Red Sea Research Center Open Science Conference

29-30th October 2019

Book of Abstracts
Agenda

About

The Red Sea Research Center (RSRC) Open Science Conference 2019 is a student and postdoctoral fellow-led symposium exhibiting RSRC research and featuring international keynote speakers.

As during previous Open Science Conferences in 2017 and 2018, we aim to provide a friendly platform for all RSRC students, postdocs, research technicians and research scientists to showcase their work (at varying stages of completion and/or success). Published something interesting? Let us know! Stuck with an intractable problem? Perhaps a member of the audience can suggest new ideas!

The talks will be punctuated by other exciting events: there will be a poster session and five keynote talks.

The keynote speakers are luminaries in marine science and include:

Prof. Camilo Mora, University of Hawaii, U.S.A.
Dr. Maria Dornelas, University of St. Andrews, U.K.
Prof. Ameer A. Eweida, NEOM, Saudi Arabia
Mr. Philipppos Papageorgiou, National Fisheries Development Program, Saudi Arabia
Prof. Kyle Lauersen, Department of Bioscience, KAUST, Saudi Arabia

Organizing committee

Conference Chair: Dr. Daffne C. López Sandoval
Invited Speakers Committee: Dr. Daffne C. López Sandoval, Sebastian Overmans
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Red Sea Research Center
Open Science Conference 2019
King Abdullah University of
Science and Technology (KAUST)
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Program (click on the underlined links to access to further information about the talks/posters)

Tuesday, 29 October
Level 0 Auditorium between buildings 4 and 5

09:00 - 09:05  Welcome from the Center Director
Prof. Michael Berumen
RSRC Acting Director

09:05 - 09:15  Opening speech
Prof. Donal D. C. Bradley
Vice President for Research
Distinguished Professor, Materials Physics & Device Engineering

09:15 - 10:00  Keynote Lecture: Exploring the potential of algae as a sustainable biotechnological production platform
Prof. Kyle Lauersen

10:00 - 11:45  Session 1: Marine Microbial Ecology and Biotechnology

10:00 - 10:15  Diel variations of picoplankton growth and division rates in the central Red Sea
Najwa Al-Otaibi, Francisca C. García, and Xosé Anxelu G. Morán

10:15 - 10:30  Food, grazing or temperature? What matters most for heterotrophic bacteria
Luis Silva, et al.

10:30 - 10:45  Coffee break

10:45 - 11:00  Low host abundance and high temperature determine switching from lytic to lysogenic in planktonic microbial communities in a tropical sea (Red Sea)
Ruba Ashy and Susana Agusti
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11:00 - 11:15
Variability of bacterioplankton top-down controls in inshore and offshore waters of the central Red Sea
Eman I. Sabbagh, Miguel Viegas, and Xosé Anxelu G. Morán

11:15 - 11:30
Thermal preferences for Synechococcus growth
Alexandra Coello-Camba and Susana Agustí

11:30 - 13:00
Lunch break

13:00 - 13:45
Keynote lecture: Detecting and dissecting biodiversity change
Dr. Maria Dornelas

13:45 - 16:15
Session 2: Coral Reef Ecology

13:45 - 14:00
Forecasting coral functional responses to future warming and ocean acidification

14:00 - 14:15
Ocean warming rather than acidification shapes the transcriptomic and proteomic response of a coral reef fish
Alison A. Monroe, Michael D. Jarrold, Celia Schunter, Huoming Zhang, Philip L. Munday, and Timothy Ravasi

14:15 - 14:30
Fine-scale delineation of host-specific Symbiodiniaceae genotypes shows little correspondence to patterns in previous bleaching severities on a Central Red Sea reef system
Alejandro Mejia-Restrepo, Benjamin C. C. Hume, Christian R. Voolstra, and Michael L. Berumen

14:30 - 14:45
Photonic cooperation between Tridacninae and their photosynthetic symbionts – how giant clams cope with high UV radiation in shallow reefs
Susann Rossbach, Sebastian Overmans, Altnay Kaidarova, Juergen Kosel, Susana Agustí, and Carlos M. Duarte
Irene Antonina Salinas Akhmadeeva and Héctor Reyes Bonilla

Coffee break

Transcription factor binding motifs coupled with DNA methylation profiles in Aiptasia
Kashif Nawaz, Maha J. Cziesielski, Guoxin Cui, and Manuel Aranda

Latitudinal variation in thermostolerance of Porites lobata in the Red Sea
Marcelle M. Barreto, Sebastian Schmidt-Roach, and Manuel Aranda

Exploring strategies to increase thermal resilience of corals in Saudi Arabian waters
Sebastian Schmidt-Roach, Marcelle Muniz Barreto, Maha J. Cziesielski, E.J. Howells, Marcela Herrera, A. Prasanna, and Manuel Aranda

Feeding ecology does not match morphological functionality in American parrotfishes
Lucia Pombo Ayora, Jose J. Tavera, and Fernando A. Zapata

Poster session
Keynote lecture: NEOM: Introducing a new era of sustainable development
Prof. Ameer A. Eweida

Session 3: Remote Sensing and Numerical Modelling

Monitoring and evaluating the status of NEOM’s marine ecosystem from space
Nikolaos Papagiannopoulos, Dionysios E. Raitsos, Georgios Krokos, John A. Gittings, Vassilis P. Papadopoulos, Alexandra Pavlidou, Nick Selmes, Robert J. W. Brewin, and Ibrahim Hoteit

A model-based connectivity study in the Red Sea: how seascape features influence population genetics
Yixin Wang, Dionysios Raitsos, and Ibrahim Hoteit

Marine heatwaves reveal coral reef zones susceptible to bleaching
Lily G. C. Genevier, Tahira Jamil, Dionysios E. Raitsos, George Krokos, and Ibrahim Hoteit

Coffee break

A Bayesian Statistical Approach for Understanding and Predicting Red Sea Temperatures
Nabila Bounceur, Ibrahim Hoteit, and Omar Knio

Climate Oscillations May Counteract Red Sea Warming over the Coming Decades
George Krokos, Vassilis P. Papadopoulos, Sarantis S. Sofianos, Hernando Ombao, Patryk Dybczak, and Ibrahim Hoteit

Resolving the Short-term Persistence of Oceanographic Measurements from an Autonomous Underwater Vehicle in the Central Red Sea, October 2017
Michael Campbell, Lohitzune Solabarietta, Malika Kheireddine, and Burt Jones
11:00 - 11:15  
**Remotely sensing harmful algal blooms in the Red Sea**  
Elamurugu Alias Gokul, Dionysios E. Raitsos, John A. Gittings, Abdulsalam Alkawri, and Ibrahim Hoteit

11:15 - 11:30  
**Ibex for Red Sea Research**  
Nagarajan Kathiresan and Saber Feki

11:30 - 11:45  
**Hindering effects of tides on the Gulf of Aden Intermediate Water intrusion**  
Daquan Guo, Fengchao Yao, Peng Zhan, George Krokos, and Ibrahim Hoteit

11:45 - 13:00  
**Lunch break**

13:00 - 13:45  
**Keynote lecture: Prospects and Challenges for the Aquaculture Industry in Saudi Arabia**  
Mr. Philippos Papageorgiou

13:45 - 16:00  
**Session 4: Aquaculture, Environmental Monitoring and Conservation**

13:45 - 14:00  
**Effects of temperature on the growth performance and feed efficiency of sobaity seabream and gilthead seabream cultured under Red Sea conditions**  
Joseph Leopoldo Q. Laranja, Jorge F. Alarcon, Asaad Mohamed, Muhammad Danial A. Nor Azli, Nurhisham Razali, Gerry Carbonell, Jupit Donoso, and Abdulaziz M. Al-Suwailem

14:00 - 14:15  
**Underwater Red Sea UVB levels have negative effects on growth, behavior, physiology, immune function and antioxidant capacity in gilthead seabream**  
Ricardo N. Alves, Sebastian Overmans, Micaela Justo, Asaad H. Mahamed, Jorge F. Alarcon, Abdulaziz Al Suwailem, and Susana Agustí

14:15 - 14:30  
**Monitoring the impact of offshore aquaculture on ambient water quality in the Red Sea**  
Aislinn Dunne, Susana Carvalho, Xosé Anxelu G. Moran, and Burton Jones
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14:30 - 14:45  
**Ecological effects of non-native species in marine ecosystems relate to co-occurring anthropogenic pressures**  
Nathan R. Geraldi, Andrea Anton, Julia Santana-Garcon, Scott Bennett, Nuria Marbà, Catherine E. Lovelock, Eugenia T. Apostolaki, Just Cebrian, Dorte Krause-Jensen, Paulina Martinetto, John M. Pandolfi, and Carlos M. Duarte

14:45 - 15:00  
**A comparison of hatchling locomotor performance and scute pattern variation between in-situ and relocated nests**  
Lyndsey Tanabe, Marion Steenacker, Mohd Uzair Rusli, and Michael L. Berumen

15:00 - 15:15  
Coffee break

15:15 - 15:30  
**Ecophysiological interactions in intertidal macroalgal assemblages**  

15:30 - 15:45  
**Environmental DNA fingerprints marine macrophytes in Blue Carbon ecosystems**  
Alejandra Ortega, Nathan Geraldi, and Carlos M. Duarte

15:45 - 16:00  
**Global ecological impacts of marine exotic species**  
Andrea Anton, Nathan R. Geraldi, Catherine E. Lovelock, Eugenia T. Apostolaki, Scott Bennett, Just Cebrian, Dorte Krause-Jensen, Nuria Marbà, Paulina Martinetto, John M. Pandolfi, Julia Santana-Garcon, and Carlos M. Duarte

16:00 - 16:15  
Voting break

16:15 – 17:00  
**Keynote lecture: Climate change is worse than you think but still fixable**  
Prof. Camilo Mora

17:00 – 17:15  
Closing remarks, awards and group photo

18:00 – 20:00  
Social dinner
Contacts

Dr. Daffne C. López Sandoval
Conference Chair
Phone: +966128082659
Email: daffne.lopezsandoval@kaust.edu.sa

Conference email:
rsrcosc2019@gmail.com

Prof. Michael L. Berumen
RSRC Acting Director
Phone: +966128082376
Email: michael.berumen@kaust.edu.sa

Manal Bamashmos
RSRC Business Manager
Phone: +966128080503
Email: manal.bamashmos@kaust.edu.sa

Christine Nelson
RSRC Executive Secretary
Phone: +966128084959
Email: christine.nelson@kaust.edu.sa
Diel variations of picoplankton growth and division rates in the central Red Sea

Najwa Al-Otaibi, Francisca C. García, and Xosé Anxelu G. Morán

Abstract

Using flow cytometric tools, we followed the diel variations of autotrophic (Synechococcus, Prochlorococcus and picoeukaryotes) and heterotrophic picoplankton (low and high nucleic acid content prokaryotes) at a mesopelagic station in the central Red Sea. High-frequency samples were taken every 2 hours in each of the four seasons. Here, we provide an attempt to estimate the diel patterns of the processes of cell growth and division of the dominant plankton size-class in the Red Sea. This study is necessary for interpreting the short to long term dynamics in the entire water column.

Keywords

Red Sea; Diel variation; Prochlorococcus; Synechococcus; Picoeukaryotes; Heterotrophic bacteria; HNA; LNA
Food, grazing or temperature? What matters most for heterotrophic bacteria

Luis Silva et al.

Abstract

The Malaspina 2010 Global Circumnavigation Expedition has provided information about the global distribution of heterotrophic prokaryotes in subtropical and tropical waters. The Red Sea, which shares these characteristics, remained largely unexplored until very recently. The coastal waters of the central Red Sea, though warmer and richer, showed consistently lower bacterial abundances. Fewer bacteria with higher chlorophyll-a concentrations are explained by strong top-down control of their standing stocks by protistan grazers. Indeed, coastal Red Sea heterotrophic bacteria showed a high potential to grow, with specific growth rates significantly higher than their oceanic counterparts.

Keywords

Red Sea; Subtropical and tropical waters; Heterotrophic prokaryotes; Bacterial abundances; Specific growth rates
Low host abundance and high temperature determine switching from lytic to lysogeny in planktonic microbial communities in a tropical sea (Red Sea)

Ruba Ashy and Susana Agustí

Abstract

The lytic and lysogenic life cycles of marine phages are influenced by environmental conditions such as solar radiation, temperature, and host abundance. Temperature can regulate phage infection, but its role is difficult to discern in oligotrophic waters where there is typically low host abundance and high temperatures. Here we study the temporal variability of viral and lysogenic dynamics in a coastal lagoon in the oligotrophic Red Sea, which showed strong seasonality in terms of temperature (22.05 - 33.25°C), and occurrence of high phytoplankton blooms. Viral abundances ranged from 2.22 \times 10^6 to 1.53 \times 10^7 viruses mL^{-1} and were closely related to chlorophyll-a concentrations. Phages exerted a tight control of their hosts, as suggested by the significant decrease in bacterial abundance with increased virus concentrations, and supported by the high virus-to-bacterium ratio (maximum 79). However, the viruses became temperate when the bacterial abundance decreased. Lysogeny was observed at low percentages in half of the incubations and increased when the host abundance decreased, with a maximum of 29.1% in the fall. Bacterial abundance significantly decreased with increasing temperature, pointing to an indirect effect of temperature on lysogeny through a reduction in host abundance. Overall, our study contributes to the understanding of lysogeny in marine phages.

Keywords

Lysogenic marine microbes; Lytic; Marine viruses; Temperature; Induction
Variability of bacterioplankton top-down controls in inshore and offshore waters of the central Red Sea

Eman I. Sabbagh, Miguel Viegas, and Xosé Anxelu G. Moran

Abstract

Bacterioplankton are pivotal in marine food webs and biogeochemical cycling. In this study we compare the impact of top-down controls on the standing stocks of autotrophic and heterotrophic bacterioplankton in two coastal environments in the central Red Sea. Monthly samples in 2018 from KAUST Harbor and a 30 m station near Abushusha reef were analyzed for physiological groups of heterotrophic bacteria, cyanobacteria, viruses and heterotrophic nanoflagellates (HNFs). Largely confirmative of a previous study conducted at KAUST Harbor in 2017, our results however suggest that the role of viruses and HNFs in controlling bacterioplankton standing stocks was different in Abushusha reef.

Keywords

Bacterioplankton; Viruses; Heterotrophic nanoflagellates
Thermal preferences for *Synechococcus* growth

Alexandra Coello-Camba and Susana Agustí

**Abstract**

Cyanobacteria are important primary producers in the oligotrophic oceans of the world including the Red Sea. Amongst them, *Synechococcus* has been described as an abundant and ubiquitous genus, genetically diverse, and with different clades showing different ecological preferences. Here, we studied the thermal preferences of several *Synechococcus* strains isolated from this warm water mass, to shed light on the effects of temperature on their growth and distribution in the Red Sea.

**Keywords**

*Red Sea; Synechococcus; Temperature*
Forecasting coral functional responses to future warming and ocean acidification


Abstract

Overwhelming evidence indicates that climate change continues to degrade coral reef ecosystems globally. However, despite the vast efforts to examine reef-building coral responses to ocean warming (OW) and ocean acidification (OA), disparate experimental observations have limited our ability to make meaningful predictions. Here we evaluate the scale of the climate change threat by quantifying the sensitivities of eight coral traits (symbiont density, pigment content, photochemical efficiency, photosynthesis, calcification, growth, survival, and respiration) across 95 coral species to rates of OW and OA, derived from the Representative Concentration Pathway scenarios (RCP2.6 to RCP8.5). Symbiont traits and calcification are most sensitive to climate change, suggesting that productivity and structure of reef ecosystems will deteriorate even under optimistic scenarios (RCPs2.6 and 4.5). Insight from our analysis is derived from hundreds of experiments conducted across the globe and forecasts further critical coral loss if they cannot adapt or acclimatize to the rapid change under RCP4.5 (average ~ +1.8 °C increase by the end of the century). Consequently, if anthropogenic emissions are not radically reduced in the near future, the rate of current mass mortality in coral reef ecosystems will accelerate. These findings have direct implications on millions of livelihoods depending on coral reef ecosystem services, prioritize directions for critical research, and provide independent support for recent IPCC statements.

Keywords

Coral reefs; Climate Change; Ocean Acidification; Ocean Warming; Symbioses; Holobiont; Bleaching
Ocean warming rather than acidification shapes the transcriptomic and proteomic response of a coral reef fish

Alison A. Monroe, Michael D. Jarrold, Celia Schunter, Huoming Zhang, Philip L. Munday, and Timothy Ravasi

Abstract

In the coral reef fish, Acanthochromis polyacanthus, the separate effects of ocean acidification and ocean warming have been extensively studied showing effects on behavior, metabolism, growth, and survival. Investigating for the first time the combined effects of these stressors on molecular responses of a coral reef fish we exposed juvenile damselfish to four different conditions for eleven weeks: control, elevated temperature, elevated pCO₂, and combined. We measured transcriptomes and proteomes from livers and brains of juveniles and analyzed differential expression between conditions. Our results suggest that elevated temperature has a much stronger effect than elevated pCO₂ on fundamental molecular pathways.

Keywords

Climate change; Fish; Transcriptomics; Proteomics
Fine-scale delineation of host-specific Symbiodiniaceae genotypes shows little correspondence to patterns in previous bleaching severities on a Central Red Sea reef system

Alejandro Mejia-Restrepo, Benjamin C. C. Hume, Christian R. Voolstra, and Michael L. Berumen

Abstract

We characterized the coral host-associated Symbiodiniaceae community and monitored temperatures 6 reefs of the Thuwal reef system. We show that previous bleaching patterns correlate poorly to the host-specific structure of the Symbiodiniaceae community but are in better agreement with absolute and intraday sea water temperature variations. We demonstrate a greater uniqueness of Symbiodiniaceae community more severely bleached inshore reefs compared to those reefs further offshore. Finally, we discuss how our fine scale delineation of genotypes, including putative genotypes of Durusdinium trenchii that represent alluring targets for further taxonomic identification, corroborate a niche adapted rather than generalist character of coral-Symbiodiniaceae associations.

Keywords

Symbiodiniaceae; SymPortal; ITS2; Coral; Coral bleaching; Phylogenetics; Genotyping
Photonic cooperation between *Tridacninae* and their photosynthetic symbionts – how giant clams cope with high UV radiation in shallow reefs

**Susann Rossbach, Sebastian Overmans, Altynay Kaidarova, Juergen Kosel, Susana Agusti, and Carlos M. Duarte**

**Abstract**

Giant clams of the subfamily *Tridacninae* live in a symbiotic relationship with unicellular algae of the family *Symbiodiniaceae*. Some species have even been found to function as net photoautotrophs, and their net calcification is significantly dependent on incident light. However, since the requirements of their symbionts for photosynthetically active radiation restricts *Tridacninae* to the sunlit, shallow waters of the euphotic zone, both, giant clams and algal symbionts are exposed to potentially high levels of environmental UV radiation. This led to the evolution of a three-dimensional system of brightly reflective cells, called Iridocytes, which have both, light-harvesting and light-protective properties.

**Keywords**

*Tridacna; Giant clam; Photosynthesis; Symbiosis; UV radiation; Light; Reef*
At What Size Does a Pocillopora Coral Fulfills Its Ecological Role In A Reef? A Guide For Reef Restoration

Irene Antonina Salinas Akhmadeeva and Héctor Reyes Bonilla

Abstract

The success of restoration efforts is usually measured on the basis of coral survival and growth rates, but that approach may be improved by taking in consideration specific evaluations of the ecological role that transplanted colonies play in a reef. The objective of the study was to detect the size that colonies of naturally settled *Pocillopora* *spp.* require to host a full set of associated reef fishes, and use that information as a proxy indicator of success for restoration projects.

Keywords

*Coral restoration; Eastern Tropical Pacific; Restoration ecology*
Transcription factor binding motifs coupled with DNA methylation profiles in *Aiptasia*

Kashif Nawaz, Maha J. Cziesielski, Guoxin Cui, and Manuel Aranda

**Abstract**

While various studies have addressed the molecular processes underlying the endosymbiosis in corals, the role of epigenetic modifications remains largely unknown. Here, we compared DNA methylation patterns of symbiotic and aposymbiotic *Aiptasia* to study the role of this mechanism in symbiosis. Our results show that methylation is sporadically spread across the genome but majorly devoid inside CpG island that are located around transcription start sites (TSS). Using in silico motif identification we found at least one CpG present inside every motif for which the methylation status could affect the binding affinity of transcription factors (TFs). These findings suggest a potential role for DNA methylation in regulating transcriptional during symbiosis.

**Keywords**

*DNA methylation; CpG island; Epigenetics; Transcription factors; Transcription start sites; Symbiotic; Aposymbiotic*
Latitudinal variation in thermotolerance of *Porites lobata* in the Red Sea

Marcelle M. Barreto, Sebastian Schmidt-Roach, and Manuel Aranda

Abstract

Spatial environmental heterogeneity creates different selective pressures that can lead to genetic variability and species adaptation. Due to its latitudinal temperature, the Red Sea constitutes an ideal location to investigate local adaptation and acclimatization potential of corals to increased temperatures. This becomes particularly important in the context of global warming and the rise of assisted gene flow as a tool to accelerate coral adaptation to increasing temperatures. In this study, we investigated differences in the physiological response of the coral *Porites lobata* from 3 different latitudes in the Red Sea to evaluate the potential of applying assisted gene flow to Red Sea reefs.

Keywords

*Porites lobate; Thermotolerance; Assisted gene flow*
Exploring strategies to increase thermal resilience of corals in Saudi Arabian waters

Sebastian Schmidt-Roach, Marcelle M. Barreto, Maha J. Cziesielski, E.J. Howells, Marcela Herrera, A. Prasanna, and Manuel Aranda

Abstract

The desert seas of Saudi Arabia are home to some of the warmest coral reefs in the world. While corals in the Northern Red Sea experience mean monthly summer maximum temperatures around 27°C, the Southern Red Sea and Arabian Gulf regularly exceed 32°C and 34°C, respectively. Here we aimed to elucidate the evolutionary history, connectivity, and thermal resilience of coral populations in these regions. We sampled Platygryra daealea colonies from seven locations across a latitudinal gradient along the Red Sea coast as well as one reef in the Gulf including survivors of the 2015/2016 mass bleaching event, which severely impacted the visited reefs in the Southern Red Sea and the Gulf. ITS2 amplicon sequencing of the algal symbiont populations showed a latitudinal shift from Cladocopium taxa in the North to Durusdinium taxa in the Southern Red Sea, whereas the Gulf corals were either associated with Cladocopium thermophilum or Symbiodinium species. eZRAD sequencing of the coral host colonies correlates with these findings, showing the highest structural divergence for the Southern Red Sea and the Gulf. To elucidate the potential for assisted gene flow via transplantation we conducted a common garden experiment in the Central Red Sea and investigated how individuals from divergent populations differ in their performance and survival. During the summer temperature peaks, bleaching was exclusively observed in individuals from the Northern Red Sea which also showed the highest mortality. Conversely, the lowest mortality rate was for local individuals, stressing the importance of local adaptation. High mortality rates, especially of the Arabian Gulf individuals, strongly suggests that translocation across diverse habitats may have uncertain success. To elucidate the potential for assisted gene flow via intra-specific hybridization we cross-bred individuals from five populations spanning the entire Saudi Red Sea coast as well as the Arabian Gulf population. Parental colonies were long-term acclimated to Central Red Sea conditions to ensure that embryogenesis occurred under the same conditions. Larval heat selection experiments showed increased survival rates for crosses with populations from warmer regions. Our work identifies both capacities and limitations of adaptive resilience-based coral reef management under climate change.

Keywords
Assisted gene flow; Thermal tolerance; Larval selection; Population genetics
Feeding ecology does not match morphological functionality in American parrotfishes

Lucia Pombo Ayora, Jose J. Tavera, and Fernando A. Zapata

Abstract

In functional ecology, we can expect a concordance between function and morphology. Still, sometimes we can find a decoupling between those two. That is the case of parrotfishes of the genera Scarus and Sparisoma. We reconstructed a phylogenetic tree including 50 species, based on 12 genes to make our morphological analysis and to perform and ancestral reconstruction of parrotfishes feeding modes. We found that although all Scarus species feed by scraping, they are morphological more diverse compared to Sparisoma species, which have three different feeding modes (i.e., scraping, browsing and excavating) and appear to be morphologically constrained. The morphological differences were quantified within each genus using disparity of the lower jaw mechanical traits. It is possible that different evolutive pressures or ecological conditions have shaped the differences both in the feeding ecology and the feeding morphology of these two genera given that they have had different biogeographical paths.

Keywords

Feeding ecology; Feeding traits; Functional roles; Phylogeny; Scarinae
Monitoring and evaluating the status of NEOM’s marine ecosystem from space

Nikolaos Papagiannopoulos, Dionysios E. Raitsos, Georgios Krokos, John A. Gittings, Vassilis P. Papadopoulos, Alexandra Pavlidou, Nick Selmes, Robert J. W. Brewin, and Ibrahim Hoteit

Abstract

NEOM is a $500bn megaproject that will expand over an area of 26,500 Km² along a 468 Km coastline. The success of NEOM will rely partly on preserving its marine biodiversity hot-spots, which will directly translate into food security and societal support through fisheries, recreation, and tourism. Monitoring the variability of ecological Indicators, in relation to the regional environmental conditions and climate change, is vital for such a goal. In this initial effort, we used satellite-derived regionally-tuned chlorophyll-a data from the ESA Ocean Colour - Climate Change Initiative at 1 Km resolution, and in situ cruise datasets of chlorophyll-a and nitrate concentrations.

Keywords

NEOM; Remote sensing; Phytoplankton biomass
A model-based connectivity study in the Red Sea: how seascape features influence population genetics

Yixin Wang, Dionysios Raitos, and Ibrahim Hoteit

Abstract

Using a coupled hydrodynamic (MITgcm) and particle tracking (CMS) model, this study describes in details the circulation-driven physical connectivity patterns of the Red Sea coral reef regions. A statistical analysis (multivariate distance matrix regression) was performed on published genetic datasets of different species, to further quantify the influence of multiple seascape features, including the circulation, on the genetic structures. The results enabled a deeper understanding of the processes driving the genetic variations, suggesting a feasible approach to predict genetic structures of coral reef species in the Red Sea.

Keywords

Seascape Genetics; Connectivity Modelling; Multivariate Distance Matrix Regression; Red Sea
Marine heatwaves reveal coral reef zones susceptible to bleaching

Lily G. C. Genevier, Tahira Jamil, Dionysios E. Raitos, George Krokos, and Ibrahim Hoteit

Abstract

The recent development of a hierarchical definition for marine heatwaves (MHWs) has led to studies revealing that these extreme anomalous heating events have increased over 50% during the past century, and will continue to increase in frequency and intensity. These MHWs may also be tuned to conditions likely to lead to coral bleaching. Following the implementation of this methodology to the Red Sea, we now compare them to bleaching conditions for the Arabian Gulf. Such materials can be used by policymakers to limit further threats to reefs at risk and prioritize the protection of those likely to survive future conditions.

Keywords

Bleaching threshold detection; Conservation management tool; Coral bleaching; Marine heatwaves; Red Sea; Arabian Gulf
A bayesian statistical approach for understanding and predicting Red Sea temperatures

Nabila Bounceur, Ibrahim Hoteit, and Omar Knio

Abstract

Prediction of future spatio-temporal patterns in coral reef bleaching conditions with an estimate of uncertainty, is a key role in enhancing decision making for environment management over the Red Sea. Sea surface temperature (SST) variability is at first level the factor impacting coral reefs through increasing thermal bleaching events. Therefore, detecting and understanding the drivers of SST variability is critical for making meaningful projections of coral bleaching risk. In this work, we applied a practical statistical framework based on the Bayesian structural time series model and we showed its efficiency to predict and analyze bleaching risk alerts by (1) predicting SST for the next season with a very high accuracy and by (2) detecting the main predictive factors of its variability. SST predictions were obtained over three main regions of the Red Sea, clustered hierarchically based on long term variability dissimilarities. Thanks to this approach, we were able to isolate predictors of SST in an efficient and systematic way considering a large number of global climate indices. Efficiency in the prediction scheme is ensured by avoiding redundancy thanks to the combination of (1) prediction over the clustered regions and (2) the use of Bayesian paradigm and the MCMC algorithm with a structural time series model to perform variable selection at the same time as model training. The new insight gained from the application of this approach is that large-scale spatial patterns of ENSO and MJO are important predictive factors over the southern part of the Red Sea only. On the other hand, AO and NAO are predictors of monthly SST A over the Northern part. The connection between ENSO, AO and NAO climate indices and coral time series over the Red Sea is supported by northern Red Sea coral records during recent centuries.

Keywords

Bayesian predictive model; Red Sea surface temperature; Climate indices; Coral reef bleaching
Climate oscillations may counteract Red Sea warming over the coming decades

George Krokos, Vassilis P. Papadopoulos, Sarantis S. Sofianos, Hernando Ombao, Patryk Dybczak, and Ibrahim Hoteit

Abstract

The recent warming trend of the Red Sea SST is critical for the fragile basin’s ecosystem and its precious coral reef community. We show that the long-term variation of the SST over the Red Sea is influenced by a natural oscillation related to the Atlantic Multidecadal Oscillation (AMO). Recently reported warming rates based on satellite-era datasets coincide with a positive phase of this oscillation, and the associated SST trend is overstated compared to the long-term trend. As AMO currently shifts from positive to negative phase, the Red Sea is expected to shift into a cooling phase during the next decades.

Keywords

SST; Long-term trends; Atlantic Multidecadal Oscillation
Resolving the short-term persistence of oceanographic measurements from an autonomous underwater vehicle in the central Red Sea, October 2017

Michael Campbell, Lohitzune Solabarietta, Malika Kheireddine, and Burt Jones

Abstract

This research presents a new multi-method statistical process for resolving short-term persistence [features and temporal/spatial scales of concern] of observed oceanographic variables from glider deployments in the central Red Sea. Short-term persistence can be considered as the minimum characteristic time scale of observable patterns in the study area, which can then determine the most important processes influencing circulation and variable distributions within the central Red Sea. Autocorrelation, Error X, and a variation of the Wilcoxon rank sum have been applied to data collected from the central Red Sea in October of 2017 along specific depth levels (6 m, 75 m, and 150 m) and density surfaces (25.75 kg/m$^3$, 26.75 kg/m$^3$, and 27.75 kg/m$^3$).

Keywords

Gliders; Statistics; Circulation
Remotely sensing harmful algal blooms in the Red Sea

Elamurugu Alias Gokul, Dionysios E. Raitos, John A. Gittings, Abdulsalam Alkawri, and Ibrahim Hoteit

Abstract

Sporadically, large areas of the Red Sea are occupied by harmful algal blooms (HABs). Using satellite remote sensing observations and a second-order derivative approach, in conjunction with available in situ datasets, we investigate for the first time the relevance of a remote sensing model to detect and monitor HABs in the Red Sea. The algorithm is able to successfully detect and generate maps of Red Sea HABs, matching concurrent in situ data remarkably well. This model is currently being utilized to investigate the seasonal and interannual variability of HABs in the Red Sea over the period 2003-2017.

Keywords

Red Sea; Harmful algal blooms; Satellite remote sensing; Second-order derivative approach
Ibex for Red Sea research

Nagarajan Kathiresan and Saber Feki

Abstract

Nowadays, biological science brings larger volume of dataset from research laboratories, industries and health care sectors. To process these biological data and build large scale reference database, often requires the use of High-Performance Computing (HPC) systems. To accelerate the research outcome and minimize the data processing time, biological datasets like genomics, metagenomic and omics can be parallelly analyzed using the HPC systems. In this presentation, we describe the various Ibex resource available for Red Sea Research with an example use cases. Additionally, we explain our technical support model for Bioinformatics users which includes (i) software and workflow support, (ii) development and/or customization of user scripts and (iii) effective usage of ibex heterogenous computing platforms to accelerate the research outcome.

Keywords

Biological data processing; High Performance Computing; Bioinformatics
Hindering effects of tides on the Gulf of Aden Intermediate Water intrusion

Daquan Guo, Fengchao Yao, Peng Zhan, George Krokos, and Ibrahim Hoteit

Abstract

Based on a 3D high-resolution Red Sea general circulation model utilized by configuring modes with and without a tidal forcing, we found that the intrusion of Gulf of Aden Intermediate Water (GAIW) is strongly affected by tidal influences. With the tides included, the along-axis extension of the intrusion is reduced by a maximum of 1.0 degrees; the volume transports are reduced by 20 percent on average. Analysis of the vertical mixing parameters indicates that the reason for these projections is likely due to the enhancement of the vertical mixing along thermocline and topography when introducing the tides into the model.

Keywords

Simulation; Baroclinic tides; Mixing
Effects of temperature on the growth performance and feed efficiency of sobaity seabream and gilthead seabream cultured under Red Sea conditions

Joseph Leopoldo Q. Laranja, Jorge F. Alarcon, Asaad Mohamed, Muhammad Danial A. Nor Azli, Nurhisham Razali, Gerry Carbonell, Jupit Donoso, and Abdulaziz M. Al-Suwailem

Abstract

In this research, we determined the effects of different rearing temperatures (24, 28 and 32°C) on the growth performance, feed conversion ratio (FCR) and protein efficiency ratio (PER) of sobaity seabream (Sparidentex hasta) and gilthead seabream (Sparus aurata) cultured in tanks using the seawater from the Red sea. Fish were fed with a commercial diet to satiation at two times daily. The results showed that growth, FCR and PER were significantly influenced (p<0.05) by temperature in both species. Specifically, growth, FCR and PER of sobaity seabream were significantly better at 32°C as compared to 28 and 24°C. However, opposite results were observed for gilthead seabream wherein the growth, FCR and PER were significantly better at 24°C than at 28 and 32°C. The results suggest that the two fish species have different water temperature preference and that culturing these fish in the Red sea where the sea surface temperature varies during winter and summer months could provide some effects on their culture performance.

Keywords

Temperature; Sobaity seabream, Gilthead seabream; FCR; Growth
Red Sea Research Center
Open Science Conference 2019

Underwater Red Sea UVB levels have negative effects on growth, behavior, physiology, immune function and antioxidant capacity in gilthead seabream

Ricardo N. Alves, Sebastian Overmans, Micaela Justo, Asaad H. Mahamed, Jorge F. Alarcon, Abdulaziz Al Suwailem, and Susana Agustí

Abstract

It has recently been recognized that the role of ultraviolet B (UVB) radiation as a stressor for Red Sea organisms may have been underestimated in the last years. Thus, it is expected that the UVB comprises a critical threat to fish, particularly those confined to aquaculture cages. The present study aimed to investigate, for the first time, the negative effects of UVB radiation on commonly non-native aquaculture species, namely the gilthead seabream (Sparus aurata). Juveniles were exposed to short- (10 days) and long-term (43 days) UVB irradiation conditions representing the Red Sea natural UVB levels registered between 2 and 10 m depth in the water column. The present results indicate that exposure to UVB retarded growth, decreased survival, and impaired behavior in seabream juveniles. Also, physiological changes, potential suppression of innate immune system, and reduction of antioxidant capacity, concomitant with severe lesions in the skin, suggest that exposure to UVB has the potential to interfere and affect S. aurata health in natural UVB doses present in the Red Sea waters. These results have important ecological and economic implications when put in the context of UVB tolerance of fish in the Red Sea and aquaculture loss, particularly under current climate change predictions.

Keywords

Ultraviolet B radiation; Stress; Skin lesions; Reduced growth; Immune system suppression; Changes in antioxidant capacity
Monitoring the impact of offshore aquaculture on ambient water quality in the Red Sea

Aislinn Dunne, Susana Carvalho, Xosé Anxelu G. Morán, and Burton Jones

Abstract

We investigated the impacts of marine aquaculture on Red Sea coastal water quality. Water quality parameters were measured seasonally around an offshore fish farm along the south-central coast of Saudi Arabia to determine the impacts of fish farm effluent on the surrounding waters. Particulate matter, phosphate, and ammonium concentrations showed patterns of enrichment close to the fish farm. Additionally, N:P ratios as well as chlorophyll-a and bacterial concentrations were altered down current from the fish farms. This field study aims to understand the potential impacts of future offshore aquaculture development in Saudi Arabia and other tropical, oligotrophic seas.

Keywords

Aquaculture; Water quality; Environmental monitoring
Ecological effects of non-native species in marine ecosystems relate to co-occurring anthropogenic pressures

Nathan R. Geraldi, Andrea Anton, Julia Santana-Garcon, Scott Bennett, Nuria Marbà, Catherine E. Lovelock, Eugenia T. Apostolaki, Just Cebrian, Dorte Krause-Jensen, Paulina Martinetto, John M. Pandolfi, and Carlos M. Duarte

Abstract

Predictors for the ecological effects of non-native species are lacking, even though such knowledge is fundamental to manage non-native species and mitigate their impacts. Current theories suggest that the ecological effects of non-native species may be related to other concomitant anthropogenic stressors, but this has not been tested at a global scale. We combine an exhaustive meta-analysis of the ecological effects of marine non-native species with human footprint proxies to determine whether the ecological changes due to non-native species are modulated by co-occurring anthropogenic impacts. We found that the effects of non-native species decreased native biodiversity where human population was high and caused reductions in individual performance where cumulative human impacts were large. On this basis we identified several ecoregions where non-native species may have the greatest ecological effects, including areas in the Mediterranean Sea and along the northwest coast of the USA. In conclusion, our global assessment suggests co-existing anthropogenic impacts can intensify the ecological effects of non-native species.

Keywords

Invasive; Exotic; Alien; Introduction; Anthropogenic impacts; Global change
A comparison of hatchling locomotor performance and scute pattern variation between in-situ and relocated nests

Lyndsey Tanabe, Marion Steenacker, Mohd Uzair Rusli, and Michael L. Berumen

Abstract

We collected 2,133 newly emerged hatchlings from 37 green turtle (Chelonia mydas) nests and recorded the vertebral and costal scute patterns of each hatchling. From each nest, we randomly selected 10 hatchlings with modal scute patterns (normal) and 10 with non-modal scute patterns (mutants), and measured mass, carapace length, carapace width, self-righting ability, crawling speed, and swimming speed. We investigated the proportion of hatchlings with non-modal scute patterns to determine if it varies depending on incubation duration, nest shading, distance from vegetation, and relocation. We also assessed the relationship between hatchling fitness and scute pattern. Preliminary results indicated that the proportion of scute pattern abnormalities is higher in relocated nests, and in nests with shorter incubation duration.

Keywords

Sea turtle; Hatchery management; Relocation; Conservation; Scute abnormalities
Ecophysiological interactions in intertidal macroalgal assemblages


Abstract

Intertidal macroalgal communities represent complex mosaics of benthic organisms shaped by various abiotic and biotic factors. However, little is known about direct and indirect effects of species interactions on the physiology of individuals. Here we assessed the ecophysiological effects of interspecific interactions between three dominant species of macroalgae in southeast Brazil and the potential consequences for their palatability to herbivores. Algae were collected from monospecific patches or from assemblages where individuals were in physical contact with another species. The results indicate that close co-existence with other species induced changes in algal physiology, as well as in consumption rates by herbivores.

Keywords

Macroalgae; Physiology; Competition
Environmental DNA fingerprints marine macrophytes in Blue Carbon ecosystems

Alejandra Ortega, Nathan Geraldi, and Carlos M. Duarte

Abstract

Estimation of marine macrophytes contribution to the organic carbon pool within coastal vegetated sediments is key to understand dynamics of blue carbon sequestration. Nevertheless, identification of macrophytes carbon sources is challenging, thus those estimations remain unreliable. Here, we provide high-resolution identification of marine macrophyte in mangrove and seagrass sediments using environmental DNA (eDNA). Furthermore, we experimentally found a positive correlation (92%, $R^2 = 0.85$) between macrophytes eDNA abundance and organic carbon content. Habitat-forming macrophytes were the major eDNA sequences contributor: seagrass contributed the most to seagrass sediments, while mangrove did to mangrove sediments; macroalgae were the second-most contributors to the eDNA pool. Proportions of eDNA contributions were similar to organic carbon contribution based on stable isotopes, yet isotopes could not differentiate properly among macrophyte lineages due to signatures overlap. We demonstrate that eDNA is an unparalleled method to estimate organic carbon contribution of marine macrophytes in blue carbon ecosystems.

Keywords

eDNA; Blue carbon; Seagrass; Mangrove; Macroalgae; Cool stuff
Global ecological impacts of marine exotic species

Andrea Anton, Nathan R. Gerald; Catherine E. Lovelock, Eugenia T. Apostolaki, Scott Bennett, Just Cebrian, Dorte Krause-Jensen, Nuria Marbà, Paulina Martinetto, John M. Pandolfi, Julia Santana-Garcon, and Carlos M. Duarte

Abstract

Exotic species are a growing global ecological threat; however, their overall effects are insufficiently understood. While some exotic species are implicated in many species’ extinctions, others can provide benefits to the recipient communities. Here, we performed a meta-analysis to quantify and synthesize the ecological effects of 76 exotic marine species (about 6% of the listed exotics) on ten variables in marine communities. These species caused an overall significant, but modest in magnitude (as indicated by a mean effect size of $g < 0.2$), decrease in ecological variables. Marine primary producers and predators were the most disruptive trophic groups of the exotic species. Approximately 10% (that is, 2 out of 19) of the exotic species assessed in at least three independent studies had significant impacts on native species. Separating the innocuous from the disruptive exotic species provides a basis for triage efforts to control the marine exotic species that have the most impact, thereby helping to meet Aichi Biodiversity Target 9 of the Convention on Biological Diversity.

Keywords

Ecological impact; Exotic species; Invasive species; Meta-analysis
<table>
<thead>
<tr>
<th>Code</th>
<th>LIST OF POSTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01</td>
<td>Using drones and machine learning to quantify beach litter at a national scale</td>
</tr>
<tr>
<td>P02</td>
<td>Comparative assessment of unmanned aerial vehicle and baited underwater video surveys for the monitoring of sharks and rays in shallow water habitats</td>
</tr>
<tr>
<td>P03</td>
<td>Major and trace element concentrations of zooplankton from the Red Sea, Saudi Arabia</td>
</tr>
<tr>
<td>P04</td>
<td>Nesting site preference of marine turtles in the central Red Sea</td>
</tr>
<tr>
<td>P05</td>
<td>Nitrogen-Carbon equilibrium as the basis of the symbiosis between Cnidaria and zooxanthellae</td>
</tr>
<tr>
<td>P06</td>
<td>Automated oil spill source tracking model, combining HFR and AIS data</td>
</tr>
<tr>
<td>P07</td>
<td>Abundance and Distribution of Phyllosoma in Southern Cuban Waters</td>
</tr>
<tr>
<td>P08</td>
<td>Constructing a comprehensive transposon library of the plant growth promoting bacterium Enterobacter sp. SA187</td>
</tr>
<tr>
<td>P09</td>
<td>Quantifying the accumulation of $^{13}$C-labelled phenanthrene in phytoplankton and transfer to corals using Cavity Ring Down Spectroscopy</td>
</tr>
<tr>
<td>P10</td>
<td>Arabian Albulids: A Biological Assessment of Bonefish (Ablula spp.) in the Saudi Arabian Red Sea</td>
</tr>
<tr>
<td>P11</td>
<td>Cultivation of novel bacterial genera from the Red Sea mangrove sediments using diffusion chamber</td>
</tr>
<tr>
<td>P12</td>
<td>Spatio-temporal pattern of UV attenuation in the Red Sea</td>
</tr>
<tr>
<td>P13</td>
<td>Variability of Water Exchanges Through the Strait of Hormuz</td>
</tr>
<tr>
<td>P14</td>
<td>Red Sea Cnidaria and Microplastic</td>
</tr>
<tr>
<td>P15</td>
<td>Phytoplankton fungi parasites in the sea</td>
</tr>
<tr>
<td>P16</td>
<td>Contribution of the Microbial Loop into the Carbon Flow of the Higher Trophic Level in the Red Sea</td>
</tr>
<tr>
<td>P17</td>
<td>Cryptofaunal Diversity in Fringing Reef Rhodoliths</td>
</tr>
<tr>
<td>P18</td>
<td>Using satellite data to detect internal tides in the Arabian Sea and the Red Sea</td>
</tr>
<tr>
<td>P19</td>
<td>Exploring marine ultramicrobacteria in the Red Sea</td>
</tr>
<tr>
<td>P20</td>
<td>Seasonal Evolution of Mixed Layers in the Red Sea</td>
</tr>
<tr>
<td>P21</td>
<td>Inhibition of uric acid synthesis alters the state of the Cnidarian-Alga Symbiosis</td>
</tr>
<tr>
<td>P22</td>
<td>Flipping the perspective! Using the upside-down jellyfish Cassiopea sp. to study cnidarian-Symbiodiniaceae symbiosis</td>
</tr>
<tr>
<td>P23</td>
<td>Responses of Prochlorococcus RSP50 to experimental temperatures</td>
</tr>
<tr>
<td>P24</td>
<td>Ureotely modelation in Lusitanian Toadfish Halobatrachus didactylus in different environmental condition</td>
</tr>
</tbody>
</table>
Poster Code: P01

Using drones and machine learning to quantify beach litter at a national scale

Cecilia Martin, Qiannan Zhang, Matthew F. McCabe, Xiangliang Zhang, and Carlos M. Duarte

Abstract

A global beach litter assessment is challenged by use of low-efficiency methodologies that impede data acquisition at a national scale. Here we show the application of a remote sensing-based methodology that implies use of Unmanned Aerial Vehicles for acquisition of beach images coupled with an automatic processing of the high volume of imagery through machine learning. The aerial survey resulted 40-times more efficient than the traditional visual census and the machine learning proved to have a mean (±SE) sensitivity of 60±3%. Estimates were corrected following ground truth assessments and resulted in a mean (±SE) density of 0.12±0.2 litter items m⁻².
Comparative assessment of unmanned aerial vehicle and baited underwater video surveys for the monitoring of sharks and rays in shallow water habitats

Ashlie McIvor, Julia Spaet, and Michael L. Berumen

Abstract

The current understanding of elasmobranch ecology is built primarily from fishery-dependent data. By the nature of its collection, this data can often be biased, invasive to the study organisms and logistically restrictive. Non-extractive methods have become increasingly popular where threatened, endangered, and protected species are concerned. However, it is crucial to identify the most appropriate method(s) and the associated biases of each method to interpret any observed patterns. This study provides a comparison between data collected using unmanned aerial vehicles and baited underwater video surveys based on each method’s ability to survey elasmobranchs in low densities accurately.
Poster Code: P03

Major and trace element concentrations of zooplankton from the Red Sea, Saudi Arabia

Chunzhi Cai and Susana Agustí

Abstract

Zooplankton are interesting groups for heavy metal studies. In this study, 8 Red Sea zooplankton samples were subjected to elemental analyzes. The average elemental concentrations were ranked as: Co < Cd < Pb < Ni < Cr < Cu < Mn < As < B < Al < Zn < Fe < P < Mg < K < S < Ca < TN < Na < TOC. Al, Zn, Fe, Cu, and Mn exhibited positive correlation with latitude, but negative correlation with longitude ($R^2 > 0.7$, $p < 0.05$), indicate potential heavy metal pollution in the North middle Red Sea.
Nesting site preference of marine turtles in the central Red Sea

Kirsty Scott, Lyndsey K. Tanabe, and Michael L. Berumen

Abstract

Coastal beaches and sandy islands are essential to the life cycle of marine turtles. Due to climate change and planned coastal development on the Red Sea, we are likely to see an alteration of beach characteristics dictating the success of endangered sea turtle populations. As part of Saudi Arabia's 'Vision 2030' two giga-projects are being developed on the Red Sea coastline, 'The Red Sea Project' a luxury tourist resort centred around Red Sea coral reefs and 'NEOM' a cross-border city between Egypt and Saudi Arabia. Extreme temperatures are already observed in the Red Sea, significantly greater than other tropical basins. Additionally, ocean warming is to have a profound effect on marine turtles due to their temperature dependent sex ratio, the Red Sea can be used to monitor the response of turtle populations to climate change and ocean warming. Across all species, turtles share similar nesting requirements yet there is a large amount of variation in specific beach characteristics between and within species. In this study we assessed the seasonal variability in physiochemical parameters of sandy islands in the central Red Sea to measure sea turtle nesting suitability of these sites during the proposed nesting season of March to October. Um Mesk and Abu Gisha were sampled on a bi-weekly basis, we took in-situ measurements of various sand parameters such as temperature, moisture and change in overall beach area and topography. Peak nesting was observed in late June to early July clustering on the Western side of both study sites. At this location we saw the greatest elevation and the steepest beach slope $x = 25.875^\circ$ and $x = 25.25^\circ$ of Um Mesk and Abu Gisha, respectively. Total beach area did not change over the nesting period it was observed that Abu Gisha seemed to migrate northward over the duration of this study. The highest sand temperature recorded was 36°C at the end of July. This assessment can be used to advise conservation management strategies and protect preferential nesting sites in the region. From this, we can create beach monitoring programs and inform environmental assessments.
Nitrogen-Carbon equilibrium as the basis of the symbiosis between Cnidaria and zooxanthellae

Alessandro Moret, Jessica Menzies, Yat Long Angus Li, Guoxin Cui, and Manuel Aranda

Abstract

The Cnidaria-zooxanthellae symbiosis is at the basis of the coral reef ecosystem, and one of the reasons why tropical waters, oligotrophic per se, are a hotspot of biodiversity. In these nutrient-poor waters, these two organisms have co-evolved to reduce the waste of nutrient sources and use the other’s scraps as metabolic resources. In particular, the photosynthetic symbionts can support more than the 100% of the animal’s metabolic requirements, providing nutrients in form of sugars, amino acids and lipids, while the host provides a CO₂ rich environment and protection to the algae. It is commonly believed that the zooxanthellae have an unregulated access to nitrogen from the host’s waste, up-take it, process it and release the nitrogenous products back to the host. In this study, we propose that the host regulates the quantity of nitrogen available to the symbionts in accordance with the quantity of received photosynthates. Here we show that the host can increase or decrease, indirectly, its population of symbionts based on the availability of the two above-mentioned nutrients. By providing an exogenous source of ammonium, glucose or a mix of the two, we induced an alteration of the metabolic equilibrium resulting in changes of the symbiont density. Moreover, by performing the same treatment on different cnidarian host species, we observed that the mechanism behind this relationship is the same across the phylum Cnidaria. We expect these findings to help elucidating this complicate partnership and to be a starting point to unravel the mechanism that allow the host to regulate and control its symbiont population.
Poster Code: P06

Automated oil spill source tracking model, combining HFR and AIS data

Lohitzune Solabarrieta and Burton Jones

Abstract

The use of High Frequency Radar (HFR) technology is increasing worldwide for operational oceanography, as it provides real-time coastal surface currents at high temporal and spatial resolution. In this poster, a real-time oil spill source tracking model will be showed, combining real-time AIS (Automatic Identification System) and HFR data, to trace a detected oil spill back to its probable source. The spill backtracking does not prevent an accident, but it may prevent an intentional illegal discharge if the ship operators know that their action can be traced back to their vessel.
Poster Code: P07

Abundance and Distribution of *Phyllosoma* in Southern Cuban Waters

*Kiana Ford, Estrella Malca, John Lamkin, and Trika Gerard*

**Abstract**

The spiny lobster (*Panulirus argus*) represents an important resource to the Cuban economy. By studying the distribution of larval populations, patterns of recruitment can be deduced to improve the management of this species. Spatial analysis of *Phyllosoma* samples were evaluated to visualize density distributions across the southern region of Cuba. *Phyllosoma* were collected during an oceanographic survey from 25 April to 3 June 2015. Abundances were mapped and analyzed using ArcGIS Pro. We found dissimilar distributions of *Phyllosoma* across the region. Further study of the region is needed to better understand larval patterns of distribution and density in Cuban waters.
Poster Code: P08

Constructing of a comprehensive transposon library of the plant growth promoting bacterium *Enterobacter sp.* SA187

Abdulrahman Hashim, Abdul Aziz Eida, Wiam F. Alsharif, Rashad R. Al-Hindi, Heribert Hirt, and Maged M. Saad

Abstract

Plants surviving under stressed conditions are believed to get help from associated microorganisms named plant growth promoting bacteria (PGPB). *Enterobacter sp.* SA187 is a model PGPR that was isolated from the root nodules of *Indigofera argentea*, Saudi Arabia. SA187 showed several PGPB traits for nutrient acquisition, hormone production, as well as enhancing the growth of crop plants under different abiotic stresses. A complete genome sequence of the SA187 showed different metabolic capacity with 4,347 predicted protein-coding DNA sequences (CDS). To identify the essential genes/pathways involved in the beneficial SA187/plant interaction, we constructed a saturated mutant library using Tn5 random mutagenesis. The generated library covered all the genome of SA187 with approximately 16,000 generated clones. The Tn5 insertion SA187 library was mapped using the PCR techniques. Overall, the generated mutagenesis library provides a toolbox to screen and identify the essential genes involved in the SA187 lifestyle as a free-living soil bacterium and as an endophytic bacterium with its host plant.
Quantifying the accumulation of $^{13}$C-labelled phenanthrene in phytoplankton and transfer to corals using Cavity Ring Down Spectroscopy

Ananya Ashok, Sreejith Kottuparambil, Lone Hoj, Andrew Negri, Carlos M. Duarte, and Susana Agustí

Abstract

While bioaccumulation of persistent pollutants is a serious concern, accumulation kinetics and pathways in aquatic organisms and their food chains are hardly quantified mostly due to methodological limitations. Polycyclic aromatic hydrocarbons (PAHs) are toxic and can bioaccumulate. Here, we present a new method to quantify the accumulation and uptake kinetics of a $^{13}$C-labeled PAH, phenanthrene using Cavity Ring Down Spectroscopy (CRDS). We first quantified accumulation on the microalgae Dunaliella sp., observing that phenanthrene per cell increased as $^{13}$C-phenanthrene dosage increased. Then, we followed the signal of $^{13}$C-phenanthrene in tissues of the coral Acropora millepora, and quantified the uptake and accumulation of phenanthrene when exposed via two routes: a) by ingestion at feeding on $^{13}$C-phenanthrene labeled Dunaliella sp., and b) by diffusive uptake from the water. From the accumulated concentrations, we estimated bioconcentration factors (BCF). While uptake of phenanthrene in corals was faster by diffusion than when ingested, both routes resulted in similar accumulated concentrations. Passive diffusion showed large variability between individuals while accumulation by ingestion represented a sustained uptake. The $^{13}$C-PAH labeling and analysis by cavity ring down mass spectroscopy method proved to be as sensitive as radioactive methods and due to quantification of both carbon content and $^{13}$C/$^{12}$C ratio allowed accurate detection of PAHs accumulation, uptake kinetics and transfer to the next level in a coral reef food chain.
Poster Code: P10

Arabian Albulids: A Biological Assessment of Bonefish *Ablula spp.* in the Saudi Arabian Red Sea

Collin Williams and Michael L. Berumen

Abstract

Bonefish (*Albula spp.*) support an unregulated fishery in Saudi Arabia, and there is currently no biological information available for these fish in the Red Sea. We utilize molecular tools and conventional fisheries techniques to resolve the taxonomy of these fish and provide foundational data to base management upon. Considering the value of bonefish as a sportfish and the anticipated growth of eco-tourism along Saudi's coast, it is important to understand bonefish biology so that they can be best managed into the future.
Poster Code: P11

Cultivation of novel bacterial genera from the Red Sea mangrove sediments using diffusion chamber

Fatimah Sefrji, Giuseppe Merlino, Gregorie Michoud, Ramona Marasco, and Daniele Daffonchio

Abstract

Microorganisms are the major players in the global biogeochemical cycles. Molecular ecology surveys have revealed an impressive diversity of microbes in nature, most of which have not cultivable representatives. The Red Sea is a unique environment exposed to strong selection forces, including high temperatures, salinity and oligotrophy. We have explored the cultivability of bacteria from the sediments of the Red Sea mangrove by applied a diffusion chamber cultivation method. This approach allowed us to isolates several bacteria taxa which we describe here through their genome and phenotypic properties. Our study reveals that the extreme conditions of the Red Sea have selected a unique and yet untapped culturable microbiome.
Poster Code: P12

Spatio-temporal pattern of UV attenuation in the Red Sea

Sebastian Overmans and Susana Agústí

Abstract

The Red Sea experiences intense UV radiation while its waters are thought to be highly transparent. Here, we present an evaluation of the latitudinal and seasonal variability of UV attenuation in the Red Sea. As part of four scientific cruises between 2016 and 2018, UV-spectroradiometer profiles were recorded, and the concentration of Chl-a and absorbance by CDOM were quantified to determine their contribution to UV attenuation. Our findings provide substantial evidence that UV attenuation in the Red Sea exhibits a distinct spatio-temporal pattern, but even the less optically-transparent southern Red Sea is still amongst the clearest marine water bodies worldwide.
Variability of Water Exchanges Through the Strait of Hormuz

Panagiotis Vasou, Vassilios Vervatis, George Krokos, Ibrahim Hoteit, and Sarantis Sofianos

Abstract

We investigate the exchanges between the Arabian Gulf and the Indian Ocean through the Strait of Hormuz using a high-resolution (1/36°) ocean model simulation. Model results for the period between December 1996 to March 1998 are in close agreement with available observations and show a complex and variable flow pattern at the upper layers compensated by a perpetual deep outflow of high salinity. Analysis of the exchange dynamics reveals that synoptic processes based on the wind forcing are the key factor for the variability of the water mass exchanges at the strait.
Poster Code: P14

Red Sea Cnidaria and Microplastic

Michelle-Nicole Havlik, Cecilia Martin, Shannon Klein, and Carlos M. Duarte

Abstract

Globally, microplastics (plastics < 5mm) are a source of pollution harmful to many forms of marine life, widely overlooked until recent years. In the Red Sea, the first plastic trawls in 2018 found a lack of typical surface microplastics. The cnidarians are postulated to impact on the “disappearance” of this size class of plastics, through acting as a trap, ingestion, or by the effect of mucus in biofouling and transporting the microplastics down to sediments. This was explored ex-situ with the zooxanthellate mangrove jellyfish Cassiopea andromeda, and the brain coral Lobophyllia sp., building on recent ingestion experiments with scleratinian corals.
Poster Code: P15

Phytoplankton fungi parasites in the sea

Ashwag Asseri and Susana Agustí

Abstract

Diatoms are a highly diverse and abundant group of microalgae which are key primary producers at the bottom of most autotrophic food webs in sea, diatoms have been shown to be common hosts for parasites (chytrids) of the phylum Chytridiomycota. Chytrids are true fungi and are characterized by cell walls composed of chitin. They may have significant impacts on the ecology of individual diatom hosts and the composition of communities at both the producer and consumer trophic levels of food webs. Parasites appeared at population densities as low as about 1 cell·ml⁻¹ in some host species, with infection prevalence sometimes exceeding 80%. This study is assessment of the quantitative impact of parasitic chytrids on diatoms in the Red Sea.
Poster Code: P16

Contribution of the Microbial Loop into the Carbon Flow of the Higher Trophic Level in the Red Sea

Afrah Alothman, Daffne Lopez-Sandoval, and Susana Agustí

Abstract

In oligotrophic Red Sea, bacteria production (BP) might be a significant source of carbon that can be potentially transferred to higher trophic levels. During Deep cruise in April, 2019, PP ($^{13}$C-HCO$_3$), and BP ($^{13}$C-D-glucose) were measured in the two-fraction size < 1.2 μm and > 1.2 μm of the community. Our results showed that in the bacteria pathway, > 1.2 μm fraction size has a higher rate than the small fraction possibly due to bacterivorous nano-flagellates and ciliates ingesting bacteria (Koshikawa et al., 1996), suggesting significant possible contribution of BP to the higher trophic levels in the studied stations.
Poster Code: P17

Cryptofaunal Diversity in Fringing Reef Rhodoliths

Viktor Nunes Peinemann, Mira Abrecht, Braden Charles DeMattei, Madeline Kestler, Ara Yazaryan, and David Jacobs

Abstract

Here, we provide the first detailed survey of rhodoliths and their cryptofaunal communities in the fringing reefs of Moorea. We collected 1880 organisms from 144 rhodoliths and identified a total of 180 Operational Taxonomic Units (OTUs) spanning 98 families. Individual rhodoliths contained anywhere from 1 to 119 cryptofaunal organisms. There is a significant relationship between cryptofaunal diversity and rhodolith morphotype. Branching rhodoliths, which have the most complex physical structure, had a considerably greater cryptofaunal diversity than both laminar and columnar rhodoliths. Overall, we report a much greater habitat complexity and diversity than would be expected given the minimal attention rhodoliths have received from ecologists and taxonomists.
Poster Code: P18

Using satellite data to detect internal tides in the Arabian Sea and the Red Sea

Jingyi Ma, Daquan Guo, Peng Zhan, and Ibrahim Hoteit

Abstract

Using along-track satellite sea level anomaly data, we studied the features of internal tides in the Arabian Sea, including their propagation and energy distribution. Two main source regions of internal tides in the Arabian Sea are identified: Kilmia Island, and the western India Peninsula. Inside the Red Sea, three main sources are identified: The Strait of BAM, the southern Red Sea and the northern Red Sea. Significant seasonal and spatial variabilities are established in the energy flux of internal tides, most likely caused by bottom topography and varying seasonal stratifications.
Exploring marine ultramicrobes in the Red Sea

Inês Raimundo Gonçalves, Cristina Andrés-Barrao, and Xosé Anxelu G. Morán

Abstract

Ultramicrobes (UMB) are heterotrophic prokaryotes smaller than 0.2 μm. These microbes are widespread in nature, but their role in biogeochemical cycling remains unknown. We will survey for the first time the abundance, phylogeny and ecology of UMB in the Red Sea, based on the hypothesis that there are intrinsic UMB while others may become small due to extrinsic factors. Here we present the flow cytometric characterization of epipelagic UMB from an offshore station in the central Red Sea and preliminary results on DNA extraction in the 0.1-0.2 μm size fraction which will be used in the project.
Seasonal Evolution of Mixed Layers in the Red Sea

George Krokos, Ivana Cerovecki, Peng Zhan, Myrl Hendershott, and Ibrahim Hoteit

Abstract

The Spatial and temporal variability of the seasonal evolution of ocean mixed-layer in the Red Sea have been analyzed using available hydrographic observations and the results of a very high resolution (~1 km) numerical model simulation forced with downscaled (~5 km) atmospheric fields, covering the period 2001-2015. We provide for the first-time a detailed spatial description of the MLD seasonal variability in the Red Sea and examine the variability of buoyancy forcing, through both heat and freshwater fluxes, that largely determine stratification and the potential for vertical mixing.
Poster Code: P21

Inhibition of uric acid synthesis alters the state of the Cnidarian-Alga Symbiosis

Jessica Menzies, Alessandro Moret, Migle Konciute, Guoxin Cui, Mathieu Pernice, and Manuel Aranda

Abstract

Nitrogen cycling in symbiotic cnidarians is based on competition between the host and symbionts for ammonium, the main nitrogen source. In hospite, endosymbionts are nitrogen limited but can assimilate and temporarily store N as uric acid crystals. We treated Aiptasia, Stylophora and Breviolum minutum cultures (SSB01) with allopurinol, an inhibitor of uric acid synthesis, and determined the effect on symbiont proliferation. In hospite, treatment increased the symbiont count per ug host protein, whereas proliferation of free-living B. minutum decreased. Nutrient limiting B. minutum cultures, RNA sequencing, TEM, SEM and NanoSIMS investigations should further clarify the molecular interactions underlying this relationship.
Flipping the perspective! Using the upside-down jellyfish *Cassiopea sp.* to study cnidarian-*Symbiodiniaceae* symbiosis

Shiou-Han Hung, Jordi Sola, Shannon G. Klein, Carlos M. Duarte, and Manuel Aranda

**Abstract**

Corals heavily rely on the symbiosis with *Symbiodiniaceae*, receiving photosynthates in exchange for inorganic nutrients. The breakdown of this relationship leads to the expulsion of *Symbiodiniaceae* from coral tissue, resulting in coral bleaching. As a potential contributor to the cnidarian-*Symbiodiniaceae* symbiosis model, *Cassiopea* is able to develop mutualistic relationships with *Symbiodiniaceae*. Studies of this symbiotic relationship require the comparison of symbiont and symbiont-free *Cassiopea*. We optimized a method using menthol and DCMU for producing aposymbiotic *Cassiopea* polyps. To assess the success of our method, the autofluorescence emission of *Symbiodiniaceae* cells was using confocal microscopy to detect any background *Symbiodiniaceae* populations.
Responses of Prochlorococcus RSP50 to experimental temperatures

Abbrar H. Labban, Ahmed A. Shibi, Peiying Hong, and Xosé Anxelu G. Morán

Abstract

Picocyanobacteria play a crucial role in global aquatic primary production. Prochlorococcus is an important component of microbial communities in the oceans, contributing significantly to total photosynthetic biomass and productivity. The Red Sea is an oligotrophic body of water characterized by high salinity, high temperature and minimal water exchange. Analysis of the 16S-23S rRNA internal transcribed spacer (ITS) region and rpoC1 sequences of Prochlorococcus indicated the predominance of a high-light adapted ecotype (HL II) in the surface waters of the Red Sea. Prochlorococcus sp. RSP50 was isolated from the main basin of the Red Sea and maintained at 27°C. Here, we investigated some of metabolic ecology properties of this strain as a function of temperature. To this end, Prochlorococcus sp. RSP50 was incubated in Pro99 medium at different temperatures, covering the assumed optimal temperature of 27°C (ca. 22-30°C). The response to temperatures was investigated during the logarithmic growth phase using flow cytometry for cell counting and cell size estimates. Our results showed that the specific growth rates (μ = 0.43 - 0.80 d⁻¹) increased with temperature while cell size (0.07 - 0.11 μm³) was positively correlated with temperature, contrary to previous findings in higher latitude regions. Future experiments will include investigation of dissolved organic carbon (DOC), chromophoric and fluorescent properties of dissolved organic matter (DOM), and transcriptomic responses of this Prochlorococcus strain to temperature fluctuations in the Red Sea.
Poster Code: P24

Uroctely modelation in Lusitanian Toadfish Halobatrachus didactylus in different environmental condition

Micaela Justo, Alexandra Alves, and Pedro Guerreiro

Abstract

Teleost fish of the family Batrachoididae use ammonia as their main nitrogen metabolism excretory product. Nonetheless, under stress conditions, some species are able to shift their excretion to urea. Our study aimed to estimate the effects of different salinities on the excretion patterns of nitrogenized products in the Lusitanian toadfish Halobatrachus didactylus, by analysing levels of excreted ammonia, urea and plasma osmolality. Our results suggest that plasma osmolarity increases with salinity, and urea was released by pulses during the day. Overall, our results show that the salinity may be one of the stress triggers for urea excretion.