



**52<sup>nd</sup> EUROPEAN MARINE BIOLOGY SYMPOSIUM**

**25 - 29 September 2017**

**52** **EMBS**  
EUROPEAN  
MARINE BIOLOGY  
SYMPOSIUM

**Piran, Slovenia**



# EMBS - 52<sup>nd</sup> EUROPEAN MARINE BIOLOGY SYMPOSIUM

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## ABSTRACT BOOK

## 52<sup>nd</sup> EUROPEAN MARINE BIOLOGY SYMPOSIUM

**25 - 29 September 2017**

**Editors:** Andreja Ramšak, Janja Francé, Martina Orlando-Bonaca, Valentina Turk, Vesna Flander-Putrlé, Patricija Mozetič, Lovrenc Lipej, Tinkara Tinta, Domen Trkov, Timotej Turk Dermastia & Alenka Malej

**Piran, Slovenia**

52<sup>nd</sup> European Marine Biology Symposium - EMBS 52

September 25 - September 29 2017, Piran, Slovenia

Abstract book

Editors: Andreja Ramšak, Janja Francé, Martina Orlando-Bonaca, Valentina Turk, Vesna Flander-Putrlle, Patricija Mozetič, Lovrenc Lipej, Tinkara Tinta, Domen Trkov, Timotej Turk Dermastia & Alenka Malej - Piran: National Institute of Biology, Marine Biology Station Piran, 2017

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## Welcoming Address

Dear Colleagues:

The 52<sup>nd</sup> European Marine Biology Symposium – the 52<sup>nd</sup> EMBS will be held in Piran (Slovenia) for the very first time at the premises near the Marine Biology Station Piran. In 1969 the Marine Biology Station was established as an independent research group, and later joined the Institute of Biology, which is now National Institute of Biology. Because the EMBS is appreciated among researchers at the Marine Biology Station, the organisation of the 52<sup>nd</sup> EMBS was undertaken with pride and enthusiasm.

The tradition of the EMBS is respected since it is a symposium that addresses broad issues. This approach makes it attractive for a wider audience and thus stimulates the exchange of knowledge and advances in the science of marine biology in Europe and abroad. The idea behind the symposium, which began in the mid of 60's by Otto Kinne, Director of Biologische Anstalt Helgoland, has grown dramatically and lives through the EMBS.

The sessions of the symposium have been selected in order to present novel and interesting topics in marine biology. This year's EMBS will start with a session on *Marine Symbiosis*, which stresses the importance of living together in different associations, and uncovers a diversity of associations by using omics tools and experimental approaches. The subsequent sessions will guide us from new achievements in *Imaging in Marine Biology* essential for adequate description and understanding of life processes in the marine environment, to *Benthic-pelagic coupling*. This session presents physical-chemical and biological processes shared by the two environments, which regulate global-scale bio-geochemical cycling. The session *Marine metagenomics* explores advances in sequencing technology. High throughput sequencing enables rapid detection of the impacts of climate changes, uncovers biodiversity, characterises food webs, and is also the foundation of marine biotechnology for improvements in fisheries and aquaculture. Special attention is given to *Mesophotic ecosystems* and the exploration of marine-derived biomolecules in invertebrates and their symbionts. This topic will take place under the *General session*.

The important feature of the EMBS is that there is only one session at time, and so attendees can follow all sessions. This gives researchers the opportunity to become acquainted with a variety of topics which might otherwise be neglected or overlooked. As for communication, this organisation allows for an exchange of ideas and for the making of contacts that are more personal. The social component is also pronounced through the funny and traditional 'Yellow Submarine' competition. In this extremely busy time, this is very valuable because it provides the opportunity to strengthen our research community through social events, and also promotes knowledge transfer, and thus progress in research. The education and support of young researchers has always been an important issue of the EMBS, and is also recognised by the Marine Research Stations Network (MARS), and the Marine Biology Association (MBA). The MARS and MBA awards reward their excellence in research work.

We owe gratitude to our sponsors, who provided financial support, and some also contributed to the 52<sup>nd</sup> EMBS programme with presentations.

I would like to thank the members of the Scientific and Organising Committees for their professional work and devotion to fulfil the EMBS mission, for making this event a pleasant exchange of scientific knowledge, and for opportunity to make new friendships and collaborations.

Dr. Andreja Ramšak  
Marine Biology Station Piran  
National Institute of Biology

## General Information

### SYMPOSIUM VENUE

Grand Hotel Bernardin  
EMERALD congress room  
Obala 2, 6330 Piran, Slovenia  
[www.h-bernardin.si/hoteli-bernardin-portoroz](http://www.h-bernardin.si/hoteli-bernardin-portoroz)

### LANGUAGE

The official language of the Symposium is English.

### SYMPOSIUM OFFICE

The symposium office is situated at the entrance to the EMERALD congress room. The office is open on Sunday from 17:00 till 19:00, on Monday from 7:30 till 17:00 and from Tuesday to Friday from 8:00 till 17:00.

All participants receive a name badge upon registration. Participants are kindly requested to wear the name badge when attending the symposium programme and social gatherings.

### INSTRUCTIONS FOR ORAL PRESENTATION

Talks are scheduled in 15-minute time slots. The time limit will be strictly enforced to facilitate movement between sessions.

The presentation room is equipped with a video projector, a Laptop PC computer with a mouse, a Screen, a Laser pointer, and a Microphone.

Speakers are asked to leave their presentation material at the registration desk one day before the oral presentation.

### INSTRUCTIONS FOR POSTER PRESENTATION

The poster exhibition is in direct connection with the congress room. Posters are grouped by sessions. Poster numbers are provided in the Book of Abstracts and numbers are placed on each stand designating your placement.

Posters should be on display throughout the congress, from Monday, September 25, 2017 till Friday, September 29, 2017. The presenting author should be present at the poster during the Poster Sessions. In addition, at least one of the authors of each poster is asked to be present at the poster board during as many lunch and coffee breaks as possible, to allow for direct discussions with interested congress participants.

### COMPUTERS AND INTERNET ACCESS

Symposium participants have the possibility to use computers with internet access at the symposium office during its opening hours. In addition, a wireless LAN (WLAN) network is available in the conference area for those who wish to access the Internet with their own laptop. A password can be obtained from the reception desk.

## SOCIAL EVENTS

### Welcome Reception

On Monday, September 25, 2017 all participants and accompanying persons are invited to attend the Welcome Reception with the Mayor of the Municipality of Piran in the art gallery "Mestna galerija Piran", Tartinijev trg 3, Piran.

### Yellow Submarine Competition

In 2017, in the Yellow Submarine Competition, we shall witness "**The rise of the sediment**" in the mysterious and unexplored surroundings of the Symposium venue on Tuesday at 17:30.

Bring all the courage, exploration spirit and protective swimwear.

Explorers should submit their application to the expedition by no later than 12:00 on Tuesday at Yellow submarine black board next to the registration desk.

Details will be announced at the Symposium. Be prepared, be very prepared!

### Symposium dinner

The symposium dinner is organized on Thursday, September 28, 2017, at the VINAKOPER Wine Cellar, Šmarska cesta 1, Koper. Local food will be served.

## EXCURSION

On Wednesday, September 27, 2017 afternoon we'll have an excursion to the [Sečovlje Salina Nature Park](#).

At Sečovlje Salina Nature Park, the past and present still walk hand in hand. The ancient method of salt-making, learnt ages ago by the Piran salt-workers from their teachers, the salters from Pag Island, is still something special, even in the entire Mediterranean.

Not only that the traditional manual gathering of salt in salt fields is a special feature of the cultural heritage of the Mediterranean Slovenia, but it also provides for conditions that enable conservation of the most significant natural heritage of the Sečovlje Salina. According to the available written records, the Sečovlje salt-pans are more than 700 years old, and even much older according to some other sources. Once upon a time, salt-pans were quite common along the mouths of the rivers in the Gulf of Trieste and Istria.

## CONTACT INFORMATION

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## Committees

### Scientific Committee

Chairperson: Andreja Ramšak (National Institute of Biology, Slovenia)

Genuario Belmonte (University of Salento, Italy)

Monica Bright (University of Vienna, Austria)

Ute Hentschel Humeida (Helmholtz Centre for Ocean Research Kiel, Germany)

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Alberto Pallavicini (University of Trieste, Italy)

Martin Pfannkuchen (Ruđer Bošković Institute, Croatia)

Adam P. Summers (University of Washington's Friday Harbor Laboratories, USA)

Jasna Štrus (University of Ljubljana, Slovenia)

Tom Turk (University of Ljubljana, Slovenia)

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Valentina Turk

All members of the Organizing Committee: National Institute of Biology, Marine Biology Station Piran, Slovenia



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## Symposium Programme

Sunday, September 24, 2017

17:00 – 19:00 Registration

Monday, September 25, 2017

7:30 – 9:00 Registration

9:00 – 9:30 Welcome

### MARINE SYMBIOSIS

Chair: Monika Bright

9:30 – 10:15 **Keynote lecture:** Ute Hentschel Humeida  
Exploring microbial dark matter in marine sponge symbioses

10:15 – 10:45 Monica Bright  
Cycles of symbiont transmission and escape facilitate the persistence of the giant tubeworm symbiotic mutualism at deep-sea hydrothermal vents

10:45 – 11:00 Ulyana Simakova and Galina Koliuchkina  
*Coccomyxa*-like putative pathogenic microalgae from mytilid mussels *Mytilus* spp. of the White sea

11:00 – 11:30 Coffee break

11:30 – 11:45 Christopher D. McQuaid, Katy R. Nicastro, Terence P.T. Ng, Justin Lathlean, Laurent Seuront and Gerardo I. Zardi  
For better and for worse: shifting costs and benefits in a marine symbiosis

11:45 – 12:00 Marleen Stuhr, Bernhard Blank-Landeshammer, Claire E. Raymond, Albert Sickmann, Justin B. Ries and Hildegard Westphal  
Proteomic response of photosymbiont-bearing foraminifera to global impacts on ocean conditions

12:00 – 12:15 Sergio Rossi, Nadine Schubert, Darren Brown, Marcelo De Oliveira Soares and Roberto Iglesias-Prieto  
Octocoral symbiosis: exploring the relationship between host morphological traits and symbiont photosynthesis

- 12:15 – 12:30 Petar Kružić, Lovrenc Lipej, Borut Mavrič and Petra Rodić  
The status of Mediterranean symbiotic corals in the forthcoming “tropicalization”
- 12:30 – 12:45 Giovanna Pesante, Federico Sabbadin, Clare Steele-King, Yi Li, Simon Cragg, Davide Tagliapietra, Neil Bruce and Simon Mcqueen-Mason  
Insights into the diversified mechanisms of wood digestion of the shipworm *Lyrodus pedicellatus* and its symbionts
- 12:45 – 13:00 Salvador Espada-Hinojosa, Jean-Marie Volland, Judith Drexel, Nathalie Elisabeth, Julia Kesting, Helena Constance Zambalos and Monika Bright  
Partner fidelity feedback maintains the giant ciliate *Zoothamnium niveum* – *Cand. Thiobios zoothamnicoli* mutualism

13:00 – 14:30 Lunch break

Chair: Alenka Malej

- 14:30 – 14:45 Florian Scharhauser, Jörg Ott, Judith Zimmermann and Harald Gruber-Vodicka  
White, foul and everywhere: global distribution and phylogeny of the Stilbonematinae, a marine benthic thiotrophic symbiosis
- 14:45 – 15:00 Tobias Viehböck, Gabriela F. Paredes and Silvia Bulgheresi  
C, S, and N metabolism in chemosynthetic marine nematode symbioses

#### GENERAL SESSION

- 15:00 – 15:15 Charlotte Angove, Camilla Gustafsson and Alf Norkko  
Plant traits and nutrient uptake rates
- 15:15 – 15:30 Conxita Avila, Carlos Angulo-Preckler, Blanca Figuerola, Juan Moles and Laura Núñez-Pons  
Chemical war under the sea: a few examples of chemical ecology in the Antarctic benthos
- 15:30 – 15:45 Alejandro Tagliafico, David Rudd, Salomé Rangel, Brendan Kelaher, Les Christidis, Ken Cowden, Sander Scheffers and Kirsten Benkendorff  
Lipid enriched diets reduce the impacts of thermal stress in corals
- 15:45 – 16:15 Coffee break

## MESOPHOTIC ECOSYSTEMS: MYSTERIES AND RESEARCH CHALLENGES

Chair: Yehuda Benayahu

- 16:15 – 16:35 Sergio Rossi, Martina Coppari, Núria Viladrich and Andrea Gori  
Beyond SCUBA limit: the challenge of the coastal animal forests of the mesophotic
- 16:35 – 16:45 Suchana Chavanich, Voranop Viyakarn, Charoen Nitithamyong, Somkiat Piyatiratitivorakul, Yehuda Benayahu and Jamal Ouazzani  
Cultivation of marine organisms as a tool for sustainable ecosystem rehabilitation and drug discovery
- 16:45 – 17:05 Assaf Ariel and Alessandra Prampolini  
The needle in the haystack: sustainable bioprospecting in the TASC MAR project
- 17:05 – 17:15 Claire Laguionie Marchais, Ryan Young, Sylvia Soldatou, Jacqueline Von Salm, Mark Johnson, Bill Baker and A. Louise Allcock  
Using biology to help bioprospecting in marine environment
- 17:15 – 18:30 Poster session
- 19:00 – 21:00 Welcome reception

## Tuesday, September 26, 2017

8:00 – 9:00 Registration

## IMAGING IN MARINE BIOLOGY

Chair: Jasna Štrus

- 9:00 – 9:15 Mauro Bastianini, Simone Marini, Marco Pansera, Fabrizio Bernardi Aubry and Elisa Camatti  
Deployment of the underwater video system GUARD1 to monitor *Mnemiopsis leidyi* temporal evolution in the Gulf of Venice
- 9:15 – 9:30 Kajetan Deja, Katarzyna Dragańska-Deja, Agnieszka Tatarek and Józef Wiktor  
Fresh food in the darkness – macrophytes detritus export from the euphotic zone in Svalbard

- 9:30 – 9:45 Edoardo Casoli, Luisa Nicoletti, Daniele Ventura, Andrea Belluscio and Giandomenico Ardizzone  
Photography in the study of bryozoan assemblages in coralligenous habitats; how different growth forms contribute to the development of the framework
- 9:45 – 10:00 Alexandra Leeper, David Benhaïm, Birgir Örn Smáráson and Jón Árnason  
A sustainable novel feed in Atlantic salmon aquaculture during a crucial growth period: an investigation of nutrition and behaviour
- 10:00 – 10:15 Jonas Jäger, Claudia Kruschel, Stewart T. Schultz, Dubravko Pejdo, Viviane Wolff, Klaus-Fricke Neuderth and Joachim Denzle  
Underwater and in the cloud: web-based machine learning for fish video analysis
- 10:15 – 10:30 Valentina Turk, Magda Tušek Žnidarič, Maja Kos Kramar, Ana Fortič, Rok Kostanjšek, Jasna Štrus and Alenka Malej  
Surface ultrastructural observations of *Aurelia aurita* (Scyphozoa)
- 10:30 – 10:45 Eva Turicchia, Massimo Ponti, Matteo Bettuzzi, Maria Pia Morigi, Rosa Brancaccio, Annalisa Falace, Sara Kaleb, Fabio Rindi and Marco Abbiati  
Combining high resolution computed tomography and scanning electron microscopy to assess bioconstruction and bioerosion processes in biogenic reefs
- 10:45 – 11:00 Svenja Christiansen, Henk-Jan Hoving, Florian Schütte, Helena Hauss, Johannes Karstensen, Arne Körtzinger, Martin Schröder, Lars Stemman, Bernd Christiansen, Peter Brandt and Rainer Kiko  
Increased abundances of the flux-feeder *Poeobius* sp. lead to particle depletion in mesoscale eddies
- 11:00 – 11.30 Coffee break
- Chair: Valentina Turk
- 11:30 – 11:45 Rainer Kiko, Svenja Christiansen, Simon-Martin Schröder, Reinhard Koch and Lars Stemmann  
PlanktonID - combining in situ imaging, deep learning and citizen science for global plankton research
- 11:45 – 12:00 Paola Piazza, Vonda Cummings, Drew Lohrer, Simone Marini, Fabio Menna, Erica Nocerino, Andrea Peirano, Fabio Remondino and Stefano Schiaparelli  
Employment of image-based protocol for benthos monitoring in constraining field conditions: the case of photogrammetry in ice-covered Antarctic areas

- 12:00 – 12:15 Lennert Tyberghein, Jonas Mortelmans, Elisabeth Debusschere, Sofie Vranken, Klaas Deneudt and Francisco Hernandez  
Plankton biodiversity in the Belgian part of the North Sea
- 12:15 – 12:30 Elena Stanca, Leonilde Roselli, Francesco Cozzoli, Nicola Fiore, Ilaria Rosati and Alberto Basset  
Phytoplankton morphological and demographic traits computation in a virtual research environment Phyto-VRE
- 12:30 – 12:45 Maja Berden Zrimec, Mojca Poklar, Dean Mozetič and Duško Vranac  
Seabed habitat mapping with underwater photogrammetry
- 12:45 – 13:00 Sergei Aleksandrov and Lilia Rudinskaya  
Effect of "critical salinity" on primary production and eutrophication of lagoon ecosystem (Vistula Lagoon, the Baltic Sea)

13:00 – 14:30 Lunch break

Chair: Jasna Štrus

- 14:30 – 15:15 **Keynote lecture:** Adams P. Summers  
Natural history as an engine of inspiration for biomimetic design
- 15:15 – 15:45 WORKSHOP Microtomography applications in the field of marine biology: a powerful tool for researchers

15:45 – 16:15 Coffee break

#### MESOPHOTIC ECOSYSTEMS: MYSTERIES AND RESEARCH CHALLENGES

Chair: Yehuda Benayahu

- 16:15 – 16:35 Jamal Ouazzani and TASC MAR consortium  
TASC MAR EU-H2020 project, a unique opportunity to lift the veil on the under-investigated mesophotic coral ecosystems (MCEs) through a global, industry-driven, approach
- 16:35 – 16:45 Yehuda Benayahu, Erez Shoham, Ronen Liberman, Catherine S. McFadden, Leen P. Van Ofwegen and Bastian Reijnen  
Octocorals: key players in mesophotic reefs (Eilat, Northern Red Sea)
- 16:45 – 17:05 Géraldine Le Goff, Anne-Isaline Van Bohemen, Michal Weis, Erez Shoham, Ronen Liberman, Yehuda Benayahu and Jamal Ouazzani  
Microbial symbionts of mesophotic invertebrates, is there something new to expect?

17:05 – 17:15 Carolina Alonso Pozas and Pedro A. Álvarez Molina  
Culture improvements: integrated aquaculture as an innovation tool

17:30 – YELLOW SUBMARINE

### Wednesday, September 27, 2017

8:00 – 9:00 Registration

#### GENERAL SESSION

Chair: Lovrenc Lipej

- 9:00 – 9:15 Tasman Crowe, Martina O'Brien, Grainne O'Brien *and* Jan Baars  
Optimising regimes of multiple stressors to control invasive tunicates *Didemnum vexillum*
- 9:15 – 9:30 Aylin Ulman, Jasmine Ferrario, Agnese Marchini, Christos Arvanitidis, Alfonso Ramos-Esplà, Jean-Marc Guarini and Anna Occhipinti-Ambrogi  
Recreational boating as a major vector of spread for alien species around the Mediterranean
- 9:30 – 9:45 Clarissa M. L. Fraser and Benny K. K. Chan  
Heat stress alters mating behavior and reproductive success in intertidal mangrove barnacles
- 9:45 – 10:00 Stewart T. Schultz, Dubravko Pejdo and Claudia Kruschel  
Lure-assisted visual census documents the effects of both harvest protection and habitat on fish communities in marine protected areas in the eastern Adriatic Sea
- 10:00 – 10:15 Andrew J. Richardson, Sam B. Weber and Judith Brown  
Horizontal and vertical movement of the blue marlin (*Makaira nigricans*) at the site of a proposed, pelagic marine protected area
- 10:15 – 10:30 Nazli Demirel  
Depletion of European hake stock in the Sea of Marmara

10:30 – 10:45	<u>Davide Agnetta</u> , Fabio Badalamenti, Francesco Colloca, Giovanni D’Anna, Fabio Fiorentino, Germana Garofalo, Michele Gristina, Bernardo Patti, Carlo Pipitone, Cosimo Solidoro and Simone Libralato  An ecosystem model as a basis for the holistic approach to fisheries in the Strait of Sicily
10:45 – 11:00	<u>Julia Meyer</u> , Petra Nehmer, Andreas Moll and Ingrid Kröncke  Changes in bioturbation potential and functional diversity of southern North Sea macrofauna communities between 1986, 2000 and 2010-2015
11:00 – 11:30	Coffee break
11:30 – 11:45	<u>Francesco Cozzoli</u> , Elena Stanca, Géza B. Selmeczy, Janja Francé, Ioanna Varkitzi and Alberto Basset  Uncertainty of phytoplankton indicators with respect to sample-size: a case study on a large transitional water dataset (WISER)
11:45 – 12:00	<u>Chiara Facca</u> , Andrea Bonometto, Rossella Boscolo, Alessandro Buosi, Piero Franzoi, Federica Oselladore, Emanuele Ponis, Federico Rampazzo, Luca Scapin, Matteo Zucchetta and Adriano Sfriso  Biodiversity changes after seagrass transplantation in coastal lagoon (habitat 1150*): LIFE SeResto project results in Venice lagoon (Italy)
12:00 – 12:15	<u>Carlos Jimenez</u> , Katerina Achilleos, Louis Hadjioannou, Antonis Petrou and Rana Abu Alhajja  A dream within a dream: a singular marine cave ecosystem in Kakoskali islet (Cyprus)
12:15 – 13:00	<b>Special lecture:</b> <u>Alenka Malej</u>  Jellyfish in changing world: portrayal, research and perception in the northern Adriatic
13:00 – 14:30	Lunch break
14:30 –	Excursion to the Sečovlje Salina Nature Park



Thursday, September 28, 2017

8:00 – 9:00 Registration

BENTHIC-PELAGIC COUPLING

Chair: Damir Viličić

- 9:00 – 9:45 **Keynote lecture:** Martin Pfannkuchen  
Life strategies in a shallow marine ecosystem like the northern Adriatic: using or avoiding benthic pelagic coupling
- 9:45 – 10:00 Benjamin Weigel and Erik Bonsdorff  
Trait-based predation selectivity offers insight into effects of changing prey communities
- 10:00 – 10:15 Michael D. Streicher, Katrin Reiss and Henning Reiss  
Effects of multiple nutrient sources on benthic primary producers and grazers: a mesocosm study
- 10:15 – 10:30 Laura Pezolesi, Salvatore Pichierri, Chiara Samorì, Cecilia Totti and Rossella Pistocchi  
Polyunsaturated aldehydes (PUAs) production and toxicity in a benthic environment: the microphytobenthos community of the Conero riviera (northern Adriatic Sea)
- 10:30 – 10:45 Giorgia Dimuzio, Daniela Pessani, Letterio Guglielmo, Antonia Granata, Enrico Zambianchi and Genuario Belmonte  
Circulation of Brachyura zoeae in the south Adriatic: propagules for a dispersal strategy or supply for open marine food chain?
- 10:45 – 11:00 Martina Kralj, Branko Čermelj, Massimo Celio, Marina Lipizer, Janja Francé, Michele Giani and Patricija Mozetič  
Multidecadal frequency of bottom hypoxia in the Gulf of Trieste (northern Adriatic Sea) and recent 2015-2016 events
- 11:00 – 11:30 Coffee break
- 11:30 – 11:45 Tamara Cibic, Francesca Alvisi, Rocco Auriemma, Matteo Bazzarro, Lucia Bongiorno, Daniele Cassin, Stefano Fazi, Annalisa Franzo, Federica Nasi, Federica Relitti, Manja Rogelja and Paola Del Negro  
Influence of the Po River discharge on benthic biodiversity and ecosystem functioning in the prodelta area

11:45 – 12:00 Olivier Glippa, Lauri Kuismanen Louise Lindroos and Jonna Engström-Öst  
Effect of salinity on the emergence and survival of calanoid copepods in the Baltic Sea

12:00 – 12:15 Fernando Rubino, Manuela Belmonte and Genuario Belmonte  
Benthic-pelagic coupling and resurrection ecology for the plankton dynamics in the Mar Piccolo of Taranto (southern Italy, Mediterranean sea)

#### GENERAL SESSION

12:15 – 12:30 Thomas A. Schlacher, Charles H. Peterson, Ben L. Gilby, Ellen Bingham, Christine Voss, Andrew D. Olds and Rod M. Connolly  
Scavengers create hot spots of marine carbon processing on ocean shores

12:30 -12:45 Barbro T. Haugland, Samuel P. S. Rastrick, Ole B. Samuelsen, Ann-Lisbeth Agnalt, Tina Kutti and Vivian Hus  
Mortality and reduced photosynthetic efficiency of *Saccharina latissima* caused by sea lice treatments

12:45 – 13:00 Karine Gagnon, Laura Carugati, Marjolijn Christianen, Roberto Danovaro, Elizabeth Grace, Tunka Eronat, Cristina Gambi, Laura Govers, Silvija Kipson, Lukas Meysick, Liina Paajusalu, Eli Rinde, Inci Tüney Kizilkaya, Tjisse Van Der Heide, Johan Van De Koppel and Christoffer Boström  
A global review of plant-bivalve interactions: implications for marine ecosystem restoration

13:00 – 14:30 Lunch break

#### BENTHIC-PELAGIC COUPLING

Chair: Genuario Belmonte

14:30 – 14:45 Marc J. Silberberger, Paul E. Renaud, Ingrid Krönke and Henning Reiss  
Marine food-web structure indicates functional differences between temperate and sub-Arctic shelf ecosystems

14:45 – 15:00 Annekatriin Enge, Julia Wukovits, Ursula Witte, William Hunter, Wolfgang Wanek and Petra Heinz  
Depth-related changes in food uptake and abundance of benthic foraminifera in an oxygen-depleted deep-sea environment

15:00 – 15:15	<u>Qian Huang</u> , Sergej Olenin and Marleen De Troch Impact of non-indigenous scallop ( <i>Argopecten irradians</i> ) farming in Laizhou Bay (Bohai Sea, China): evidence from meiofauna communities and their food source utilization
15:15 – 15:30	<u>Ee Zin Ong</u> , Mark Briffa, Tom Moens, Sarah Woodin, David Wetthey and Carl Van Colen Living in warmed and acidified sediment: behavioural responses of the deposit feeding bivalve <i>Scrobicularia plana</i>
15:30 – 16:15	Coffee break
16:15 – 16:30	<u>Federica Costantini</u> , Massimo Ponti and Marco Abbiati The eunicellas: genetic diversity and connectivity patterns of two gorgonians populations inside and outside a western Mediterranean marine protected area
16:30 – 16:45	<u>Massimo Ponti</u> , Federica Fava and Marco Abbiati Benthic-pelagic coupling in the recruitment processes in the northern Adriatic mesophotic biogenic reefs
16:45 – 18:00	Poster session
18:00 –	Conference dinner at the VINAKOPER Wine Cellar

## Friday, September 29, 2017

8:00 – 9:00 Registration

### MARINE METAGENOMICS

Chair: Andreja Ramšak

9:00 – 9:45	<b>Keynote lecture:</b> <u>Alberto Pallavicini</u> Genomics of bivalve immunity, the host and the metagenomics study of mussel microbial community
9:45 – 10:00	<u>Sergio Stefanni</u> , David Stanković, Elisa Camatti, Carolina Cantoni, Marco Pansera, Katrin Schroeder, Alberto Pallavicini and Jacopo Chiggiato Large scale metabarcoding analysis of zooplankton in the western Mediterranean Sea

- 10:00 – 10:15 Lise Klunder, Marc S.S. Lavaleye, Judith D.L. Van Bleijswijk, Henk W. Van Der Veer and Gerard C.A. Duineveld  
The influence of hydrothermal vent plumes on surrounding benthic biodiversity: metabarcoding versus classical taxonomy
- 10:15 – 10:30 Timotej Turk Dermastia, Emma L. Carroll, Oscar Gaggiotti and Claire Garrigue  
Insights into the high population growth rates on the New Caledonian humpback whale breeding grounds using paternity analysis
- 10:30 – 10:45 Drahomíra Faktorová, Olga Flegontova, Binnypreet Kaur, Pavel Flegontov, Daria Tashyreva, Galina Prokopchuk, Anzhelika Butenko, Akinori Yabuki, Julius Lukeš and Aleš Horák  
Diplonemids - extremely diverse marine protists with unknown function
- 10:45 – 11:00 Judith van Bleijswijk, Lise Klunder and Henk van Der Veer  
Seasonal patterns of fish community composition in the western Wadden Sea based on environmental DNA analyses of sea water

11:00 – 11:30 Coffee break

Chair: Patricija Mozetič

- 11:30 – 11:45 Andreja Ramšak and David Stanković  
Phylogenetic divergence within Pelagiidae

#### GENERAL SESSION

- 11:45 – 12:00 Matt Frost, John Baxter, Paul Buckley, Stephen Dye and Beth Stoker  
10 years of reporting marine climate change impacts: lessons from the science-policy interface
- 12:00 – 12:15 Carl J. Reddin, Adam T. Kocsis and Wolfgang Kiessling  
Marine invertebrates migrate with climate change throughout the past 480 million years
- 12:15 – 12:30 Justyna Swiezak and Ana R. Borrero-Santiago  
Reduced fertilization rates and abnormal development of the tellinid *Limecola balthica* embryos under hypercapnic conditions
- 12:30 – 12:45 Leen Vandepitte, Stefanie Dekeyzer, Bart Vanhoorne, Wim Decock, Sofie Vranken, Daphnis De Pooter, Filip Waumans, Simon Claus, Kevin Verfaillie and Francisco Hernandez  
The LifeWatch Taxonomic Backbone: how can it help you with your research and how can you help to make it more complete?

- 12:45 – 13:00 Tilen Genov, Paul D. Jepson, Jon L. Barber, Ana Hace, Stefania Gaspari, Tina Centrih and Polona Kotnjek  
Linking organochlorine contaminants with demographic parameters in a marine top predator from the northern Adriatic Sea
- 13:00 – 14:30 Lunch break
- 14:30 – 14:45 Annalisa Franzo, Katja Guilini, Tamara Cibic and Paola Del Negro  
The effect of severely contaminated sediments of the Mar Piccolo of Taranto (Ionian sea, Italy) on free-living nematodes
- 14:45 – 15:00 Nicola Bettoso, Ida Floriana Aleffi, Lisa Faresi, Alessandro D’Aietti and Romina Zamboni  
Ecological status of the macrozoobenthic community in the Marano and Grado Lagoon (northern Adriatic Sea): past and present
- 15:00 – 15:15 Špela Korez, Lars Gutow and Reinhard Saborowski  
Looking under the microscope: who is the main plastic polluter on the coast of Slovenia?
- 15:15 – 15:30 Martina Orlando-Bonaca, Janja Francé, Borut Mavrič, Mateja Grego, Lovrenc Lipej, Vesna Flander-Putrlje, Milijan Šiško and Annalisa Falace  
Assessment of the *Cymodocea nodosa* (Ucria) Ascherson meadow’s status with the new MediSkew index
- 15:30 – 16:00 Closing ceremony

## List of posters

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- I-02      Jean-François Hamel, Igor Eeckhaut and Annie Mercier  
New host for the parasite worm *Anoplodium* sp. (Rhabditophora: Platyhelminthes) found in the sea cucumber *Isostichopus fuscus* (Holothuroidea: Echinodermata)
- I-03      Ines Kovačić and Emina Pustijanac  
Occurrence of the *Nematopsis* sp. in cryosections of mussel *Mytilus galloprovincialis* from the northern Adriatic Sea, Croatia

### IMAGING IN MARINE BIOLOGY

- II-01      Giovanni Chimienti, Lorenzo Angeletti, Porzia Maiorano and Francesco Mastrototaro  
ROV vs trawling approaches in the study of benthic communities: the case of *Pennatula rubra*
- II-02      Adriana Lopes Dos Santo, Thibaut Pollina, Priscillia Gourvil, Erwan Corre, Dominique Marie, José Luis Garrido, Francisco Rodríguez, Mary-Hélène Noël, Daniel Vaultot and Wenche Eikrem  
Chloropicophyceae, a new class of picoplanktonic prasinophytes from the sunlit oceans
- II-03      Karoliina Koho, Charlotte Lekieffre, Hidetaka Nomaki, Iines Salonen, Emmanuelle Geslin, Guillaume Mabillean, Louise Sjøgaard Jensen and Gert-Jan Reichart  
Ultrastructure of foraminifera (*Ammonia* spp. tepida morphocomplex) in oxic and anoxic conditions
- II-04      Jasna Štrus, Magda Tušek Žnidarič and Urška Repnik  
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## BENTHIC-PELAGIC COUPLING

- III-01 Zahra Alsaffar, João Cúrdia, Joanne Ellis, Xabier Irigoien and Susana Carvalho  
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- III-02 Jakov Dulčić and Branko Dragičević  
Lessepsian migrant *Siganus luridus* (Pisces: Siganidae) in the Adriatic Sea: established population or not?
- III-03 Marie Järnström, Johanna Gammal, Alf Norkko and Erik Bonsdorff  
Macrozoobenthic functionality in the shallow coastal zone - an example from the northern Baltic Sea
- III-04 Jacqueline Jerney, Joanna Norkko, Sanna Suikkanen and Anke Kremp  
Effect of hypoxia and bioturbation on genetic diversity of phytoplankton seed banks in the Baltic Sea
- III-05 Lauri Kuismanen, Louise Lindroos, Jonna Engström-Öst and Olivier Glippa  
Are copepods well adapted to low salinities?
- III-06 Emina Pustijanac, Daniela Marić Pfannkuchen, Ana Baričević, Mirta Smodlaka Tanković, Ingrid Ivančić, Nataša Kužat, Nikola Medić, Grozdan Kušpilić, Tihana Novak, Blaženka Gašparović and Martin Pfannkuchen  
*Chaetoceros peruvianus* Brightwell, 1856: a generalistic/opportunistic approach to success in the northern Adriatic plankton
- III-07 Sandra Thorsen, Erik Kristensen, Thomas Valdemarsen, Mogens Flindt and Marianne Holmer  
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- IV-02 Myrsini Chronopoulou, Iina Salonen, Tom Jilbert and Karoliina Koho  
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- IV-03 Rade Garić and Mirna Batistić  
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- IV-04 Joana Hevia-Orube, Sandra Gran-Stadniczenko, Elianne Egge, Emma Orive, Aitor Laza-Martínez, Bente Edvardsen and Sergio Seoane  
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- IV-05 Nik Lupše, Amanda Reid, Louise Allcock and Tsunemi Kubodera  
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- IV-06 Pieterella C. Luttikhuisen, R. Crooijmans, A.R. Boon, H. van Pelt, L. Becking, F. Kleissen and J.W.P. Coolen  
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- IV-07 Amalia Mailli, Henning Reiss and Truls Moum  
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- IV-08 Iines Salonen, Myrsini Chronopoulou, Elina Leskinen, Clare Bird, Gert-Jan Reichart and Karoliina Koho  
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- IV-09 Maya Sertic, Ana Baričević, Petar Kružić and Bojan Hamer  
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- IV-10 Maria Skazina, Anastasia Gagarina, Marina Katolikova and Petr Strelkov  
Effect of introgressive hybridization on segregation of male and female mitochondria in *Mytilus edulis* species complex
- IV-11 David Stanković, Giuseppe Arcangeli, Paola Venier, Fabrizia Gionechetti, Omelkher Salem Ali Zaltum and Alberto Pallavicini  
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- V-04 Lorena Basso, Lucia Rizzo, Stefano Piraino and Loredana Stabili  
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- V-05 Mirna Batistić and Rade Garić  
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- V-06 Genuario Belmonte, Pietro Alifano, Gaetano Ciccarese, Antonella De Donno, Francesca Serio, Vincenzo Nassisi, Michele Onorato, Raffaele Onorato, Vittorio Pasquali and Maurizio Tredici  
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- V-08 Samia Ben Mohamed, Imen Jmil, Maïssa Khedher, Nizar Alaya, Manel Rebaya, Abdellah Chalh, Jean-Pierre Quignard and Monia Trabelsi  
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- V-09 Sabina Berne, Kristina Sepčić, Dorte Janussen, Daniel Kersken, Jerneja Ambrožič Avguštin, Marco Faimali, Francesca Garaventa, Veronica Piazza, Silvia Morgana, Vanessa Ochi Agostini, Špela Zemljič Jokhadar, Tina Eleršek and Tom Turk  
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- V-10 Paul Brooks, Tasman Crowe and partners in WHP workgroup 2, led by Melanie Bishop, Beth Strain and Peter Steinberg  
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- V-11 Pablo Camacho-Bolós, Amelia Gómez-Garreta, Jordi Rull-Lluch, Cristina García-Aljaro, Carlos Angulo-Preckler and Conxita Avila  
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- V-12 Laure Carassou, Mandla Magoro, Alan K. Whitfield and Nicole B. Richoux  
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## MARINE SYMBIOSIS



## Keynote lecture

### EXPLORING MICROBIAL DARK MATTER IN MARINE SPONGE SYMBIOSES

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Marine sponges (phylum Porifera) harbor enormously dense and diverse communities of symbiotic microorganisms in their tissues. Up to 41 bacterial phyla and candidate phyla as well as two archaeal lineages representing thousands of symbiont lineages per sponge individual have been recorded. This diverse array of microbial communities has received considerable research attention, yet much remains unknown about the mechanisms of interactions with the sponge host and their in situ ecological function(s). This presentation will explore the power of single-cell genomics and (meta)-omics for sponge symbioses. Single-cell genomics has advanced the field of microbiology from the analysis of microbial metagenomes where information is literally “drowning in a sea of sequences”, to recognizing each microbial cell as a separate and unique entity. This methodology is particularly valuable when dealing with uncultivated microorganisms, as it is still the case for many environmental bacteria including those living in association with animal or plant hosts. The presentation will further report on recent insights into the HMA LMA dichotomy obtained by machine learning and finally summarize our current understanding of the genomic adaptations of sponge symbionts to a lifestyle within sponges.

## DOES WARMER AND SALTIER MAKE LIFE MORE COMFORTABLE? HOST-PARASITES INTERACTIONS UNDER CLIMATE CHANGE EFFECTS

**Claudia BOMMARITO**<sup>1,2</sup>, Martin WAHL<sup>2</sup>, David THIELTGES<sup>3</sup> and Fabio PRANOVI<sup>1</sup>

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Presentation type: POSTER

Nowadays natural habitats, both marine and terrestrial, are changing faster than in the past due to climate change. The impact of these rapid shifts on survival and population dynamics have often been analysed, but so far few studies explored the effects on one of the most intimate symbiosis between species: the host-parasites interaction. Parasites strongly affect their hosts' fitness leading to mass mortalities and castration, especially in mollusc populations, which represent an important part of stocks exploitable by fisheries. Recent evidence indicates that phenomena such as ocean warming are highly correlated with parasite' infection levels in molluscs but, up to date, few studies analysed the influence of environmental parameters, in particular temperature and salinity, on a large latitudinal scales. The European coasts, characterized by strong human activity, pollution, eutrophication and species invasions can be considered ideal hotpots for this research subject. The aim of this study is to analyse the temperature and salinity effects on parasite load and fitness of molluscan hosts across a wide geographical range, from the Baltic to the Adriatic Sea, both characterised by particularly rapid warming, high freshwater discharge and limited water exchange. The analysed species are the bivalves *Ruditapes philippinarum*, *Chamelea gallina* and *Cerastoderma edule*, and the gastropod *Littorina littorea*, which are common in the studied areas, representing also an important economic resource. Specimens were collected along the West coast of the North Adriatic Sea, the German and Danish coasts of the Baltic. Subsequently, the organisms were transferred to the laboratory and freshly dissected under a microscope. Parasite presence, biodiversity and abundance were registered as well as the host condition index. This study represents a first attempt to analyse interactive effects of salinity and temperature modifications in the host-parasite interactions. Our results could help to identify the effects of climate change effects on these interactions allowing to foresee their future modifications.

## CYCLES OF SYMBIONT TRANSMISSION AND ESCAPE FACILITATE THE PERSISTENCE OF THE GIANT TUBEWORM SYMBIOTIC MUTUALISM AT DEEP-SEA HYDROTHERMAL VENTS

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Presentation type: ORAL

The giant tubeworm *Riftia pachyptila* from deep-sea hydrothermal vents is one of rare exceptions among symbiotic mutualism with only a single microbial partner *Cand. Endoriftia persephone*. We have been investigating in this mutualism which mechanisms evolved that manage the persistence over ecological and evolutionary time scales. We characterized cycles of symbiont uptake from the environment into the host larvae each host generation anew and escape from the host upon host death. Upon symbiont infection through the skin, the trophosome develops. Using metagenomics and MLST approaches we show polyclonal populations with varying dominant genotypes in the host shifting in dominance from juveniles to adults. Nourishment of the host is then taken over by the symbiont and the gut is reduced. The host, in turn, provides all inorganic nutrients necessary for carbon fixation to the symbiont. Ultimately the system, however, relies on the availability of chemicals in the environment. Volcanic eruptions are in the range of a decade and waxing and waning of vent flow is in the range of years. Thus, colonization of a vent site is rapid, tubeworm growth is fast, and host deaths occur quickly. The symbiont escapes the dead host and colonizes other vents as well as the surrounding deep sea. We show that variability of free-living genotypes is larger than in the host, but also dominated by the same genotype present in juveniles. Escape from the host might enable adaptations in the symbiont to spread within host populations and therefore contributes to the stability of this mutualism.

PARTNER FIDELITY FEEDBACK MAINTAINS THE GIANT CILIATE *ZOOTHAMNIUM NIVEUM* – CAND. THIOBIOS ZOOTHAMNICOLI MUTUALISM

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Symbiotic mutualism remains a puzzle for evolutionary biology. Among several mechanisms of maintenance proposed, partner fidelity feedback posits fitness alignment through repeated and conditional exchanges of benefits between partners. The giant colonial ciliate *Zoothamnium niveum* and its ectosymbiont *Candidatus Thiobios zoothamnicoli* from shallow-water decaying seagrass and wood is the only thiotrophic symbiosis that has been cultivated as of yet. Controlled parameters under flow-through conditions allow to set up experiments optimal for the chemoautotrophy of the symbiont nourishing its host. Because the host can feed additionally on free-living microbes we hypothesized that it will grow to smaller sizes with low microbial abundance (MA) in the seawater but to larger sizes with high MA. We expected then under partner fidelity feedback the symbiont (not directly influenced by the microbes) to follow host fitness, while without this mechanism the symbiont proliferation should not be affected, so that it overgrows a small host and is sparsely spread on a large host. The experiments ran for seven days with MA ranging in similar concentrations to what the symbiosis experiences in nature throughout the year. Fitness-related traits for both partners were measured. We show that under low MA the host indeed grew to smaller sizes than under intermediate MA, but did not become larger under high MA, indicating saturation. Most remarkably, MA in the water clearly affected the symbiont morphology and proliferation: one phenotype with a larger volume and slower division rate for intermediate MA, and another phenotype with smaller volume, but faster division rate at both extremes of MA. Nevertheless, the symbiotic monolayer on the host surface was fully maintained, with a perfect trade-off between bacterial cell size and cell number per unit of host surface. Using geometric colony and symbiont cell models revealed a positive correlation between individual host volume and symbiont population volume. These results strongly suggest partner fidelity feedback as a mechanism to maintain this association in a naturally fluctuating habitat over ecological and evolutionary time scales. This however, is not simply accomplished by alterations of symbiont proliferation but by the expression of phenotypes differing in size, shape, volume, and division rate.

NEW HOST FOR THE PARASITE WORM ANOPLIDIUM SP. (RHABDITOPHORA: PLATYHELMINTHES) FOUND IN THE SEA CUCUMBER ISOSTICHOPUS FUSCUS (HOLOTHUROIDEA: ECHINODERMATA)

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A flatworm was discovered inside the coelomic cavity of the commercial sea cucumber *Isostichopus fuscus* along the Pacific coast of Mexico. Based on morphological and genetic evidence, it was determined to be *Anoplodium* sp. belonging to class Rhabditophora. The sea cucumber *I. fuscus* constitutes a new host. The flatworms were consistently found on the surface of the haemal vessels and the *rete mirabilis* of 92% of sea cucumbers sampled along the coast of Mazatlan and 88% of sea cucumbers collected in the sea of Cortez. The infestation rate varied from 1 to 725 flatworms per individual, in both male and female sea cucumbers. When more than ~120 *Anoplodium* sp. were counted in a single host, the gonad of the latter were either very small ( $\leq 1.2$  g wet weight or GI  $< 0.26$ ) or absent, suggesting that this species is detrimental to *I. fuscus* and may be considered parasitic. Combined with the threat of overfishing throughout its distribution range, the discovery of this parasitic infestation in certain areas of the Eastern Pacific could regionally deplete or decimate populations of *I. fuscus*.

OCCURRENCE OF THE *NEMATOPSIS* SP. IN CRYOSECTIONS OF MUSSEL *MYTILUS GALLOPROVINCIALIS* FROM THE NORTHERN ADRIATIC SEA, CROATIA

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Presentation type: POSTER

Detection of parasites and pathogens of molluscs allows the management of natural stocks and disease control in native and cultured species. In this study, we investigated digestive gland cryosection of the Mediterranean mussel *Mytilus galloprovincialis* Lamarck, 1819 sampled at two locations (St. Andrew and ACI Rovinj) in the northern Adriatic Sea across annual cycle. The protozoan of the genus *Nematopsis* Schneider, 1892 (Apicomplexa, Gregarina) have been found for the first time in cryosections of mussel from both sampling stations. One to three oocyst of *Nematopsis* sp. were detected in most cryosections located within phagocyte in connective tissue between digestive tubules of mussel digestive gland. In some cryosections, five to eight oocyst were observed. The prevalence of *Nematopsis* sp. ranged from 20% to 100% in the one-year study. Intensity of infection was variable, with < 30 oocyst per section in most of the cases (maximum 110 oocysts/mussel). We observed the parasite infection in relation to habitat, time of sampling and environmental factors.

## THE STATUS OF MEDITERRANEAN SYMBIOTIC CORALS IN THE FORTHCOMING “TROPICALIZATION”

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Presentation type: ORAL

There are reasonable concerns that climate change could reduce marine biodiversity in the Mediterranean Sea. Warmer sea temperatures are also associated with the spread of invasive species and marine diseases. Due to the increased frequency of above-average temperatures and the occurrence of warm-water organisms, the Mediterranean Sea is under a process known as tropicalization. Mass mortality of marine invertebrates is becoming more common in temperate seas. Several episodes of mass mortalities, affecting populations of corals and other sessile invertebrates, have been recorded over the past 20 years in the Mediterranean Sea. Symbiotic coral species suffered the most extensive damages during the mass mortality events. Current hypotheses about the causes of coral mass mortality events mostly focus on their relationship with the occurrence of distinctive climatic anomalies during the late summer and early fall (exceptionally high and constant temperatures for over one month) usually related to the local hydrological conditions. Mortality events of the scleractinian corals *Cladocora caespitosa* (Linnaeus, 1767), *Madracis pharensis* (Heller, 1868) and *Balanophyllia europaea* (Risso, 1826) were recorded in the Mediterranean Sea. Coral mortality resulted from polyp bleaching (massive zooxanthellae loss) and polyp tissue necrosis, leaving the calyx rim deprived of tissue coverage. The highest mortality rates were registered after the exceptionally hot summers of 2003, 2007, 2008, 2009, 2011 and 2012, when up to 30% specimens of *C. caespitosa* and *M. pharensis* colonies were affected and more than 40% of the *B. europaea* specimens died, all caused by bleaching events and polyp tissue necrosis. In most cases bleaching has been attributed to elevated temperature. However, some populations could recover after bleaching events. These possible coral recoveries provide clear evidence as to how corals can adapt to stressors and thus to potentially future climate change. Unfortunately, nothing is still known of the inherent variability of key environmental factors that regulate coral fitness (like sea temperature, light, symbionts, food) or how this variability drives sensitivity to bleaching-induced mortality. Taking into account the global warming context in the Mediterranean Sea, monitoring programs of physical-chemical parameters and vulnerable coral populations should be rapidly set up.

## FOR BETTER AND FOR WORSE: SHIFTING COSTS AND BENEFITS IN A MARINE SYMBIOSIS

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Living together comes with both costs and, sometimes, benefits. Symbiotic endolithic organisms, including photosynthetic cyanobacteria, are a ubiquitous problem for calcareous organisms. By dissolving calcium in the shell for use as a source of carbon dioxide during photosynthesis, they can cause extensive damage to the shell. In intertidal mussels, this leads to a variety of sub-lethal effects as energy must be re-routed to deal with shell damage and endoliths can even cause high rates of mortality through shell collapse. Levels of infestation depend on a combination of external factors, including shore aspect, topographic shading, wave action and possibly latitude, as well as intrinsic properties of the host. Initial infestation depends on damage to the periostracum of the shell through wave or sand abrasion so that the nature and thickness of this outer protective layer is important and are linked to differences among species in their susceptibility to endolithic infestation. In the case of invasive species, immunity to endoliths can offer an example of enemy-free space in the invaded locality. Despite these negative effects, endolithic cyanobacteria can also have positive effects on the host. Through their boring activity, cyanobacteria cause whitening of the shell, altering its albedo and reducing heat uptake. Here we describe how this results in lower body temperatures for infested than non-infested mussels when they are exposed to the sun. Under extreme heat stress, the effect is so strong that infested mussels suffer significantly lower levels of mortality. The findings indicate how symbiosis is not simple, but involves positive and negative effects, with the balance shifting in time and space. The results underline the complexity of symbiosis and of predicting how species interactions will alter under a regime of climate change.



## INSIGHTS INTO THE DIVERSIFIED MECHANISMS OF WOOD DIGESTION OF THE SHIPWORM *LYRODUS PEDICELLATUS* AND ITS SYMBIONTS

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This study investigates the physiology and enzymology of wood digestion of the shipworm *Lyrodus pedicellatus* and its symbionts. The project's ultimate aim is to discover and characterise new lignocellulolytic enzymes for the conversion of woody biomass into sugars for the production of second-generation biofuels. Like other xylophagous animals, *L. pedicellatus* hosts a community of symbiotic bacteria thought to be involved in wood degradation, which resides in the gills in specialized cells called bacteriocytes. However, the relevance of the bacteria in wood digestion and the role of the lignocellulolytic enzymes produced by the shipworm itself are poorly understood, as well as the route followed by the enzymes from the gills to the distant caecum, where wood digestion occurs. A combination of transcriptomics, proteomics and microscopic studies have been performed to clarify where and how wood digestion occurs, the different role of bacterial and shipworm lignocellulolytic enzymes (CAZymes) and their movements within the shipworm's organs. RNA was extracted from gill, digestive gland, caecum and crystalline style sac from specimens from the Mediterranean and Atlantic stock. RNA sequencing was performed with Ion Torrent PGM and Illumina Hiseq 3000 and the contig assembly was done with Trinity. Proteomics analyses were performed by trypsinolysis and LC-MS/MS on the same organs and results were matched against the RNAseq database. CAZymes were identified with dbCAN. Transmission electron microscopy images were obtained from the same four organs. Our results indicate that CAZymes classes are expressed at different levels and in different organs by the symbiotic bacteria and the shipworms, indicating a subdivision of roles. The data also suggest that the bacterial CAZymes move from the gills to the distant caecum via the food groove, and that the crystalline style has a pivotal role in the assembly of the enzymes, particularly those of prokaryotic origin. Marked difference in the level of expression of bacterial CAZymes have been found between the Atlantic and Mediterranean lineages of *L. pedicellatus* (0.89% vs 24.57%), which reflects the amount of bacteria hosted by the shipworms. These results are valuable for the bio-refinery sector because they help understanding which enzymes are essential for lignocellulose digestion.

## OCTOCORAL SYMBIOSIS: EXPLORING THE RELATIONSHIP BETWEEN HOST MORPHOLOGICAL TRAITS AND SYMBIONT PHOTOSYNTHESIS

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Octocorals are abundant and important members of coral reef communities throughout tropical reefs. In contrast to dramatic declines scleractinians are currently experiencing, octocoral abundance has remained unchanged, and in some populations has increased. Many scleractinian and octocoral species have a symbiotic relationship with the dinoflagellate *Symbiodinium*, however, while extensive research has been conducted on how the morphological traits of scleractinians interact with the physiological traits of *Symbiodinium*, research on octocorals has focused mainly on the host without addressing the contribution of *Symbiodinium*. The present study characterizes and compares photophysiological traits of nine Caribbean octocoral species, relating key animal morphological features with symbiont photobiology. An in-depth approach combining measurements of micro- and macro- animal and symbiont morphological traits allowed for an increased understanding of how species distribution and potential survivorship are effected by environmental conditions. Branch shape and thickness, polyp volume, spicule abundance, length and color, were measured to contrast with photobiological parameters (i.e. Pmax, alpha, dark respiration, symbiont cell concentration, chlorophyll *a* and *c2*, P/R). Species with thinner branches exhibited higher photosynthetic and respiratory rates (per ash-free dry weight and per symbiont cell), while species with thicker branches showed lower respiratory rates. These parameters were also tightly linked to polyp size (calyx volume), where species with thinner branches have smaller polyps, increasing their SA/V, favoring higher metabolic (respiration) rates, while species with thicker branches have larger polyps favoring lower metabolic rates. Photosynthesis/respiration ratios (P/R), when integrated over 24hr, ranged from 1.6 to 2.3, indicating a strong dependence of these species to autotrophic nutrition. This study increases our knowledge of the implications of the current transition from tropical coral reefs dominated by scleractinians, to tropical reefs dominated by octocoral and sponge species.

## WHITE, FOUL AND EVERYWHERE: GLOBAL DISTRIBUTION AND PHYLOGENY OF THE STILBONEMATINAE, A MARINE BENTHIC THIOTROPHIC SYMBIOSIS

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Presentation type: ORAL

Since the discovery of the chemoautotrophic symbioses thriving around the hot vents in the deep sea at the East Pacific rise, a broad variety of chemosynthesis based ecosystems and species have been found in the world ocean. However, their shallow water counterparts in reduced sediments are still not as well known as the ones in the deep sea. In sulphide-rich sediments worm-like animals such as gutless oligochaetes, nematodes and plathelminths live in symbiosis with chemoautotrophic sulphur oxidizing bacteria. One example is the nematode subfamily Stilbonematinae and their ectosymbiotic gammaproteobacteria *Candidatus* Thiosymbion. This relationship is used as a model system in symbiosis research and molecular cell biology. The current knowledge, however, on the biogeography and phylogeny of this group is in an unsatisfactory state. By using a combination of classical morphological methods, electron microscopy and next generation sequencing, we show that the distribution of this enigmatic nematode subfamily is much wider than previously known and expected. Collections from the Caribbean, the Bahamas, the Mediterranean Sea, the Red Sea, the Indian Ocean, the tropical NW and SW Pacific show that most genera are distributed worldwide. Additionally, recent research in the Mediterranean showed that the diversity on the genus as well as on the species level is not fully sampled and understood yet. We present new distribution data and modern phylogenetic trees of this fascinating symbiosis.

COCCOMYXA-LIKE PUTATIVE PATHOGENIC MICROALGAE FROM MYTILID MUSSELS  
*MYTILUS* SPP. OF THE WHITE SEA

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Distribution of the green putative pathogenic microalgae *Coccomyxa* cf. *parasitica* in mytilid mussels *Mytilus* spp. from the White Sea is discussed. It was found in five out of nine bays explored in Kandalaksha and Onega gulfs during the survey in August 2016. 18S DNA sequencing (999 base pairs) shows that studied algae belongs to a group of *Coccomyxa*-like taxa (more than 99% similarity) isolated from several species of Mytilids (*Mytilus edulis*, *M. trossilus*, *Modiolus kurylensis*) of various regions of the World Ocean (West Atlantic, East Atlantic, Pacific).

## PROTEOMIC RESPONSE OF PHOTOSYMBIONT-BEARING FORAMINIFERA TO GLOBAL IMPACTS ON OCEAN CONDITIONS

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The proliferation of coral reef building organisms greatly relies on the mutual association with photo-symbiotic algae, albeit making the holobiont more sensitive to light and temperature fluctuation. A key ecological engineer and highly diverse group of (sub-) tropical carbonate producers harboring algal endosymbionts are large benthic foraminifera (LBF). They are widely used as bioindicators of ecosystem health and, much like corals, they are vulnerable to projected environmental changes. With respect to of global impacts such as ocean warming and acidification, acclimatization and adaptive physiology are highly important to the future of photosymbiotic reef calcifiers. To evaluate their adaptive capacity, it is essential to understand the underlying mechanisms involved in stress responses at the cellular and molecular level. To date, probing proteins in host and symbiont cells and partitioning these two components are major obstacles for ecological studies. Even for the cosmopolitan group Amphisteginidae, very little is known about their molecular biology. Therefore, we applied a label-free shotgun proteomics approach to detect changes in the relative abundance of protein-candidates in response to environmental stress and subsequent protein identification allowed for the partial assignment of proteins to either the foraminiferal host or the endosymbiotic algae. In a combined 2-months ocean acidification and temperature stress experiment on *Amphistegina lobifera*, a common LBF currently invading the Mediterranean, we universally identified and relatively quantified >1,000 protein cluster. Elevated temperature (28°C) was found to have stronger influence on the LBF than even extremely high seawater pCO<sub>2</sub>. At ambient temperature (25°C), higher pCO<sub>2</sub> appears to fertilize the photosymbionts and thereby increase holobiont growth. The interaction of both variables, ocean warming and acidification, did not induce a linear response, but indicated a highly complex response system. Under thermal stress only, photosynthesis-related proteins were reduced among the symbionts, while stress response proteins and chaperones increased in abundance. In the foraminiferal host, metabolic pathways seemed to be affected by allocation of energy resources. By allowing component partitioning, proteomic approaches provides novel insights into the cellular response mechanisms of LBF towards environmental changes and offer opportunities to monitor interactions in this host-photosymbiont system.

## C, S, AND N METABOLISM IN CHEMOSYNTHETIC MARINE NEMATODE SYMBIOSES

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Presentation type: ORAL

Free-living marine nematodes belonging to the subfamily *Stilbonematinae* live in symbiotic association with autotrophic sulfur-oxidizing Gammaproteobacteria. These possess the genetic repertoire to drive CO<sub>2</sub> fixation through the oxidation of reduced sulfur compounds, to denitrify and they may also engage in nitrogen fixation. They may occur at extremely high abundances (>10<sup>5</sup> per m<sup>2</sup>) in shallow water sediments characterized by an oxygen-sulfide gradient with oxygenated upper layers and anoxic deeper sulfide-rich sands. Therefore, these chemoautotrophic symbioses might substantially contribute to S, C and N cycling in shallow water marine sediments and affect their biogeochemistry. It has long been hypothesized that the symbionts associate to the nematodes to exploit their vertical migrations through this redox zone as these can alternatively expose them to sulfide (electron donor) and oxygen (electron acceptor). Additionally, it has been hypothesized that the ability of using nitrate as an alternative electron acceptor (denitrification) might stimulate the oxidation of sulfide in anoxic sediment layers. However, none of these hypotheses has been tested so far. Here, we determined the effect of high and low redox potential environments on symbiont C, S, N metabolisms by incubating symbiotic stilbonematid nematodes in either oxic or anoxic (sulfidic) conditions and by quantifying the transcription of key metabolic genes (i.e. *nifH*, *norB*, *aprA*, *dsrA*, *cbbL*) by qPCR (1) and by measuring the incorporation of isotopically labelled NaHCO<sub>3</sub> (<sup>13</sup>C) in both symbionts and hosts (2). Transcripts level of metabolic genes and preliminary mass spectrometric measurements of <sup>13</sup>C incorporation indicated higher sulfur oxidation, CO<sub>2</sub> fixation and denitrification rates in reduced conditions. All in all, our data suggest that the S oxidation-driven chemosynthesis does not require vertical migrations through the redox zone. Instead, stilbonematid symbionts metabolism appears to be optimized to exploit environment with low redox potential.

## IMAGING IN MARINE BIOLOGY

## Keynote lecture

### NATURAL HISTORY AS AN ENGINE OF INSPIRATION FOR BIOMIMETIC DESIGN

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The sea is an ideal place to look for new materials and solutions to technical challenges. Biology has conquered this corrosive, fouling, and rough environment over and over again. In my work I look to fishes for new solutions to problems... sometimes problems we did not know we had. I will talk about how fishes stick to surfaces better than any man made attachment systems. I will also touch on how they burrow, filter particles, and defend themselves. The basic premise of my research is that good, thorough, field observation of natural behaviours is the foundation for innovative experiments that unlock the mechanism behind complex functions. For example, clingfishes can attach to rocks despite the rugosity and overgrowth typical of the intertidal. The solution they exploit leads us to an entirely new class of suction devices. Similar observations of manta rays, sharks, and flatfishes push us to see new solutions to technical problems.



DEPLOYMENT OF THE UNDERWATER VIDEO SYSTEM GUARD1 TO MONITOR  
*MNEMIOPSIS LEIDYI* TEMPORAL EVOLUTION IN THE GULF OF VENICE

Mauro BASTIANINI<sup>1</sup>, Simone MARINI<sup>2</sup>, Marco PANSERA<sup>1</sup>, Fabrizio BERNARDI AUBRY<sup>1</sup> and Elisa CAMATTI<sup>1</sup>

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Presentation type: ORAL

Many devices exist in the scientific and industrial literature for the acquisition of underwater images. Most of them have been designed to be towed by support vessels or to be installed on cabled observatories. These devices transfer the acquired data through cables and the video/image process is performed outside the acquisition device. Also the power needed for their functioning, including the lighting system, is assured by cables. On the contrary, very few devices have been designed to be stand-alone (not wired), autonomous (without human interaction) and suitable for working over extended periods of time. The GUARD1 imaging system consists of a low-power and a stand-alone system conceived for installation on both fixed and mobile platforms for acquiring images of objects or organisms from 1 mm to 100 cm in size. On-board the device, the image content is analyzed, recognized and classified, with the aim of monitoring the ocean interior at various scales in space and time. The information extracted from the acquired images is then transmitted outside the device in order to be accessed for further analysis. The device is completely autonomous and designed for long lasting deployments and here we present the first results from the 2017 deployment on the "Acqua Alta" oceanographic tower. Starting from July 2016 the specimen of ctenophore *Mnemiopsis leidyi* have been recorded in huge numbers along the coasts of the northern Adriatic Sea. Even if this species is harmless to humans it has a great ecological relevance due to its predation on planktonic organisms fish larvae included. The employment of autonomous video system for monitoring purposes is of great help since the observation and counting of this kind of organisms are often difficult.

## SEABED HABITAT MAPPING WITH UNDERWATER PHOTOGRAMMETRY

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Presentation type: ORAL

Remote sensing / Earth observation techniques (satellite imaging, multispectral imaging, aero-photo, LIDAR) are already widely utilized for the research of mainland areas. This approach enables frequent monitoring of the large areas, providing details depending on the technique being used. Geo-referenced data can be easily utilized for the simply accessible and interoperable maps of habitats, and represent a good basis for more detailed inspection in the field (ground-truthing). Remote sensing is much more challenging in the water environment, where optics is limited by the light penetration, especially in turbid waters. Recent technology improvements enable monitoring at increased signal-to-noise ratio and spatial/spectral resolutions. Together with progress in the computing technologies, such as multi-sensor data fusion, remote sensing can greatly increase the range of successful water-related applications and improve the real-time monitoring of benthic habitats and water quality. Technology advancements have fostered significant new developments also in the field of photogrammetry. Photogrammetry has been used in the underwater archaeology since the sixties, but now it has also a great potential for non-invasive research of the complex structure of large habitats as well as size and biomass assessment. In this study, the utilization of photogrammetry has been tested for the monitoring of seagrass beds and associated macrobenthos in the Slovene coastal waters. Imaging was performed with the sensor-equipped autonomous surface vessel (ASV). Photogrammetry from the multi-sensor data (sonar, optical) provided a detailed overview of the seabed through its reconstruction and 2D/3D modelling. The seagrass' meadows specific structure was clearly visible. The results were compared with the outputs from other techniques. The meadows were mapped through several seasons and changes of their distribution were tracked. Photogrammetry enabled easy monitoring of the presence/absence, area distribution and distribution limits of seagrass meadows as well as distribution of several macrobenthos organisms. Further upgrades of imaging and data processing are being made for additional applications in the shallow waters.

## PHOTOGRAPHY IN THE STUDY OF BRYOZOAN ASSEMBLAGES IN CORALLIGENOUS HABITATS: HOW DIFFERENT GROWTH FORMS CONTRIBUTE TO THE DEVELOPMENT OF THE FRAMEWORK

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Presentation type: ORAL

Coralligenous habitats are primarily produced by the accumulation of encrusting algae growing at low light levels and secondarily by bio-constructor animals that help develop and consolidate the framework created by the calcareous algae. Coralligenous reef formations are considered, in terms of biodiversity, as the second benthic habitat in the Mediterranean Sea after the *Posidonia oceanica* meadows. The aim of this study is to report, through the application of photographic and non-destructive methods, both diversity and distribution of Bryozoans found in coralligenous habitats. Sampling was carried out during summer of 2015 in central Tyrrhenian Sea (Island of Giglio), with seven sites and two depth zone at each site: Shallow was considered as 14-25 m in depth and deep as 28.5-38.5 m in depth. Three replicates, each consisting of six contiguous quadrats of 25 cm × 25 cm (total area = 5650 cm<sup>2</sup>), were shot along the different depth zones. Photographs were taken with a Canon G12 camera in a Canon WP-DC34 housing case, which was arranged within a PVC frame to minimize parallax error. The subsequent photographic analyses were performed using the photoQuad software. Photographic sampling did not allow a robust species identification, therefore we prefer to analyze morphologies, growth form and ecological role of bryozoans in the bioconstruction framework. The present work highlights the importance of bryozoans both as secondary builders and binders organisms within the coralligenous habitats. Considering their skeleton fragility, bryozoan species are exposed to anthropogenic pressures; therefore the monitoring of sensitive and frame-builder species should be improved for the coralligenous habitats.

## ROV VS TRAWLING APPROACHES IN THE STUDY OF BENTHIC COMMUNITIES: THE CASE OF *PENNATULA RUBRA*

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Presentation type: POSTER

Megabenthic soft bottom communities have been studied since the first few decades of the last century, thanks to the relentless advancement of trawl fishing technologies. Despite providing an extensive amount of presence data, trawling cannot be considered so reliable from a quantitative point of view, frequently providing only weak information about species density, large and small-scale distribution and main habitat features. The recent development of visual technologies allows to observe, directly or remotely, the seabed in order to improve our knowledge about habitats and species. One of the faster progress in imaging technology in the field of Marine Sciences is represented by the use of Remotely Operated Vehicles (ROV) for the study of the megabenthic communities. The present study reports the application of both ROV and trawling approaches for the study of a large *facies* of the red seapen *Pennatula rubra* (Ellis, 1764) in the Ionian Sea. This *facies* was identified between 60-70 m depth on sandy-mud bottom within an experimental trawl fishing survey in 2012. A mean density of  $5268 \pm 3778$  colonies/km<sup>2</sup> was estimated in 2015 based on three years of trawl surveys in this site. In the same year, a 780 m long ROV transect was carried out on the same *facies* following the trawling path. All the colonies of *P. rubra* observed were counted and their density was found to be about 42 times higher than the mean density estimated with the three-year series of trawling surveys. This remarkably different density values showed that trawling gear efficiency in the *P. rubra* removal is overall low. Nevertheless, incidental mortality, in terms of collected discard, can be occasionally very high and an additional mortality quota must be added with those specimens that are not directly captured by the net. Besides being extremely less invasive, the ROV visual survey was found to be much more accurate in the quantitative study of benthic communities in respect to trawl fishing surveys. Moreover, the scarce knowledge about pennatulaceans, the reduced number of direct observations as well as the anthropic pressure on soft bottoms bias the general picture of these populations in pristine conditions.

INCREASED ABUNDANCES OF THE FLUX-FEEDER *POEOBIUS* SP. LEAD TO PARTICLE DEPLETION IN MESOSCALE EDDIES

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Presentation type: ORAL

The distribution and ecological and biogeochemical functions of fragile gelatinous zooplankton in the pelagic ocean are largely unknown. While nets destroy and undersample gelatinous fauna, underwater optical systems are better capable to observe this highly diverse group of organisms. We used a combination of an Underwater Vision Profiler 5 (UVP5) and the towed pelagic in-situ observation system PELAGIOS for the investigation of gelatinous zooplankton in the tropical Atlantic Ocean. This revealed high abundances of the gelatinous flux-feeding polychaete *Poeobius* sp. (Flabelligeridae) in a mesoscale eddy, where it co-occurred with very low particle concentrations and resulting low calculated vertical particle flux. To investigate the biogeochemical impact of *Poeobius* sp. in mesoscale eddies, and to determine the horizontal and vertical distribution of this holopelagic flux-feeder, we analyzed 956 UVP5 profiles in the tropical Atlantic Ocean. We found *Poeobius* sp. in a broad horizontal and vertical range: it occurred between 5°S and 20°N and between 16°W to 46°W with the shallowest observation at around 22 m and the deepest at around 1000 m depth. A comparison between non-eddy stations and three different eddy types revealed elevated abundances and a restricted depth distribution of *Poeobius* sp. especially in anticyclonic mode water eddies. These findings for the first time confirm theoretical results regarding feeding strategies of flux feeders. Reduced particle abundance and flux was observed directly under high *Poeobius* sp. abundances. Conservative estimates suggest that by efficiently foraging with their mucus nets, *Poeobius* sp. may catch up to 65% of the vertical particle flux. Our findings show that individual zooplankton species may have a significant impact on the regional biological carbon pump.

## FRESH FOOD IN THE DARKNESS – MACROPHYTES DETRITUS EXPORT FROM THE EUPHOTIC ZONE IN SVALBARD

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Recent studies on the Arctic fjords food web indicate, that both isotope and lipids analyses point to the macroalgae as a food source for deep water (below 100m depth) deposit feeders mainly polychaetes, but also minute crustaceans and mollusks. The vegetation of macroalgae is limited by the available substrate (rock or large stones) and light conditions (usually 30m depth) and was intensively studied in Kongsfjorden, Hornsund and Isfjorden. The biomass was assessed for at least two Spitsbergen fjords and range to several kg wet weight per m<sup>2</sup>, while primary production between 100 and 500g C/m<sup>3</sup>/year, what compared to the microplankton in the water column may be even 30% of organic matter produced in fjords. Algal detritus was observed frequently ashore and recorded on underwater video and photo frames. Recent observations indicate important shifts in the macroalgae occurrence – on one hand upward movement due to the limited light (increased glacial discharge with suspensions), on the other hand better light conditions as the fast ice recedes from fjords. Lack of fast ice permits more wave action and erosion on the shore, that limits the upper limit of occurrence of some species. Aim of this study is to assess the amount of macroalgal detritus on the deep seabed in Spitsbergen fjords and compare it to the known carbon demand of benthos and carbon content in the sediment. The null hypothesis is that macroalgae detritus supply for the deep parts of the fjord may exceed that of the microplankton.

## CHLOROPICOPHYCEAE, A NEW CLASS OF PICOPLANKTONIC PRASINOPHYTES FROM THE SUNLIT OCEANS

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Presentation type: POSTER

Prasinophytes form a group of nine paraphyletic lineages of microalgae corresponding to different taxonomic levels: class, order and undescribed clades. Clade VII emerged after an attempt to organize the paraphyletic lineages recognized as prasinophytes. Clade VII appears as a major picoplanktonic green algae in moderately oligotrophic marine waters. However, it remains without formal description, despite being in culture since the 60's. Originally, phylogenetic analysis of the 18S rRNA gene divided prasinophytes clade VII into three lineages, A, B and C the latter formed by *Picocystis salinarum* only, a species only found in saline lakes. Strains from lineages A and B cannot be distinguished by light or electron microscopy and harbor very similar sets of photosynthetic pigments corresponding to pigment group prasino-2A. The phenotypic and genetic data we obtained on a large set of cultured strains of prasinophytes clade VII allowed us to clarify the taxonomy of this important marine group. Here, we describe two novel classes Picocystophyceae and Chloropicophyceae which contains two novel genera, *Chloropicon* and *Chloroparvula*, and eight new species of marine picoplanktonic green algae.

## UNDERWATER AND IN THE CLOUD: WEB-BASED MACHINE LEARNING FOR FISH VIDEO ANALYSIS

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Presentation type: ORAL

Fish stocks should be monitored with fisheries-independent and non-destructive methods. In Croatia, we are using baited, remote, underwater, stereo video (BRUV) and diver-operated video-visual census (DOV), potentially operated inexpensively by personnel untrained in fish biology, but requiring lengthy and tedious office labor by experts to classify, count, and measure fish. Automated methods will potentially greatly reduce this labor cost and allow greater video data-processing per unit time, and increased statistical power for detecting spatio-temporal variation in fish populations and fish communities. We are currently developing computer-vision tools for automated processing of high resolution underwater videos from BRUV and DOV videos taken in the shallow Croatian Adriatic under varied fish assemblage, water, and habitat conditions. The method is based on deep machine learning and consists of three major steps: detection, classification, and movement tracking of fish. The current prototype achieves accuracies for fish-species classification of 69%, 94% and 98% on the Croatian dataset (794 images), the fish4knowledge 2012 dataset (27370 images) and the seaclef 2015 dataset (22443 images) respectively. The positive correlation between dataset volume and classification accuracy indicates that experts should annotate over 25000 images for the algorithm to be trained to achieve accuracies above 90%. In the near future we plan to embed our algorithms into a lifelong machine-learning framework that continuously improves through incremental learning from newly arriving annotated data. Human-machine collaboration is facilitated by the software tool L3P which allows for annotation within a web-based image-processing engine. This tool enables fish experts to improve analysis algorithms in the cloud without specialized computer-vision knowledge. Our core system achieved best results in a competition to estimate fish abundances within the seaclef 2016 dataset and is foreseen to accomplish several more specialized tasks. We present an innovative machine learning approach that will utilize human-machine collaboration and is suitable for the overall challenge of monitoring marine species and habitats. This work was partially supported by the Croatian Science Foundation, under the project COREBIO (3107).



## PLANKTONID - COMBINING IN SITU IMAGING, DEEP LEARNING AND CITIZEN SCIENCE FOR GLOBAL PLANKTON RESEARCH

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Recent publications revealed the global importance of single-celled zooplankton, belonging to the super group Rhizaria and highlighted the need of in-situ imaging to study these fragile organisms. The advance of *in situ* plankton imaging techniques leads to increasing amounts of image data sets that require identification to different taxonomic levels. Automatic classification by computer algorithms provides the means for fast data availability, however the accuracy of those algorithms still requires manual identification by humans. We combined state of the art automatic image classification by convolutional neural networks (deep learning) with a citizen science project to classify a large dataset of ~ 3 million images from an Underwater Vision Profiler 5 (UVP5). On our website <https://planktonid.geomar.de>, citizen scientists can confirm or reject the automatic assignment of UVP5 images to different plankton categories in a memory-like game. Inbuilt quality controls and multiple validations per image enable scientific analysis of the citizen science data. We will present data on citizen scientist engagement, data quality and the distribution analysis of large protists (Rhizaria) in the Mauretanian, Benguela and Humboldt Current upwelling systems.

## ULTRASTRUCTURE OF FORAMINIFERA (*AMMONIA* SPP. *TEPIDA* MORPHOCOMPLEX) IN OXIC AND ANOXIC CONDITIONS

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Presentation type: POSTER

Ultrastructural studies can provide important insights into the physiology of foraminifera and their adaptation, or coping strategies under different environmental conditions. In this study the ultrastructure of living foraminifera, *Ammonia* spp. (*tepida* morphocomplex), which were collected from surficial and deeper, subsurface (anoxic) sediments from Dutch Wadden Sea tidal mudflat, were viewed under transmission electron microscopy. In addition, specimens from oxic and anoxic incubation experiments were inspected. The ultrastructural results show a clear stress response in *Ammonia* spp. (*tepida* morphocomplex) recovered from anoxic, natural sediments and anoxic incubations with the size and numbers of lipid droplets increasing in comparison to specimens collected from surficial, natural sediments or oxic incubations. Other ultrastructural changes in *Ammonia* spp. (*tepida* morphocomplex) in response to anoxia included presence of intact bacteria and numerous electron dense opaque bodies within the foraminiferan cytosol, and thickening of the foraminiferan organic lining. Although foraminifera are known to be able to survive prolonged anoxia, the stress response seen in this study implies that anoxic conditions are not the preferred habitat of shallow water, intertidal species of *Ammonia* spp. (*tepida* morphocomplex).

## A SUSTAINABLE NOVEL FEED IN ATLANTIC SALMON AQUACULTURE DURING A CRUCIAL GROWTH PERIOD: AN INVESTIGATION OF NUTRITION AND BEHAVIOUR

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Ever increasing pressure on global wild fisheries, coupled with a need for food security for a growing population have driven the expansion of the aquaculture sector. Commercial production widely uses feeds based on fish meal and fish oil, negating the full potential benefit of aquaculture for conservation of wild fish populations. Recent research effort has focused on the development of alternative feed ingredients that support commercial growth rates and fish nutritional needs, the most successful of which, soybean has even reached the commercial market. However, soybean based feeds are not without their ecological and physiological impacts. This research assesses Black Solider Fly (BSF) larvae meal as a novel feed ingredient that does not require extensive agriculture. Feed inclusion levels of: 0%, 7.5%, 15%, 22.5% and 30% respectively will be assessed for the effect on growth and survival of Atlantic Salmon fry. The fry stage is a crucial life stage for Atlantic Salmon and it is a time when the potential end weight of an individual is determined. This research will also consider the potential impact of this diet change on behavioral traits such as swimming activity and boldness that can be related to fish welfare.

## PLANKTON BIODIVERSITY IN THE BELGIAN PART OF THE NORTH SEA

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Presentation type: ORAL

Planktonic organisms are indispensable for the functioning of marine food webs and are considered as one of the major drivers of global biogeochemical cycles. Because of their short life cycles, these organisms respond rapidly to environmental changes and consequently their abundance and species composition are indicators for the health of the pelagic ecosystem. The planktonic community is composed of numerous organisms from distinct taxonomic groups and their sizes range from about 0.2  $\mu\text{m}$  up to 2 mm. The traditional sampling techniques, such as the WP2 net, filtering, and microscopic identification and counting, are still conducted. These are now complemented by new continuous sampling technologies such as the real-time high resolution underwater camera (VPR) and the Imaging Flow Cytometer which is connected to the continuous water flow system of our RV Simon Stevin. Furthermore, the (semi-) automated data processing software associated with these and other new technological developments (Zooscan and Flowcam) reduce the processing time of samples substantially. Combining these biological sensors, nearly the full size spectrum of phyto- and zooplankton is covered. Additionally, the phytoplankton fluorescence and productivity can be studied using the Fast Repetition Rate Fluorometer (FRRF). This talk illustrates how the Flanders Marine Institute and LifeWatch infrastructure study and quantify the plankton communities in the Belgian part of the North Sea.

## EMPLOYMENT OF IMAGE-BASED PROTOCOL FOR BENTHOS MONITORING IN COSTRAINING FIELD CONDITIONS: THE CASE OF PHOTOGRAMMETRY IN ICE-COVERED ANTARCTIC AREAS

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Presentation type: ORAL

SCUBA-based benthic monitoring programs in extreme and logistically challenging underwater environments, such as Antarctica, necessarily have to be efficient, rapid, minimize bottom time and, at the same time guarantee useful results with the minimum environmental impact. Recent technological enhancements in image-based technique, meaning the availability of photogrammetric software and their even more frequent employment in underwater environments, represent a powerful tool to this kind of operational activities. Here we present the results of the elaboration of georeferenced videos, consisting in 3D models and orthophotos, obtained by means of photogrammetric techniques, and depicting the permanent transects deployed in 2015 by the PNRA (Italian National Antarctic Research Program) ICE-LAPSE project and of 'historical' transects videoed in 2006 by a NZ expedition in the same area. Several technological challenges in image elaboration for photogrammetric reconstructions have been faced, but in both cases, 3D models of the seabed were successfully obtained through photogrammetry. Thanks to the details of the models, that enable fine-scale evaluations of spatial patterns with an unprecedented level of detail, it is possible to count invertebrates and estimate shape and volume of large organisms such as sponges. Taking advantages by the use of geospatial packages of R and GIS software and specific image analysis software, such as those based on chromatic hierarchical segmentation processes (e.g. Seascape and photoQuad), it is possible to obtain a series of quantitative measures that can be used to document the changes occurring in the benthos and hence establish a monitoring program of the communities studied. The availability of photo-mosaics of the Antarctic bottom communities is thus a promising tool in monitoring activities in other polar or logistically challenging scuba-accessible near shore sites. This approach, now part of the proposed monitoring protocols of SCAR-ANTOS, due to its non-destructive nature and relatively low costs, is expected to be adopted by other Antarctic research programs in order to establish a network of benthos monitoring stations. Evenly the purposed protocol could become a useful tool in a large variety of areas, as a main or complementary operative activity in monitoring programs.

## PHYTOPLANKTON MORPHOLOGICAL AND DEMOGRAPHIC TRAITS COMPUTATION IN A VIRTUAL RESEARCH ENVIRONMENT PHYTO-VRE

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Presentation type: ORAL

Phytoplankton plays an important role in aquatic ecosystems because it accounts for most of global primary production and affects the biogeochemical processes and trophic dynamics. In the context of conservation, protection and management of the aquatic resources, phytoplankton is a key biological element in monitoring ecological status of aquatic ecosystems. Demographic and morpho-functional traits of phytoplankton are the most commonly metrics used for ecological studies and monitoring evaluation. In order to ensure data quality, the aims of the work are to define procedures for the morphological (biovolume, area, etc) and functional traits assessment and its standardization allowing actual inter-comparability and interoperability of data. To these aims, we have developed and present here the PhytoBioImaging Virtual Research Environment (Phyto-VRE), a collaborative working environment for researchers interested in phytoplankton community structure, organization and ecological function. Phyto-VRE consists of i) an Atlas of phytoplankton, a taxonomic Atlas including illustrative cards from phylum to species level; ii) an Atlas of shapes characterized by a set of 51 geometric models, including specific shape linear dimensions and biovolume and area formulas; iii) a data template to harmonize raw data compilation and iii) a set of computational tools to calculate demographic and morphological traits and some multimetric indicators to assess the ecological status of marine and transitional ecosystems. Both Atlases are integrated and can be easily and jointly browsed switching from taxonomic identification to morphological characterization of phytoplankton. They are intended to be a reference point for marine, transitional and freshwater scientists interested in phytoplankton biodiversity and ecology. The Phyto-VRE provides users with a suite of tools and services that will enable them to: a) obtain and share harmonized data on taxonomy and morpho-functional traits by using the Atlas of Phytoplankton, the Atlas of Shapes and the Phytoplankton Traits Thesaurus, b) discover, access, integrate and export both own and other datasets. Therefore, in Phyto-VRE, groups of scientists and analysts find a user friendly and transparent access to both a set of computational tools and sharing data facility. It is a researchers' virtual office where data aggregation, interoperability, analysis and modelling take place.

## MICROSCOPY OF EXTRACELLULAR MATRICES IN MOLTING SEA SLATERS *LIGIA PALLASSII* (CRUSTACEA: ISOPODA)

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Presentation type: POSTER

Crustacean cuticle is an extracellular matrix secreted by epidermal cells which is constantly remodeled during molt cycle. Exoskeletal cuticle of marine crustaceans is generally thick, composed of numerous layers, pigmented and heavily mineralized. Cuticle of marine isopod crustaceans is less complex and shows specific adaptations to terrestrial lifestyle in amphibious species. Sea slaters of the genus *Ligia* are an excellent model for studies of exoskeleton structure, and its structural and functional adaptations related to transition from marine to land habitats. Cuticle of sea slaters is an important surface barrier, prevents ion and water loss and enables mobility and communication in terrestrial environment. Cuticle of strictly terrestrial woodlice is well described and its structure reflects specific adaptations to land lifestyle. Here we describe cuticle ultrastructure of sea slaters *Ligia pallasii* from US North Pacific coast with special emphasis on structure and composition of individual layers during molt cycle. We combine different microscopies, from computer tomography (CT) to light and electron microscopy, focusing on visualization of chemical composition of layers with gold-conjugated WGA lectins on frozen Tokuyasu sections of tissue samples. In premolt animals epidermal cells secrete new cuticle already before the old cuticle is cast. Preecdysal cuticle is composed of lipo-proteinaceous epicuticle with diversified scales and chitinous-proteinaceous exocuticle. A remarkable feature of epicuticle is an extensive layer of spirally woven tubular structures, which are mostly located at the scale bases, and is similar to wax layer of insect cuticle. In intramolt animals that undergo ecdysis and in postmolt animals endocuticle is secreted and cuticle is further elaborated by secretion of additional layers and calcification. Cuticle is perforated by numerous pore channels with extending cytoplasmic projections which connect the hypodermis and the apical cuticular layers. Our results show that cuticle of amphibious sea slaters is a living structure which is constantly remodeled by secretion of chitinous fibers and different proteins including proteins that nucleate calcium minerals. Anti adhesive and hydrophobic surface of cuticle is probably maintained by secretion of wax-like lipids through epicuticular channels resulting in an extensive epicuticular network of nanotubules on the surface of premolt and postmolt animals.

## COMBINING HIGH RESOLUTION COMPUTED TOMOGRAPHY AND SCANNING ELECTRON MICROSCOPY TO ASSESS BIOCONSTRUCTION AND BIOEROSION PROCESSES IN BIOGENIC REEFS

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Bioconstruction and bioerosion are key processes in mesophotic temperate reefs, and act at different spatial and temporal scales. The study of the microscale processes, driving the dynamic balance leading to the formation of coralligenous banks, requires sophisticated investigation techniques. The scanning electron microscopy (SEM) coupled with molecular tools, are essential for the identification of the building species and of their growth patterns. These approaches are particularly effective for the coralline algae, which are among major reefs builders. SEM can be used to study morpho-anatomical features and bio-mineralisation patterns in coralline algae. Investigation on bioerosion species and processes requires the analysis of the shape of holes and cavities hidden inside the substrates, and the signs left by organisms, often vanished after their death. SEM may reveal occurrence of microborers in algal tissues (i.e., cyanobacteria and endolithic chlorophytes). High resolution Computed Tomography (CT), offers new opportunities to visualise the internal and external morphology of the bioconstructions. This technology is widely used in medical, archaeological, geological and industrial applications. CT combines the use of X-rays and computerised analysis of the images allowing the generation of 3D volume reconstruction of the object. This imaging technique allows investigating the inner structure of biogenic substrates at a very fine scale, without destroying the sample. CT has been used to analyse short and long-term (i.e., 3 and 14 years) bioconstruction and bioerosion processes occurring in travertine tiles deployed on different typologies of mesophotic biogenic reefs in the northern Adriatic Sea. Builders were mainly represented by coralline algae, bivalves and polychaetes, while the most important borers were sponges and bivalves. Boring species leave recognisable traces inside the substrates allowing measuring the eroded volume and estimating the net balance between construction and destruction. Understanding of these processes is a major step towards the conservation of biogenic habitats in the Mediterranean Sea.



SURFACE ULTRASTRUCTURAL OBSERVATIONS OF *AURELIA AURITA* (SCYPHOZOA)

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Moon jellyfish (*Aurelia aurita* s.l.) is a widespread, well-studied scyphozoan that frequently blooms in the Northern Adriatic. It has bipartite life cycle comprising attached polyp and free swimming medusa, both of which were examined during our study. The surface of a jellyfish is covered with mucus layer, which provide a unique habitat for microorganisms. As 16S rDNA sequencing analyses examination of bacterial communities associated with jellyfish surfaces revealed a considerable bacterial diversity, we visualized the mucus and associated microbes to better understand the interactions between the jellyfish host and microbes. For that purpose, we used light and electron microscopy in combination with different sample preparation and staining protocols. Sections of the body wall showed a thick epithelial layer of epidermis and gastrodermis, covering the outer and inner surface of the polyp, respectively, and thin mesoglea in between both epithelia. Both, epidermis and a gastrodermis contain cnidocytes and glandular cells among the other cells. Histological staining confirms presence of abundant mucus around moon jelly polyps, which contains acidic and neutral mucins. The surface examined by scanning electron microscopy revealed epidermal ciliated cells, as well as nematocysts in different stages, both undischarged and discharge. The most prominent features of the tissue surface of adult jellyfish were cilia protruding from the epidermal cells and microvilli surrounded the base of each cilium. Mucus secretions were observed on all external surfaces in form of flocs. Despite thorough examination, the bacteria were not observed on the surface of epidermal cells. In order to further examine the presence of microbes in the mucus, we used transmission electron microscopy. These methods revealed considerable amount of various bacterial morphotypes, embedded in mucus sheets, and in the inner part of the polyp, where prokaryotic, eukaryotic microbes and viruses were also found.

## BENTHIC-PELAGIC COUPLING

## Keynote lecture

### LIFE STRATEGIES IN A SHALLOW MARINE ECOSYSTEM LIKE THE NORTHERN ADRIATIC: USING OR AVOIDING BENTHIC PELAGIC COUPLING

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The northern Adriatic is characterized by particularly steep ecological gradients over space and time. Some of those gradients are strongly connected to benthic pelagic coupling, like e.g. the sudden availability of nutrients during the onset of water column mixing. Living species have to adapt to abiotic processes in the ecosystem and of course to processes in benthic pelagic coupling. However, they also play an active role in the mechanisms driving benthic pelagic coupling. The analysis of aggregates in the water column and the metabolic activity of planktonic species in and around those aggregates exemplifies the danger of generalization, black box approaches and again the need for in situ observations. It also demonstrates how the borders between benthic and pelagic life can be crossed in both directions. To understand adaptations to and active roles in such processes, meticulous in situ observations are of pivotal importance. The large variability in phytoplankton species (and other pelagic species) stands in strong contrast to the apparent continuity and lack of structure of their environment. However, research on phytoplankton life strategies, in particular with regard to competition for nutrients, unveils a rather rich structure of the pelagic ecosystem and a correspondingly rich variability of life strategies. Such rich variability can be found for interactions between different planktonic organisms as well. Food preference as well as grazing efficiency of planktonic and benthic species vary throughout their lifecycle already and showcase the complexity of the biology behind benthic pelagic coupling.

## EFFECT OF "CRITICAL SALINITY" ON PRIMARY PRODUCTION AND EUTROPHICATION OF LAGOON ECOSYSTEM (VISTULA LAGOON, THE BALTIC SEA)

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Presentation type: ORAL

Vistula Lagoon is one of the largest lagoons in Europe, where there is intense interaction of the sea water and river runoff, and salinity varies from 0 to 8 ‰. This lagoon is a classical object for studying the impact of "critical salinity" on biodiversity of planktonic and benthic communities. The influence of the "critical salinity" on primary production and chlorophyll, as indicators of the abundance and productivity of phytoplankton, which can be integrated measure of the resulting changes in chemical and biological processes, poorly studied, especially in the lagoons. Analyzed the long-term (1995-2016) monthly (March-November) observations of hydrological, hydrochemical and hydrobiological parameters (salinity, chlorophyll, primary production, nutrients, benthos, etc) for 9 stations located from the mouth of the river Pregel to the sea strait. In 1995-2010 in the eastern part at salinity of 0.5-4.5‰ hypertrophic level of production and abundance of phytoplankton was observed. In the central part of the lagoon in the mean annual salinity of 4.5‰, a sharp decrease primary production and chlorophyll (in 1.5-2 times) to eutrophic level was observed, which are further stabilized in the whole area to the sea strait. This phenomenon can not be explained by simple dilution with low productive marine waters, as content of nutrients in the whole area remains fairly stable. Great changes have taken place in the Vistula Lagoon ecosystem in the 2011-2016 after the invasion of the North American filter-feeding bivalve *Rangia cuneata*, when the benthic biomass increased by 20 times (to 650 g/m<sup>2</sup>), and chlorophyll decreased by 2 times (from 39 to 20 mg/m<sup>3</sup>). However, the spatial distribution of primary production and chlorophyll isn't change and sharp decrease is observed at 4-4.5‰. Consequently, the salinity of 4-5 ‰, close to the previously established mean value of the "critical salinity" for zooplankton and benthic also has significant impact on productivity and abundance of phytoplankton as a result of changes in the rate of photosynthesis and reproduction. Reduced productivity and abundance of phytoplankton in the area of "critical salinity" has positive value for the Vistula Lagoon. Eutrophication does not attain its potentially possible level, there is no hyperbloom of toxic Cyanobacteria.

## SOFT-SEDIMENT MACROBENTHIC ASSEMBLAGES IN SPACE AND TIME: EXPLORING PATTERNS OF VARIATION IN A HYPERSALINE SUB-TROPICAL COASTAL LAGOON

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Presentation type: POSTER

Assessing patterns of diversity over space and time and the factors that control and generate those patterns is critical for conservation efforts. Many of the environmental factors that shape soft-sediment macrofauna communities (e.g. sediment composition, organic matter, vegetation cover) vary temporally, and different ecological patterns may be observed depending on the sampling period. The factors driving macrobenthic dynamics in coastal lagoons are still poorly understood in the Red Sea, as well as in most of sub-tropical and tropical regions. The present study applied a combination of uni- and multivariate techniques to test whether patterns of biodiversity, composition and structure of macrobenthic assemblages change across different habitats (mangrove, seagrass meadows and lagoon channel) and seasons. We also applied the concepts of resilience and resistance against natural pressures aiming at assessing the stability of the macrobenthic community in space and time. The study was carried out in the central Red Sea (~22 °N) in winter and summer seasons. Despite the seasonal variability in seagrass biomass, seagrass cover had a consistent effect on the uni- and multivariate patterns of the associated benthic assemblages. Seagrass beds consistently supported a higher diversity of taxa and number of individuals (especially bivalves and gastropods) than the other habitats. Differences in community structure and composition were observed between habitats but not between seasons. The different habitats present in a small lagoon clearly increase the diversity of the area and serve as biodiversity repositories. This study provides relevant information on the spatial and seasonal patterns of variability in sub-tropical coastal lagoons. Given the structural and functional importance of seagrass beds documented in this study, the results also highlight the importance of conservation measures to preserve these important habitats particularly along the coast of the Red Sea where rapid urban and industrial development are occurring.

## INFLUENCE OF THE PO RIVER DISCHARGE ON BENTHIC BIODIVERSITY AND ECOSYSTEM FUNCTIONING IN THE PRODELTA AREA

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Presentation type: ORAL

To investigate the impact of the Po River plume, in terms of organic load and contamination, on benthic photoautotrophic and heterotrophic communities and ecosystem functioning, in October 2014 we collected sediment samples at ten stations located along north-south (NS) and coastal-offshore transects in the prodelta area. The <sup>7</sup>Be signal indicated a major recent riverine input in correspondence with the three main river mouths (up to 234.29±16.51 Bq kg<sup>-1</sup>) with a general decreasing NS trend. Clear NS and coastal-offshore decreasing gradients of terrigenous inputs were further confirmed by total organic C, biopolymeric C contents and δ<sup>13</sup>C values of sedimentary organic matter. The highest concentrations (above the legal limits) of PCBs were displayed nearby the main river mouth, and of Hg and As at the offshore stations. The highest bacterial abundance (8.56±0.15×10<sup>9</sup> cell g<sup>-1</sup>) was detected nearby the main river mouth together with major lipid, protein and pheopigment contents, while Archaea showed the highest values (up to 9.32±2.32×10<sup>8</sup> cell g<sup>-1</sup>) offshore. The bacterial community was dominated by delta- and gamma-Proteobacteria. At three stations where mucilage was observed in the overlying water, the lowest meiofaunal abundance and benthic primary production were found, whereas heterotrophic prokaryotic production did not seem to be affected. The highest photosynthetic rate (3.37±1.22 mgC m<sup>-2</sup> h<sup>-1</sup>) was estimated offshore where the microphytobenthic abundance reached 57000 cells cm<sup>-3</sup>. Among diatoms, *Gyrosigma* spp. that prefers organic-rich sediments was the most represented taxon together with *Paralia sulcata* that proliferates in low light conditions. Nearby the river mouths macrozoobenthos was dominated by suspension feeders (i.e. the polychaete *Owenia fusiformis* and the crustacean *Ampelisca intermedia*) whereas increasing numbers of deposit feeders (i.e. the polychaete *Sternaspis scutata*) were detected offshore. The principal component analysis highlighted two groups of stations, each characterised by similar depths and grain-size, and a separate station located at the main river mouth that is continuously influenced by the river discharge. A higher environmental stability (more marine features, better oxygenation) established during the river's lean season flow, favoured the recovery of the benthic communities that showed a certain degree of resilience.

## THE EUNICELLAS: GENETIC DIVERSITY AND CONNECTIVITY PATTERNS OF TWO GORGONIANS POPULATIONS INSIDE AND OUTSIDE A WESTERN MEDITERRANEAN MARINE PROTECTED AREA

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Marine Protected Areas (MPAs) are mainly aimed to protect species diversity and ensure persistence of marine populations. For achieving these purposes, MPAs should be effective in maintaining genetic diversity and connectivity at different spatial scales. Populations within MPAs should have a genetic variability similar, or even higher, than populations outside MPAs, and to be connected with them. Genetic markers, able to discriminate spatial scales at which populations can be differentiated into discrete units, allow us to infer patterns of genetic variability and connectivity in sessile marine species. *Eunicella cavolini* and *E. singularis* are two congeneric differing in life histories, habitat morphology and for the occurrence of symbiotic algae. These gorgonians are habitat-forming species characterising Mediterranean subtidal rocky bottoms. Their aesthetic and ecological values represent a natural heritage to be preserved, and therefore they are among the target of many MPAs. In recent years both species were affected by climate-induced mass suggesting the need of specific conservation measures. In the present study, colonies from both species were sampled in two sites inside and two sites outside the Tavolara-Punta Coda Cavallo MPA (northern Tyrrhenian Sea). Patterns of genetic diversity, structure and connectivity of the two species inside and outside the MPA were compared using specie-specific microsatellite loci. The results highlighted similarity and differences in the genetic patterns between the two species, providing information useful to develop effective management and monitoring plans for Mediterranean subtidal rocky reef assemblages.

## CIRCULATION OF BRACHYURA ZOEAE IN THE SOUTH ADRIATIC: PROPAGULES FOR A DISPERSAL STRATEGY OR SUPPLY FOR OPEN MARINE FOOD CHAIN?

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In two oceanographic cruises the neuston of the South Adriatic Sea has been studied. In the first cruise (May 2013) a notable swarm of Brachyura zoeae (belonging to 19 different *taxa*, with *Xantho granulicarpus* at 75%) has been recorded at stations “PennaGrossa” and “n.13”, on the Italian side of the basin. In the second cruise (March 2015) a similar swarm (15 different *taxa*, with *Liocarcinus* sp. at 41%) has been recorded on the Balkan side of the basin (stations “Alb2” and “Alb3”). Complementary collections of zooplankton in the whole water column demonstrated that zoeae were present only in the neuston layer, and here they were dispersed by surface currents. Satellite-tracked surface drifters launched during the cruises (passing by or starting from the same area of zoeae, nine in May 2013, nine in March 2015) provided a good approximation of the geographic distribution of the larvae with time. During the first cruise, four drifters entered the Ionian sea, four remained on the Italian Side of the south Adriatic, and one reached the Balkan neritic area in 30 days (a reasonably lifetime of zoeae before their metamorphosis). In the second cruise, in the first 15 days (here the larvae were megalopa, thus closer to the final metamorphosis) none of the drifters launched on the eastern side of the southern Adriatic reached the Italian coasts. An Albanian-to-Italian coastal connection has not been found in the short period analysed, but is typically realized in the turn of months following the multiple cyclonic gyre surface circulation of the Adriatic. The results strongly support the along shore dispersal of Decapoda larvae, practically reducing to negligible the possibility of a coast to coast connection of benthic populations of the same species, if based on this propagation strategy. In addition, the most of collected larvae were dead and their huge amount has, from an energetic point of view, an interesting role as a supply of organic material to the open sea food chain more than to genetic connection of populations on the opposite sides of the South Adriatic basin.



## LESSEPSIAN MIGRANT *SIGANUS LURIDUS* (PISCES: SIGANIIDAE) IN THE ADRIATIC SEA: ESTABLISHED POPULATION OR NOT?

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Since the opening of the Suez canal in 1869, there has been an influx of Red Sea and Indo-Pacific organisms into the Mediterranean Sea, a phenomenon known as lessepsian migration. During the past decades, 14 lessepsian fish species have been recorded in the Adriatic Sea. The first record of the dusky spinefoot in the northern Adriatic Sea occurred in 2010 in the Gulf of Trieste. A second record occurred in the southern Adriatic (Mljet channel) the very same year. Juveniles were observed for the first time in Molunat Bay (southern Adriatic, Croatian coast) on 15 December 2011. Three years later, a specimen of *Siganus luridus* was caught in 2014 in Bigova (cape Trašće) (southern Adriatic Sea, Montenegrin coast). This was the first record of this species for Montenegrin coast, and fourth for the Adriatic Sea. Last observations in the area of Prevlaka and Molunat bay (southern Adriatic, Croatian coast) showed a presence of large schools of this species clearly indicating an established population in the area. Meanwhile, this species started to appear in the catches of fishermen in the area. The success of the *S. luridus* in the Adriatic Sea has been attributed also to its large eco-physiological plasticity. The impact of successful colonization by this and other exotic fish species should be evaluated through future research.

## DEPTH-RELATED CHANGES IN FOOD UPTAKE AND ABUNDANCE OF BENTHIC FORAMINIFERA IN AN OXYGEN-DEPLETED DEEP-SEA ENVIRONMENT

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Primary production in surface waters of the Arabian Sea and the resulting export of particulate organic matter (POM) to greater depths is high. Bacterial decomposition of the enormous amounts of sinking POM causes widespread O<sub>2</sub> consumption which leads to the formation of a water body permanently O<sub>2</sub> depleted between 150 and 1200 m water depth in the eastern Arabian Sea. This Oxygen Minimum Zone impinges on the continental margin, exposing benthic organisms like Foraminifera to low O<sub>2</sub> conditions. The study aim was to quantify the short-term C and N uptake and the abundances of benthic Foraminifera at three different water depths. To this end a series of *in situ* feeding experiments was carried out across the Indian margin. A stable isotopically labelled (<sup>13</sup>C, <sup>15</sup>N) food source (*Thalassiosira weissflogii*) was applied to concurrently trace phytodetrital carbon (pC) and nitrogen (pN) uptake. The labeled food source was released to the sea floor at 540, 800, and 1100 m water depth, using semi-enclosed mesocosms (spreaders). Sediments were recovered after 4, 7 or 10 days and the isotopic composition of foraminiferal cytoplasm was analyzed. The abundance, species composition, and size distribution of Foraminifera were also examined at these sites. Elevated pC and pN values in Foraminifera after 4 days at all depths indicate the rapid response to food and highlight the relevance of freshly deposited phytodetritus as food source to Foraminifera. After 10 days (no data for 540 m), pC and pN values were similar (800 m) or higher (1100 m) to 4 days. Foraminifera at 540 m were most numerous, larger in size, and exhibited highest C and N uptake rates. Although O<sub>2</sub> conditions here are lowest of all sites, the present (dysoxia-tolerant) species benefit from high POM fluxes and the lack of competition for space and food by other higher organisms. Towards greater water depths food uptake by Foraminifera declined, and specimens were smaller and less numerous. This presumably results from an increased competition (as other organism were present at greater water depths), and from lower food demand in Foraminifera as an adaptation to reduced POM flux or lower temperature.

## EFFECT OF SALINITY ON THE EMERGENCE AND SURVIVAL OF CALANOID COPEPODS IN THE BALTIC SEA

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Climate change is considered to be the dominant factor shaping global marine food webs and the Baltic Sea forms no exception to this problem. Zooplankton populations, which represent a central part in the aquatic food chain show decreasing trends in many Baltic Sea basins. This is suggested to be due to warming, eutrophication and overfishing. Among these threats, the salinity is expected to decrease by the end of this century and it is nowadays well known that salinity profoundly affects organisms. That is particularly true for organisms inhabiting the Baltic Sea, since they live at their physiological limits. The present study aims to understand how the resting egg bank, which is an important component of benthic-pelagic coupling, will be affected if salinity decreases as projected. A preliminary study showed that the hatching success of copepod resting eggs (*Acartia* sp. and *Eurytemora* sp.) from the sea bed was much higher at a salinity of 15 in comparison with ambient (~5 psu) or higher salinities. For both species, we found higher survival at a salinity of 15, whereas they did not survive in freshwater or more saline waters. A complementary study is currently being carried out to investigate the effect of salinity (10 treatments: from 0 to 25 psu) on the emergence and the survival of calanoid copepods from the Baltic Sea. The results will be discussed in the context of global change for the planktonic community.

## IMPACT OF NON-INDIGENOUS SCALLOP (*ARGOPECTEN IRRADIANS*) FARMING IN LAIZHOU BAY (BOHAI SEA, CHINA): EVIDENCE FROM MEIOFAUNA COMMUNITIES AND THEIR FOOD SOURCE UTILIZATION

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Non-indigenous species (NIS) have become an important section of aquaculture but culturing NIS especially shellfish implies high risks on ecosystem. Benthic meiofauna is sensitive to environmental stressors and could respond to the stressors through structural and functional changes in communities. We investigated the impact of farming NIS shellfish *Argopecten irradians* in Laizhou Bay (Bohai Sea, China) on benthic meiofauna in terms of community composition and food source utilization. Two sampling events in Laizhou were conducted before aquaculture activity and during a high organic loading period. Meiofaunal higher taxon composition was compared between control sites and farming sites. The nMDS showed that no separation between 'farm community' and 'control community' before aquaculture activity, but a clear separation occurred during the high organic loading period, indicating the changes of community caused by *A. irradians* farming. Nematoda were found to explain most of this difference. Food utilization by meiobenthic Nematoda and Copepoda was tested by analyzing their carbon and nitrogen stable isotope composition and this of their food sources in control sites and farming sites. The organic matters derived from the scallop farms was consumed by Nematoda and Copepoda under the scallop farm, indicating that changes in the energy flow and the overall ecosystem functioning caused by farming *A. irradians* can be expected.

## MACROZOOBENTHIC FUNCTIONALITY IN THE SHALLOW COASTAL ZONE - AN EXAMPLE FROM THE NORTHERN BALTIC SEA

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Presentation type: POSTER

Macrozoobenthos are an important organism group in the shallow coastal zone. Through their activities, they oxidize the sediment, influence nutrient dynamics and function as a food source for benthivorous fish. By studying the macrozoobenthic community using measures of functionality, such as biological trait analysis, we are able to estimate the functional diversity and the effect of the traits expressed by these organisms on ecosystem processes. In our study, we were interested in the distribution of macrozoobenthic traits in the shallow coastal zone, and surveyed 18 sites on a gradient from coarse sand to fine silt in August 2014. The macrozoobenthos at three of these sites, representing different habitats, were further monitored throughout one year. Our goal was to investigate whether macrozoobenthic functionality can be linked to differences in habitat, such as grain size composition, organic content and vegetation coverage. We were also interested in the possible changes in macrozoobenthic functionality in different habitat types across season. To be able to study the actual link between the macrozoobenthic functionality and ecosystem processes, we further measured oxygen and nutrient fluxes at each of our sampling locations at each sampling time. In our results, we present possible links between the traits expressed by the macrozoobenthic communities in different habitats with the environmental variables measured at each site. We also link effect traits studied to nutrient fluxes measured, to add to the understanding of in what ways macrozoobenthic organisms affect processes of nutrient cycling.

## EFFECT OF HYPOXIA AND BIOTURBATION ON GENETIC DIVERSITY OF PHYTOPLANKTON SEED BANKS IN THE BALTIC SEA

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Bottom-water hypoxia resulting from eutrophication and water column stratification is frequently observed in the Baltic Sea. Increasing hypoxia can decimate macrofaunal communities, leading to reduced sediment mixing. The physical mixing of the sediment by bioturbating macrofauna strongly influences both the distribution and dispersal of phytoplankton resting stages within the sediment. Thus, bioturbation plays a crucial role in the population dynamics of resting stage-forming species. When mixing is absent due to a lack of macrofauna in anoxic or hypoxic sediments, newly formed resting stages are not dispersed throughout the sediment, but accumulate in permanent distinct layers. As a result genetic diversity of phytoplankton blooms is expected to get restricted, causing a decreased capability to adapt to changing environmental conditions. To test if hypoxia-related absence of macrofauna in the sediment 1) prevents mixing of resting stages in surface sediments and 2) affects genetic diversity of the seed bank at the sediment surface, bioturbation experiments were carried out. Resting stages of the dinoflagellate *Alexandrium ostenfeldii* and the diatom *Skeletonema marinoi* were produced under laboratory conditions and layered in different depths of sediment cores. Fluorescent particles (luminophores) were added to the same layers to trace reworking of the sediment by bioturbating macrofauna (the polychaete *Marenzelleria* spp., the bivalve *Macoma balthica* and the amphipod *Monoporeia affinis*). Additionally genetic characterization of *A. ostenfeldii* and *S. marinoi* resting stages from the surface layer was done with the help of microsatellites. Microcosm replicates with and without addition of benthic macrofauna were compared and first results of vertical cyst and luminophore distribution, as well as vertical transportation rates will be presented here.

## MULTIDECADAL FREQUENCY OF BOTTOM HYPOXIA IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA) AND RECENT 2015-2016 EVENTS

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In the Northern Adriatic episodic late summer – early autumn hypoxic and anoxic events during the 1970s, 1980s and beginning of the 1990s were observed. These events could be ascribed to river-borne nutrient discharges coupled with a closed circulation, which favors the entrainment of waters in the northernmost part of the sub-basin. In recent decades, however a marked decrease in the continental discharge of nutrients and in particular of phosphates has caused an oligotrophication of the system. Remarkable variations of nutrient loads discharged by local rivers of the Gulf of Trieste occurred during the last years, from the extreme drought in the mid 2000s to increased freshets in the 2010s, which induced consequent variations of phytoplankton biomass and of the dissolved oxygen in the water column. Physical and chemical data collected in three time-series stations, mostly on a regular monthly basis, from 1983 to 2016 were analyzed in order to detect trends and frequency of occurrence of hypoxia events in bottom waters. Even if preliminary results of the analysis of 30-years data show a tendency toward increasing oxygen concentration in the bottom waters, two marked hypoxia events were recorded during the summers of 2015 and 2016, which have been exceptionally observed in a marginal and relatively shallow area (17m) of the Gulf. In order to evaluate the temporal and spatial extent of these hypoxia events, hydrographic, chemical and biological variables of about 30 sampling stations were analyzed. The area was characterized by extremely high sea water temperature (up to 20.6 °C) and salinity (37.7) at bottom and vertical stabile stratification of the water column, which prevented the mixing of oxygen-rich surface water with oxygen-poor water on the bottom. These conditions were maintained until wind-induced turbulence destabilized the entire water column. The main contribution to oxygen depletion are attributed to benthic and plankton respiration, which exceeded the oxygen production. Moreover, the increasing temperature trend in bottom waters, coupled with the increase in riverine discharges, is possibly favoring the hypoxia events in this shallow coastal ecosystem.

## ARE COPEPODS WELL ADAPTED TO LOW SALINITIES?

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Climate change and rising atmospheric CO<sub>2</sub> are associated with several changing factors in marine ecosystems. These changing factors can and will affect the life of marine organisms, because the changes give rise to new environments, altered dispersal patterns and changed species interactions. The health of ecosystems in the Baltic Sea has been notably affected by climate change. The average surface water salinity in the Baltic Sea is 5-8 psu and is controlled by freshwater run-off and occasional inflow of saline water through the Danish Straits. As a consequence of the lowered frequency of salt inflows, and the simultaneous increase in river run-off, the salinity has decreased from 5.9 to 5.2 psu (surface waters) in the Baltic Proper (1950-1990), and has been projected to decrease even further around the same area by the year 2100, by 0.2-2.0 psu. Faunal and floral biodiversity in the Baltic Sea is affected by salinity, and the zooplankton species composition appears to change following changes in salinity. Zooplankton are an important food source for many organisms, and are therefore important in the marine food-webs. Decreasing trends in zooplankton abundance have been observed with declining salinity in the Baltic. The present study aims to see how the expected decrease in salinity affects the emergence of copepods. In a preliminary study, the hatching success of *Acartia* sp. and *Eurytemora* sp. resting eggs were much higher at 15 psu than 5 psu or at salinities higher than 15 psu. The survival to adulthood was also higher at 15 psu than in freshwater or more saline waters, for both species. A complementary study is currently being performed to investigate how different salinities (10 treatments, 0-35 psu) affect the emergence and survival of calanoid copepods. The results from this experiment will be related to a global scale: from aquaria to the Baltic Sea, and from the Baltic Sea to a global scale.



## LIVING IN WARMED AND ACIDIFIED SEDIMENT: BEHAVIOURAL RESPONSES OF THE DEPOSIT FEEDING BIVALVE *SCROBICULARIA PLANA*

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Estuarine biodiversity plays an important role in providing essential ecosystem services and functions; however, these habitats are increasingly threatened by multiple interactive stressors including ocean acidification and warming. The effects of acidification and warming may be additive, synergistic or antagonistic; therefore, it is crucial to investigate how these stressors will affect the behaviour of shallow water marine species such as the peppery furrow shell *Scrobicularia plana*. Behavioural changes (e.g. feeding, predation avoidance, competition among others) are likely to influence individual health, ultimately affecting the ecosystem services and functioning provided by the habitat. To fulfil the objective, we experimentally investigated the behaviour and condition of *S. plana* under current and future ocean scenario predicted by IPCC. Our experiment included warming and acidification under both single and combined stressor conditions. In order to capture the behaviour of *S. plana* (e.g. burrowing, manoeuvring, siphon relocation, expulsion of faeces and pseudofaeces) in the muddy sand sediment, we used non-destructive pressure sensors, which were inserted in sediment to obtain porewater pressure signals generated by their hydraulic activities. To identify the different pressure signals patterns generated, time lapse cameras were used to document the behaviour of *S. plana* on the sediment surface. By synchronising and analysing both porewater pressure signals and time lapse images, the activities of *S. plana* can be quantified and compared. Furthermore, we calculated the condition of *S. plana* as dry tissue weight divided by dry shell weight multiplied by 100. This index gives a realistic indication on the bivalve fitness at longer time scale than what can usually be studied under laboratory conditions. This experiment provides valuable information on how multiple interactive stressors affect the behaviour and condition of *S. plana* that might affect the diversity and functioning of shallow water ecosystems.

POLYUNSATURATED ALDEHYDES (PUAS) PRODUCTION AND TOXICITY IN A BENTHIC ENVIRONMENT: THE MICROPHYTOBENTHOS COMMUNITY OF THE CONERO RIVIERA (NORTHERN ADRIATIC SEA)

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Diatoms have been shown to produce and release a wide range of secondary metabolites that mediate interactions with organisms of different groups. Among these compounds, fatty acid derived long-chained polyunsaturated aldehydes (PUAs) have been related to multiple functions such as intra- or inter-specific signals and adverse effect on the reproduction of marine invertebrates. Several studies reported that a number of planktonic diatoms produce PUAs which affect growth, cell membrane permeability, flow cytometric properties and cell morphology in other microalgae, but little information is available on the production and effects of these compounds on benthic microalgae. Three common benthic diatoms (*Tabularia affinis*, *Proschkinia complanatoidea* and *Navicula* sp.) of the Conero Riviera (northern Adriatic Sea) were studied, providing the first evidence on the real capacity of benthic diatoms to produce PUAs in concentrations from 1.8 to 154.4 fmol cell<sup>-1</sup>, which are within the range observed for planktonic species. The production of a large family of PUAs, including some with four unsaturations, such as decatetraenal, undecatetraenal and tridecatetraenal, was observed. The intracellular values found in the present study reflect the PUA potential release of the three benthic diatoms: similar PUA concentrations and compositions could be released at a very late stage of the growth, affecting the benthic invertebrates and/or the succession of other microalgae, including toxic bloom-forming species. *Ostreopsis* cf. *ovata* is a toxic benthic dinoflagellate which causes massive blooms along the Mediterranean coasts and also in the Conero Riviera, typically during summer. The effects of some common PUAs (heptadienal, octadienal and decadienal) on the growth, cytological features and cell morphology of *O. cf. ovata* were investigated. Results showed a higher decrease of *O. cf. ovata* growth with longer-chain PUAs than with shorter-chain ones. Moreover, morphological analysis highlighted up to 79% of abnormal forms of *O. cf. ovata* cells at high concentrations of decadienal (9, 18 and 36  $\mu\text{mol L}^{-1}$ ), a gradual DNA degradation and an increase of lipids with all tested PUAs. Further studies are needed to better clarify the potential impact of PUAs in this benthic environment and the interactions between diatoms and *O. cf. ovata*, especially on bloom-forming dynamics.

## BENTHIC-PELAGIC COUPLING IN THE RECRUITMENT PROCESSES IN THE NORTHERN ADRIATIC MESOPHOTIC BIOGENIC REEFS

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The northern Adriatic mesophotic coralligenous outcrops host very rich and diverse epibenthic assemblages. Several studies quantified the low temporal variability and high spatial heterogeneity of these habitats, while processes driving structuring and differentiation are still poorly understood. To shed light on these processes, temporal and spatial patterns of colonisation were investigated for three years using travertine recruitment panels deployed at 20-25 m depth on three coralligenous outcrops, corresponding to the main typologies of benthic assemblages described in previous studies. Colonisation through planktonic propagules was particularly important in the first year. Pioneer species with high reproduction rate, long distance larval dispersal and fast growth (e.g. the serpulid polychaete *Spirobranchus triqueter* and the bivalve *Anomia ephippium*), were the most abundant in the early stages of recruitment on the two outcrops further away from the coast and with lower sedimentation. Their success may vary according to larval availability and environmental conditions (e.g., sedimentation rates). At these sites early-stage lasted 10±12 months, during which some species from surrounding natural substrates began colonising tiles by settlement of planktonic propagules (e.g., encrusting calcareous Rhodophyta) and lateral encroachment (e.g., sponges and ascidians). As time passed the pelagic larval contribution was less important in maintaining the species diversity of the epibenthic assemblages. Exploring the mechanisms that underlie the formation and maintenance of the species diversity is crucial to improve our understanding of ecological processes and to implement appropriate conservation strategies of the mesophotic biogenic reefs.

## CHAETOCEROS PERUVIANUS BRIGHTWELL, 1856: A GENERALISTIC/OPPORTUNISTIC APPROACH TO SUCCESS IN THE NORTHERN ADRIATIC PLANKTON

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The northern Adriatic is a very suitable ecosystem for observing phytoplankton under a variety of different ecological conditions. This shallow basin is characterized by steep gradients of nutrient concentrations with an expressed N/P imbalance and sustained phosphate limitations. Here we characterize the non bloom forming, omnipresent, planktonic diatom *Chaetoceros peruvianus* Brightwell, 1856 with respect to its presumed life strategy in the northern Adriatic. Long term data of phytoplankton monitoring suggests omnipresence of *C. peruvianus*. To further understand the metabolic adaptation of *C. peruvianus* we report growth rates, phosphate uptake rates, alkaline phosphatase activity, alkaline phosphatase localization and activation patterns and characteristics of alkaline phosphatase enzyme activity. We observed cell cycle durations of about 24 h and only little differences between growth rates in F/2 medium and in P-limited medium. P uptake rates around 1.13 pm/cell/day could be perceived in F/2 medium as well as in P-limit medium. However, during the adaptation phase to P-limited conditions significantly lower P-uptake rates were observed. Cellular alkaline phosphatase activity was up to 20 am/s/cell. In P-limited conditions we could measure Km values of 64 μM. Observed morphological adaptations include the transition between different forms. All results combined suggest *C. peruvianus* to be a generalistic/opportunistic phytoplankton species.

## BENTHIC-PELAGIC COUPLING AND RESURRECTION ECOLOGY FOR THE PLANKTON DYNAMICS IN THE MAR PICCOLO OF TARANTO (SOUTHERN ITALY, MEDITERRANEAN SEA)

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In confined marine areas, where variability of conditions is the rule, muddy bottoms host high densities of plankton resting stages in cyst banks which represent the basis for the community resilience. The Mar Piccolo of Taranto has been chosen to test to what extent the monitoring of marine cyst bank can explain species richness and community dynamics of the plankton. An integrated sampling approach has been proposed with multiple devices, in substitution or integration of plankton nets and long time sampling series. The whole sampling effort (249 samples), performed in 2010-2011 during two periods lasted four months each, was able to individuate the presence of more than 200 taxa/categories (97 of them were resting stages) and the benthic – pelagic exchanges of the whole system. The abundance of planktonic forms was somehow linked to that recorded in the sediment, and species can disappear completely from the water column. The cyst bank in the sediment, on the contrary, appeared as interested by replenishment-subtractions only for the 20% of its whole composition. More than the general phenomenon, however, it appeared useful and educative the exploration of benthic-pelagic coupling for single species. It emerged that different species showed different behaviours and/or strategies so impeding the proposal of a unique model to explain their co-existence and the unpredictability of plankton dynamics. It was noteworthy, however, that an integrated sampling effort is more useful and informative to perceive, in short times, the complexity of a planktonic community in a confined marine area.

## MARINE FOOD-WEB STRUCTURE INDICATES FUNCTIONAL DIFFERENCES BETWEEN TEMPERATE AND SUB-ARCTIC SHELF ECOSYSTEMS

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Stable isotope ratios of carbon and nitrogen are widely used to study individual trophic positions and trophic pathways. We used a stable isotope approach to study the food-web structure of selected locations on the northern European continental shelf, which were chosen to represent contrasting habitats in the temperate North Sea (German Bight vs. northern North Sea) and in the sub-Arctic Lofoten-Vesterålen region (fjord vs. open shelf). Phytoplankton represented the dominant primary producer throughout this study, while organic carbon originating from macroalgae was of minor importance, even in the fjord. The reliance on benthic affinity prey was higher in the North Sea than in the Lofoten-Vesterålen region. In the North Sea, *Gadus morhua* (Atlantic cod) was identified as the sole top-predator, utilizing prey from both, benthic and pelagic trophic pathways. The pelagic and benthic trophic pathways were more separated in the Lofoten-Vesterålen region where no species occupied the position as top-predator exclusively. Cod was part of the pelagic trophic pathway in the sub-Arctic. Furthermore, our data shows that the recent outburst of small mesopredatory fish in the southern North Sea might have been favored by reduced predation pressure due to a collapse of the local cod stocks. We conclude that top-down control has a strong role in structuring the North Sea ecosystem, while bottom-up processes play an important role in the Lofoten-Vesterålen region.

## EFFECTS OF MULTIPLE NUTRIENT SOURCES ON BENTHIC PRIMARY PRODUCERS AND GRAZERS: A MESOCOSM STUDY

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Presentation type: ORAL

The expansion of marine aquaculture is one main strategy in several countries to cover the nutritional requirements of a growing world population. However, this can only be sustainable if farms are managed according to the resilience of communities and carrying capacity of their respective environments. Until now, many fish farms are operated as open-systems, releasing uneaten food pellets, fish faeces as well as dissolved nutrients into surrounding waters. Increasing nutrient levels around fish farms were shown to cause increased macroalgal growth in the direct vicinity. However, additional or synergistic effects of nutrients from several farms in close vicinity or the additional impact of agricultural run-off from land is still unknown. In this study, we assessed ecosystem effects from multiple nutrient sources in two mesocosm experiments. We measured the effects of two different nutrient sources (aquaculture and agriculture) on perennial (*Fucus vesiculosus* and *Zostera marina*) and annual primary producers (*Ulva spec.*) as well as their cascading effects on grazing invertebrates. Our hypotheses were: (I) Nutrient enrichment positively affects the growth rate of coastal primary producers. (II) Nutrients from different sources have a synergistic effect on the growth of coastal primary producers. (III) Grazers modulate the response of primary producers and strongly affect the growth of opportunistic algae. Two mesocosm experiments were performed over a course of 6 weeks each. First, we tested the effect of different nutrient sources (aquaculture, agriculture and a combination of both) on the growth of *F. vesiculosus* and *Z. marina*. In the second experiment, we tested how grazers modulate the effect of the different nutrient sources on primary producers. Nutrient effects on primary producers were determined by measuring growth rates and comparing nutrient- and pigment-composition before the experiment, after 3, and 6 weeks. Additionally, effects on grazer biomass were included in the second experiment. The preliminary results indicate varying responses to the different single and multiple source nutrient treatments for *Z. marina* and *F. vesiculosus*, but their growth was in general suppressed during the second phase of the experiment probably due to overgrowing filamentous algae. Our preliminary results highlight the importance of interactive effects of nutrient pollution on ecosystem properties.

## FERTILIZER-DERIVED NITROGEN FEEDS ALGAE BLOOM AFTER FLOODING OF FARMLAND BY MANAGED REALIGNMENT

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Presentation type: POSTER

Climate change and associated rising sea level threaten many low-lying terrestrial areas. Managed realignment by deliberate flooding of coastal areas can mitigate negative effects of rising sea level. Our knowledge is limited about the consequences of flooding agricultural land with seawater. One such area, Gyldensteen Strand, Denmark, was reclaimed for agriculture around 1870, and reflooded to a shallow coastal lagoon about 140 years later (29 March 2014). Flora succession was followed intensively in the new lagoon, and this study reports on macroalgal development. Our hypotheses were that 1) opportunistic macroalgae bloom initially due to nutrient release from the now flooded agricultural soils, and 2) algal blooms are driven by nutrients remaining from the agricultural past. Algal coverage was monitored using a semi-quantitative approach (5 levels). Samples of the dominating macroalgae were collected for stable isotope ( $\delta^{15}\text{N}$ ) analyses. As expected, massive green algal blooms (100% coverage) occurred during the first summer (2014). No blooms were detected the following year (2015) where coverage never exceeded 25 %. The origin of N supporting algal growth in 2014 can be deduced from low  $\delta^{15}\text{N}$  in harvested algae (2.1 – 6.1 ‰) compared to algae sampled outside the lagoon (4.8 - 9.2 ‰).  $\delta^{15}\text{N}$  of algae from inside was in 2015 (4.9 – 9.7 ‰), similar to those outside the lagoon. This indicates that fertilizer remaining in the soil had disappeared within the first year. A laboratory experiment tested the  $\delta^{15}\text{N}$  response of green algae (*Ulva* sp.) exposed to inorganic (IF,  $\delta^{15}\text{N}_{\text{IF}} = 1.7 \pm 0.06$  ‰) and organic fertilizer (OF,  $\delta^{15}\text{N}_{\text{OF}} = 12.6 \pm 0.09$  ‰). And yes, algae growing on IF had lower  $\delta^{15}\text{N}$  ( $2.7 \pm 0.2$  ‰), than those growing on OF ( $11.1 \pm 0.08$  ‰) confirming that  $\delta^{15}\text{N}$  in algae tissue reflects the N sources. Accordingly, the algal bloom in 2014 was fed largely by inorganic fertilizers that were released from the soil after flooding. This nitrogen source was apparently rapidly depleted, and no blooms were observed in 2015 where algal  $\delta^{15}\text{N}$  was similar inside and outside. Thus, frequent water exchange and no N input from land are advisable when agricultural land is realigned.



## TRAIT-BASED PREDATION SELECTIVITY OFFERS INSIGHT INTO EFFECTS OF CHANGING PREY COMMUNITIES

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Presentation type: ORAL

Morphological and behavioural characteristics contain key ecological information on why prey species appear attractive to predators. Ever increasing environmental pressures are reshaping community structures and species interactions throughout all trophic levels. Expanding our knowledge on how changing prey communities alter food quality for predators is vital for understanding predator-prey dynamics in changing ecosystems. We propose a novel concept to describe predatory diet-selectivity based on predation-relevant traits of prey. Linking trait-based predation profiles to the community weighted means of prey traits (CWM) provides a resource quality-measure that can be applied to all predator-prey systems and over broad spatiotemporal scales. We demonstrate our approach on a coastal system in the Baltic Sea, linking multi-decadal changes of zoobenthic prey communities to the benthic-feeding fish community. First, we assess if structural changes of prey communities impact the food-resource quality of predator communities over time and space. Using generalized linear mixed-effect models, we expose the direction of change in resource quality from the perspective of the fish community. We then evaluate predator-specific responses to answer, which fish species are likely to profit or be disadvantaged by changes in their pool of benthic prey. Furthermore, we test the relationship between functional diversity of prey communities and food quality for predators, and whether predation linkage-structures are affected through prey community-changes. Our results show that structural changes in zoobenthic communities had an effect on the food quality for benthos feeding fish. We observed species-specific responses to changing food resources suggesting a varying plasticity of predators to cope with prey assemblages of different quality. Furthermore, our study highlights a positive functional diversity–food quality relationship of prey communities. Lastly, we demonstrate how a changing functional composition of prey can alter the predator-prey linkage-structure by modifying the predator specialisation toward the available food resource. This novel framework for evaluating food resource quality on community levels is independent of taxonomic identities and enables cross-system comparisons. It allows long-term evaluation of predator-prey dynamics in changing systems without the need of stomach content data and can deal with undescribed feeding links if traits match the consumer predation profile.

## MARINE METAGENOMICS

## Keynote lecture

### GENOMICS OF BIVALVE IMMUNITY, THE HOST AND THE METAGENOMICS STUDY OF MUSSEL MICROBIAL COMMUNITY

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Mussels belong to the phylum Mollusca, one of the largest and most diverse taxa in the animal kingdom, only second to Insecta. Marine mussels have also a significant commercial value. Their production corresponds to 50% of global EU aquaculture in weight and about 30% in value. Despite the commercial and scientific interest in mussels in marine biology and aquaculture, the number of genomic resources available in public databases for these organisms is quite limited. We start working on mussel genomics late in the '90s applying genomics methodologies until that time reserved to human genomics and related model organisms. We are now close to the release of the genome sequence of this important marine model organism. In almost 20 years we have learned a lot about the biology of this mollusc, in particular we have focused our study on the genes that modulate its incredible immune response conferring to *M. galloprovincialis* the ability to survive in the most extreme conditions. We have for the very first time proved the existence of immune genes believed to be not encoded by the genome of Lophocotrozoa. At the same time, we have described new genes coding proteins that are involved in the innate immunity of *M. galloprovincialis* and shifted some attention to other tissues other than emolymphs. But other bivalve molluscs do not shown this level of resilience and suffer of massive outbreaks that often plague their aquaculture. In this contest, we are actively working on the definition of the beneficial and pathogenics mussel microbial communities.

## MALTA'S SEAWEED BIODIVERSITY ASSESSED WITH GERMLING EMERGENCE AND DNA BARCODING

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Presentation type: POSTER

This study, starting in 2017, aims to determine the marine macroalgal diversity of Malta, situated in the centre of the Mediterranean Sea, by combining germling emergence (GE) with DNA barcoding of individual isolates. GE includes the incubation of the substratum in a herbivore-free and nutrient-rich environment, with subsequent isolation into unialgal culture of germlings developing from microscopic stages. It takes advantage of the fact that marine macroalgae are cultivable except for parasitic species. For comprehensive sampling, substratum was collected from representative spots around the Maltese Islands (Malta, Gozo and Comino), from the surface down to 40m depth. The sites included different habitats such as ports, desalination outfall sites, urban wastewater treatment outfall sites, aquaculture facilities and NATURA 2000 sites. Isolates from substratum were supplemented with classical macroalgal field samples. Unialgal isolates were obtained at the Station Biologique de Roscoff thanks to a MARS (The European Network of Marine Research Institutes and Stations) Travel Award. Barcoding will use markers employed widely in the study of seaweed diversity and phylogeny, such as *rbcLS*, *COI-5P*, *tufA*. GE has been shown to reveal the cryptic macroalgal diversity in marine bioregions around the globe and is particularly suitable for habitats where access is limited, such as deep diving sites. Our study will likely increase the knowledge of macroalgae of Malta since GE has the potential to identify new records, which would have been missed out during previous studies restricted to macroscopic field samples. We expect to assess the flora as comprehensively as possible (approaching the “entire” diversity), which will make Malta the first country to achieve an inventory of its marine macrophyte flora underpinned by sequence data. The study will also allow identification of the proportion of Mediterranean, Atlantic and Red Sea origin in the flora.

## SEASONAL PATTERNS OF FISH COMMUNITY COMPOSITION IN THE WESTERN WADDEN SEA BASED ON ENVIRONMENTAL DNA ANALYSES OF SEA WATER

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Presentation type: ORAL

The Wadden Sea is an important nursing area for juvenile fish and the Marsdiep tidal inlet between the western Wadden Sea and North Sea is a gateway for adult fish migration. NIOZ holds records of over 60 years of fish monitoring in this area based on daily fyke catches. In 2015 a start was made with additional sampling and analyses of environmental DNA of the seawater in the Marsdiep. The aims of this project were to determine seasonal patterns in fish community composition, and (2) investigate effects of sampling time (in relation to tide). Samples were taken weekly both at high tide and at low tide and fish DNA was amplified with primers selective for bony as well as cartilaginous fish. Community composition was inferred from sequence analyses of the amplicons. We will present the results for the period of April through September 2015 and compare the DNA work with the fyke catches.

## IDENTIFYING BIODIVERSITY PATTERNS IN AQUACULTURE INFLUENCED MARINE SEDIMENTS THROUGH DNA METABARCODING

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Presentation type: ORAL

Fish farming is a globally expanding industry that can lead to extensive eutrophication of the water column, and degradation of benthic communities in the vicinity of farms. Many Norwegian fjords are sites of intensive fish farming activities, with between 3000 and 5000 tons fish produced in each fish farm mainly situated in sheltered coastal waters. Therefore, the sustainable development of aquaculture requires accurate monitoring and surveillance of the ecosystem impacts. Biodiversity measures have most commonly been used to assess the impact of disturbances on the marine environment, which is time and resource demanding. Species identification using DNA is a rapidly developing approach, which is currently supported by a global initiative to generate so-called DNA barcodes. We can potentially determine the species composition of complex communities, such as that of small, bottom-dwelling marine organisms, from reading the barcodes of the total DNA content of a sediment sample. Species identification using DNA is an attractive alternative to traditional morphological techniques with rapid high throughput at an affordable cost. It has been shown in multiple studies that DNA metabarcoding techniques can perform as well as morphological techniques for benthic monitoring of marine ecosystems, and potentially discriminates between drivers more comprehensively. However, most of these studies have focused on one size class or faunal group only, but this technique enables analysis of the whole benthic community simultaneously. By applying DNA metabarcoding analysis to bulk DNA extracts from marine sediments at aquaculture sites in Hardangerfjord Norway, we were able to quantify variation in biodiversity of whole communities from impacted and control sites, to a low taxonomic level. The depth of data gained from metabarcoding methods will foster our understanding of biodiversity patterns in marine systems and the underlying natural and anthropogenic drivers.

## NEXT GENERATION SEQUENCING AS AN ASSESSMENT TOOL OF ECOSYSTEM'S HEALTH IN THE BALTIC SEA

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Presentation type: POSTER

Marine coastal ecosystems are vulnerable to human activities. Lack of effective assessment of the coastal ecosystem's status and inadequate implementation of protective measures, may result in their fast deterioration. The Baltic Sea has a long history of environmental monitoring, following traditional assessment methods such as the use of Benthic Quality Index (BQI) and the Brackish water Benthic Index (BBI). These indices are based on assessment of benthic macrofaunal assemblages and indicator species but they often fail to reveal sources of variation and to identify environmental change. Moreover, their application is time consuming and requires highly skilled taxonomical expertise, while neglecting smaller parts of the community, such as prokaryotes and small eukaryotes. The use of NGS technology offers a rapid way of in-depth targeting the biodiversity in the whole sediment community from small sample sizes, and can be used to identify new pollution indicator species. In this study benthic sediment samples were collected, using intact sediment cores, from the vicinity of a steel factory (non-functional since 2012), across a six-station transect of declining heavy metal pollution gradient. Sediment DNA was extracted and amplified using general 16S and 18S rRNA primers to target the prokaryotic and eukaryotic sediment community, respectively. Amplicons were sequenced with the Illumina MiSeq NGS platform. In addition, a suite of biogeochemical parameters (e.g. total organic carbon and nitrogen, oxygen, pore water nutrients, hydrogen sulphide) was measured. Sediment community diversity and changes will be examined in conjunction to the pollution levels and to the measured biogeochemical parameters, allowing for the determination of key drivers of the observed community variations. Finally, macrofaunal samples were collected with a view to calculating the BQI and BBI indices and comparing them with the NGS diversity data, which will allow for assessment of the performance of the NGS tool.

## DIPLOMEMIDS - EXTREMELY DIVERSE MARINE PROTISTS WITH UNKNOWN FUNCTION

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Presentation type: ORAL

Diplonemids are heterotrophic protists recently identified as one of the major eukaryotic groups populating the ocean. They represent the most diverse marine eukaryotes and rank as the 6<sup>th</sup> most abundant group among eukaryotic taxa. However, only a few species have been described so far and we know nothing about the life style of diplonemids. To fill the large gap in our knowledge, we are studying their diversity and distribution, morphology and life cycle. We are assembling and annotating two transcriptomes and genomes that share some features with related kinetoplastid flagellate, but differ from them f.e. by the abundant presence of introns. We are also trying to get representative species into culture. Moreover, we were recently able to transform *Diplonema papillatum* and hope to turn it into a tractable organism suitable for functional analyses.



PHYLOGENETIC POSITION OF THE ELUSIVE THALIACEAN *DOLIOPSIS RUBESCENS*

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Presentation type: POSTER

*Doliopsis rubescens* was a very common species in the Mediterranean in 19<sup>th</sup> and in the beginning of the 20<sup>th</sup> century. In the past it was a very abundant species, so much that it formed large blooms at the coast of France. Afterwards it has become extremely rare with sporadic records in the Atlantic. *D. rubescens* was found in the Adriatic for the first time in 2016 and 2017, in the depth layer from 50 to 200 m. Two individuals preserved in ethanol were sequenced and the phylogenetic tree was constructed based on 18S rRNA gene sequence. The phylogenetic position of *D. rubescens* is discussed in relation to other Thaliacea and its morphological peculiarities.

## DIVERSITY AND DYNAMICS OF MEDIOPHYCEAE DIATOMS IN THE BILBAO ESTUARY (SPAIN) REVEALED BY METABARCODING

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Presentation type: POSTER

Blooms of diatoms in the class Mediophyceae have been recorded in the Bilbao Estuary by light microscopy and the Utermöhl method over the past 15 years. They have been identified to species or genus level or classified into categories according to their morphology and size. The aim of this study was to gain further insight into the species composition of members of Mediophyceae in this area, as well as to confirm the dominance of this group in the estuary. The assessment was made using Illumina Hi-seq metabarcoding, based on the hypervariable V4 region of the nuclear 18S rRNA gene. It was performed on 18 field samples collected during one year (6 samplings) in three areas (inner, middle and outer) of the estuary. The study confirmed that the class Mediophyceae was the most diverse and abundant taxon, formed by at least 20 genera of which *Cyclotella*, *Skeletonema*, *Chaetoceros*, *Conticribra*, *Thalassiosira*, *Stephanodiscus*, *Cerataulina*, *Minutocellus* and *Minidiscus* were, in this order, the most abundant. These genera were present in almost all the samples and their relative abundance and distribution showed temporal and spatial variation.

## THE INFLUENCE OF HYDROTHERMAL VENT PLUMES ON SURROUNDING BENTHIC BIODIVERSITY: METABARCODING VERSUS CLASSICAL TAXONOMY

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Seafloor Massive Sulfide (SMS) deposits, containing valuable metals, are commonly found at hydrothermal vent sites through precipitation of metal sulphides as acidic hydrothermal fluids exit the seafloor in volcanic active regions. Because of worldwide shortages of these valuable metals, these areas have recently gained the special interest of deep sea mining (DSM) industries. Suspended sediment plumes created during DSM activities are highlighted as one of the major threats to deep-sea benthic fauna. Whereas deep-sea mining itself is potentially harmful for the vent-communities, these artificial plumes possibly affect the background fauna. These surrounding communities are poorly known and would benefit from studying a model area, containing a natural vent plume, yet untouched by mining activities. The Rainbow hydrothermal vent site at the Mid-Atlantic Ridge was chosen as study, a site at which one of the largest continuous plumes emits, covering an extensive area. Video-surveys have shown a lower macrofauna diversity at downstream sites with a significant loss of filter feeders. Acquisition of further data on the biodiversity of deep sea benthic systems in the traditional way by looking at morphological differences is a time-consuming, labour-intensive and costly process as it requires taxonomic expertise which is scarce. The identification of species based on morphological characteristics is often restricted to large and distinguishable metazoan, thereby neglecting meiofauna although these smaller species are often referred to as sensitive indicators for changing habitats. By now, multiple studies have successfully implemented metabarcoding approaches to explore deep sea benthic communities. However, the reliability of these metabarcoding approaches for real and complex environmental samples are still underexplored. During this study, benthic samples were taken both upstream and downstream of the Rainbow hydrothermal vent site. Metabarcoding methods were used to determine the effects of hydrothermal vent plumes, and thereby predict the effects of DSM plumes, on the understudied vent background fauna. Finally, these methods were compared to traditional, morphological methods and are shown to be a suitable tool for assessing anthropogenic and/or natural effects on benthic communities.

## EVOLUTION OF CUTTLEFISHES, FAMILY SEPIIDAE, AND THEIR RADIATION THROUGH THE INDO-WEST PACIFIC

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Presentation type: POSTER

Reconstructing the sequence of events that have led to extensive speciation in many regions of the world remains one of the biggest frontiers for exploration in marine evolutionary science. To tackle these key questions, we have examined the evolutionary history of a well known group of molluscs: the cuttlefishes, family Sepiidae. Evolution among these charismatic cephalopods is thought to be mainly influenced by historical geological changes that have affected the distribution of shallow water shelf seas and intervening bodies of deep water that impose physical and physiological constraints to dispersal and has led to allopatric speciation by introducing barriers to gene exchange. Through DNA extraction and polymerase chain reaction (PCR), we amplified a selection of nuclear and mitochondrial genes and constructed a comprehensive multi-gene molecular phylogeny of the group that explains their radiation. We then mapped morphological characters onto this phylogeny to further understand development and evolution within the group and examine the utility of characters used for identification with respect to their usefulness in reflecting their evolutionary relationships. These results provide significant insights into cuttlefish evolution and provide the framework for a long overdue revised classification of this diverse group.

## NON-EQUILIBRIUM GENETIC CONNECTIVITY AND THE CASE OF ARTIFICIAL HARD SUBSTRATES IN THE NORTH SEA AS STEPPING STONES

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Increasingly many artificial hard substrates such as oil platforms and wind turbines are constructed in marine habitats. In particular in soft sediment habitats these structures form a novel type of substrate and facilitate colonization by sessile taxa that are new to the area. As a result these structures may serve as stepping stones, connecting populations of hard substrate species that were not connected before. In the North Sea numerous man-made structures exist that are inhabited by communities of hard substrate sessile taxa. We examined the case of the mussel *Mytilus edulis*, which has pelagic larvae, and assess the level of genetic connectivity among the structures using multilocus microsatellite DNA data. Simulations from a particle tracking model for the North Sea are used to predict connectivity based on physical conditions. Because the objects have only existed for up to a century, equilibrium between genetic drift and migration cannot yet have been reached. We therefore use a coalescent simulation approach that takes this into account. We address the question whether the artificial hard substrates in the North Sea act as stepping stones for *Mytilus edulis* between the coastlines of the North Sea, and we compare traditional methods of estimating genetic connectivity with our coalescent modelling approach and the particle tracking model.

## ASSESSING THE FUNCTIONAL DIVERSITY OF BENTHIC COMMUNITIES USING METATRANSCRIPTOMICS

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Presentation Type: POSTER

Marine benthic communities constitute an important part of the marine seafloor environment, as they are involved in a multitude of important ecological processes such as geochemical cycling and the distribution of pollutants. Studying these communities *in situ* and exploring their activity down to the gene level can reveal insights into their functional role within the benthic ecosystems. Our aim is to investigate the molecular profile of benthic communities exposed to organic effluents from aquaculture farms by comparing the gene expression levels of targeted sequences of benthic communities found at impacted and non-impacted sites. We use a metatranscriptomic approach, i.e. the analysis of the complete RNA contents of benthic organisms contained within environmental samples. We hypothesize that the effect of organic effluents will be reflected in the metatranscriptome of the benthic community; indicators such as stress signals and metabolic pathways will vary between affected and controlled sites as a response to environmental stress. While bacterial communities of environmental samples have previously been studied by similar approaches, our study includes both the prokaryotic and eukaryotic constituents of the benthos. We collected sediment samples from two locations that are affected by salmon farm effluents in a Norwegian fjord. We extracted the total RNAs from sediment samples and obtained adequate amounts of the prokaryote and eukaryote communities for functional analyses. The sequencing and bioinformatics part of the study is currently underway and preliminary results show that there are sufficient eukaryotic mRNA sequences for the subsequent functional diversity analysis. A successful workflow established by this project could greatly facilitate future studies of ecosystem functioning as it can provide an accurate, detailed and fast look at the status of benthic communities of interest at the time of sampling.

## PHYLOGENETIC DIVERGENCE WITHIN PELAGIIDAE

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Presentation type: ORAL

Scyphozoan taxa are particular due to complex life cycle, ecological plasticity, unpredictable appearances and thus taxa rearrangements are common. A cladistics analysis revealed re-description of many taxa within Pelagiidae family and recently, a new genus *Mawia benovici* was included into family Pelagiidae. Moreover, phylogeographic inference used for substantial rearrangements of the genera within this scyphozoan family leading towards more consistent evolutionary relationships. Even though, many of phylogeographic studies on scyphozoan jellyfish do not estimate dates of evolutionary events, because the time of origin is still elusive, due to a lack of calibrated substitution rates. In this study, we calculated molecular clock and estimated the time of origin of *Mawia benovici*. Phylogenetic tree for COI, 12S, 16S, 28S, ITS1 and ITS 2 was reconstructed using Maximum Likelihood with RaxML v. 8.2.8, while molecular clock analysis was done using Bayesian inference (BI) with BEAST v. 1.8.3. Both ML and BI approach were conducted on partitioned dataset using *Cyanea capillata* as an outgroup. Finally, we used TreeAnnotator to calculate a maximum clade credibility tree, median values of divergence times, posterior probabilities, and bounds for the 95% highest posterior density (HPD) interval.

## INSIDE OUT – SHEDDING LIGHT ON THE ENDOBIONT BACTERIAL COMMUNITY OF FORAMINIFERA

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Foraminifera, single-celled eukaryotes, are widespread in the marine benthic ecosystem. They play a vital role in the benthic carbon cycle via uptake of bicarbonate for shell formation and detritus feeding. They also have the ability to survive for long time periods in anoxic sediments, which has been linked to their ability to switch from aerobic respiration to denitrification, linking foraminifera to the benthic nitrogen cycle. Despite their importance in benthic nutrient cycles, many aspects of foraminiferal ecology, such as the role of endobionts or their feeding preferences, remain unresolved. In this study, we aim to investigate interactions between foraminifera and associated sediment bacterial community. In more detail, the microbiome inside benthic foraminifera is targeted as it might provide a key to understanding the organism's biology, trophic interactions and survival strategies in harsh, dynamic environments such as intertidal areas. Living foraminifera (*Ammonia tepida*, *Elphidium excavatum* and *Haynesina germanica*) were isolated from sediment cores retrieved from intertidal mudflats in the Dutch Wadden Sea. Foraminifera were picked from the top 10 cm of sediment (at one cm intervals), and DNA was extracted from within individual cells. In addition, DNA was extracted from the ambient sediment samples. The intracellular DNA from foraminifera and DNA from sediment samples was amplified with bacterial 16S rRNA primers and sequenced with the Illumina MiSeq NGS method. The bacterial community from individual foraminifera was analyzed and compared with the ambient sediment bacterial community and linked to pore water chemistry. The results show that the relative abundance of different sediment bacteria taxa changes within sediment depth, depicting changes in the pore water chemistry. The bacterial community within individual foraminifera is similar to that of the sediments but displays contrasting relative abundances, thus suggesting a preference of certain taxa. Furthermore, the composition of these bacterial communities appears to differ from one species to another, implying species-specific bacterial interactions.



## THE CROATIAN SEA CUCUMBER FISHERY: COLLECTING ONLY *HOLOTHURIA TUBULOSA*?

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Having overexploited the western Pacific Ocean, the sea cucumber fishery has expanded to new regions of the world to supply the Asian market with this traditional delicacy. Sea cucumbers were removed from the Croatian marine protected species list in 2013, and 2017 marked the beginning of a commercial sea cucumber fishery in the Eastern Adriatic Sea. However, holothuroid species are difficult to distinguish, and the status of several taxa in the Mediterranean Sea has been a source of dispute for over a century. This is the first study to genetically analyze sea cucumbers in the Adriatic Sea. We used genetic barcoding of the mitochondrial gene cytochrome *c* oxidase subunit 1 (COI) to verify the existence and estimate the relative abundance of *Holothuria mammata* Grube, 1840 in the eastern Adriatic Sea. *Holothuria mammata* is a species that has rarely been reported in this region and strongly resembles the common species *Holothuria tubulosa* Gmelin, 1791. In addition to specimens collected from the northern and central Adriatic, we barcoded a specimen previously identified as *H. sp. cf. mammata* based on its morphological characteristics (Zavodnik, 2003). While genetic analyses showed that Zavodnik's specimen is actually *H. tubulosa*, 30% of the collected specimens were genetically identified as *H. mammata*. These results call into question the historically accepted sea cucumber assemblage in the Adriatic Sea, which regarded *H. mammata* as a rare species and generally disregarded its presence in large census studies. Such species distribution data are extremely important in developing and monitoring a sustainable fishery.

EFFECT OF INTROGRESSIVE HYBRIDIZATION ON SEGREGATION OF MALE AND FEMALE MITOCHONDRIA IN *MYTILUS EDULIS* SPECIES COMPLEX

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In animal kingdom strict maternal inheritance of mitochondrial DNA (mtDNA) had been concerned as a rule, until doubly uniparental inheritance (DUI) was discovered in blue mussels *Mytilus* and some other bivalve species. Species possess DUI have distinct gender-associated mitochondrial genomes – female (F-) and male (M-mtDNA). Typically, adult female mussels have only F-mtDNA inherited maternally, while adult males have F- and M-mtDNA received from both parents. F- and M-genomes are divergent enough (~30%) and have species specific features in *Mytilus*. Thus, they could be used as precise mtDNA markers for sex and species identification of individual. However, disruption of DUI and introgression of mitochondrial genomes was recorded in hybrid zones between *Mytilus* species. Our goal was to find out the rate of mtDNA introgression and DUI breakdown in hybrid zone between *M. edulis* (ME) and *M. trossulus* (MT) in Northern Europe. Samples from hybrid zones located in Scotland, Norway and the White Sea (Russia) together with control pure *M. edulis* sample from Lake Mogilnoe (the Barents Sea) were studied. Sex of individuals was determined by microscopic examination of gonad tissue. Mussels were genotyped by 4-8 taxonomic nuclear markers and classified into putative ME and MT purebreds and hybrids. Species and gender specific fragments of 16S RNA mitochondrial gene (Rawson et al, 1996) were studied by RFLP and sequencing. Minor mtDNA introgression was recorded in Scotland and Russia. Few females possessed M-mtDNA, while as much as 18% of males had no M-genome. Anomalous mtDNA genotypes were distributed randomly among purebreds and hybrids. Segregation of F-mtDNA of two species, and M-mtDNA of ME in Norway was similar to the other samples from this study. At the same time no M-mtDNA of MT was found at all. Possible explanation could be “masculinization” of F-mtDNA which replaces “standard” M genome. Good correspondence between physiological and mitochondrial sex was observed in the Lake Mogilnoe sample. Surprisingly, 75% of mussels here were males. No extraordinary sex ratios were observed in any other populations studied. This work was financially supported by RFBR grant 16-04-00723 A.

## SHIFTS IN MICROBIOME DIVERSITY ASSOCIATED WITH MORTALITY OUTBREAKS IN ITALY

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The complex interactions occurring between farmed bivalves and their potential pathogens in the circumstances of global climate changes are a matter of a common interest in Europe, owing to the reports of recurrent production breakdowns. The European project VIVALDI (H2020, Preventing and mitigating farmed bivalve diseases) is aiming to increase the sustainability and competitiveness of the European shellfish industry by studying, preventing, controlling and mitigating bivalve diseases affecting the main farmed species. Within the framework of this project we are using a metabarcoding approach to investigate shifts in microbiome diversity associated with mortality outbreaks in Italian seas. So far we have analyzed shifts in microbiome associated with six mortality outbreaks identified and sampled by the Italian NRL for Fish, Mollusc and Crustacean diseases in 2015 and 2016. Microbiome identification of all the affected bivalve samples and accompanying control bivalve samples collected nearby was done using amplicon sequencing of the 16S gene V4 region with Ion Torrent PGM platform (amplified with 515F, 802R and 806R primers). Intermediate to very strong shifts in alpha and beta diversity were detected in all the examined cases. Here, we present an overview of the microbiome diversity associated with bivalve mortality outbreaks and discuss the suitability and robustness of our approach, especially focusing on the selection of molecular markers and extraction protocol. We also discuss our progress on identifying the core pathobiome associated with mortality outbreaks in bivalve spp. farmed in Italy and the feasibility of routine microbiome analysis during mortality alerts in the light of the sampling-related problems identified in this work experience.

## LARGE SCALE METABARCODE ANALYSIS OF ZOOPLANKTON IN THE WESTERN MEDITERRANEAN SEA

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Presentation type: ORAL

Zooplankton play a key role in regulating the climate related CO<sub>2</sub> cycle and seafood production and are highly sensitive to climate change and other stressors. The EU project OCEAN-CERTAIN is investigating the impact of climatic and non-climatic stressors on the whole planktonic food web, the associated biological pump and the important natural and socio-economic feedback mechanisms. Within the framework of this project, CNR-ISMAR carried out a large scale oceanographic cruise in summer 2015 in the Western Mediterranean Sea. Here we discuss the biodiversity emerged from 30 selected sampling stations distributed along transects crossing all the major regional sub basins representative of different oceanographic conditions, from coastal eutrophic boundary currents to the open, oligotrophic ocean. Samples were collected by vertical net hauls, from 0 to 500 m depth, using an Indian Ocean Standard Net (200 µm mesh). We applied metabarcoding analysis (targeting highly variable fragments of the mtDNA cytochrome oxidase subunit I gene) using the PGM Ion Torrent technology along with a morphological screening under the microscope. Potential applicative implementation of this large dataset was investigated through a multidisciplinary approach, integrating zooplankton distribution (in terms of genetics and morphology) and oceanographic conditions and processes, is investigated along with the potential applicative implementation of this large dataset.

## INSIGHTS INTO THE HIGH POPULATION GROWTH RATES ON THE NEW CALEDONIAN HUMPBACK WHALE BREEDING GROUNDS USING PATERNITY ANALYSIS

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The New Caledonian (NC) humpback whale breeding grounds are an important migratory destination for whales that constitute the Oceania population. This population has not experienced substantial increases following the cessation of whaling in the 20th century. In recent years, there is indication that the low abundance NC congregation has been experiencing growth of unprecedented levels, possibly driven by immigration from other breeding grounds in Oceania. To investigate this hypothesis, we employ paternity analysis on a dataset of 115 mothers and calves sampled in NC waters between 1996 and 2012. The paternal dataset constituted of 584 males sampled in NC, and 334 males from Tonga, the nearest breeding ground and a hypothesized source of migrants. Paternity analysis was based on genotyping at 14 microsatellite loci and using programs that employ different methods: CERVUS, a maximum-likelihood method; COLONY, a full-likelihood method that also constructs a pedigree; and SOLOMON, a Bayesian method. We constructed eight 3-year time windows covering the entire sampling period with a one-year overlap, and searched for fathers of calves born in each respective window. In addition, genetic diversity of calves born in different periods was inspected. If immigration has taken place, we would expect to: (1) detect a decreasing or stable assignment rate (AR) to NC males with time; (2) observe an increase in the AR to Tongan males or non-resident individuals (transients); (3) see an increase in the genetic diversity with time. Our results show that (1) the AR of residents is stable with CERVUS, but with COLONY and SOLOMON, a decreasing trend is observed (2) The AR to non-resident males was generally decreasing with time and (3) the genetic diversity of calves from the later periods increased compared to the earlier periods ( $t=-2.25$ ,  $p=0.014$ ). Overall (1) and (3) are consistent with the hypothesis that immigration is taking place in NC. A more dedicated statistical analysis of the trends is also needed. This study demonstrates the utility of paternity analysis in questions of migratory behavior and gene-flow on a generational and ecologically meaningful time scale.

## GENERAL SESSION

## Special lecture

### JELLYFISH IN CHANGING WORLD: PORTRAYAL, RESEARCH AND PERCEPTION IN THE NORTHERN ADRIATIC

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People have been fascinated with jellyfish, admiring their fragile beauty and fearing sometimes fatal stings since ancient times. The study of jellyfish, here defined as pelagic cnidarians and ctenophores, has a long tradition in the Adriatic. The turn of the 20<sup>th</sup> century saw the 'first golden age of gelata research' (Haddock 2004) in the Adriatic, although earlier reports of large jellyfish exist. C. Claus, D.J. Cori, A. Steuer, E. Graeffe, G. Stiasny R. Issel, V. Neppi, K. Babić, T. Krumbach, J. Hadži described morphology, development, ecology and evolution of jellyfish from the northern Adriatic. Unlike the 'internet age' when interested individuals may access information easily, the public at that time did not have similar possibilities. Nevertheless, the public could enjoy jellyfish depicted in art, for example, in the glass sculptures created by the Blaschkas who received specimens from the northern Adriatic. The following decades saw a stagnation of jellyfish research in the northern Adriatic, partly due to turbulent times and partly because marine biologists focused research on fish, crustacean plankton and benthic organisms. The final two decades of the 20<sup>th</sup> century saw a resurgence in interest towards jellyfish stimulated by blooms of scyphomedusae, in particular painfully stinging *Pelagia noctiluca* during the 1980s. The main focus of research was ecology, behaviour and physiology of bloom-forming jellyfish and their trophic role in the 'classical' food web. With few exceptions, jellyfish were considered as a trophic dead end and a nuisance for humans. On the other hand, public health issues due to jellyfish envenomations stimulated research on nematocysts, stings and venoms. In the last two decades realization of the potential repercussions of jellyfish for public health, tourism, fisheries, aquaculture, and marine ecosystem health brought the focus of research on long-term fluctuations, causes/drivers of jellyfish blooms and socio-economic impacts. Advances in field techniques, in particular diving and underwater photography, greatly improved life history research while molecular tools and modelling increased our ability to assess population connectivity. And finally, recent research and field observations have changed the view about jellyfish as trophic dead end. Moreover, the complementary notion that jellyfish provide beneficial services to humans and the ecosystem, in addition to their predominant perception as pest, has begun to emerge.

## DESCRIPTOR FIVE (EUTROPHICATION) WITHIN THE MARINE STRATEGY FRAMEWORK DIRECTIVE IN THE GULF OF TRIESTE: A PRELIMINARY ASSESSMENT

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Presentation type: POSTER

Eutrophication is a process driven by enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, leading to a general water quality degradation. The Gulf of Trieste (northern Adriatic sea) is a semi-enclosed basin characterized by variable oceanographic properties and production processes, due to the presence of huge runoff and pronounced annual climatic cycle. Several activities pose along the whole coast (i.e., maritime traffic, fishery, aquaculture, tourism, urban and industrial settlements, waste water treatment plant). During the last years, research on coastal water quality and monitoring has been intensified towards the implementation of the Water Framework Directive 2000/60, aiming to the achievement of a good ecological status in European waters by 2015, and the Marine Strategy Framework Directive (MSFD). This latter requires to achieve (maintain) a Good Environmental Status (GES) by 2020. Eutrophication is explicitly considered in terms of water quality descriptors, practical guidelines and methodologies. The dataset analysed in this work consists of a continuous 7-year monitoring conducted from ARPA-FVG in selected water bodies and transects in the Gulf of Trieste. Salinity, dissolved inorganic nutrients (DIN,  $\text{PO}_4^{3-}$ ,  $\text{Si(OH)}_4$ ), chlorophyll *a* levels, water transparency and dissolved oxygen together phytoplankton composition were considered. The indicators were statistically treated following the MSFD recommendations and categorized with the nutrient enrichment and its direct and indirect effects. Integrated evaluation was attempted by the application of common methods of eutrophication assessment.



## AN ECOSYSTEM MODEL AS A BASIS FOR THE HOLISTIC APPROACH TO FISHERIES IN THE STRAIT OF SICILY

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The central position in the Mediterranean Sea and the impressive biological diversity, productivity and habitat heterogeneity found there makes the Strait of Sicily an important fishing ground for the whole basin. In the Strait several target fish species are exploited by one of the largest Mediterranean fisheries. Despite the economic and ecological importance of the area an in-depth study of the interaction between species and gears as a whole for the sustainable use of the marine resources is still lacking. A holistic ecosystem model has been developed for the ecological and bio-economical analysis of the fisheries in the area. The applied ECOPATH model included the reconstruction of the Strait of Sicily food web which includes 72 functional groups, from bacteria to large pelagic species. Important commercial species were treated as single groups, including the red mullet and the European hake represented in age classes. In order to better represent main ecological and exploitation differences, many functional groups were split into shelf and slope components. Fishery was described by 39 fleet segments resulting from combination of 13 métiers and 3 fishing vessel sizes. Results showed ontogenetic diet shifts for red mullet and European hake; moreover, large hakes were at the top of food web. Red mullet, European hake, deep water rose shrimp, giant red shrimp and clupeids represent the bulk of catches (more than 60%) and as a consequence mean trophic level of catches resulted about 3.5. Although trawlers highly impacted the system, functional groups remained largely interconnected as suggested by the system omnivores index (SOI=0.34). Furthermore, the Strait of Sicily appeared at an intermediate stage of maturity (Tot PP/Tot R=1.71) compared to other Mediterranean regions. The approach followed in this study allowed to identify interactions between fleet segments as well as species with key ecological role for ecosystem resilience. The model developed permitted a first ecosystem evaluation of fishing effects in the Strait of Sicily and a basis for testing management scenarios.

## ASSESSING THE IMPACT OF WASTEWATER FROM A CANNING INDUSTRY ON BENTHIC ECOSYSTEM, ENVIRONMENTAL CONCERNS OF THE LIFE-SEACAN PROJECT

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The Galician Rías Baixas, a set of elongated bays of tectonic origin located in the NW coast of the Iberian Peninsula, host a great marine biodiversity. They also host intense fishing and aquaculture activities, as well as 80 % of the fish canning industries in Spain, which produce 4300 million cans every year. These industries are characterized by high water consumption and the subsequent emission of large quantities of wastewater. The project LIFE-SEACAN (LIFE14 ENV/ES/000852) was designed with the aim of demonstrating the potential of two innovative biofilm-based technologies (aerobic granular sludge and hybrid bioreactors) to decrease the impact of this industrial activity on marine ecosystems. The project includes a monitoring of the impact of the wastewater from a canning industry on benthic ecosystem before and after the installation of a biofilm-based technology prototype. Here we present the results of an initial assessment of the wastewater impact. With that purpose, samples were taken at 6 sites at each of the 4 sampling stations (2 potentially impacted by wastewater and 2 controls). Sampling at each site included taking 6 samples with a Van-Veen grab, 5 for the study of the fauna and 1 for the study of the sediment, plus water samples for the study of its physical-chemical characteristics. Furthermore, sediment traps were installed at each sampling station to measure matter fluxes towards the sediment. One of the control stations was discarded from this study because of its major differences with the 3 remaining stations regarding sediment type. Benthic assemblages in the area under the influence of the wastewater discharge were found to be significantly different from those in the control area. Molluscs and echinoderms were more abundant and diverse in the control sites, while polychaetes and nematods presented higher densities in the sites affected by wastewater. Crustaceans were more diverse in the control sites, but more abundant on average in the affected ones, mostly due to the tanaid *Apseudopsis latreillii* (Milne Edwards, 1828). This was the most abundant species in the affected sites, followed by another deposit-feeder, the capitellid polychaete *Mediomastus fragilis* Rasmussen, 1973.

## COMBINING TAXONOMIC AND FUNCTIONAL APPROACHES TO STUDY THE TEMPORAL VARIATION OF BENTHIC MACROFAUNA IN A SEDIMENTARY BOTTOM

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Temporal variation in benthic assemblages is influenced by a broad range of factors. The life cycles of each species, environmental factors such as changes in sediment features or hydrodynamism, jointly with human pressures, overlap to determine the structure and functioning of these assemblages. Furthermore, results are very dependent on the scale and periodicity of the study; this and related random factors make difficult to properly study temporal variation of fauna in these ecosystems. Our aim in this study was to assess such topic by considering both taxonomic and functional classifications of the benthic fauna, in order to obtain a complete and detailed view of its temporal variation in a sedimentary bottom. The studied site was a subtidal muddy sand bottom (18 m deep), located in the inner part of a small embayment, the Ría de Aldán (NW Iberian Peninsula). Five replicate samples were taken monthly during a year by means of a Van-Veen grab and then sieved through a 0.5 mm mesh. All the fauna in the samples was sorted, identified to the lowest possible taxonomic level and counted. Taxa were grouped according to their trophic guild, life habits and the combination of both traits. An additional sample was taken to determine sediment characteristics. Results showed the existence of significant changes over time in the assemblage, which fitted into a cyclical pattern, as expected, despite of the classification considered. Such pattern, however, was affected by two abrupt changes in the characteristics of both the sediment and the assemblage. In those two months, sediment was coarser, with more carbonates and less organic matter, while the assemblage was richer in number of individuals and taxa, but it was less diverse overall; crustaceans replaced polychaetes as the dominant taxonomic group, the number of predators and carrion-feeders increased, and infauna was replaced by organisms that can live both over and among the sediment as the most represented life habit. Temporal variation of the whole assemblage considering different classifications of the fauna was found to be significantly correlated with that of the sediment features.

## PLANT TRAITS AND NUTRIENT UPTAKE RATES

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Aquatic plant meadows host diverse communities of infauna. The activity of infauna, such as bioturbation, affects the nutrient microenvironment around the root network of aquatic plants. This talk describes a study that investigated how plants respond to aspects of such activity; by measuring nutrient uptake responses by plants to short term nutrient enrichments. A suite of different plant species native to the Baltic Sea were fertilised *in situ* with <sup>15</sup>N-labelled ammonium sulphate and their uptake responses were measured after 3.5 hours. Relationships between plant traits and uptake rates were explored. Results identified a nutrient compromise that plants experience as they increase in size, and they highlight the potential for bioturbators to help plants to meet their nutrient demand. Findings from this study can help to predict plant responses to nutrient enrichment, changes in the behaviour or community composition of infauna and changes in the sediment properties of aquatic plant meadows.

## CHEMICAL WAR UNDER THE SEA: A FEW EXAMPLES OF CHEMICAL ECOLOGY IN THE ANTARCTIC BENTHOS

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Presentation type: ORAL

The structure of marine benthic ecosystems is determined by both environmental and biological factors. Among the biological ones, the ecological relationships (symbiosis, competition, predation), the life-cycles, the phylogenetic history, and the colonization rates of the organisms are crucial for their survival. In contrast to what happens in other regions of the planet, the Antarctic ecosystems are ruled by a strong environmental stability, only comparable to that observed in caves or abyssal regions, and thus the interactions between organisms become a very important factor in structuring these communities. Since 1998, the Antarctic research projects ECOQUIM, ACTIQUIM, and DISTANTCOM aimed at gaining a better understanding of the diversity and structure of Antarctic benthic marine communities, both at biological and chemical levels. To do so, among other aspects, we studied the ecological activity of the marine natural products from benthic organisms, by carrying out *in situ* chemical ecology experiments. The chemical ecology of marine benthic organisms includes, among others, repellence, toxicity, and antifouling activity assays, as well as the identification of the natural products and their potential bioactivities. A few selected examples are presented here on how benthic organisms use natural products in their interactions with others, including sponges, soft corals, molluscs, bryozoans, and tunicates. Over the years, our studies have diversified to include other related topics in marine ecology. Therefore, we also study the trophic relations, symbiosis and bioaccumulation in shallow Antarctic benthic communities. As further related topics arise, our team is also producing new methodologies to answer new questions about marine benthic invertebrates.

## DYNAMIC OF MICROBIAL COMMUNITY COMPOSITION ASSOCIATED WITH *RHIZOSTOMA PULMO* (SCYPHOZOA: RHIZOSTOMEAE)

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Presentation type: POSTER

Marine jellyfish are currently recognized as subject to proliferations in many coastal areas, where their populations experience seasonal and inter-annual large fluctuations, characterized by sudden outbreaks alternate with rarity periods. The proximate causes for these changes are unknown, but presumably a combination of factors, including eutrophication, overharvesting of fish, climate changes, increase habitat modifications and polyp abundances. The Mediterranean Sea is among the heavily affected regions by jellyfish blooms due mainly to scyphozoans such as *Rhizostoma pulmo* (Macri, 1778). The jellyfish have few natural predators, and their bodies represent an organic-rich substrate as well as a source of nutrients that could support rapid bacterial growth with great impact on the structure of food webs. Our study focuses on the analysis of the abundance and metabolic diversity of bacteria associated with *R. pulmo* umbrella and oral arms. Samples were collected at Ginosa Marina (Taranto, Ionian Sea, Italy) in July 2016 and February 2017. The abundance of culturable heterotrophic bacteria was determined on Marine Agar 2216 (Difco). The analysis of the metabolic profiles was performed by using the Biolog system-Ecoplates™. The obtained results show that oral arms represent the most fouled compartment in both periods with a bacterial concentration of  $5.6 \times 10^3$  and  $2.3 \times 10^3$  CFU/ml respectively. In the umbrella bacterial density was always lower than in the oral arms ( $1.3 \times 10^3$  and  $2 \times 10^2$  CFU/ml). These results were also consistent with those concerning the bacterial metabolic activity; indeed the highest activity was found in the bacterial community associated with the oral arms, capable of using 6 carbon sources in July and 13 in February after incubation for 72 hours. Moreover, the analysis of the metabolic profiles highlighted that the microbial communities associated with the two compartments degraded different substrates suggesting that several parts of the medusa body host a specialized bacterial community. Further studies will clarify the role of here investigated bacteria in the degradation processes of jellyfish biomass and consequently on marine biogeochemical cycles.

## BLOOM OF TUNICATA *PEGEA BICAUDATA* IN THE OPEN SOUTH ADRIATIC IN JUNE 2016

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*Pegea bicaudata*, cosmopolitan species, known from the west Mediterranean, was recorded for the first time in the Adriatic Sea in June 2016 at the open waters. Bloom with maximum of 2.6 blastozooids/m<sup>3</sup> was recorded in the layer 50-100 m at the beginning of June. This bloom happened after spring phytoplankton maximum at the open South Adriatic. Increasing of the records of newly recorded planktonic tunicata species in the Adriatic Sea in the last two decades contributed to the higher marine biodiversity of the Adriatic Sea and could be in a connection with hydroclimatic changes in the Mediterranean Sea.

**BIOLUMINESCENCE IN THE SUBMARINE COASTAL CAVE ZINZULÙSA (CASTRO, SOUTH ITALY)**

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Bioluminescent bacteria have been searched and identified in the dark submerged habitat of *Grotta Zinzulùsa*, one of the 10 most important caves of the world from the biological point of view. The identification has been associated with measurement of luminescence *in situ*, and compared with marine bacterial flora immediately outside the cave, and around the Salento peninsula. Methods of identification (culture media and molecular genetics) allowed to recognize the bacteria as belonging to the genus *Vibrio* group and TEM observations revealed the presence of endo-cellular granules resembling magnetite crystals. The recording of the luminescence activity allowed to recognize a rhythm in the light production which has been compared with the circadian one present in Protista. The comparison with open sea water allowed to establish affinities between inside and outside *Vibrio*. Presence of bioluminescent bacteria has been considered as an indication of environmental quality because the phenomenon needs Oxygen and it cannot be expressed in hypoxic habitats. The production of light, in addition, allows the bacteria to perform a photo-remediation of damaged DNA, which could derive by natural radioactivity (Radon) present in the rocks. The rhythm of light production, finally, has been proposed as affected by a mix of tide oscillation and cyclic variation of the earth magnetic field. The first rhythm supplies to the system the necessary Oxygen; the second rhythm is still to be justified, but could be perceived by bioluminescent vibrios (sensitive to magnetic fields in laboratory conditions) thank to the presence of endo-cellular Magnetite granules. The submerged part of *Zinzulùsa* appears as a conservative habitat where evolutionary archaic organisms evolved the biochemical capacity to defend themselves by Oxygen, eliminating it in a bioluminescent activity which, in turns, is useful to repair damages on DNA (possibly deriving from the natural radioactivity).



## OTOLITHS' DISCRIMINANT ANALYSES OF *MULLUS BARBATUS* OF THE TUNISIA'S COASTS (SOUSSE AND MONASTIR)

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Presentation type: POSTER

Otoliths are small calcareous concretions in the inner ear of teleost fish; they represent the organs of hearing and balance. Their interest in fish identification and determination of species identity and stocks has been shown by many studies. The Sagitta is in most cases, the largest of the three parts limestone, but also the first to appear during the formation of the larva. That is why this otolith is used in this work in order to compare two Tunisian populations of *Mullus barbatus*: a population from the sea of Sousse and the other from Monastir. The specimens of *Mullus barbatus* were collected during three months in 2015 at two sites: Sousse and Monastir. In total, 120 fish were collected from the two sites and were included in different statistical analyses. The Fourier coefficients were determined to evaluate the degree of similarity in the otoliths and detect the reciprocal variability. The Wilks' Lambda test shows the existence of two distinct populations with very significant differences (with p-value = 0.0001 < 0.05). The projection of otoliths of individuals collected from these two stations shows that the two populations are separated by the axis F1. In conclusion, the comparison of the otolith morphology of the two populations show a clear difference in shape of otoliths which allowed us to confirm the role of Otolith as a great discriminating.

## DISCRIMINATION OF TWO POPULATIONS OF RED MULLET (*M. BARBATUS* L. 1758) OF TUNISIAN COASTS (GOULETTE AND SIDI RAÏS) BY USING OTOLITH SHAPE

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Presentation type: POSTER

The red mullet, *Mullus barbatus* (Linnaeus, 1758), is the most common Mullidae fish in the Mediterranean Sea. It is widespread in Tunisia. Despite their economic importance, no studies have focused on stock discrimination by analyzing the shape of sagittal otoliths of *M. barbatus*. The aim of this study was to evaluate the stock discrimination for 120 specimens of the Red mullet *M. barbatus* sampled from two Tunisian stations coast (Goulette and Sidi Raiis) using different statistical approaches. Statistical analysis showed significant differences between the pairs of otoliths (L and R) ♂ and ♀ of the two stations with a p-value <0, 0001. The results obtained from the comparison between the two fish populations showed the absence of resemblance of the otoliths, which confirms that it is a heterogeneous fish stock. In conclusion, we can mention that the two lots (Goulette and Sidi Raiis) are different in shape of otoliths and this difference may be related to environmental conditions or genetic basis.

## SCREENING OF THE ANTARCTIC MARINE SPONGES AS A SOURCE OF BIOACTIVE COMPOUNDS

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We report here on screening of ethanolic extracts from 24 Antarctic marine sponges for different biological activities. The extracts were tested for cytotoxic effects against normal and transformed cell lines, red blood cells and algae, for modulation of the activities of physiologically relevant cholinesterase enzymes, and for growth inhibition of pathogenic and ecologically relevant bacteria. Moreover, the antifouling properties of some extracts were investigated by performing settlement assays on cypris larvae of the crustacean *Amphibalanus amphitrite*. Besides antisetlement activity, the toxicity of the extracts was tested too on naupliar larval stage of the same species, in order to check whether settlement inhibition is due to toxicity or other mechanisms, and the Therapeutic Ratio (TR=  $LC_{50nauplii}/EC_{50settlement}$ ) was calculated. Results showed that an extract from *Tedania (Tedaniopsis) oxeata* was selectively cytotoxic against the cancer cell lines, while the sponge extracts from *Isodictya erinacea* and *Kirkpatrickia variolosa* inhibited the activities of the cholinesterase enzymes. Several sponge extracts inhibited the growth of multiresistant pathogenic bacterial isolates of different origins, including extended-spectrum beta-lactamase and carbapenem resistant strains, while sponge extracts from *K. variolosa* and *Myxilla (Myxilla) mollis* were active against a human methicillin-resistant *Staphylococcus aureus* strain. These data show that Antarctic marine sponges represent a valuable source of biologically active compounds with pharmacological potential.

## ECOLOGICAL STATUS OF THE MACROZOOBENTHIC COMMUNITY IN THE MARANO AND GRADO LAGOON (NORTHERN ADRIATIC SEA): PAST AND PRESENT

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Presentation type: ORAL

A monitoring program was established for the macrozoobenthic community in the Marano and Grado Lagoon (hereafter Lagoon) as Biological Quality Element, according to the Water Framework Directive (WFD 2000/60/CE) requirements. The Lagoon is one of the best conserved wetlands of the whole Mediterranean area, belongs to the extended transitional system network of the northern Adriatic Sea and extends for approximately 160 km<sup>2</sup>. This system is classified as a coastal microtidal lagoon of large dimensions (Italian Decree n. 131/08) and has been protected by the Ramsar Convention since 1971. Following the implementation of the Habitats Directive (92/43/EC) the Lagoon was also designated as a Site of Community Importance (SCI - IT3320037). In this area, the first extensive study on macrozoobenthos was conducted from 1993 to 1995 by collecting samples with a 0.047m<sup>2</sup> van Veen grab. Within the WFD 16 water bodies (WB) were identified and benthic samples were collected in 2008, 2011 and 2014 by means of the same sampling and analysis methodologies previously applied. In this work, this Biological Quality Element was considered with the aim to compare past and present status of the Lagoon by means of M-AMBI, AMBI, Shannon-Wiener diversity index ( $H'$ ) and richness (as number of taxa). In addition biocenotic status, sensu Pérès and Picard, was considered. The results display that present macrozoobenthic ecological status (sensu M-AMBI) is almost Good, whereas in the past was Bad. AMBI revealed a slightly disturbed condition of the community in both periods, whereas a clear increase of richness and  $H'$  values occurred. Taking into consideration the biocenoses, a slightly increase of characteristics species typical of marine environment was mainly observed in WB closed to sea inlets. Thus, a trend of the Lagoon macrobenthic communities versus typical marine characteristics could be hypothesized probably as a consequence of the evolution of northern Adriatic lagoons toward more open (bay-like) environment of today.

USING GREEN ENGINEERING TO ENHANCE THE BIODIVERSITY AND FUNCTIONING  
OF SEAWALLS IN HARBOURS AND PORTS: IRELAND'S ROLE IN THE WORLD  
HARBOURS PROJECT (WHP)

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It is estimated that over 70 % of humans live within 100km of the coast. In particular, coastal cities in many countries, now house high proportions of an expanding population. As such, the development of artificial structures in urban harbors (sheltered bays and estuaries) has concomitantly increased. Given that artificial structures can have widespread ecological consequences through a reduction in biodiversity and by enhancing the distribution and spread of non-indigenous species. There is a growing interest in eco-engineering artificial structures to enhance native biodiversity: either through the provision of microhabitats and/or seeding with habitat-forming species (such as mussels or oysters). Along with 15 other global WHP partners, we tested the efficacy of habitat enhancements (using custom-designed concrete tiles 25 x 25 cm) and bivalve seeding and its potential role in enhancing native biodiversity on artificial structures (vertical seawalls). At Dublin Port: experimental manipulations included adding tiles with enhancements (flat, 2.5 cm & 5 cm tiles), microhabitats (crevices & ridges on 2.5 cm, 5 cm tiles) and seeding (mussels, no mussels). Tiles and associated biota will be sampled 6 times over a twelve-month period and results will be combined with data from global partners to evaluate spatial variation in the outcomes.

## ANTIMICROBIAL ACTIVITY OF MACROALGAE FROM THE SOUTH SHETLAND ISLANDS AND THE ANTARCTIC PENINSULA

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Antarctic marine ecosystems are unique, with benthic communities dominated by sponges, gorgonians, soft corals, ascidians, bryozoans, as well as macroalgae in shallower depths. Interestingly, along evolution these sessile organisms have developed diverse chemical strategies to defend themselves or resist predator's attacks, as well as avoid fouling damage. All these make the Antarctic benthic organisms an interesting field to study, among others, in search of new antibacterial and antifungal compounds. These bioactivities could result in interesting applications in algal chemical ecology and also for pharmaceutical industries. With the aim of investigating some of these activities, we developed an antimicrobial activity screening using nine selected Antarctic macroalgal species. We analyzed separately lipophilic and hydrophilic extracts of the macroalgal samples and further tested them on 14 different microbial strains (7 Antarctic bacteria, 6 pathogenic bacteria and one pathogenic fungi), measuring their growth inhibition halii, if any. We found that, in general, lipophilic compounds were clearly more active than the hydrophilic ones, and also that brown algae (specifically *Desmarestia antarctica*) appeared to be stronger inhibitors than red algae. Even so, all the algal species studied presented some antimicrobial activity, and thus, this is an interesting preliminary approximation to the topic, which will be further developed in the future.

## IMPACT OF AN INTRODUCED PREDATOR (*MICROPTERUS SALMOIDES*, CENTRARCHIDAE) ON NATIVE ESTUARINE FISH ELUCIDATED THROUGH FATTY ACID ANALYSES

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The introduction of alien fish species on local aquatic communities can have contrasting impacts, depending on the species involved, and environmental and anthropogenic factors characterizing the ecosystem of interest. In South Africa, the largemouth bass (*Micropterus salmoides*, Centrarchidae) was introduced in 1928 to many rivers in the country to improve recreational angling. The largemouth bass is a facultative piscivore and its predatory impact on local fish raises concerns, in particular for juvenile stages of marine fish utilizing the river/estuary interface. Previous studies using stomach content and stable isotope methods have highlighted the consumption of several species of marine juvenile fish by the bass in the Kowie River/Estuary interface. However, the importance of such prey in the bass diet over multiple seasons and through ontogenetic stages of the bass is unknown. We used a fatty acid approach to assess the strength of the bass predatory impact on locally migrating juvenile marine fish. The largemouth bass and its potential fish and invertebrate prey were collected at the Kowie River/Estuary interface over four seasons during a one year period. Estuarine fish prey analyzed included *Rhabdosargus holubi* (Sparidae), *Myxus capensis*, (Mugilidae) and *Monodactylus falciformis* (Monodactylidae), while invertebrate prey included the crab *Potamonautes sydneyii* (Decapod), and insects (Hemiptera and Odonata). The relative amounts of 35 fatty acids (% of total lipids for invertebrates, and % of total neutral lipids for fishes) were estimated using gas chromatography, and their values compared across species, seasons and predator sizes using non-parametric multidimensional scaling, among other methods. We compared the fatty acid results with those derived from stomach content and stable isotope approaches, and confirmed that the contributions of invertebrate versus fish prey into the diet of the largemouth bass changed with season and bass size. This fatty acid approach could be applied to additional aquatic ecosystems, including European estuaries, to assess trophic relationships between introduced and native species, thereby allowing for an assessment of the impact of species introductions on aquatic ecosystem functioning.

## ECOLOGICAL AND ECONOMIC EFFECTS OF EU CFP DISCARD LANDING OBLIGATION EVALUATED USING A QUANTITATIVE ECOSYSTEM APPROACH FOR THE NORTHERN ADRIATIC SEA

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Presentation type: POSTER

Assessing the effects of the introduction of the discard landing obligation (EU 1380/2013 and 1392/2014) by the reformed Common Fishery Policy using an ecosystem model, allowed to quantify the direct and indirect ecological and economic implications of the new regulation, which are all negative. In particular, the increase of landed material (approx. +13%) will reduce indirectly biomasses at sea (approx. -0.25%) even of commercial species; such reduction will have effects on catches of commercial species that will decline at current effort; revenues are thus expected to decline (approx. -0.5%), but the workload for fishermen not, because of the large increase of material to land. Negative effects are not compensated from revenues coming from use of non-commercial landings (e.g. fishmeal). Moreover, a series of fisheries management scenarios of adaptation to the new measure highlighted that reduction of effort, quotas for small pelagics and realistic changes in gear selectivity cannot compensate completely the negative effects of landing obligation. Overall, a multi-species, multi-gear and ecosystem approach allows for evaluating some indirect effects of fisheries policy and might be included in fisheries analysis to be complementary with single species approaches.



## UNCERTAINTY OF PHYTOPLANKTON INDICATORS WITH RESPECT TO SAMPLE-SIZE: A CASE STUDY ON A LARGE TRANSITIONAL WATER DATASET (WISER)

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Presentation type: ORAL

Phytoplankton is a key element for the assessment of ecological and environmental status of aquatic ecosystems. The methods used to sample phytoplankton communities are based on cell counts, determining a trade-off between the number of cells counted and the number of phytoplankton samples in a monitoring plan, whenever the financial budget, the available personnel or the response time are limited. We investigated the optimal sample size effort, intended as number of phytoplankton cells counted per sampling station, of many commonly used metrics. To this aim, precision and uncertainty of the metrics as a function of sample size have been addressed using a case study carried out in the Lesina lagoon (Apulia, Italy), where 12000 cells have been counted per sample within five sampling stations. Overall, we show that some of the commonly used indices/metrics for the description of phytoplankton communities are strongly dependent upon the sampling effort (as number of counted cells per sample), while other metrics are relatively independent. Metrics based on the number of taxa only (e.g. Taxonomic richness) or on the ratio between number of taxa and number of individuals (e.g. Margalef's diversity index) or on the species evenness (e.g. Pielou's evenness index) strongly depend on the sample size and their uncertainty (in term of sampling variance), which is usually large on small samples. Some other metrics [metrics of taxonomic diversity accounting for the proportional abundance of each taxa (e.g. Shannon-Wiener's diversity index); metrics accounting for the dominance of the most abundant taxa (e.g. Hulburt dominance index); metrics derived from the individual size distribution (e.g. Inter-decile range, ISS Phyto)] are able to achieve high precision and low uncertainty at small sample sizes (virtually less than 50 counted cells) and thus they maximize the ratio between allocated effort and gained information. The investigated relationships can be used as a guideline to interpret the response of different datasets and provide recommendations about the optimal effort per sample to be allocated in phytoplankton monitoring plans.

## OPTIMISING REGIMES OF MULTIPLE STRESSORS TO CONTROL INVASIVE TUNICATES *DIDEMNUM VEXILLUM*

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Invasive species pose one of the most significant threats to biodiversity and ecosystem functioning. Fouling taxa such as tunicates are a particularly pervasive group and pose a significant threat to shellfish aquaculture where extensive fouling of equipment and overgrowth of stock can cause major operational challenges, impede production and negatively affect the survival and growth of cultured species. While several studies have focused on establishing the capacity of a range of biological, chemical and mechanical control techniques to reduce fouling by invasive species, few have evaluated practical aspects associated with their long term control and management in aquaculture. The invasive tunicate *Didemnum vexillum* can potentially be controlled in oyster farms using vinegar sprays and/or 'bag turning' (i.e. periodically turning oyster bags over causing desiccation/UV exposure). A field experiment was set up on intertidal trestles at an oyster farm on the West coast of Ireland to test the effectiveness of these measures and identify an optimal regime for their delivery. They were applied individually or in combination to oyster bags fouled by *Didemnum*, following six regimes of treatment that incorporated the frequency (low, high), timing (early, late) and variance (spread, clustered) of their delivery. Percentage cover of *Didemnum* and total fouling biomass were significantly reduced by a number of the treatments. Mortality rates, condition indices and growth rates of cultured oysters exposed to a subset of the treatments were not significantly affected. The most cost-effective and time-efficient treatments involved combining bag turning and vinegar spray treatments and applying these at a low frequency. We found that treatments that were (i) spread throughout the growing season or (ii) clustered early within the growing season were significantly more effective than those which were clustered late. These results show that the success of invasive species control can be influenced by a range of complex interacting factors, which are often overlooked both within and outside aquaculture. This research builds our capacity to successfully manage invasive species and to reduce their ecological and economic impacts.

## EXPERIMENTAL CULTIVATION OF A MEDITERRANEAN BATH SPONGE IN THE OPEN SEA

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The native Mediterranean bath sponge *Spongia officinalis* is threatened for the past decades due to unregulated harvesting and outbreaks of disease incidents. However, it still attracts worldwide commercial interest and is being actively exploited. Since late 2014, an experimental aquaculture of this sponge has been maintained in the Underwater Biotechnological Park of Crete, an open-sea experimental platform operated by the Hellenic Centre for Marine Research. Specimens from 4 native populations have been transported to the cultivation area and attached on vertical units. Following initial acclimatization, a total of 36 maternal individuals were fragmented into explants, resulting in a total of 118 cultivation clones with an initial average size of 91 cm<sup>3</sup>. Daily monitoring immediately after the fragmentation event showed a quick recovery process, with explants covering exposed tissue with epithelium (pinacoderm) and developing new exhalant pores within 48 h. Regular monitoring followed at bimonthly intervals for a maximum of 212 days since initial deployment, assessing size for each cultivating explant, as well as incidents of mortality and partial necrosis. A long-term assessment was also performed, 595 days after initial deployment. Overall, a trend for growth was observed for all cultivated explants, at rates ranging from 0.13 to 1.01 cm<sup>3</sup> of volume gain per day. Especially at early stages following fragmentation, explants showed the capacity to double their volume over the course of three months. Mortality was generally low, with maximum percentages reaching 4% of the total population during the warm months. The outcomes of this experimental study are encouraging for the potential of sustainable open-sea sponge aquaculture at the operational level. This is an important outlook because of the existing commercial and biotechnological interest of certain sponge species. Moreover, since natural populations of *S. officinalis* are currently degraded and scarce, it provides a mean for maintenance of stocks that may support transplantation efforts to promote the reestablishment of this iconic Mediterranean marine species in its natural habitat.

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## ACCLIMATIZATION OF THE INVASIVE *BRANCHIOMMA BAIRDI* (ANNELIDA) TO OCEAN ACIDIFICATION. PRELIMINARY RESULTS OF A TRANSPLANT EXPERIMENT AT A CO<sub>2</sub> VENT SYSTEM

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*Branchiomma bairdi* is a sabellid polychaete native of the Caribbean Sea and recently introduced in the Mediterranean Sea where the species' range has rapidly expanded as a consequence of its ability to colonize different environments and substrates. The species has also been reported around Ischia (Naples, Italy), a volcanic Island characterized by various submerged CO<sub>2</sub> vent systems. The species is present in venting areas near Castello Aragonese where intense CO<sub>2</sub> emissions lower the seawater pH up to <7.4 values. The aim of the present work was to investigate the physiological mechanisms underlying the tolerance of *B. bairdi* to ocean acidification. To this end, the study focuses on the responses of carbonic anhydrase (CA), a key enzyme for a number of physiological processes, including pH-homeostasis and gas exchange, and known to be affected by low pH/high CO<sub>2</sub> in other invertebrate species. A transplant experiment employing the natural CO<sub>2</sub> vents of Ischia was carried out. Worms were collected from a control pH area in the Mar Grande of Taranto (Apulia, Italy) and transplanted in two areas around Ischia, a control and a low pH/high pCO<sub>2</sub> area. Three sites per area were utilized. Thirty individuals per sites were exposed in plastic cages for 30 days. pH and temperature were measured in each site every four days during the course of the experiment. CA activity was measured electrometrically on the whole body homogenate of each specimen. The statistical analysis of data by two way ANOVA indicated no significant differences in CA activity between organisms transplanted to the low pH area and to the control area. No statistical significance was also observed between the sites in each area. Moreover, CA activity values measured in native *B. bairdi* sampled in Ischia vent area was statistically indistinguishable from the activity measured in native specimens from the Taranto area. In conclusion, the exposure to acidification did not induce any changes in the CA activity of *B. bairdi* in either transplanted or native conditions. This could contribute to the high physiological plasticity of this species and to its acclimatization to the acidified conditions of the Ischia vent system.

## DEPLETION OF EUROPEAN HAKE STOCK IN THE SEA OF MARMARA

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The aim of ecosystem-approach to fisheries management is to provide the sustainability level of target stock via indicators with the minimum impact on other ecosystem components. Fishing activity must consider as a chain activity rather than evaluating it as a single activity between target organism and the fishermen, which affected all components related to target organism as well as the fishing conditions on related stocks. The main challenge of the approach is that in Turkey, stock assessments cannot be done properly. This is mainly because of the insufficient fish market data as well as the discontinuity of already few stock assessment projects. Based on this motivation, this study focuses on stock status and temporal changes of European hake in the Sea of Marmara with processing the several fisheries data which had been taken by monitoring studies between the years 1990-2016 by Istanbul University, Institute of Marine Sciences and Management. Certainly, one of the most important demersal fish species in the Sea of Marmara is the European hake. Its production occupied around 50% of demersal fishery in mid-90s. Decreasing started in mid-2000s and drastically deteriorated below 10% percent in 2015. According to national catch statistics, only 81 tonnes European hake were caught in the Sea of Marmara last year. The results of this study indicates clear decline with estimated biomass ratio in catch composition of European hake 53% in 1995, 60% in 1996, 36% in 2009, 16% in 2010, 23% in 2011 and less than 1% in 2016. According to stock assessment results performed by CMSY analysis, the European hake stock in the Sea of Marmara is outside of safe biological limits between the years 2000 and 2015. Current biomass estimation over maximum sustainable biomass is below the threshold level of 1 in whole period and after 2003 the values are estimated below the critical point of 0.5. Fishing pressure estimation is over 1.5 between the years 2000 and 2012 which implies the overfishing. After 2012, fishing pressure was below 0.5, however it is considered that the stock is severely depleted in the Sea of Marmara.

## WHAT CAN WE LEARN ON THE ICHTHYOFAUNA OF THE EASTERN ADRIATIC SEA FROM THE SOCIAL NETWORK?

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In the last decade, social networks became one of the most important tools for communication among people. Numerous interest groups existing on social networks discuss various issues and provide information which might have a value from the scientific standpoint, but are usually overlooked. In this particular case, we were able to collect various ichthyologically valuable data based on the fisherman and citizen input in the various fishery related interest groups and personal pages existing on social network. Collected data origins from either professional, sport or recreational fishery activities in the Croatian part of the Adriatic Sea. For example, we acknowledged first presence of juvenile specimens of *Sphoeroides pachygaster*, additional occurrences of recently established species like *Caranx rhonchus* and *Caranx crysos*. Occurrences of previously rare species like *Synodus saurus*, *Balistes carolinensis*, *Epinephelus aeneus*, *Xyrichtys novacula* etc. It is even possible to observe seasonality of certain fish species by the appearance in catches shared on social network. In this presentation we show some of the most interesting cases which deepen our knowledge on the ichthyofauna of the eastern Adriatic Sea.

## SPATIO-TEMPORAL TRENDS OF THE POTENTIALLY TOXIC DIATOM *PSEUDO-NITZSCHIA* AND PARTICULATE DOMOIC ACID IN THE GOLDEN HORN ESTUARY, TURKEY

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The spatio-temporal distribution of potentially toxic diatom genus *Pseudo-nitzschia* and particulate domoic acid (pDA) concentrations were investigated weekly to bi-weekly from October 2013 to September 2014 in the Golden Horn Estuary, Turkey. *Pseudo-nitzschia* species, *P. calliantha* and *P. pungens*, were commonly observed (~49%) in the study area. The highest cell densities of *Pseudo-nitzschia* were observed in late spring (May and early June) and winter (January), while very low cell densities occurred in summer (July to August). Average cell density of *Pseudo-nitzschia* was detected as  $\sim 1.1 \times 10^6$  cells L<sup>-1</sup> in May. *Pseudo-nitzschia calliantha* was commoner than *P. pungens* almost throughout the study period. These species were observed over a wide range of water temperatures (7.4 – 26.5°C) but higher cell densities occurred over a narrower temperature range (14.7 – 19.6°C) in spring. Cell densities were low at summer temperatures (> 20°C), probably due to lower growth rates at higher temperatures. *Pseudo-nitzschia* species were detected over a salinity range of 15.9 – 19.9, but the highest cell densities occurred between 18.5 and 19.0. *Pseudo-nitzschia* abundance decreased in the upper estuary, which has variable salinity and low light availability due to high concentrations of suspended particulate material. The pDA concentration in seawater ranged between 0.03 and 1.0 µg L<sup>-1</sup>. pDA levels were undetectable during certain sampling periods and were generally higher in the lower and middle estuary. There was not always a positive relationship between *Pseudo-nitzschia* abundance and pDA concentration. The results of the PCA's (Principal Component Analysis) showed that Secchi depth, dissolved oxygen (DO), salinity and pH were the main factors causing spatial variation, while the factor causing temporal variation was temperature. Low light availability and low DO, highly variable salinity may limit the growth of *Pseudo-nitzschia* in the upper estuary. The presence of pDA may be related to transport by particulate matter throughout the study area.

## CHANGES IN BACTERIAL PRODUCTION IN RELATION TO ANNUAL VARIATION IN PHYTOPLANKTON VIABILITY IN COASTAL WATERS OF THE NORTHERN BALTIC SEA

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The ratio of living to dead cells varies in phytoplankton communities in aquatic environment. Especially in oligotrophic regions release of dissolved organic matter (DOM) from dying phytoplankton cells is an important carbon source for pelagic heterotrophic bacteria. The released labile DOM is rapidly consumed by the bacteria. As a consequence, especially in DOM rich coastal waters, the changes in the concentration of new labile DOM is difficult to detect by measuring bulk DOM alone. Although labile DOM is hidden by the high ambient DOM levels, it may still be important for pelagic heterotrophic production due to the refractory nature of terrestrial DOM that dominates the DOM pool in coastal waters. In such conditions direct measurement of bacterial production together with sedimentation rate of phytoplankton may tell more of the fate of the new organic carbon than direct measurements of dissolved and particulate organic carbon. To increase understanding on the DOM related connections between the bacterial production and events of high phytoplankton cell death a field monitoring campaign was performed in an estuary in northern Gulf of Finland from January to December 2016. We monitored the biomass and percentage of viable cells of phytoplankton together with measurements of primary and bacterial production. The bioavailability of total labile DOM contained within the phytoplankton community, that is potentially accessible to bacteria through phytoplankton cell death, was also quantified. This was done by killing the phytoplankton by sonication, and measuring bacterial metabolism as oxygen consumption and changes in optical properties of DOM during a 2-3 days incubation. The changes were compared to DOM from a non-sonicated sample. The results of the experiment will be presented.



**BIODIVERSITY CHANGES AFTER SEAGRASS TRANSPLANTATION IN COASTAL LAGOON (HABITAT 1150\*): LIFE SERESTO PROJECT RESULTS IN VENICE LAGOON (ITALY)**

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The northern Venice lagoon (SCI IT3250031) experienced a wide seagrass regression at the end of 20th century. Thereafter, as a consequence of the enactment of laws aiming at reducing anthropogenic pressures at a watershed scale, the water quality improved and environmental conditions suitable for seagrass growth seemed to be restored. The LIFE SeResto (LIFE12 NAT/IT/000331) project started in 2014 to trigger the re-colonisation of seagrasses by means of low-cost, small-scale manual transplantation mainly of *Zostera marina* and *Z. noltei*, at 35 shallow sites. An intensive monitoring of water, sediment and biological parameters is ongoing to investigate both the factors affecting seagrass growth and the changes in macrophyte, macrobenthic fauna and fish fauna communities. The first transplantations were carried out in 2014 (17 sites) and in 2015 (18 sites). The seagrass cover in the 17 sites after 30 months was ca. 60% of the intervention areas (size of each site: 10x10m). In the other 18 sites after 18 months the cover was ca. 44.5%. Macrophyte assemblages showed a rapid change with a significant increase of the number of species (from ca.17 taxa per site in 2014 to 26 in 2016), which particularly concerned sensitive species as *Polysiphonia spinosa*, *Laurencia obtusa*, *Osmundea truncata*, *Palizada patentiramea*, *Pneophyllum fragile*, *Hydrolithon boreale* and *Chaetomorpha linum*). The improvement of the fauna components was slower, because seagrass meadows are not yet well-developed and the habitat recover is in progress. Moreover, the considered sites displayed significant different environmental conditions from areas where seagrasses did not root (cover 0%) to areas with a fast colonization rate (cover 100%). On the whole, the preliminary results showed a slight improvement of the community diversity: the mean number of species of benthic invertebrates was 15 in 2014 and 17 in 2016, despite the mean Shannon indices decreased (2.97 in 2014 and 2.84 in 2016). In the case of fish fauna the number of species was 5 in 2014 and 6 in 2016 but Shannon indices increased from 0.95 to 1.18. Moreover, considering commercial organisms (traditional fishing systems) a significant increase of captures was observed for *Atherina boyeri* and *Carcinus aestuarii*.

## SUCCESSFUL RELOCATION OF *PINNA NOBILIS*: NAMELY, HOW TO RECONCILE ECONOMIC DEVELOPMENT AND THE CONSERVATION OF AN ENDANGERED SPECIES

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Presentation type: POSTER

The widening and modernization of the Taranto Port required the deepening of the sea bottom in front of a pier and the consequent creation of a “sediment tank” to host the dredged sediments. During the operations performed to secure the tank area, several hundreds specimens of *Pinna nobilis* (L. 1758) were observed and, accordingly, an urgent action was set up to safely relocate them to another suitable site and to assess the effectiveness of the intervention. In fact, *P. nobilis* is a threatened Mediterranean species that requires a special conservation granted by European (EC Directive 92/43/EEC, Annex IV; Barcelona Convention, Protocol for Specially Protected Areas and Biological Diversity in the Mediterranean, Annex II) and national laws (Italian DPR 357/97). Almost 2,000 specimens were successfully relocated by 6 divers in 33 days (May-July 2016) of SCUBA diving. The fan shells were explanted from the sediment tank and replanted in a site in the Mar Grande of Taranto, just 1 km away from the tank. The bottom depths were, in both areas, between 2 and 4 m. The presence of a population of *P. nobilis* in the relocation site guaranteed the suitability of the site itself for replanting. In particular, the seabed with a dead mat of *Posidonia* allowed a relatively easy replanting and, at the same time, facilitated the anchoring of the shells. The explanting was performed with the help of garden tools, paying particular attention to preserve the byssus filaments and glands. Then, the fan shells were moved to the relocation site in tanks with a continuous water circulation and, once there, they were replanted in clusters of 9-12 individuals, geolocated to facilitate subsequent monitoring. Two weeks after the relocation a first monitoring was carried out to evaluate the effects caused to the fan shells by transplanting operations: a very low distress was observed, while the mortality of *P. nobilis* was mostly due to predation, especially by octopus. The success of these transplantation activities confirms their usefulness both for conservation purposes and to make eco-sustainable those activities needed for the economic development of the territory.

## FIRST SURVEY ON MEGABENTHOS OF THE BOTTOM TRAWLING IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA)

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The first survey on megabenthos of the bottom trawling was conducted according to the Descriptor 6 - Sea-floor integrity -of the Marine Strategy Framework Directive (MSFD Dir. 2008/56/EC), which was transposed into Italian law by Legislative Decree no 190/2010. For this survey a trawl net with 40 mm cod-end mesh size was used in a 100 Km<sup>2</sup> trawled area of the Gulf of Trieste, for a total of 36 hauls. Over 386,000 individuals were collected and 168 taxa were identified. The average number of taxa was 52 haul<sup>-1</sup> and the average number of individual was 10,734 haul<sup>-1</sup>. The main taxa in term of abundance were Crustacea (38%), Echinodermata (34%), Mollusca (12%), Ascidiacea (7%), Porifera (5%), Cnidaria (2%) and Polychaeta (2%); they included 28, 19, 60, 14, 28, 5 and 13 taxa respectively. The decapods *Pisidia longimana* and *Paguristes eremita*, the echinoderms *Ophiothrix fragilis* and *Psammechinus microtuberculatus* and the bivalve *Mimachlamys varia* constituted together 72% of total abundance in the trawl net. Cluster analysis and biocenoses sensu Pérès & Picard revealed a benthic zonation on the basis of sediment texture in the trawled area.

## HISTORICAL DATA ON FISH AND FISHERIES IN THE ADRIATIC SEA (MEDITERRANEAN)

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In the last two decades, the interest in the recovery, digitisation and analysis of historical data (e.g. written narratives, archival documents, catches, early surveys, photographs) on fish and fisheries has greatly increased in the framework of marine historical ecology (MHE). Historic data on biodiversity and drivers provides the historical context for present observations and allows studying long-term changes in marine populations and ecosystems. Here we present a database on fish and fisheries of the Adriatic Sea covering two centuries, and including from qualitative observations to standardized scientific monitoring. The database consists of three parts: 1) Naturalists' descriptions of fish fauna, including information on 139 fish species reported in 24 books for the period 1818-1936. Species are described in terms of presence/absence, perceived abundance, habitat preferences, seasonality, size, and other life-history traits. 2) Historical disaggregated yearly landings (kg per species) from the Trieste (1902-1968), Venice (1905-1927) and Rijeka (1914-1932) fish-markets, Italian official landings for the Northern and Central Adriatic (1955-2012), and landings from the Lagoon of Venice (1945-2001). 3) Historical trawl-survey data from seven surveys performed with bottom otter-trawl nets and spanning the period 1948-1991. Catch data (kg/h and/or n/h) by species for 956 hauls performed at 301 stations is reported. The integration of these datasets has already demonstrated to be useful to analyze historical marine community changes over time, and its availability through open-source data portal is going to increase analyses in the framework of MHE.

## THE EFFECT OF SEVERELY CONTAMINATED SEDIMENTS OF THE MAR PICCOLO OF TARANTO (IONIAN SEA, ITALY) ON FREE-LIVING NEMATODES

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Since the 1960s, industrial activities have been affecting the Mar Piccolo of Taranto (Ionian Sea, Italy). At present, the largest steelworks in Europe, a navy arsenal and other smaller industrial plants are responsible for severe contamination of the basin by disposing heavy metals, polycyclic aromatic hydrocarbons and polychlorinated biphenyls via sewage discharge, dumping and river runoff. Recent studies highlighted that benthic microalgae, meiofauna and macrofauna are affected by contamination, as indicated by their low abundances and poorly structured communities, especially in the sediments nearby the navy arsenal, the main source of pollution. Furthermore, the functioning of the benthic ecosystem seems inhibited both in terms of microalgae production and microbial processes of C reworking, indicating a modest transfer of C both into a solid microbial loop and to the higher trophic levels if compared to less contaminated sediments. Nematodes represent the dominant meiofaunal group at all the investigated sites, and may therefore fulfill an important and large portion of the ecological role of meiofauna. The present study represents the most thorough description of nematofauna of the Mar Piccolo, being focused on nematodes composition, presence of sensitive/tolerant genera and trophic traits. In this study, we investigate the nematode community from four sites that were sampled twice (June 2013 and April 2014): St. 1E, adjacent to the main channel that connects the basin to the open sea; St. 1I, nearby the navy arsenal; St. 2C, in the innermost part of the basin; St. 2B, in an intermediate position between St. 1I and St. 2C. Preliminary results show dissimilar taxonomic composition among stations, reflecting different responses of nematodes to contamination. Genera known to tolerate disturbed environmental conditions, like *Daptonema* and *Terschellingia*, were dominant nearby the navy arsenal. With the increasing distance from the main source of pollution, i.e. at St. 2B and in particular at St. 2C, more sensitive genera were observed, like *Halalaimus*. At St. 1E the co-presence of tolerant taxa (*Terschellingia*) with sensitive ones (*Marylynnia*) suggested that the ingression of marine water through the channel could favor the survival of the latter, partly counterbalancing the negative effects of the contamination.

## HEAT STRESS ALTERS MATING BEHAVIOUR AND REPRODUCTIVE SUCCESS IN INTERTIDAL MANGROVE BARNACLES

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Climate change is currently having, and will continue to have, a profound impact on patterns of animal distribution and behaviour. Amongst these potential impacts, behavioural changes are predicted to be the first place where the effects of human induced environmental change will be seen. Changes in behaviour, however, may not necessarily lead to true fitness consequences for the species, and consequently fail to adequately predict how patterns of distribution may change under climate change. In comparison, changes in mating behaviour are more likely to have important fitness consequences. In the present study, we examined the effect of heat stress on mating activity and reproductive success of the intertidal barnacle *Fistulobalanus albicostatus*. Whilst abundant on mangrove tree trunks and branches (often shaded), *F. albicostatus* is also found in large numbers on open mud flat boulders. Consequently different individuals can experience very different thermal conditions. We hypothesised that the proportion of barnacles that displayed mating activity and the total larvae produced would differ between individuals exposed to different thermal conditions. In tidal tanks, barnacles were subjected to temperatures similar to what they would experience across different microhabitats, including on days of extreme heat, based upon field deployed robo-barnacle measurements. Barnacles were filmed during post heat stress high tides and larvae collected regularly. Barnacles exposed to heat stress during low tide rarely attempted to mate during the subsequent high tide, with less than 1% of individuals displaying mating activity. In contrast where barnacles were not exposed to high temperatures, nearly 30% exhibited mating activity. Heat stressed barnacles nearly never released larvae, compared to an average of 106 larvae/litre seawater over the experimental period in the low temperature treatments. Our findings suggest that heat stress reduces mating behaviour in barnacles and potentially results in lower reproductive success. It is also possible that barnacles on mangrove trees act as a source population to other microhabitats where mating and reproductive success is lower. The decline in abundance and distribution of mangroves coupled with predicted increases in air temperature and more frequent and longer heat waves under climate change, should therefore be of concern.

## 10 YEARS OF REPORTING MARINE CLIMATE CHANGE IMPACTS: LESSONS FROM THE SCIENCE-POLICY INTERFACE

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The first 150 years of climate change science was characterised by occasional but important reports and observations leading to a gradual development of knowledge over time. More recently body of evidence on climate change including that for marine impacts has grown rapidly leading to a number of challenges, including the need to collate and summarise a large volume of information and to be able to analyse and interpret complex messages for a wide variety of stakeholders from scientists to policy-makers and the wider public. The Marine Climate Change Impacts Partnership (MCCIP) has been functioning at the science-policy interface for ten years collating, assessing and interpreting information on marine climate change impacts. This experience, and the fact that the MCCIP model is being more widely adopted, provides an opportunity to look at examples of how understanding has changed on the range and scale of marine climate change impacts on key components of the marine ecosystem (with a focus on the last 10 years) and to compare earlier statements on the expected impacts on the marine environment to be evaluated in the light of current scientific knowledge. An overview is also provided of the Scientific Integrity and Independence Risk Management Scheme (SIIRMS) developed by MCCIP and recommended for all those working at the science-policy interface.

## A GLOBAL REVIEW OF PLANT-BIVALVE INTERACTIONS: IMPLICATIONS FOR MARINE ECOSYSTEM RESTORATION

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In marine ecosystems, the success of ecosystem restoration projects has been mixed. A number of processes appear to be important for ensuring restoration success, among these are interactions and feedbacks between foundation species. In this study, we aimed to determine the current state of knowledge about interactions between two important groups of ecosystem engineers in coastal waters. We analysed 321 studies (from 178 papers) examining plant-bivalve interactions in intertidal and subtidal seagrass meadows, salt marshes, and mangrove forests. We categorised these studies by type of study (experimental or correlative), bivalve species (infaunal or epifaunal), habitat, and native/non-native status of species. For each study, we determined whether the overall interaction was positive, negative, mixed (both positive and negative effects were recorded), or neutral (no significant effects recorded), as well as the mechanisms involved. Overall, 54% of the studies showed positive interactions between plants and bivalves, while 22% showed negative interactions and 14% were mixed, showing the importance of interactions between foundation species in coastal systems. However, the relative prevalence of different effects varied between habitats and species types. Epifaunal bivalves generally showed more positive interactions than infaunal bivalves, except when only considering the experimental effects of bivalves on plants. Similarly, interactions were mostly positive in subtidal seagrass meadows, but mostly mixed or negative in intertidal seagrass meadows. In salt marsh and mangrove habitats, correlative studies showed nearly even positive and negative interactions, but experimental work showed mostly positive interactions. Finally, 60% of studies involving native species showed positive interactions, but only 16% of studies involving at least one non-native species had any positive interactions. Different types of mechanisms are involved in governing the interactions between plants and bivalves in different habitats, showing their importance in driving community structure in coastal ecosystems. The critical role of these mechanisms and resulting feedbacks must be taken into account when planning restoration efforts to maximise the chances of success.



## LINKING ORGANOCHLORINE CONTAMINANTS WITH DEMOGRAPHIC PARAMETERS IN A MARINE TOP PREDATOR FROM THE NORTHERN ADRIATIC SEA

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Marine top predators such as cetaceans bio-accumulate persistent organochlorine pollutants such as polychlorinated biphenyls (PCBs), a serious conservation concern for these species. Although PCBs declined in European seas since the 1970s-1980s ban, considerable levels still persist in European and Mediterranean waters. Stranded animals are a valuable source of samples for pollutant studies, but may introduce biases. Biopsy samples from live, free-ranging cetaceans offer a good alternative for evaluating toxicological burdens of populations, especially when linked to known histories of identified individuals. Furthermore, due to their trophic level, long life span and considerable mobility, cetaceans are good regional indicators of organochlorine pollution. In this study, we evaluated PCB and other organochlorine levels in free-ranging common bottlenose dolphins (*Tursiops truncatus*) from the Gulf of Trieste (northern Adriatic Sea), one of the most human-impacted areas in the Mediterranean Sea. Biopsies were collected from 36 male and female dolphins during 2011–2017. All animals were photo-identified and are part of a well-known population of ~150 individuals monitored since 2002. We tested for the effects of sex, parity and social group membership on contaminant concentrations. Males had significantly higher organochlorine concentrations than females, suggesting offloading from reproducing females to their offspring via gestation and/or lactation. This is consistent with limited evidence of first-born calf mortality in this population. Furthermore, nulliparous females had substantially higher concentrations than parous ones, providing further support for maternal offloading of contaminants. Overall, 91% of dolphins had PCB concentrations above the toxicity threshold for physiological effects in experimental marine mammal studies (9 mg/kg lw), while 59% had concentrations above the highest threshold published for marine mammals based on reproductive impairment in ringed seals (41 mg/kg lw). The potential population-level effects of such high contaminant levels are of concern particularly in combination with other known or suspected threats to this population. We demonstrate the utility of combining contaminant data with demographic parameters such as sex, reproductive output, etc., resulting from long-term studies.

## MORTALITY AND REDUCED PHOTOSYNTHETIC EFFICIENCY OF *SACCHARINA LATISSIMA* CAUSED BY SEA LICE TREATMENTS

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*Saccharina latissima* (Sugarkelp) is one of the dominating kelp species on sheltered sites along the Norwegian coast line, providing important habitats and ecosystem services. In algae, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is produced during respiration and photosynthesis, and is commonly grouped together with other reactive oxygen species (ROS). Damage to the photosynthetic apparatus occurs when the accumulation of ROS exceeds the scavenging systems, and could eventually lead to cell death. External exposure to low concentrations of H<sub>2</sub>O<sub>2</sub> have shown to decrease the photosynthetic efficiency of some algae, though the sensitivity is highly species-specific. Sea lice infections is an increasing problem in the Norwegian aquaculture industry, and different chemicals are today being used to remove sea lice from infected Salmonids. H<sub>2</sub>O<sub>2</sub> is considered to be an environmentally friendly alternative, and in 2016 an amount of 26 000 ton was used and released to the environment. Recent studies have suggested that it has negative consequences for some faunal species, but today no risk assessment for the use of H<sub>2</sub>O<sub>2</sub> is conducted, and there is a knowledge gap regarding concentrations that may negatively affect the surrounding environment. The treatment involves bathing the fish in a solution that is commonly 1.7 g/L H<sub>2</sub>O<sub>2</sub> (converted to 100% H<sub>2</sub>O<sub>2</sub>), and consequently releasing the solution to the surrounding environment. A pilot study showed that a 1-hour exposure to concentrations down to 10% led to 100% mortality in *S. latissima*. Further studies were conducted to estimate a LC<sub>50</sub> value. Here, the photosynthetic efficiency was measured after a 1-hour exposure to H<sub>2</sub>O<sub>2</sub> concentrations ranging from 0.1% to 10% of the bathing solution. The algae's ability to recover was also assessed, and tissue samples were collected to determine changes in enzymatic activities. Impacts of H<sub>2</sub>O<sub>2</sub> bathing practices on coastal kelp ecosystem functioning will be inferred.

## ZOOPLANKTON COMPOSITION IN THE GOLDEN HORN ESTUARY AFTER THE OPENING OF THE WATER CHANNEL FROM BOSPHORUS, TURKEY

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Presentation type: POSTER

The Golden Horn Estuary was the most widely-known entertaining-resting place, having rich fisheries, suitable to land and marine transportation and to be a useful inland port in the Ottoman Era, but it has lost its specialties by pollution problems due to industrialization and rising population as of the middle part of 20th century. The monthly abundance and taxonomic composition of zooplankton of Golden Horn Estuary were studied from December 2014 to November 2015 considering four sampling stations. Zooplankton abundance changed seasonally in the Golden Horn. A total of 40 species/groups were registered, of which 13 were from Copepoda and of which 7 were from Cladocera, including first records for the Turkish fauna. Zooplankton species numbers increased significantly from the outer part stations towards the inner part. *Acartia clausi*, *Paracalanus parvus*, *Oithona davisae*, *Pleopis polyphemoides* and heterotrophic dinoflagellate (*Noctiluca scintillans*) were very important species. Additionally, five jellyfish species (*Aurelia aurita*, *Mnemiopsis leidy*, *Beroe ovata*, *Pleurobrachia pileus* and *Rhizostoma pulmo*) were observed for the first time in the Golden Horn. As a result, the diversity and abundance of marine species have increased in the Golden Horn. It is seen that the estuary is in an eutrophic state, the zooplankton fraction changes seasonally and the physical parameters are important in their change. The opening of the water channel from the Bosphorus to the Golden Horn has altered the ecological balances in the very sensitive situation and caused the existence of marine species in this ecosystem.

## A DREAM WITHIN A DREAM: A SINGULAR MARINE CAVE ECOSYSTEM IN KAKOSKALI ISLET (CYPRUS)

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Submerged marine caves are particular environments that are considered refugia or reservoirs of biodiversity in the Mediterranean Sea. One of such caves, located in Kakoskali Islet (NW Cyprus), host a singular ecosystem that only recently has been explored. Given the small area of the islet, it is remarkable that important ecosystems (cave, coralligenous, and seagrass meadows) are found there and in close proximity to each other. Kakoskali is a shallow blind cave with a *Posidonia oceanica* meadow encircling its entrance. The cave is nearby extensive coralligenous habitats found in the drop-off margin of the islet. Sections of the cave are covered by bioconstructions or biostalactites (pseudo stalactites) built by skeletal organisms and microbial organisms. These bioconstructions are deflected from the walls and towards the cave's entrance. The macro-organisms responsible for these build-ups are serpulid polychaetes, and on a lesser extent, foraminifers, bryozoans, brachiopods, and corals. Distinct assemblages of organisms are related to their position (e.g. exposure to light) and topography (e.g. wall interstices without biostalactites). Of particular interest is the high abundance of the scleractinian coral *Guynia annulata*. Hundredths of this serpulid-like coral were found on the lower face of biostalactites. These associated communities are established in a dark, nutrient-poor environment where low water circulation restricts dispersion over prolonged periods of time. However, several nutrient pathways have been identified involving large predatory fish sheltering in the cave, transient mobile organisms (e.g. crustaceans), and the occasional arrival of significant loads of organic matter during stormy weather. As in other cave habitats in the Mediterranean region, Kakoskali is affected by recreational diving and possibly by episodic changes in water temperature, alien species and marine pollution. The last three causes of stress are currently under investigation in Kakoskali. After consultation with relevant stakeholders, results of the preliminary evaluations of the Kakoskali cave habitats were integrated in a proposal to declare the islet a Marine Protected Area. In Cyprus, not often that many important habitats are found together and offering excellent opportunities for research and conservation. To date, the proposal is under scrutiny of the authorities.

## IMPORTANCE OF OTOLITH MORPHOLOGY IN THE DISCRIMINATION OF TWO MARINE POPULATIONS (MAHDIA AND SFAX) OF *LIZA AURATA* IN TUNISIA

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Presentation type: POSTER

The otoliths are mineral concretions in the inner ear of teleost fish. They have long been known for their use as an indicator of age. Indeed the otoliths appear as real memories recording all significant events in the life of each fish since birth. Otoliths morphology analysis is a robust tool which allows us to compare several populations. In fact, it evaluates the stock structure of fish. Also, it can distinguish them in groups. The Sagittas are extracted by dissection, rinsed, wiped and then photographed. A discriminant analysis is applied to otoliths of both populations to illustrate the differences and / or similarities between the two populations and this after processing the pictures of otoliths by software "Photoshop", "Shape" and "XLSTAT". This research shows that there is an existence of two different populations basing on the otoliths projection. As well, wilks' Lambda test gives us a p-value less than 0.001. This study confirms the distinction between the two populations although both sites are very close.

## DISCRIMINATION OF TWO MARINE POPULATIONS (BIZERTE AND GOULETTE) OF *LIZA AURATA* IN TUNISIAN COAST USING THE OTOLITH SHAPE

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Presentation type: POSTER

Otolith morphology analysis is an effective method to discriminate the fish stocks and it's species-specific. However, the stock structure of golden grey mullet *Liza aurata* is little studied in the tunisian coast. The main of this study is to discriminate the stock of *Liza aurata* of two marine populations in the coastal north of Tunisia (Bizerte and Goulette) by using the otolith shape. This research shows that there are two separate populations along the axis F1 (absorption = 39.43%); Population Goulette occupies the positive part of this axis, while Bizerte located in the negative part. For each of these populations, left and right otoliths are separated by the axis F2 (absorption = 16.15%); otoliths rights of individuals caught in Bizerte are placed on the positive side of this axis while the left otoliths occupy the negative part like the otoliths of individuals caught Goulette (duties are placed on the side positive while the left otoliths occupy the negative part). However, statistical tests show significant differences on the one hand, between the two populations, and also between the left and right otoliths of each population ( $P < 0.0001$ ). This study confirms the distinction between the two populations although both sites are very close.

## SOME REMARKS ON AGE AND GROWTH PARAMETERS OF *MERLUCCIOUS MERLUCCIOUS* (L. 1758) FROM THE SEA OF MARMARA, TURKEY

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Presentation type: POSTER

In Turkish waters, the fisheries management approaches especially for commercial species require updating. For that reason, the information on age, growth and mortality of this species is really important. However, little information is available for European hake in the study area. Therefore, the present study aims to determine the age composition, growth parameters, and mortality rates of European hake *Merluccius merluccius* in the Sea of Marmara, Turkey. The sampling depths surveyed from 40 to 200 m. However, in some periods, especially in summer months when the beam trawlers were forbidden, the samples were obtained from the bottom trawlers (with codend mesh size of 34 mm) operating illegally and from the fishermen using various types of gillnets. A total of 777 specimens were sampled monthly from the Sea of Marmara mostly by commercial fishermen using beam trawls (with mesh size of 32 mm) and bottom-set gillnets (with mesh size of 52 mm) between October, 2014 and September, 2015. Total lengths of all sampled individuals ranged from 10.4 cm to 55.3 cm. The length–weight relationship for all samples was calculated as  $W = 0.9656 L^{2.989}$ . The ages of the specimens ranged from 1 to 6. Growth parameters calculated according to the von Bertalanffy growth equation were  $L_{\infty} = 106.358$  cm,  $k = 0.082$ ,  $t_0 = -1.097$  for females,  $L_{\infty} = 102.431$  cm,  $k = 0.091$ ,  $t_0 = -0.829$  for males, and  $L_{\infty} = 103.971$  cm,  $k = 0.087$ ,  $t_0 = -0.926$  for all samples. According to age–structured analysis, the total, natural, and fishing mortality rates were calculated as 2.01, 0.19, and 1.81, respectively. The exploitation rate,  $E = 0.90$ , indicated an over-exploitation on the European hake stocks in the Sea of Marmara.

## THE COMPOSITION OF THE COASTAL FISH SPECIES AROUND GOKCEADA ISLAND (AEGEAN SEA, TURKEY)

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The catch composition of the species caught by demersal gill nets and trammel nets with eight different mesh sizes were determined from March 2004 - February 2005 around Gökçeada Island, which is the largest island belonging to Turkey in the northern Aegean Sea. It has a coastal length of 92 km and a total surface area of 279 km<sup>2</sup>. Actually, the northern Aegean Sea is affected by the Black Sea waters. This effect has a great importance in terms of fish diversity and biomass. This influence is especially pronounced in Gökçeada and the Saros Bay, where there is more zooplankton than in the southern Aegean Sea, and this region is a part of migratory path of some pelagic fishes. Around Gökçeada, year-round coastal fisheries are carried out by small fishing vessels ranging from 6 to 10.5 m. In this study, the demersal multifilament gill nets and trammel nets with eight different mesh sizes (16, 18, 20, 22, 26, 28, 30 and 32 mm bar length) were used. Depths in the study area were less than 30 m. The bottom of the study area was sandy, rocky and covered in sea grass. All organisms that were caught were classified to the species level. A total of 5998 individuals weighing 450 kg were collected. In all sampling 83 fish species (75 osteichthyes and 8 chondrichthyes) were recorded. In addition, a total of 6 crustacean and 5 cephalopod species were also collected. The weight ratio of the osteichthyes in total catch was calculated as 80.09%, followed by cephalopod with 9.84%, chondrichthyes with 9.37%, and crustacean with 0.70%. The most abundant families were Sparidae (29.23%, 1753 individuals), Centrarchidae (18.59%, 1115 individuals), Mullidae (12.45%, 747 individuals), Serranidae (6.95%, 417 individuals), Scorpaenidae (6.42%, 385 individuals), Labridae (5.93%, 356 individuals), Carangidae (5.35%, 321 individuals), and Sepiidae (1.42%, 85 individuals).



## LOOKING UNDER THE MICROSCOPE: WHO IS THE MAIN PLASTIC POLLUTER ON THE COAST OF SLOVENIA?

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Marine litter is attracting attention of scientists and environmentalists worldwide, as it is easily entering the marine environment through river runoff, sewage systems or winds. Accordingly, ports, industries, maritime and road traffic, tourism and agriculture are the main producers of litter. Synthetic plastic products are particularly hazardous to the environment, as they are fragmenting into numerous tiny microplastics under the influence of intense solar radiation and mechanical agitation. Microplastics can originate from larger plastic items (i.e. secondary microplastics) or are entering the marine environment as primary microplastics. A steadily growing number of publications and reports are documenting the continuous littering of the marine environment and the consequences of microplastics on marine biota. In this study, the occurrence, distribution and composition of microplastics is being investigated in sediments of Slovenian beaches. Sediment samples were collected in March 2017 and are currently being analysed for comparison with results from a previous study conducted in July 2012. Microplastics are recovered from sediments by density separation and filtration. The particles are analysed by infrared spectroscopy to identify the polymer type of the plastics. Microplastics are abundant in Slovenian beach sediments. Most of the items are of irregular shape, including fibres, films and fragments, indicating that the particles mostly constitute secondary microplastics. In the previous study, it has been proven that tourism is not the main producer of microplastics. Accordingly, major polluters of the Slovenian coast are yet to be identified. The applied approach will provide in-depth information on the plastic pollution on the coast of Slovenia. The data generated in this project will be of societal importance, as pollution tends to reduce the aesthetic value of the environment and can, thus, reduce revenues from Slovenian tourism.

## INTERACTIONS BETWEEN BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) AND TRAWLERS IN THE GULF OF TRIESTE

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Presentation type: POSTER

Interactions between cetaceans and fisheries are a widespread occurrence in the Mediterranean Sea and worldwide, effects of which range from positive to negative for one or both sides involved. Between 2002 and 2012 we studied interactions between common bottlenose dolphins (*Tursiops truncatus*) and different types of trawlers in the Gulf of Trieste and adjacent waters, as part of a long-term study on bottlenose dolphin ecology and conservation. Out of 205 recorded sightings, 22 % involved an interaction with trawlers. Of those, 51.1 % interactions were with pelagic pair trawlers, while 46.7 % were with (single) bottom trawlers. Even though the frequency of interactions among two types of trawlers was similar, dolphins appeared more likely to follow pelagic pair trawlers, with the fleet size 15 times smaller than that of bottom trawlers. We also compared the frequency of interactions with trawler catch quantity and type. The amount of total catch is largely influenced by the catch of pelagic pair trawlers. We found that the cumulative quantity of catch has dramatically declined over a decade (more than 6 times). Despite catch decline, there was no trend in frequency of interactions or overall sightings. The most important catch was represented by anchovies (fam. Engraulidae), sprats (fam. Clupeidae) and golden grey mullets (fam. Mugilidae), suggesting that this was also the target prey for dolphins. Group size during interactions ranged from 1 to 28 individuals. Calves were present in almost half of all interactions. The animals followed trawlers for a variable amount of time, from 9 to 149 minutes. Photo-identification data showed that most recorded interactions involved the same identified individuals, while such behaviour was never observed in others. Out of all identified individuals more than 50 % were included in the interactions at least once. Both types of trawlers appear to attract dolphins and thus alter their movements and behaviour.

## DO LURE-ASSISTED UNDERWATER VISUAL CENSUS (LURE-UVC) AND DIVER-OPERATED VIDEO CENSUS (DOV) DETECT SIMILAR FISH COMMUNITIES, HABITAT MOSAICS AND SPECIES-SPECIFIC HABITAT PREFERENCES?

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Presentation type: POSTER

Fish communities within two Croatian MPAs were surveyed using both diver-operated underwater video (DOV) via SCUBA and lure-assisted visual census (Lure-UVC) via snorkeling. Both methods were applied at similar depths within replicate MPA locations, Kornati NP (4) and Brijuni NP (2). We predicted that the methods detect similar fish communities, habitat mosaics, and fish habitat preferences. To avoid inter-observer variability-errors, fish and habitat identification in all surveys was done by the CK. Habitat types were defined by a common protocol. Higher species richness ( $35 > 30$ ) was detected by lure-UVC in Kornati. In Brijuni, DOV detected more species ( $31 > 25$ ). The MPA-specific communities observed by the two methods were 72% similar within Kornati NP and 92% similar within Brijuni NP (Sørensen Index). Both methods recognized the same six habitats in Brijuni NP and five common habitats in Kornati NP, with one unique observed by DOV. In Kornati NP, Lure-UVC detected significant habitat preferences for 10 (28%) species of which nine preferred transitional habitats, the edges between R and U (RU) and R and P (RP); DOV detected significant habitat preferences for 15 (50%) species of which 12 preferred either R or RP transitions. In Brijuni NP lure-VC detected four (13 %) and DOV seven (28 %) species with significant habitat preference, and all eleven species were significantly attracted to transitions from rocky reefs to sedimentary bottoms (RU) and all significantly avoided bare sand (U). We conclude that the two methods are comparable in their ability to sample fish communities, habitats and habitat preferences. Decisions about which method to use should focus on availability of resources and target depths. Lure-UVC is more cost and time efficient because it does not need SCUBA and video-processing but requires the presence of a fish/habitat expert in the field, preferably the same individual. DOV requires costly SCUBA operation and lengthy post-video analysis in the lab but allows for multiple experts relying on permanent records. Sample sizes per unit field-time is high for DOV and depends on the number of divers operating DOV. DOV can be applied at wider depth range than surface-based UVC.

## CAN RED CORAL (*CORALLIUM RUBRUM*) POPULATIONS BENEFIT FROM MARINE PROTECTED AREAS IN THE ADRIATIC SEA?

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Presentation type: POSTER

The great majority of marine protected areas in the eastern Adriatic Sea fail to meet their management objectives. Many common, but declining species could benefit from protected areas, but sometimes this is not a rule. The goal of this study was to assess the average proportions of the most severe long-term declining of red coral populations inside and outside protected areas in the eastern Adriatic Sea as well as their temporal stability. Several species, which are mostly dependent on human activities, exhibited a negative long-term trend. Long-lived corals are especially vulnerable to human-induced mortality, given their slow growth and low recruitment rates. Long-term data (from 2000 to 2015) of commercial marine invertebrate *Corallium rubrum* populations in the National Park Kornati, National Park Mljet and Nature Park Telašćica were compared with unprotected areas. Red coral populations showed no difference in abundance or size between the MPAs and adjacent control areas, all in negative trends. The data suggest fishing pressure within the MPAs is at least as high as at other “fished” sites. On average, red coral populations were up to ten times more abundant in marine protected areas in 2000 than in 2015. The MPAs had the lowest mean numbers and sizes of studied populations of all areas, no-take or open to fishing. A poaching event, which was detected during our monitoring in MPAs was associated with a loss of approximately 80% of the biomass of red coral colonies. Current populations have shown a dramatic shift in their size structures characterized by the absence of large colonies. This negative phenomenon may cause MPAs and reserves to fail to meet their targets. The lack of recovery of red coral species within the MPAs, despite the restrictions, indicates that populations were almost exterminated. Possible recovery of red coral populations may be measured by several decades or even centuries.

OCCURRENCE OF DEVELOPMENTAL ABNORMALITIES IN BIVALVE LARVAE AND  
POSTLARVAE FROM THE GULF OF GDANSK (SOUTHERN BALTIC SEA) AND ITS  
POSSIBLE USE IN ENVIRONMENTAL QUALITY ASSESSMENT

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The prevalence of developmental abnormalities in bivalve larvae from the Gulf of Gdansk was analyzed in a time-series sampling during 2012 and 2013. Species identification was done by using molecular tools. The results showed that larvae of *Mytilus trossulus*, *Mya arenaria* and *Cerastoderma glaucum* had abnormalities which consist mainly in shell deformities, but also missing soft tissue fragments and protruding velum. Percent of abnormal larvae varied seasonally and in some samples reached 36%. To our knowledge this study is one of the few reporting such high rates of abnormalities in pelagic bivalve larvae. Benthic postlarvae of *Mytilus trossulus* were also analyzed: shell abnormalities were observed in the form of grooves and notches at different locations of the prodissoconch, dissoconch and shell margin. Some of these deformations reminded the indentations found on the shell edge of pelagic larvae and suggested that survival of larvae with shell abnormalities was low. Based on these findings, the use of larval abnormality rates as field bio-indicators of pollution effects is discussed.

## SPATIOTEMPORAL VARIANCE IN ZOOPLANKTON SAMPLING – A FIELD STUDY

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Presentation type: POSTER

We studied the spatial and temporal variability of sampled zooplankton abundances in the Hanko archipelago, in the Gulf of Finland. Long-term time-series of zooplankton monitoring data have been collected from the same area. Our goals are threefold: 1) we want to investigate the repeatability of sampled zooplankton abundance between replicated samples, 2) we estimate spatiotemporal variance components within the same sampling season and area, and 3) we aim to recognize the most important environmental covariates which can be used for correcting sampling bias. The experiment was conducted during the summers of 2015 and 2016, at three locations outside of the Hanko peninsula in the Gulf of Finland along a gradient from sheltered to exposed stations. Each station was sampled twice in June and August with three replicates each. The sampling method was in accordance with long term study praxis from the same site. The repeatability of the sampling events and the spatiotemporal variation are predicted to have important implications for monitoring efforts and for the usability of long term data. In upcoming studies, we hope to use this quantitative information to approximate the level of observation error variance in existing monitoring data, to facilitate further state-space modelling of long-term trends and population dynamics.

## DISTRIBUTION AND ABUNDANCE OF CHAETOGNATHS IN THE COLOMBIAN PACIFIC OCEAN AND FIRST APPROACH TO THEIR BIOMASS

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Presentation type: POSTER

Phylum Chaetognatha is important due to its abundance in the oceans (usually the second most abundant holoplanktonic group after copepods), as very active predators in marine food chains and some species as indicators of certain water masses conditions and global oceanic environmental changes. Twenty-three oceanographic stations along the Colombian Pacific Ocean (CPO) were considered for collecting zooplankton with a bongo net (mesh 294  $\mu\text{m}$ , oblique tows to an average depth of  $184 \pm 42\text{m}$ ) during September 2007. Distribution, abundance ( $\text{n}/100\text{m}^3$ ) and wet biomass ( $\text{g}/100\text{m}^3$ ) were calculated. Undamaged chaetognaths were measured and weighed to define their size (head to tail, excluding the tail fin) and wet biomass ( $\text{g}/100\text{m}^3$ ). Temperature ( $^{\circ}\text{C}$ ), salinity, dissolved oxygen (DO) ( $\text{ml}/\text{l}$ ) (CTD) and chlorophyll-a (Chl-a) ( $\text{g}/100\text{m}^3$ ) (estimation of phytoplankton biomass) were assessed with a CTD and a spectrophotometer respectively. Factor and cluster analyses were performed. All planktonic biota exhibited a very wide distribution along the CPO. Highest abundances of chaetognaths (juveniles 46.8%, adults 42.0%), zooplankton (34.7%) and phytoplankton (55.4%), were registered in nearshore waters, and biomass of adult chaetognaths offshore (42.7%), while juveniles exhibited similar coastal and oceanic biomasses (34.7% vs. 35.5%). Correlations among the abundance/biomass of chaetognaths, zooplankton biomass (0.81-0.92), and phytoplankton (-0.52) were attributed to trophic relationships. Temperature (0.91), DO (0.86) and salinity (-0.60) also showed some influence on the organisms. Highest abundance/biomass percentages occurred at night (50.7-59.4%), possibly related with vertical migrations of organisms (correlations= day 0.93 vs. night -0.86). The dendrogram showed one cluster formed by nearshore and intermediate stations (except one oceanic), and other two clusters of intermediate and oceanic stations. The three groups included mainly high abundances/biomasses values, as well as day and night stations. Results are similar to other regions of the American Pacific and other oceans. Besides this first chaetognaths biomass approach, to further know the role of these organisms in the CPO, additional research are needed, e.g., chaetognaths species and prey identifications, plus biomass estimates by carbon analysis to assess the energy transfers to other trophic levels.

## UNUSUAL ZOOPLANKTON BLOOM IN THE OPEN SOUTHERN ADRIATIC SEA

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Presentation type: POSTER

The paper reports an unusual response of the microzooplankton community to oceanographic conditions observed during the winter of 2015 at the open South Adriatic. Record-breaking nauplii abundance of 13 734 ind. m<sup>-3</sup> have been sampled for the open South Adriatic by 50 - µm net sampling. High densities were noted up to the 300 m depth for all copepods developmental stages. The observed zooplankton maximum could have been ascribed to (i) warmer-than-usual surface and intermediate ocean temperatures, (ii) a high excess in precipitation preceding the samplings for a prolonged period, which freshened and widened surface layers and pushed saline Levantine Intermediate Water inflow below 400 m depth, and (iii) strong wind episodes that could transfer nutrients from coastal area to open ocean and induce limited vertical convection. The latter has been confirmed by observing neritic tintinnids species exclusively in the mesopelagic layer and autotrophic cells below the photic zone. Average seasonal maximum of zooplankton abundance is shifted from spring and early summer towards late winter months. Our results are documenting large and fast variations of production conditions, rarely found to occur in oligotrophic waters such as the South Adriatic Sea.



FIRST RECORD OF THE ALIEN RED ALGA *LOPHOCLADIA LALLEMANDII* IN CROATIAN PART OF ADRIATIC SEA

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Presentation type: POSTER

The Indo-Pacific red alga *Lophocladia lallemandii* (Montagne) F. Schmitz 1893, has been probably introduced in the Mediterranean Sea through the Suez Canal. It was first recorded in Greece and Lybia in 1908, and since then, over a wide area of the Mediterranean Sea. In some locations, *L. lallemandii* shows invasive behavior with negative consequences on *Posidonia oceanica* meadows, native macroalgae and marine invertebrate. It is considered one of the 100 most dangerous alien Mediterranean marine species. In the Adriatic Sea it was found only in few locations: at the entrance to the Adriatic Sea - Sazani Island (Albania), Tremiti Islands (Italy) and the Gulf of Trieste (Italian and Slovenian side). According to recent information, in the northern Adriatic is not present anymore. Here we report a new location for the Adriatic Sea which we discovered in October 2012 on Blitvenica Island (Middle Adriatic). It was found as an extensively developed species. This represents the first record in the East part of the Middle Adriatic which is also one of the northern locations in Mediterranean. Since the first observation, *L. lallemandii* was constantly present with full development in autumn. Seawater bottom temperature at 15 m measured by data loggers from October 2014 till October 2016 has average values of 18.2 °C, with the minimum 12.8 °C in March 2015 and maximum 26.1 °C in July and August 2016. Species develops between 1 and 30 m, mainly as an epiphyte on *Cystoseira* and *Sargassum* species. In October 2016, the maximum coverage of 12% between 5 and 15 m depth was found. Reproductive structures were noted: trichoblasts and slightly spirally twisted tetrasporangial stichidias occurred on basal cells of trichoblasts. Based on previous studies on invasive behavior of this species in other parts of the Mediterranean and extensive development on Blitvenica Island, we believe that this species could negatively affect the special composition of the communities of the region where some very rare species exist, such as *Cystoseira jabukae*. Also, there is a possibility of further spreading across the Adriatic Sea, where it could have an impact on the native benthic biota and habitats.

USE OF OTOLITH MORPHOLOGY IN STOCK DISCRIMINATIONS OF *PAGELLUS ERYTHRINUS* IN THE NORTHERN TUNISIAN COASTS (BIZERTE AND GOULETTE)

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Presentation type: POSTER

The common Pandora, *Pagellus erythrinus* (Linnaeus, 1758), which belongs to the family Sparidae, is a valuable species for aquaculture and fisheries. The species has a relatively wide distribution, inhabiting the Black and Mediterranean seas and from Norway to Angola (Bauchot and Hureau, 1986). This species is widespread in Tunisia. Despite their economic importance, few studies have focused themselves to stock discrimination and to the fisheries management. The goal of this research was to evaluate by using otolith shape, the stock structure of Sparidae (common Pandora) for two Tunisian marine populations (Bizerte and Goulette) using different statistical approaches. In the same population, the P-value (left-right) is highly statistically significant ( $p < 0.05$ ). However, the p values for the distances were significant ( $P < 0.05$ ) for the two populations. The asymmetry (Left-Right) of otoliths revealed here indicates that the two populations of fish have a different morphology of otoliths and belongs to different fish stock.

COMPARATIVE MORPHOLOGY OF THE SAGITTAL OTOLITH OF THE COMMON PANDORA (*PAGELLUS ERYTHRINUS*) (LINNAEUS, 1758) FROM TWO TUNISIAN COASTS (MAHDIA AND SFAX)

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Presentation type: POSTER

The aim of this research is to investigate by using otolith shape, the stock structure of Sparidae (*Pagellus erythrinus*) in the Tunisian coasts (Mahdia and Sfax). Otolith shape was determined by using Fourier analysis. The mathematical analysis of the otolith shape was achieved by the Discriminant Factor analysis (D.F.A). The basis of this method is the detection of the phenotypic polymorphism between two marine populations of fish, between pairs of otoliths from each station and between the pairs of otoliths of different stations. In the same population, the P-value (left-right) is statistically significant ( $p < 0.05$ ); however, the p values for the distances were significant ( $P < 0.05$ ) for the two marine populations. The asymmetry (Left-Right) of otoliths revealed here indicates that two populations have a different morphology of otoliths and belongs to different fish stock.

## VERTICAL MIGRATIONS IN THE OCEAN AND THE DEEP SOURCE-SINK HYPOTHESES: INSIGHTS FROM PRESSURE TOLERANCE INVESTIGATIONS

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Presentation type: POSTER

It has been postulated that, throughout geological times, faunal migrations between the shallow-water and deep-sea environments have resulted in the broad colonisation of oceanic depths we see today. Attempts have been made to explain the current bathymetric ranges of animals by the submergence (shallow to deep) hypothesis and the high-latitude emergence (deep to shallow) hypothesis, but there has so far been no clear consensus. Here, we explore empirical support for both hypotheses, in addition to a newly proposed parsimony hypothesis, which would explain colonization as a bi-directional movement of species between the shallow-water and deep-sea environments. We collated and analyzed data from >130 studies reporting the pressure tolerance of adults and embryos/larvae of >250 species obtained from different regions and depths. Subsets of the main database were used to test whether the ability to tolerate a change in pressure is influenced by (i) depth stratum of origin, (ii) geographic location of origin, and (iii) phylogeny. This review revealed stronger empirical support for the general tolerance of deep-water taxa to atmospheric pressure than for tolerance of shallow-water taxa to increases in pressure. Overall, species from bathyal depths survived longer under atmospheric pressure than those from abyssal depths. Deep-sea species also survived better than shallow-water species to pressure trials. If tolerance to non-native pressures is taken as a predictor of potential for vertical migration, empirical and experimental data currently lend more support to the parsimony and/or the emergence hypotheses. Species collected at depth from tropical locations were less tolerant to a pressure change than those from northern latitudes, emphasizing the confounding impact of thermotolerance. Phylogeny was also investigated as a driver of pressure tolerance in adults and larvae. Taken together, these findings provide a valuable overview of the current state of knowledge and offer a framework for further investigation of vertical movements of marine species across depths, which will be particularly useful in predicting ecosystem shifts in the face of climate change.

## CHANGES IN BIOTURBATION POTENTIAL AND FUNCTIONAL DIVERSITY OF SOUTHERN NORTH SEA MACROFAUNA COMMUNITIES BETWEEN 1986, 2000 AND 2010-2015

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Presentation type: ORAL

Macrofauna bioturbation activities including key processes of sediment reworking and ecosystem engineering in marine habitats are carried out by benthic organisms during feeding, foraging and burrowing activities. Only little is known about spatial and temporal variability of functional diversity and community bioturbation potential (BPC) of southern North Sea macrofauna. For the present study large-scale and long-term functional diversity and BPC of southern North Sea macrofauna were analyzed within an area between 53°30' to 56°N and 3° to 8°E. Based on macrofauna data of the North Sea Benthos Survey (NSBS) in 1986 and the North Sea Benthos Project (NSBP) in 2000, functional diversity and BPC were calculated and compared with present data from 2010-2015. The NSBS 1986 sampling took place after three cold winters within a period of a longer lasting negative NAOI; NSBP 2000 after the cold winters in 1995/95 during the *abrupt BRS* in 2000/2001. The recent sampling period from 2010-2015 was dominated by positive SST anomalies, although it involves a colder (2010-2013) and a warmer (2014-2015) period. In all study periods four mobility traits (fixed tube (FT), limited movement (LM), slow free movement (SM) and free movement (FM)) and four sediment reworking traits (surficial modifiers (S), upward/downward conveyors (U), biodiffusers (B) and regenerators (R)) were found, approving 11 combinations into functional groups. Within NSBS 1986 three basically different trait based communities at the Dogger Bank, Oysterground and coastal waters were found, dominated by the functional group B/SM. Long-term comparison of 1986 communities with 2000 and 2010-2015 data revealed basic changes in BPC. Trait based communities, comparable with the four main macrofauna communities of the southern North Sea (*Amphiura filiformis*-, *Bathyporeia* spp.-, *Tellina fabula*- and *Nucula nitidosa*-community) were found only in 1986. Since the three data sets represent three basically different hydro climatic environments, temperature and climate induced changes were analyzed and results were linked to observed changes in water clarity since the beginning of the 20<sup>th</sup> century. Variability of macrofauna community traits showed only minor correlations with environmental parameters primary production and depth.

“BIODIVERSITY MARE TRICASE” PROGRAMME: PROMOTING COASTAL AND MARINE  
BIODIVERSITY AT MARE OUTPOST (TRICASE PORTO, APULIA, ITALY)

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Presentation type: POSTER

Biodiversity is the result of billions years of evolution and it is the most precious good we have on earth. Biodiversity is fundamental for the functioning of ecosystems and it provides us many goods and services. Due to an unsustainable mode of development, we risk to lose this immense heritage. Avamposto MARE, newly inaugurated in Tricase Porto, is a Mediterranean outpost for the development of coastal territories and biodiversity protection. It is a place of international cooperation for the sustainable development of Mediterranean coastal communities but it is also a marine biological station. Here, scientists have the opportunity to interact and collaborate with local people, tourists, artisanal and recreational fishermen, politicians, and other stakeholders. Tricase Porto is an ideal place for biodiversity researches and valorization: it is a small village of fishermen in the Salento peninsula and it is situated at the heart of a regional park, where local economy is mostly based on artisanal fishery and eco-tourisms. “Biodiversity MARE Tricase” programme ([www.biodiversitymaretricase.org](http://www.biodiversitymaretricase.org)) aims to research and promote marine and coastal biodiversity at the MARE Outpost. The programme started with the realization of a first taxonomic inventory of the area, a starting point for long term biodiversity monitoring. The whole community has been involved: fishermen and local people played a key role in species collection. Moreover, conferences, workshops, summer courses for children and guided visits have been organized to increase people awareness of the value of biodiversity. Thanks to the PADI Foundation grant 2017, scientific dissemination activities of the programme will be improved. The great limit for biodiversity conservation is the lack of concern for nature: without awareness of the importance of biodiversity to humankind, people are not likely to mainstream biodiversity consideration in daily life and in consequence, it is unlikely that biodiversity issues have high political priority. The involvement of citizens in biodiversity research and promotion activities at the Avamposto MARE results in a growth of curiosity and respect for nature, a concrete example of achievable biodiversity conservation action. Passion and goodwill can do great good for the marine environment even with a relatively small amount of money.

## SEAWATER FROM DINOFLAGELLATE *OSTREOPSIS OVATA* FUKUYO 1981 CULTURES CAUSES INCREASED PERMEABILITY OF NASAL TISSUE

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Presentation type: POSTER

The species of the genus *Ostreopsis* produce a range of palytoxins and ovatoxins. Massive abundances are observed in shallow coastal areas, especially close to the shoreline in only a few meters of depth. Blooms with dramatic impacts on human health are so far mainly reported from the coasts around the Mediterranean. In the area around Genova, Italy, several hundred persons had to be hospitalized after exposure to aerosols during a bloom of *Ostreopsis* in summer 2005. Clinical symptoms range from rhinitis over asthma like symptoms, violent contractions of all muscle types, sperm immobility, to hemorrhagic and ultimately fatal effects. The rising interest in *Ostreopsis*, which is able to produce toxic aerosols along shorelines, resulted in searches for its distribution independent of reported impacts on human health. It was therefore the aim of this study to investigate the impact of the toxin on the modulation of the permeability across the porcine nasal mucosa, which is very similar to the human one. The study was performed using the Ussing chambers method. The results showed an increase in the permeability across the nasal mucosa, in comparison with only sea water, showing that this could be the cause for the respiratory problems induced by the toxin.

## FUNCTIONAL BIODIVERSITY OF MARINE SOFT-SEDIMENT POLYCHAETES FROM TWO MEDITERRANEAN COASTAL AREAS IN RELATION TO CONTAMINATION

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Human activities have the potential to alter diversity and composition of benthic communities in natural environments. In the present study, the effects of contamination on the functional adaptation of coastal polychaete assemblages were analyzed. The study was carried out in two impacted coastal areas with different level of contamination: the harbor of Trieste (Adriatic Sea) and the Mar Piccolo of Taranto (Ionian Sea). Biological Traits Analysis (BTA) was used by applying two functional indices i.e. the functional dispersion (FDis) and the community weighted mean of expression (CWM), to explore how contaminated sediments structure the functional diversity of polychaete species. The analysis was performed on a dataset of 103 taxa, collected at four stations in each area during two sampling campaigns (2014-2015). Multivariate analyses highlighted that the polychaete assemblages differed significantly in taxonomic composition between the two areas, but this was not observed for their trait expressions. FDis and trait richness displayed fairly constant values despite varying polychaete richness. The anthropogenic stressors have caused a decline in diversity but this was not clearly reflected in functional diversity, probably due to the reduction of species that contribute little to community functions or are functionally redundant in the analyzed polychaetes assemblages. The most distinct trait patterns were shown for traits reproductive frequencies as mobility, environmental position, movement methods, and feeding habits in relation, principally, with levels of copper, mercury and total nitrogen in the sediments. The trait composition changed from a well-balanced functional structure toward highly motile species in the most severely contaminated site and sessile, tube-builders and suspension-feeders, from high to low contamination in relation also with organic enrichment. High motility of the species seems to be an essential trait for living in highly contaminated sediments. This could be linked to the ability to avoid hotspots of contaminants through active movements, impacting the sediment reworking and nutrient exchange. The results illustrate how BTA, in particular the functional identity, offers an integrative approach to detect the functional adaptation related with contamination, and thus be relevant in explaining the ecosystem functioning in an area subjected to multiple anthropogenic stress.



RECRUITMENT IN *MACOMA BALTHICA* POPULATION OF THE WHITE SEA: SEASONAL AND LONG-TERM DYNAMICS OF THE SETTLING

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Presentation type: POSTER

*Macoma balthica* (Linnaeus, 1758) is a common bivalve inhabiting the boreal intertidals. In this study we examined growth, seasonal and long-term trends in density variation of *M. balthica* recruits in the Kandalaksha bay, the White Sea. To assess this, we analyzed the extensive data set (1987-2016) from seasonal monitoring observations at the White Sea Biological Station "Kartesh" (Zoological institute, RAS) performed in two closely located bights (Naumov, 2006). *M. balthica* recruits in the White Sea have been previously reported to settle in July-early September at the size of 0.3 mm (Maximovich, 1985; Flyachinskaya, 2008). To infer spat linear growth, we calculated the midst (arithmetical mean) between 0+ and 1+ clams mean sizes in each season of 2016. We further used these values as size thresholds to discriminate recruits in other samples. According to our observations, recruits grow up to 1.2 ( $\pm 0.05$ ) mm from settling to October and up to 1.6 ( $\pm 0.05$ ) mm to next June. For each year, we evaluated densities of spat ( $\leq 1.6$  mm molluscs) in autumn and of  $\leq 1.9$  mm molluscs in next spring, and we estimated annual recruits survival by ratio of these two densities. Mean annual recruits survival rate varied between 0 and 98% during 20 years of study, the median value along 20 years period being around 30%. Settlement of *M. balthica* postlarvae took place annually and varied from 40 to 6000 ind.\*m<sup>-2</sup> among study sites, years and tidal elevations. According to ANOVA, recruit abundance depended on both year and site of settling. Low negative correlation was found between density of *Macoma* recruits and mean air temperature of February ( $r=-0.34$ ,  $p=0.04$ ) and April ( $r=-0.33$ ,  $p=0.04$ ) was found. The highest numbers of postlarvae were observed in years when density of adults was low, but no correlation between abundance and settlement success was found. We would like to thank all people involved in the fieldwork and processing of samples, and personally Dr. Andrew D. Naumov (WSBS "Kartesh" ZIN RAS) who allowed us to use the long-term data set on *M. balthica*. The study was partly supported by the RFBR grants 16-34-00682 and 15-29-02507.

## RECENT RESEARCH ON DISTRIBUTION OF TINTINNIDS IN THE SOUTH ADRIATIC SEA

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Presentation type: POSTER

The Adriatic Sea is a semi-enclosed sea and its ecosystem is influenced by the regular exchange of water with the Eastern Mediterranean. Levantine Intermediate Water and Ionian Surface Water flow into the Adriatic along the sea's eastern border. The volume of this flow depends on climatic oscillations that occur from the Atlantic to the Southeast Mediterranean. The South Adriatic, the deepest part of the Adriatic Sea, represents a key area for both the Adriatic Sea itself and the entire Eastern Mediterranean basin. Tintinnids are the best known ciliates in the marine plankton. Their high frequencies and identifiable morphology have been suggested as indicators of oceanographic conditions including water temperature and origin, such as neritic, oceanic, and even upwelling water. Samples in South Adriatic were collected at four stations with a 53 µm mesh Nansen net. The spatial and temporal distribution of tintinnids was investigated at monthly intervals in the South Adriatic Sea during 2016. Of the 68 species identified, there were 47 surface, 15 subsurface, 3 mid-water, and 1 deep sea species. The dominant surface and subsurface species were *Codonella aspera*, *Codonella amphorella*, *Undella claparedei* and *Salpingella accuminata*. Species *Parundella lohmanni* predominated in the mid-water layers and *Xystonellopsis scyphium* in the deep-sea layers. While the majority species are always present in the South Adriatic Sea, some species were occasionally immigrants from the Mediterranean Sea. The highest variability in the number of species occurred in the surface and subsurface layers. A mid-water community of species *Parundella lohmanni* indicated inflowing South Adriatic Deep Water. Some other species such as *Poroceus apiculatus*, *Undella subcaudata* and *Eutintinnus elegans* appeared with strong inflows of the Levantine Intermediate Water during winter and spring. Based on these results, tintinnids may be used as a biological indicator of the state or possible changes in the marine ecosystems of the South Adriatic Sea.

## ASSESSMENT OF THE *CYMODOCEA NODOSA* (UCRIA) ASCHERSON MEADOW'S STATUS WITH THE NEW MEDISKEW INDEX

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In the Mediterranean Sea meadows of the the Lesser Neptune grass (*Cymodocea nodosa* (Ucria) Ascherson) are widely distributed throughout shallow sites. Therefore, the correct assessment of the status of such meadows is essential for the implementation of the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD), and the Habitat Directive (HD). The previously proposed index for the evaluation of the status of *C. nodosa* meadows (CymoSkew) was further improved, and a new index (MediSkew) was developed. The MediSkew is a combination of two metrics, both based on *C. nodosa* leaf length: deviation from the reference median length (Medi-) and skewness of the length frequency distribution (-Skew), though greater importance was assigned to the first. The combination of the two appropriately weighted metrics gave a more precise evaluation of the status of all *C. nodosa* meadows than using only one metric. To be compliant with WFD, reference conditions were defined for *C. nodosa* meadows and a Pressure Index for Seagrass Meadows (PISM) was developed for the evaluation of pressure-impact relationship. The status of *C. nodosa* meadows in the Gulf of Trieste (northern Adriatic) assessed with the MediSkew showed a good correlation with the sum of the main human-induced pressures evaluated using PISM. Within seven *C. nodosa* meadows only two sites did not achieve a Good Ecological/Environmental Status. The MediSkew and the PISM indices are proposed to be a rapid screening method for *C. nodosa* meadows, especially for areas where *Posidonia oceanica* meadows (the most frequently used indicator in the Mediterranean Sea) are rare or not present. The MediSkew index has a potential broad applicability in the context of three important European Directives, and its use is recommended in regular monitoring programmes.

## ESTIMATING MICROZOOPLANKTON GRAZING BEFORE AND AFTER OCEAN MACRONUTRIENT FERTILIZATION: AN EXPERIMENTAL CASE STUDY FROM OFFSHORE OF SYDNEY, AUSTRALIA

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Presentation type: POSTER

Moderating the global average temperature increase to less than 2°C as proposed in the Paris Agreement of December 2015 has motivated innovative approaches to reduce the concentration of greenhouse gases in the atmosphere. One technology proposed for carbon dioxide removal (CDR) in the atmosphere is ocean macronutrient fertilization (OMF) using the macronutrients nitrogen and phosphorus to increase marine biomass and subsequently carbon export through phytoplankton growth. Increasing primary production of the ocean is expected to increase carbon sequestration to the deep ocean as well as potentially enhancing the higher trophic levels of the marine food web. However, there is a gap in quantifying the amount of primary production that may be grazed by microzooplankton following macronutrient fertilization of the ocean. Microzooplankton grazing affects the transference of carbon into the marine food web. The present study aims to experimentally examine microzooplankton grazing before, during and after simulated OMF, in order to elucidate the fraction of primary production grazed by this predator class. A total of 3 experiments were conducted between January and April 2017 at a long term ocean monitoring site offshore of Sydney, Australia. The preliminary results on phytoplankton biomass show the difference made by microzooplankton grazing before and after ocean macronutrient fertilization.

POPULATION STRUCTURE OF COMMON LOBSTER, *HOMARUS GAMMARUS* IN THE NORTHERN ADRIATIC SEAMišo PAVIČIĆ<sup>1</sup>, Dario VRDOLJAK<sup>1</sup> and Sanja MATIĆ-SKOKO<sup>1</sup><sup>1</sup>Institute of Oceanography and Fisheries, Meštrovićevo šetalište 63, 21000 Split, Croatia

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The common lobster, *Homarus gammarus* is economically very important species of large crabs in the Adriatic. However, its catches are very intense and irregular. Therefore, economic importance in the last 20 years is not based on the total catch but on a very high price that this species achieved on the market. Unfortunately, there is still no sufficient biological and ecological knowledge of this species in the area of its distribution range, and especially not in the Adriatic. To elucidate some biological parameters that can indicate the status of *H. gammarus* in the northern Adriatic Sea and to show which consequences fishery effort may have on its population structure, sampling was carried out on the west coast of Istra using trammel nets and traps. Additionally, existence of temporal trends in landings of *H. gammarus* was assessed using long-term data including specimens caught in last decade. Temporal trends of *H. gammarus* in the northern Adriatic indicated significant increase in catch in term of both biomass (27%) and abundance (11%) over time. Also, official landings for the last five years showed an increase of almost 40%. However, this increasing trend most likely reflects the continuous change in national policies for reporting the catches. Both catch data and landings statistics showed peak in catch per unit effort during summer which coincides with catch season of *H. gammarus* (June). Total male to female sex ratio was 1:0.7. Length analysis revealed range from 17 cm (male) to a 48 cm long as probably the oldest specimen. Length-weight relationship revealed positive allometric growth ( $b = 3.092$ ,  $R^2 = 0.941$ ). Length classes from 30 to 34 cm were predominant in the total catch. However, almost 32 % of immature individuals were represented in total catch. Considering the identified biological implications that confirm our assumptions of inherent vulnerabilities and negative effects arising from continued fisheries practice, existing management should be complemented by a more holistic, ecosystem approach to regulations in order to assure more effective conservation measures for this large crab.

## POTENTIAL FOR DEVELOPING MULTISPECIES CHRONOLOGIES IN THE MEDITERRANEAN SEA - CASE STUDY OF PAG BAY, ADRIATIC SEA

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Sclerochronology is the study of calcified structures, including fish otoliths, bivalve shells and corals, to reconstruct the past events. During the last decades, it has become increasingly evident that bivalve shells can enhance our knowledge about climatic and environmental changes, that can, due to long life span of some bivalve species, extend for decades and centuries into past. This study was conducted in Pag bay, location for which the first bivalve chronology for the Adriatic Sea was recently developed. Samples of two bivalve species, *Glycymeris bimaculata* and *Callista chione*, were live collected by skin and SCUBA diving from 3-5 m depth in a period from May 2014 to July 2016. *G. bimaculata* is a large and long lived bivalve that can grow over 80 mm in length with age surpassing 60 years. The other target species (*C. chione*) is a commercially important bivalve whose life span can extend over four decades. We analyzed 53 samples of *G. bimaculata*, which ranged in length from 82 to 98 mm and 50 shells of *C. chione*, which ranged in length from 64 to 79 mm. Each shell length, height, width and dry shell weight was measured before every sample was cut around the hinge and embedded in epoxy resin. Embedded samples were cut along the maximum growth axis, grinded, polished and etched and acetate peel replicas of shell sections were prepared. Series of images for each specimen were taken using Zeiss microscope and camera, and composite images were prepared using Image Pro Premier program. List year method was used for visual crossdating of images. Measurements of increment widths were then continuously taken along maximal growth axis using Image Pro Premier. Crossdating was verified using program COFECHA while dendrochronology software package ARSTAN was used to construct chronologies for both *G. bimaculata* and *C. chione*. Constructed chronologies were compared to each other and to available environmental data. Advantages and challenges of use of each species for chronology construction and potential for developing multi-species chronologies in the Mediterranean Sea are presented and discussed.

## BAITED REMOTE UNDERWATER VIDEO (BRUV) SUITABILITY FOR DETECTING FISH COMMUNITY VARIATION IN AND OUT OF A MARINE PROTECTED AREA IN CROATIA, EASTERN ADRIATIC SEA

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Baited remote underwater video is a non-destructive method for censusing fish species abundance that is currently under consideration for use in the Mediterranean Sea for monitoring fish stocks and the effectiveness of fisheries regulations. We tested the method in the eastern Adriatic for effectiveness in detecting impacts of habitat degradation and fish harvest on fish abundance, size, and community assembly. A total of 215 BRUVs were deployed at 10 locations during all months from April to September of 2015 and 2016 at and near Kornati National Park (KNP) in Croatia, at benthic habitats including unconsolidated sand/gravel to rocky reefs, with and without macro vegetation consisting of seagrasses *Posidonia oceanica*, *Cymodocea nodosa*, or macroalgae *Cystoseira* species. We analyzed species abundance using generalized linear models with protection or habitat status as fixed predictor factors, location and date of sampling as a random blocking factor, and the maximum number of individuals visible within any single video frame as the proxy of abundance within a species. To estimate asymptotic total species richness we used the Chao estimator, or standard methods of jackknifing or bootstrapping the dataset. We found very highly significant differences in species richness across 10 sampling locations, with the maximum estimated richness within KNP ranging from 53 to 65 (SE 2 to 10), and outside KNP ranging from 24 to 27 (SE 1 to 2). In addition, we find significantly higher species richness associated with structured and edge habitats, such as rocky reefs, and lower richness associated with uniform seagrass or anthropologically degraded habitat. Taxa found more abundant inside the MPA include species heavily targeted by local fisheries, such as *Diplodus* species, *Spaurus aurata*, *Dentex dentex*, *Mullus surmuletus*, and schooling pelagic genera such as *Spicara*. We conclude that BRUV has power to detect responses of individual species both to harvest, and to human habitat disturbance, and can assist in testing hypotheses about fish community assembly in the Adriatic Sea. This work was supported by the Croatian Science Foundation under the project COREBIO (3107).

## MARINE INVERTEBRATES MIGRATE WITH CLIMATE CHANGE THROUGHOUT THE PAST 480 MILLION YEARS

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Presentation type: ORAL

Climate shifts are expected to cause changes in species' distributions as species migrate with their thermal niche. Wide and sometimes dramatic distributional responses in marine organisms are then perhaps unsurprising given current trends of global warming. Range shifts towards higher latitudes have already been observed with a breathtaking average pace of 70 km per decade. Here we assess if marine species in the geological past consistently track climate change and discuss how these patterns from deep time can inform conservation efforts. Using the Paleobiology Database and various geochemical proxies for ancient climate, we test how well latitudinal migrations of fossil marine invertebrate genera can be predicted by changes in shallow sea temperatures. After removing most biases in the fossil data such as geographical variation in sampling effort, differential preservation of taxa and sedimentary rocks and plate tectonic movement. We show latitudinal migration of marine invertebrates to be a consistent response to global warming events throughout the history of metazoan life. We also show evidence of a greater migratory response to global warming by tropical taxa relative to higher latitude taxa, suggesting that these organisms may be more vulnerable to current global warming than those at higher latitude. We do not have replicate Earths among which to compare responses to global climate change, but we do have evidence of climatic events and their accompanying fossil records throughout the past 500 million years. Paleobiological studies, such as the one we present here, can therefore help support or direct hypotheses regarding responses of marine organisms to current climate warming.



## HORIZONTAL AND VERTICAL MOVEMENT OF THE BLUE MARLIN (*MAKAIRA NIGRICANS*) AT THE SITE OF A PROPOSED, PELAGIC MARINE PROTECTED AREA

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Presentation type: ORAL

The creation of a large-scale MPA (LSMPA) around Ascension Island (7.9°S, 14.3°W) is a key commitment of the United Kingdom Government's "Blue Belt" initiative, and the most high-profile conservation issue currently affecting this South Atlantic Overseas Territory. An important milestone was reached in January 2016 with the announcement of a "no-take" zone covering 50% of Ascension's 440,000 km<sup>2</sup> EEZ. However, there are still substantial knowledge gaps that need to be addressed to identify areas that would benefit most from spatial protection measures. Spatial data on the distribution of vulnerable species are fundamental to this discussion, but are currently lacking for key, highly mobile taxa such as sharks and billfish. The current study aims to address some of this knowledge gap by using tracking technology to describe the movements of a billfish species, thereby strengthening the evidence base for policy. Specimens of the blue marlin *Makaira nigricans* were tracked using archival light geolocation tags, having been caught in the recreational sportsfishery in the inshore waters of Ascension Island in 2017. Data showed horizontal movement and residency at a variety of spatial and temporal scales, together with significant differences in vertical habitat use and diving behaviour between individuals. Tracks showed extensive movement of several *M. nigricans* away from Ascension Island, with some tracks indicating overall displacement from original tagging location of over 2000 km. The implications of such patterns on marine management are discussed in the context of Ascension Island and future LSMPA plans for this Overseas Territory.

## INTEGRATING VMS AND AIS DATA TO MAP HIGH RESOLUTION SPATIAL FISHING EFFORT IN THE NORTHERN ADRIATIC SEA

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Trawling activities, such as otter trawling and dredging, have occurred for centuries on large spatial scale and today are considered one of the main and widespread causes of anthropogenic disturbance and habitat alteration. These activities have perturbed marine ecosystems and locally modified the continental shelves, producing strong alterations of ecosystem structure, functioning and resilience. In this context, the Ecosystem Based Fisheries Management (EBFM) suggests a long-term holistic approach to delineate when, where and how marine ecosystems have been perturbed and to delineate future management strategies in order to maintain biodiversity. Recently, satellite-based technologies, such as Vessel Monitoring System (VMS) and Automatic Identification System (AIS), are used to investigate the spatio-temporal aggregation and fleet's dynamics. VMS transmits in time intervals varying of *ca.* 2 hours while AIS transmissions can be as frequent as every few seconds, enabling the monitoring of fine-scale vessels behaviour and movement patterns. Here we present the distribution of the fishing activity for two dominant fleet segments in the Northern Adriatic Sea: trawl and dredge. In particular, we carried out a finest spatial resolution analysis of the fleet's dynamics taking advantage from the integration of VMS with AIS data. This work has permitted to analyse and investigate temporal and spatial aggregation patterns and fleet's dynamics, allowing to highlight areas at different levels of fishing intensity. In the next future, these results will permit to test the effectiveness of fisheries management measures and to suggest possible implementation of new ones, in order to achieve a sustainable fishery. Indeed, the possibility to delineate the distribution of anthropogenic disturbance, through high spatial resolution data, represents a useful tool for conservation and management strategies.

## OCCURRENCE OF THE ALLOCHTHONOUS CRAB *DYSPANOPEUS SAYI* ALONG THE NE ATLANTIC COAST: *BIS REPETITA PLACENT*

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The Say's mud crab *Dyspanopeus sayi* (Smith, 1869) native to the Atlantic coast of North America (Chaleur Bay, Canada to the Florida Key's) is currently reported from two shallow bays i.e. Marennes-Oléron and Arcachon, SW Atlantic coast of France Since its first report from the Marennes-Oléron Bay in April 2007, ovigerous females together with numerous juveniles have been repeatedly sampled. Similarly, the discovery of the first two specimens in Arcachon Bay was dated 2013 but was subsequently followed by recording abundant populations on intertidal bare mudflats, where abundant benthic preys and fragmented patches of Pacific oyster *Crassostrea gigas* occur. These findings suggest that *D. sayi* is experiencing a new phase of naturalization in the north-eastern Atlantic following a first attempt at Swansea Queen's docks (Wales) during the second half of the 20<sup>th</sup> century. Today, *D. sayi* is no longer present in Wales and is considered as not established in Great-British. Analyses of mitochondrial DNA cytochrome c oxidase subunit 1 gene were performed in view of validation of species identity because morphological confusion may occur with the closely related species the Gulf grassflat crab *D. texanus*. Preliminary MtDNA cox1 analyses confirm distinctiveness of the two species, and specific identity of *D. sayi* among native and alien European populations. Determining human-mediated introduction routes and colonization history of the two French *D. sayi* populations require deeper investigations in view of the alien status of *D. sayi* in the Mediterranean Sea (Italy, Spain) and Black Sea (Romania), where it was presumably introduced by shipping and/or clam and mussel culture activities. Vectors of introduction of *D. sayi* in both Marennes-Oléron and Arcachon bays remain hypothetical but the Manilla clam *Ruditapes philippinarum* international trade is the most likely. Introductions through ship ballast waters should also be considered in the case of the Marennes-Oléron Bay due to the vicinity of two regional ports i.e. Rochefort and La Rochelle. Both ports are involved in transatlantic trade but traffic flows at the European scale are dominant. This suggests that secondary introductions may have also occurred due to shipping routes between La Rochelle and western Mediterranean and Adriatic ports of load.

## SCAVENGERS CREATE HOT SPOTS OF MARINE CARBON PROCESSING ON OCEAN SHORES

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Conventional wisdom holds that ecological interfaces are sites of enhanced biological activity, representing hotspots of carbon processing at ecotones in landscapes and seascapes. This is a prominent but rarely tested paradigm for ocean-exposed beaches, one of the globe's longest interfaces. This paradigm is prominent for ocean-exposed beaches, yet rarely tested for one of the globe's longest interfaces. Here we present an explicit test of the *'interface paradigm'* by quantifying carrion consumption by scavengers at sites where non-vegetated beaches abut coastal dunes, and comparing this with a number of upland sites in vegetated dunes. The design mimicked medical drug trials where the fate of 2,000 individually-tagged mullets ('patients' aka animal carcasses) was tracked over time with wildlife cameras, yielding detailed information on 'survivorship' (a measure of carbon processing by scavenging vertebrates) and the spatial patterns of this consumption. Beach-dune interfaces are indeed sites of substantially enhanced carbon processing by vertebrate scavengers, supporting the hotspot hypothesis. A spatial gradient signal was evident at some sites, with carcass consumption declining with distance from the beach; this spatial signal could, however, be over-ridden by chance events where scavengers detect carcasses early. Conversely, massive invasion of dipteran maggots impeded further carcass removal by most vertebrates, with the exemption of large varanid lizards, irrespective of sites. Our results strengthen concepts that emphasize intensification of ecological processes at coastal ecotones, but equally stress that spatial dynamics can be more subtle and complex.

## LURE-ASSISTED VISUAL CENSUS DOCUMENTS THE EFFECTS OF BOTH HARVEST PROTECTION AND HABITAT ON FISH COMMUNITIES IN MARINE PROTECTED AREAS IN THE EASTERN ADRIATIC SEA

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Lure-assisted visual census, a fisheries-independent and non-destructive method for quantifying fish abundance and benthic habitat, was used to assess fish communities inside Croatian (eastern Adriatic Sea) marine protected areas, and outside these areas at similar locations. Marine protected areas included National Parks Brijuni, Kornati, Mljet, and Nature Park Lastovo. A total of 19678 visual transects were followed at 149 locations throughout the Croatian nearshore at depths from two to seven meters. Relative species abundances were compared within a generalized linear mixed model with MPA protection as a fixed effect and location as a random blocking effect, and species accumulation curves were constructed using Chao, jackknife, and bootstrapping methods. We found the total species richness was slightly higher inside all four MPAs than outside, but communities were highly significantly different inside versus outside all MPAs. The results indicate that organization of fish communities is highly sensitive to 1) regulation of fishing activities, and 2) degradation of bottom habitat, such that commercially valuable predatory species (including *Diplodus sargus*, *D. puntazzo*, *Mullus surmuletus*), and species dependent on intact and undisturbed macro-vegetation (*Oblada melanura*, *Sarpa salpa*) and rocky reef habitat (*Epinephelus marginatus*) are more abundant inside MPAs where habitat is less disturbed. Lure-assisted visual census is a powerful non-destructive method for quantifying the effects of fishing regulations on populations of common and commercially important fish species. This work was partially supported by the Croatian Science Foundation, under the project COREBIO (3107).

## ARTIFICIAL VS NATURAL HABITATS: COMPARING COMMUNITIES AT SESSILE AND VAGILE LEVEL IN ALGECIRAS BAY

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Marine urbanization is going upwards coupled with increased coastal populations in the last decades, leading to the introduction of numerous artificial structures (e.g., coastal defense structures, offshore aquaculture facilities) and therefore to the addition of new habitats and the destruction or replacement of natural ones. This fact has led to multiple research focusing on sessile community assemblages over these structures usually concluding that artificial substrata do not function as surrogates of natural habitats. Only in the Mediterranean Sea, over 50% of coastlines are dominated by concrete structures. In the Alboran Sea (western Mediterranean Sea) we find four main kinds of artificial structures: sea walls, cubes, tetrapods and rip-raps. Our study is focused in the Algeciras bay (Cádiz, Spain), where these four artificial structures are found together, providing a unique spot for studying artificial structures under the same local conditions and avoiding biogeographical effects. Sessile and macrofaunal vagile intertidal assemblages over the abovementioned structures were studied and compared with close natural habitats to clarify which artificial structures hold the less dissimilar communities. At every location (artificial and natural) three sites were selected and at every site three replicates (20x20cm scrapes) were taken. Sessile fauna and flora were identified until species level and volumetrically quantified. Each sample was sieved through a 0,5mm mesh and separated macrofaunal assemblages of epifauna were identified at coarse taxonomic level. On one hand, sessile community on artificial structures was different compare to the natural habitat: natural habitat and rip-rap were dominated by *Ellisolandia elongata*, while vertical wall was dominated by *Mytilus galloprovincialis* and *Perforatus perforatus*. This supports the non-surrogate hypothesis (artificial habitats are different to close natural habitats). On the other hand, in spite of holding different sessile community, vertical wall was the most similar structure to natural habitat in terms of abundance of the different macrofaunal groups of epifauna (being dominated by peracarids). These data suggest that a holistic study, at different community levels (sessile and vagile including associated macrofaunal and meiofaunal assemblages) is needed in order to test the non-surrogate hypothesis of artificial structures compare to natural habitats.

## MACROBENTHIC COMMUNITY IN KLISSOVA LAGOON, GREECE

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The benthic community was studied in Klissova lagoon, a hypersaline restricted lagoon in Western Greece, in four seasons. Salinity and temperature presented seasonal variation but not a large spatial variation within the lagoon. Oxygen concentration was high in all stations and seasons. Sediment composition also showed seasonal variation. The inner part of the lagoon was covered by *Ruppia cirrhosa*, while the outer by *Cymodocea nodosa* meadows, although their density and biomass differed among stations. Most macrofaunal species found are common lagoonal species, euryhaline and tolerant to the naturally stressed conditions. Benthic assemblages were characterised, in general, by higher species richness and abundance than usually found in this type of ecosystems. The community structure differed between the inner and in the outer parts of the lagoon. Species richness increased towards the area of communication with the sea and dominance was higher in the inner stations.

INTERSEXUALITY IN THE BLUE MUSSEL *MYTILUS EDULIS* COMPLEX

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Presentation type: POSTER

The aim of this study is to describe intersex phenomenon occurring in *M. edulis* complex and to analyze spatial changes in its frequency in three areas of the Baltic Sea and the Skagerrak strait (the Gulf of Gdańsk, Poland; Tvärminne area, Finland; Trosa Archipelago, Sweden; Kristineberg, Sweden). Diagnosis was based on two different techniques, i.e. histology (image analyzing tools) and squash analyses for comparative purposes. Finally, sex ratio, gametogenic activity (gonadal index, GI) and the allocation of energy in reproduction (gonado-somatic index, GSI) were tested for any differences potentially resulting from inhabiting diverse environments (longitudinal salinity decrease, local pollution sources) and sexual disorders such as intersex. Intersexual individuals were identified in all four geographical areas at an average frequency of 1.8%. Squash analyses revealed the highest frequency of intersexuality in the Gulf of Gdańsk (3.5%) whereas histology examination resulted in a maximum frequency of 8.3%, occurring in the Kristineberg area. In the Tvärminne area and at the Trosa Archipelago the average frequency of intersex did not exceed 1% regardless of the technique used. Intersexual individuals were characterized by less developed gonads and lower GSI compared to males and females (GSI  $0.078 \pm 0.01$ ,  $0.163 \pm 0.008$  and  $0.14 \pm 0.007$  respectively). All studied *M. edulis* complex populations were characterized by similar GI indicating semi-mature and mature gonads (GI 3.06). Significantly lower GSIs were observed in populations from the Trosa Archipelago and the Tvärminne area in comparison to the Kristineberg area ( $0.196 \pm 0.010$  and  $0.102 \pm 0.005$ , respectively). Low GSI revealed less energy allocation towards reproduction in intersexual individuals and populations from the Trosa Archipelago and Tvärminne in comparison to those from the Gulf of Gdańsk and Kristineberg. Overall, the squash technique is less sensitive in identifying intersex compared to histology. Therefore, it is not recommended for mussels with severe reproductive impairments disabling proper analyses of gonads. Finally, three main hypotheses explaining the etiology of bivalves intersexuality are proposed: (i) natural induction, (ii) pollution-based induction and (iii) change of reproduction strategy under adverse risks in order to increase the reproductive success.



BEHAVIORAL EFFECT OF DIFFERENT SEX COMPOSITION OF THE SOCIAL GROUP:  
CHANGES OF BRAIN AND PLASMA ARGININE VASOTOCIN AND ISOTOCIN LEVELS  
WITH REPRODUCTIVE STATUS OF ROUND GOBY *N. MELANOSTOMUS*

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Presentation type: POSTER

Round goby, *Neogobius melanostomus*, a cavity-spawning fish, during spawning season show socio-sexual behaviors including territoriality, establishing nesting site and courtship. On the spawning grounds, round gobies experience such social impacts as high fish density, social hierarchy or changes in sexual composition of the stock. Various sexual arrangements during breeding are usually linked to temporal separation from fish of opposite sex that leads to close proximity of the same sex conspecifics. It may affect socio-sexual interactions among fishes such as aggression, social hierarchy or competition for hiding places and nests. In this study, we designed the experiment to simulate social stress to which round gobies are usually exposed during breeding in the wild: fish were kept in laboratory conditions in high density with conspecifics of opposite or same sexes. It can be assumed that in breeding males and females exposed to proximity of the same-sex conspecifics the neuropeptide levels and socio-sexual behavior may change in comparing to both-sex control groups. Brain nonapeptides, arginine vasotocin (AVT) and isotocin (IT) act as neurotransmitters and neuromodulators in central nervous system in fish. Both neurohormones are also involved in numerous sexual behaviors and related social interactions in fish i.e. courtship, submission, competition and parental care. In this study, we measured brain and plasma concentration of AVT and IT in males and females of round goby and examined their socio-sexual behavior after exposure to opposite sex and same sex conspecifics within high-density groups. It was found that males kept without females show the highest level of brain AVT. Long term exposure to same sex individuals induces high aggression both in males and females, and establishes a clear social hierarchy with strong role of dominants. Males separated from females do not attain full sexual maturity. Aggression is not linked with specific reproductive stage but is related to social status of round goby and interactions with conspecifics.

## THE EFFECT OF CO<sub>2</sub>-INDUCED WATER ACIDIFICATION ON SHELL GROWTH OF THE INFAUNAL BIVALVE *LIMECOLA BALTHICA* UNDER INCREASED HYDROSTATIC PRESSURE

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Sub-Seabed Carbon Capture and Storage (CCS) is regarded as a key technology for the reduction of CO<sub>2</sub> emissions, but little is known about the mechanisms through which leakages from storage sites may impact benthic species. Impacts of CO<sub>2</sub> leakages might be of particular significance in marginal seas like the Baltic Sea, which differ from other coastal seas by low salinity, eutrophication and extended anoxic conditions. Due to increased solubility of gaseous carbon dioxide at elevated hydrostatic pressure and low salinity, lowered water pH caused by potential CO<sub>2</sub> leaks might have specific biological impact in deeper brackish areas. In this study, the effect of CO<sub>2</sub>-induced seawater acidification on shell growth of the Baltic clam *Limecola balthica* (Linnaeus 1758) from the southern Baltic Sea (Gulf of Gdańsk) was quantified using the Karl Erik hyperbaric tank (TiTank) at NTNU (Norway). Experimental conditions were set up to mimic a broad range of seawater pHs (7.7-control, 7.0 and 6.3), which simulate potential scenarios of changes in acidity of the overlying bottom water following CO<sub>2</sub> leakage from the sub-seabed storage site. The experiments were run under relevant pressure (9 bar), and the main objective was to support environmental risk assessments of CCS implementation in the southern Baltic. The bivalves were exposed to each seawater pH over 10 days (10d), 20d, 30d and 40d, and shell growth was determined using shell fluorochrome marking. After being submerged in the marking solution, the entire shells were embedded in epoxy resin blocks (Epo Fix Resin) and sliced transversely along the longest distance from the umbo to the growing edge into 500-µm slices. Slices with the preserved shell edges were then examined under a compound fluorescence microscope, using an excitation wave length of 460-490 nm. Net shell growth was estimated as the increment deposited between the fluorescent calcein mark and (1) the top edge of the shell (growth in length) and (2) the ventral edge of the shell (growth in thickness).

## REDUCED FERTILIZATION RATES AND ABNORMAL DEVELOPMENT OF THE TELLINID *LIMECOLA BALTHICA* EMBRYOS UNDER HYPERCAPNIC CONDITIONS

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Presentation type: ORAL

Carbon capture and storage is a promising technology to reduce carbon dioxide emission to the atmosphere for global warming prevention. Nevertheless, it is essential to evaluate the effects of any potential CO<sub>2</sub> leakage from sub-seabed storage sites within the framework of risk assessment. The aim of the study was to address the possible effects of CO<sub>2</sub>-induced seawater acidification on embryos of common bivalve species in the Baltic Sea in order to assess the vulnerability and future of benthic invertebrates. In vitro fertilization of infaunal tellinid *Limecola balthica* was conducted at three different seawater pH: 7.7 as control, 7.0 and 6.3, reflecting CO<sub>2</sub>-driven ambient acidification. Fertilization and early life stages were fixed in time sequences (1 hour, 3 hours and 8 hours post fertilization) to track bivalve embryonal development under different pH conditions. As a result of exposure to high levels of carbon dioxide, fertilization rates were reduced by half and even by 75% under pH 6.3. Additionally, a number of deformations in consecutive cleavages of embryos, as well as delays in embryonic development when comparing control pH (7.7) with two remaining treatments (pH 7.0 and 6.3) were observed. Alterations that were noticed in the bivalve embryos under CO<sub>2</sub>-induced acidification indicate susceptibility of *Limecola balthica* propagules to pH changes, meaning that high levels of carbon dioxide in the aquatic environment exhibit toxicity to bivalve gametes and embryos.

## LIPID ENRICHED DIETS REDUCE THE IMPACTS OF THERMAL STRESS IN CORALS

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Coral species are better able to survive bleaching events with heterotrophic feeding, which raises the level of lipid provisions and coral resilience against stress episodes. We report that a lipid enriched diet allowed two coral species (*Duncanopsammia axifuga* and *Acropora millepora*) to resist an experimental bleaching event that involved exposure to temperatures of 32 °C for 14 days. The diet, containing omega-3 polyunsaturated fatty acids enriched *Artemia*, increased the proportions of essential fatty acid within coral tissue at normal temperatures, as well as maintained normal levels under high temperatures. Neither of the two species significantly bleached when fed an enriched diet, and *D. axifuga* grew faster, increased colour, chlorophyll, symbiont density and PUFA proportions. Overall, this study sheds new light on the role of heterotrophic feeding in coral resilience to bleaching and provides a novel approach for bleaching prevention, reef restoration and improved coral aquaculture.

## ALIEN SEASLUGS (GASTROPODA: HETEROBRANCHIA) IN HARBORS AND MARINAS OF SLOVENIA

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Presentation type: POSTER

Harbors and marinas are considered as susceptible environments for bioinvasion and they act as recipients of newly introduced alien species. Such environments are characterized as disturbed areas with numerous oscillations of abiotic factors such as temperature and salinity (due to freshwater inflow) and are often subject of pollution. In a period from 2006 to 2017 occasional samplings (39 sampling days) of alien fauna were performed in 9 Slovenian marine harbors and marinas. In the period 2013-2016 a monitoring of alien biota was performed twice a year in the harbor of Koper in the framework of the project BALMAS. Particular attention was given to the presence of alien mollusks, especially gastropods. Five alien sea slug species, *Bursatella leachii*, *Haminoea japonica*, *Polycera hedgpethi*, *Polycerella emmertoni* and *Okenia zoobotryon* were found during the last decade in different marine harbours and marinas of Slovenia. The later three species were found dwelling on bryozoans such as *Zoobotryon verticillatus* and *Bugula neritina*, while *H. japonica* was found feeding on sea lettuce *Ulva* sp. The anaspidean *Bursatella leachii* was found in mediolitoral belt crawling on muddy sea bottom. It was found on 37 sampling days in 8 localities and it could be considered as a well-established species. Other sea slug species were found more or less only sporadically. All five species were recorded only in the harbor of Strunjan. In comparison with other harbors Strunjan is characterized by intense fishermen boat traffic and is known to host more or less exclusively vessels of fishermen. Some of the boats are not active, which facilitate the growing of bryozoans on boat hulls and ropes. Such belts of bryozoans attract alien sea slugs *P. hedgpethi*, *P. emmertoni* and *O. zoobotryon* as their food source. Such dense bryozoan communities are hosting a high number of *O. zoobotryon*. Due to the predicted water warming the spreading of *Z. verticillatum* could be expected in the nearby future which will facilitate also the spreading, introduction and establishment of alien slugs in new areas.

## RECREATIONAL BOATING AS A MAJOR VECTOR OF SPREAD FOR ALIEN SPECIES AROUND THE MEDITERRANEAN

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Marinas are biologically diverse hotspots often constructed out of artificial materials that act as moving island habitats in contrast to neighboring natural habitats. This research presents the results of a wide investigation on the importance of recreational boating as a major vector of spread of alien species around marinas in the Mediterranean. To begin, marinas were chosen based on: frequency of non-resident visiting recreational boat traffic, number of berths, permissions and feasibility. Over 2015 and 2016, 34 marinas were assessed for their presence of alien species from 7 countries (Spain, France, Italy, Malta, Greece, Cyprus and Turkey), representing a west- to east gradient. In 25 of the examined marinas, random surveys were completed with approximately 25 recreational boat captains to determine boat history of travel and hull maintenance and techniques, and then fouling biota were collected from the boat hulls and later identified in the laboratory to species level. Firstly, the marinas of highest risk will be illustrated using the number of alien species present combined with the realized marina connectivity of recreational boaters, and then the similarities between various marinas are compared. Select marinas in the eastern Mediterranean were found to contain the highest amount of alien species (30+) due to the higher number of Indo-Pacific species in the eastern Mediterranean from the proximity of the Suez Canal as the major gateway of invasion in the Mediterranean. Next, several abiotic factors were tested to determine which ones favor alien species settlement and survival in marinas. Thirdly, an analysis of alien species found on the boat hulls will be presented for resident vs. visiting recreational vessels to illustrate how recreational boating is a major vector of spread in comparison to other vectors such as ballast water. This work required many taxonomic expertises (from Europe to Australia) to competently complete the species identification portion of the work. The main taxonomic groups found both in the marinas and on the vessels, as part of the fouling communities, were ascidians, bryozoans, crustaceans, molluscs and polychaetes.

## BIVALVE *GLYCYMERIS PILOSA* – AN ARCHIVE OF ENVIRONMENTAL CHANGE IN THE ADRIATIC SEA – CASE STUDY OF THE NERETVA CHANNEL

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Presentation type: POSTER

Bivalves have a wide geographic distribution and can therefore provide information about the environment for the most diverse marine habitats. Sclerochronological analyses are based on growth patterns preserved in the shell, which help to create a continuous decadal to centennial data time series on the growth and variability in the marine environment. Long lived species of bivalves are ideal paleoclimatic archives, because they provide insight into the conditions and variability in the environment for periods with different anthropogenic impacts. By studying the shells of long-living bivalves, scientists are trying to comprehend the historical range of environmental changes in order to understand the past climate changes as well as to forecast future ones. Due to its longevity and clarity of growth lines in shell sections, dog cockle *Glycymeris pilosa* was recently identified as a species with great potential for sclerochronological research in the Mediterranean. Data on the distribution and biology of this species in the Adriatic, as well as in other parts of the Mediterranean Sea, have long been limited since species was often misidentified as *G. glycymeris*. In this study we analyzed 49 large sized (> 60 mm) *G. pilosa* shells live collected by SCUBA in the south Adriatic Sea. Shells were collected on two occasions, in July 2015 and July 2016, near village Drače, northern side of the Pelješac peninsula. Samples of the umbo region were embed in the epoxy resin, cut through the maximal growth axis, grinded, polished and etched and acetate peel replicas were prepared from them. Growth increments were measured using Image-Pro software, and statistical analysis was conducted in dendrochronological software packages COFECHA and ARSTAN. Growth increments were clearly visible on 29 shells, with age ranging from 31 to 98 years, and those were used for chronology construction. Data series covered period between 1924 and 2015, and was statistically robust (EPS~0.85) from 1982 to 2015. Presence of marker years was discussed and chronology was related to available measured and modelled environmental parameters, including the influence of the Neretva River.

## THE LIFEWATCH TAXONOMIC BACKBONE: HOW CAN IT HELP YOU WITH YOUR RESEARCH AND HOW CAN YOU HELP TO MAKE IT MORE COMPLETE?

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The LifeWatch Taxonomic Backbone facilitates the standardization of species data, and the integration of the many distributed databases and data systems. It – virtually - brings together different component databases and data systems, dealing with five major components: (1) taxonomy, through regional, national, European, global and thematic databases, (2) biogeography, based on databases dealing with species occurrences, (3) ecology, in the form of species-specific traits, (4) genetics and (5) literature, by linking all available information to the relevant sources and through tools that can intelligently search this literature. The development of the LifeWatch Taxonomic Backbone started in 2012 and almost completed its 5-year construction phase. During this phase, tremendous progress has been made on the taxonomic and biogeographic components, as well as on traits information and linking available information with literature. The LifeWatch Taxonomic Backbone offers a whole range of services to the scientific community which can support them in answering specific ecological questions which have so far not been dealt with due to the lack of accessibility, availability, standardization and linking of data. Both easy-to-use online tools and web services allow scientists to e.g. compare their own data with already collected data from the same or similar regions, to check whether any of the taxa in their database is still known under that name or to see whether any of their listed species is e.g. tagged as an endangered or alien species. The LifeWatch Taxonomic Backbone is a two-way street: besides using the tools and functionalities it is offering – which are often developed based on identified needs within the scientific community -, scientists can also contribute themselves to make it more complete. Feedback on e.g. taxonomy and traits is highly appreciated and communicated with the involved experts of the different component databases. And all distribution information collected by individual scientists can become part of the biogeographic component of this backbone, e.g. by contributing occurrence data with the biogeographic component of the system.

Link: [http://www.lifewatch.be/en/taxonomic\\_backbone](http://www.lifewatch.be/en/taxonomic_backbone)



GROWTH, ADAPTATION AND DISTRIBUTION OF *AURELIA AURITA* EPHYRA IN THE STRAIT OF ISTANBULNoyan I. YILMAZ<sup>1</sup> and Dalida BEDIKOGLU<sup>1</sup>

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*Aurelia aurita* is among the most important gelatinous predators in the Sea of Marmara and the Black Sea with yearlong occurrence and occasionally reaching very high densities. Although there are some information on the distribution of *Aurelia* medusa in the region, no information exist on ephyra dynamics. Samplings targeting ephyra distribution has been carried out biweekly for a period of two years. In order to assess the age of the captured ephyra, experiments were carried out by using laboratory reared ephyra. Ephyra kept at 18, 24 and 30 salinities in ambient temperatures were fed *ad libitum* with freshly hatched *Artemia* naupli, considering the eutrophic conditions in the Strait of Istanbul. Meristic measurements on daily obtained microphotographs for a period of 35 days were used in derivation of equations for age determination. The comparison of equations showed that central disc diameter provided the most consistent results in calculation of age, followed by distance between rhopaliums and distance between overlapping lappets. 18 and 24 salinity experiments provided near identical results, indicating that salinity difference was not a major factor within this salinity range. On the other hand, ephyra used in 30 salinity experiments were short lived, with poor overall condition, providing incomparable results, reflecting the brackish water preference of the species. Plankton samplings highlighted two periods of ephyra abundance; December 2014 – May 2015 (maximum abundance 17.6 ephyra/m<sup>3</sup> in March) and December 2015 – April 2016 (maximum abundance 195 ephyra/m<sup>3</sup> in February). Average age of ephyra showed an increasing trend in both periods, reaching maximum average age from the initial ~2 days in December to 25-27 days in mid-March. *Aurelia* populations are reported to reach higher abundance in warmer years. The winter of 2015-2016, as an El-Nino year, had the warmest recorded temperatures. The 3.5 °C difference with the previous year's winter temperatures yield in ~11 time higher ephyra densities and higher survival rates, supporting the stimulating effect of warmer temperature on population dynamics of *Aurelia aurita*.

## IMPACT OF OCEAN ACIDIFICATION IN THE MEDITERRANEAN SEA ON BENTHONIC ORGANISMS AND ECOSYSTEMS

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Presentation type: POSTER

Seawater acidification along with global change drivers is projected to affect the Mediterranean Sea over the coming century causing significant changes in the ecosystems. We performed a meta-analysis of published studies focused on the direct responses of benthic organisms in the Mediterranean Sea. The underlying objectives are to quantify the emergent patterns by applying specific statistical procedures. The quantitative results obtained by the meta-analysis highlight: (a) an increase in fleshy algae cover, which may lead to a competitive advantage over calcifying macroalgae; (b) a reduction of calcification by both algae and corals; (c) an increase in seagrass shoot density under low pH; and (d) a general increase in the photosynthetic activity of macrophytes. We used the results of the analysis to build conceptual models of two of the most important and vulnerable habitats of the Mediterranean Sea (coralligenous and seagrass habitats). The integration of both the direct and indirect effects results in the reduction of the structural complexity of these habitats and consequently to the loss of their ecosystem functions. The work is a first step toward the identification and the assessment of the ecosystem functions and services at current and future conditions for the seagrass and coralligenous habitats.

## ECOLOGY OF *CLADOCORA CAESPITOSA* (LINNAEUS, 1767), THE MEDITERRANEAN STONY CORAL, IN THE NORTHERN ADRIATIC SEA (GULF OF TRIESTE)

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Presentation type: POSTER

*Cladocora caespitosa* is an endemic coral of the Mediterranean Sea and an important carbonate bioconstructor that adds 3D complexity to the habitat, thus increasing marine biodiversity. Despite its important role in the ecosystem, the real status of the population along the majority of the Mediterranean coastline is still poorly investigated while very little is known about the resilience of the species. Using non-destructive visual surveys, colonies of *C. caespitosa* were investigated by SCUBA-diving in 2013 at 7 sites along the southern part of the Gulf of Trieste. Besides, one site was also sampled in July 2015. Data about colony size, index of sphericity and corallite diameter along each transect were collected. Almost all biometrical parameters significantly differed among sampling sites showing low occurrence of the larger size classes, which were relatively rare, compared to the abundance of small-sized colonies. This pattern of distribution is typical of long lived organisms. The positively skewed colony size distribution could be attributed both to a high mortality rate of small colonies unable to reach larger size class and to high fragmentation rate of colonies due to high hydrodynamism force. The historical comparison of our data of Bernardin site with the Schiller (1993) studies (1984-1989) has shown a change in the colonies size distribution, with a decrement of the small class and an increase of the medium class. In view of these findings we think that further assessment is required in order to evaluate the trend of the northernmost *C. caespitosa* population of the Mediterranean Sea.

## SCLEROCHRONOLOGY AS A TOOL FOR RECONSTRUCTING CHANGES IN MARINE ENVIRONMENTS – OPPORTUNITIES AND CHALLENGES IN THE ADRIATIC AND MEDITERRANEAN SEAS

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Sclerochronology is developing research field that analyses structural elements and geochemical composition of hard structures of marine organisms, including bivalve shells, fish otoliths, corals and algae. Variations in widths of growth increments, as well as changes in composition of stable isotopes and elements are evaluated, as part of sclerochronological studies, for their potential as proxies for marine environmental variability. So far, majority of sclerochronological research was conducted in the Atlantic and Pacific, and there is lack of studies in semi-enclosed basins such as Adriatic and Mediterranean Seas. Species growth rate, longevity and clarity of growth lines are some of the criteria used for choosing a target species, and in case of bivalves and Mediterranean, target species in previous studies included smooth clam (*Callista chione*), date shell (*Lithophaga lithophaga*), Mediterranean scallop (*Pecten jacobaeus*), noble fan shell (*Pinna nobilis*), thorny oyster (*Spondylus gaederopus*), and two species of dog cockles *Glycymeris bimaculata* and *Glycymeris pilosa*. Out of these, the last two species have the longest life span, extending over half the century, and thereby present a potential decadal archive of environmental data. We will present current research efforts, conducted in a framework of project financed by the Croatian Science Foundation, on sclerochronology in the Adriatic. This includes creation of chronologies for long lived bivalve *Glycymeris pilosa* from several locations along the eastern Adriatic. Data on other potential target species and sampling and analysing methodologies will be presented, including their advantages and disadvantages. Opportunities and challenges for establishing a sclerochronology research network in the Mediterranean will be presented.

## **MESOPHOTIC ECOSYSTEMS: MYSTERIES AND RESEARCH CHALLENGES**

## CULTURE IMPROVEMENTS: INTEGRATED AQUACULTURE AS AN INNOVATION TOOL

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Presentation type: ORAL

iMare Natural S.L. is 'spin-off' company of the University of Granada specialized in developing methods for invertebrates culture, incorporating these techniques into the aquaculture sector. The technics are based upon the correct use and recirculation of surplus organic products produced by the integrated multi-trophic (IMTA) cultivation of sea anemones with echinoderms and Chenopodiaceae (salty plants). iMare Natural works with the TASCMAR equipment, focused now on the culture improvements phase, innovating in the cultivation of invertebrate species in both recirculation and open sea structures. The use of sponges as biofilters is being tested using integrated culture with other species. The species from MACLIB that have offered better results in the analyzes, carried out during the second stage of the project, are being harvested in the different facilities available. We are studying too, how stress could influence in the production of interesting biomolecules by symbionts.

## POTENTIAL EXPLOITATION FOR THE CULTIVATION OF MESOPHOTIC INVERTEBRATES IN THE FRAME OF THE TASC MAR PROJECT

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Lots of marine mesophotic invertebrates produce secondary metabolites that can be used as natural source for the design of new drugs, cosmetics and nutraceuticals. There is, however, a supply problem with these natural substances for research and commercialization of the products. Unfortunately, enormous quantities of secondary metabolites, higher than what can be found in the natural populations are necessary for its pharmaceutical applications. To overcome this supply problem, different approaches were assayed. One of the most bottlenecks of culture techniques for invertebrates is low survival rate when organisms are removed from their natural environment. This study was focus on culture improvements in indoor recirculation systems. New ecological attachment techniques had been tested that consist of tying the organism to a support using a biodegradable cotton mesh. When cotton mesh disappears, invertebrates were attached to the rock. Different species of three Phylum were tested in this study: cnidarians, sponges and tunicates. A 300 l aquarium with a home made external filtration system was used. The flow of water was 600l/h, so the aquarium had two water renovations per hour. For simulate different hydrodynamics inside the tank, a plastic barrier was placed in the middle of the aquarium. Water flow was bigger in left half of the aquarium than in right one. Our first hypothesis is that Sponge that live in more open areas, moderate flow of water is necessary for a correct attachment to their support (the case of *Crella elegans*). Other species from the experiment (*Dysidea avara*, *Acanthella acuta*, *Axinella damicornis*) are demonstrating well behavior in the trials of fixing. All of them have good aspect, independent of flow of water. All of them usually live in caves, which are less exposed to strong current. Biodegradable cotton mesh can be a very good solution for this purpose, as well as being sustainable.

## INTEGRATED CULTURE OF FILTERS FEEDERS (SPONGES) IN PRODUCTION TANKS OF SEA ANEMONES

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Since the filtering nature of sponges, and their ability to move large flows of water to eat all kinds of phytoplankton, zooplankton (copepods, ciliates, rotifers, nauplii) and suspended organic matter, they can be integrated into production tanks of cnidarians and echinoderms of IMARE, with the dual aim of making biofilter in the recirculation system and biomass generation. This experiment was designed with the aim of successfully cultivating mesophotic species in the frame of the TASCAMAR project. It consists in testing whether the sponges are effective in reducing the bacterial load of aquaculture residual water and, therefore, its application as biofilters in multitrophic systems. We are analyzing the number of bacterial colonies in the water, both in the circulating water of culture and in the water after its passage through the sponges to verify if they really filter a significant part of bacterial load. A plastic cage of 0.5 cm net fit into the drain of each culture tank of anemones. This is where a strong suction current charged of suspended particles is generated. These filter feeders capture dissolved nutrients of the water and act as a mechanical biofilter, before the wastewater pass through all phases of the recirculation system (silica sand filter, bio-balls and skimmer). For this experience we are using the production system of 7 tanks of 300 ls, that only contains mesophotic anemones and other marine mesophotic invertebrates in cultivation and some sea urchins like algae cleaners of walls and bottoms. Three species of sponges are been used. Each species are being stored in two tanks, leaving the 7th tank as a control tank without sponges. The sponges are placed in reticulated plastic baskets, fitted into the drainage drain of each tank. The drain pipe of each tank, on the outside, is drilled to insert a 6mm plastic-macaroni with its corresponding valve, to possible to extract water for microbiological analysis (DBO, DQO and microbiological analyses: Total coliforms, fecal coliforms and mesophilic aerobes). A water analytical plan for each tank is beeing established. Two sampling points per tank: a) circulating water from the tank, b) water from the drainage duct after its passage through the sponges (*Dysidea avara*, *Chondrosia reniformis* and *Sarcotragus spinosula*). Comparative water analyzes are being conducted and results will be available for the next month.



## THE NEEDLE IN THE HAYSTACK: SUSTAINABLE BIOPROSPECTING IN THE TASCMAR PROJECT

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Presentation type: ORAL

The mesophotic zone is increasingly recognised by scientists as vital and connected physically and biologically to shallow water habitats. Mesophotic reefs have the potential to provide refuge for shallow reefs taxa such as coral and sponges, and can be a source of larvae that could contribute to the resiliency of shallow water reefs. However, due to technical challenges, mesophotic ecosystems remain less researched and underexploited compared to the shallow zones, calling for academic and business actors to work together to fill in this gap and explore its great potential for the development of new natural compounds. To this aim, it has to be considered that marine bioprospecting possesses great threats to the marine environment and its biodiversity, when done in none sustainable manner. The European research project TASCMAR (Tools And Strategies to access original bioactive compounds by Cultivating MARine invertebrates and associated symbionts) aims to fulfil the need for innovative and scientifically sound investigation of mesophotic ecosystems for both academic and market exploitation. In the context of the project impact assessment and in order to reduce the environmental impact of its activities, TASCMAR developed a set of recommendations for the investigation of the mesophotic zone and for the collection of its resources. These recommendations are comprised of selective collection methods, including progressive and sophisticated technologies such as the use of remotely operated vehicles (ROVs) and technical diving techniques, a selection of standards based on national and international regulations, documentation and monitoring, restriction of sample sizes, innovations in cultivation methods of invertebrates, innovative cultivation of symbiotic microorganisms and highly efficient compound recovery technologies. The contribution will provide results and findings from the application of this approach to the TASCMAR project.

## OCTOCORALS: KEY PLAYERS IN MESOPHOTIC REEFS (EILAT, NORTHERN RED SEA)

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Presentation type: ORAL

Octocorals are common throughout the Indo-Pacific reefs and play an important role in their ecology. They are well recognized by their polyps featuring eight pinnate tentacles and internal skeleton comprised of a variety of microscopic calcite-made sclerites. Studies have revealed their high diversity on numerous shallow reefs, comprising hundreds of species, including many new ones. Yet, octocorals of many reefs remained to be described in order to appreciate their diversity, phylogeny and biological function. The mesophotic coral-reef ecosystem (MCE) has been defined as comprising the light-dependent communities (30 to >150 m) in tropical and subtropical regions. Until the past decade most octocoral surveys have been restricted to the upper ~30 m. Remotely-operated vehicles (ROV) and technical diving have now facilitated the investigation of MCEs. Yet, most of mesophotic octocoral studies are lagging behind their stony corals counterparts, being limited to photography and thus do not allow examining their actual diversity. The northern Red Sea shallow reefs, situated at the most northern boundary of global coral-reef distribution, have been quite extensively studied, revealing vast octocoral richness. The scarce data available on MCE octocorals there intrigued us to conduct within TASCAR project ROV surveys on MCE octocorals. So far the results revealed diverse octocoral communities also inhabited by new species to science and new zoogeographical records, as well as their depth distribution and abundance. The findings highlight the possibility that MCEs may host octocorals also found below the deepest fringes of these MCEs; and that specifically, the deep-water octocorals may populate the zone alongside those of the lower MCEs, contributing to the high biodiversity there. In addition, the findings enable us to portray the depth distribution of both symbiotic (zooxanthellate) and asymbiotic octocorals. The evidence suggests that MCEs constitute unique benthic species assemblages, octocorals being the most prominent one, far beyond what has been envisioned.

## CULTIVATION OF MARINE ORGANISMS AS A TOOL FOR SUSTAINABLE ECOSYSTEM REHABILITATION AND DRUG DISCOVERY

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Chulalongkorn University, as a partner of TASC MAR, has been assigned to explore biodiversity of marine invertebrates and symbionts found in the mesophotic coral-reef ecosystems (MCEs) in the Andaman Sea, Thailand, which had not previously been done before. More than 8 Phyla were collected in MCEs for investigation of applications in pharmaceuticals, nutraceuticals and cosmetics. In addition, our team also tries to develop new strategies to overcome bottlenecks in the environmentally sustainable discovery of applications of novel marine derived biomolecules. One of the new strategies is the cultivation of marine invertebrates and symbionts. In this presentation, we will give an example of cultivation of corals using sexual propagation technique. Eggs and sperms of corals were collected for an artificial fertilization. Then, juveniles were raised into certain sizes before releasing back to the sea for ecosystem rehabilitation. The cultivation technique, not only can be applied for increasing marine organism populations for conservation purpose, but also can offer the sustainable yields for future use as drug candidates and for solving the supply problem in the initial steps of drug discovery. In addition, cultivation provides a stable environment, and allows to promote higher yields of target metabolites.

## UNIVERSAL FERMENTER FOR CULTIVATION OF MICROORGANISMS FROM THE MESOPHOTIC ZONE

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Presentation type: POSTER

Microbial fermentation technology has recently introduced new techniques to facilitate the implementation of experiments. However, the whole shape, accessories and processes have remained the same for centuries. Few operators act in the field and the market is shared among them with equivalent offers. With the experience of Platotex developed by CNRS and built by Pierre Guerin and an international benchmark and survey including various operators and end-users, CNRS and Pierre Guerin developed a clear idea on how to move beyond the state of the art by offering a groundbreaking new version of the Platotex, covering every application in the microbial fermentation field. The device is called UNIFERTEX (UNIversal Fermentor EXpert). With this innovative approach, new technology and an available operational device for demonstration, TASC MAR will achieve one of its key project objectives. An entire work package in the EU H2020 TASC MAR Project benefits from a lasting interaction and complementarity between the two involved partners, the successful building of an operational unique device and the “natural ecosystem driving technology”. It consists of filling a black box by listing the ideal requirements for the equipment taking into account the mesophotic ecosystem specificities: liquid state cultivation & solid state cultivation, coupling extraction steps, up-scale & down-scale shape, liquid & solid sampling technology, liquid & viscous inoculation accessories, being compact from laboratory to industrial version, easy handling, remote control, international safety requirements. Although challenging it is the aim to integrate all of the requirements in one device. The prototype consists in a 50L WV vessel with innovative tools and accessories, able to support micro-organisms cultivation under sterile conditions. We established the main characteristics of the prototype such as working volume capacity, shape of the vessel, raw materials, rough dimensions, accessories foreseen to be implemented within the equipment, instrumentation for measuring and controlling process parameters such as temperature, pressure, etc. Pierre Guerin project team has ‘translated’ the User Requirement Specifications into technical specifications in accordance to industrial regulations: design according to construction codes: CODAP, PED; compliance to international regulations and standards: ASME BPE, GAMP, 97/23/EC, ISA; using advanced tools including: INVENTOR CAD system for full 3D design and ANSYS MECHANICAL for mechanical constraints calculations.

## INVESTIGATING THE MARINE MESOPHOTIC ZONE FOR THE DISCOVERY OF BIOACTIVE SMALL MOLECULES WITH APPLICATIONS IN THE COSMECEUTICAL AND PHARMACEUTICAL INDUSTRY

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Presentation type: POSTER

**TASCMAR** is the acronym of an H2020 EU-funded project that aspires to develop new tools and efficient strategies on discovering novel marine derived bio-molecules with applications in pharmaceuticals, nutraceuticals and cosmeceuticals with a particular focus on the theme of anti-ageing. The project also focuses on the development of innovative cultivation technologies and equipment for marine invertebrates and associated symbionts aiming their extraction from lab to pilot-scale. Accordingly, marine invertebrates (more than 180 species) and microorganisms (more than 300) were collected from the under-investigated mesophotic zone (between 30 and 100 meters depth) of Indian Ocean, Red Sea and Mediterranean. The samples extracted by optimized protocols in order to collect all the bioactive molecules that they contain. All extracts were investigated for their chemical content and the metabolites present in each extract were identified using various analytical chemistry techniques (dereplication). The library of extracts was sent for biological evaluation. According to the results, 5.3% of the organisms showed elastase and tyrosinase inhibitory activity, 7.94% inhibition to Fyn kinase, 6.35% to proteasome and 4.76% to CDK7 kinase. These organisms were further examined for their metabolic profile and were divided into a number of smaller quantities (fractions) during separation processes. The fractionation was followed by the preparation of library of fractions for bio-evaluation i.e. tyrosinase and elastase inhibition. Structure elucidation will be performed by NMR and LC-MS methodologies and the compounds of interested will be selected for further development. Furthermore, the biological activity of the associated microorganisms was examined based on tyrosinase, elastase and FYN kinase inhibition. The microorganisms showed 0.5% inhibition activity to tyrosinase and elastase and 0.9% to Fyn kinase. Thus a comparison between the profiles of the invertebrate extracts and the profiles of the microbial symbionts was made. According to the results, it was observed that the percentage of the common masses between the invertebrates extracts and the symbionts was more than 4% and in one cases it was more than 14%. This overlapping could indicate the contribution of microorganisms to the whole invertebrate metabolome.

## RESEARCH OF BIOACTIVE MOLECULES FROM MARINE ENVIRONMENT IN THE CONTEXT OF *TASC*MAR PROJECT: NEW PERSPECTIVES FOR LCSNSA

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Presentation type: POSTER

Marine invertebrates are considered as a gold mine with respect to the diversity of their secondary metabolites, which are in most cases, bioactive. The biological effects of new metabolites from marine invertebrates have been reported in hundreds of scientific papers. They have the potential to provide future drugs against important diseases, such as cancer, a range of viral diseases, malaria, and inflammation. Since the early 1990s, the Chemistry Laboratory of Natural Substances and Food Sciences (LCSNSA, University of La Reunion) has been trying to gain a foothold in this field of research. The laboratory which is located at Reunion Island is at a strategic location for the research of natural bioactive molecules. Indeed, with a series of islands scattered in the western Indian Ocean along the southeast coast of Africa (Madagascar, Seychelles, the Comoros, Mayotte, Mauritius, Eparses islands), Reunion Island belongs to a global biodiversity hotspot. This communication will therefore provide an outline of the contribution made by the LCSNSA to marine natural products research in the west of Indian Ocean. Over the last years, our research programs were more precisely concentrated on marine invertebrates from Reunion Island, Mayotte and Madagascar. Among the numerous marine invertebrates encountered in these areas, sponges, ascidians and soft corals have predominated in all our collection expeditions and have therefore received special attention from our research group. However, there is an increasing evidence that many metabolites are not produced by the animals themselves but by associated micro-organisms. Thus, thanks to the H2020 *TASC*MAR project, we have the opportunity to continue to build our basic knowledge of marine environment by working now in the field of marine biotechnology.

## FISH ALPHA AND BETA DIVERSITY DECLINE WITH DEPTH (10-90 M) ON A RED SEA CORAL REEF

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Presentation type: POSTER

Research into the distribution and biodiversity of mesophotic fish is restricted to a small number of areas worldwide, with most Red Sea mesophotic coral ecosystems being unstudied. The study site was Ras Qusier, on the Egyptian coast of the central Red Sea. Fish species relative abundances (maximum number seen at one time, MaxN) were recorded from 134 stereo-video camera deployments, over a depth range of 10 to 90 m. Species richness and diversity (Shannon Weaver) for each camera drop ( $\alpha$  diversity) and variability in species composition between drops within depth bands ( $\beta$  diversity) were calculated. 59 species from 20 families were observed. Species richness and Shannon Weaver diversity both decreased significantly with depth with the surgeonfish *Naso hexacanthus* being the only fish observed >80 m.  $\beta$  diversity decreased significantly with depth, with greater variability in species composition between drops in the 10-19.9 m depth band than in all depth bands >40 m. The patterns observed in the fish assemblage appear to be linked to changes in substratum type, with stations deeper than 50 m being dominated by rocky and sediment substrata, with greater proportions of coral and seagrass <50 m. Species richness and relative abundance (MaxN) also increased significantly with distance from the nearby fishing community. Ongoing studies will explore a wider range of sites in order to disentangle the relative importance of anthropogenic and natural drivers of fish assemblage characteristics in the Red Sea.

## USING BIOLOGY TO HELP BIOPROSPECTING IN MARINE ENVIRONMENT

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Presentation type: ORAL

One goal of the Science Foundation Ireland project “Exploiting and conserving deep-sea genetic resources” that started in September 2016 is to analyse the economic potential of deep-sea Irish waters in relation to Porifera and Cnidaria bioactive compound production. However, defining the bioactivity of natural compounds is a complex task as few natural products have been tested in a comprehensive series of bioassays, but rather too often limited to a particular group of diseases. We have developed a method to assess the potential drugability of secondary metabolites found in marine organisms that we illustrate here for Cnidaria. Firstly, the metabolites originating from this phylum were extracted from the Royal Society of Chemistry’s MarinLit database and their 3-dimensional structures obtained. Secondly, the 3D structures of all the FDA-approved small molecule drugs were downloaded from ChempSpider. Thirdly, Schrödinger’s QikProp was utilized to evaluate 52 physicochemical features of each compound contained within the two datasets. The features of each compound were analysed using multivariate analyses and the two datasets compared in order to identify overlapping chemical space between the secondary metabolites and the already approved drugs. We test how informative this approach is and whether it can be used to predict the likelihood of families and genera of Cnidaria producing bioactive / drug-like marine natural products. Our end goal is to generate estimates of drug-related marine economic potential and identify biological “hot spots” for biodiscovery as well as developing informed bioprospecting approaches to maximise the chance of finding pharmaceutical active natural products in difficult environments to sample such as deep-sea ecosystems.



## MICROBIAL SYMBIONTS OF MESOPHOTIC INVERTEBRATES, IS THERE SOMETHING NEW TO EXPECT?

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Presentation type: ORAL

In parallel to the scarce investigation of the invertebrate communities in the mesophotic coral-reef ecosystem (MCE), the microbial symbiotic communities deserve intensive efforts both at the ecological and chemical levels. In the frame of the EU project TASC MAR, fast growing actinomycetes and fungi were isolated from invertebrates collected in the northern Red Sea (Gulf of Aqaba) between 40 and 140m depth. The microorganisms were grown in marine broth using innovative SSF/SPE and AgSF/SPE methodology and their extracts submitted to a large panel of molecular and cell based bioassays. The objective is to discover new compounds against age-related diseases and dysfunction. In parallel, the isolated microorganisms are identified based on molecular 16R and ITS sequencing in order to attest for their diversity and originality.

## SKIN PROTECTIVE EFFECTS OF MARINE INVERTEBRATES AND SYMBIONTS FROM THE MESOPHOTIC ZONE

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Presentation type: POSTER

Nowadays, there is a huge interest on natural products obtained from marine organisms that can promote the state of health and well-being for humans. Mesophotic coral ecosystems (MCEs) appear to support a diverse biological community. The organisms living in this ecosystem need to adapt themselves to a suite of environmental conditions such as high pressure, lower sun radiation and lower temperature compare to the ones prevailing in the shallow water. Through evolution, this environmental stress has led to the development of unique structures, metabolic pathways, reproductive system, sensory and defense mechanism. Extracts from marine invertebrates and symbionts from the mesophotic zone consider as primary source of bioactive compounds that could be used as functional ingredients. The aim of the present study is to evaluate *in vitro*, the effects of these extracts on primary normal human dermal fibroblasts (NHDF), so as to investigate the potential applications in cosmeceuticals focusing on potential anti-ageing activity and angiogenesis regulation activity. In order to gain an insight into the molecular mechanisms of extracts bioactivity, we studied the transcript accumulation for an array of genes involved in anti-ageing and angiogenesis processes. NHDF cells were purchased from Lonza Clonetics™. NHDF incubated with extracts for 48hours at three different concentrations. At first step, cytotoxicity was assessed by using MTT assay. In addition, anti-ageing activity and angiogenesis regulation activity of extracts on NHDF was confirmed by the regulation of several related transcripts (SIRT1, MMP9, IL8 and VEGF) involved in the relative pathways. Current findings indicate that marine invertebrates and symbionts extracts from mesophotic zone possess strong anti-aging properties and provide new insights into the beneficial role of marine bioactive compounds in cosmetic formulations for skin protection.

## LIFE HISTORY TRAITS OF MESOPHOTIC OCTOCORALS IN COMPARISON TO THE SHALLOW ONES

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Presentation type: POSTER

Mesophotic coral ecosystems (MCEs) are light-dependent coral communities found at 30-150 m and considered as potential reservoir of coral diversity. Recent technological advancement in technical diving has allowed us to examine whether MCEs communities are able to provide a viable reproductive source to shallower reef areas. Even though octocorals are a major component in MCEs, very little is known on their sexual reproduction in such depths. The current study is the first to examine octocoral reproduction in the upper MCEs (30-45 m, Eilat, northern Gulf of Aqaba, Red Sea), also in comparison to the shallower reefs there. The study deals with the reproductive features of two common zooxanthellate species, the internal brooder *Ovabunda* sp. and the surface brooder *Rhytisma* f. *fulvum*. Both species have been monthly sampled since January 2016. They were examined for sex determination, presence of gonads and their annual development and in addition their larval release (planulation) was recorded. So far, the results have demonstrated that *Rhytisma* f. *fulvum* breeding season is similar in the upper MCEs and in the shallow reefs, thus suggesting possible connectivity between the populations of these two reef zones. Upper MCE's *Ovabunda* sp. colonies exhibit a disordered and prolonged breeding season, a possible adaptation to the mesophotic environment. The study also examines several physiological features of the upper MCEs octocorals, including percent of sclerites in the tissue, density of symbiotic zooxanthellae, their mitotic index and amount of chlorophyll. The results are expected to contribute to our understanding the biology and ecology of the mesophotic inhabitants in general and of the octocorals there in particular.

TASCMAR EU-H2020 PROJECT, A UNIQUE OPPORTUNITY TO LIFT THE VEIL ON THE UNDER-INVESTIGATED MESOPHOTIC CORAL ECOSYSTEMS (MCES) THROUGH A GLOBAL, INDUSTRY-DRIVEN, APPROACH

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Presentation type: ORAL

TASCMAR project aspires to develop new tools and strategies in order to overcome existing bottlenecks in the biodiscovery and industrial exploitation of novel marine derived biomolecules (secondary metabolites and enzymes) with applications in the pharmaceuticals, nutraceuticals, cosmeceuticals and fine chemicals industries. Exploitation of neglected and underutilized marine invertebrates and symbionts from mesophotic zone will be combined with innovative approaches for the cultivation and extraction of marine organisms from lab to pilot-scale, using the unique prototypes Platotex™ and Zippertex™, both reaching the Technology Readiness Level 7. Thus, marine dedicated cultivation and extraction equipment will be built and validated. These unique improvements will ensure sustainable supply of biomass and promote the production of high added value bioactive marine compounds. An integrated, holistic technological metabolomic approach will be applied, in conjunction with bioactivity profiling, as filtering and bio-prioritisation tools. Moreover, state-of-the-art analytical instrumentation and in-house databases will be employed for the dereplication and characterization of valuable compounds. A panel of libraries (marine organisms, extracts, pure metabolites and biocatalysts) will be constructed and exploited throughout the project. A focused panel of in-vitro, cell-based, in-ovo and in-vivo bioassays for discovering metabolites with anti-ageing and/or angiogenesis modulating activity will frame the entire work-flow and will reveal the lead compounds. In addition, the catalytic potential of mesophotic symbionts and deriving enzymes candidates will be evaluated in fine chemicals and bioremediation industries. The project activities will be constantly assessed via effective management for their societal, economical and environmental impact in order to find the best compromise between industrial development and sustainable growth.

## DISCLOSING THE MESOPHOTIC BIOGENIC REEFS OF THE NORTHERN ADRIATIC CONTINENTAL SHELF

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Presentation type: POSTER

Marine Mesophotic Biogenic Habitats (MBHs), lying in twilight conditions, have recently drawn the attention of researchers due to the opportunities offered by the implementation of underwater exploration techniques. These habitats are often considered protected from natural and anthropogenic disturbances (e.g. wave action, thermal stress, pollution, harvesting) affecting shallow habitats. Their possible role as refuges for threatened species has been hypothesised. Studies, carried out mostly in tropical areas, stressed the relevance of these habitats, but little is known about their distribution and role in temperate seas, and on their resistance and resilience to anthropogenic impacts and threats due to Global Climate Change (GCC). Northern Adriatic MBHs are mainly represented by coralligenous outcrops scattered on the sedimentary continental shelf. MBHs are arranged in metapopulations, potentially exposed to local extinctions due to their fragility and isolation. Recent investigations highlighted variations in species diversity at different spatial scales, ranging from single outcrops to basin. A complex geographic pattern of the most abundant species, including the main reef builders (i.e., encrusting calcified Rhodophyta) and borers (e.g., the bivalve *Rocellaria dubia* and sponges *Cliona* spp.), was found. Coralline algae (e.g., *Lithophyllum incrustans*), sponges (e.g., *Chondrosia reniformis*) and colonial ascidians (e.g., *Polycitor adriaticus*) were the drivers of the observed spatial differences, in terms of species turnover ( $\beta$  diversity). Role of environmental parameters in determining spatial patterns of distribution have been tested using a large scale habitat suitability model. Moreover, diversity of benthic assemblages is driven by recruitment dynamics and asexual reproduction. However, processes supporting the spatial complexity of these habitats are still unknown. Connectivity among populations, bioconstruction/erosion ratio, and species responses to human threats, increasing water temperature and acidification are the core of a research project aimed at estimating resistance and resilience of these assemblages, and predicting future MBHs distribution under GCC scenarios (<https://reefresearch.jimdo.com>).

## BEYOND SCUBA LIMIT: THE CHALLENGE OF THE COASTAL ANIMAL FORESTS OF THE MESOPHOTIC

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Presentation type: ORAL (Invited Speaker)

Beyond the “common” SCUBA diving depth limit (25-35 meters depth), a huge benthic community extends having its own distribution, trophic ecology and biodiversity patterns. New technologies (for SCUBA divers and the introduction of ROVs for scientific purposes) applied to study the habitats between 30 and 150 meters depth, was crucial to have an opportunity to reach species and communities only barely approached in the past. In this area, commonly called “twilight zone”, light is not the main driver for the biomass production, being suspension feeders the dominant organisms, and the heterotrophy the main trophic strategy. The animal forests dwelling in mesophotic ecosystems (i.e., communities composed of engineering species such as sponges, scleractinians, gorgonians, bryozoans, etc.) generate complex three-dimensional bioconstructions that enhance the diversity and abundance of the associated fauna. In these communities, the recent scientific approach raised several ecological questions to be answered, and claim for the development of new tools for the management and conservation of coastal areas. For example, what is the degree of connectivity between shallow stressed areas and deeper populations? Can the twilight reefs contribute to the recovery of damaged shallow coral reefs? Which is the trophic ecology of the ecosystem engineering species below certain depths? How can we quantify the role of light in the energy budget of mixotrophic species? Which is the role as carbon sinks of these sea forests? How will Global Change affect the organisms living in the twilight zone? Will the conservation of coastal areas change with the inclusion of these systems in new and existing MPAs? These and more questions will be addressed in this presentation, in a overview on the current knowledge about some mesophotic species and communities. The study of mesophotic ecosystems is a great opportunity for naturalists to establish new patterns in coastal ecosystems functioning: new discovers and challenges are waiting for an answer.

## MARINE-DERIVED MESOPHOTIC BIOCATALYSTS AS TOOL FOR THE DEGRADATION OF PERSISTENT ORGANIC POLLUTANTS

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The constantly expanding field of Biocatalysis is in search of novel biocatalysts to meet its new needs. Marine world is a particularly interesting place for the bioprospecting of novel biocatalysts. Marine-derived microorganisms and enzymes may possess appealing properties, acquired through millions of years of evolution in unfriendly habitats, which render them valuable for biotechnological applications. These characteristics include tolerance in high salt concentrations (halophiles), high pressure (piezophiles), either high thermal (thermophiles) or cold adaptivity (psychrophiles), and combination of the above (polyextremophiles). The mesophotic zone is an underexplored marine habitat, probably due to the fact that it is below depths (30-100 m) reached with traditional SCUBA diving techniques. The biodiversity of mesophotic coral systems is considered a potential source of novel symbiotic microorganisms, which can contribute to the enzymatic arsenal of Biocatalysis and specifically biodegradation of recalcitrant pollutants such as persistent organic pollutant (POPs). Pollution by POPs often takes place in marine ecosystems and the exploitation of microorganisms might be a feasible alternative against typical mechanical methods. In the present work, we study the potential of 44 marine-derived symbiotic filamentous fungi that were isolated through TASC MAR H2020 project (grand agreement No 634674) to bioconvert POPs. The fungi were grown in marine medium and their biomass was used as a biocatalyst in resting-cell reactions, aiming in the degradation of two POP compounds; one model compound 2,4-dichlorophenol and one POP compound 2,4,5-trichlorobiphenyl (PCB29). The most efficient bioconversion reactions will be further explored by mass spectrometry to elucidate the degradation pattern that lead to less toxic metabolites.