfish otoliths from the three locations were analyzed. The shape indices showed some differences in the form factor and roundness of the otolith but they were not significant ($p = 0.4192$; $p = 0.076$), in contrast, Rectangularity was statistically different among the three sites, a post hoc test revealed that the differences were only between San Andrés and Bolivar ($p = 0.034$). With respect of the wavelet coefficients, the Canonical analysis of principal coordinates (CAP) showed variability of the otolith shape in the three sampled sites, which was statistically significant (95%). Finally, the cross-validation estimation of the classifiers success rate based on Linear discriminant analysis for all the three populations was of 62.45%, which is a relatively good success rate based on three sites. It is concluded that the populations of the three sampled sites are diferent based on OSA.

O10-3 Oral Presentation

Better in the cold – temperature effects on a new potential ecosystem engineer in the North Sea

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Keywords: temperature adaptation, invasive seaweed, cold tolerance, growth rate, biochemical composition.

The kelp *Undaria pinnatifida* is of high economic importance in its native range but critically observed as an invasive species worldwide. Its northern distributional limit in continental Europe is currently at Sylt, Germany at 54˚47′ latitude. In contrast to seasonal growth in aquaculture, the population in Northern Germany persists almost year round, likely due to the differences in temperature regime. To characterize this population and assess its potential for further northward migration, sporophytes were bred by selfing gametophyte cultures of the German population and a Chinese cultivar, respectively. The juvenile plants were exposed to a range of experimental temperature (4, 8, 12, 16˚C) for the duration of 12 days. At the beginning and end biomass, size and appearance were recorded, and biochemical analyses performed. Both German and Chinese sporophytes performed best at 8 to 12˚C. Both isolates grew much less at 4˚C and disintegrated at 16˚C before the end of the experiment. While the Chinese culture had a slightly higher increase in biomass and length at 8-16˚C, the German sporophytes grew more than twice as fast than the Chinese at 4˚C. None of the experimental conditions affected the biochemical performance negatively. The overall results indicate that the German *U. pinnatifida* population is already better adapted to colder temperatures than the Chinese cultivar it was compared to. This could support its future spread to colder regions in northern Europe. Furthermore, the German strain might be of economic interest for breeding of cold tolerant cultivars.

P10-1 Poster Presentation

Mechanisms underlying predator-driven biotic resistance against introduced barnacles on the Pacific coast of Hokkaido, Japan

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Keywords: biological invasions, predation, predator nonconsumptive effects, *Balanus Balanus glandula,* recruitment

Introduced species are a major threat to marine coastlines worldwide. Therefore, understanding biotic resistance (i.e. the ability of native species to limit introduced species), is a central goal of invasion biology. On the Pacific coast of Hokkaido, biotic resistance by native predatory dogwhelks (*Nucella lima*) limits introduced barnacles (*Balanus glandula*). Thus, we examined mechanisms underlying this predator-driven biotic resistance. Consumption by native predators can limit introduced prey given that these predators prefer such prey. Also, predator nonconsumptive effects (NCEs), that are mediated through predator-released waterborne cues perceived by prey, can limit prey recruitment, a key demographic process that is essential for prey population establishment. However, information on predator NCEs on recruitment in introduced prey is missing. Thus, we experimentally examined dogwhelk feeding preferences for barnacles in the lab and dogwhelk NCEs on barnacle recruitment in the field. We found that *N. lima* preferred *B. glandula* over the native barnacle *Chthamalus dalli*, likely as *B. glandula* is the more profitable prey, as suggested by previous findings in congeneric dogwhelks (*N. emarginata*, *N. lamellosa*) on the Pacific coast of North America. Moreover, we found that *N. lima* NCEs limited recruit density in *B. glandula* and *C. dalli*, presumably as barnacle larvae moved away from dogwhelk cues to reduce future risk of predation. Thereby, our study suggests that predator feeding preferences for prey and predator nonconsumptive limitation of prey recruitment are two mechanisms that can contribute to predator-driven biotic resistance against introduced prey. As *B. glandula* has recently been introduced to the European Atlantic coast, we propose to monitor whether biotic resistance by native predators, such as Atlantic dogwhelks (*N. lapillus*), can limit the anticipated *B. glandula* spread.

Session 11

The Recording Structures of Marine Animals

Call for Abstracts

For centuries, marine biological studies were limited by the complexity or even the impossibility of examining animals in their natural environment. To a significant extent, this has changed with the development of disciplines related to the study of recording structures. Hard structures such as; calcareous skeletons of corals, mollusk shells, cephalopod beaks, fish scales and even mammalian teeth hold an innumerable amount of information on an individual's life history and the biology of the species. At this theme session, we welcome researchers who use recording structures to study a species biology using such methods as sclerochronology, shape and chemical analysis.

Session chairs

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O11-1 Oral Presentation

What does it mean? The ambiguity of the hard structures' terminology

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Keywords: recording structures, terms, sclerochronology, misinterpretation

Recording structures represent a powerful and reliable tool used in a wide variety of studies. Shells, bones and beaks have been used in the taxonomy studies for hundreds of years, nowadays such structures as otoliths and statoliths, scales, rays have found their application in sclerochronology. Every year new recording structures are added to the list of tools used in studies of trace element accumulation. However, despite (or even thanks to) such a variety of application methods definition of recording structures terms is quite ambiguous. In particular, some traditionally used terms don't correctly reflect the meaning of the structures or processes to which they are applied. the most pronounced example of this issue is such terms as 'hard structures' or 'growth rings'. In fact, in cephalopods, for example, the actual number of hard structures are significantly greater than the number of structures bearing relevant life history data. Growth rings, in turn, are not rings at all, in most cases representing bands or complex geometric structures instead. In some other cases, terms are so wide and unclear that their utilization leads to misinterpretation of the whole study. The typical example of this issue is the application of the term 'age' to the definition of the increments number. Often, the increments form on a regular basis (daily, seasonally or annually), however, increment deposition is greatly affected by the metabolic rates of animal and environmental factors. Thus, the application of the term 'age' to the growth increments in animals living in harsh conditions may result in over or underestimation of their age. In the framework of the current presentation, we would like to discuss these and other pronounced issues in the field of terminology and suggest some ways for their correction.

O11-2 **Oral Presentation – Invited Speaker**

From shellfish to South Georgia: Utilizing sclerochronology of age registering structures to inform fisheries management

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Keywords: Fisheries Management, Statolith, Otolith, Toothfish, common whelk, Geochemistry

The ability of fisheries scientists to estimate the individual age, growth rate and longevity of commercially important species is the keystone of many stock assessments and management strategies. The use of calcified hard structures such as otoliths (fin fish), statoliths (squid, gastropods) and shells (mollusks) often allows the reconstruction of growth on an annual and sometimes daily periodicity. Use of these structures for fisheries management has been present in all of the work I have undertaken since finishing my undergraduate in 2011. In this talk I will outline my PhD which focused on fisheries for whelk, *Buccinum undatum*, which have experienced a dramatic expansion over the last 20 years, often without informed management in place. My work validated the annual growth rings in whelk statoliths using a combination of laboratory and geochemical analyses, which has allowed accurate estimates of age and growth to be developed for this species for the first time. This has led to more informed management in many fisheries across the UK. I will also discuss my current role as fisheries ecologist at the British Antarctic Survey where I oversee the ageing program for Patagonian toothfish (*Dissostichus eleginoides*) around the Sub-Antarctic island of South Georgia. The management of this fishery, of which age determination forms an integral part, is world renowned and as such it is accredited as sustainable by the MSC. We are currently using geochemistry and sclerochronology to improve our understanding of spatial and depth migration behavior and environmental drivers of growth, the preliminary results of which I will discuss in this presentation.

O11-3 Oral Presentation

Can statolith outlines be used to distinguish between squid populations? A case study using the Patagonian long-finned squid (*Doryteuthis gahi*)

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Keywords: Wavelet, shape, taxonomy, image analysis, cephalopod

Recently, analysis of population genetic structure in *Doryteuthis gahi* has identified two divergent groups within its species range; one group originating from Peru and the other from Chile and the Falkland Islands. Inconsistencies in the teeth on the sucker rings of the tentacular club have been found between the original taxonomic description and the Peruvian group, prompting an investigation into differences between the two groups which appear largely separate. The effectiveness of statolith shape for identifying among populations of *D. gahi* from Peru and the Falkland Islands was investigated. Statolith shape was characterised using shape indices and discrete Wavelet transform, corrected for mantle length before being analysed using multivariate methods. Linear discriminant analysis (LDA) indicated an overall correct classification rate to geographic region of 87.6%. The Falkland Islands population was characterised by a groove between the lateral and dorsal dome and a larger size. The Peruvian population's statoliths were flat between the lateral and dorsal dome with a prominent medial fissure. Potential reasons for the observed differences from a genetic and environmental perspective are discussed. It is recommended that a holistic approach combining several techniques for stock discrimination is used in such situations to provide greater insight into stock structure and the mechanisms that underlie it.

P11-1 Poster Presentation

First approach to the estimation of *Octopus insularis*' age and growth in the Veracruz Reef System (southwestern Gulf of Mexico)

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Keywords: Cephalopod; *Octopus insularis;* age estimation; growth; stylet analysis

Octopus insularis is the main target species of the artisanal octopus fisheries from the tropical western Atlantic. Age and growth of *O. insularis* were estimated for the first time by examining stylets of 127 specimens (70 males, 57 females) collected in the Veracruz Reef System (southwestern Gulf of Mexico), between December 2017 and October 2018. So far, 53 stylets have been processed. Among these, 17 (32%) were discarded for reading due to morphological imperfections that made ring count impossible. Reading of the remaining 36 stylets produced C. V. values lower than 10% and therefore, were considered valid. Females ranged in age from 163 days (5.4 months) to a maximum of 493 days (16.4 months), corresponding to weights of 280 g to 2028 g. Males ranged in age from 153 days (5.1 months) to a maximum of 430 days (14.3 months), corresponding to weights of 379 g to 1313 g. Maximum and minimum values derived from the readings were 493 and 153 rings, respectively. Assuming a relationship 1 ring = 1 day, these values correspond to 16.4 months (= 1.36 years) and 5.1 months respectively. Our results indicate that under favorable conditions the life cycle of *Octopus insularis* within the Veracruz Reef System lasts around a year. Back calculation of hatching dates showed that spawning occurred throughout the year although the maximum activity was estimated to occur during the summer months. These results are very useful for management purposes given the socioeconomic importance of this species in the study area.

P11-2 Poster Presentation

Age and growth of the bigfin reef squid, *Sepioteuthis lessoniana* in the waters of the Nha Trang Bay, Vietnam

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Keywords: *Sepioteuthis lessoniana*, statoliths, age estimation, life history

Sepioteuthis lessoniana is among the most important commercially exploited species in Vietnamese waters. In the waters of the Nha Trang Bay, squid is fished all year round, supporting a well-developed artisanal fishery. However, the data on the life history of the squid in the area is very scarce. The current study aims to fill this gap. Sampling was performed in the Nha Trang Bay in April-May of 2019. In total 85 specimens were studied. Sampling included measurement, weighting, sex and maturity determination and collection of statoliths for age estimation. During the study period, squid aggregation was represented by maturing and mature females and developing and maturing males. Female size ranged from 108 to 209 mm, male size - from 93 to 326 mm. Weight - from 94 to 645 g and from 63 to 1231 g, respectively. Age of males ranged from 70 to 159 days, age of females - from 70 to 151 days. Our observations showed that hatching of both males and females occurred from November 2018 to March 2019, which means that spawning of the studied group of *S. lessoniana* occurs from November to February. Growth of squid was reconstructed using the Gompertz model. According to the model, average daily growth of males in the first 50 days of life is 1,22 mm/day, then, in the following 50 days it rises to 1,59 mm/day, from 101 to 150 days it decreases to 0,99 mm/day and in the last 50 days drops to 0,46 mm/day. In turn, the daily growth of females using the same time segments changes from 1,9 mm/day to 1,24 mm/day, then to 0,24 mm/day and finally to 0,04 mm/day. Considering our findings, squid stock in the area of the Nha Trang Bay could be represented by two successive cohorts with the spawning peaks in July and November.

P11-3 Poster Presentation

Statolith shape as the tool for taxonomic identification of Loliginid squids in Vietnamese waters

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Keywords: statoliths, geometric morphology, *Sepioteuthis lessoniana, Uroteuthis (Photololigo) chinensis, Uroteuthis (Photololigo) sibogae*

Statolith shape is believed to be a useful tool for cephalopod stock separation. To date, this approach was applied mainly to species which live in temperate waters which have relatively stable statolith shapes. Unlike them, statoliths of squids inhabiting tropical waters often have distorted shapes with outlines interrupted by numerous aberrations. This study represents an analysis of statoliths shapes of tropical loliginid squids belonging to different genera and species in order to test their utility as identification tools. Sample of 85 individuals of *Sepioteuthis lessoniana*, 48 individuals of *Uroteuthis (Photololigo) chinensis*, 49 individuals of *Uroteuthis (Photololigo) sibogae* and 23 individuals of *Uroteuthis sp.* was collected in the waters of Nha Trang Bay in April-May 2019. Squids were identified following the large-scale morphological traits. Their statoliths were collected as part of the standard sampling, then their shapes were analyzed using elliptic Fourier approximation. Discriminant analysis based on the obtained harmonic values allowed identification of squids at the genera level with arelatively high accuracy (93,7% of correct classifications). At the same time at the species level discriminatory power was significantly lower. The average level of correct classification within the genus Uroteuthis was 79%, with the highest level of correct identification in *Uroteuthis (Photololigo) sibogae* (85,7%) and the lowest in *Uroteuthis sp.* (60%). A separate analysis of the clearly identified squids of the genus *Uroteuthis (Photololigo)* allowed for more accurate classification. In this case, the average level of correct classification was 89,7 %, ranging from 87,5 % in *U. (P.) chinensis* to 91,8 % in *U. (P.) sibogae*. Thus, the statolith shape was confirmed to be a useful tool for identification of tropical squid species. At the same time analysis of the statolith shapes of *Uroteuthis sp.* showed that this sample represents a mix of individuals belonging to species *U. (P.) chinensis* and *U. (P.) sibogae.*

Session 12

Functions of Tropical Marine Ecosystems under Environmental Change

Call for Abstracts

Shallow-water tropical marine ecosystems such as coral reefs, mangrove forests, and seagrass beds provide a range of important services. These ecosystems are often affected by environmental change including ocean warming, acidification, eutrophication, and overfishing. The investigation of their functions (e.g. productivity, calcification, nutrient cycling, and associated biodiversity) is of paramount interest for conservation and management, but a holistic understanding is still missing. Thus, we invite researchers from all disciplines working on these ecosystems and/or topics to send us their abstracts and discuss their findings in our session with us.

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O12-1 Oral Presentation – Invited Speaker

Coral and Reef Ecosystem Functioning: Integrating the Prokaryotic Perspective

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Keywords: Coral holobiont, symbiosis, microbial traits, nitrogen fixation, *Endozoicomonas*

Identifying the potentially diverse microbial functions underlying metabolic interactions within the coral holobiont is paramount for a complete understanding of coral reef ecosystem functioning. In this light, the importance of the nutrient exchange symbiosis between reef-building corals and their dinoflagellate symbionts (Symbiodiniaceae) has been investigated for decades. In contrast, the relationship between corals and their prokaryotic associates (Bacteria and Archaea) has shifted into the center of attention only recently. The advent of high throughput Sequencing tools has allowed to comprehensively characterize coral-associated bacterial diversity, community structure, and dynamics under environmental fluctuation and stress. In contrast, studies targeting prokaryotic metabolism in corals are only slowly getting traction due to the inherent challenges of working with corals. Thanks to recent research efforts, prokaryotic functional groups and taxa are emerging as potential corner stones of coral microbiomes. In this talk I will present recent advances in understanding coral-associated nitrogen fixation as well as my current explorative work on the role of the enigmatic bacterium *Endozoicomonas* isolated from the Red Sea coral *Acropora humilis*. Integrating these functional contributions of prokaryotes will not only advance our understanding of coral reefs on the holobiont, but also on the ecosystem level.

O12-2 **Oral Presentation**

Assessment of water quality in the lower Nyong estuary (Cameroon, Atlantic Coast) from environmental variables and phytoplankton communities' composition

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Keywords: Quality assessment, Nyong estuary, environmental variables, phytoplankton, water quality index

The aim of this study was to provide a first-hand water quality assessment of the River Nyong estuary, Southern Atlantic coast of Cameroon. Environmental variables and phytoplankton communities were monitored at four surface stations in the estuary for 2 season cycles from 2014 to 2015. A total of 208 species of phytoplankton, belonging to five (5) groups of microalgae, were identified. The Shannon- Weaver diversity index showed a qualitative seasonal difference in composition of the phytoplankton community. Dissolved nutrients (nitrogen and phosphorus) values showed seasonal fluctuations throughout the sampling period. A ratio N/P appeared high (42.78) in the rainy season and low (5.89) in the dry season, two values corresponding to the change in specific richness (high and low respectively during the major rainy season and the small dry season). The Water Quality Index (WQI) showed that water quality fluctuates from good to bad, in conjunction with biological indicators (Shannon-Weaver, Abundance and Specific richness).

O12-3 Oral Presentation

Intestine flexibility in coral reef fishes in response to changing environmental conditions

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Keywords: Adaptive variation, Diet, Functional traits, Gut morphology, Phenotypic flexibility

Phenotypic flexibility is advantageous for organisms living in variable environments. The alimentary tract is particularly flexible, responding to changes in diet quality and quantity, and allowing organisms to adapt to changing environmental conditions. Intestine size reflects a balance between the benefits in terms of nutrients and energy acquisition, and the energetic cost of its maintenance, and it can be influenced by diet and evolutionary processes. We assessed the relative contribution of phylogeny, body size, trophic status and spatial variability (as a proxy of morphological flexibility) in determining intestine morphological traits of coral reef fishes. We collected 1,060 individuals belonging to 140 species and 34 families in three locations in French Polynesia (Moorea, Tetiaroa and Mangareva) spanning large environmental gradients. We measured the length and diameter of the intestine and we estimated the outer surface of the intestine (as a proxy of mucosal surface area). Results of Bayesian phylogenetic multilevel analysis showed that phylogeny, body size and trophic level are all important descriptors of variation in intestine morphology. Intestine size varied markedly across the phylogenetic tree, with increases in length and/or diameter occurring in parallel across different lineages. All traits were positively related to body size and inversely related to trophic level. Moreover, spatial variation influenced intestine morphology in several species after accounting for all other effects. Intraspecific variation was mostly due to differences, in one or more intestine traits, between Mangareva and the other two locations. Mangareva has very different environmental characteristics and a lower fishing impact compared to Tetiaroa and especially to Moorea, which most likely affects trophic dynamics and, ultimately, intestine morphology. This highlights that several fish species, belonging to different trophic groups, may be able to adapt to varying environmental conditions, an important fact in the face of future environmental changes.

O12-4 Oral Presentation

Benthic community changes under herbivore exclusion at Los Cóbanos, El Salvador

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Keywords: Eastern Tropical Pacific, exclusion experiment

The Eastern Tropical Pacific (ETP) is one of the most isolated and least studied regions in the world. Little is known about the benthic community composition and functioning of its reefs and most importantly about the anthropogenic impacts on these ecosystems. This particularly applies to the coast of El Salvador. The present study, therefore, described the benthic community of the former coral reef Los Cóbanos, El Salvador, using the Line-Point-Intercept-Transect method and investigated the benthic community development under complete herbivore absence using exclusion cages over a period of seven weeks. Results showed high algae benthic cover (up to 98 %), dominated by turf and green algae, and low coral cover (0 - 4 %). *Porites lobata* was the only hermatypic coral species found during the surveys. Surprisingly, the complete exclusion of herbivores caused a rapid increase of crustose coralline algae (CCA) by 82 % and a decrease of turf algae benthic cover by 57 % relative to controls. This contradicts findings of previous similar studies. These drastic community changes were apparently caused by the exclusion of key grazing species (e.g. *Stegastes acapulcoensis*) that control growth of crustose coralline algae and their potentially inhibiting effects on turf algae. Further research should include experimental manipulations of the physical factors affecting the reef (in particular sedimentation) and video surveys of feeding behavior of the marine fauna at Los Cóbanos. This study, however, provides for the first time information on the benthic community interactions and possible biodiversity functional traits at the reef Los Cóbanos, El Salvador.

O12-5 Oral Presentation

Distribution of Soft Corals in the Egyptian Coasts of the Red Sea and Gulf of Aqaba

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Keywords: Soft Coral, Ecology, Biodiversity, Red Sea, Conservation

The Red Sea is a resource-rich area with a distinctive coral reef ecosystem where soft corals represent the most diverse species. Knowledge about soft coral biodiversity and its distribution in the Egyptian coast of the Red Sea and Gulf of Aqaba is limited, so this study aimed to elucidate soft coral distribution and abundance in these areas. Eight sites along these areas were surveyed using transect of 25-meter length using the point intercept transect (PIT) method in three depths: (from 0 to 5m), (from 5 to 10m) and (from 10 to 15m) at all sites during summer 2015 and only two sites; Lighthouse and Marsa Egla, were additionally surveyed in winter. Eleven genera belong to three families were recorded. Of them the five gener0a (*Sinularia, Sarcophyton, Lobophytum, Nephthea* and *Xenia*) were considered the most common at all selected sites. Although *Xenia* was the most abundant genus at the Gulf of Aqaba area (112 ind. trans.$^{-1}$), *Sinularia* was the common genus at the Red Sea area (71 ind. trans.$^{-1}$), on the other hand, *Lobophytum* showed the rare genus in this study. It was very cleared that the diversity and abundance of soft corals decreased from north to south. This might be due to topography of the Red Sea and the increase of human impacts.

O12-6 Oral Presentation

Corals exhibit physiologically mediated species-specific responses to ocean acidification

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Keywords: coral reefs, ocean acidification, reef-building corals, species-specific, ecophysiology

Coral reefs are widely regarded as one of the most vulnerable marine ecosystems to ocean acidification (OA). Particularly reef-building corals, which provide essential reef structure, are impacted by OA. Among reef-building corals, some species have been characterised as more susceptible to OA than others. However, such comparative analyses generally encompass distantly related species and are commonly based solely on the coral calcifying response. Yet, others aspects of coral physiology may also be affected. The present study investigated the response of corals to control (pH 7.9) and reduced pH (pH 7.7) by assessing a broad set of physiological parameters of six coral species from three genera: *Porites cylindrica, Porites lutea, Acropora humilis, Acropora millepora, Pocillopora damicornis* and *Pocillopora verrucosa*. Overall, we found that all species were affected by the OA treatment. Interestingly, the coral response to OA was species-specific, potentially even among closely related species, with different underlying physiological processes driving this response. These differences were present among closely related taxa for *Porites*, but not for *Acropora* or *Pocillopora*. Specifically, acidification induced a greater reduction in volume growth in *P. lutea*, whereas no large changes were found in *P. cylindrica*. In *Acropora*, enhanced apoptotic activity constituted the main physiological change. Whereas in *Pocillopora*, main changes were found as decreased surface area growth. Thus, this study furthers the current knowledge on the species-specific susceptibility of corals to OA. Understanding the full landscape of physiological impacts on coral species will inform on how OA may shape the species composition of future coral reef communities.

O12-7 Oral Presentation

Coral sensitivity to iron enrichment: how ecotoxicological assays can tell us about species distribution in the reef

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Keywords: Gulf of Aqaba, heavy metal pollution, iron

Coral reefs play a very important role as complex ecosystems, hosting about 25% of all marine organisms. In the last few decades, reefs around the world have been experiencing net decline, mainly as a result of elevation of seawater temperatures and ocean acidification. In some specific locations however, corals are displaying signs of resilience. The Gulf of Aqaba (GoA) hosts such corals and is now considered a coral refuge. Land-based pollution is yet threatening such resilient corals, especially in a context of rapid coastal development, as for example in the GoA. Heavy metal pollution has been extensively studied for its adverse effects on corals, and it was observed that soft corals can withstand higher concentrations of pollutants than hard corals. Iron (Fe) is an important micronutrient crucial to maintain photosynthesis and anti-oxidant defence mechanisms. However, when in excess, its high reactivity can also lead to reduction of primary production. This study reports the impact of Fe on four common coral species from the Red Sea, two scleractinian branching corals *Stylophora pistillata* and *Acropora spp.*, and two soft corals *Litophyton arboreum* and *Dendronephthya hemprechi*. Corals were exposed to10µg L^{-1} of $FeCl_3$ for up to 24 days, and physiological parameters were assessed at different time intervals (0, 4, 7, 14, 24 days). Results show a net impact of Fe enrichment on the photosystem performance of each coral, especially for *Litophyton* (Fv/Fm, rETRmax, alpha and iK), as well as a significant decrease of *Symbiodinium* density and chlorophyll in *Stylophora*. These results contradict the patterns observed in the natural environment in polluted sites of equivalent dissolved iron concentration, with higher abundance of soft corals. Studying additional stress related parameters on a longer period of time would be necessary to understand the sensitivity of each coral species to Fe.

O12-8 Oral Presentation

Ecological responses of *Xenia umbellata* to organic eutrophication and ocean warming

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Keywords: Phase shifts, Soft corals, Pulsation rates, Growth rates, Glucose addition

Recent research in coral reefs indicates that hard corals in a process that is termed phase shift are often replaced by soft corals. The simultaneous occurrence of global (i.e. ocean warming) and local factors (i.e. organic eutrophication as highly under-investigated parameter) may facilitate these phase shifts as we know that hard corals are negatively affected by both ocean warming and organic eutrophication. Despite decades of research, knowledge about soft corals remains incomplete, although these organisms are becoming important players in reefs. The present bachelor thesis investigated the individual and combined effect of organic eutrophication (glucose addition) and warming on the ecophysiology of the pulsating soft coral *Xenia umbellata*. Using ecological methods, I observed and quantified the health status, growth, and pulsation rates of soft corals in a 45 days aquarium experiment. Findings revealed that exclusive DOC exposure did not affect health status, growth or pulsation rates. Under simulated ocean warming soft corals, had experienced organic eutrophication before, maintained significantly higher pulsation rates and health status compared to the controls that showed a decrease of 56 % in pulsation rates and an increased mortality by 30 %. The apparently positive effect of organic eutrophication on the ecophysiology of soft corals under an ocean warming scenario decreased with increasing organic eutrophication. This study indicates that a) organic eutrophication as additional energy source may increase the resilience of soft corals to ocean warming and b) pulsation rates may be used as inexpensive, easily detectable, and non-invasive early warning indicator for ocean warming effects on benthic communities. When comparing findings of this study with previous results for hard corals, I can assume that soft corals under the predicted increases of organic eutrophication and warming gain more and more competitive advantages. This may further facilitate phase shifts from hard to soft corals in disturbed reefs.

O12-9 Oral Presentation

Effect of organic eutrophication and ocean warming on the ecophysiology of the gorgonian *Pseudopteurogorgia americana*

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Keywords: coral reefs, gorgonians, ecophysiology, eutrophication, climate change

Eco-engineering organisms, as corals, carry out a fundamental role for the functioning of reef ecosystems that strongly rely on the coral-microalgae-microbiome (holobiont) relationship. Nowadays, scientific studies agree that anthropogenic local organic eutrophication and global warming are associated with the coral reefs decline. Nevertheless, a holistic understanding of their combination still need to be fully understood. Furthermore, despite octocorals are likely becoming key players in future reef communities, they are still highly under-investigated. For Thus, the individual and combined effects of organic eutrophication and ocean warming on the gorgonian *Pseudopterogorgia americana* ecophysiology has been investigated. Different manipulated environmental scenarios have been simulated and the relative oxygen fluxes variation, for respiration and photosynthesis activities, over time has been calculated. Results show that, the individual effect of DOC enrichment, negatively affected the coral holobiont. The respiration and photosynthesis activity were 36% and 25% respectively lower compared to controls. After the first manipulation, the water temperature has been raised following a step-wise increasing until 32˚C. Then, the individual temperature and the combined treatment have been possible to test. The colonies treated with only temperature showed a decreasing of respiration rate of 30% and photosynthesis rate of 10% related to controls. Ultimately, the crossed treatment resulted in a strong effect on respiration and photosynthesis activity, with decreasing rate of 45% and 80% respectively compared to controls. These evidences suggest that, individual factors can have significant impact on the ecophysiology of the model organism *P. amaericana* but also that an enriched DOC environment can potentially increase the susceptibility of soft corals to global warming. In the end, this study provides (I) scientific elements on the impact of local and global activities on important key organisms and (II) information for a local land management as well as global conservation and monitoring plans to mitigate coral reefs degradation.

O12-10 Oral Presentation

Unravelling the links between heat stress, bleaching and disease: fate of tabular corals following a combined disease and bleaching event

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Keywords: Coral reefs, Coral bleaching, Coral disease, Climate change, Heat stress, Ecosystem functions

In the Anthropocene, marine heatwaves are predicted to increase in frequency and severity impacting coral reef ecosystems. While links between heat stress and coral bleaching are well described, links between heat stress and outbreaks of coral diseases are less well understood. In this study, the effects of accumulated heat stress on 100 tagged *A. hyacinthus hyacinthus* (Dana, 1846) colonies at Beaver Reef (central Great Barrier Reef) were repeatedly monitored over the 2017 austral summer. Documenting coral tissue loss and mortality due to to a thermal anomaly causing coral bleaching and disease. Overall, coral cover on Beaver Reef was reduced by more than half to 31.0 ± 11.2%. Heat stress peaked at 8.3 ˚C-weeks on 31 31 March, which coincided with the highest prevalence of White Syndrome (WS) recorded in the study (~48% of tagged colonies), indicating a link between heat stress and WS. At the final survey, 68 of the 100 tagged colonies had suffered whole-colony mortality and only four colonies had not displayed signs of bleaching or disease (WS) in any of our surveys. Significant tissue loss due to severe bleaching (i.e. categorised as >50% bleached) was observed with up to 20 times greater tissue loss compared to mildly/moderately bleached colonies (<50% bleached). The threshold of 50% colony bleaching was found as a good indicator that substantial mortality is likely to follow a heat stress event. WS caused a threefold increase in accumulated tissue loss (69.6 ± 10.5% tissue lost) in the mildly bleached category, suggesting that disease exacerbated mortality. The degradation of the dominant corals observed in this study and the following reef flattening most likely decreased ecosystem functions such as productivity, carbonate accretion and sustaining high biodiversity. Preventing disease could therefore be an active management tool to reduce coral mortality and associated ecosystem function loss.

O12-11 Oral Presentation

Coral reef resilience and post-bleaching trajectories at Aldabra Atoll, Seychelles

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Keywords: climate change, coral bleaching, recovery, marine monitoring, remote

The 2014-2017 global coral bleaching event caused mass mortality of corals worldwide and affected even the best protected and most remote reefs. This challenges the common notion that reefs far removed from local human impacts are more resilient to the effects of climate change. To understand reef resilience under the exclusive influence of global impacts, we studied the susceptibility to, and recovery since, the 2016 coral bleaching event at Aldabra Atoll, a UNESCO World Heritage site in the Western Indian Ocean. We combined the annual long-term monitoring of benthic assemblages with additional observations of coral juvenile density, coral larvae settlement and turf algae height at 12 permanent sites to assess post-bleaching trajectories (i.e. stability/recovery/degradation) and how these differ on an atoll-wide scale. Aldabra lost 50% of its hard corals during the 2016 bleaching event and experienced reductions of taxonomic and morphological diversity within the benthic assemblages. Throughout three years following the bleaching event, we observed location-specific diverging trajectories: Easterly reefs showed an increase in the cover of calcifying macroalgae (*Halimeda* spp.) while the reefs in the west and inside the lagoon experienced an increase in hard coral cover and a decrease in turf algae cover to pre-bleaching levels. The density of juvenile corals increased substantially within the three post-bleaching years on the western and lagoon reefs, but remained unchanged on the easterly reefs. Additional observations indicate atoll-wide similarities in turf algae height but marked differences in the density of settled coral larvae, which was substantially higher within Aldabra's lagoon. These results suggest that prevailing environmental conditions at individual reefs around the atoll are important drivers of reef resilience. Our results will contribute to our understanding of the natural drivers of coral reef resilience, thereby aiding the prioritisation of areas for conservation.

O12-12 Oral Presentation

Not all corals bleach the same: the case of high salinity environments

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Keywords: Thermotolerance, Aiptasia, Osmoadaptation, Climate Change, Symbiosis

Coral reefs are threatened by ocean warming that triggers coral bleaching, although bleaching occurs globally, not all corals bleach equally. Thus, raising the question of what are the factors that affect these differences in coral thermotolerance. The Red Sea provides a unique environment to investigate this since it is one of the hottest and saline bodies of water that harbours thermotolerant corals. Recently, high salinity has been linked to increased thermotolerance in the coral model *Exaiptasia pallida*, i.e. Aiptasia. We found that increased salinity reduced photosynthetic inhibition and symbiont loss during heat stress. To understand the mechanism behind this salinity conveyed thermotolerance, we characterised the osmolytes of Aiptasia and Red Sea corals using targeted Gas Chromatography/Mass Spectrometry. Our analysis showed that the osmolyte floridoside was increased in high salinity and high salinity-heat conditions. Concomitantly with this increase, we measured a reduction in reactive oxygen species (ROS) leakage from the algal symbionts. Intriguingly, floridoside, besides its osmoadaptation function, can act as an antioxidant capable of scavenging potentially damaging ROS, a hallmark of coral bleaching. Thereby, our results from Aiptasia and corals may provide a mechanistic link between decreased bleaching susceptibility and high salinity. They further highlight the putative importance of osmoadaptation in the thermotolerance of cnidarian-dinoflagellate symbioses and add another perspective to highly saline environments such as the Red Sea and the Persian Arabian Gulf.

O12-13 Oral Presentation

Seagrass Habitat Influence on Blue Carbon Storage: Insights from Mangrove Fringed Creeks of Gazi Bay, Kenya

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Keywords: Biomass, above-ground, below-ground, sediment carbon

Seagrass meadows are important carbon sinks and thus understanding this role and their conservation provide opportunities for their applications in climate change mitigation and adaptation. This study aimed at understanding seagrass habitat characteristics and how it influence carbon storage in two mangrove-fringed creeks of Gazi bay. Specifically, the objectives included assessing physio-chemical parameters, distribution and abundance and carbon stocks in the above ground, below-ground and sediment components. Stratified random sampling strategy was used in collecting data within 80 square quadrats of 0.25m^2 from five species selected based on dominance. The results showed a significant variation in water parameters between the creeks. There was also higher seagrass diversity and abundance in eastern creek (with no fresh water inflow) than in western creek. Total biomass varied significantly between the creeks (t= -8.44, D.F. = 53, $p < 0.001$) and among species with a mean of 7.25 ± 4.2 Mg C ha^{-1}, (range: 4.1 - 12.9 Mg C ha^{-1}). Sediment carbon also varied between species for the 48.89 ha creeks with a range of 97.6 – 302.4 Mg C ha^{-1}, (mean: 183.4 ± 100.5 Mg C ha^{-1}). This is lower than 236 ± 24 Mg C ha^{-1}, reported in the open bay although is within the global range. These findings contribute to the knowledge of seagrass carbon stocks in the entire bay and justify the importance of conserving the seagrass meadows. It also explains the need to consider habitat assessment in seagrass conservation and restoration initiatives.

O12-14 Oral Presentation

Assessing carbon dynamics in the changing mangrove forest of Bonaire, Dutch Caribbean

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Keywords: Blue carbon, climate change mitigation, greenhouse gas emissions, biogeochemistry, remote sensing

Of the global carbon sinks, mangroves have one of the highest organic matter storage capacities in their soil due to low mineralization processes resulting from waterlogging. Compared to tropical rainforests, mangrove forests are thought to bury carbon at rates up to 50 times higher. By sequestering and storing significant amounts of carbon, known as coastal blue carbon, mangroves can mitigate climate change. However, the areal extent of mangrove forests has declined by 30–50% over the past half century as a result of coastal development, aquaculture expansion and over-harvesting and they might be vanished by the end of the century. When vegetation is removed the sediments become exposed to the atmosphere or water column resulting in the carbon stored in the sediment bonding with the oxygen in the air to form CO_2 and other greenhouse gases that get released into the atmosphere and ocean, turning mangrove from a carbon sink into a carbon source. Not only does the reducing extent of mangrove forests result in CO_2 emissions but also results in changes of nutrient outwelling which might affect adjacent ecosystems like coral reefs and seagrass meadows. In our study we assessed sediment carbon storage, dissolved organic and inorganic carbon in pore and surface waters as well as CO_2 fluxes out of the sediment in the mangrove forest of Bonaire, Dutch Caribbean. The forest of Bonaire is special as it is partly degrading and therefore enabling us to measure changes in carbon dynamics as the mangroves die. We used a combination of remote sensing techniques and ground-truth data to estimate the mangrove health distribution and noted key forest characteristics. The compiled data will enable us to detect effects of the changing mangrove forest on the carbon cycling and can contribute to treaties about CO_2 certificates and to prevent further deforestation.

O12-15 Oral Presentation

Sediment dynamics in a transboundary mangrove habitat: a perspective of sediment sources, current and historical sedimentation in Vanga, Kenya

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Keywords: Mangroves, sediments, sedimentation, transboundary, sea level

Mangroves provide goods and services that are of ecological, economic and environmental values. Mangrove coverage has been declining and it has been attributed to diverse factors. Losses due to climate change and sea level rise are least understood in the context of the Western Indian Ocean region. Although mangroves can keep pace with rising sea levels, their stability will partially depend on the balance between the rates of sediment accumulation and sea level rise. Therefore, determining localized current and historical sediment accumulation rates through field studies remains vital. This study is premised on an ongoing multi-institutional collaboration project "Transboundary coastal processes and human resource utilization patterns as a basis for a Kenya-Tanzania conservation area initiative". This study answers part of the need to generate ecological and biophysical data that could help in understanding the hypothesized connectivity between the dynamic environment, ecological habitats and resource use. This PhD investigates the source of sediments, amounts of sediments delivered by the transboundary Umba River, sediment accumulation rates within the mangroves and model historical sediment accumulation rates. Sediment samples were collected along the river channel from source to mouth. A combination of sediment-elevation tables and marker horizons are used to measure current sediment accumulation rates. Sediment cores were taken and ^{210}Pb activity downcore were measured and historical mass/sediment accumulation rates modelled. A combination of δ^{15}N and δ^{13}C, elemental C/N ratios were used to partition sources of sediments delivered to Vanga mangroves. Additionally, petrographic and geochemical analyses were used to determine the source geology of the sediments delivered to the Vanga transboundary mangroves. From the preliminary results the sediments deposited in the mangroves of Vanga indicate a terrestrial origin and therefore an indication that land-use within the river catchment have a direct influence. However, a marine origin of sediments is also evident.

O12-16 Oral Presentation

Mangrove trees on backreefs: Familiar functions in unlikely places

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Keywords: Water motion, Sedimentation rates, Fish aggregation, Ecosystem functions

The study focused on mangrove trees growing on a consolidated offshore backreef system in Laucala Bay, Suva, Fiji. This unusual occurrence provided an opportunity to study changes in physical processes following mangrove establishment, together with their effect on associated fauna. Combining field surveys and experiments, we quantified the extent to which mangrove trees attenuate water motion, enhance sediment deposition in their proximity, and function as refugia for solitary or schooling fish. Using mimic trees, we disentangled effects attributable to the physical structure of trees from those related to their bio-chemical properties. We surveyed 24 of the 120 mangrove trees encountered and expected them to act as ecosystem engineers, influencing physical processes which change the otherwise low topographic complexity of the shallow backreef habitat. Methods included visual stationary point counts and video-based censuses for assessing fish abundance and aggregating behavior, plaster dissolution rates to calculate water motion indices as well as deployment of sediment traps to measure sedimentation rates. We found that fish abundance was higher in proximity to trees and mimics and correlated significantly with root system perimeter. The roots of larger trees were used for sheltering by aggregations of reef fish at incoming and high tides. Water motion indices were significantly lower near the trees compared to control sites and significantly lower close to the trunk of larger trees than at 2 m and 6 m distance. In contrast, no significant predictor for sedimentation rate could be determined. Ancillary reviews of literature and satellite images show that the occurrence of mangrove trees on reefs might be atypical, but not unique to Laucala Bay. Not only does our study provide valuable insights applicable to mangrove rehabilitation efforts or ecosystem design, but also reveals novel connections between mangroves and coral reefs that may be of relevance for many tropical coastal areas.

O12-17 **Oral Presentation**

Litter Decomposition of Mangrove Species in Marovo Lagoon, Solomon Islands

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Keywords: *Rhizophora apiculata*, *Ceriops tagal*, *Bruguiera gymnorhiza*, Marovo Lagoon, Mangrove decomposition

The decomposition of mangrove litter is important for the survival and sustainability of mangrove and surrounding ecosystems. Decomposition provides the neccessary nutrients to food webs along the coast, and can be influenced by environmental conditions such as water temperature, hydrological process, tides and salinity. Despite the importance of mangrove decomposition to food webs, nutrient cycling and carbon sequestration within tropical lagoons there are only few studies from the Pacific region. Therefore, rates of decomposition of leafs of *Rhizophora apiculata, Bruguiera gymnorhiza* and *Ceriops tagal* were assessed in their respective areas of dominance using the litter-bag method and the Olson exponential model in both seaward and landward sites in the mangrove estuary of Marovo lagoon, Eastern New Georgia, Solomon Islands. The aim of the research was to determine decomposition rate of leafs among the three species under different inundation sites.Comparisons were made between species, locations and among treatments. Six plots were established at seaward and landward sites for the three species. The rate of decomposition varied among species. Decomposition of *R.apiculata* did not differ significantly from *B.gymnorhiza*, but both showed significant differences with *C.tagal*. The rate of decomposition for *B.gymnorhiza* leafs was higher at seaward sites (k=0.019) than in landward sites (k=0.011) but were similar for *R.apiculata* (k=0.013; k=0.011) and *C.tagal* (k=0.007; k=0.005) irrespective of the landward/seaward position. The time in days required for the loss of half the initial dry mass (t_{50}) was *R.apiculata* 53, *C.tagal* 99 and *B.gymnorhiza* 36 at seaward sites and *R.apiculata* 63, *C.tagal* 138 and *B.gymnorhiza* 63 at landward sites. Result showed that litter decomposition is site and species dependent. Decomposition rate of mangrove leafs in Marovo Lagoon were generally similar to those reported in other tropical regions. This suggests that the processes of decomposition are in response to similar environmental conditions at each location.

O12-18 Oral Presentation

Spatiotemporal Remote Sensing of Mangrove Forest Structure and Function

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Keywords: Satellite, RPAS, UAV, Neural Networks, Machine Learning

Mangroves are a productive tropical forest ecosystem whose structure and functioning is influenced by the conditions of the ocean and atmosphere, and the dynamics of associated disturbance events. As an aboveground, vegetated ecosystem that exists on the land's surface, they are an example for which freely available data repositories from the earth observation sector can provide information on change in structure and function, over large areas and at regular intervals through time. This talk discusses the application of these data sets for the assessment of ecosystem dynamics against climatic data that are measured and modelled, as a potential source of information to predict changes in ecosystem functioning under future conditions. Focus is given to our ability to collect and model information on ecosystem structure and function accurately thus far at the scales necessary for such an approach, using combined aerial and satellite remote sensing data to cover wide areas in an otherwise restrictively inaccessible environment. Analysis algorithms emerging from the fields of computer vision and machine learning for processing remotely sensed image data show great promise for automating such an approach with accurate and consistent results, and are demonstrated for sites across North and Central America. The challenges that remain in combining these spatial modelling approaches with techniques emerging from the field of complex systems analysis, that quantify a systems dynamic behaviour through time, are discussed. Do the bioclimatic conditions of the present provide analogues that allow us to understand ecosystem response to climatic conditions of the future? The existence of these data in open and accessible repositories allows us to set the scene of observable changes against wide scale concurrently available data on environmental conditions, but this question inevitably remains open.

O12-19 Oral Presentation

Vegetation Carbon Stocks of the Mangrove Forests of Lamu Archipelago and the Opportunities for Nationally Determined Contributions

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Keywords: Mangroves, Climate change, Paris Agreement, NDCs, Kenya

Blue carbon (BC) ecosystems (such as mangroves and seagrass) capture huge carbon stocks in both above and below-ground components. This carbon risks being released back into the atmosphere when BC ecosystems are lost or degraded. These ecosystems are now recognized as potential candidates for climate mitigation and adaptation under Paris Agreement (2015). Like many coastal countries, Kenya has not incorporated blue carbon ecosystems into its Nationally Determined Contributions (NDCs). This study aimed at quantifying vegetation carbon and assessed regeneration potential of Lamu archipelago mangrove forests. Mapping was done using remotely sensed data and GIS. A stratified random sampling strategy was used and transects selected perpendicular to the waterline. A total of 122 plots, each 400m^2 were sampled. Generalized allometric equations were used to determine both standing and below-ground root biomass. Five mangrove species were encountered in Lamu; *Avicennia marina, Bruguiera gymnorhiza, Ceriops tagal, Rhizophora mucronata* and *Sonneratia alba.* Based on the importance values, the mangroves are dominated by *Rhizophora mucronata* and *Ceriops tagal*. Across all the management blocks, natural regeneration was adequate (12,374 juveniles ha^{-}) ensuring recovery of the forest. The mean vegetation carbon was 138.3 ± 16.98 MgCha^{-1}. A decline of vegetation cover of 234 ha was recorded between 1990 and 2018, translating to a loss of 13 ha (0.03%) annually. Forty percent (14,000ha) of the 36000ha of mangroves in Lamu are degraded. Assuming an emission factor of 9 tCO_2/ha/yr, the avoided carbon emission from Lamu alone is 126,000 tCO_2/yr. Assuming an offset price of US$10/ton the estimated cost of avoided emission in Lamu is US$1.3m/yr; plus other co-benefits such as fishery functions and shoreline protection. The biomass data portrays a degraded forest with the potential to recover. Results of the study have direct application in the inclusion of mangroves in climate change agenda.

P12-1 Poster Presentation

Robustness of tropical and temperate food web networks to species removals

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Keywords: extinctions, coastal ecosystems, tide pools, warming, food web dynamics

Climate change affects marine communities through its impact on the physiological performance of organisms and recent evidence shows that tropical organisms are more vulnerable to warming than temperate organisms. However, we do not know what this means for trophic interactions that occur among species within ecological communities. Are tropical food webs more vulnerable to warming than temperate food webs? Are they more likely to have secondary extinctions when species are removed? What are the consequences of species removal from different trophic levels in ecosystem biodiversity and function? Intertidal rock pools were used to investigate these issues, as they are known to present as much network complexity as large open systems and are therefore good models to study food web dynamics. Sampling took place in Brazil (tropical climate regime) and in Portugal (temperate climate regime). All macro-biodiversity occurring in selected tide pools was registered and complex network models were assembled for their food webs. Removals of species were performed following various extinction sequences (based on the species' level of connectance in the network, abundance, size and thermal tolerance). Changes to food web network properties, secondary extinctions and overall network robustness were compared among tropical and temperate food webs, and results show that although food webs in different climate regimes showed similar robustness, tropical food webs presented alterations in more food web properties, with significant impacts in the ecological function of different trophic levels. Altogether, we conclude that trophic dynamics between species are being impacted by ocean warming, causing community deterioration and biodiversity erosion with associated loss of ecosystem function and services.

P12-2 Poster Presentation

The distribution and relative abundance of *A. bicinctus*-hosting sea anemone species on coral reefs in the Central Red Sea

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Keywords: Clownfish, Reef Ecology, Saudi Arabia

This ongoing work aims to characterize the species distribution, relative abundance, and host frequency of sea anemones that support Red Sea clownfish, *Amphiprion bicinctus,* in the Saudi Arabian Central Red Sea. Currently, most literature sources (field guides and publications primarily from the Gulf of Aqaba) report *E. quadricolor, S. gigantea, S. haddoni, H. magnifica*, and *H. crispa* as the anemone hosts for clownfish in the Red Sea, with *E. quadricolor* (bubble tip anemone), *H. crispa* (leathery sea anemone) *H. magnifica* (magnificent anemone) and *S. gigantea* (giant carpet anemone) cited as the primary anemonefish hosts. S. *haddoni* and *S. gigantea* are often the only carpet anemone host species identified in Red Sea field guides. Our preliminary surveys in the Central and Southern Red Sea (from Jeddah to the Farasan Islands) have recorded many carpet anemones on transects, but we believe most of these anemones may be *S. mertensii*, not *S. haddoni* or *S. gigantea.* We now aim to comprehensively survey and map anemones at nine local Red Sea reefs to the species level, in addition to recording clownfish abundance and reproduction. Using survey data from previous years in the Central Red Sea, this study will characterize patterns in anemone and anemonefish distributions as well as identify regional differences in host anemone preference within the Red Sea.

P12-3 **Poster Presentation**

Tracking sewage pollution in coral reefs and mangroves with the upside-down jellyfish (*Cassiopea* spp.)

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Keywords: bioindication, sewage discharge, reef conservation

Coastal waters of the Caribbean and the Red Sea are home to coral reefs, mangroves, sea grasses and sand flats - the most productive habitats in the world. Unfortunately, many islands around those regions lack proper sewage treatment and discharge their toxic compounds (mainly ammonia) to the surrounding water. The discharge kills marine life, turns pristine waters into dead zones, leads to decline in tourism and huge economic losses. Those coastal waters are home to the upside-down jellyfish (*Cassiopea* spp.), which can make up to 20% of the marine community. The jellyfish is unique, as it can take up toxic ammonia from water and produce oxygen, therefore it helps protect and sustain marine life. The aim of my research to examine what effects ammonia pollution has on early life stages of this species, and whether we can use it as an early-warning system to track toxic sewage pollution. Polyps and ephyrae were grown in tanks filled with water containing different concentrations of ammonia. After 24h and 96h number of dead animals was was counted, and their sensitivity to ammonia was estimated by calculating the median lethal concentration (LC_{50}) of this compound. After 24h, 0.8 mg L^{-1} of un-ionized ammonia was lethal to half of the ephyrae population. The values of LC_{50} for the polyps were equal 1.17 (after 24h), and 0.58 (after 96h) mg L^{-1} of un-ionized ammonia. Number of symbiotic photosynthetic cells in jellyfish tissues also decreased with increasing ammonia concentration. Although jellyfish are commonly believed to wreak havoc in marine ecosystems, young life stages of *Cassiopea* contradict this opinion. They are more sensitive to the excessive ammonia discharge than other invertebrates, therefore the decline in their density can be used as an early-warning system of wastewater pollution, playing an important role in protecting those pristine waters.

P12-4 Poster Presentation

Study of the CO2 air-sea flux anomaly in 2010 in the tropical Atlantic from numerical simulations and *in situ* observations

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Keywords: air-sea CO_2 flux, CO2 fugacity, North tropical Atlantic

By exploiting the CO_2 and Sea Surface Temperature (SST) fugacity data of the merchant vessel, some authors revealed anomalies in 2010 on the France Brazil line. In order to study CO_2 fluxes in the northern tropical Atlantic, and more precisely between 0 and 30_ N, we first checked that the MERCATOR model reproduced these anomalies at and assessed the performance of the model. The calculation of fugacity in the model was carried out using total alkalinity (TA) and inorganic carbon from the system equations of the carbonate equation using the CO2SYS program . The model reproduces quite well the anomalies of SST and fugacity of CO_2 in the same amplitudes and in the same zones as during the campaigns. (r> 0.9, RMSE <1) and CO_2 fugacity (r> 0.7, RMSE <12) for most campaigns. This result allowed us to evaluate the average CO_2 flux in the basin from 2006 to 2014. The air-sea CO_2 flux varies spatio-temporally with the lowest values in winter being -0.17 Pg C yr^{-1} and the highest values in summer are 0.06 Pg C yr^{-1}. Air-sea flux anomalies were also highlighted by the Mercator model in the boreal spring with maximum anomalies reached in February (0.2 Pg C yr^{-1}) explained not only by the positive anomalies of CO_2 in 2010 but also by of negative wind anomalies during spring 2010.

Session 13

‘Winter is Leaving’ – Polar Regions in the Age of Climate Change

Call for Abstracts

Increases in global temperature have been most pronounced in the Artic during wintertime. The warming impacts all domains, from bottom ‘primary producers’ to top ‘predators’, as well as their habitat: It is causing drastic changes in many abiotic factors, and biota respond via regime shifts in marine systems. Due to the strong interaction between land and sea in the polar regions, we would like to include marine and terrestrial projects in this session. So if your research is on-shore, but your results might be of interest to those working on the marine ‘runoff-recipients’, please feel also welcome!

Session chair

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O13-1 Oral Presentation – Invited Speaker

Breaking the ice: What sea-ice models need to learn from Broccoli to better predict climate change

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Keywords: sea ice deformation, leads, ice-albedo feedback, self-similarity

Arctic sea ice has changed in the course of global warming: its summer extent is shrinking and the ice gets thinner. The thinner ice is weaker and thereby is deformed more easily by winds, tides, and ocean swell that break the ice cover in a multitude of floes. Along the floe boundaries open ocean is exposed in so-called leads. Due to its darker color the open ocean absorbs more sun light and heats up faster. Surrounded by the warmer water in leads the ice floes erode faster and the retreat of the Arctic sea ice cover is enhanced. Sea ice models currently used for climate projections do not resolve the floe character of sea ice. Thus, these models are not capable to capture the described feedback cycle. In this presentation modifications of the sea ice model are introduced such that individual floes and leads are resolved explicitly. Using a high resolution, the sea ice model is able to reproduce the fracture and breaking of ice cover. Due to the chaotic behavior of sea ice deformation, an evaluation of the simulated fracture patterns is not straight forward. Fractal statistics are presented as one tool to compare the simulated leads with satellite observations.

O13-2 **Oral Presentation**

The influence of environmental changes on meio- and macrofauna community structure in regions under different ice regimes

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Keywords: Benthic ecosystems, climate change, community composition, sea-ice cover, Southern Ocean

Changes in sea-ice cover have a major impact on sensitive marine ecosystems in the Southern Ocean. Benthic organisms depend on sinking food input from the water column. Previous studies demonstrated the influence of environmental factors on macro- and meiofauna separately, with the major structuring factor being ice-cover concentration. However, it is unknown how environmental changes may affect the community composition of meio- and macrofauna simultaneously. Here, we investigate the relation between major environmental factors, the resulting food availability at the sea floor, and meio- and macrofauna community compositions. During two expeditions with RV *Polarstern*, PS 81 to Drake Passage, Bransfield Strait, and the North-Western Weddell Sea, and PS 96 to the South-Eastern Weddell Sea, sediment samples for meio- and macrofaunal analysis were taken with the Multicorer (MUC). The study areas represent different sea-ice conditions in the Southern Ocean: The South-Eastern Weddell Sea with its constant sea-ice cover contrasts Drake Passage (least ice cover), Bransfield Strait and the North-Western Weddell Sea (variable ice cover). Additionally, samples for the analyses of environmental parameters of the water column (temperature, salinity, chlorophyll *a* at the chl a-maximum and bottom), and the sediment (grain size, total organic carbon and nitrogen, content of chlorophyll *a* and phaeopigments) were taken. Preliminary results indicate that the macrofauna community composition in regions with "lasting ice cover" is more similar to regions with "least ice cover", than areas with "variable ice cover". Meiofauna abundances were highest in the highly productive North-Western Weddell Sea. Based on the proxy CPE (Chloroplastic equivalents), we found that food input has a higher effect on the abundance of meiofauna compared to macrofauna. This study will contribute to the overall assessment of the effects of climate change on the Antarctic marine ecosystem in the Weddell Sea and the Antarctic Peninsula.

O13-3 Oral Presentation

The impact of combined temperature and salinity stress on the endemic Arctic brown alga *Laminaria solidungula*

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Keywords: multiple stressor, Mannitol, F_v/F_m, C:N, Spitsbergen

Temperature increase is one of the major drivers of climate change, and the most pronounced warming trends are detected in the polar regions. Increase in air and sea water temperatures cause glacier and sea ice melting, and enhance terrestrial run-off from snowfields. Within fjord systems with limited seawater exchange and stratification, the latter can result in hyposaline conditions. Macroalgae such as kelp act as important ecosystem-engineers in rocky shore habitats and are particularly affected by freshening and ocean warming. One endemic species of Arctic kelp is *Laminaria solidungula.* For this study, we conducted a multiple-stressor experiment at four temperatures (0, 5, 10, and 15˚C) and two salinities (S_A 25 and 35) to investigate the combined stress of increasing temperature and decreasing salinities on young sporophytes of *L. solidungula*. Therefore, house-keeping biochemical and physiological parameters such as maximum quantum yield (F_v/F_m) and pigment profiles, Mannitol, and C:N were investigated. Both, increasing temperatures and a lower salinity had significant and accumulating impacts on the physiological and biochemical status. Maximum photosynthetic quantum yield was affected by temperature increase and declined significantly to < 0.550 at 15˚C. In combination with low salinity, it decreased to < 0.400. However, the pigment composition was not affected. Higher temperatures (> 10˚C) affected the C:N ratio significantly (> 20), due to reduced nitrogen uptake and increased carbon storage. On the other hand, S_A 35 supported the nitrogen uptake, resulting in an attenuation of the effect. The storage product Mannitol acted as a compatible solute, and accordingly decreased at S_A 25. Whereas its concentration at S_A 35 was steady between 0 and 10˚C, the 15˚C treatment resulted in a significant decrease in concentration. Conclusively, our results showed *L. solidungula* to be very susceptible to the drivers of climate change and their ecological consequences, especially when they are combined.

O13-4 Oral Presentation

Transcriptional bases of acclimation in an abundant kelp, *Saccharina latissima*, from gametophytes to sporophytes

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Keywords: temperature, salinity, seaweed, gene expression, life cycle

Climate change is significantly impacting the structure and function of marine ecosystems worldwide. The increase in temperature results in the shift of distribution range of several species. Concomitantly, in coastal systems, salinity might tend to decrease due to the increased ice melting and higher occurrence of raining events. Kelps (order Laminariales) are brown macroalgae that dominate the rocky benthic ecosystem in temperate regions. Moreover, kelps feature a haplo-diplophasic life cycle, in which microscopic haploid gametophytes alternate with macroscopic diploid sporophytes. Due to technical and sampling constraints, gametophytes are often overlooked in literature, resulting in a gap in knowledge of species survival and performance. *Saccharina latissima* is a temperate kelp species ranging from the Arctic to the north of Portugal. It displays a high phenotypic plasticity and dynamic acclimation capability. However, the genomic basis of acclimation to stress remains understudied in kelps. Here, we linked physiological measurements to transcriptomic responses of *S. latissima* under multiple abiotic stresses by RNA sequencing. Firstly, we investigated the response of sporophytes to salinity stress after acclimation to temperature in two populations of *S. latissima*. Our results revealed interactive effects of temperature and salinity on the transcriptomic level. Moreover, our data suggest that under identical culture conditions sporophytes from different locations diverged in their transcriptomic responses. Secondly, we investigated the sex-related response of vegetative gametophytes to extremes in temperature. Temperature modulated sex-biased gene expression with differences between sexes connected to their respective physiology and behavior. Taken together, these experiments provide a dynamic picture of gene expression modulation by environmental factors in both life-history stages (gametophyte and sporophyte) studied that include a wide range of metabolic pathways.

O13-5 Oral Presentation

Temperature performance and survival limits of life cycle stages reveal contrasting pattern in two co-occurring Arctic kelp species (Laminariales, Phaeophyceae): a laboratory approach

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Keywords: Gametogenesis, growth rate, PAM, sporophyte, thermal tolerance

Understanding the physiological responses of macroalgae to changing temperatures is crucial to predict future scenarios ecosystems will face due to climate change. The two phenotypically similar kelp species, *Laminaria digitata* and *Saccharina nigripes*, inhabit overlapping ecological niches in the Arctic, but their southern distribution boundary is dissimilar. This suggests a different adaptation towards temperature as their life cycle stages have to withstand a broad temperature range from Arctic to Sub-Arctic or temperate waters. The present study comparatively investigated the respective two life cycle stages (sporophytes and gametophytes) of both kelp species, starting from unialgal clonal cultures. Gametophytes and sporophytes were subjected to temperature gradients in the laboratory in a full-factorial approach. Gametogenesis, sporophyte recruitment and gametophyte survival was investigated in gametophytes. Growth rate, photosynthetic quantum yield and chlorophyll fluorescence vs. irradiance curves (PI-curves) and CN content in sporophytes all over two weeks. *L. digitata* gametophytes and sporophytes survived 24 ˚C and 22 ˚C, and thereby 4 or 5 ˚C higher temperatures than *S. nigripes* gametophytes and sporophytes, respectively. Although both species recruited between 0-10 ˚C, and *L. digitata* also at 15 ˚C, *S. nigripes* showed a much better performance at 0 and 5 ˚C than *L. digitata* in growth, but not in photosynthetic parameters. The overall temperature performance of *S. nigripes,* investigated here for the first time shows a true Arctic affinity of this species, while *L. digitata* behaves similarly to populations from temperate populations. Future increase in Arctic seawater temperatures, especially over winter, most probably will reduce the presence of *S. nigripes*. Whether both species take the same or different functional roles in Arctic kelp forest communities, however, remains unresolved.

O13-6 Oral Presentation

Boreal marine fauna from the Barents Sea disperse to Arctic Northeast Greenland

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Keywords: Atlantic cod, Barents Sea, population genetics, dispersal routes.

As a result of ocean warming, the species composition of the Arctic seas has begun to shift in a boreal direction. One ecosystem prone to fauna shifts is the Northeast Greenland shelf. The dispersal route taken by boreal fauna to this area is, however, not known. This knowledge is essential to predict to what extent boreal biota will colonise Arctic habitats. Using population genetics, we show that Atlantic cod (Gadus morhua), beaked redfsh (Sebastes mentella), and deep-sea shrimp (Pandalus borealis) recently found on the Northeast Greenland shelf originate from the Barents Sea, and suggest that pelagic ofspring were dispersed via advection across the Fram Strait. Our results indicate that boreal invasions of Arctic habitats can be driven by advection, and that the fauna of the Barents Sea can project into adjacent habitats with the potential to colonise putatively isolated Arctic ecosystems such as Northeast Greenland.

O13-7 **Oral Presentation**

Habitat use of minke whales (*Balaenoptera acutorostrata*) in Skjálfandi Bay, North Iceland

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Keywords: site-fidelity, distribution, prey, minke, whale

The focus of this study is distribution and habitat use of minke whales from 2005 - 2018 in Skjálfandi Bay. Icelandic minke whale abundances had been found to decrease in the past due to a possible distribution shift north and therefore trends within the bay were investigated. Furthermore, distribution patterns within the feeding ground were examined for the first time on various levels. Data were obtained through continuous sighting surveys by trained volunteers using whale watching vessels as research platform. Per year, the percentage of surveys positive for minke sightings and the sightings per unit effort declined through the study period. Abundances of minke whales might have decreased due to a population decline and a distribution shift to higher latitudes. Highest peak of the season might have shifted recently to earlier in the year than before. Spatio-temporal distribution changes had been investigated on population level. Prey and competition for prey might be the main driver of minke whales' distribution between years, seasons, months and daytimes. Interannual distribution shifts might be due to a change in the cetacean community. Seasonal distribution shifts were found after prey distributions. Schooling fish and minke whales inhabited areas along the shore in spring and a plankton bloom through the whole bay in summer and fall provided feeding grounds for minkes in summer and fall. Minke whales seemed to be more separated in the morning but then joined their ranges through the day. Such segregation might be the result of the avoidance of intraspecific competition during feeding. Small scale site fidelity was proven for the first time for the species modelling distances between individual relocations and random relocations. Small scale site fidelity was previously hypothesized but never modelled for minke whales in other areas. The whales' hatitat use patterns will be discussed in a conservational context.

Session 15

Towards Sustainability in Aquaculture

Call for Abstracts

Aquaculture is one of the fastest growing food production sectors and has great potential for food security and livelihoods. However, it generates concerning consequences for the environment and society, including chemical and biological pollution, disease outbreaks, unsustainable feeds and competition for coastal space. Recent investigations are focusing towards sustainable techniques (e.g. polyculture, aquaponics) to improve the relationship between the industry, environment and society. However, communication between sectors needs improvement. Are you involved in research on sustainable aquaculture? We encourage scientists from both natural and social sciences to present solution-driven research and discuss current and proposed technologies and research methods.

Session chairs

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O15-1 Oral Presentation

Effect of different irradiances of PAR on growth, photosynthetic efficiency and chlorophyll *a* content of Sea grapes (*Caulerpa lentillifera*)

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Keywords: Fv/Fm, green caviar, macroalgae aquaculture, pond culture, recovery potential

An essential part of future aquaculture solutions is the sustainable culture of organisms low in the food chain, like marine algae. The green macroalga *Caulerpa lentillifera* (also known as sea grapes or green caviar) is of high demand especially in Japan, China and Singapore, due to its high nutritional value, the antioxidant capacity and the special texture. In Vietnam, sea grapes are cultured in open tidal ponds, where the cultured algae are exposed to the prevalent environmental conditions. Covers of the ponds provide shelter from high solar irradiances. However, the ideal irradiances of photosynthetically Active Radiation (PAR) and the potential of recovery after stress exposure are still not yet clearly investigated. This study examines the influence of high (100 µmol photons m^{-2} s^{-1}) and low irradiances of PAR (25 µmol photons m^{-2} s^{-1}) compared to the prevalent conditions found in the culture pond (50 µmol photons m^{-2} s^{-1}) on the specific growth rate (SGR) in weight and length of fronds, the photosynthetic efficiency (Fv/Fm) and the chlorophyll a content of sea grapes. The recovery potential after stress exposure of seven and 14 days is investigated. Our preliminary data suggest that high and low irradiances lead to decreased photosynthetic efficiencies, and faster death compared to the control group. The results are expected to help farmers to optimally adapt the culture conditions to ensure a high quality and quantity of the harvest.

O15-2 Oral Presentation

Meagre (*Argyrosomus regius*) metabolic responses when reared under different salinities: opportunities for aquaculture refinement

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Keywords: Juvenile, Energy Metabolism, Fish Farming Optimization, Growth, Oxidative stress

The aquaculture of Meagre (*Argyrosomus regius*), an important commercial fish species, is still under development towards its full potential and optimized production. Although the species main strengths are well known in fish farming - namely high growth rate and feed conversion ratio, flesh quality, nutritional value, size, and husbandry techniques - additional scientific research might generate rearing opportunities. This species is migratory, spending their first months in estuaries, and then moving to coastal and offshore areas, constantly facing environmental differences that strongly determine their feeding activity, reproduction, and trophic migrations. Nonetheless, meagre production has been restricted to sea cages and land salt-based tanks. Considering its high tolerance to a wide range of factors such as salinity, the present study aimed to assess the stress and biochemical costs associated with the rearing of juveniles under hypo-osmotic environments, to better profit from this species characteristics and potentially settle them on diverse locations without productivity loss. Organisms were reared for 28 days at salinity of 5, 10, 20 or 30 ppt, resembling estuarine and lagoon conditions. Growth rate was calculated, and biochemical responses associated with oxidative stress, oxidative damage, and energy metabolism were measured in muscle, liver and heart tissues, with limited effects detected in meagre for any of these conditions. These results confirm the euryhaline characteristic of this species early life stages at the biochemical level, which are further on related to organism fitness, improving knowledge on future aquaculture techniques towards reduction of production costs and spread under diverse environmental conditions and practices, such as IMTA or aquaponics.

O15-3 Oral Presentation

A novel closed recirculating aquaculture system integrating milkfish, sea cucumber and sea purslane

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Keywords: IMTA, halophyte, biofilter, nitrification, denitrification

Aquaculture is a growing sector globally and gaining in importance in East Africa, where ocean resources are a key part of local livelihoods. Sustainable aquaculture has the potential to provide food security and income, but manifold improvements are still required before societal needs can be met without adverse social and ecological impacts. Integrated Multi-Trophic aquaculture (IMTA) is a best management practice that reduces feed input and pollution and optimizes the use of water and space, but few case studies of such systems with tropical species exist. The eight-week experiment was carried out at the FAO hatchery facility on Zanzibar, Tanzania. For the species of milkfish *Chanos chanos* and sandfish *Holothuria scabra*, aquaculture production is being developed on Zanzibar, Tanzania. Sea purslane *Sesuvium portulacastrum*, is an edible halophyte with medicinal application and bioremediation potential. The objective of this study was to test a closed recirculation aquaculture system (RAS) integrating these three species. Three replicate systems were operated and each stocked with 1000 g of milkfish, 85 g of sandfish and 900 g of sea purslane, cultivated in separate tanks connected through continuous water flow. Solid waste from fish tanks was added to the sea cucumber tank as feed. Both milkfish and sea purslane showed good growth, while sea cucumber growth was highly variable. Total N concentrations increased over the course of the experiment, but water quality remained tolerable for milkfish. Ammonia levels were reliably decreased and a nitrate peak occurred within the first 50 days, indicating good biofilter performance in the sea cucumber and sea purslane tanks. The experiment provides a case study of a simple RAS integrating three tropical species at different trophic levels. The system operated without producing solid waste or discharging polluted water. The biomass of the different organisms should be further increased to optimize system performance.

O15-4 Oral Presentation – Invited Speaker

Sustainable Aquaculture: let´s try!

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Keywords: Aquaculture technologies, environmental impact, zero-waste, aquaponic enterprise

Aquaculture is the fastest growing food production sector in the world and already in 2016 half of the global seafood was produced by aquaculture. Regarding the expected rate of human population growth and the increasing need for resilient, sustainable and effective food production systems, aquaculture offers promising opportunities. Along with the steady growth of the aquaculture industry, many negative aspects became evident. Major issues are related to the in-, and outputs of aquaculture facilities, the direct effects on the surrounding environment and the lack of governmental regulations. Considering that aquaculture is a relatively young sector, improvements have been done with a growing trend from classical “linear” approaches to “circular” closed farming systems, aiming to achieve a zero waste environmental friendly aquaculture. Despite positive trends, the major challenge remains to establish these aquacultures in economies, where aspects of profitability mostly prevail sustainability. Nevertheless, in Germany, the number of aquaponic (combination of aquaculture and hydroponics) related projects has grown strongly in the past few years. With “Watertuun” being one of them, I would like to share some motivations, experiences and challenges we encountered, trying to build up the first aquaponic farm in Bremen.

P15-1 Poster Presentation

Modelling Climate Change Impacts And Adaptation On Aquaculture In The Gulf Of Guinea Coast

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Keywords: Influence, Climate, Population, Ecosystem

The global climate change influence marine animals through the ocean warming, acidification and oxygenation. This has affected the socioeconomic aspect of aquaculture through changes in seawater chemistry, sediment transport, decrease in seawater pH (acidification) etc. This research then assessed the potential impacts of climatic change on the aquaculture and its sustainability in the society. The study was conducted in the Gulf of Guinea region of the North Atlantic which stretches from the Senegal in the West to Gabon to the South-Eastern part of Africa. It is home to a large number people and economic activities with a population of over fifty (50) million. In order to ensure the preservation of preserving natural resources and marine ecological features, a modified methodological approach was developed to evaluate the risk to the marine ecosystem. The ASTER, MODIS and LANDSAT satellite images were acquired to extract emissivity and temperature and spatial modelling, that are in combination with historical estuary evolution and field observation was applied for effective management and conservation the ecosystem features of the area. It was then observed that the climate change impacts on aquaculture is highly predominant in tropical and subtropical climatic regions of the world, thus there is a need to assess the implications of future scenarios in terms of climate change and research development in the areas of aquaculture. The recommendations from this research thus improve strategies and policy measures needed to fight the observable and projected climate change impacts on fisheries and aquaculture, so as to protect the livelihoods of the fishing communities and food security. Finally, Integrating the needs of fish farmers and aquaculturists into adaptation planning is very essential.

Session 16

Biodiversity and Resilience in the Anthropocene

Call for Abstracts

While our society is slowly realizing the seriousness of climate change, scientists have long been aware and are now racing to catalogue the world's biodiversity before it is simply too late. From intertidal habitats to the deep-sea environment, there is a need to increase knowledge on the resilience of marine organisms. Our understanding of the biodiversity upon which all marine ecosystems depend is too valuable to renounce in the face of anthropogenic disturbances and destruction. This session invites contributions covering a broad range of topics surrounding resilience and biodiversity from a genetics, species, or ecosystem level.

Session chair

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O16-1 Oral Presentation

Impacts of deep-sea mining – Experimental assessment of particle burial effects on deep-sea meiobenthic communities

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Keywords: polymetallic nodules, nematodes, sediment plumes, migratory response

In search for new sources of metals and rare-earth elements to fuel our industrial growth and satisfy the future demand for technological development, mineral deposits in the deep sea are receiving increasingly more attention. While mining regulations are already being formulated, the environmental consequences of deep sea mineral extraction remain largely unknown. Abyssal sediment communities live in a very stable environment with low currents and constant, low temperatures and are thought to be especially vulnerable to strong disturbances. A mining operation will inevitably remove hard substrates and sediments at the mined site, but the activity will also produce large sediment plumes that may settle within a radius of multiple kilometers around the mining site, blanketing the local fauna. This may not only impact the epifauna (i.e. animals living on the seafloor) but also animals inhabiting the sediments such as the meiobenthos, a size class of organisms between 32 µm and 1 mm. To gain insights in the responses of deep sea meiobenthos to sediment burial, two short-term, in situ experiments were conducted in a polymetallic nodule area in the Peru Basin, located in the south-east Pacific. In these experiments, an undisturbed sediment community was buried with crushed nodule particles and artificial sediment. The results are compared with a similar laboratory experiment on a bathyal fjord sediment community. In all experiments, meiofaunal organisms showed an upward migratory response to the added particle layer, and a viability assessment of nematodes in the laboratory experiment also showed increased mortality. Due to their relatively high importance in deep sea sediments, the observed responses of the meiobenthos to particle burial may have wider consequences for the structure and functioning of abyssal communities.

O16-2 Oral Presentation

Molecular analyses of hydrothermal vent plankton samples from the Central and South Eastern Indian ridges

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Keywords: DNA Barcoding, COI, Plankton, community structure, Hydrothermal vents

The first hydrothermal vent fields were discovered in 1977 along the Galapagos rift while the first vent field in the Indian Ocean was discovered 24 years later in 2001. Our knowledge of deep sea hydrothermal vent species is rather poor compared to other marine habitats, although these animals play an important role in the marine food web. The aim of this biodiversity study was to analyze the composition of deep sea hydrothermal vent plankton from the Central and Southeast Indian ridges in the Indian Ocean and to compare the communities of active and inactive hydrothermal vent sites. In seven different areas, 13 sites were sampled with a rosette water sampler during the 2018 INDEX cruise of RV Sonne. A total of 952 animals were sequenced, of which 728 were usable, and analyzed using Geneious Bioinformatics Software. The most abundant species at all stations belonged to the copepod order of calanoids, followed by cyclopoids and harpacticoids. Comparison of one active and one inactive vent site showed no significant difference in diversity, but in community composition. From a total of 68 molecular operational taxonomic units, only eight could be found at both sites. The most abundant species was *Clausocalanus paululus* with 16 individuals at the active vent site and 13 at the inactive one. With respect to the possibility of deep sea mining in the examined areas in the near future, it is crucial to understand these ecosystems and their associated fauna.

O16-3 Oral Presentation – Invited Speaker

Demographic Inference of a Deep Sea Copepod using 2b-RAD Methods

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Keywords: Deep Sea Mining, Next-Generation Sequencing, Bioinformatics, Meiofauna

The potential for the exploitation of polymetallic massive sulphide deposits in the deep sea has already given way to exploration and as such, driven an increase in research on the fauna dependent on these chemosynthetic ecosystems. It is well understood that the mining of these systems would cause multiple stressors to both macro- and meiofaunal communities, reducing the abundances of certain species and biodiversity as a whole. The ability of these animals to recover to pre-disturbance levels of abundance is in part dependent on the level of genetic connectivity of their populations, reflecting the potential to colonise other similar vent environments through various dispersal methods. We target a deepsea, vent-endemic, globally distributed and highly abundant copepod of the meiofaunal fraction (32 µm – 1mm), *Stygiopontius lauensis*. Samples were collected from the Lau Basin, off the coast of the Kingdom of Tonga in the South Pacific. We use restriction site-associated DNA (RAD) genotyping methods that use type IIB restriction endonucleases (2b-RAD). RAD sequencing has fueled studies in ecological, evolutionary and conservation genomics by using Next-Generation Sequencing (NGS) to identify thousands of polymorphic genetic markers across the genome in a fast and cost-effective way. Using demographic-modelling software FastSimCoal2, we then estimate demographic parameters from the joint Site Frequency Spectrum (SFS), using simulations to compute the expected SFS and a robust method for the maximization of the composite likelihood. This coalescent modelling can then be harnessed to predict the gene flow strength and direction of future populations under different disturbance scenarios, allowing us to infer their resilience to human activity in the deep sea.

O16-4 Oral Presentation

Exploring genetic connectivity between abyssal populations of the deep-sea ophiuroid *Ophiacantha pacifica* (Ophiuroidea: Ophiacanthidae) across the Kuril-Kamchatka Trench in the Northwest Pacific using a 2b-RAD approach

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Keywords: deep- sea benthos, macrofauna, population genetics, Echinoderms, RAD- sequencing

Studying the population genetics of deep-sea animals is important to understand their divergence and dispersal potential, as well as their ability to overcome natural barriers like oceanic trenches. We used the deep-sea ophiuroid *Ophiacantha pacifica* (Ophiuroidea: Ophiacanthidae), distributed across the Kuril-Kamchatka Trench (KKT) in Northwest Pacific, as a model organism to study these phenomena, applying population genetics. Using 2b-RAD sequencing, 7,877 genomewide single nucleotide polymorphisms (SNPs) were obtained from 46 individuals collected from six stations located on both sides of the trench. Previous haplotype network analyses based on the mitochondrial gene *cox1* showed that only one of more than two dozen haplotypes was shared between sampling areas, indicating low genetic exchange across the trench. Nevertheless, when using SNP data, almost all individuals formed a single genetic cluster, with the exception of a few outliers–indicating that the KKT is no barrier to gene flow between the Sea of Okhotsk and the Northwest Pacific. The species seems to be under the influence of the East Kamchatka Current and several anticyclonic eddies, so although virtually nothing is known of the reproductive life history of *O. pacifica*, the genetic homogeneity shown here suggests that it likely includes a planktotrophic larval dispersal stage. In conclusion, the present study offers novel perspectives on the population connectivity of *O. pacifica* ophiuroids, revealing the potential interaction of ocean currents and geological barriers with reproductive adaptations in shaping genetic structure patterns in the Northwest Pacific.

O16-5 Oral Presentation

Diversity of macrofauna associated with deep-sea sponge aggregations in the North Atlantic

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Keywords: Porifera - Sponge ground – Benthos – Community – Twilight zone

Among deep-sea ecosystems, sponge aggregations have been observed to host rich and diverse megafaunal communities. Sponges are known to provide habitat and food for a wide range of other benthic invertebrates and pelagic organisms. A recent focus on deep-sea sponge grounds highlighted their ecological importance as an ecosystem engineer and their role in enhancing megafaunal diversity. Yet, few studies have been conducted on sponge-associated epifauna and infauna. Ground-forming sponges are often impacted by anthropogenic activities such as demersal fisheries, hence the need for better understanding the ecological importance of sponges to protect these valuable and fragile organisms. This study focuses on diversity and abundance of macrofauna associated with deep-sea sponges of the North Atlantic. In 2018, specimens of *Pheronema aff. carpenteri* were sampled in different areas around the Azores (Portugal) during two surveys, aboard the *LULA1000* manned submersible of the Rebikoff Foundation and the RV *Meteor* using an Agassiz trawl. Samples of *Vazella pourtalesii* were collected in 2017 on the Scotian Shelf (Canada) during a campaign aboard the CCGS *Martha L. Black* using the ROV *ROPOS*. Sponge samples were dissected under a stereomicroscope to collect the associated fauna, which was later identified using a classic taxonomical approach. Species richness, abundance and diversity indices were calculated in order to characterize and quantify sponge-associated fauna diversity. Overall, foraminiferans, polychaetes and gastropods were the most abundant and diverse taxa associated with *Pheronema*, while amphipods, isopods and bivalves dominated among taxa associated with *Vazella pourtalesii.* On average, *Pheronema* sponges showed higher macrofaunal species richness. Investigating sponge-associated macrofauna increases the current knowledge about the ecology of sponge aggregations, recognized as vulnerable marine ecosystems (VMEs) under international law. Such information is essential to support biodiversity conservation measures and advise toward a sustainable management of deep-sea natural resources.

O16-6 Oral Presentation

Assessment of local differences between benthic trophic structures in the Southern North Sea

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Keywords: Food webs, benthos, German Bight, stable isotopes

Benthic communities are key components in marine ecosystems as they contribute considerably to nutrient cycling and provide a mayor food source for higher trophic levels. In this study we examined if adjacent benthic assemblages that differ in faunal structure also differ in their trophic composition. Infauna, epifauna, demersal fish and the possible primary food sources (suspended organic matter and particulate organic matter) were analyzed for their $\delta^{15}N$ and $\delta^{13}C$ composition. Samples were collected from the shallow *Bathyporeia-Tellina* (BT) community, and the deeper northern Central North Sea (CNS) community in the German Bight. Results provide evidence that trophic composition between communities was different and similar at the same time: Regarding the food web structure of the BT and CNS communities, there was an overlap in their wider trophic niches, and food chain length and sequence of feeding groups were similar. However, their core areas of trophic niche did not overlap, and CNS had a broader trophic niche and slightly longer food chain than the BT community. The dominant feeding mechanism in the CNS were deposit feeders, while suspension feeders dominated in the BT community. Dissimilarities between the two assemblages were linked to food availability, which is influenced by the sediment type, current circulation and wave activity of each site. Our study shows that faunal differences do not necessarily lead to trophic differences indicated by the overall similar trophic composition. However, it also demonstrates that local environmental settings cause slight adaption of the fauna in a certain environment, leading to local trophic differences. Gaining more knowledge on differences in local food webs is important to refine management practices. In addition, it illustrates the value of considering trophic assemblages in order to accurately depict different habitats.

O16-7 Oral Presentation

Bottom trawling on benthos in the German Bight: correlating different biotic indexes with fishing effort and natural disturbances

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Keywords: benthic fauna, bottom trawling, VMS data, natural disturbance

The damages of bottom trawling are now acknowledged worldwide as one of the major sources of disturbance for benthic fauna. Its role in the loss of biodiversity and in the shift in the organisms' functional traits has been widely investigated. Bottom trawling poses a serious threat for ecosystems where sensitive and fragile species occur. Interestingly, bottom trawling is expected to have a lower impact in shallow areas that are subjected to highly dynamic tidal movements. A deep understanding of the relation between fisheries and natural disturbances is still lacking in the Wadden Sea. Therefore, we analysed data collected from 5 stations characterized by different fishing pressures between 1987 and 2015. We calculated different biotic indexes (Margalef, Shannon, AMBI, M-AMBI and BESITO). In addition, we performed a quantitative analysis of functional and life history traits. The fishing effort was calculated in hours using the Vessel Monitoring System (VMS) data. This GPS system, created to track and control fishing activity, became mandatory in 2000 and only pertains to fishing vessels larger than 12 m since 2012. The data before 2008 were unreliable as the dataset was incomplete. We were therefore only able to correlate the biotic indexes between 2008 and 2015. The natural conditions were observed to be very similar within the five stations, due to the short distance between them. A multivariate analysis will be performed to correlate the natural disturbance of the fishing effort and consequently bottom trawling with the biotic indexes. Quantifying the impact of fisheries is fundamental to aid nature conservation in a delicate ecosystem like the Wadden Sea, habitat to several endangered species and stop-over site for many migratory seabirds.

O16-8 Oral Presentation

The overlap extent and fisheries exposure risk of pelagic sharks and commercial tropical tuna purse seine fisheries in the Eastern Pacific Ocean

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Keywords: Sharks, Bycatch, Animal Telemetry, Conservation, Fisheries

Bycatch in commercial fisheries is detrimental to shark populations globally. Slow growth and low reproductive output make sharks particularly vulnerable to over-exploitation, thus low-to-moderate levels of fishing can have far-reaching effects. Tuna purse seine fishing has a wide extent throughout the tropical and subtropical zone (~30˚N to 20 ˚S) of the Eastern Pacific Ocean (EPO), with estimates of interaction with sharks severely hindered by poor recordkeeping throughout the past decades. Fisheries science is currently being revolutionized by big data and technological advancement for better monitoring and transparency, and ultimately better species management. The automatic identification system (AIS) is an anti-collision messaging system legally required for large vessels. Repurposing this data, Global Fishing Watch (GFW) are tracking the movements and activities of global fishing fleets, now available freely online. Utilizing a satellite tracking database of seven pelagic shark species and AIS data of the commercial fishing fleet in the EPO, the habitat use of sharks and fishers, and the extent of shark and fishing effort overlap was determined through space and time. Fisheries exposure, fishing intensity and risk of interaction were calculated per month, with some species spending 50% of their time in areas overlapping with fishing activity. Spatially, 55% of shark habitat use that overlapped with fishing pressure was found to happen in the high seas, with 45% happening within the Exclusive Economic Zones (EEZs) of ten Pacific nations. Nearly 50% occurred within the EEZ of Mexico and its oceanic islands. Given the difficulties in initiating international management plans, localisation of impact allows initiation and direction of conservation measures. This fisheries-independent analysis allows for increased knowledge and quantification of impacts on shark populations, especially for rarer and protected species, which tend to be under-reported.

O16-9 Oral Presentation

Abrupt collapses and resilience in North Sea cod stocks

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Keywords: Anthropogenic stressors, Atlantic cod, regime shifts, stochastic cusp modelling, tipping points

Cumulative impacts of anthropogenic stressors, such as overfishing and ocean warming, can result in abrupt ecosystem changes, generally termed regime shifts. Detecting and understanding the consequences of these shifts is essential in understanding the resilience of a system to human stressors, and especially to manage marine resources sustainably. Atlantic cod is a paragon example for abrupt collapses of important marine resource species with drastic socio-ecological consequences. In the North Sea, cod declined around the 1980s and its population is still in a depleted state. Different management plans have been executed to recover the stock but have largely failed. The failed recovery is not fully understood yet and suggests that the return of the current depleted state to its previous state is hindered hindered even when external influences stop, i.e. hysteresis. Here, using data from stock assessments and monitoring surveys, we applied the stochastic cusp model derived from catastrophe theory to understand whether North Sea cod has undergone discontinuous dynamics implying hysteresis. The stochastic cusp model allows the detection of non-linear discontinuous dynamics of a state variable, depending on the interactions between two control variables. We analyzed biomass and recruitment dynamics and their dependence on stock structure, fishing mortality mortality and climate change. The method also quantifies the stock's resilience and provides information on the vulnerability of the stock to future changes. Preliminary results indicate that the stock experienced discontinuous dynamics and hysteresis, explaining why recovery might be hindered. Our results contribute to a better understanding of the resilience and vulnerability of North Sea cod, which is fundamental to efficiently manage the stock, and to understand potential consequences for the entire North Sea socio-ecological system. We argue that the methodology can be applied to other systems, helping to assess their vulnerability to tipping points, important in quantifying risks and uncertainties of ecosystem-based management.

O16-10 Oral Presentation

Trophic interactions and cascading control exemplified in its multitude of effects for the Baltic Sea ecosystem

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Keywords: Trophic interactions, cascading processes, density dependence, Atlantis ecosystem model, food web.

Direct and indirect biological interactions and trophic cascades can control entire marine ecosystems. However, it can be misleading for our understanding and for ecosystem-based management to only investigate the influence of biological interactions and trophic cascades in terms of biomass on an annual basis, or to compare separate species-specific data time series in simple food chains. To investigate this, we applied an end-to-end marine ecosystem model including both intra- and inter-specific competition and density-dependent regulations. We explored certain trophic interactions and cascading dynamics of a disturbed ecosystem using a holistic model which includes all trophic levels of the Baltic Sea food web. The model was able to capture the functional responses in interactions and cascading of the different groups and levels. Its main results emphasize the importance of integrating the whole food web, not just considering the change in biomass on an annual basis, and instead also including the density and the condition of the individuals. This approach is favorable as density dependent interactions will shape the state of the entire ecosystem. This study also indicates that trophic interactions, as well as cascading processes and control, change in time variant patterns and rates, e.g. growth and maturation rates. We conclude that, in order to better understand ecosystem interactions and trophic cascade state and control mechanisms, a holistic approach is needed, integrating several indicators and seasons, and including the complexity of all the intra- and inter-specific interactions of the entire food web.

O16-11 Oral Presentation

Temporal change of benthic communities in coral reefs of Koh Phangan (Thailand) in the last decade

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Keywords: Live coral cover, winner-loser, coral biodiversity, long-term development

Due to mass bleaching events and other anthropogenic influences, such as pollution, overfishing and coastal development, many coral reefs have been severely degraded in their hard-coral cover and diversity. The Gulf of Thailand is a highly under-investigated area and spatiotemporal changes in benthic community composition of local coral reefs have not been described so far. We thus analyzed benthic community data (256 surveys of 9 reefs), collected from reefs around the north and west coast of Koh Phangan from 2012 to 2019. We thereby also identified winners and losers among hard corals over the last decade. Findings revealed that, contrary to expectations, average live coral covers around Koh Phangan have increased by 16.1 % since 2012, although there was a high spatial variability. Corals with massive and plate-like growth forms increased by 2.63 % and 2.06 %, respectively, whereas branching and solitary forms declined by 3.57 % and 0.92 %, respectively. Of all analyzed 47 hard coral genera, the genus *Porites* (+24.09 %) exhibited the highest resilience, while the genera *Echinopora* (-11.41 %), *Lobophyllia* (-8.27%) and *Acropora* (-1.58%) appeared the most vulnerable to the recent combination of stressors in the Gulf of Thailand. Turf algae cover has reduced by 23.6 % and covers of other benthic organisms remained constant. Local variability of live coral cover and turf algae cover may be explained by local drivers, such as anthropogenic influences and effects caused by coastal development and tourism. As more diverse reefs possess a higher resilience to disturbances this could be an indication for the future development of reefs in the Gulf of Thailand.

O16-12 Oral Presentation

Within- and transgenerational plastic responses of congeneric marine annelids under global and local change drivers

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Keywords: life-history, ocean warming, chemical pollution, marine invertebrates, omics

Ocean warming and metal pollution are known to affect the metabolism of ectotherms, inducing changes in cellular functioning, whole-organism performance and fitness. However, little is known on how within- (WGP) and trans-generational plasticity (TGP) operates in response to complex environmental changes in closely related species. This study aimed to uncover the WGP and TGP of fitness-related traits as well as the underlying molecular mechanisms (i.e. proteome adjustments), in a common (*Ophryotrocha japonica*) and a rare (*Ophryotrocha adherens*) species of congeneric marine annelid exposed to global and local change drivers. Specifically, we first compared the WGP of the two species exposed to four scenarios: (i) control (24˚C, no pollution), (ii) ocean warming (+3˚C), (iii) copper pollution (10 µg mL^{-1}), (iv) copper pollution and ocean warming (10 µg mL^{-1}, +3˚C). Species differed in their ability to respond to ocean warming and copper pollution conditions within-generation, the rare species (*O. adherens*) showing greater reduction in fitness when both stressors were combined. Thus, we investigated the rare species' (*O. adherens*) capacity for TGP (F1 to F3 generations) under the effect of ocean warming, testing its ability to buffer environmental changes throughout generations. *O. adherens* was able to thrive across generations under higher-than-control temperatures despite a reduction in fitness compared to the control scenario. Moreover, fitness-related traits were less plastic under the ocean warming scenario, and therefore proteomic analyses are currently being completed to detect metabolic changes and possible energetic trade-offs throughout generations. Overall, we found that congeneric species have markedly different sensitivities to future global and local changes, and that more sensitive species may persist over consecutive generations through a re-allocation of the cellular energy budget. This information is helpful to predict future changes in marine biodiversity through the identification of reliable bioindicators for ecotoxicological assays and global change impact assessments.

O16-13 Oral Presentation

Effects of Noise on the Acoustic Behaviour of Killer Whales (*Orcinus orca*) in Iceland

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Keywords: aquatic noise, conservation, cetaceans, vocalization

Killer whales (*Orcinus orca*) are frequently found in the waters around Iceland and have been observed to use a unique call type known as the 'herding call' (i.e. relatively long, lower frequency vocalisations associated with feeding events) in this location. The use of sound is not only important for killer whales during foraging behaviour, but also during other activities, such as social interactions. The Vestmannaeyjar archipelago in the south of Iceland is a known feeding ground for killer whales, as herrings spawn there in summer. However, the area also has relatively high marine traffic. With the increase in shipping and other anthropogenic stressors on the oceans, questions arise regarding impacts of noise on killer whales. Vocalisations may be masked, potentially resulting in reduced foraging efficiency and hampered communication, and noise may directly disturb behaviour. Anthropogenic noise may thus have direct and indirect impacts on individuals, and therefore on the overall population. The aim of this study was to assess the effects of increases in ambient noise on the acoustic behaviour of killer whales in Vestmannaeyjar. Acoustic data were gathered continuously between June and August 2018 using two bottom-moored acoustic recorders. Individual killer whale calls were identified using an automatic detection algorithm and then characterised in Raven Pro. Ambient noise levels were characterized in broadband and third octave bands directly before vocalizations occurred and analyzed using MATLAB. We quantified the effects of noise on the acoustic behaviour of the whales by modelling the relevant signal parameters as functions of noise levels in different frequency bands. Preliminary results show a possible trend in increased frequency and call duration as a response to the noise levels. To further investigate these trends and enhance our knowledge about noise impacts on this population, a follow-up study will be carried out in the following months.

O16-14 Oral Presentation

Serial reversal learning and cognitive flexibility in ocellate river stingrays (*Potamotrygon motoro*)

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Keywords: behavioral cognition, progressive improvement, vision

The ocellate river stingray (*Potamotrygon motoro*) inhabits various South American rivers of different chemical and physical compositions. Different conditions thus present this species with varied light regimes that are further influenced by flood cycles, deforestation, and farming. Since *P. motoro* has been shown to orient visually, changes to the visual complexity encountered in its environment could pose a challenge for learning in this species. However, the existing complexity that *P. motoro* encounters also suggests that the species should be cognitively flexible, i.e. able to quickly switch between learned associations when appropriate. Previous research shows that *P. motoro* can switch an association at least once, but no serial reversal experiments were conducted. To further explore the learning of this species, the present study exposed seven juvenile stingrays to a serial reversal learning paradigm within a two-alternative forced-choice setup. Food was associated with one of two colorful stimuli and then switched to the alternative stimulus whenever the Learning Criterion was achieved. Expectations were that *P. motoro* would be capable of reversing a learned association more than once and more quickly with experience, and the results support these hypotheses. Variation between individuals does indicate that potentially conflicting aspects of learning may be more or less prevalent in the species, so this deserves further investigation. In the face of anthropogenic change, behavioral studies that demonstrate learning abilities in threatened animals, such as Elasmobranchs, can provide insight into the non-physiological resilience of ecophysiologically flexible animals.

O16-15 Oral Presentation

The physiology of degrading kelp detritus from two North East Atlantic species across different environmental contexts

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Keywords: Climate change; Oxygen production; PAM fluorescence; Respiration; Spatial subsidy.

A significant proportion of kelp biomass from temperate to subpolar regions is transported into recipient marine communities as detritus. Although the study of kelp detritus is a burgeoning field, the present study is unique because the physiological properties of detrital resource subsidies are measured for the first time. The warming climate threatens to re-shuffle the species composition of important kelp forest ecosystems and perturbs the dynamic of these crucial habitats. Two competing North-East Atlantic species are the focus of this study; the native *Laminaria hyperborea* and a thermally tolerant species, *L. ochroleuca*, whose range is expanding northwards. To simulate conditions for the fate of detritus, detrital degradation was measured across an artificial gradient of depth where the spectral attenuation of light replicated conditions at 0, 15 and 30 m. Microcosms were artificially enriched in nutrients to compare how eutrophic conditions would affect kelp detrital physiology relative to ambient seawater. The degradation of detrital fragments was quantified for a two-month period by measuring the primary productivity, respiration and efficiency of Photosystem II, employing in-situ incubation experiments and PAM fluorescence. Generalised Least Squares regressions (GLS) indicated that kelp detritus continued to produce oxygen across time, although photosynthetic performance declined, and some differences were observed between the two species. Depth had significant influence on all measured physiological variables (Gross Primary Production, Respiration, ΦPSII and Fv/Fm) while nutrient enrichment was less important. This study reveals the underestimated importance of kelp detritus during its degradation. However, shifts in kelp species composition may have knock-on effects on the cycling of organic matter in benthic ecosystems. Furthermore, the physiological response of kelp detritus is dependent upon the range of habitats which it is transported to in the dynamic marine environment.

P16-1 Poster Presentation

Tropical fish in future oceans: how does living at the warmer edge of the thermal regime affect lipid dynamics and metabolic pathways?

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Keywords: clownfish, ocean warming, targeted metabolomics, biological pathways, eco-physiology

Climate warming is causing the rapid expansion of tropical warm pools in the oceans at rates exceeding 2 million square kilometers per decade. This phenomenon is leading to increasingly larger ocean areas delimited by high temperature isotherms, especially in the range between 29˚C and 30˚C. From an ecological perspective, this means that marine animals in these geographical areas will be trapped at the warmer edge of their temperature temperature regimes. This study used the clownfish *Amphiprion ocellaris* as a model species to determine how exposure to temperatures at the maximum of its thermal regime affected organismal lipid dynamics. A targeted lipidomics approach was used on the muscle and liver liver tissues by analyzing variation of fatty acid profiles, lipid dynamics and metabolic pathways, as well as the production of lipid peroxides. Two different experimental conditions conditions were implemented over 28 days: juvenile fish were exposed to average tropical water temperatures (26˚C, control), and the higher temperature of their thermal regime (30˚C). Results showed significant shifts in fatty acid profile between tissue types and quantitative enrichment & pathway analysis revealed changes in specific pathways in the liver after exposure to 30˚C for seven days. Enhancement of arachidonic acid, α-linolenic and and linoleic metabolic pathways suggest adjustments in the cell membrane's fluidity and melting point in response to higher temperatures, likely through an increase in saturation level of fatty acids esterified to membrane phospholipids and metabolization of polyunsaturated fatty acids into bioregulator eicosanoids that initiate several cell signaling pathways, promoting a process of thermal acclimatization. Coupled with the increase of lipid storage capacity at higher temperatures, despite moderate levels of lipid peroxidation due to a faster metabolism, our results indicate that *A. ocellaris* can persist in a warmer environment and may even extend their geographic distribution with the expansion of tropical warm pools.

P16-2 Poster Presentation

Assemblage structure of mesopelagic fishes in the Canary Current

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Keywords: Upwelling, deep-sea fish, community composition, size frequency distribution

Eastern Boundary Upwelling Systems are known as highly productive areas that are vital for fisheries. As they provide about 20% of global fish catches, it is important to understand the community assemblage and trophic interactions. Factors such as climate change and over-exploitation can have significant impacts on these environments. The Canary Current, located in the eastern Atlantic, has been overfished for many decades. As a result, a 75% decrease in demersal resources has occurred since the 1960s, as well as a change in the composition of dominant fish species. The highest biomass of fish on earth is that of mesopelagic fishes, which are important prey for many predatory fish. We aim to compare the community composition and size frequency distribution of mesopelagic fishes in the Mauritanian and Senegalese portions of the Canary Current. A rectangular midwater trawl was used to collect mesopelagic fish samples at stations off the coast of Mauritania and Senegal in July 2016. Samples were identified to species level and standard length was measured. Community composition and size frequency distributions were compared between the two sampled areas. Preliminary results suggest that while the dominant fish species differ between stations, the similarity in community composition is not greater within sampling regions than between sampling regions. In addition, size frequency distributions are similar between regions. Abiotic factors will be added to the analysis to confirm if parameters such as temperature or depth influence community composition and size distribution. It is important to research organisms that play an important role in the food web, especially since oceanic ecosystems are changing quickly due to climate change and other anthropogenic activity.

P16-3 Poster Presentation

Cyanide fishing will become deadlier in warming coral reefs of tomorrow

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Keywords: destructive fishing, climate change, Pomacentridae, marine aquarium trade, tropical ecosystems

An array of anthropogenic pressures are currently affecting tropical ecosystems, posing major conservation challenges for scientists, stakeholders and populations. Illegal cyanide fishing is one of the major threats to Indo-Pacific coral reefs, targeting a multitude of small colorful species for the marine aquarium trade as well as more palatable, larger groupers and wrasses for the food fish trade. Ultimately, the coupling of this destructive practice with climate change forcing may overload tropical ecosystems and result in irreversible ecological damage. Here we show that the impact of cyanide fishing in ornamental tropical marine fish is notably magnified by ocean warming. A sole pulse exposure to 50 mg L^{-1} of cyanide under current temperature (26 ˚C) caused substantial mortality (50-100%) in eight species of Pomacentridae. The clownfish *Amphiprion ocellaris* was the most resilient medium-sized fish (average total length = 38 mm; LC_{50} = 50.00 mg L^{-1}) that showed shorter recovery times and higher survival rates when compared to smaller-sized ones (average total length = 25 mm; LC_{50} = 28.45 mg L^{-1}). However, when the most resistant size-class was concomitantly exposed to a sub-lethal dosage of cyanide (25 mg L^{-1}) and ocean warming scenarios for 2100 (control 26 ˚C, +3 ˚C and heat wave +6 ˚C), survival rates decreased to 60% and 20%, respectively, and recovery times increased in the worst-case scenario. Mortality outbreaks, as well as vulnerability to predation, will likely expand in tropical reef fishes exposed to cyanide fishing, unless stronger conservation measures are taken to limit this destructive practice in the oceans of tomorrow. To promote the implementation of a reliable traceability protocol and contribute to the ban of this practice from coral reef areas, new research priorities are also suggested, for instance focusing on the clarification of fish excretion physiology and cyanide pharmacokinetics and associated interspecific differences.

P16-4 Poster Presentation

Cellular stress response and thermal tolerance limits of the ragworm *Hediste diversicolor* under global change scenarios

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Keywords: Critical Thermal Maximum, Heat shock proteins, Ubiquitin, Estuarine species, Polychaete

Climate projections predict significant changes in ocean chemistry, salinity variations and ocean temperature by 2100. This has led to a substantial interest in thermal ecophysiology, as temperature is a major factor shaping marine communities. Considering that most marine species are ectotherms, and thus cannot regulate body temperature, biochemical changes can occur with temperature variations. Moreover, salinity fluctuations can also induce physiological and metabolic changes in marine organisms. In this study, we experimentally evaluated the physiological and molecular responses of the ragworm *Hediste diversicolor* under predicted global change scenarios. Organisms were collected from the intertidal zone in Ria de Aveiro (Portugal) and subjected to an experimental trial under control (24˚C), and two treatment scenarios (27˚C and 30˚C) predicted by the Intergovernmental Panel on Climate Change, combined with salinity variations (20 ppt and 30 ppt) in full factorial design. We measured upper thermal limits after 30 days of acclimation, as well as cellular stress response biomarkers (Heat shock protein 70 kDa (Hsp70) and Ubiquitin) after 14 days (D14) and 28 days (D28) of acclimation. Results showed that higher acclimation temperatures lead to higher thermal tolerance limits and thermal tolerance limits increased when the salinity value was higher, suggesting that polychaetes that live in saltier water may cope better with warming. Thermal stress biomarker Hsp70 had a greater response at D14 than in D28, and overall no significant differences were found for Ubiquitin at both timepoints. This suggests that warming may have caused mild protein denaturation at D14, leading to the induction of chaperoning activity (*via* Hsp70 induction), but no irreversible protein damage occurred as ubiquitin levels remained constant. Finally, we concluded that this ragworm species is physiologically plastic as it shifts thermal limits according to acclimation temperature. Thus, it may be able to withstand environmental fluctuations and may be resilient to global change.

P16-5 Poster Presentation

Ecosystem services assessment provides key evidence for deep sea conservation management in the South Atlantic

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Keywords: Ascension Island; ecosystem services; deep sea; ecological functions; human activities.

Humans benefit from marine and coastal habitats in a multitude of ways. Some benefits are obvious, such as the use of natural resources (e.g. shellfish/fish, oil and gas), while others are less obvious, for example ecological functions (e.g. productivity and biodiversity), all of which can be described as ecosystem services. To date, the ecosystem goods and services provided by the different habitats and associated fauna of the Ascension Island Exclusive Economic Zone (EEZ) has not been assessed comprehensively. This study aims to present the first case study that links deep-sea habitats of connected remote islands with ecosystem services provided by ecological components within the habitats. Literature review and analysis of available data were undertaken to determine the presence of deep-sea habitats, as well as potential ecosystem services and habitat vulnerability within the Ascension Island EEZ. Key habitats reviewed are deep-sea benthic habitats, cold-water coral reefs, raised features in the seabed (seamounts and ocean ridges), and hydrothermal vents. The results showed that deep-sea habitats provide supporting services, which were considered significant to support ecosystem function and delivery of final ecosystem services that contribute to human well-being. Ecosystem services that can be translated to direct benefits for humans are of key interest. Although cultural services are underutilised, Ascension Island offers opportunities to develop high-value cultural services around scientific research, education and tourism. The lack of detailed information on the species present and general lack of information on life histories and habitat dependencies of deep-sea benthic invertebrates results in a high degree of uncertainty for assessing sensitivity. This study highlights the lack of evidence of ecological functions of deep-sea habitats and fauna within the Ascension Island EEZ, while providing an important resource for policy makers and stakeholders when considering the importance of the Ascension Island EEZ for human wellbeing.

P16-6 Poster Presentation

Origin of deep-sea hydrothermal vent copepods along the Mid-Atlantic Ridge

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Keywords: Deep-sea habitat, hydrothermal vents, meiofauna, population dynamics, connectivity

Hydrothermal vents are hotspots for life in the deep sea, with many mysteries still unsolved. The extreme environmental conditions have led to high adaptation of macrofauna species living at the vent fields, often resulting in endemism. Curiously, many genera and potentially even species of vent meiofauna seem to be shared with the shallow-water environment. In this project, we selected copepods to determine the phylogeography and degree of genetic and morphologic differentiation between two environments, namely the shallow water intertidal zone and deep-sea hydrothermal vents along the Mid-Atlantic Ridge. Copepods from a hydrothermal vent field southwest of Iceland (Steinahóll), located between 150 m and 300 m depth, were compared to copepods collected from multiple locations along the coastline of Iceland. We collected meiofauna in the intertidal zone on the Reykjanes Peninsula, the southwestern most tip of Iceland. We additionally sampled along the northwestern coast of Iceland and at two extremely shallow (15-30 m depth) hydrothermal vent fields in the Eyjafjörður in North Iceland, using scuba diving. We will utilize COI analyses to find shared species between these environments and further investigate the population dynamics using 2bRAD analyses. We hypothesize that geographic distance is the most important factor in, and a predictor of, high population connectivity, while depth and habitat type are less influential. This new knowledge will extend our understanding of the evolution of vent meiofauna as well as the resilience of hydrothermal vent habitats, which are currently threatened by anthropogenic activities, such as deep-sea mining. In addition, it will highlight the population connectivity of copepods in Iceland.

P16-7 Poster Presentation

Global patterns of seaweed species diversity

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Keywords: Algae, biogeography, environmental drivers, biogeographic realms, richness gradients

Knowledge of global patterns of biodiversity is fundamental for contemporary studies in ecology, evolution and conservation. Recent studies on global patterns of species diversity are predominantly conducted across heterotrophic taxa, but do not consider the major oceanic and coastal primary producers. Using macroalgae as a model, we aim to understand their biogeography along spatial and latitudinal gradients, and to detect potential drivers behind their distribution. Using the geographical range of macroalgae extracted form online databases (AlgaeBase and OBIS), we created global distribution maps of macroalgal species richness at different taxonomic levels (genus and species). We examined latitudinal patterns of species richness and range sizes and compared them with those predicted by mid-domain models. By formulating and fitting of global spatial regression models (GLS), we determined to what extent environmental variables could predict macroalgal species richness. Finally, we delimited biogeographical realms for benthic macroalgae. Macroalgal richness is highest in the Pacific Ocean, specifically in South East Asia, for all taxonomic levels and macroalgal groups. Red and brown seaweeds show an increased richness in temperate regions. Latitudinal gradients for macroalgae show the same bimodal pattern observed for most marine organisms. Deviations from mid-domain effect expectations indicate a lower diversity in polar regions and the tropics, and a peak in biodiversity in the northern temperate zone. GLS show that sea surface temperature and nutrients are important predictors of macroalgal genus richness at a global scale. Delimitation of the optimal number of biogeographic realms varies between groups. We found strong support for the delimitation of nine distinct marine realms for macroalgae. Macroalgae originated from temperate areas, as reflected in the high values of richness at latitudinal and spatial scales. The lower values of model coefficients indicate that biotic interactions (such as competition and predation) affect their presence in the tropics.

Session 17

Not as bad as it seems?! Why we need a differentiated evaluation of the impact of marine plastic litter

Call for Abstracts

Though numerous studies demonstrated the ubiquitous distribution of synthetic particles along with various detrimental impacts on both invertebrate and vertebrate marine species, your study objects refuse to eat the plastic dinner you served? Have you tried multiple methods to separate sediment particles from synthetic ones until you finally succeeded? We encourage you to share with us your field and laboratory lessons learned! Let's talk about why we also need the rather inconvenient results to truly assess the potential effects of (micro-) plastic on marine organisms and habitats – both from a scientific and a social perspective.

Session chair

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O17-1 Oral Presentation – Invited Speaker

Cellular effects of synthetic and natural microparticles in the Brown shrimp *Crangon crangon*

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Keywords: microplastics, natural microparticles, marine decapods, ingestion, oxidative stress

Microplastics are matter of debate in environmental science, politics, and the public. They are mostly degradation product of bigger plastic items, abraded fibers from fabrics or fishing gear, or exfoliators from cosmetic products. These particles are accumulating in the marine environment and may be ingested by marine organisms. Apart from microplastics, marine environments and, particularly, coastal regions, contain by nature various microparticles of biological and non-biological origin. These comprise empty or broken diatom frustules, chitinous or calcareous body parts of animals, sand grains, and other minerals. Such natural microparticles can be ingested by marine organisms as well and may cause adverse cellular effects. Vulnerable are especially filter-feeders, and those animals living in estuaries, with constant exposure to a variety of suspended particles. Bigger particles are usually expelled from the digestive system via avoidance, formation of pseudo faeces, or regurgitation. Smaller particles, however, can easily pass the filter systems, enter the digestive organs, and cause cellular stress. A complementary approach of field observations and laboratory experiments will investigate the differences between natural and anthropogenic microparticles in the cellular stress response of the Brown shrimp (*Crangon crangon*). The aim of this doctoral project is to determine the actual hazard potential of microplastics and define their boundaries for marine decapods.

O17-2 Oral Presentation

Riverine microplastic as a vector for multidrug-resistant and potentially pathogenic bacteria

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Keywords: culture-dependent, species richness, transport, North Sea, River Weser

Microplastic (MP), as an emerging threat to the marine environment, has recently been recognised as a potential vector for the dispersal of microorganisms, including pathogenic and multidrug-resistant bacteria. Consequently, this poses the risk of propagating these harmful microbes into new environments in an invasive manner. While a lot of research has been conducted on MP in the oceans, less is known about MP in rivers and estuaries. However, it has been proposed that rivers might serve as important transportation routes and sources of MP in the oceans, and hence could be transferring pathogens on MP from terrestrial into marine environments. The aim of our study was to investigate the potential of riverine MP to transport harmful bacteria into the ocean. Therefore, we analysed the occurrence of multidrug-resistant and potentially human-pathogenic bacteria in biofilms sampled from freshwater, estuarine and marine sites. Two types of MP (polyethylene and tyre wear particles) and a natural substrate for comparison (wood particles) were sequentially incubated at multiple sites to simulate riverine transport. Incubations started upstream in the River Weser in Bremen and ended off Heligoland in the North Sea. A second set of particles was incubated at Heligoland in the same time-period. Water samples and subsamples of particles were collected and transferred to selective media for the enrichment of potentially pathogenic coliforms and *Vibrio* spp. Obtained bacterial isolates were identified with Matrix-Assisted Laser Desorption/ Ionisation – Time Of Flight Mass Spectrometry. Our results show higher species richness in water samples compared to particles, with wood displaying higher richness than MP particles. Samples with higher species richness always contained more potential pathogens. Particles transported through the River Weser showed much higher species richness than particles only exposed to seawater off Heligoland. Thus, we could demonstrate riverine transport of bacteria on both, wood and MP particles. This leads us to conclude that MP acts as an additional vector for potentially pathogenic and multidrug-resistant bacteria even though they are not enriched on it compared to water and wood.

O17-3 Oral Presentation

The anthropogenic impact on modern coral skeletons

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Keywords: Coral, Microplastics, Pollution, Marine Health Threat, Carbonate Sedimentology

The calculated global carbonate production is five billion tons per year – of which three billion tons are estimated to be solid and accumulating in sediments. Recent studies indicate that those sediments are heavily polluted with plastics. Almost 13 million tons of plastic enter the marine environment every year, accumulating in gigantic garbage patches. Through different processes of degradation, larger plastic pieces are subsequently fragmented into microplastic particles. These initially very light particles are constantly subject to biofouling and are gradually being deposited. Microplastics have been detected everywhere in the ocean, from beaches and surface waters to deep sea habitats. They have the capacity to mimic taste and texture of food items. This trait makes them a potentially high risk for bioaccumulation and biomagnification. Microplastics are suspected to threaten the health of marine biota by spreading diseases or by soaking and leaching of toxic components. To date, little is known about the concrete effects of plastic pollution, and while avoiding is the first choice, research is needed to counteract the effects of microplastic in the marine environment. We aim to understand the interactions between microplastics and coral skeleton production. Therefore, we conducted experiments in the aquarium facility at the Leibniz Centre for Tropical Marine Research. During a 5-month experiment we exposed four different coral species to high concentrations of microplastic and in further analysis investigated their tissue and skeleton for significant alterations to the natural growth form. Analytical methods range from scanning electron microscopy (SEM) to microtome cuttings, as well as micro computed tomography (µCT) imagining. The impact on skeletal composition and stability as a result of possible microplastic incorporation is a topic for discussion in future research.

O17-4 Oral Presentation

What behavioural differences does the hard coral *Pocillopora damicornis* show towards PET microplastics of fibre and irregular shape of environmentally realistic concentration?

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Keywords: Coral-microplastics interaction, Microplastics shape, Method development, Low coral responsiveness

Microplastics in the marine environment appear in various shapes. So far, little is known about how corals interact with microplastics and whether their responses differ with particle shape. Thus, in this study, colonies of *Pocillopora damicornis* were exposed to environmentally realistic concentrations (ca. 20 items / individual) of fibre and irregular shaped polyethylene terephthalate microplastics (250 – 2000 µm). Polyp interactions with microplastics were monitored over a period of 12 hours using an underwater camera. Five common types of polyp responses were observed and classified into levels of increasing polyp activity. Polyps were generally inactive and insensitive towards microplastics and polyp retraction was infrequent in both exposed and control colonies. Interactions of polyps with fibre and irregular microplastics lasted on average 34 minutes and in 5 % of the cases, led to uptake and egestion. There was no difference in the frequency of different types of polyp behaviours towards microplastics that could be attributed to particle shape. However, fibres formed aggregates and came in contacts with twice as many polyps as irregular shaped microplastics. The residence time of an average fibre on the coral colony was twice as long, whereas residence on the coenosarc tissue was 9 - times longer than those of irregular shaped particles. Findings of this study indicate a high risk for *P.damicornis* to be exposed to microplastics of fibre shape for longer periods of time. Yet, microplastics caused minimal behavioural stress to coral colonies and feeding occurrences were rare compared to high ingestion rates recently reported by exposing corals to unrealistically high microplastics concentrations. Thus, future studies should prioritise the application of microplastics in environmentally realistic concentrations to test whether the previously reported extent of stress caused by microplastic exposure holds true.

O17-5 Oral Presentation

A costly decision—picky corals prefer food over microplastics

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Keywords: *Artemia* cysts, coral reefs, feeding rates, ingestion, pollution

Ubiquitous plastic litter in the oceans is an increasing threat, as it occurs along coastal areas where most coral reef ecosystems are located. Direct contact and interactions with microplastics, like handling and ingestion, are associated with negative effects for marine life. In particular, suspension feeders, such as corals, might be affected. It has been demonstrated that heterotrophic coral species preferentially ingest microplastics over natural food. However, little is known about the effects on reefbuilding corals that mainly rely on photosynthetic energy of the associated symbionts and might feed more selectively. Therefore, the goal of the study was to assess microplastic feeding rates and reactions of symbiotic reefbuilding corals as a proxy for its impact on these species. Feeding rates of the species *Acropora muricata*, *Porites lutea*, *Pocillopora verrucosa*, and *Heliopora coerulea* on microplastics were compared to those on natural food (*Artemia* sp. cysts) and the reactions to the exposure was documented. The experiments showed that corals fed more on natural food than on microplastics. This suggests that reefbuilding corals may be able to discriminate between food and microplastics. This is likely triggered by chemical stimuli present on the particles. However, corals produced more mucus and everted their mesenterial filaments more often in the presence of microplastics. These defence reactions may in turn incur negative effects on their energy budget. The results underline that, although reefbuilding corals appear to be able to discriminate between microplastics and natural food, they nonetheless respond with energetically costly defence mechanisms, likely adding up to the existing anthropogenic stressors posed on coral reefs.

O17-6 Oral Presentation

Efficient Microplastic Extraction from Intestinal Tract and Gills of Commercial European Seabass (*Dicentrarchus labrax*)

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Keywords: KOH, Ingestion, Translocation, Gill, Intestine

Several digestion methods have been used, making it impossible to compare results between studies and draw conclusions about plastic contamination within biota. Furthermore, some digestion methods led to a degradation or alteration of plastic polymers which may lead to an over- or underestimation of microplastics in aquatic organisms. In this bachelor thesis, which is part of the TRAMIS project (Translocation of Microplastic in Fish Filet), we have investigated the effectiveness of digestion method on European seabass, *Dicentrarchus labrax* intestine and gill. Juvenile European seabass were fed diets with and without fluorescent microplastic (MP) particles ~1-5 µm under controlled conditions in a recirculation aquaculture system for 16 weeks. Subsequently, the digestion efficiency (%) of intestines and gills from European seabass were tested using a 10 % KOH digestion protocol. Both organs were digested efficiently (>98 %) using a 10% KOH solution. Microplastics (1-5 µm) were found in the intestinal tract as well as in gills and showed different size patterns. An average amount of 26.8 ± 18.7 MPs/g (2.8 ± 1.6 MPs/individual) was detected in intestine samples, while 9.3 ± 8.9 MPs/g (8.6 ± 8.1 MPs/individual) was found in gills. Therefore, the amount of MPs/g was higher in intestines compared to gills whereas the number of MPs/individual was less in intestines than in gills. Regarding our results, possible translocation pathways are discussed, as well as the human health risk in terms of European seabass consumption.

O17-7 Oral Presentation

Plastic for Breakfast? Study on Feeding Preferences of Seabreams in a Coastal Lagoon System

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Keywords: Ria Formosa, Sparidae, *Spondyliosoma cantharus*, Microplastic, Diet

Aquatic coastal habitats such as lagoons and estuaries are productive areas and represent important nurseries for various marine fish species, the recruits of tomorrow. These ecosystems link the terrestrial environment to the marine realm, however, they also function as bridges for the transport of plastic debris from land- based sources to the ocean. In fact, the abundance of microplastics (MP; <5 mm) is high in coastal waters, especially near urbanized areas. The effects of MP on different fish species vary. Knowledge on the impact of MPs on young fish is still scarce, in particular with respect to the connection between MP occurrence and diet preference. The present study focused on the investigation of potential spatial variation of MP occurrence in the Ria Formosa lagoon (Southern Portugal) and possible ingestion of MPs by juvenile black seabream (*Spondyliosoma cantharus*) along with the presence of organic food items, in relation to environmental parameters and fish condition. Preliminary results indicate low plastic abundance in surface waters and benthic seagrass habitats of the Ria Formosa during low tides in Autumn 2018. Only low numbers of MP, mainly exhibiting a filamentous shape, could be collected in *S. cantharus* gastrointestinal tracts (GITs). It remains to be discussed, whether the low findings of MP in the water column and in the fish's GITs are connected to the tidal cycle, high water exchange rates, fish foraging type and specific fish characters such as size or feeding preferences.

P17-1 **Poster Presentation**

Microplastics in aquatic systems – threat or exaggeration?

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Microplastics (synthetic polymers, <5 mm) are ubiquitous, in the environment and in the news. The potential effects of microplastics on flora and fauna are currently only established through laboratory-based exposure trials; however, such studies have come under scrutiny for employing excessive concentrations with little environmental relevance. A meta-analysis of results from published experimental (n = 128) and environmental (n = 180) studies allowed us to compare the reported impacts on organisms, and the concentrations of microplastics found in the wild. Our results highlight three issues that should be modified in future work: (1) use of extreme dosages, (2) incompatible and incomparable units, and (3) the problem of establishing truly informative experimental controls. We found that 5% of exposure trials did not use any control treatment, and 82% use dramatically elevated dosages without reference to environmental concentrations. Early studies in this field may have been motivated to produce unequivocal impacts on organisms, rather than creating a robust, environmentally relevant framework. The existing literature on the extent of plastic pollution also has limited utility for accurately synthesizing broader trends; environmental extraction studies use many different units, among which only 76% (139/180) could be plausibly converted for comparison. Future researchers should adopt the units of microparticles/kg (of sediment) or mp/L (of fluid) to improve comparability. Now that the global presence of microplastic pollution is well established, with more than a decade of research, new studies should focus on comparative aspects rather than the presence of microplastics.

P17-2 **Poster Presentation**

Microplastics in estuarine protected areas of the Bay of Biscay

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Keywords: Cantabric coast, Estuaries, Marine litter, Marine Protected Spaces, Open beaches

Plastic pollution is one of the major ecological problems that endangers many vulnerable marine species. Here, microplastics were quantified from different beaches of southwest Bay of Biscay (Spain) within Natura-2000 Special Protection Areas for birds. Sand samples were taken using a randomized quadrat-based protocol inside three estuaries, and in the closest beaches on the open sea. Between 201 and 382 microparticles per kg of dry sand were found, which is relatively high in comparison with other European beaches. Microfibers were more abundant than microplastics. Statistical analysis revealed a significant effect of the beach location (inside versus outside the estuary). Open beaches contained a higher density that inner-estuary beaches, which suggests beached microplastics are coming mainly from the ocean. Lack of microplastics association with population density and industry suggests an effect of poor wastewater treatment in small communities. As microplastics act as vectors of contaminants and toxic substances which can cause several damages (such as cancer), all marine species that ingest microplastics are in danger. One of the most vulnerable taxa to plastic ingestion are birds. These animals are found to have preference for light-coloured fibres. As this study has been performed in Special Protected Areas for birds, and results showed high concentrations of their preferred light-coloured fibres (white/transparent), these birds are at risk of ingestion, and therefore, they are expose to this toxic substances.

P17-3 Poster Presentation

Beyond single polymers: The effects of microdebris on reef-building corals

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Keywords: 3D scanning, growth rates, microplastic, reef-building corals, photosynthetic activity

The pollution of the environment with anthropogenic debris gained recent attention in public and science as it is considered to be a major threat to marine ecosystems. Given that particles are mainly of terrestrial origin, coastal ecosystems, such as coral reefs are particularly threatened. Increasingly, studies focus on the effects of microplastics (i.e. fragments <5 mm) and could show that reef-building corals respond differently to microplastic exposure and are negatively affected by it. However, all studies assessed the impact of single polymer types, but little is known about the effects of naturally occurring mixtures of microdebris. Thus, the goal of our study was to assess the influence of three types of microdebris on two scleractinian coral species (*Stylophora pistillata* and *Pocillopora verrucosa*), known to frequently ingest microplastics. We conducted an 8-week laboratory experiment and exposed corals to 1) a mixture of secondary marine microplastics, composed of fragmented plastic debris, 2) a combination of residues from the automobile sector, consisting of tire wear, brake abrasion and varnish, and 3) an assortment of artificial fibres from customary clothes, and compared corals' responses to those observed in 4) a single polymer exposure to polyethylene and 5) a plastic-free control treatment. In particular, we studied corals' growth rates using 3D scanning together with buoyant weighing. In addition, the photosynthetic activity of the associated photosymbionts was measured using Pulse Amplitude Modulation Fluorometry to infer on the integrity of the coral holobiont. We hope to get a better understanding of how microdebris of different anthropogenic origins affect reef-building corals and what measures might be undertaken to alleviate this anthropogenic pressure posed on coral reefs.

P17-4 Poster Presentation

Quantification of stranded and buried plastic and ingestion by the mud crab *Scylla tranquebarica* in a mangrove forest, Java, Indonesia

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Keywords: Plastic; micro plastic; mud crab; pollution

This study provides baseline data for plastic litter quantification in the Segara Anakan lagoon, the largest remaining mangrove forest of Central Java, Indonesia. One commercially important mangrove species (the mud crab, Scylla tranquebarica) was investigated for micro plastic inhalation and ingestion. Stranded plastic litter was heterogeneously distributed in the whole lagoon with the largest amounts in proximity to the city of Cilacap and the river mouth of the Cibeureum River with up to 27.1 ± 21.2 items m^2 at the low tide waterline and an average of 5.86 ± 8.32 items m^2. Stranded plastic did not penetrate the mangrove forest deeply, possibly prevented by thick vegetation growth. The majority (86%) was macro (2-100cm) or mega plastic (>100cm) and plastic packaging for food or household items followed by polystyrene which was possibly derived from nearby fishing activities and food packaging. Buried plastic was quantified to a depth of 20cm with a mean of 105.7 ± 118.6 items kg^{-1} of dry sediment. 30.7% was classified as film, 44.6% as fibers, 16.9% as particles and 7.8% as foam. The majority of buried plastic was 0.5-1.9mm (55.2%). Buried plastic concentration was not correlated with grain size. Microplastic was found in all 20 *S. tranquebarica* individuals. On average 16.4 ± 6.5 items $individual^{-1}$ were found or 0.16 ± 0.7 g^{-1}wet weight of whole crab with 95% of them being fibers. The most items were found in the hepatopancreas followed by gills and stomach content. The mangrove forest has a higher concentration of plastic on the sediment surface and in the sediment than reports from other mangroves and other Indonesian shorelines. The ingestion of micro plastic by *S. tranquebarica* shows that plastic has entered the mangrove food web possibly affecting other organisms. *S. tranquebarica* could be a vector for micro plastic into the human food chain.

P17-5 Poster Presentation

Mediterranean *Posidonia oceanica* to micro- and nano- plastics and sorbed additives

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Keywords: Diazotrophs, marine litter, seagrass, cyanobacteria

Posidonia oceanica (L.) Delile is an endemic angiosperm that forms extensive meadows (50.000 km^2) that constitute the most productive ecosystem in the Mediterranean basin. It is widely accepted that *P. oceanica* meadows constitute an important source of new atmospheric nitrogen (N_2) to the system. This may be due to the vast variety of N_2-fixing or diazotrophs epiphytic and endophytic microorganisms that potentially could supply the entire nitrogen demand of this seagrass. Since 1970, plastic pollution has risen as a main threat to marine ecosystems, particularly in the Mediterranean Sea, which has been recently considered one of the most contaminated seas reaching plastic concentrations of 900-2500 $g{\cdot}km^{-2}$. Diazotrophs appear to be highly sensitive to environmental stressors, causing the deterioration of the seagrass itself, and thus, modification of Mediterranean nitrogen cycle. However, investigations on the effects of plastic (nano/microplastic) pollution are relatively new and have not been described in marine bacteria. The present study is part of a further extent research on studying the repercussions of the most abundant nano/microplastics and their sorbed additives in some bacterial strains appeared to be associated with *P. oceanica*. In order to assess the consequences of nano/microplastics, fluorescent polystyrene [PS] beads (nanoparticles) and polyethylene [PE], polypropylene [PP] and polyvinyl-chloride [PVC] (prepared powder) were added to N_2-fixers cultures growing. These plastics were combined with chemical additives that usually are present in these types of plastics (*i.e.* fluoranthene). The results presented showed a clear bacterial-plastic interaction, indicating that low levels of microplastics, nanoplastics or additives do not have a significant effect on these diazotrophs N_2 fixation, growth or other biochemical parameters. On the other hand, high concentrations appeared to cause different responses, showing even beneficial effects. Further studies are needed to evaluate the effects of the predicted concentrations of plastic contamination *in situ* in *P. oceanica* meadows.

Session 18

Emerging Technologies in Marine Science

Call for Abstracts

We call for participants to join the session "Emerging technologies in marine science." New technology is rapidly evolving and we are looking for the pioneers making it happen. We call on students who use new approaches in answering old questions or students who are asking new questions entirely with technological advances. This could range from applying new software to model marine habitats, to novel bioinformatics pipelines, or innovative self-constructed experimental designs. If it's new and you think it could benefit other students, we want to hear about it! So, submit your abstract to our session and let's update the field with your fresh perspective!

Session chairs

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O18-1 Oral Presentation – Invited Speaker

Validating underwater hyperspectral imaging and automated habitat mapping method for coral reef surveys

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Keywords: Habitat assessment, HyperDiver, machine learning, benthic maps, comparative analysis

Coral reef assessments are inherently challenging due to the trade-off between taxonomic resolution and spatial range. Methods that prioritize fine-scale taxonomic accuracy are limited in scale of coverage, whereas methods that maximize spatial range lose taxonomic resolution as well as minute-scale heterogeneity within a coral reef. An underwater hyperspectral imaging and automated benthos mapping system called the HyperDiver is a promising development in coral reef monitoring because it addresses these trade-offs. By training a machine learning classifier on the HyperDiver's rich hyperspectral data, we have the ability to generate habitat maps of a higher taxonomic resolution than remote sensing platforms, while having a much larger spatial range than conventional in situ underwater survey methods. We can alleviate the annotation bottleneck in coral reef survey workflows by using a machine learning classifier to accurately predict benthic classes with an accuracy of approximately 80%, with minimal annotation effort by human experts. With the aim of validating the HyperDiver method as a coral reef survey methodology, we carried out a comparative analysis of both a traditional image-based survey method that relies on random point count sampling and the new hyperspectral method. Survey data using both methods were collected from the same transects in coral reef sites around the Caribbean island of Curaçao. We demonstrate that the hyperspectral method not only produced a comparable output to traditional methods, such as biodiversity indices and coral cover, but was also able to capture reef-scale variations and heterogeneity that would have otherwise been lost during index calculation and data aggregation. The HyperDiver survey method allows for continued analysis of long-term monitoring data and comparisons to historical baselines, while at the same time producing spatially-explicit habitat maps that could be useful for spatial pattern analysis.

O18-2 Oral Presentation

Alternative Antifouling Applications (A³)

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Keywords: Biofouling, Aquaristics, Coral Reef Restoration, Benthic Community, Surface Coating

Biofouling creates problems or serious drawbacks not only in the shipping industry, but also in the food processing industry, water treatment and in desalination plants. Aquaculture units need to be cleaned and maintained periodically due to severe growth of biofouling. A smaller industrial sector, marine aquaristics, also suffers from high maintenance costs. In the course of the PhD project A³, new applications for antibiofouling will be explored and eventually applied to a new product design in the marine aquatic ornamental industry. Another aim is to enlarge the scientific knowledge behind coral reef restoration via sexually reproduced coral larvae, since corals are in serious danger and selected species might go extinct in a few decades, if causes of stressors are not being decreased and restoration efforts fail to succeed. Without corals and their genetic diversity, also the marine ornamental trade will lose its trading products and therefore the attractiveness to the consumer. Therefore, the objectives of the study are to test for the toxicity of different surfaces and antifoulants, including new and scarcely studied antifouling agents, in order to effectively support future antibiofouling management. The focus of the study organisms will be on biofilms and scleractinian coral larvae due to their local and global importance for the environment and economy. The benthic community response to different antifouling surfaces will be determined and the physiological response of coral life stages in response to antifouling agents available in the surrounding water and in surface coatings will be studied.

O18-3 Oral Presentation

Copepodamides in blue mussels (*Mytilus edulis*): Applications for predictive biotoxin monitoring

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Keywords: Grazer cues, Harmful algae bloom, Diarrhetic shellfish toxin, Yessotoxin, Copepodamides

As shellfish filter feed they accumulate chemical compounds, integrating a chemical record of the water column. Accumulation of algae toxins is a main challenge for shellfish aquaculture, and methods for predicting toxicity are urgently needed. Recent discoveries have identified copepodamides, a group of chemical cues produced by grazing copepods, to be main drivers for toxins in key species of harmful algae. In this project I aimed to link copepodamides to harmful algae toxins by comparing extracts from blue mussels. I show the first experiments characterizing copepodamides in mussels and explore copepodamide accumulation as an early warning for biotoxins. I extracted and quantified copepodamides from blue mussels along Swedish west coast over a period of 8 months in 2018. Results showed seasonal variation with highest copepodamide concentrations in May, low concentrations through summer, and increasing concentrations after October. Over the same period and geographic region, blue mussels were contaminated twice with diarrhetic shellfish toxins (DST) and once with yessotoxins (YTX). Toxins were preceded by copepodamides with correlations that were stronger or equal to correlations with cell counts of toxic taxa. Different results were observed for DST and YTX, supporting theories of diversity in predator-prey dynamics and defensive signalling between different plankton species. Further research on the quantitative relationships between grazer cues and harmful algae blooms may advance development of accessible and predictive methods for biotoxin monitoring.

O18-4 Oral Presentation

Collaborative technologies – high-resolution data, 3D biogeochemical models, statistical software: Black Sea oxygen dynamics

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Keywords: isopycnals, waves, oxygen, phytoplankton, R-software

Decomposing the influence Internal Waves (IW's) impose on biogeochemical processes, contributing to the oxygen dynamics in seawater bodies, is essential in understanding and combating the declining trend of oxygen content in global oceans and coastal waters. In this study, oxygen observations were obtained from the northeastern Black Sea continental slope waters between January and March 2016, sampling across the oxygen gradient from the ventilated surface layer to the deeper permanently anoxic water masses. Water column oxygen conditions were decomposed relative to localized oxygen regimes to identify anomalous observations pertinent to enveloped processes such as IW's. The observational data was then qualified within the state-of-the-art NEMO-BAMHBI 3D biogeochemical open ocean physics model, for a finer understanding of mechanistic biogeochemical implications. The North East Black Sea Rim Current zone was observed to transmit IW perturbations throughout the oxygenated water column, conveying low to high frequency bands as coastal-trapped Kelvin Waves (~15 day period), Near-Inertial Waves (from ~8 to- ~3 day periods), and the latitudinal locked Inertial period Wave (~17hr), respectively. Investigation of Black Sea biogeochemical processes through the NEMO-BAMHBI 3D model validated both the presence and seasonal migration of the primary Kelvin Wave signal (2.149 ms^{-1}), and the maintenance of a biological 'pump' exerted along the ventilated layer isopycnals (14-15 kg m^{-3}), influencing multiple biogeochemical cycles. The Kelvin Wave's importance on the Black Sea basin oxygen budget is defined through modelled increases of ~500 % in Net Primary Production values through a basin-wide cyclonic, vertical displacement of isopycnals, directly respective of coastal regions but with further implications suggested for the greater basin processes.

O18-5 Oral Presentation

profi: A Bioinformatic Tool for the Prediction of ssDNA Prophages within Prokaryotic Genomes

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Keywords: Bioinformatic Pipelines, Bacteriophages, Inoviridae, Microviridae, Hidden-Markov-Models

Viruses are the most abundant entity in the marine environment and shape the microbiome drastically: by infecting bacteria, archaea and eukaryotes, phages alter community composition and diversity, mediate horizontal gene transfer (HGT) and can even change the metabolism of their respective hosts. In order to study these *phages*, they are either cultivated or bioinformatically detected and analysed in metagenomes or in single-amplified genomes (vSAGs). Cultivated representatives are dominated by double-stranded DNA phages, while the few single-stranded DNA counterparts can be classified into only two families: inoviridae and microviridae. At the same time, existing bioinformatic tools for the prediction of phages within (meta-)genomes, are also developed for dsDNA phages. Here, we present a novel tool for the prediction of ssDNA phages within (meta-)genomes: **Pro**phage **Fi**nder - **Profi**. Profi uses a custom-made database of Hidden-Markov-Models of viral ssDNA proteins, together with traditional blast approaches in order to detect distant viral homologs within a given sequence. It furthermore classifies potential prophage regions into categories, depending on the presence of certain hallmark genes of ssDNA prophages. Currently (July 2019), we are analysing over 300,000 bacterial and over 3,500 archaeal genomes in a large-scale effort to detect ssDNA phages. Profi will be available as an online tool and for download.

O18-6 Oral Presentation

A new approach of mapping interactions among human stressors for marine spatial planning in the North Sea

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Keywords: Random Forest, environmental assessment, anthropogenic seascape, early strategy

Anthropogenic stressors have a profound influence on the biome, leading to changes - often degradation - of habitat structure and species composition. Traditionally, a data driven process, from measurements and related analyses to developed management plans, is too slow for the general goal of nature protection and conservation. Therefore, it would be useful to introduce a tool that allows the implementation of management plans before knowing the actual impact of anthropogenic stressors. In fact, we believe that the identification of areas where human activities are mostly taking place can already serve for management purposes. However, currently environmental assessments consider stressors cumulatively, as their potential danger has been assumed to be related to a sum of anthropogenic activities. In this study, we developed a tool that identifies the interacting stressors, with their intensity and sign of interaction at each location. This way, we were able to map attributes of interactions while acknowledging their spatial variation across the seascape. The method was designed in R, using Unsupervised Random Forest to select the interacting variables, with the intensity and sign of their interaction being provided by the coefficient in a regression model. These steps were repeated using a moving window approach across our study area. We applied this method in the North Sea and the English Channel, as they are well-known human exploited areas. We focused on stressors with a potential impact on the benthic fauna such as bottom trawling, presence of wind farms, protected areas, aquaculture and pollutant distribution. The description of interacting stressors provides a new approach in the framework of environmental assessment and marine spatial planning, as it can contribute to develop early strategies of mitigation before an impact assessment on the entire ecosystem has been achieved.

O18-7 Oral Presentation

Development of a low-cost open-source potentiostat for in-situ electrochemical measurements

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Keywords: Voltammetry, Geochemistry, Redox Chemistry

Electrochemical measurements are an important part of the analytical toolbox for the characterization of aquatic environments. Voltammetry is an electrochemical method based on measuring the electrical current generated by redox reactions at an electrode surface as a response to an applied electrical potential. It can be used to measure a wide range of analytes depending on the electrode type used as well as the applied potential range. In recent years, great advances have been made in the field of low-cost and open source electronics for analytical measurements including several potentiostat designs for laboratory voltammetric measurements. However, laboratory measurements bear the risk of contamination during sample acquisition, transport, storage, and analysis. For in-situ voltammetric measurements, the KStat potentiostat – based on the low-cost, open source DStat by Michael Dryden – was developed by modifications of the circuit and interface for increased potential range and field control. This design can be produced at a material cost of only ~130 $US and is easily encased into underwater housings. It can also be controlled by Python programs and integrated with peripheral sensors and electrode manipulation systems. In laboratory tests, the modified version performed equally as well as commercially available potentiostats for use with Hg/Au working electrodes allowing for measurements of oxygen concentration, sulphur speciation, and Fe(II) and Mn(II) (the latter three given absence of oxygen) in the water column and sediment porewater. It was successfully deployed for measurements in the anoxic bottom water of Nomilo Fishpond on Kaua´i island as well as sedimentary porewaters using a low-cost integrated system with a Raspberry Pi control unit. The KStat is a further development in the growing field of low-cost, open source analytical methods allowing for broader access to scientific data and potentially increasing spatial and temporal resolution of voltammetric measurements.

O18-8 Oral Presentation

Classification of plankton images with a Capsule Neural Network (CapsNet)

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Keywords: FlowCam, machine vision, spatially-composed features

Manual classification of plankton images as generated by imaging systems like the FlowCam is a process with strong temporal and personnel demands. Machine Learning theory enables the design of automatic image classifiers based on the "neural network" multi-layer processing architecture. Once trained for a specific task, such algorithms can classify tens of thousands of images in short times, limiting human involvement to the design and fine-tuning of the neural network, and to the labeling of a training data set. Common models like basic convolutional neural networks (CNNs) and the older support-vector machines perform many tasks reliably. Still, plankton classification is a daunting task, especially when differentiation between a high number of classes is desired. Recently developed Capsule Neural Networks (CapsNets) give reason to expect overall improvements in classification due to their superior ability to take account of spatially composed features, supposedly reducing the need for training images. Furthermore, CapsNets have been shown to outperform basic CNNs in classification accuracy on recognition of handwritten digits. In our study, we modified an existing Capsule Neural Network for the classification of FlowCam plankton images. Contrary to the expectations set on CapsNets, early results show no improvements over regular CNNs, suggesting that the faster CNN algorithm is a more suitable tool for the given task. Future analyses on CapsNet performance will concern size of the training data set, the extent of class separation, and nested classification approaches.

O18-9 Oral Presentation

Reliable Assessment of marine biogeochemical Models using diffusion based Kernel Density Estimation

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Keywords: data evaluation, non-parametric density estimation, data comparison, Earth system modelling, model calibration

Assessing the quality of marine biogeochemical models is important to construct reliable climate projections. Biogeochemical models estimate the changing distribution of carbon and nitrogen in the Earth system. This element cycling confines the amount of carbon the ocean can remove from the atmosphere. Optimizing a model requires a model assessment calculating the model-data misfit. A possibility for such an assessment is the comparison of the probability density function of simulation results and corresponding field data. Unfortunately, a probability density function is in general not possible to construct directly from the data. Kernel density estimators (KDEs) provide a non-parametric approximation of the probability density function. However, available KDEs have shortcomings in the application on biogeochemical data in terms of structure resolution, maximum data size or performance speed. We developed a new implementation of a diffusion-based KDE, which is defined as the solution of the diffusion heat equation. Our implementation is based on a finite element discretization and shall be provided free as an open source Python function. We designed it with a new approximation of optimal kernel bandwidth and pilot estimate. In numerical experiments we tested our KDE individually and in comparison to the traditional Gaussian KDE. We found our implementation to work fast and reliable on large, noised and multimodal data sets. Compared to the Gaussian KDE, our implementation showed superior performance in the last point. The advantage of this is visible in the detection of the model-data reproduction. We conclude a high suitability of the new diffusion based KDE implementation for the calculation of biogeochemical model assessments. Our study will provide a reliable tool to conduct model optimization and construct trustworthy climate projections.

O18-10 Oral Presentation

A probabilistic damped-persistence forecast of the sea ice edge location

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Keywords: Sea ice, Forecasting, Modeling, Ice edge

Increased presence of marine traffic and tourists in the Arctic in recent years has highlighted the necessity for meaningful prediction of sea ice conditions at sub-seasonal to seasonal time scales. In this regard, reference forecasts based on present and past observations of the ice edge location are important to benchmark the added value of dynamical forecast systems. However, the simplest types of reference forecasts – persistence of the present state and climatology – do not exploit the observations optimally and thus lead to overestimation of forecast skill. For spatial objects such as the ice edge location, the development of damped-persistence forecasts that combine persistence and climatology in a meaningful way way poses a challenge. We have developed a probabilistic reference forecast method that combines the climatologically derived probability of ice presence with initial (present) anomalies of the ice edge. We have tested and optimized the method method based on minimization of the Spatial Probability Score, using observed as well as idealized model data. The resulting reference forecasts provide a challenging benchmark to assess the added value of a dynamical forecast system.

O18-11 Oral Presentation

Rapid Biodiversity Assessment of Harpacticoid Copepods using MALDI-TOF MS

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Keywords: species identification, proteomic fingerprint, Random Forest

Meiofauna research has always been a challenge considering the trouble of morphological identification. Especially for ecological studies accurate identification of specimens is required if a precise picture of biodiversity and community structures is desired. This is a time-consuming task when working with samples containing high numbers of specimens such as small harpacticoid copepods. As the second most abundant animal group in sediment samples, specimen numbers can easily exceed 1,000 specimens in a single sample. Thus, morphological identifications would be highly time-consuming while other accurate methods such as single gene barcoding would be too costly. Moreover, single gene barcoding is highly primer biased and especially in meiofauna research, amplification success is rather low. To accelerate species identification Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF MS) was proven a rapid method for species identification based on a proteomic fingerprint in a wide range of metazoan taxa. Employing a previously generated reference library and a machine learning approach, the proteomic fingerprint is used to identify specimens to species level. In this study, for the first time, MALDI-TOF MS was applied for rapid biodiversity assessment of previously unidentified harpacticoid copepods from four sampling sites across the German EEZ. Acquisition of proteomic data and subsequent identification to species level was carried out for more than 600 specimens within a single week. This accelerated data generation by weeks or months to answer further ecological questions. Results in terms of species identification are promising and hence a method is provided that will potentially reduce the time invested for species identification which so far took most of the time in meiofauna research.

P18-1 Poster Presentation

Flood Patterns in the Mekong Delta Based on Satellite Data Time Series: Impact on Vietnamese coastline

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Keywords: Mekong Delta, flood mapping, flood patterns, time series, synthetic aperture radar (SAR).

The Mekong Delta, one of the world's largest plains, is located in Southern Vietnam and the lower Mekong river basin, and runs directly into the Gulf of Thailand and the South China Sea. It is one of the most affected areas by climate change and sea level rise, especially through the effects of flooding. Flooding is increasing in frequency and magnitude with each hydrological event, which may cause major damage to livelihoods. Therefore, flood mapping is essential for understanding the flood regime and mitigating its impacts. Remote sensing and GIS are useful and suitable tools for evaluating flood patterns and their impacts by analysing time series. In this study, we used high spatial and temporal resolution images covering the entire Mekong Delta by combining multiple scenes from 903 Sentinel-1, 660 Sentinel-2 and 103 Landsat-8 scenes and MODIS images, in order to generate water masks at a regular 10-day interval for the observation of the hydrological year 2015-2016 and 2016-2017. Doing so, we provide spatially explicit information on the core zones of seasonal flooding for the entire Mekong Delta. Additionally, the flood frequency and progress over the hydrological year are presented. The utilisation of floodwater for rice cultivation and the effects of the dyke system on flooding were also evaluated. Finally, the advantages of high spatial resolution and temporal resolution of SAR and optical data based on water body time series were explored. The combined effects of flooding and sea level rise represent a threat to Vietnamese farmers and the coastline of Vietnam in general. Here, we present a customized approach for the analysis of flood patterns and their impact on the Vietnamese coastline, providing a more easily understandable tool for policymakers and stakeholders, and ultimately improving coastal planning and management.

P18-2 Poster Presentation

The Catch Monitoring Probe: A novel method to observe behaviour and welfare of fish during purse seine fishing operations

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Keywords: catch welfare, fish behaviour, purse seine, delayed mortality

Purse seining is a fishing practice commonly used to catch pelagic schooling fish of different sizes. During the fishing process the school of fish is surrounded by the net and progressively crowded as the net is hauled on board. This exposes the animals to stressors including hypoxia, crowding and injury. Not all fish experiencing this stress are retained. Unwanted catch, due to fish size or species composition, can be released by "slipping" the animals over the float line or by opening the bunt-end of the net. Studies have shown that these stressors can be fatal for a high proportion of the released catch. Therefore, fish welfare, which has rarely been considered in the past, may be an important factor that contributes to survival of released catch and should be considered as a valuable component of a sustainable fishery. The objective of this study is to investigate the behaviour of fish during the capture process in a purse seine related to the different stressors induced by the fishing method. Schooling behaviour can be indicative for the stress experienced by the animal and its state of well-being. Observations were conducted in commercial purse seine fisheries. Monitoring probes containing oxygen-, depth- and temperature-sensors, and 360˚ cameras were deployed into the net during the capture process. The behaviour of the fish (from video footage) was reviewed and analysed, along with other variables (e.g. dissolved oxygen concentration, crowding density and duration) to determine the effect of capture-related stressors on the behaviour and potential welfare of the catch. Improving the knowledge of individual- and species-specific behaviour during capture can help identify and mitigate some sources of stress. This in turn can help improve the animal's welfare and post-slipping survival and contribute to a more sustainable fishery.

P18-3 Poster Presentation

Structural Characterization of Spirolides using Mass Spectrometry-based techniques

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Keywords: Spirolides, LC-MS/MS, fragmentation pattern

Spirolides constitute the growing group of spiroimine toxins produced by *Alexandrium ostenfeldii*. Spirolides are macrocylic molecules made up of a cyclic imine and trispiroketal ring system. To date, high structural diversity is observed from spirolides isolated from different strains of *A. ostenfeldii* collected from different regions. While nuclear magnetic resonance (NMR) is the only technique for absolute structural elucidation of novel compounds, high amounts of pure compounds are required. Tandem mass spectroscopy coupled to liquid chromatography (LC-MS/MS), which is a complementary technique to NMR, provides partial structural information while requiring only sample amounts several orders of magnitude lower than NMR. This makes LC-MS/MS appropriate for the structural characterization of samples that have minimal biomass available. This study aims to characterize the novel spirolides from the clonal isolates of *A. ostenfeldii* using mass spectral techniques. By using the spirolides with known structure and fragmentation patterns such as 13-desmethyl spirolide C and 20-methyl spirolide G, the preliminary structures of novel spirolides were proposed. This study demonstrated how the mass spectrometric characterization can not only describe the structural diversity of spirolides, but also provide useful information that led to the discovery of new spirolide subclass.

Session 19

Marine Engineering

Call for Abstracts

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.

Session chair

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O19-1 Oral Presentation

How thick is the Arctic Sea Ice?

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Keywords: electromagnetic induction, sea ice, EM-Bird, remote sensing

The measurement system of the EM-Bird uses an electromagnetic induction technique to evaluate the ice thickness in the polar regions in order to access the sea ice impact on the thermohaline circulation of the ocean and climate change. The development of the EM-Bird prototype was realized during a two semester project at the University of Applied Science in Bremerhaven in the study course Maritime Technologies and through a cooperation with the Alfred Wegener Institute. The Sea Ice Physics Department is especially interested in regaining knowledge regarding electromagnetic inductive methods. To realize the system it was necessary to elaborate the measurement principles, develop a versatile wooden made test setup to decrease material impacts on electromagnetic fields, generate programming skills to set up data transfer and finally data processing. The final set-up consists of three coils located on a measurement platform, a laser-altimeter, amplifiers and an onboard computer system and was used for in-situ tests. The results of this test have been compared to theoretical data in order to validate the accuracy of the prototype system. The presentation will give a quick overview of the set-up, functionality, data acquisition and achievements of the students group.

P19-1 Poster Presentation

Hydrogeology of the submarine slope off Nice, France

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Keywords: pore pressure, piezometer, in situ, groundwater charging, submarine landslide

Nice (France) and the Côte d'Azur in general is a highly populated and touristy region where shoreline protection and safety are of the utmost importance. Sadly, the Nice area is not only famous for its pristine beaches but also for the catastrophic tsunamigenic submarine landslide that took place in October 1979, causing several casualties as well as damages to on- and offshore infrastructure. A combination of several triggers such as high precipitation prior the failure and the resulting pore pressure increase in the Nice Slope as well as the anthropogenic influence due to overloaded sediments as a function of marine constructions were made responsible for the collapse of the narrow shelf south of the airport. Ever since, many national and European studies have been conducted in order to better understand trigger mechanisms for slope failure and the likelihood of reoccurrence of such an event in the near future. Nevertheless, the processes prevailing and causing the initial failure are still poorly understood. The main scientific objective of an ongoing Franco-German project is to monitor seafloor deformation and assessing landslide hazards associated with fluid pressures at the Nice Slope. Here, the link between precipitation and groundwater charging on one hand, and fluid pressure build-up and strain in the sub-seafloor on the other hand will be unraveled. Pore pressure data recorded over the last 13 years by 14 piezometers installed off the coast of the Nice airport were analyzed and show a specific, unique behavior characterized by sudden variations associated with fluid fluxes (and potentially other drivers). We will wrap up the key results, discuss the main drivers, and shed light on future hazard potential in the Nice area.

Session 20

Open Session

Call for Abstracts

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.

Session chairs

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O20-1 Oral Presentation

Balanced harvest – The wrong idea to minimize fishing impacts on the biomass structure of marine ecosystems?

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Keywords: EcoTroph, fishing impacts, balanced harvest.

Distributing fishing mortality across the widest possible range of species, stocks and sizes in proportion to their natural productivity (i.e. balanced harvest, BH) has been suggested as a new paradigm of fisheries management to minimize the effects of fishing on the ecosystem structure, while maximizing overall yield. Size spectrum and multispecies models of fish communities usually show that BH theoretically maintains ecosystem structure and sustains higher catches. Maximizing total catch rather than looking at their trophic composition is often central to these studies and is justified by the goal to meet the nutritional needs of a growing population. It remains the question, however, which trophic levels will ultimately be used to feed the world, when fishing with BH at an ecosystem level. Furthermore, technological and practical impossibilities of harvesting all ecosystem components according to their productivity could have unforeseen consequences that merit thorough evaluation. We used the trophic-level approach EcoTroph to investigate the effects of BH on the biomass and catch trophic spectra in a virtual ecosystem assuming restricted access of lower and intermediate trophic levels to fisheries. We assessed the performances of various fishing strategies characterized by different fishing intensities and trophic level at first capture. Results show that either we cannot maintain ecosystem structure, or we must withdraw from extracting high trophic level species. While a full implementation of BH is impossible in practice, expending the fishing pressure to low or intermediate trophic levels leads to higher impact on the biomass structure; and we will observe an increase in inaccessible biomass: the sea will fill up with “undesirable” biomass. To prevent such scenarios, we must protect the biomass of trophic levels that is less accessible to fisheries management. Protecting lower trophic levels enables us to balance the goal of maximizing total catches and maintaining catches of predatory trophic levels.

O20-2 Oral Presentation

Below the sea – below the radar? The United Nations' Sustainable Development Goals (SDGs) as an opportunity for raising awareness of the ocean?

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Keywords: Ocean Literacy, Citizen Science, Interdisciplinary, SOPHIE, Social sciences

The 2030 Agenda for Sustainable Development, adopted by the UN in 2015, consists of 17 Sustainable Development Goals (SDGs) and provides a framework for action including, next to social and economic aspects, also the sustainable management of natural resources. The Agenda comprises a goal on the conservation and the sustainable use of the oceans, seas and marine resources (SDG 14 – 'Life Below Water'). Despite several studies highlighting the importance of the marine environment for advancing sustainable development, the awareness of the ocean and ocean literacy is still poor, and SDG 14 is not perceived as an important goal. In this context the present study aims to answer the question if the SDGs can be operationalized for raising awareness of the ocean. The study's first part looks at how how the personal background influences the perception of importance of SDGs by means of an online survey with the alumni of the Master's programme 'Oceans & Lakes' as the target group. For the second part an expert workshop was conducted which identified concrete actions to increase ocean literacy and awareness. Results show that the personal background influences the perception of the importance of SDGs, with SDG 14 and SDG 4 ('Quality Education') perceived as most important by marine educated people. Further, differences in perception between participants from developed and developing countries were observed. The expert workshop showed that an interdisciplinary expert group with a reasonable background knowledge on SDGs can develop concrete citizen science projects on topics combining SDG 14 with other SDGs. This study suggests that linking perceived importance of SDGs with studies on the interrelation of SDGs can produce incentives and opportunities for raising awareness of the ocean which can be a good starting point for developing citizen science projects but can also be relevant to define (policy) agendas.

O20-3 Oral Presentation

The role of artificial material for benthic communities – establishment of different concrete materials to a natural hard ground environment

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Keywords: concrete, succession processes, natural habitats, artificial material

Concrete and steel are the materials mostly used in artificial coastal structures (e.g. harbors, causeways, dikes, piers and breakwaters). They are colonized by specialized hard-bottom biota consisting of macroalgae and associated invertebrates, but typically less diverse than the natural hard ground assemblages. For our experiments, 15 blocks of five concrete materials (15x15x15cm), containing different granulated blast furnace slag and binding agents, were deployed in April 2016 in a natural hard ground environment near to Helgoland Island (German Bight). In order to study succession on artificial materials a regular photographic documentation was conducted. Further, we investigated if differences in settlement between different types of concrete materials can be observed after one year of deployment. All blocks were investigated, regarding species composition and coverage. This study presents first results of statistical analyses, indicating differences in settlement on the different materials. Overall, our study provides new insights into the ecology of artificial substrates.

O20-4 Oral Presentation

The significance of depth for the structure of a sublittoral hard bottom community from the Chilean Patagonian fjord region

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In order to better understand the structure of the sparsely known deeper sublittoral hard bottom communities of Patagonian Comau Fjord, the macroepibenthos from six depth zones (30–480 m) was analyzed. A total of 70 still images derived from two video transects, recorded at the two remotely operated vehicle (ROV) stations Punta Gruesa and Near Telele were assessed quantitatively. Overall 14 mainly suspension-feeding species/taxa were observed. Of these, 50 % have an antarctic-boreal distribution, while the remainder are cosmopolitan. The overall mean epibenthos abundance was 203 ind. m2 with maximum values at 350 m depth (1314 ind. m2). The majority of the taxa inhabited large zones of the depth range, but abundances changed significantly. The mussel Aulacomya atra and the gastropod Crepidula sp. characterize the assemblage of the shallow zone. The cold-water coral Desmophyllum dianthus, Aulacomya atra and the brachiopod Magellania venosa are prominent below 30 m, the bivalve Acesta patagonica and the scleractinian D. dianthus are characteristic for the community below 50 m water depth. Cluster analysis and non-metric multidimensional scaling based on abundance data showed differences between the assemblages along the bathymetric gradient. The ANOVA, as part of the program PRIMER showed a correlation between D. dianthus and other species for Near Telele (P=0.026). Surprisingly the Shannon diversity index did not indicate a relation between the abundance of the cold-water coral and the associated fauna. In contrast, the abundance of the fish Sebastes oculatus was closely related to the abundance of D. dianthus. Thus, the Shannon diversity indicated a mutualistic relationship between S. oculatus and D. dianthus. As surface and tidal current impacts attenuate with increasing depth, there is a gradual trend from robust individuals towards more fragile ones (i.e. skeletons of shallow D. dianthus are more massive, deeper ones rather elongated), in line with the 'Physical control hypothesis'. Moreover, this possible dissociation between the upper and deeper circulation, could be favoring the larvae settlement by allowing more contact time with the substrate, reflected in the larger abundance at deeper waters.

O20-5 Oral Presentation

Marine venoms and how to find them: predicting the discovery of new toxins from predatory Polychaeta along the tree of life

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Keywords: polychaetes, marine toxins, multi-trait phylogenetics, histology, blue biotechnology

The European Blue Growth Agenda promotes a holistic vision for ocean sustainability, with the goal of improving environmental health and socio-economic wellbeing. Marine biotechnology has emerged in this context as a research field with significant potential to address these challenges. The immense diversity of marine organisms, especially invertebrates, presents a unique opportunity for the discovery of novel bioactive compounds compounds (BCs) that can be used in innovative, safer and affordable downstream applications (e.g. new biomaterials, foods and pharmaceutics). The development of a pipeline for the discovery of BCs, namely from marine toxins, will allow overcoming the randomness of discoveries and turn bioprospecting into a systematic science. We envisage that by combining systematics with ecology and life-history traits into phylogenetic models, we can construct a roadmap to identify potentially venomous species, therefore predicting the occurrence of novel BCs from toxin mixtures. Using Polychaeta's most fierce predators as a case study in the Portuguese coast, our research integrated: 1) molecular systematics (COI-5P gene sequencing) with 2) morphoanatomical features (presence of jaws and venom glands) and 3) ecological characteristics (trophic level). Results allowed us to identify several families within the Order Phyllodocida, including Glyceridae, Phyllodocidae, Nephtyidae and Nereididae that have evolved to produce complex toxin mixtures as defence or predation strategies. To validate the prediction of BCs occurrence in these mixtures, we used histological & immunohistochemical techniques in several species and 1) identified microanatomical structures (such as gland tissue), 2) detected the presence of thiol-rich secretions (typical of animal venoms) and 3) located the production of mucous (vehicle of toxins) and related mechanisms of toxin-delivery and bioactivity. Overall, this allowed us to confirm that multi-trait phylogenetics combined with frontline bioinformatics can be used as powerful tools to locate new species of interest secreting BCs with biotechnological potential.

O20-6 Oral Presentation

The coral window into the past – high resolution climate reconstruction from massive corals of sea surface temperature and pH

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Keywords: high resolution climate archive, stable isotopes, tropical oceans, coral climatology

Coral reefs are not only an important part of our tropical ocean ecosystems, but also hold important information about the Earth's and oceans' climate history. By incorporating the oceans' chemistry into their calcareous skeleton, corals make it possible to reconstruct sea surface temperature, salinity, rainfall patterns, and other climatic proxies for several centuries. Some measurements such as pH of the ocean are especially sparse and only date back to the 80s of the last century. However, since preindustrial times the level of CO_2 in the atmosphere and the oceans has increased leading to warming temperatures, rising sea levels, and ocean acidification. Consequences that stress marine organisms such as corals. Coral skeletons serve as high resolution climatic achieves that make it possible to have a monthly to yearly resolution for SST, SSS, and pH. By measuring trace elements as well as carbon and boron isotopes from the skeletal material of a slow growing massive coral, an increase in SST and a decrease in pH can be shown. Changes in SST and pH correlate with the oceans' uptake of anthropogenic CO_2 and furthermore, indicate a coupling of temperature, dissolved inorganic carbon, and ocean acidification. So far, the majority of studies have focused on using the boron isotope measurement to reconstruct pH variation in the marginal areas like the Chinese Sea and at the Great Barrier Reef but have neglected open ocean conditions. This project focuses on the Indian Ocean, Pacific Ocean and Atlantic Ocean and tries to create a first temporal, as well as spatial global, picture of the environmental changes in the tropical oceans. The data collected will not only help in understanding past changes in the ocean but can also be used for models to predict future changes.

O20-8 Oral Presentation

Food web analysis of the southern Benguela Upwelling System by means of trophic biomarkers

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Keywords: trophic links, ecosystem functioning, stable isotopes, fatty acids

The Benguela upwelling system (BUS) is one of the four major coastal upwelling systems in the world. It reaches highest primary production rates of all Eastern Boundary Upwelling Systems (EBUS). However, the high primary production is not reflected by the production of higher trophic levels (fish, seabirds, and seals) in the BUS. It has the lowest fish production of all EBUS, a tenth of the production found in the Humboldt Current, off the coast of Peru. The BUS is divided into two very distinct subsystems, the northern and southern Benguela upwelling system (nBUS, sBUS). Despite similar primary production, significant differences in composition and biomass of fish stocks exist between the two subsystems. Fishing yields in the nBUS are significantly lower than in the sBUS, while the mechanisms are not yet resolved. This study clarifies the food web structure of the sBUS by means of trophic biomarkers: stable isotopes and fatty acids. It compares these results to the nBUS, identifies differences in the two food webs and their potential consequences for higher trophic levels. Fatty acid trophic markers can be used to identify trophic interactions in an ecosystem. They are incorporated in the body tissue of a consumer with almost no modification. Stable isotope analyses of nitrogen and carbon are used to identify species-specific trophic levels and carbon sources of the ingested food by an organism in a food web. This study uncovers and compares the food webs, trophic pathways, and food chain lengths of two different subsystems in one of the most important upwelling systems in the world, the BUS. Thereby revealing if their differences can be linked to changes in the overall fish biomass.

O20-9 Oral Presentation

Assessment of the diagenetic overprint of sediments within the deep subseafloor biosphere in the Nankai Trough, Japan – IODP Expedition 370

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Keywords: deep biosphere, diagenetic iron cycling, alteration of iron (oxyhydr)oxides, pyritization, magnetic minerals

IODP Expedition 370 established Site C0023 down to 1180 mbsf in the Nankai Trough, Japan, to explore the upper temperature limit of microbial life in deep subseafloor sediments. The area is characterized by strongly changing sedimentation rates. The diagenetic iron (Fe) cycling is an important process within the deep biosphere. However, microbial and abiotic alterations of Fe phases in deep subseafloor sediments are poorly understood. Fe (oxyhydr)oxides are important carriers of sedimentary magnetic signals. Diagenetic cycling, especially the reductive dissolution of Fe (oxyhydr)oxides driven by microbial degradation of organic matter and/or by reactions with hydrogen sulfide, may lead to transformations of primary ferrimagnetic Fe (oxyhydr)oxides to secondary Fe sulfides, and thus, to modification of rock magnetic properties. In this study, we aim at assessing the alteration of the primary sedimentary record at Site C0023, including authigenic formation of secondary minerals, pyritization as well as effects on rock magnetic properties. To investigate the Fe mineralogy, sequential extractions of Fe (oxyhydr)oxides and sulfides are combined with rock magnetic analyses and SEM-EDS observations. The reactive Fe pool includes Fe carbonates and Fe (oxyhydr)oxides. Amorphous Fe oxides are the dominant reactive Fe fraction at Site C0023. Fe sulfides, mainly pyrite, are present in all investigated intervals. However, pyritization only affects 5 to 15% of the reactive Fe pool. Rock magnetic properties also show the presence of metastable Fe sulfides in the upper interval between 200 and 450 mbsf. Their preservation might be caused by limited hydrogen sulfide availability, an increase in sedimentation rates, which prevents a complete pyritization by decreasing the time the interval was located in the sulfidic zone, or by recent authigenesis. Combining our geochemical and rock magnetic data improves the understanding of iron cycling in subseafloor sediments and the role of iron minerals in maintaining life in the deep biosphere.

O20-10 Oral Presentation

Students to the front: Conceptual design and realization of a sampling strategy for plastic particle accumulation at frontal systems in the German Bight

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Keywords: river plume front, scientific planning process, research vessel, plastic, North Sea

Coastal oceans are highly heterogenous in their physical and biogeochemical parameters as they are subject to terrestrial influence through rivers and subterranean groundwater discharge. The mixing process of the typically low saline, high organic matter containing waters with the marine water masses can result in strong gradient formation on horizontal and vertical scales, typically denoted as fronts. Recently, river influx was also identified as a source of microplastic particles, related to anthropogenic sources along the catchment area. In the framework of a research project module three graduate students develop their own research from the first idea up to the publication. Within this module, the development of a research question based on the state of the art is as essential as planning and preparing a nine days expedition. Here we focus on the southeastern German Bight, a region permanently influenced by the plume of the rivers Elbe and Weser. We identified the topic of frontal systems and their potential accumulation of plastic particles and developed a nested sampling strategy. The results of sea surface temperature and salinity measured with underway sampling systems and CTD casts along a predefined grid facilitated the localization of regions for a high intensity sampling. Manta net trawls were used to investigate the density of plastic particle accumulation within the frontal system to approach the impact of anthropogenic influences. First results confirm the effectiveness of the conceptual study design and show a presence of plastic particles at this strong hydrographic gradient. Furthermore, the approach of the research project module proved to be a successful tool to introduce students to the complexity of scientific planning processes. Its establishment would provide a unique opportunity for young researches and its findings might initialize the basis for a funded research project.

O20-11 Oral Presentation

Life and death on Tagoro submarine volcano (Canary Islands, Spain): eight years monitoring the nutrient release, oxygen levels, and fluorescence anomalies

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Keywords: Submarine volcano; hydrothermal vents; dissolved inorganic nutrients; dissolved oxygen; natural fertilization

Submarine volcanic activity has been poorly characterised in comparison to subaerial volcanoes. In October 2011 a shallow submarine volcanic eruption south of El Hierro (Canary Islands) gave rise to drastic physical-chemical changes in the water column. The initial eruptive stage (first six months) produced abrupt perturbations in a wide area south and north of the island, including a marked acidification and severe deoxygenation, even reaching anoxic levels, which resulted in high mortality among the local biota. After March 2012, the eruptive process evolved into a low-temperature hydrothermal system with diffusive emission of heat, gases, metals, bioavailable iron, and inorganic nutrients. These emissions, which exhibit a stationary cyclic behaviour, still produce important physical-chemical anomalies in the water column over the main and secondary craters. Here, we present a detailed study of the emissions of inorganic macronutrients (NO_2^-+NO_3^-, PO_4^{3-}, and SiO_4^{4-}) from an 8-year dataset comprising over 3300 discrete water samples collected with three different sampling methodologies, as well as oxygen and fluorescence data from over 600 vertical profiles and 130 tow-yo transects. Our results show a significant nutrient enrichment throughout the whole studied period, up to 781% (nitrate), 296% (phosphate) and 1530% (silicate) in the water column, and larger enrichments of phosphate (946%) and silicate (32440%) in the samples collected directly from the vents. Additionally, positive oxygen and fluorescence anomalies were observed in the waters surrounding the main craters, suggesting a possible effect of these nutrient-rich emissions on the local biota. This study represents a relevant contribution to the understanding of the effects of shallow submarine volcanic activity on the local marine environment.

O20-12 Oral Presentation

Effects of marine protected areas on blue carbon storage in seagrass meadows and mangrove forests across Tanzania and Mozambique

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Keywords: Marine sediment, Carbon sinks, Blue carbon hotspots, Climate change mitigation, Western Indian Ocean

Climate change mitigation strategies encompass both a reduction in human carbon emissions and an increased protection of natural carbon sinks. Coastal vegetated habitats, such as seagrass meadows and mangrove forests, are considered significant blue carbon sinks, which efficiently sequester and store atmospheric- and oceanic carbon. However, as the coastal habitats are declining worldwide, we need to preserve and protect them through, among other management strategies, establishing marine protected areas (MPA), while unfortunately, carbon storage has generally not been considered within the framework of the reserves. Therefore, this research study focuses on the assessment of sedimentary carbon stocks in seagrass meadows and mangrove forests, within and outside different types of protected areas across Tanzania and Mozambique in the Western Indian Ocean (WIO), to discover if current MPAs match current blue carbon hotspots. Results of this study will help us understand what drivers and spatial variabilities are promoting successful carbon sinks. Preliminary results show that there might be, to some degree, a mismatch between blue carbon hotspots and excising MPAs. Further analysis will give us more information on where to find these blue carbon hotspots. This in turn will be available to managers and MPA planners to give them a greater understanding of how to include, enhance and protect carbon storage and sequestration in their regions. The implementation of this important ecosystem service into their management plans can in a wider perspective contribute to climate change mitigation, and in doing so maintain economic and social development.

O20-13 Oral Presentation

Habitat preference of common dolphin *Delphinus delphis* in the waters to the West of the UK and Ireland

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Keywords: Cetacean ecology, marine mammal conservation, habitat modelling, generalised additive models, high use habitats.

Delphinus delphis are an enigmatic cetacean species, found in ocean systems across the globe. As a result of the spatial scale at which they interact with their environment, investigating *D. delphis* habitat preference offers a considerable challenge to ecologists. In addition to challenges in study, we know their environment is experiencing growing pressures due to human activity. This study identifies key areas of habitat for *D. delphis.* A dedicated line transect survey from R/V Song of The Whale was conducted in the waters to the West of the UK and Ireland. Visual sighting data and environmental variables (depth, slope, sea surface temperature and chlorophyll-a surface concentration) were used to construct generalised additive models (GAMs) via forwards stepwise selection. GAMs provide a quantifiable relationship between species and habitat. *D. delphis* occurrence was best explained by slope; a proxy for prey distribution, and sea surface temperature. The strongest associations were in flat low sloping coastal waters and the shelf break with a slope of 4-6˚. *D. delphis* showed a preference for warmer waters in the lower latitudes of the study site. This suggests *D. delphis* distribution is likely driven by prey distribution, with aggregations in areas of upwelling and convergence of nutrients. The findings of this study could be used in the development of future conservation strategy, and provide useful information on the ecological niche occupied by *D. delphis*.

O20-14 Oral Presentation

Stress and metals in green sea turtles (*Chelonia mydas*) in São Tomé: an assessment of contamination impacts

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Keywords: Gene expression, Marine pollution, Metal levels, Oxidative stress, Turtles

São Tomé and Príncipe (STP) archipelago harbors important sea turtle nesting and feeding grounds for four of the seven existing sea turtle species. Each sea turtle population is affected by different threats of variable severity, while very little is known on how marine pollution is affecting these charismatic animals. Thus, the main goal of this study was to evaluate the impacts of metal contamination in the female green sea turtles (*Chelonia mydas*) nesting in São Tomé (ST) island, by addressing molecular stress responses in blood and relating them to metal levels (Al, As, Pb, Cd, Cr, Fe, Cu, Mn, Hg, Se and Zn). The gene expression analysis was performed using quantitative real-time PCR and included target genes involved in detoxification/sequestration and metal transport, antioxidant and oxidative stress responses. Biomarkers of genotoxicity were also addressed by micronuclei analysis in blood. Results showed very high Al, As, Fe, Se, and Zn concentration in the sampled turtles and the presence of micronuclei in their erythrocytes, although no correlations could be found between number of micronucleus and metal levels. However, several positive and negative relationships were found between gene expression and metal levels, as for instance the strong positive correlation of metallothionein expression and Hg and Se levels. The different correlations found, revealed candidate genes with the potential to be used for future biomonitoring studies as biomarkers of interest. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these sea turtle species nesting in ST, contributing with information to support better conservation measures in ST island.

O20-15 Oral Presentation

Shelter preference and antipredator responses of European lobster juvenile (*Homarus gammarus)* under noise and predation exposure

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Keywords: lobster biology, noise pollution, multiple stressors, video analysis

Juvenile European lobsters (*Homarus gammarus)* are dependent on finding a suitable shelter for protection and survival. However, due to their cryptic lifestyle, their shelter preferences and the different stressors that may influence their choice remain largely unknown. Of all the parameters that may have an influence on shelter occupancy, one that remains largely unaccounted for is noise. Anthropogenic noise in the ocean may have an impact on lobster's locomotor activity and immunological responses. On the community level, juvenile lobsters also compete with predators, like the green crab *Carcinus maenas* for shelter and resources. In this study, we investigated the effect of noise and predation on shelter preference (n= 96) between rocks and European oyster shells *Ostrea edulis* and the antipredator responses (n= 48) of juvenile lobster (14.0 ± 1.7 mm carapace length or CL) with four treatments: control, predator presence, noise and the combination of both stressors. The predator presence consisted of a green crab (62 ± 1 mm CL) in a 5 mm mesh-box. The added noise was a constant low frequency of 100 Hz produced by a "noise egg" device attached to the mesh-box top. Shelter preference was assessed after three hours of each treatment. There was no effect on the final choice of shelter among treatments: 67% of the lobsters selected rocks, and 33% oyster shells. Video recordings of 1 h allowed the analysis of behaviour, initial shelter preference and mobility among shelters. We identified six key behavioural units: peeking, shelter excavation, exploring, stillness, burrowing and hiding. First results show that lobsters in noise treatment and the joint noise and predation treatment spent more time hiding (84.12%, 80.28% respectively) and less time shelter excavating. The results of our study suggest that noise interferes with sheltering behaviour, which is key for the protection against predators and reaching sexual maturity.

O20-16 Oral Presentation

State-space modeling to estimate foraging areas of satellite-tracked fin and humpback whales around the Antarctic Peninsula

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Keywords: Baleen whales, Biotelemetry, Southern Ocean, Feeding grounds, Bayesian model

State-space models have been applied to satellite telemetry data to elucidate the movement patterns and estimate the underlying behaviors of several marine species, including whales. Most baleen whale species in the Southern Hemisphere feed in cold waters of the Southern Ocean, where they exhibit complex movements in the search for their prey. Bayesian hierarchical state-space models were fitted to telemetry data from six humpback whales (HW) tagged in January 2004 and 2006 and four fin whales (FW) tagged in February 2014-2016, in waters around the Antarctic Peninsula. We used the *bsam* package in R to fit two MCMC chains of 60,000 samples, with burn-in of 40,000 and time step of 6 hours, and retained every 20th position. The model provided posterior positions with mean estimate values between 1 and 2. Values below 1.25 were interpreted as transiting, values above 1.75 as area restricted search (ARS), presumably related to foraging, and values in between as uncertain behavior. 69% of overall HW posterior positions were inferred as ARS behavior. FW models distinguished 39% of positions as ARS. Our results suggest that tracked HW presented foraging-related behavior mostly within the Gerlache and Bransfield Straits, ranging from Dallmann Bay to the south of Livingston Island. The southwest of Biscoe Archipelago and Marguerite Bay were also used as foraging areas. FW behavior was not well classified, but ARS was estimated for one individual close to the South Shetland Islands, both in the Bransfield Strait and open-sea sections. FWs also engaged in ARS in relatively open waters in the northern section of the Antarctic Peninsula. Although estimated behaviors should be interpreted carefully given the data limitations, our findings provide information on whales' habitat use around the Antarctic Peninsula, which is key to the management of these species and their main prey, the Antarctic krill.

P20-1 Poster Presentation

Sequestration of carbon from *Laminaria* kelp forests may be diminished in a warmer climate

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Keywords: photosynthetic efficiency, detrital decomposition, blue carbon, climate mitigation, ecosystem services

Among the services provided by kelp forests, their contribution to blue carbon sinks is currently of utmost relevance. Detritus from these fast-growing plants, together with assimilated carbon, is sequestered into sediments. Along the Northeast Atlantic coast, the predominant kelps are of the genus *Laminaria*. While the cold-adapted *L. digitata* (*Ld*) and *L. hyperborea* (*Lh*) are shifting northward, the warm-adapted *L. ochroleuca* (*Lo*) is currently expanding its range due to climate change. This study aimed to compare photosynthetic efficiency and decomposition between the three *Laminaria* spp. in order to better understand whether the contribution of kelp forests to carbon sequestration is altered in a warmer climate. Detritus from all species was aged in a litter bag field experiment. Weight, chlorophyll fluorescence, respiration and net primary productivity of the detritus were measured before deployment and after 25 and 32 days at sea. Moreover, photosynthetic pigment loss was quantified using imaging software. First, biomass was lost at a faster rate in *Lo* than *Lh*. Second, operating efficiency of PSII declined in all species after 32 days, being highest in *Lh* and lowest in *Lo*. Third, gross primary productivity remained constant over time in the northern species, while it decreased in *Lo*. Fourth, detritus of *Lo* had a larger proportion of discolouration than the two cold-adapted species after 32 days. The faster consumption of *Lo* detritus and its lower photosynthetic performance suggest a decreased carbon export and sequestration potential. Considering that in the near future *Lo* will become the dominant kelp in the Northeast Atlantic, climate change will likely reduce the carbon sequestration function of temperate kelp forests – a vicious cycle, which further exacerbates the effect of anthropogenic carbon emissions. This study hopes to inform climate mitigation strategies and emphasises the need to protect cold-adapted kelps as they are driven north with rising temperatures.

P20-2 Poster Presentation

Barcoding coffee grounds - Exploring pteropod biodiversity with dregs in collection jars

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Keywords: Biodiversity, 2010 Expedition Malaspina, pelagic Heterobranchia, Pteropoda

Marine Pteropoda Cuvier, 1804 a holopelagic group of shelled (Thecosomata) and shell-less (Gymnosomata) gastropods are a key focus of ecological studies assessing the impact of human induced climate change. Globally distributed, pteropods play a fundamental role in zooplankton communities but are threatened by changing seawater conditions. Ecological consequences of their potentially dropped abundance in marine ecosystems can lead to significant shifts in species composition/ biodiversity loss. Despite their cosmopolitan occurrence, the genetic diversity within this group is still largely unexplored. A comprehensive insight into present diversity and distribution of these planktonic molluscs is an important prerequisite for stating possible future changes in species composition and in species-specific responses to changing ocean conditions. In the face of growing extinction rates a focus should be placed on fast and accurate biodiversity analyses. DNA barcoding serves as a powerful tool to complement complement traditional morphology-based taxonomic research as an efficient method to identify and delimit different lineages. In this study we present a next-generation environmental barcoding approach to zooplankton bulk samples, collected during the global 2010 Malaspina expedition. We introduce a technique that avoids destructive procedures and material stays intact for further morphological investigations. We extracted DNA out of the dregs (organic material like mucus or body parts) of 25 sample containers for molecular barcoding (350 bp of COI). We were able to identify several “OTUs”, corresponding to the species composition contained in the examined samples. This present study thus represents a contribution to the development of alternative DNA sequence-based biodiversity analyses by implementing a next-generation environmental barcoding approach that is able to complement existing taxonomic practice. It is useful to gathering new data on a broad global scale, in order to gain a better understanding of species abundance and distribution of pteropods and possibly other poorly studied planktonic invertebrates in the world´s oceans.

P20-3 Poster Presentation

Sources and sinks of fluorescent dissolved organic matter in a mangrove estuary (North Brazil)

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Keywords: DOM, PARAFAC, porewater, Mangroves, Caeté estuary

Mangroves are highly productive intertidal ecosystems, which can transport high amounts of dissolved organic matter (DOM) to adjacent waters. DOM remains one of the most elusive parts of biogeochemical cycling, due to its great diversity. A fraction of DOM has fluorescent properties, allowing the characterization of fluorescent DOM (FDOM) in aquatic ecosystems. During the mixing of freshwater with seawater, estuarine DOM can be altered due to biological and photo-degradation. Moreover, DOM can be transformed abiotically in porewaters of sulfidic mangrove sediments, when sulfide is incorporated into the organic molecules. On the one hand, hereby received DOM can be less bio-available for microbes and on the other hand, photo-lability can be increased. Yet, the impacts of sulfurization on (F)DOM are not well understood. The discharge of (sulfidic) porewater containing refractory DOM in the Caeté estuary (North Brazil) was shown in previous studies. The present study aims to further characterize the biogeochemistry of FDOM in this estuary. We used optical analytical techniques to investigate the FDOM porewater composition and to study the biological and photochemical processes altering the FDOM composition along the estuarine transect with fringing mangroves. Additionally, an incubation experiment was conducted to reveal differences between biological and photo-degradation, before and after sulfurization of mangrove-derived FDOM. Excitation–emission matrix (EEM) fluorescence spectroscopy combined with parallel factor analysis (PARAFAC) revealed four fluorescent components in the estuary as well as in the incubation experiments. We found that a relatively high proportion of FDOM is discharged with porewater from the mangroves into the estuary. Mangrove-derived sulfurized and non-sulfurized FDOM in the incubation treatments was photo- and biodegradable, but a fraction of the FDOM was stable on the timescales of the incubation experiments (days). This suggests that a part of the mangrove derived FDOM is stable enough to be transported from the estuary into the coastal ocean.

P20-4 Poster Presentation

Pesticides present in faeces of 3 penguin species from Kopaitic Island and the Antarctic Peninsula

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Keywords: Indicator, concentration, bioaccumulation

The Antarctica was for a long time considered as one of the last pristine environments, due to lack of industrial and agricultural operations. However, contamination is a global phenomenon and transport of pollutants may occur even in remote areas. Over the last decades, many organochlorine pesticides (OCP) have been continuously analyzed in almost all regions of the planet due to their negative health and environmental impacts and its potential to bioaccumulate. Pesticides were first found in fat tissues of polar bears in the Arctic and Antarctic penguins in the late 1960s. These facts pushed researcher to study environmental contamination in Antarctica over the last years, assessing the fate and distribution of many pollutants in different biotic and abiotic matrices. Seabirds are at the upper levels of the trophic chain, they are considered among the most reliable indicators for environmental changes caused by pesticides. During the austral summer, in January 2009, feaces were sampled at colonies of Adelie, Chinstrap and Gentoo penguins near the O'Higgins Antarctic Base. Samples were taken with the utmost care to avoid stress to the penguin colonies and nesting chicks. Fresh stool samples were collected from five nests for each penguin species. The results showed the presence of eleven pesticides, with Methoxychlor occurring in the highest concentration followed by HCB. Gentoo penguins presented the highest concentration of pesticides, followed by Chinstrap and Adelie, which is probably explained by their trophic levels. Importantly, no DDT was present in the faeces of Chinstrap penguin, which might be due to the ability of bioaccumulation of DTT.

P20-5 Poster Presentation

Temporal variation of social dynamics among Killer Whales (*Orcinus orca)* of the Falkland Islands

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Keywords: sociality, association patterns, social network analysis, marine mammals, top predators, Falkland Islands.

Killer whales are top marine predators with a complex social structure, which includes nested hierarchical levels, stable bonds between individuals, which strength decreases as the level increases, and cultural transmission among generations. Killer whales' sociality shows temporal and spatial variations that are due to a complex synergy of different factors, including the availability of prey. We studied the temporal dynamics of sociality of the killer population of Sea Lion Island (Falkland Islands), that includes both resident and transient individuals, focusing on the effect of the availability of their marine mammal prey (elephant seals and sea lions). We used photo-identification, coastal surveys, and observations from vantage points to collect four years (2013-2017) of killer whales' association data. From these data we then calculated the network metrics and created sociograms to analyze the variation of social networks in relation to the different phases of the annual cycle of killer whales' prey. We found that: 1) the mother-calf units and the pods (assemblages of different mother-calf units) are temporally stable, at least for the whole length of the season (September-March); 2) different pods, and non-pod individuals, frequently associate together in a dynamic fashion, in particular during predation events; 3) the higher levels of the social structure show a greater temporal variability than the lower levels; 4) the overall social structure may be strong influenced by some individuals that have a central role in the networks; 5) the short term (minutes to hours) associations between specific individuals of each pod is variable, but shows repeatable patterns; 6) an important part of the temporal variation of sociality is related to the elephant seal annual cycle, and to specific predation events. To our best knowledge, this is the first study of the social network temporal dynamics of a Southern Hemisphere killer whale population.

P20-6 Poster Presentation

Geophysical mapping of a coral reef in the turbid environment of Abra de Ilog, Occidental Mindoro

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Keywords: Geophysics, Seafloor Mapping, Coral Reef

Mapping the extent of coral reefs may pose a difficulty because of their irregular surfaces and limitations due to light attenuation at depths. In this study, we employ several geophysical methods to map the shallow coral reef and its extension into the upper mesophotic depths in Abra de Ilog, Occidental Mindoro. This coral reef was previously uncharted and likewise invisible in satellite imagery. Multibeam echosounder and side scan sonar surveys enabled delineation and characterization of the sea floor and the coral reef morphology to a depth of 46 m. Due to the absence of a reef flat and a well-defined crest, the coral reef has an atypical morphology. The more continuous segments of the reef are found on extensions of drainage divides or headlands. Beyond 20 m, coral communities occur on bathymetric highs which are surrounded by silty to muddy substrate. These coral-covered bathymetric highs extend to the upper mesophotic depths. This is consistent with the fact that these coastal sites are traditional fishing sites of locals. This study indicates the need for inclusion of mesophotic coral ecosystems in fisheries management. Furthermore, geophysical mapping tools can be used in identifying and delineating the extent of such sites.

P20-7 Poster Presentation

Chemical characterization of the water in the estuaries located in the Mangrove Fauna Production Reserve “El Salado” in the canton of Guayaquil – “El Guayas” province. 2018 (Ecuador)

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Keywords: Temperature, pH, salinity, water quality

The Gulf of Guayaquil is home to Estero Salado, which is the largest and most productive estuary in the South Pacific and part of the National System of Protected Areas of Ecuador. In order to carry out the characterization of the water in the estuaries located in the Mangrove Fauna Production Reserve of El Salado in the canton of Guayaquil, the water quality was determined in 2018. Therefore, monthly monitoring was carried out during the period from May to November 2018, through 23 stations located in the central axis of the different estuaries of the Reserve. For this study the chemical analysis of the samples collected in the two tidal states (flow and reflux), at surface level and one meter above the bottom, where the depth allowed it, was contemplated. A 4-liter Van Dorn bottle was used for sampling and analysis of the variables (temperature, pH, salinity, alkalinity, total dissolved solids, total suspended solids, total solids, calcium hardness, phosphate and silicate). In relation to water quality, no thermal or pH anomalies were detected in the studied areas, since their monthly averages were consistent within the study period. The salinity of the zones showed a divided behavior whilst the alkalinity maintained an irregular distribution. Suspended, total and dissolved solids had the same behavior in the areas and time studied, however, suspended solids showed averages well below the permissible Ecuadorian level (250 mg/L). The nutrient content (phosphate and silicate) during the studied months in both surface and bottom waters in the two tidal states, evidenced the presence of strongly eutrophicated waters.

P20-8 Poster Presentation

Harbor porpoise (*Phocoena phocoena*) spatio-temporal distribution in Skjálfandi Bay (Iceland) using whale-watching platforms (2009-2018)

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Keywords: Conservation, environmental variables, cetacean-habitat

The harbour porpoise (*Phocoena phocoena*) is a frequent species present in Skjálfandi Bay (Iceland). This study used data collected from whale watching tours over the past 10 years to give an estimation of the annual and seasonal distribution of this species in relation to the effort and environmental variables. The kernel distribution analysis showed a clear hotspot for harbour porpoises on the west side of the bay, which might be related to the water dynamics such as vertical mixing as this area appeared to be relevant for other cetacean species in previous studies too. The GAM analysis included variables such as latitude, longitude, distance to coast, sea surface temperature (SST), depth, slope and aspect but only the first four were found significant explaining 31% of the deviance. This is one of the few studies on harbor porpoise distribution carried out in Iceland and so further studies on this species and their ecological interactions should be done for future conservation and managing purposes.

P20-9 Poster Presentation

Elaboration of an e-flora of Solanaceae for a wide community: Going digital on the plants of the lower Tapajós river basin, Central Amazon, Brazil

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Keywords: Solanaceae, Taxonomy, Identification key, Amazon biodiversity

Increasing high-quality data on species distribution is urgently needed in order to improve primary research and conservation planning. To produce this crucial data, a proper identification of taxa is essential. Traditional floras and dichotomous keys are difficult to use for non-familiarized public with technical terminology. Recently, online tools have made species identification easier by developing simpler and more accessible methods, reaching a broader public. This study is included in the frame of a floristic inventory project running since 2012. The flora of the lower Tapajós Basin a poorly known botanically and is thus considered a strong candidate for applying such methods. Solanaceae, a medium-sized family was chosen as a model. The Solanaceae are subcosmopolitan, flowering and economically important plants for their alimentary, ornamental or pharmacologic uses. Of the 488 species listed in Brazil, 150 are present in Amazonia, whereof at least 45 are expected to be found at lower Tapajós. To provide up-to-date information, we aim to use different strategies such as revision of the identified taxa and an inventory of herbaria collections not consulted yet. Collecting samples and adding pictures of different species to the flora define in situ activities while revision of previously identified specimens in herbaria are considered ex-situ investigations and the most relevant part of the project. From this, we aim to produce an online, accessible flora and identification key for a wide public. This would improve the available information about Solanaceae in the region. Moreover, it would be useful for managers and decision-makers to enhance conservation efforts.

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