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## Inshore Commercial Fisheries in the Service Economy

### Session 1 Small-Scale Fisheries Research - towards sustainable fisheries using a multi-entry perspective

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An underwater photograph showing a large school of small, dark fish swimming in clear blue water. In the foreground, there is a dark, textured coral reef. The top left corner shows a bright, white, cloud-like shape against the blue background.

*YOUMARES | 5*

# BOOK OF ABSTRACTS

C. Jessen & V. Golz

# Book of Abstracts

**YOUMARES 5.0**

[www.youmares.net](http://www.youmares.net)

September 10<sup>th</sup> – 12<sup>th</sup> 2014  
Stralsund, Germany

**Cover photograph** Christian Jessen

**[ YOUMARES | 5 ]**  
THE CONVENTION FOR YOUNG SCIENTISTS AND ENGINEERS

**Opportunities and Solutions – Research For Our Changing Oceans**  
10. - 12. September 2014 | Stralsund, Germany



# **I**ndex

Index .....	2
Welcome.....	3
1 Small-Scale Fisheries Research .....	4
2 Individual Engagement in Environmental Change .....	10
3 Aquaculture in a Changing Ocean.....	14
4 Coral Reef Ecology, Management & Conservation in a Rapidly Changing... ..	20
5 Tools and Methods Supporting an Ecosystem Based Approach to Marine Spatial... ..	26
6 Measurement and Control Engineering .....	32
7 Aquatic Plastic Pollution .....	33
9 Effects of Global Climate Change on Emerging Infectious Diseases of Marine Fish .....	41
10 Cold Water Research .....	43
11 Additional Poster Presentations .....	59
Conference Schedule .....	62

# W elcome

Dear students,

Dear researchers,

Dear engineers,

Dear participants,

Dear visitors,

It is a pleasure to have all of you at YOUMARES 5 and in the OZEANEUM in Stralsund. It is already the fifth year of this successful conference series that once started as a small meeting but soon discovered its potential and became this important platform for young people to meet, discuss, and exchange ideas in a relaxed atmosphere with the attempt to generate a professional standard.

This year we were again able to select an exciting mix of sessions ranging from cold and dark ecosystems in the depth and colorful coral gardens in the tropics to emerging anthropogenic threats and approaches how to protect and manage these magnificent places. Further, we will have a look how communities can wisely use their marine resources and what technical approaches exist to explore and measure these manifold underwater landscapes.

It was an awesome experience to work within such a great and super-motivated team that spent many hours, days, and weeks of their leisure time to overcome difficulties of planning, organization, acquisition, communication etc. We were generously supported by sponsors and especially the German Society of Marine Research and our this year's venue the OZEANEUM.

We hope that all of you can enjoy the conference, learn about the wonders of the marine ecosystems, exchange and discuss ideas and point of views and enlarge your network with great and ambitious people. It is YOU who make this conference such a success. We would be happy to see all of you again next year in Bremen and/or in our organization team! Keep up the good spirit!

Vera Golz & Christian Jessen  
(YOUMARES coordination team)

September 2014

# 1

## Small-Scale Fisheries Research

### *Towards Sustainable Fisheries Using Multi-Entry Perspective*

Anna Schuhbauer<sup>1\*\*</sup>, Soledad Luna<sup>2\*\*\*</sup>

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#### ABSTRACT

Small-scale fisheries, which encompass about 90% of all fishers globally, are often tied to their local communities. However, many are marginalized, suffer from poverty, industrialization, climate change and low economic performance. Additionally, small-scale fisheries are seriously understudied. The proposed session aims to contribute to rectify the underestimation of the importance of small-scale fisheries in addressing global challenges. This session will offer students and early career scientists the chance to present their work and promote networking within this field of research. We seek to synthesize contributions from ecological, social, economics and governance research fields, to present lessons learned from different small-scale fisheries systems.

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#### ORAL PRESENTATIONS

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- 1.1) **Soledad Luna** Brief Introductory Talk about Small-Scale Fisheries
- 1.2) **Sophia Kochalski** Assessing the Sustainability of Small-Scale Fisheries
- 1.3) **Malin Andersson** Inshore Commercial Fisheries in the Service Economy
- 1.4) **Lotta Kluger** Understanding Mangrove Social-Ecological Systems and Artisanal Fisheries in Climatic Extremes of the Tropical Eastern Pacific Ocean
- 1.5) **Lena von Nordheim** Effects of Spawning Substrates on Hatching Success of Atlantic Herring (*Clupea harengus*) in the Western Baltic Sea

#### POSTER PRESENTATIONS

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- 1.7) **Luceni Hellebrandt** Artisanal Fishery Productive Chain at Patos Lagoon Estuary (Brazil)

## *Assessing the Sustainability of Small-Scale Fisheries*

**Sophia Kochalski<sup>1</sup>\*\***

<sup>1</sup>*Department of Earth, Ocean & Ecological Sciences, University of Liverpool, Brownlow Street, L69 3GP Liverpool, UK*

### **ABSTRACT**

Small-scale fisheries provide food and employment and are often linked to the identity of the local fishing communities. Their taking place in vulnerable coastal waters has converted sustainability in a key factor for management decisions. International agreements and national legislation call for sustainable small-scale fisheries management that must strive towards a balance between socioeconomic benefits and environmental protection.

We present a new assessment framework that incorporates ecological, social, economic and cultural concerns and its application to the North western English inshore fisheries. The framework incorporates the state, adaptability and vulnerability of the target stocks, the ecosystem, the fishery and the fishing community. It is applicable to a wide range of small-scale fisheries and allows for comparison between them.

Through a Bayesian network structure, quantitative, qualitative and incomplete data can be incorporated. The framework is an adaptable tool that can holistically assess data-deficient small-scale fisheries to inform stakeholders and management decisions.

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## *Inshore Commercial Fisheries in the Service Economy*

**Malin Andersson<sup>1\*\*</sup>**

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### **ABSTRACT**

The study frames a traditional industry in transition with the aim to understand the ways in which a work-identity is formed in the service economy along the west coast of Sweden. More specifically, we want to understand how diversified inshore commercial fisheries are *discursively* established and negotiated as a service enterprising subject in three everyday relationships; authorities, customers and colleagues. The theory behind the study lies within the application of cultural analysis and discourse-analysis (du Gay and Hall 1998) with a focus on three theoretical concepts; governance (Hajer 1996) experienced authenticity (Di Domenico and Miller 2010) and work identification (du Gay and Hall 2002).

Field-notes from participation and observations, together with thirty-five in-depth qualitative work-life interviews were generated and analyzed between 2011 and 2014 in 16 inshore commercial fisheries along the west coast of Sweden. The fieldwork was conducted within three EU-funded areas, where small-scale fisheries are considered having a potential to further diversify by developing for instance tourism activities, (FLAGS) of one in particular is a focused case of study.

Discourses of the inshore commercial fishery in the service economy play out in three prominent relationships, those to authorities, customers and colleagues. First, in meetings on various levels of fisheries management, narrative threads are commonly used to negotiate and enlighten changes from various situated perspectives. Both authorities and fishermen are aware of the contemporary coastal commercial fisheries in decline, but based on different knowledge basis and views of the future of fisheries. Secondly, in service work discourses from participant observations in fisheries service enterprising, “experienced authenticities” are negotiated, between fishermen and their customers. Third, in fishing discourses from interviews and observations in relation to colleagues and fishing, the fishery is constructed and negotiated between sets of “we” and “them”, to establish work identity.

To sum up, authorities and fishermen form and negotiate small-scale inshore commercial fisheries as modern and sustainable from different knowledge basis. The study addresses opportunities, challenges and expectations that permeate the coastal commercial fishing in a service-oriented economy.

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## *Understanding Mangrove Social-Ecological Systems and Artisanal Fisheries in Climatic Extremes of the Tropical Eastern Pacific Ocean*

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<sup>2</sup>WWF-Colombia, Marine Programme, Carrera 35 NO. 4A-25, Cali, Colombia.

### **ABSTRACT**

Coastal ecosystems such as mangroves offer valuable ecosystem goods and services to humans, playing an important role for people's livelihoods (e.g. nurseries for fisheries resources, tourism, and coastal protection against tsunamis). However, increasing anthropogenic activities and environmental changes put these ecosystems at risk. Understanding the complexity and functioning of mangrove social-ecological systems and exploring their potential response to climate variability allows for the development of adequate management strategies. A recently initiated project (MAPES, [www.mapes2014.wordpress.com](http://www.mapes2014.wordpress.com)) aims at the comparative analysis of two social-ecological systems (SES) located in two mangrove areas along the South American Pacific coast (South Colombia and North Peru). Both locations support artisanal fisheries targeting invertebrate and vertebrate species (e.g. mangrove cockles and crabs, and a variety of estuarine fishes), recreational activities (tourism), aquaculture and urban development. However, mangrove settings, user groups, types of fisheries, targeted species, market chains and coastal development greatly differ among systems due to historical and environmental reasons. In order to characterize and analyze the structure of these complex networks, ecological and social variables were integrated using a qualitative. As both locations represent climatic extremes (S-Colombia: very wet; N-Peru: arid), results of this project are expected to generate knowledge on how mangrove-associated resources and the entire social-ecological system may respond to climate-related changes. Understanding likely scenarios for the small-scale fishery depending on these areas is crucial to protect the ecosystem and people's livelihoods on a long-term. This work represents one of the first attempts to holistically understand possible impacts of climatic variability on mangrove social-ecological systems in the Tropical Eastern Pacific and could potentially help in designing management plans for other mangrove systems in the region.

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## *Effects of Spawning Substrates on Hatching Success of Atlantic Herring (*Clupea harengus*) in the Western Baltic Sea*

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### **ABSTRACT**

Small scale fishery of spring-spawning herring is culturally and economically one of the most important activities of western Baltic coastal regions. In spring huge schools of herring migrate to inshore lagoons and estuaries for mating and spawning on submerged vegetation. Strong homing behavior makes the stock an optimal target for local fisheries, as massive waves of fish accumulate in a relatively small region such as the Greifswalder Bodden, a major spawning ground of western Baltic spring-spawning herring. Seasonal gillnet fishery depends on the spawning migration and reproduction success of this population. However, this site fidelity makes the stock vulnerable against environmental changes and habitat alterations. Despite the decline of aquatic plants, the preferred spawning substrate, herring regularly returns to the Greifswalder Bodden. Additionally, increasing ambitions of modification and commercial utilization of coastal zones introduces artificial structures such as harbor walls and wave-breakers. At the political level, it is argued that these steel and concrete units might work as artificial spawning structures. Hypothesizing that spawning on alternative substrates would affect herring hatching success; we defined potential natural and artificial spawning units. Those were incubated in the laboratory and in the field to analyze the embryonic development and the number and condition of hatchlings. Investigations revealed that artificial substrates did not directly cause a lower hatching success than natural substrates. Nonetheless the results indicate that structural complexity increased hatching success and exudates of artificial substrates might have affected the condition of hatching fish larvae. This is the first study about the effects of artificial substrates on herring embryonic development. Increasing the knowledge of substrate requirements for herring reproduction is essential to evaluate consequences of environmental changes and anthropogenic alteration on coastal spawning grounds. This is a basis for effective management of coastal habitats and thus a foundation for resilient herring stocks and sustainable fisheries.

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## *Artisanal Fishery Productive Chain at Patos Lagoon Estuary (Brazil)*

**Luceni Hellebrandt<sup>1\*\*</sup>, Tatiana Walter<sup>2</sup>, Lucia Anello<sup>2</sup>**

<sup>1</sup>UFSC, Brazil

<sup>2</sup>FURG, Brazil

### **ABSTRACT**

This paper presents data of a research project developed between 2012 and 2014 for a multidisciplinary group, which involved undergraduate and master students, PhD candidates and graduate researchers from the Federal University of Rio Grande (FURG, southern Brazil). From an initiative of the Rio Grande do Sul State Government, in Brazil, the team of students and professors have been contacted to elaborate a diagnosis of artisanal fishery productive chain of the estuarine area from Patos Lagoon. Through participative workshops, in-depth interviews and observations, we could map the work of the artisanal fishery stakeholders within this region. We collected data such as first commercialization value, process types, added value and market for distribution and commerce from each of the target species from this area (shrimp, mullet, catfish and croaker), but especially for pink shrimp the most economically and socially valuable species for fishing communities of Patos Lagoon Estuary. Furthermore, we gathered information on the workers description of the catch, processing and the market for fish in the area. With this data, we hope to enrich the knowledge about the artisanal fishery productive chain in this area and to provide information to design better public policies for the artisanal fishery sector, and beyond this, we hope to contribute to the joint efforts of artisanal fishery research around the world.

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# 2

## Individual Engagement

### *Individual Engagement in Environmental Change*

Diana Süßer<sup>1\*\*</sup>, Corinna de Guttery<sup>1\*\*\*</sup>

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#### ABSTRACT

Dealing with actual and expected environmental changes (including climate change) in coastal areas involves a range of infrastructural measures, from coastal protection to use of renewable energies. This session focuses on the individual engagement in these often policy led environmental issues by addressing coastal inhabitants' attitudes and behaviours. How do coastal inhabitants perceive environmental changes in their daily life and in their regional landscape? Do (and if so why and how) individuals engage in environmental issues? How (if) is it possible to enhance the societal engagement and involvement in environmental issues? What are the economic and social challenges and opportunities related with those issues? To discuss different perspectives and approaches of engagement in environmental change, applications from different fields (including geography, social sciences, psychology, politics, and economics) are welcome.

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#### ORAL PRESENTATIONS

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##### 2.1) Corinna de Guttery

Diana Süßer

Engaging Individuals with Environmental Change - Is it all about distances?

##### 2.2) Lisa Mertens

Ocean Literacy - How to Involve Children and Teens in Marine Sciences and Ocean Politics

##### 2.3) Isabel Richter

Changing Oceans - Changing Seafood Consumption

##### 2.4) Pascal Sommer

*(invited speaker)*

Wind Energy - From Onshore to Offshore: Technology Evolution and Public Acceptance

## *Ocean literacy - How to Involve Children and Teens in Marine Sciences and Ocean Politics*

**Lisa Mertens**<sup>1\*\*</sup>, Sören Häfker<sup>2</sup>, Sarina Jung<sup>3</sup>, Christina Roggatz<sup>4</sup>

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<sup>4</sup>University of Hull, Cottingham Rd, Hull, Yorkshire HU6 7RX, United Kingdom

### **ABSTRACT**

Currently, marine ecosystems are not implemented in German school curricula. Further, the media image of marine ecosystems is dominated by dolphins and whales. But how can children and teens learn about marine sciences and related fields like climate change? We are introducing the independent media-platform MBS (Meeresbiologie-studieren.de), which serves as an information source for education choices and career paths, and it is also a nouveau form of science communication. MBS has attracted 190,000 page views in the first 18 months and has become the leading resource for all German speaking countries. In a daily effort, news, articles and advances in marine policies are discussed on our Facebook page, which reaches around 400 followers. We settle a moderated community, where everybody can spark an exchange of opinions by contributing with links, images or questions. A virtual team of four young marine scientists located in the UK, Netherlands and Germany runs MBS. We aim to serve as ocean ambassadors for children and the greater public in order to raise awareness and knowledge about the marine realm and its environmental challenges. The talk will highlight important results and future strategies from the project that can be applied for citizens' engagement in other fields as well.

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## Changing Oceans - Changing Seafood Consumption

Isabel Richter<sup>1\*\*</sup>, Christian A. Kloeckner<sup>1</sup>, Mehmet Mehmetoglu<sup>1</sup>

<sup>1</sup>Psykologisk institutt, Norges teknisk, Naturvitenskapelige Universitet Norway

### ABSTRACT

Overfishing is getting oceans to collapse - if we don't change. Today's precarious situation is caused by a complex interaction of many driving forces. Central is the consumers' steady demand for huge amounts and variations of seafood products. This implies that turning towards a sustainable way of seafood consumption can make a difference. In this study psychological means are used to foster sustainable fish consumption (SFC) in Norway as one of the world's largest fish producing, consuming and exporting nation.

The theoretical section of the study consists in an overview of the particular characteristics of SFC in Norway. Governmental and scientific reports about fisheries and aquaculture, expert interviews, field excursions and focus group studies serve as data to discover subjective and objective situational constraints and facilitators for the performance of SFC. Subsequently the Comprehensive Action Determination Model (CADM) proposed by Klöckner and Blöbaum (2010) is applied. The CADM is utilized because it is a comprehensive combination of some selected, well-established models used to predict environmental behavior in previous studies. It incorporates intentional, normative, situational and habitual influences on environmentally friendly behavior. Analysis of the final model will reveal the main predictors of SFC in Norway. Using those predictors as well as applying the Stage Model of Self-Regulated Behavioral Change (Bamberg, 2011) interventions to foster SFC will be designed, pretested and executed which reflects the practical contribution of the project.

This is in all conscience the first research on this topic and therefore essential for future change makers concerned with SFC - not only in Norway but across the world. The project is also central for theory development and application within the emerging field of environmental psychology.

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## *Wind Energy - From Onshore to Offshore: Technology Evolution and Public Acceptance*

**Pascal Sommer**<sup>1\*\*</sup>

<sup>1</sup>*University of Hamburg, Germany*

### **ABSTRACT**

Over the past decades wind energy has come a long way: from small single onshore turbines in the 1980s to large offshore power plants today. Throughout the decades wind energy has been subject to controversy and discussions. This talk aims to illustrate the evolution of technological development and how this has been related to public acceptance and public participation of wind energy in Europe.

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# 3

## Aquaculture in a Changing Ocean

Nina Bloecher<sup>1\*\*</sup>, Stefan Meyer<sup>2\*\*\*</sup>

<sup>1</sup>SINTEF Fisheries and Aquaculture, Trondheim, Norway

<sup>2</sup>Gesellschaft für Marine Aquakultur (GMA) Büsum, Germany

### ABSTRACT

In the last decade, the production from marine aquaculture and the number of producer countries has increased. The product range has been expanded from mainly food to also include food additives, medical substances and biofuels. However, the aquaculture industry faces many biological, technological and sociological challenges with a multitude of possible impacts on the coastal marine ecosystem. The aim for this session is to show how these risks can be measured and how solutions for handling these challenges can be developed. In addition, opportunities for aquaculture in a changing ocean will be discussed.

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### ORAL PRESENTATIONS

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- |      |                                                             |                                                                                                                                              |
|------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1) | <b>Muhammed A. Oyinlola</b><br><b>Folasade M. Adeboyejo</b> | Modelling The Impact Of Sea Surface Temperature On Global Mariculture Production Using ArcGIS                                                |
| 3.2) | <b>Giannina Hattich</b>                                     | The Spatial Footprint of Fish Farms on Benthic Microbial Communities.                                                                        |
| 3.3) | <b>Vanessa Fuchs</b>                                        | Evaluating Dietary Supplement Compensation of Growth Performance Loss due to Fishmeal Substitution in Turbot ( <i>Scophthalmus Maximus</i> ) |
| 3.4) | <b>Kevin Torben Stiller</b><br>(invited speaker)            | Metabolic Fuel Use of Rainbow Trout Feed with Varying Macronutrient Feeds in Low Oxygen Environment at three Different Temperatures          |

### POSTER PRESENTATIONS

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- |      |                     |                                                                                                                                      |
|------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 3.5) | <b>Steffi Meyer</b> | Evaluating the Impact of Scallop ( <i>Argopecten purpuratus</i> ) Cultivation on the Benthic Infaunal Community in Sechura Bay, Peru |
|------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|

## *Modelling the Impact of Sea Surface Temperature on Global Mariculture Production Using ArcGIS*

**Muhammed A. Oyinlola<sup>1\*\*</sup>, Folasade M. Adebeyejo<sup>1\*\*\*</sup>**

<sup>1</sup>*Leibniz Center for Tropical Marine Ecology, Fahrenheitstr. 6, 28359 Bremen, Germany*

### **ABSTRACT**

The impacts of Climate change on global food supply have been assessed with projections directed towards production from terrestrial biomes and marine capture fisheries. Lack of existing study on the impact of climate change on animal protein production from the Aquaculture sector creates a gap in knowledge, as fisheries production from Aquaculture constitute about 50% of the total fisheries supplies. With this in mind, we modelled the prospect of mariculture production as influenced by increase in sea surface temperature (SST) within the different world climate regimes. Utilizing three levels of B2 scenario from the projected increase in SST by Intergovernmental Panel on Climate Change (IPCC), reported temperature preferences (TP) of cultured species within the large marine ecosystem (LMEs) and mariculture statistics, interpolations were made for all mariculture producing coastal states using ArcGIS 9.3.

For all projected SST, tropical LMEs might not be suitable for mariculture production due to small window frame of TP and higher SST above the TP of cultured species while a few LMEs in the sub-tropics will be affected. SST of the temperate did not increase above the TP of species presently cultured in this region. Unsuitability of tropical LME's to support mariculture in the tropics, especially within major producers in South East Asia, and Japan indicates reduction in total production, hence additional threat to food security in the tropics. With projected SST, shift in tropical cultured species to other regions, especially to sub-tropical region with temperature within the TP of these species is a possibility. Though, this study provides information about the impacts of increase in SST on mariculture, it is one of the few studies been done and is with uncertainties associated with modelling and interpolation.

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Keywords: Geographical Information System (GIS), Aquaculture, Climate change, Temperature preference, LME's and IPCC

## *The Spatial Footprint of Fish Farms on Benthic Microbial Communities*

**Giannina Hattich**<sup>1\*\*</sup>, Barry Thornton, Nia B. Gray and Daniel J. Mayor

<sup>1</sup>*University of Aberdeen, Oceanlab, Newburgh, Aberdeenshire AB41 6AA, Scotland*

### **ABSTRACT**

Benthic microbial communities are responsible for recycling the majority of organic matter that reaches the seabed. Nevertheless, little is known about how they respond to fish farming activities and the associated release of organic matter. Sediments were collected beneath five Scottish fish farms that ranged in size from 120-2106 tonnes. Phospholipid fatty acid (PLFA) profiles were examined to investigate potential shifts in benthic microbial community structures and the distribution of fish farm-derived organic matter.

Microbial biomass, calculated from bacteria-specific PLFAs, was significantly increased in close proximity to fish farms ( $\leq 25$  m). It was also affected by a significant interaction between current speed and farm size; increasing current speed at farms  $\leq 900$  tonnes reduced predicted levels of bacterial biomass whereas the opposite occurred at larger farms. PLFA composition, a proxy for microbial community structure, changed significantly in response to farm size and distance from the cage edge. The data suggest a shift towards anoxic conditions beneath smaller farms. Proportions of the PLFA 18:1 $\omega$ 9, likely derived from fish feed, were highest in close proximity to the cage edge and also increased with farm size.

Our analyses suggest that 1) fish farming has discernable effects on benthic biomass and their community structures and 2) the magnitude of effects resulting from fish farm-derived organic matter are complex, depending on factors such as farm size, current speed and distance from the cage edge. Understanding the effects of fish farm-derived organic matter on benthic microbial communities could allow a more environmentally sustainable management of fish farming activities.

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## *Evaluating Dietary Supplement Compensation of Growth Performance Loss Due to Fishmeal Substitution in Turbot (*Scophthalmus Maximus*)*

Vanessa I. Fuchs<sup>1\*\*</sup>, Jan Schmidt<sup>2</sup>, Matthew J. Slater<sup>2</sup>, Bela H. Buck<sup>3</sup>,  
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### ABSTRACT

Rising demand and limited supply of fishmeal (FM) forced the feed industry to substitute FM partly with alternative protein sources. However, substitution with plant protein can reduce fish growth and health due to the deficiency or lower digestibility of nutrients. Diet additives are known to improve growth and health and may compensate negative effects of low FM diets. The current study assessed four additives effect on growth performance, feed conversion and health condition in turbot when fed a FM (32%) reduced diet.

The experimental diets contained soy protein concentrate and wheat gluten (40% inclusion) as a partial replacement of FM. Four additives were selected as promising types of substances: (1) glucans and mannans, (2) nucleotides, (3) alginic acids and (4) bacteria of the genus *Bacillus*. Turbot were fed six experimental diets, four supplemented with an additive and two as control diets with high and low FM content, over a period of 84 days. Fish weight, specific growth rate, daily feed intake, feed conversion ratio, condition factor and hepatosomatic index were monitored. Additionally, parameters of the innate immune system, plasma lysozyme activity and neutrophil reactive oxygen species, were investigated to monitor health conditions.

Fish fed the low-FM diets exhibited significantly lower weight gain and specific growth rate than fish fed the high-FM diet, however, growth performance remained unaffected by additive supplementation. FM reduction had no significant effect on feed conversion ratio compared to the high FM control diet. No significant changes were observed in the condition factor and hepatosomatic index. Turbot accepted diets containing up to 400 g kg<sup>-1</sup> plant proteins without significant effects on feed conversion. Feed intake and growth performance of turbot is depressed by high levels of FM replacement. The effect of feed additives on low-FM diets was marginal and did not compensate growth performance loss in turbot.

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## Metabolic Fuel Use of Rainbow Trout Fed with Varying Macronutrient Feeds in Low Oxygen Environment at Three Different Temperatures

Kevin Torben Stiller<sup>1, 2, 3\*\*</sup>, C. Dietz<sup>2</sup>, K. H. Vanselow<sup>1</sup>, D. Moran<sup>4</sup>, G. Riesen<sup>5</sup>, S. Marx<sup>6</sup>, S. Heckmann<sup>6</sup>, E. Savino<sup>7</sup>, P. Moschetta<sup>7</sup>, C. Schulz<sup>2, 3</sup>

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### ABSTRACT

Metabolic fuel use is becoming increasingly important for the evaluation of feedstuffs for intensive aquaculture. However standardized methods for measurement of metabolism under culture-like conditions are not well developed. The respiratory quotient (RQ) is the ratio of CO<sub>2</sub> produced and O<sub>2</sub> consumed and ammonia quotient (AQ) is the ratio of produced total ammonia nitrogen and consumed O<sub>2</sub>. Together, these quotients give a proxy of protein, carbohydrate and fat fuel use rates. We investigated these metabolic rates and quotients of rainbow trout (*Oncorhynchus mykiss*) fed two isoenergetic diets with different protein levels (43 and 50%) in a recirculating aquaculture respirometer system (RARS) under different temperatures (12 °C, 16 °C and 20 °C) and low evening oxygen conditions (4 PM to 8 AM, 40 to 50 %). The water chemistry analysis unit measured the following parameters: O<sub>2</sub>, pH, temperature, TAN and dissolved CO<sub>2</sub>. With a few exceptions, temperature, diet and oxygen availability had no significant effect on whole body composition, growth variables and digestibility results. The higher protein diet exhibited slightly higher digestibility (2.2 %) than the other diet. The only significant differences in oxygen consumption were detected at 12 °C, where fish fed the 50 % protein diet consumed on average 1.1 % more oxygen. The oxygen consumption rate decreased for all treatments during the one-day fasting period in a similar fashion. Fish fed the 50 % protein diet exhibited higher rates of protein fuel use (11.5 % at 12 °C, 7.7 % at 16 °C and 7.9 % at 20 °C) compared to the lower protein diet. An oxygen challenge at night during the digestive process appears to have no significant influence on the AQ value. The results demonstrate the utility of automated RARS to non-invasively evaluate the physiological performance of different fish diets in an aquaculture setting.

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## *Evaluating the Impact of Scallop (*Argopecten purpuratus*) Cultivation on the Benthic Infaunal Community in Sechura Bay, Peru*

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### ABSTRACT

One of the main natural banks of *Argopecten purpuratus* can be found in Sechura Bay, Peru, and by now this area has become the principal cultivation site for scallops within the country. The majority of the production is exported and the livelihood of many people is based on this industry. This generates the need for a secure and stable production based on a sustainable way of cultivation and a healthy environment. Common indicators for assessing the environmental impact of bivalve cultivation are the levels of hydrogen sulfide and/or the infaunal community structure. The latter was more feasible for this study and thus the method of choice.

In March 2014, the sampling was done in areas with and without long-term, on-bottom cultivation. Sediment cores were taken to analyze the infaunal communities as well as abiotic features of the sediment (organic enrichment, nitrogen content, calcium carbonate and granulometry). In addition, a multisensor was deployed to obtain sea water parameters close to the sea floor (e.g. temperature, dissolved oxygen). The analyses of the samples are still in progress but preliminary results suggest a difference in the infaunal communities between the sampled areas. Once all samples are processed, multivariate statistics and calculated diversity indices are used to analyze the infaunal community structure in relation to the respective density of *A. purpuratus* and abiotic characteristics. Previous studies have mainly focused on suspended and off-bottom bivalve cultivation, making it difficult to estimate the effects of an on-bottom cultivation such as the one in Sechura Bay. Thus this study provides a valuable insight into the environmental impact of this cultivation type and whether it has the potential of being a sustainable way of cultivating bivalves or not.

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# 4 | Coral Reef Ecology, Management and Conservation in a Rapidly Changing Ocean Environment

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## ABSTRACT

Coral reefs are among the most diverse and productive marine ecosystems but face increasing pressure from local and global threats. In recent decades, the fast decline of many reef ecosystems has challenged researchers and managers to provide strategies that reconcile human activities with the conservation of the ecological processes that drive these ecosystems (e.g. productivity, herbivory). Therefore, in this session, we welcome contributions reporting the latest ecological processes shown to be important in structuring reef communities, responses of coral reefs to changing ocean scenarios, and management and conservation strategies that may help sustain reef ecosystem function in exploited areas.

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## ORAL PRESENTATIONS

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|------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 4.1) | <b>Ulisse Cardini</b><br><b>Laura Rix</b> | Coral Reef Ecology, Management and Conservation in a Rapidly Changing Ocean Environment                                                  |
| 4.2) | <b>Ines Stuhldreier</b>                   | Coral Reef Functioning in Upwelling-Influenced Reefs at the Pacific Coast of Costa Rica                                                  |
| 4.3) | <b>Sabrina Schmalz</b>                    | Abundance and Development of Coral-Algae Interactions in Coral Reefs of the Mexican Caribbean                                            |
| 4.4) | <b>Rosa van der Ven</b>                   | Genetic Diversity and Connectivity of the Stony Coral <i>Acropora tenuis</i> along the Coast of Kenya and Tanzania                       |
| 4.5) | <b>Filip Huyghe</b>                       | Connectivity in the Skunk Clown Fish Using a Combination of Microsatellite and Mitochondrial Genetic Markers                             |
| 4.6) | <b>Nanne van. Hoytema</b>                 | Seasonality Effects on Photosynthetic Carbon Fixation and Organic Carbon Availability in Reef-Surrounding Waters of the Northern Red Sea |



## Coral Reef Functioning in Upwelling-Influenced Reefs at the Pacific Coast of Costa Rica

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### ABSTRACT

The northern Pacific coast of Costa Rica is a natural laboratory for changes in water quality parameters as it experiences pronounced seasonal changes in water temperature, pH and nutrient concentrations due to wind-induced upwelling that usually takes place from December to April. This may control functioning of local coral reef communities, but related knowledge is scarce. Thus, this study monitored water quality, benthic community composition, development of coral-algae interactions and physiological responses of key reef organisms in reefs of Papagayo Bay weekly over one year from April 2013 until April 2014. Findings revealed a sharp decrease in macro-algal seafloor cover (from 15 to 1 %) which was associated with synchronized sexual reproduction and subsequent mass death of the dominant green macroalgae *Caulerpa sertularioides* in April 2013. This and a decrease in turf algae cover in June favored hard corals and crustose coralline algae (CCA) (increase in cover by 10 and 20 % respectively from April to June 2013). Over the following months (July 2013–April 2014), coral cover increased further from 30 to 50 %, whereas turf and CCA cover decreased by 8 and 16 % respectively. *C. sertularioides* increased again to 9 % benthic cover in March 2014 in response to significantly elevated nutrient concentrations compared to non-upwelling conditions. However, oxygen fluxes of key reef organisms (*Pocillopora* sp., CCA, turf algae, *C. sertularioides*) showed significantly increased photosynthesis rates in response to increased nutrient concentrations only for corals. Measurements with a pulse amplitude modulation (PAM) fluorometer confirmed that *C. sertularioides* in direct contact with the hard coral *Pocillopora* sp. can negatively affect its photosynthetic efficiency by shading and thereby reduce coral productivity. These findings indicate that the investigated reef is characterized by a high dynamic in all measured response parameters. Reef community composition is likely driven by the competition between corals and algae, primarily controlled by inorganic nutrient availability.

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## *Abundance and Development of Coral-Algae Interactions in Coral Reefs of the Mexican Caribbean*

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### ABSTRACT

Corals may be negatively affected by direct contact with algae, but there are no studies available on the character and development of these interactions in the Mexican Caribbean. This study therefore investigates abundance and development of interactions between hard corals (*Diploria strigosa*, *Porites asteroides*, *Montastraea annularis*) and algae (*Dictyota* spp., *Halimeda* spp. and turf) at four locations (Puerto Morelos, Tulum, Punta Allen, Xcalak) along the Riviera Maya and the Costa Maya over a total period of 6 months from September 2013 until March 2014. Monitored indicators were coral tissue pigmentation (using colour cards) and tissue loss (using underwater photography and subsequent image processing) supplemented by inorganic nutrient measurements at all sites. Findings revealed that all corals were in direct contact with benthic algae. About 87% of all detected interactions occurred with turf algae, 21% with the green alga *Halimeda* sp. and 21% with the brown alga *Dictyota* sp. (38%), while most coral colonies were in contact with more than one algae species. No significant differences in the abundance of coral-algae-interactions and coral tissue loss between sites occurred. However, most coral tissue loss and pigmentation loss for all investigated coral species was observed in interaction with turf algae. This particularly applied for *Montastraea annularis* and *Diploria strigosa* that were more affected at the turf contact zones than *Porites asteroides*. Where nutrients concentrations were highest (Tulum), lighter coral pigmentation in comparison to the other sites occurred. From December to March, inorganic nutrient concentrations increased by 43 % (nitrate) to 142 % (ammonia). This corresponded with a decrease in coral pigmentation at the contact zones with turf algae. Our study thus indicates that inorganic input in coral reefs of the Mexican Caribbean influences coral-algae interactions that are particularly dangerous for corals when turf algae are involved.

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## *Genetic Diversity and Connectivity of the Stony Coral *Acropora tenuis* along the Coast of Kenya and Tanzania*

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### **ABSTRACT**

The reefs along East Africa are declining and the ability of coral reefs to adapt to, and recover from, environmental stressors highly depends on genetic diversity of a population and the connectivity between reefs. Connectivity of coral populations depends on the life history of the species, the location of the reefs and oceanographic barriers between populations.

In this study we present novel research on the population genetic structure and connectivity of the stony coral *Acropora tenuis* along the coast of Kenya and Tanzania with a particular focus on the role of oceanographic barriers limiting dispersal. *A. tenuis* is a common Indo-Pacific coral species and reproduces by synchronised mass broadcast spawning events. Coral fragments were collected at six locations in Tanzania and seven locations in Kenya. Multiplex PCR was performed with seven DNA microsatellite markers and followed by fragment length analysis on a capillary sequencer. Data analysis was done with the software Genealex and Fstat.

Preliminary results show that most populations have a high diversity and connectivity which is expected for a broadcast spawner. The populations are clustered in a northern (Kenya and north of Tanzania) and a southern group (middle and south of Tanzania), which can be explained by the Northeast Madagascar Current splitting up into a northward flowing East African Coastal Current and southward flowing branch into the Mozambique Channel effectively reducing dispersal degree between the two groups. These findings on coral genetic diversity patterns increase current knowledge on the state of East Africa's coral reefs. The results are discussed in the context of coral reef conservation and the efficiency of Marine Protected Area's (MPA's) as a management option.

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## Connectivity in the Skunk Clown Fish Using a Combination of Microsatellite and Mitochondrial Genetic Markers

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### ABSTRACT

Like most coral reef associated organisms, *Amphiprion akallopisos* (Skunk Clown Fish) is unable to migrate from one coral reef to another during its adult life stage. Dispersal between reefs is limited to the pelagic larval stage. Population genetics is a useful technique to evaluate dispersal and connectivity between populations. Insight into connectivity in coral reef associated organisms is vital for a correct spacing of Marine Protected Areas, needed for conservation. *Amphiprion akallopisos* has a disjunct distribution, occurring in the Western Indian Ocean (WIO) and the Eastern Indian Ocean (EIO), separated by more than 4.500 km of open sea. This study aims to estimate levels of gene flow between and within these WIO and EIO populations. Using a combination of mitochondrial and nuclear genetic markers reduces genetic sampling error and it allows data comparisons from markers evolving at a different rate. A first analysis was performed on 263 samples of *A. akallopisos* individuals from 17 different sites in both the WIO (Kenya, Tanzania, and Madagascar) and the EIO (Indonesia) with mitochondrial DNA (Control Region). Strong population structure ( $\phi_{st} = 0.28$ ;  $P < 0.001$ ), and strong differentiation ( $\phi_{ct} = 0.61$ ;  $P < 0.001$ ) was encountered between the EIO and the WIO populations. Within the WIO, low but significant population structure ( $\phi_{st} = 0.021$ ;  $P < 0.01$ ) was observed, but no clear geographic genetic break could be detected. Selective neutrality tests (Tajima's D and Fu's Fs) indicate a recent population expansion (raggedness index  $r = 0.068$ ;  $P = 0.82$ ). The dataset has recently been extended with 76 samples of individuals from 4 new sites in Mozambique, providing an improved geographic coverage for the WIO population. The population genetic analysis will be completed with 11 microsatellite markers. In a later stage, these same markers will be applied in self-recruitment analysis and assignment tests.

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## Seasonality Effects on Photosynthetic Carbon Fixation and Organic Carbon Availability in Reef-Surrounding Waters of the Northern Red Sea

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### ABSTRACT

The waters surrounding coral reefs play a key role in the production and transport of organic matter throughout the coral reef ecosystem. Due to their high latitude location, coral reefs in the Northern Red Sea experience strong seasonal variation in light availability and water temperature which, in turn, create deep water upwelling in winter/spring and water column stratification in summer/fall resulting in seasonally varying inorganic nutrient concentrations. This provides the unique opportunity to study effects of seasonal environmental variation on planktonic primary production and organic matter availability. From January till April (winter/spring) and from September till November 2013 (summer/fall), the water column 1 m above a Jordanian fringing reef (10 m water depth) was sampled to measure planktonic net primary production and respiration, as well as particulate (POC) and dissolved (DOC) organic carbon and inorganic nutrient concentrations ( $\text{NH}_4$  and  $\text{NO}_x$ , together total inorganic nitrogen (TIN), and  $\text{PO}_4$ ). There was a strong decrease in inorganic nutrient concentrations between winter/spring and summer/fall ( $1.14 \pm 0.08$  to  $0.51 \pm 0.10 \mu\text{mol L}^{-1}$  and  $0.11 \pm 0.02$  to  $0.04 \pm 0.02 \mu\text{mol L}^{-1}$  (average  $\pm$  SD.) for TIN and  $\text{PO}_4$  respectively. Concurrently, there was a significant decrease in planktonic gross primary production ( $0.85 \pm 1.76$  to  $0.22 \pm 1.75 \text{ mmol C m}^{-3} \text{ d}^{-1}$ ). POC did not change significantly between spring and summer ( $7.90 \pm 2.98$  to  $7.74 \pm 1.79 \mu\text{mol L}^{-1}$ ), but DOC increased significantly ( $75.5 \pm 7.00$  to  $87.4 \pm 4.20 \mu\text{mol L}^{-1}$ ). This increase in DOC, not produced by an increase in planktonic primary production, most likely originates from the coral reef benthos. During low nutrient (nitrogen) summer, the benthic community shows an excess release of photosynthetic DOC, which sustains planktonic heterotrophic pathways via the microbial loop (up to zooplankton), which consequently become available as food (nitrogen) source for mixotrophs such as corals.

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# 5 | Tools and Methods Supporting an Ecosystem Based Approach to Marine Spatial Management

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## ABSTRACT

In the face of degraded ecosystems through growing demands for aquatic products and an increase in use of marine space, conflicts between sectors and conservation interests are inevitable. Spatial management tools such as Marine Spatial Planning (MSP) are advocated to support the implementation of an ecosystem approach that integrates ecological, social, and economic interests to maintain ecosystem health and services while supporting sustainable growth. Contributions are welcome presenting analytical methods to assess risks and (cumulative) effects of human uses or management approaches on the marine environment in time and/or space to support an ecosystem based approach to Marine Spatial Management.

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## ORAL PRESENTATIONS

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- 5.1) **Henrike Seidel**  
**Antje Gimpel**      Tools and Methods: Marine Spatial Management
- 5.2) **Flavia Hoering**      Population Genetic Structure of *Calanoides carinatus*  
(Copepoda, Calanoida) along the West Coast of Africa
- 5.3) **Vera Golz**      Marine Monitoring and Interdisciplinary Research  
Planning - The Spermonde Archipelago, Indonesia, as a  
Case Study
- 5.4) **Friedemann Keyl**      An Example of Geostatistical Methods in Fishery Biology

## POSTER PRESENTATIONS

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- 5.5) **Huachun He**      Assessment of Coastline Changes with Remote Sensing for  
Environmental Management of the Tidal Flat of Jiangsu  
Plain, China
- 5.6) **Haiyu Li**      Terrain Evolution and the Interaction Process of Human  
Activities in the Sand Ridge Fields of Southern Yellow Sea

## Population Genetic Structure of *Calanoides carinatus* (Copepoda, Calanoida) along the West Coast of Africa

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### ABSTRACT

Molecular markers have the potential to identify cryptic species that are difficult to characterize using morphology alone and resolve genetic patterns within species and populations. In contrast to the benthos, genetic differentiation is more difficult to explain in the pelagic realm where barriers to gene flow cannot be easily identified. We investigated the calanoid copepod *Calanoides carinatus*, an ecologically important component of the herbivorous zooplankton in marine upwelling systems worldwide, aiming to (1) look for cryptic species, (2) describe spatial patterns in the distribution of genetic variance and (3) identify potential barriers that may have shaped the genetic structure of the species. Samples were obtained in the eastern Atlantic Ocean from the Iberian Peninsula to Namibia. The preliminary analysis of the mitochondrial marker cytochrome oxidase subunit I (COI) revealed a deep split within *C. carinatus*. The magnitude of genetic differentiation between those two groups and the lack of intermediate values suggest the presence of an as yet unrecognized species inside of nominal *C. carinatus*. Inside of the two molecular operational taxonomic units (MOTU) the distribution of weakly differentiated mitochondrial haplotypes extended across potential barriers, indicating that none of the potential barriers to gene flow appear to be particularly effective at this taxonomic level in this highly dispersive species. It is especially remarkable that this pattern appeared in both of the two distinct *C. carinatus* MOTUs.

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## *Marine Monitoring and Interdisciplinary Research Planning - The Spermonde Archipelago, Indonesia, as a Case Study*

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### **ABSTRACT**

Long-term management of the marine ecosystem is essential as space and resources are becoming scarce and conflicts between the stakeholders are common. Marine spatial planning is increasingly used as a tool that acknowledges the geographic connection of resource interests and ecosystem health. It aims at facilitating a holistic management of the marine area by interpreting spatial information. This information is gained through long term monitoring and can be processed within geographic information systems, a tool that facilitates the combination of transdisciplinary layers and their spatial references.

The study at hand assesses the usability and identifies knowledge gaps of available research data to analyze the feasibility for the implementation of an integrative monitoring concept in the Spermonde Archipelago, Indonesia. Thereby, the study focuses on two factors, fisheries and nutrients, which represent ecological as well as social-ecological components of the reef system of Spermonde. A geographic information system is used to map the available data. By using the Marine Strategy Framework Directive of the European Union as a guideline for a holistic marine monitoring, recommendations for further investigations and monitoring in Spermonde are made. These recommendations include: the record of catch data of the fisheries of the Spermonde Archipelago by monitoring. Furthermore, the measurements of chlorophyll a should be standardized to make usage of the interpolation application of geographic information systems. As the basic requirement for all environmental monitoring and further data analysis, this study encourages the development and implementation of guidelines for data collection and data base management. It is essential for any interdisciplinary investigation that aims to combine social-ecological, ecological and economic data of the Spermonde system or any system that data is processed in a manner that allows recombination. This helps to avoid repetition of fieldwork, save costs and especially come to new conclusions regarding the system's dynamics.

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## *An Example of Geostatistical Methods in Fishery Biology*

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### **ABSTRACT**

Recent derivatives of geostatistical methods are able to consider co-factors and open new areas of application among fish ecology and marine biology. One of these is regression kriging (RK) that uses conventional regression techniques together with kriging. RK can estimate the probabilities of occurrence at a given location as well as the distribution of the intensity of attributes as e.g. abundance or size. It produces (pseudo) mechanistic links between environmental conditions and biota and at the same time includes aggregation processes often observed in marine species. This allows addressing the upcoming spatially explicit requirements in the context of Marine Spatial Planning (MSP).

Here, a three-step regression kriging method for the spatial-temporal prediction is presented together with an exemplarily application to different ontogenetic stages of North Sea fish. The model estimates local abundances in relation to hydrographic factors and trophic interactions and is able to deal with the statistical problems arising from skewed data distributions (zero-inflation, over-dispersion) commonly found in fisheries and survey data.

Results show that the spatial distributions of the abundances of important fish species are not stable which can lead to changes in species overlap and competition between species. Abundances of species were different in the period representing the last years of the gadoid outburst and in the past decade. Additionally a short overview on potential applications in marine ecology and MSP shows the usefulness of the method.

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## *Assessment of Coastline Changes with Remote Sensing for Environmental Management of the Tidal Flat of Jiangsu Plain, China*

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### **ABSTRACT**

The tidal flats along the coastline of Jiangsu province, China, are unique in the world in terms of their huge geometric scale, abundant sediment supply originated from large rivers, silt-dominated sediments, and the integration of both tidal flats and offshore radiating sand ridge fields. Owing to the abundant sediment supply from the ancient Yellow River and ancient Yangtze River, the coast of the Jiangsu province has mostly undergone rapid accretion (the maximum deposition rate can reach up to 20m/a). In past two decades with the rapid industrialization and urbanization, the land use of Jiangsu plain has been changed extensively. To analyze the coastline changes, we reconstruct coastline erosion/accretion by the Digital Shoreline Analysis System (DSAS), an integrated model to interpret multi-temporal Landsat and SPOT imageries and a series of historical topographical maps and nautical charts. The volumetric changes in different morphometric units are processed based on the DEM as well.

Mean high tidal lines are delineated as coastlines at intervals of about 8 years during 1984-2013, that represent the shoreline progradation or recession of the study area in the past three decades. Since 1984, the coastlines have generally advanced towards the sea and tidal flat experienced three changing periods: slow accretion (1984-1992), rapid accretion (1992-2005), and accretion-erosion equilibrium (2005-2013). The maximum coastal progradation occurred during 1992-2005 at the southern parts of Doulong port and Dongtai estuary, where the coastline advanced seaward about 8 and 6 km respectively, and mean net progradation rates were 0.22 and 0.17 km/yr, respectively. By contrast, between 1992 and 2005, the coast salt marsh progradation at Yancheng nature reserve was only ca. 100 m. A major reason for the shoreline progradation is the coastal engineering, such as sea reclamation, filling project, and wharf constructions, which decreased the riverine sediment supply significantly.

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## *Terrain Evolution and the Interaction Process of Human Activities in the Sand Ridge Fields of Southern Yellow Sea*

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### **ABSTRACT**

The radiating sand ridge fields of southern Yellow Sea are huge sediment bodies on the shallow sea of inner continental shelf of east China, where is the most active coastal zone of land-ocean interactions, as well as the key area influenced by human activities.

The terrain evolution, patterns and characteristics of radial sand ridges and the influence of human activities in this area have been investigated on the means of sediment sampling, profile monitoring, spectrum collection, LiDAR surface monitoring. Comprehensive models with multi sources of heterogeneous dataset are constructed to retrieve the topographical information from remote sensing imageries. From the high density computing of remote sensing imageries with big data, a high resolution DEMs time sequence is established, and the Space-Time Voxel Model (STVM) is developed by mixing both space and time. Relying on both DEMs and STVM, modern technologies could work with traditional geography study together well in this project.

Integrated with the result from particle size analysis, isotopic dating and other multidiscipline conclusions, we could analyze the characteristics of spatial distribution, patterns, and detail terrain evolution of radial sand ridges. The change detection, trend analysis, and total sand accumulation and deposition rate are adopted to reflect the dynamic nature of the sand ridge complex. The objectives, finding the internal rule of terrain fluctuation under extreme meteorological and geologic event and progressive process under tidal dynamic, depicting the relative equilibrium core bodies of sand ridges, discovering interactions and procedure-response mechanics of human activities in history and current, are carried out with full confidence. This research provides valuable scientific supports for the rational use and protection of coast resources in the local economic development.

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# 6

## Measurement and Control Engineering

### *The Clockwork in Marine Science*

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#### **ABSTRACT**

This session will highlight the current state-of-the-art in measurement and control technologies for the overall marine technologies sector. Marine technology provides critical input factors in the offshore sector and marine research's equipment industries, and aquaculture as well. They all are in need of individual control technologies that will cope with various industrial activities and complex water compositions. Scientists and engineers alike are addressed to summaries the most recent progress, explain to us new monitoring methods and point out unresolved threats in this field to emphasize the need in future research and development.

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#### ORAL PRESENTATIONS

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##### 6.1) Overview Session

#### **THE PERSONS BEHIND THE SESSION**

Sabrina Kalita *and the ttz*

Saskia Heckmann *and the SubCtech*

Our experiences with YOUMARES - why this conference can be useful for you.

#### **WHAT IS IT ABOUT MEASUREMENT AND CONTROL ENGINEERING?**

How to define measurement and control engineering?

Where is it applicable? - Examples in marine science: offshore, aquaculture & shipping

#### **STUMBLING BLOCK: RESEARCH AND DEVELOPMENT**

Where does the money come from?

# 7

## Aquatic Plastic Pollution

### Tackling Environmental Impacts with New Solutions

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#### ABSTRACT

As a result of the societal changes in the past decades, our throw-away lifestyle has led to a large accumulation of plastic litter in marine and freshwater environments worldwide. In combination with research on ocean acidification, climate change and other ecological and socio-economic challenges, scientific insight into aquatic plastic pollution is becoming increasingly important. Current studies mainly address various physical, biological and chemical impacts, such as ingestion, entanglement, the transport of rafting species, adsorption of POPs and leaching of plasticizers. However, applied research for feasible solutions is also needed. Young researchers are therefore invited to present their work on the effects of and, in particular, solutions to the problem of marine and freshwater plastic pollution.

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#### ORAL PRESENTATIONS

- |      |                                          |                                                                                                                                  |
|------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 7.1) | <b>Hannes Imhof</b><br>(invited speaker) | Beyond the Ocean: Plastic Particles in Aquatic Ecosystems                                                                        |
| 7.2) | <b>Claudia Lorenz</b>                    | Detection of Microplastics in Marine Sediments of German Coastal Waters                                                          |
| 7.3) | <b>Antonia Eckerlebe</b>                 | Microplastics in Shore Communities - Uptake by the Common Periwinkle <i>Littorina littorea</i>                                   |
| 7.4) | <b>Sarah Piel</b>                        | Effects of Microplastic Ingestion on the Performance of the Mangrove Whelk <i>Terebralia palustris</i> (Gastropoda; Potamididae) |
| 7.5) | <b>Magnus S. Nerheim</b>                 | Microbial Diversity of Plastic Associated Marine Biofilms                                                                        |

#### POSTER PRESENTATIONS

- |      |                         |                                                                 |
|------|-------------------------|-----------------------------------------------------------------|
| 7.6) | <b>Sina Schendekehl</b> | Composition & Origin of Marine Litter in the Southern North Sea |
|------|-------------------------|-----------------------------------------------------------------|

## *Beyond the Ocean: Plastic Particles in Aquatic Ecosystems*

**Hannes Imhof**<sup>1,2\*\*</sup>, Natalia P. Ivleva<sup>3</sup>, Christian Laforsch<sup>2</sup>

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### **ABSTRACT**

Plastics, or polymers how they are called correctly, are one of the most important technical advances of the modern world. This is reflected in a steeply rising production rate. Consequently the generated plastic waste is rising in the same manner. Disposed plastic waste as well as carelessly discarded plastic products are transported and drifted by wind and water into aquatic ecosystems. Buoyant plastic particles accumulate in pelagic habitats whereas non-floating debris accumulates in benthic habitats or on the seafloor and in beach sediments, posing risk to the respective communities. Microplastic particles are either directly introduced via sewage discharge or formed by biofouling and mechanical abrasion. The either positive or negative buoyancy make plastic particles prone to the ingestion by a wide range of freshwater invertebrates from different functional levels. The resulting bioaccumulation of microplastic particles underpins that contamination with plastic debris may be as hazardous to the biota of freshwater as well as marine ecosystems.

Although the constantly increasing contamination of plastic debris is widely documented, the impact on aquatic ecosystems is not yet fully understood. While assessing the contamination of aquatic ecosystems sampling is performed using a high diversity of different methods. Either using neuston nets or sampling of beach sediments using different protocols and methods.

Subsequently samples have been sorted by hand into fragments of sand, gravel, organic matter and debris. Larger fragments can be easily observed; however, with a decrease in size, the stochastic chance to miss particles increases. Consequently the identification of particles smaller 1 mm, so called “small microplastic particle” is not possible without sophisticated spectrometric methods.

Especially for local and global abundance estimations of microplastic a harmonization of sampling and sample processing is of utmost importance.



The aggregation of plastic debris in river mouths indicates that plastic particles are also present in headwaters, where they enter and accumulate either driven by the wind or by industrial and municipal wastewater discharge. Among the main land-based sources of plastic waste entering freshwater systems are carelessly discarded plastic products and debris originating from landfills, illegal dumping or industrial activities. There is, nevertheless, a considerable lack of knowledge on the contamination of freshwater ecosystems with plastic debris. We examined the abundance of plastic particles in beach sediments from freshwater ecosystems. The extraction of the particles was performed using density separation using the Munich Plastic Sediment Separator (MPSS) followed by optimized digestion protocols. The found particles were identified with Raman Microspectroscopy. Additionally limnetic species of different functional groups were exposed to red fluorescent microplastic particles

We show that the amount of macro- and even microplastic particles is reaching similar magnitudes as found in marine environments, suggesting that freshwater systems do not only act as a source for marine contamination. This indicates, that plastic waste pollution is not restricted to ocean system, but also poses an increasing threat to lakes and stream ecosystems. Our findings indicate that freshwater ecosystems are not only the source of pollution for the oceans, but inevitably act at least temporarily as a sink. In this context microplastic particles are generated in high amounts from larger fragments, persist due to their longevity and will therefore accumulate in freshwater habitats.

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## *Detection of Microplastics in Marine Sediments of German Coastal Waters*

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### **ABSTRACT**

The presence of microplastic debris in the marine environment has been documented during the past 40 years. With the implementation of the Marine Strategy Framework Directive (MSFD) and the initial assessment of the marine environment in 2012 the need for verified data obtained by standardized methods has been growing. In this context a reliable method for the detection of microplastics in marine sediments has to be developed.

The extraction method is crucial for the analysis of sediments. Therefore a density separation approach was adapted using the recently invented Munich Plastic Sediment Separator (MPSS) and a highly dense ZnCl<sub>2</sub> solution (> 1.7 g cm<sup>-3</sup>). The extracted samples from North Sea sediments were purified through a combination of enzymatic digestion using technical enzymes and oxidation. A successful purification was necessary to enable the subsequent identification of microplastics by spectroscopy. Since this is especially difficult for small microplastic particles (< 500 μm), the highly promising μFT-IR imaging technique was applied for this purpose: the pre-treated samples were concentrated on a 64 mm<sup>2</sup> filter area that was completely measured using Infrared spectroscopy in transmission mode. Applying this newly developed methodological setup, five North Sea sediment samples could be closely investigated for their microplastic contamination. The relative abundances of small microplastic particles in these sediments ranged from 34 to 74 particles kg<sup>-1</sup> dry weight sediment. Furthermore, eleven different types of plastic polymers could be identified with a prevalence of polypropylene (PP) as well as polystyrene (PS). Next to these low density polymers also more dense polymers like polyvinyl chloride (PVC) were identified proving the efficiency of the extraction method. The efficacy of the enzymatic digestion was proven by the clean spectra obtained during the μFT-IR measurement. This approach was applied for the first time for marine sediments and presents a first insight into microplastic pollution of German coastal sediments.

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## Microplastics in Shore Communities - Uptake by the Common Periwinkle *Littorina littorea*

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### ABSTRACT

In recent years the interest on the effects of small plastic fragments (microplastics) on marine biota has increased. Due to their small size microplastics can be ingested by many marine organisms. Microplastics can derogate the ingestion, block the alimentary tract or can even be transferred into the circulatory system. The ingestion of microplastics has already been shown for invertebrates such as bivalves, crustaceans and annelids.

Microplastics are pronounced in coastal areas. Therefore, the aim of the study was to investigate the uptake of microplastics by a frequent member of the invertebrate shore community, the common periwinkle *Littorina littorea*.

To test whether microplastics are ingested together with the food, the seaweed *Fucus vesiculosus* was chosen and the adhesion on the surface of the seaweed was studied. Pieces of *F. vesiculosus* were submerged in suspensions with microbeads (10 µm diameter), fragments (1-150 µm diameter) and fibers (90-2200 µm length). All three types of microplastics adhered on the surface of the alga. Even after washing in clean water particles remained on the surface. Accordingly, microplastics can enter food webs of marine invertebrates which are grazing on *F. vesiculosus*.

In choice-feeding assays contaminated as well as clean seaweeds were offered to *L. littorea*. *L. littorea* did not distinguish between contaminated and pristine food. Ingested microplastics were detected in the alimentary tract and in the egesta, but not in the digestive gland. Accordingly, the microplastics seem not to block the alimentary system or the cells of important organs. The egesta, in turn, may form another vector of microplastics within marine food webs.

*L. littorea* egests microplastics which were ingested with the food. In the natural environment as well, *L. littorea* ingests indigestible material (sand grains, shells of diatoms) and egests them without harm. This indicates that *L. littorea* is adapted to ingest indigestible particles and that the ingestion of microplastic (1-150 µm diameter) does not constitute a mechanical hazard.

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## *Effects of Microplastic Ingestion on the Performance of the Mangrove Whelk *Terebralia palustris* (Gastropoda; Potamididae)*

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### ABSTRACT

One of the most omnipresent and long-lasting changes within the marine environment is the accumulation and fragmentation of plastics debris. Thereby, the inconspicuous part, plastic particles less than 5 mm, called "microplastics", consistently increased over the last four decades. Microplastics lies within the same size range as the food of many marine organisms. Moreover, due to its high surface-volume ratio and hydrophobic properties, microplastics are prone to absorb persistent organic pollutants and thus, potentially acts as a vector that increases their bioavailability. Among marine organisms, benthic deposit feeders are especially vulnerable to microplastics due to their usually indiscriminate feeding behavior. Hence, we examined if the ingestion of polluted microplastics affect the performance of the deposit-feeding mangrove whelk *Terebralia palustris*. Whelks were fed with a realistic concentration (400 particles per kg sediment) of polystyrene beads (0,7-0,9 mm) during a two month laboratory feeding experiment. The raw polystyrene beads were previously exposed to the sea surface in the field at a pristine and a polluted site, as well as to artificially contaminated seawater in the laboratory.

Microplastic ingestion, regardless of pre-treatment of beads, had no effects on growth, activity, and hypoxia stress tolerance of *T. palustris*. However, whelks exposed to polystyrene beads from the laboratory had increased respiration rates in contrast to those that were exposed to beads from the field. This indicates that the exposure history of microplastics determines their effect after ingestion, and should be considered in future studies. Moreover, *T. palustris*, as well as other benthic invertebrates are probably exposed to microplastics during their whole lifespan. The current results are limited to a short-term study and thus, potential long-term effects cannot be excluded.

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## *Microbial Diversity of Plastic Associated Marine Biofilms*

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### **ABSTRACT**

Plastic-fouling microorganisms are thought to mediate the fate of plastic pollution in the aquatic environment and are expected to impact several key processes including degradation, buoyancy, chemical adsorption and colonization or ingestion by larger organisms.

This study focuses on marine plastic pollution in coastal Norway, where the relative bacterial abundance on different plastic polymers was determined to investigate the beta-diversity of their associated marine biofilms, and how these relate to a variety of physical and biological factors, including depth, polymer type and properties, surface roughness and toxicant load.

Thirteen different clean plastic polymer and surface treatment combinations (PPSTs) were deployed at the surface and sediment-water interface for 6 weeks. DNA was extracted and PCR amplification was carried out on the internal transcribed spacer (ITS) region, between the 16S and 23S rRNA genes, using Automated Ribosomal Intergenic Spacer Analysis (ARISA) and relative bacterial abundance was quantified. Polycyclic aromatic hydrocarbon (PAH) toxicant load was quantified using pentane extraction and chromatography analysis. High resolution images were obtained using Scanning Electron Microscopy (SEM) and stereo microscopy.

Preliminary results show significant differences between bacterial communities localized on plastic deployed at the surface and at the sediment-water interface, as well as between these communities and those in the seawater and sediment. However, no significant differences were found between communities in seawater and sediment. The communities on different PPSTs at the same depth seem complex and no clear pattern can be inferred. Toxicant loads of PAHs show increased levels on samples that were weathered before incubation. Plastic surface samples contain a large variety of different taxa of organisms ranging from green and red algae to cephalopods. SEM photos show no indication of microbial-plastic interactions.

Overall, these results clearly show the presence of diverse biofilm communities on plastic marine debris. Studying their effects on the inhabited debris is important in understanding the future of marine debris in aquatic systems.

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## *Composition & Origin of Marine Litter in the Southern North Sea*

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### **ABSTRACT**

All experiments were performed on the island Mellum, located between the Jade and Weser estuary. In total 6066 items were collected between May and July 2014. The first hypothesis was that the most beach litter found comes from the category shipping/fisheries, and tourism, not from rivers. The initial results were based on mathematical models, applying the matrix scoring technique from Tudor *et al.* (2004), and not on suggestions/ conclusions as by other authors. The hypothesis could be partially accepted. The investigation of the winter shore line on the North and South beach, including 100 m tracks that were monitored weekly showed that in general two thirds of the beach litter came either from shipping or fishing (incl. aquaculture) activities or was harbour-related debris. The amount of beach user (tourism-related) debris was not as extensive as expected. In general, the amount was between 10% and 13%. Therefore, it was on one level with riverine waste with exception of North Beach where the amount of riverine litter was around 18 %.

The country of origin was also determined via barcodes and labelling. In general, two third of the litter pieces (from which an origin determination was possible) came from Germany, the Netherlands, UK, France, or Belgium & Luxemburg. Therefore, it was also likely that the litter was introduced via currents into the German North Sea.

The second hypothesis was that there are significant differences between the North and South Beach. This could be proven by the chi-square-test. It can be assumed that the amounts of Polyurethane foam in the winter shore line were remains of the Jade Weser Port construction which construction started in 2009.

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# 9 | Effects of Global Climate Change on Emerging Infectious Diseases of Marine Fish

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## ABSTRACT

Climate change as an important challenge of marine environment is showing its face in health of marine organisms. Recent news about mass mortality of different species of fishes, sea birds, mammals, and marine invertebrates in some instances has been related to viral and bacterial outbreaks. Gradual warming of sea surface temperature, ocean acidification, sea level rise, melting sea ice, and other side effects of climate change can be a major cause for increasing trend of mortality of marine organisms. So far, there is an apparent increase in many infectious marine fish diseases, including some newly-circulating ones (VNN, KHV, EHN, etc.). It is expected that forthcoming climatic changes could make situation worse. Marine disease outbreaks can impact the world fisheries in quantity and quality as well as marine aquaculture. There is a need to make necessary predictions for safeguarding marine production of the world, because there is a huge dependency of different countries on fisheries. Also, knowledge gaps still exist regarding causative agents and transmission dynamics, so we need improved diagnostic methods and management strategies for control and prevention. Increasing outbreaks in some taxa are expected with climate change based on changes in physiological state for the host species (stressed or immunocompromised) and/or microbes (increased growth and virulence). The vulnerability and responses of marine organisms to climate change are highly variable, and certain species including marine calcifiers, cold-adapted species, and rare, endemic, threatened, and endangered species are particularly at risk from climate change. Meanwhile, some routine Land-based management methods such as quarantining, culling, and vaccinating are not successful in the ocean; therefore, forecasting conditions that lead to outbreaks and designing effective tools/approaches to influence these conditions may be the best way to manage fish marine emerging diseases in the world.

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Keywords: Climate change, fish marine, emerging diseases

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**ORAL PRESENTATIONS**

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- 9.1) **Jalil Zorriehzahra** Climate Change Influences on Emerging Infectious Diseases of Marine Fish
- 9.2) **Aghil Dashtiannasab** Review on Emerging Infectious Diseases in Shrimp Aquaculture and Control Methods

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**POSTER PRESENTATIONS**

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- 9.3) **Vida Sarabandi** Study on Viral Nervous Necrosis (VNN) Disease as Climate Changes Effects Model in Mugilidae Fish (*Liza klunzingeri* & *Mugil cephalous*) of Persian Gulf and Oman Sea
- 9.4) **Afra Saberi** Using of *Chlorella vulgaris* as Natural Immunostimulator in order to Prevention of Viral Nervous Necrosis (VNN) as New Emerging Disease in Caspian Brown Trout (*Salmo trutta caspius*)
- 9.5) **Khalil Khorrami** Evaluating the Effect of Ultrasonic Waves on in vitro Inhibition of *Yersinia ruckeri* Populations in Coldwater Fish Farms of I.R. Iran



## *Review on Emerging Infectious Diseases in Shrimp Aquaculture and Control Methods*

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### **ABSTRACT**

Aquaculture has been an important role in human's food production during the past 100 years. By growing the population, demand for seafood also increased that this demand couldn't come from fisheries. So aquaculture has expanded rapidly in recent decade. Aquaculture now is an economic industry in many countries. Shrimp aquaculture is also expanded since 1970 and it has provided employment and been a main driver of socio-economic development in poor rural and coastal communities, particularly in Asia. However, the rapid growth of aquaculture has also been the source of ecological changes on an enormous scale. Aquatic animals have been displaced from their natural environment, reared in high density, exposed to many stress conditions, provided artificial or unnatural feeds, and a plentiful global trade has developed in both live aquatic animals and their products. According to these reasons aquaculture practices provide an ideal environment for emergence and spread of diseases. For example since 1970 every 3 or 4 years the shrimp industry has been challenged with a new disease emergence. Now the number of shrimp diseases increased to more than 30 types. Meanwhile, regarding to some aspects of occurrence of climate changes such as globally temperature increment we can observe occurrence of some new emerging diseases e.g., Early Mortality Syndrome (EMS) in recent years in Asian shrimp farms. In this paper some of important emerging diseases will be introduced and we will discuss that why do new emerging diseases in shrimp aquaculture and how we can reduce or limit the impacts of them.

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Keywords: Shrimp aquaculture, climate change, emerging diseases, control

## Study on Viral Nervous Necrosis (VNN) Disease as Climate Changes Effects Model in Mugilidae fish (*Liza klunzingeri* & *Mugil cephalous*) of Persian Gulf and Oman Sea

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### ABSTRACT

The Climate changes could be basic phenomena in different ecosystems. Some environmental and ecological changes such as red tide and temperature increment could be considered in causing Emerging Disease. Climate warming will be accompanied by increase of average global temperatures. The rate of Global warming will be rise to 1.1°C to 6.4°C so it had been cleared that by climate warming the disease will increase. By 6-fold increase in the temperature, the rate of fish mortality will be rise to 82 to 100 times (4<sup>th</sup> IPCC assessment report, 2007). Red tide or planktonic blooming is a phenomenon that phytoplankton accumulate rapidly in the water surface. Some kinds of red tide will be resulting to produce natural toxins, reduce dissolved oxygen and could be greatest risk of red tide that causes mortality in wild aquatic marine and coastal fishes. In Persian Gulf Planktonic blooming started in early October, 2008 from Hormuz and it was observed at the southern coast of Qeshm, Bandar Abbas and Cirak port. Simultaneously the large losses of Maid (*Liza klunzingeri*) fishes were found in the southern region. Investigation in Mugilidae fish (*Liza klunzingeri* & *Mugil cephalous*) was conducted in the Oman Sea and Persian Gulf. So about 300 suspected fish samples were collected in fishing seasons by a period of six months. Target tissues such as eye and brain were used for diagnostic tests. Through a special questionnaire, Ecological characteristics like Physical and chemical properties of the fishing location and morphometric details, clinical signs and autopsy findings were recorded which were used in the final analysis. In histopathology specimens, some typical evidences were observed. Over the past decades, along with the onset of climate phenomena, spread of VNN disease has increased. It is suggested that increasing the global temperature is one of the main reason of infection of more than 50 fish species susceptible to VNN disease worldwide. It is suggested that by using epidemiological methods and continuous monitoring in south coast and based on the recommendations of OIE, Golden test such as Cell-culture and Serological and Molecular diagnostic methods (RT-PCR) and/or Electron microscopy could be used.

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Keywords: Climate Change, Red tide, Global warming, Viral Nervous Necrosis Disease, Mugilidae Fish, Histopathology

## *Using of *Chlorella vulgaris* as Natural Immunostimulator in order to prevention of Viral Nervous Necrosis (VNN) as new Emerging Disease in Caspian Brown Trout (*Salmo trutta caspius*)*

Afra Saberi<sup>1</sup>, Jalil Zorriehzahra<sup>2\*\*</sup>, Hossein Emadi<sup>1</sup>, Shapour Kakolaki<sup>2</sup>, Seyed Mohammad Reza Fatemi<sup>1</sup>, Pargol Ghavam Mostafavi<sup>1</sup>

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### ABSTRACT

Climatic changes influence the emergence and reemergence of infectious diseases, in addition to multiple human, biological, and ecological determinants. Climatologists have identified upward trends in global temperatures and now estimate an unprecedented rise of 2.0 degrees C by the year 2100. Of major concern is that these changes such as ocean warming and acidification can affect the introduction and dissemination of many serious infectious diseases to human, animal, plants and marine fishes. Also, climate and weather are important components of complex ecosystems, and with these changes, the dynamic balance between the living components of ecosystems is often disturbed. Ecosystem instability can result in changes in pathogen prevalence, altered pathogen transmission profiles, and increased host susceptibility. These instabilities can have dramatic effects on the health of humans, livestock, wildlife, and marine systems. Recently some viral emerging diseases such as VHS, KHV and Viral Nervous Necrosis (VNN) were occurred in aquaculture and mariculture in the region. VNN is a new emerging and devastating disease that has been reported in all parts of the world except for the South American region. This disease is caused by Nodaviridae family (Betanodavirus) and attacks the nervous system of the fish. So far 50 species of the fish has shown to engage with the signs of this worldwide disease. Infected fish commonly display neurological disorders, which are often associated with strong vacuolization of the central nervous system and the retina. More important signs consist of erratic swimming, enlargement of the swimbladder and abdominal distention. At present, there is neither a treatment nor a vaccine available to prevent VNN in fish so in current study we will examine a kind of marine algae (*Chlorella vulgaris*) as natural immunostimulator in order to increment of the immune system of Caspian brown trout (*Salmo trutta caspius*) and maybe this can be a valued approach to prevention of this fish population from outbreak of mentioned emerging disease in the Caspian Sea.

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Keywords: Climatic changes, Emerging diseases, Viral Nervous Necrosis, *Chlorella vulgaris*, *Salmo trutta caspius*

## Evaluating the Effect of Ultrasonic Waves on *in vitro* Inhibition of *Yersinia ruckeri* Populations in Coldwater Fish Farms of I.R. Iran

Khalil Khorrami<sup>1</sup>, Shapour Kakolaki<sup>2\*\*</sup>, Jalil Zorriehzahra<sup>2</sup>, Narghes Mooraki<sup>1</sup>

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### ABSTRACT

Rainbow trout (*Oncorhynchus Mykiss*) as main specie has been played a prominent role in the development of aquaculture in the country. Islamic republic of Iran is one of the most favorable zones for Coldwater fish farming in the world. This country yields 9.6% of the world's total production and the third largest producer of rainbow trout after Chile (28.7%) and Norway (12.7%). Some infectious diseases could be considered as most important threat for this economic sector in the country. Enteric Redmouth disease (ERMD) is a bacterial infection of freshwater and marine fish caused by *Yersinia ruckeri* as a motile, Gram-negative and rod -shaped bacterium. Enteric Redmouth Disease (ERMD) has been reported as second important infectious bacterial disease in coldwater fish industry in Iran according to recent official records of Iranian Veterinary Organization (IVO). About 15 (ERM) outbreaks were reported and confirmed by Iran Veterinary Organization in 2011 in all of 32 provinces. So using of new technologic approach could be very important in control and prevention of causative agent of mentioned infectious disease in coldwater fish industry in Iran. This study was conducted to evaluate the effect of ultrasonic wave length (50 KHz/ 30Wcm<sup>-2</sup>) on reduction or elimination of *Yersinia ruckeri* population. The bacterial suspensions (6×10<sup>8</sup>) were exposed to the radiation for 10, 20, and 30 minutes. Samples were prepared from the diluted suspension (0.1 L) before and after the exposure and incubated for 36 to 48 hours at 22.5°C. After the incubation, the colonies were counted (Using the formula =  $\frac{\sum n}{(n_1 v_1 d_1) + (n_2 v_2 d_2) + \dots + (n_i v_i d_i)}$ ) and compared with the control group, which revealed a significant reduction in the number of colonies after applying ultrasonic wave length. It can be concluded that applying the ultrasonic wave (50 KHz/ 30Wcm<sup>-2</sup>) for 30 minutes can effectively reduce the population of *Yersinia ruckeri* with concentration of 6×10<sup>8</sup>cfu/ml.

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# 10 | Cold Water Research

## *From High Latitude Coasts to Deep Sea Trenches*

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### **ABSTRACT**

Cold water ecosystems reach from polar and subpolar water bodies to deep sea trenches. Until today our knowledge about those ecosystems remains very limited. This applies especially to ongoing human impacts such as mining, bottom-trawling, waste disposal, the entire process of global change and the resilience of cold water ecosystems to those disturbances. We would appreciate abstracts dealing with different cold water habitats, like polar ice fields, fjords, cold seeps, abyssal plains and human impacts on those ecosystems. We are also interested in community structures, matter fluxes, food webs and succession of benthic cold water organisms, as well as technical improvements for cold water investigation.

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## ORAL PRESENTATIONS

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- 10.1 **Henry Goehlich**  
**Ralf Hoffmann** Cold Waters - Hot Topic
- 10.2 **Duygu Sevgi Sevilgen** The Response of Subtidal Microphytobenthos Communities from a Temperate and Arctic Site to Rapid Temperature Increases
- 10.3 **Erik Wurz** Autoecology of the Cold-Water Coral *Caryophyllia huinayensis* from the Chilean Fjord Region
- 10.4 **Michael Streicher** Primary Succession of Arctic Hard-Bottom Assemblages – Insights from a Long-Term in situ-Experiment
- 10.5 **Henry Goehlich** The Cold-Water Coral *Desmophyllum dianthus* in a Changing Environment - Patagonian Fjord, Chile.

## POSTER PRESENTATIONS

- 
- 10.6 **Anne Schuster** Characterization of Near Bottom Particle and Sediment Dynamics at the Eratosthenes Seamount in the Eastern Mediterranean Sea
- 10.7 **Christopher Nowak** Long-term in situ Growth Rate Adaptability of a Cold-Water Coral in a Natural pH Gradient
- 10.8 **Stephan Durst,**  
**Jan Schuckenbrock** Diversity of Meiofauna along the Antarctic Peninsula: Influence of Different Environmental Settings
- 10.9 **Luisa Federwisch** Glass Sponge Environments in the Weddell Sea, Antarctica
- 10.10 **Svantje Gottschlich** Modulation of the Intensity of Abiotic Parameters Caused by Substratum Inclinations and its Implication on Hard-Bottom Benthic Community Structure
- 10.11 **Khalil Khorrami** Evaluating the Effect of Ultrasonic Waves on in vitro Inhibition of *Yersinia ruckeri* Populations in Coldwater Fish Farms of I.R. Iran to Offshore: Technology Evolution and Public Acceptance

## *The Response of Subtidal Microphytobenthos Communities from a Temperate and Arctic Site to Rapid Temperature Increases*

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### ABSTRACT

We used microsensors and planar optodes to investigate the effect of short-term temperature increases on net photosynthesis and respiration rates of microphytobenthos communities from two subtidal sites with different yearly averages and diurnal temperature-fluctuations (Helgoland, Germany vs. Svalbard, Norway). We hypothesized that the Arctic community is less sensitive to short-term temperature-changes as the prevailing in situ temperature-fluctuations were much more pronounced than in Helgoland during the studied summer months.

Net photosynthesis and respiration rates of the Helgoland microphytobenthos community significantly increased with increasing temperatures ( $p < 0.0001$ ). In the Svalbard community, short-term temperature-increases solely had a significant effect on respiration rates ( $p < 0.0001$ ) but not on photosynthesis ( $p = 0.0638$ ).

Generally, temperature-responses of respiration were stronger than those of photosynthesis in both sediments, but at close to saturating light intensities net autotrophy was sustained over all experimental temperatures at both sites. However, due to the increasing light demand needed to sustain this net autotrophy in situ, in combination with the stronger temperature response of the community respiration in the dark, we conclude that on a short time scale both systems will gradually turn heterotrophic with increasing temperatures. This will become apparent particularly at the Svalbard site due to a significant contribution of macrozoobenthos to total sediment respiration.

Our results indicate that the microphytobenthos communities respond rapidly and differently to temperature-changes and that local short-term temperature-fluctuations must be taken into account for primary production estimates. Furthermore, our results suggest that if the light regime is sufficiently high in the Svalbard community temperature changes do not play a significant role for net photosynthesis. This suggests that during the summer the two sites are primarily governed by different factors: whereas in the Arctic site temperature is the primary factor, the main controlling factor in the temperate site is light.

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## Autecology of the Cold-Water Coral *Caryophyllia huinayensis* from the Chilean Fjord Region

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### ABSTRACT

In northern Chilean Patagonia the scleractinian cold-water coral *Caryophyllia huinayensis* occurs in depths from 16 m up to 265 m and was first described in 2005. Knowledge about ecological parameters and its response to environmental changes in the habitat are still rare. With global ocean warming and ongoing ocean acidification cold-water corals face possible harmful impacts. To predict the influence of these changes on *C. huinayensis* and other cold-water corals, abundance, growth and respiration rates have to be known. Furthermore complex relationships within cold-water reefs need to be revealed. In order to quantify abundance frame based individual census have been carried out in depths down to 30 m. Due to its natural horizontal pH gradient down to values of pH 7,4 the Comau fjord in Chile allows growth experiments in pH conditions that are predicted for the next century. For estimations of growth rates and the influence of changing water parameters on coral growth across transplantation experiment was carried out starting in 2013. Ten individuals from pH 7.94±0.03 and pH 7.76±0.09 have been cross transplanted, respectively. Annual growth rate of *C. huinayensis* expressed as mass increase were estimated by using the buoyancy weight method. Individual respiration rates have been measured in a closed chamber system with the use of optical sensors over a period of 12 h. Results of previous studies on the cold-water coral *Desmophyllum dianthus* from Patagonia have shown that cold-water corals can reach growth rates of 2.3 mm/yr in length, approx. 1.6 mm/yr in diameter and are able to grow under pH conditions that have been suspected to be harmful for coral skeletons. This study compares the results found for *C. huinayensis* comparatively.

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## *Primary Succession of Arctic Hard-Bottom Assemblages - Insights from a Long-Term in situ-Experiment*

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### **ABSTRACT**

For marine invertebrates living at low temperatures of high latitudes Thorson's rule suggests a comparatively reduced speed of development. Several studies conducted in different climatic zones have revealed the processes involved in the maturation of benthic assemblages. However, the duration and chronology of succession, as well as the influence of environmental impacts on arctic benthic assemblages is only scarcely analyzed. Long-term studies are still rare. By analysing species abundances and substrate coverage over an exposure time of one decade the following hypotheses are tested: (i) Exposition time significantly modifies the structure of arctic benthic hard-bottom assemblages, (ii) the macroscopic structure of the substrate surface has a significant influence on the structure of benthic hard-bottom assemblages, and (iii) the succession of benthic hard-bottom assemblages in the Arctic is in general slower compared to the benthic succession in all non-polar climatic zones. In 2002 forty Polyethylene growth panels were installed on an underwater cliff in Kongsfjorden (Svalbard, Norway) in about 20 m water depth. Six of these were grooved to create structural diversity on the panel surface. Once a year the ripening epibenthic assemblages were photographed by scientific divers. Until 2007 annually about eight panels were sampled and replaced, thus creating starting points for succession in different years. Additionally a ground truthing was carried out for reference. The findings of this study indicate a resilience time exceeding a decade. A strong heterogeneity can be observed between the assemblages on different panels, signifying an influence of different starting points. The results are discussed in comparison with results of related studies from this and other cold-water regions.

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## The Cold-Water Coral *Desomphyllum Dianthus* in the Changing Environment - Patagonian Fjord Region, Chile

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### ABSTRACT

The cold-water coral *Desmophyllum dianthus* naturally grows under low natural pH conditions. Using the buoyancy-weight technique, a 12-months in situ growth experiment revealed that CaCO<sub>3</sub> precipitation was  $0.34 \pm 0.15 \text{ kg m}^{-2} \text{ yr}^{-1}$  equal to a skeleton dry mass increase of  $0.05 \pm 0.02 \text{ \% d}^{-1}$ . A cross-transplantation experiment with specimens collected from two sites within fjord Comau with distinct pH (center: 7.76, mouth: 7.94) was conducted to describe the adaptability of *D. dianthus* to calcify under different pH. Control and transplanted corals originated from the site with the lower pH showed a significant higher percentage (Tukey-Kramer test,  $p = 0.009$ ) of dry mass increase. Our video record with a remotely operated vehicle (ROV) revealed corals living between 20 and 270 m in a wide range of pH values (pH 7.6–8.4). This proves that *D. dianthus* can thrive in a pH range of at least 0.8 units. However, other environmental parameters e.g. hypoxia or increased sedimentation may severely affect this important ecosystem engineer; a recent coral mass mortality caused a decline in abundance of Cape redfish (*Sebastes capensis*). Extensive aquaculture and the planned construction of a road along the fjord Comau are potential strong threats for this unique ecosystem. Since *D. dianthus* banks are only present in the fjords Comau, Reñihué Reloncaví, and Piti Palena and are hotspots of biodiversity their conservation is an urgent need.

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## *Characterization of Near Bottom Particle and Sediment Dynamics at the Eratosthenes Seamount in the Eastern Mediterranean Sea*

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### **ABSTRACT**

Deep ocean currents interact in a number of ways with kilometer-scale seafloor elevations, such as Seamounts. They likely have an impact on vertical mixing and near bottom resuspension events and these interactions are matter of this study. The distributional pattern of particulate organic matter (POM) and the naturally occurring, short lived (half-life 24.1 d), radioactive particle tracer Thorium-234; relative to its long-lived, and conservative (non particle reactive) parent nuclide Uranium-238 in the near bottom water column (up to 100 m) was studied around the Eratosthenes Seamount in the eastern Mediterranean Sea. Erosivity proxies (e.g. Grain size) were used to determine interaction of fluid dynamics on sediment deposition.

Activity ratios  $<1$  between  $^{234}\text{Th}$  and  $^{238}\text{U}$  near the seafloor indicate fast  $^{234}\text{Th}$  scavenging onto particles and fast settling of these particles which imply sediment resuspension events und particle motion. At the Eratosthenes seamount no considerable disequilibria in the near bottom water column were found (average  $^{234}\text{Th}/^{238}\text{U}$  ratio  $0.98 \pm 0.05$ ). On time scales of weeks this indicates very low hydrodynamic forcing. Due to the weak residual und tidal force in the Levantine basin, the sediment parameters show a homogenous pattern at all stations (Median Grain Size  $46.26 \pm 0.49 \mu\text{m}$ ). In this study the influence of the Eratosthenes Seamount on the distribution of particles in the water column and the effect on sediment dynamics was not detectable. Particularly, because of its isolated location from the Worlds Ocean and the resultant weak hydrodynamics the Eratosthenes could be a suitable object of comparison with other seamounts in higher hydrodynamic regime conditions.

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## Long-Term in situ Growth Rate Adaptability of a Cold-Water Coral in a Natural pH Gradient

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### ABSTRACT

Anthropogenic carbon dioxide lowers the ocean pH and progressively shifts the aragonite saturation horizon towards shallower depths. Accordingly, corals growing in the deep are expected to be the first affected by ocean acidification. The cosmopolitan cold-water coral *Desmophyllum dianthus* (Esper, 1794) typically occurs down to depths of 2,500 m but also in shallow waters (8 m) of the Comau fjord (Chile) within a natural pH gradient. To provide authentic growth rates for *D. dianthus* an in situ long-term experiment was conducted. Corals were collected, glued on polyethylene screws, weighted using the buoyant-weight technique and reinstalled in the fjord. One year later, a mean calcification rate of  $0.34 \pm 0.15 \text{ kg m}^{-2} \text{ year}^{-1}$  (dry mass increase:  $0.05 \pm 0.02 \text{ \% day}^{-1}$ ) was observed. These data correspond with most observations from the literature, independent of experimental length, experimental conditions or measuring method. Furthermore, the adaptability of *D. dianthus* towards a changed pH (fjord center pH =  $7.76 \pm 0.09$  and mouth  $7.94 \pm 0.11$ ) was tested by a long-term cross-transplantation experiment. Corals transplanted to lower pH showed the same growth rates as controls. Transplantation to higher pH values resulted in significantly elevated calcification rates (Tukey-Kramer test,  $p = 0.009$ ). In summary, both results prove the adaptability of *D. dianthus* towards future pH values and support the theory of physiological mechanisms enabling *D. dianthus* to increase its internal pH relative to seawater pH to facilitate its calcification mechanisms. However, other environmental parameters such as food availability, hypoxia or algae blooms may affect this important ecosystem engineer. Especially the extensive aquaculture in this region is a potential strong thread for this unique ecosystem. A recent mass mortality (mortality rate >99 %) of *D. dianthus* in fjord Comau shows how vulnerable this system is, so the conservation of these biodiversity hotspots is an urgent need.

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## *Diversity of Meiofauna along the Antarctic Peninsula: Influence of Different Environmental Settings*

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### **ABSTRACT**

During ANT-XXIX/3, sediment samples for meiofaunal analysis were collected with a Multicorer at shelf depths (~200-750 m) in three different regions along the Antarctic Peninsula: Northern Weddell Sea, Bransfield Strait and Drake Passage. The samples for faunal analysis were complemented with water-column and sediment samples for the analysis of a variety of environmental parameters (e.g. sediment: chlorophyll *a*, granulometry, TOC, TN; water column: chlorophyll *a*). Organisms were extracted from the sediment by flotation and centrifugation, handpicked, sorted to higher taxon level and counted. Meiofauna occurred in relatively high abundance (~1800-8500 ind/10 cm<sup>2</sup>) in all three regions and at all depths; Nematoda dominated the communities, followed by Copepoda Harpacticoida and their Nauplius larvae. Total meiofauna abundance showed significant differences among Weddell Sea on the one hand and Bransfield Strait and Drake Passage on the other. The three regions contrasted in terms of environmental settings, e.g. Chlorophyll *a* content in the water column was lowest in Weddell Sea and mud to sand relation varied among regions. This was reflected by the meiobenthic communities: the number of harpacticoid copepods and their nauplii was clearly higher in the Weddell Sea stations. In general, patterns found for the different areas were somewhat comparable to what has been observed in previous Antarctic studies.

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## *Glass Sponge Environments in the Weddell Sea, Antarctica*

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### **ABSTRACT**

Glass sponges (Porifera, Hexactinellida) are one of the oldest existing animal groups. These marine sessile filter feeders were highly abundant throughout the ocean in the Jurassic period, when they formed vast reefs. Today, however, they mainly inhabit the deep sea, the Antarctic shelves and the shallow fjords along the coast of British Columbia, Canada. In the Antarctic, glass sponges are of particular ecological relevance, as they dominate the benthic biomass in many areas. The richly structured sponge beds harbor a diverse associated fauna and play a significant role in silicon cycling and benthic-pelagic coupling. Unfortunately, it is still unknown which factors determine glass sponge distribution and, therefore, how environmental changes might affect these important Antarctic communities. The aim of our study was to characterize environments with and without glass sponges to identify the determining parameters. We conducted video transects with a remotely operated vehicle (ROV) and measured various environmental parameters at corresponding stations in the Weddell Sea during expedition PS82 with RV Polarstern in January/February 2014. Our poster shows some preliminary results on glass sponge abundance and community composition, as well as profiles of environmental parameters at different stations. Glass sponge environments seem to differ from areas devoid of sponges for example in bottom water temperatures and dissolved silicate concentrations. Both parameters were found to be lower at ROV stations with glass sponges compared to those without. While the distribution of sponges might be affected by temperature and dissolved silicate, the animals might, on the other hand, reduce silicate concentrations themselves. However, it is not yet clear whether the observed differences are really related to the presence or absence of glass sponges. These first results provide ample opportunity for discussion of the relationships between glass sponge communities and their environment in the eastern Weddell Sea.

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## Modulation of the Intensity of Abiotic Parameters Caused by Substratum Inclination on Hard-Bottom Benthic Community Structure

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### ABSTRACT

Due to substrate inclination the successional development of hard-bottom assemblages may vary as environmental parameters diversify. An in situ experiment using recruitment tiles as artificial hard substrata installed with distinct inclinations was conducted in a sub-Antarctic Patagonian fjord. The effects of substrate inclination and exposure on assemblages and its correlation with abiotic parameters modulated by inclination were investigated. The specific aims of the study are (1) to compare the community structure on artificial hard substrata and its modulation by certain abiotic parameters, and to identify how (2) PAR, (3) sedimentation and (4) current velocity distinguish at different substrate environments to enquire the effects of varying surface inclinations on the habitat. A photocensus using Photoshop CS4 and non-metrical multidimensional scaling indicated differences in community structure on the substrata. Thus, the analysis of abiotic parameters was of special interest to explain the discrepancies. A CTD-lightsensor detected different light intensities at distinct substrate angles as well as at exposed and sheltered locations. As expected, light intensity was highest at exposed areas facing towards the sea surface. Differences in sedimentation (mass and volume) have been estimated using sediment traps installed at distinct angles for four weeks. Current velocity was measured using Gibson-eggs installed at the substrata's inclinations. The loss of mass due to current-affection did not differ significantly between treatments. Thus, the observed differences in assemblages cannot be explained by current variability. A connection between species living at particular inclinations and their preference to certain abiotic parameters was discovered. We reason that varying substratum inclinations modulate the intensity of abiotic parameters. This results in the formation of distinct habitats overlapping with the biological niche of certain species. We conclude that examination of the interaction between surface inclination and exposure to abiotic parameters is necessary to understand the processes involved in succession of hard-bottom communities.

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## Evaluating the Effect of Ultrasonic Waves on *in vitro* Inhibition of *Yersinia ruckeri* Populations in Coldwater Fish Farms of I.R.Iran

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### ABSTRACT

Rainbow trout (*Oncorhynchus Mykiss*) as main specie has been played a prominent role in the development of aquaculture in the country. Islamic republic of Iran is one of the most favorable zones for Coldwater fish farming in the world. This country yields 9.6% of the world's total production and the third largest producer of rainbow trout after Chile (28.7%) and Norway (12.7%). Some infectious diseases could be considered as most important threat for this economic sector in the country. Enteric Redmouth disease (ERMD) is a bacterial infection of freshwater and marine fish caused by *Yersinia ruckeri* as a motile, Gram-negative and rod -shaped bacterium. Enteric Redmouth Disease (ERMD) has been reported as second important infectious bacterial disease in coldwater fish industry in Iran according to recent official records of Iranian Veterinary Organization (IVO). About 15 (ERM) outbreaks were reported and confirmed by Iran Veterinary Organization in 2011 in all of 32 provinces. So using of new technologic approach could be very important in control and prevention of causative agent of mentioned infectious disease in coldwater fish industry in Iran. This study was conducted to evaluate the effect of ultrasonic wave length (50 KHz / 30 W cm<sup>-2</sup>) on reduction or elimination of *Yersinia ruckeri* population. The bacterial suspensions (6×10<sup>8</sup> cfu/ml) were exposed to the radiation for 10, 20, and 30 minutes. Samples were prepared from the diluted suspension (0.1 L) before and after the exposure and incubated for 36 to 48 hours at 22.5°C. After the incubation, the colonies were counted (Using the formula  $C = (\sum n) / ((n_1 \times v_1 \times d_1) + (n_2 \times v_2 \times d_2) + \dots + (n_i \times v_i \times d_i))$ ) and compared with the control group, which revealed a significant reduction in the number of colonies after applying ultrasonic wave length. It can be concluded that applying the ultrasonic wave (50 KHz/ 30 Wcm<sup>-2</sup>) for 30 minutes can effectively reduce the population of *Yersinia ruckeri* with concentration of 6×10<sup>8</sup> cfu/ml.

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# 11

## Additional Poster Presentations

### POSTER PRESENTATIONS

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- 11.1 **Amelie Albrecht** Liberation of Phosphate from *Fucus vesiculosus* by the Marine Isopod *Idotea emarginata*
- 11.2 **Lindan Mlambo** Population Dynamics of euphausiid Species of the Benguela Current off the Namibian Coast

## *Liberation of Phosphate from Fucus vesiculosus by the Marine Isopod Idotea emarginata*

Amelie Albrecht<sup>1\*\*</sup>, Reinhard Saborowski<sup>1</sup>

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### ABSTRACT

Phosphorus is necessary for the growth of all marine organisms and it is an important nutrient for primary producers such as phytoplankton and seaweed. In some marine systems and depending on the season it can become a limiting factor. Major sources of phosphorus are marine sediments, riverine discharges, or anthropogenic pollution. Phosphorus occurs in various organic and inorganic forms but only the dissolved inorganic phosphorus can be utilized by primary producers. Most of the transformation and remineralization of phosphorus is attributed to microbial enzymatic activity. Besides microbes also marine invertebrates may contribute significantly to the marine phosphorus cycle.

A very important group of marine invertebrates are peracarids such as the isopod *Idotea emarginata*. It feeds on the seaweed *Fucus vesiculosus*, has very high ingestion rates but low assimilation efficiency. The fecal pellets contain high amounts of shredded but undigested material and significant activities of phosphoesterases which can be released into the seawater. Therefore, I am trying in my bachelor thesis to quantify the contribution of isopods to the liberation and remineralization of phosphorus from their food.

Preliminary results show that the P-content of *F. vesiculosus* was on average 0.3 mg P g<sup>-1</sup>. The average mass of an isopod was 100 mg. Each isopod consumed 33 mg of *F. vesiculosus* per day which equals 10 µg P per day. Almost 60 % of the phosphorus was detected in the water and 1.5 % remained in the fecal pellets. The isopods showed very high phosphoesterase activities in their digestive organs. These enzymes are capable of releasing inorganic phosphate which, in turn, is available for primary producers. Phosphoesterase-activity was present in the fecal pellets and even in the seawater of the feeding experiments. The results clearly show that isopods contribute significantly to the liberation of phosphorus from organic matter due to their high feeding activity and the release of digestive enzymes.

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## Population Dynamics of Euphausiid Species of the Benguela Current off the Namibian Coast

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### ABSTRACT

Euphausiids (krill) are holoplanktonic crustaceans that are exclusively marine. They are frequently associated with particular water masses or environments and they occupy a key position in the pelagic food web as they transfer the organic energy produced by unicellular algae to higher trophic levels such as pelagic fish stocks exploitable to man. Krill adapt to favorable environmental conditions caused e.g. by seasonal upwelling events. However, due to inevitable climate change, maintaining krill stock steady states seems elusive and this needs to be analyzed at regional then global levels. In this context, basic population parameters such as abundance and biomass, reproduction and recruitment under different conditions are essential to identify and quantify potential changes.

During the upwelling (September 2013) and off peak seasons (December 2013 to January 2014) of the northern Benguela Current krill were caught using a MOCNESS from on board R/V Meteor. Samples were either frozen or preserved in formalin. At AWI laboratories, krill were analyzed under a stereo microscope and classified according to species, size, sex, maturity stage, and hepatopancreas colour. Stable isotope analyses were also conducted. *Euphausia hanseni* was found as the most abundant species, followed by *Nematoscelis megalops* and *Nyctiphanes capensis*. Both spatial (17°S and 23°S transects) and temporal (upwelling/off-peak season) differences were noted. Sex ratios showed that females were more abundant than males. Krill trophic levels as indicated by stable isotope results during off peak season showed significantly higher values than those of the upwelling season. Obtained results contribute to the knowledge and the current state of krill populations in the Benguela and information is essential when we want to understand the dynamics of this ecosystem in a warmer future.

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# C onference Schedule

## Wednesday 10.09.2014

10:30	FINET Workshop	Seminarraum
14:30	DGM Mitgliederversammlung	Mehrzwecksaal
19:00	Icebreaker - Registration Welcome - Team - Briefing YSC	Fritz Braugasthof

## Thursday 11.09.2014

7:30	Early Registration	Mehrzwecksaal
8:00	Official Opening	Mehrzwecksaal
8:10	Keynote 1 (Sven Hille)	
8:30	Keynote 2 (Florian Weinberger)	
8:50	Keynote 3 (Claudia Hanfland)	
9:30	Session 1 <i>Small-Scale Fisheries Research - towards sustainable fisheries using a multi-entry perspective</i>	Mehrzwecksaal
10:55	Coffeebreak	
11:10	Session 10 <i>Cold Water Research - From high latitude coasts to deep sea trenches</i>	Mehrzwecksaal
12:30	LUNCHBREAK	self supply
13:45	Session 5 <i>Tools and Methods supporting an Ecosystem Based Approach to Marine Spatial Management</i>	Mehrzwecksaal
14:45	Session 9 <i>Effects of Global Climate Change on Emerging Infectious Diseases of Marine Fish</i>	Mehrzwecksaal
15:15	Coffeebreak	Mehrzwecksaal
15:30	WORKSHOPS Interdisciplinary research 15:30-17:00h Stralsund City tour OZEANEUM Highlights Aldebaran 17:00-17:45 Springer Workshop (15:30-17:00) Geisternetze (16:00-17:00) Plastic Garbage Project	Seminarraum outside Ozeaneum  Seminarraum Mehrzwecksaal Deutsches Meeresmuseum NABU St Jakobi
17:30	Postersession and WTW Keynote talk (Detlef Schulz-Bull)	Mehrzwecksaal

## Friday 12.09.2014

8:30	Session 7 <i>Aquatic Plastic Pollution - tackling environmental impacts with new solutions</i>	Mehrzwecksaal
9:50	Coffeebreak	
10:05	Session 4 <i>Coral Reef Ecology, management and conservation in a rapidly changing ocean environment</i>	Mehrzwecksaal
11:35	Session 3 <i>Aquaculture in a changing ocean</i>	Mehrzwecksaal
12:35	LUNCHBREAK	self supply
14:00	Session 2 <i>Individual Engagement in Environmental Change</i>	Mehrzwecksaal
15:30	Coffeebreak	
15:45	Session 6 <i>Measurement and Control Engineering</i>	Mehrzwecksaal
16:25	Award Ceremony und Ende	Mehrzwecksaal
	16:30 Dr Benke Ozeaneum	Mehrzwecksaal
	16:40 Boris Koch	Mehrzwecksaal
	16:50 Awards	Mehrzwecksaal
20:00	Postconference clubbing	Black Pearls