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ABSTRACTS

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What do we still not know? The 'marine unknowns', and why they matter.

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It is well known that the marine biome contains the greatest phylogenetic diversity of Earth's biosphere, with 31 of the 35 phyla of animals living in the oceans, 13 of them confined to the oceans. Yet only about 220 thousand marine species have been described so far, of a total of 2.5 million species globally that we know of, and with most of these marine species having been discovered from our shallow coastal waters from depths of less than 50 metres. In addition to the ecosystem services these species provide, their deep phylogenetic divergence with highly varied biosynthetic pathways and unique symbioses has provided significant economic resources, including the discovery of huge numbers of bioactive chemical compounds. Here we explore the diversity of marine invertebrate species (the 'Other 99%'), the concepts of megadiversity, biodiversity hotspots, and the economic imperative for their conservation.

Population structure of shallow and deep water coral *Madracis auretenra* & *M. myriaster* (Pocilloporidae: Anthozoa) in the Colombian Caribbean-Preliminary results.

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Current coral reef ecosystems show a massive decrease in their populations due mainly to overexploitation and climate change. As a consequence of this deterioration, several Marine Protected Areas (MPA) have been created to preserve the connectivity dynamics between organisms and reefs. In order to design these reserves of biodiversity (MPAs) it is necessary to have information about the genetic exchange among coral populations to allow estimating the consequences of anthropogenic and natural effects (essential to understand the reef resilience against stochastic events). For this reason, to improve conservation strategies for these ecosystems, we need to understand; (1) What is the genetic structure of the coral *M. auretenra* & *M. myriaster* in the Colombian Caribbean; (2) What is the connectivity level of these corals in Colombian reefs; and (3) How is the genetic structure of *M. auretenra* & *M. myriaster* between Colombia and other Caribbean reefs? We developed 36 new molecular markers (microsatellites) for *M. auretenra* & *M. myriaster* (Pocilloporidae: Anthozoa), using the bioinformatics tool Pal Finder from the Galaxy Centaurus Server, developed by the Preziosi's Lab at Manchester Metropolitan University. We already tested the primers and obtained amplification for all primers. We are now testing the primers in 181 samples from seven localities, distributed across the Colombian Caribbean. We expect to identify several populations in Colombia and compare the results with samples from the Caribbean. These results will support effectiveness assessments of MPAs design and will promote the understanding of the connectivity dynamics and the effects of anthropogenic stochastic events against coral reef ecosystems.

Toward a molecular taxonomy of the coral genus *Acropora*

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Coral reefs are dangerously decreasing in cover due to massive bleaching events. As these events are predicted to increase in intensity, the management and the preservation of the corals reefs is likely to become a growing challenge. To effectively protect the reef, real-time assessment of the species composition of coral communities appear to be a primary step and as corals can have a high morphological variation, a molecular delineation appears essential. As a testing ground of the possibility to perform molecular delineation of coral species, we focus on the tourist island of Landaa Giraavaru in the Maldives immediately prior and after the 2016 bleaching event. The reefs around the island were strongly affected, especially corals of the genus *Acropora*. To better understand the difference in species composition pre- and post-bleaching, a molecular delination of species was attempted. More than 150 *Acropora* individuals were sequenced for four independents markers (3 nuclears markers and one mitochondrial region), we managed to obtain a congruent conspecificity matrix and compared the obtained groups to the morphological species delimitation. Our results highlight the applicability of such approach to *Acropora* and paves the way for a molecular-grounded taxonomic revision of this difficult, highly speciose genus.

Octocoral sexual reproduction: temporal disparity between mesophotic and shallow populations

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Mesophotic coral-reef ecosystems (MCEs) are light-dependent communities occurring at 30 to ∼150 m in the clear waters of tropical and sub-tropical regions. The extent to which MCEs and shallow benthic populations are connected, and whether coral sexual reproduction is maintained under the mesophotic environmental conditions, are still unclear. Despite the trend of increasing studies concerning the MCEs, the reproductive traits of Indo- Pacific octocorals have remained uninvestigated to date. The current study engages with two common zooxanthellate octocorals in the northern Red Sea: the internal-brooder *Ovabunda* sp. and the surface-brooder *Rhytisma fulvum fulvum*. It addresses the hypothesis that, similar to their shallow-zone conspecifics, the upper mesophotic populations also reproduce sexually. Here we analyzed the annual gametogenic cycle, sex ratio, and fecundity of the MCE octocoral populations and compared it for the first time to their shallow conspecifics. In addition, we discuss the timing of surface-brooding in relation to lunar phase and daily seawater temperature. The reproductive features of *Ovabunda* sp. in both depth zones display a temporal resemblance. Consequently, this species seems to be a successful depth-generalist, which might also reflect on its connectivity along the depth gradient. In *R. f. fulvum*, in contrast the reproductive features differ between the two depth zones, exhibiting a decreased abundance of female colonies, lower fecundity, and lower surface brooding intensity in the upper MCE population. It thus seems that the *R. f. fulvum* population encounters certain constraints in the MCE that may, in turn, lead to its reduced reproductive performance. In addition, a temporal reproductive isolation was observed between the surface brooding event of the upper-mesophotic and the shallow-water populations. Overall, the current findings reinforce the viewpoint that the refuge potential of MCEs is likely to be species-specific rather than a general rule.

Integrative taxonomy, evolution, and ecology of reef- associated symbiotic hydrozoans

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Hydrozoans belonging to the superfamily Zancleida are characterised by a relatively simple anatomy and diverse ecological and reproductive traits. The taxonomy of most species is hampered by their rarity, the difficulty in observing their complete life cycles, and the recurrent presence of cryptic species. Several species, mostly belonging to the families Zancleidae, Cladocorynidae, Sphaerocorynidae, and Milleporidae, are involved in symbiotic relationships with other organisms, including scleractinian corals, octocorals, sponges, bryozoans, and algae. Little is known about the diversity of these symbiotic hydrozoans, and the relationships with their hosts or symbionts are largely understudied. Therefore, an integrative approach was used to characterise these enigmatic taxa. Specifically, detailed morphological and morphometric analyses of classical and newly discovered characters, together with DNA taxonomy techniques, phylogeny reconstructions, comparative phylogenetic analyses, and ecological surveys, allowed to shed light on different aspects of symbiotic Zancleida. For instance, in different groups the genetic diversity is better explained by the host specificity rather than the classical morphological features, even though a detailed morphometrical analysis of nematocysts and other peculiar structures statistically supported the genetic distinction of some lineages. In other cases, the systematics of entire families was updated, thanks to phylogenetic assessments, description of previously unknown life stages, and discovery of new genera and species. Finally, certain taxa were investigated from an ecological point of view, describing their prevalences and ecological preferences, and assessing their possible roles in the associations in which they are involved. All together, these results suggest that the biodiversity of tropical symbiotic hydrozoans, as well as their ecological importance, are underestimated and require further attention.

Identification of calcareous sponge spicule matrix proteins

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How animals influence the formation and shape of their skeletal elements is not well understood. In eukaryotes, the biologically controlled deposition of calcium carbonate minerals is always associated with an organic matrix. This organic matrix plays essential roles in the nucleation, morphology, growth rate and local inhibition of mineral crystal deposition within the matrix, but its composition remains unclear. A number of proteins rich in aspartic acid and/or asparagine have been previously identified as components of the organic matrix of calcareous sponge spicules, and influenced the crystallographic properties of precipitating calcite in vitro. Recent work in our laboratory has led to the identification of a number of acidic matrix proteins that are produced only during specific stages of spicule formation, but until now the full complement of spicule matrix proteins has remained unknown. The study presented here combined transcriptomic and proteomic approaches with the aim of comprehensively characterizing the spicular matrix composition of calcareous sponges. The ultimate goal of this work is to understand the general rules of biomineralization that apply across the Metazoa.

Effects of ocean warming and acidification on the geographical distribution and calcification of the scleractinian corals of the Eastern Tropical Pacific

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The aim of this work is to understand how the individual and combined effects of ocean acidification and temperature increase will affect the geographic distribution and calcification of reef-building corals of the Eastern Tropical Pacific (ETP). In order to evaluate possible changes in the geographical distribution of the coral species of the ETP, projections based on forecasts of temperature increase and pH decrease under scenarios RCP 2.6, 4.5 and 8.5 for the year 2050 were made using MaxEnt software. The results show that reef habitats which are actually considered marginal, such as those of high latitude and in the equatorial part of the ETP, are projected to persist and expand in the future climate, highlighting the importance of alkalinity and temperature to describe the future distribution of the species. To determine the response of calcification in different species of scleractinian corals, fragments of three species were used in an experimental study, using a pH treatment (7.60), two temperature treatments (30°Cand 31°C) and a combined one of temperature and pH (30°C, pH 7.60). The results indicate that the pH of 7.60 significantly reduced the calcification rate while the combined treatment of pH and temperature did not have a significantly greater effect than the pH alone. The calcification rates did not vary significantly between species. The results of this study suggest that ETP corals could adapt or acclimate to the coupled effects of acidification and temperature increase.

Coral biomineralization: Going beyond Scleractinians.

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Biomineralization is the process by which organisms form minerals that they use for support, protection, or nutrient storage, such as shells, skeletons, and bones. It is taxonomically widespread and biomineralizing species are found among bacteria, algae and several animal groups. Among the latter we find corals (class Anthozoa, phylum Cnidaria), drivers of reef formation and accretion. For decades, research on coral biomineralization has mostly focused on scleractinian corals , as they constitute the main reef building organisms. However, from a bio-mineralogical point of view scleractinian corals are quite uniform, as they all produce an aragonite exoskeleton. On the other hand, their sister taxon, the Octocorallia (commonly known as soft corals) produce a high diversity of skeletal structures, until now systematically overlooked in biomineralization studies. Significantly, among Octocorals we find species producing aragonite massive skeletons — like their scleractinian relatives — and species with calcitic exo- or endosclerites of different morphologies. One of the main questions underlying such biomineral diversity is whether this is due to independently evolved taxon-specific molecular machineries or rather through a conserved core set of biomineralization "toolkit" genes that is employed in different ways in different cnidarian taxa with lineage specific diversification. Moreover, the effects of abiotic conditions, such as seawater chemistry, on soft corals skeleton characteristics are to date poorly understood. In the light of the above, we are currently using a multi- disciplinary approach, combining especially transcriptomics and proteomics, to comparatively characterize biomineralization *molecular toolkits* in octo- and scleractinian corals. Identifying calcification-related genes in these taxa does not only provide an insight into the mechanisms underlying biomineralization in this group, but it also allows to investigate the distribution of these genes across Anthozoa and ultimately reconstruct their evolution and thus the evolution of biomineralization.

Light-dependent calcification of the symbiont giant clam Tridacna maxima

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The tropical small giant clam, *Tridacna maxima*, is one of the few mollusc species living in a symbiotic relationship with unicellular algae and is considered to be fully photoautotrophic. A sufficient light level is therefore considered to be crucial for this species to thrive. In the present study, we provide new insights in the light-dependency of net calcification rates in T. maxima as well as its depth dependent abundances in the field. *T. maxima* shows significantly enhanced net calcification rates under the highest light compared to the lower light conditions as well as under the absence of light, on which calcification rates were still positive. When comparing *T. maxima* net calcification rates with those of other tropical calcifiers, such as corals and macroalgae or with temperate heterotrophic molluscs, we identified *T. maxima* as a remarkable calcifier, only surpassed by the Caribbean coral species Montastrea faveolata. Our experimental results and field observations allowed us to calculate that net calcification rates of giant clams are up to 298 $\pm$ 58 kg CaCO3 ha-1 y-1, which constitutes between 1.8% and 2.5% of the overall calcium carbonate budget of shallow coral reef communities.

In situ growth rates of the cold-water coral Desmophyllum dianthus are highest in aragonite undersaturated waters

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Cold-water corals (CWC) were long thought to be particularly sensitive to ocean acidification (OA). However, previous laboratory studies indicate no negative effect of low aragonite saturation (Ωar) on growth rates of CWC while the few in situ studies show the same result. The CWC Desmophyllum dianthus is ubiquitous in Comau Fjord (southern Chile), a small but deep (> 400 m) semi-enclosed stratified basin with pronounced horizontal and vertical pH gradients. High densities of D. dianthus can be found below the aragonite saturation horizon (Ωar < 1) but it is not known so far if seasonal changes in Ωar lead to seasonal differences in growth rates. Corals were sampled along the pH gradients of Comau Fjord (Ωar = 0.65-1.45) and cross-transplanted between stations. Skeletal carbonate accretion (buoyant weighing technique) and calcification rates (alkalinity anomaly technique) were measured in austral summer 2016/2017 and winter 2017 and compared to physico-chemical conditions in the water column (T, Ωar). Higher growth rates were found in summer than in winter. Surprisingly, growth of D. dianthus was highest in undersaturated waters in both seasons (Ωar = 0.65 and 0.83) and cross- transplanted specimens were able to acclimatise to Ωar < 1. We conclude that Ωar is a poor predictor of D. dianthus growth and more factors (like plankton food supply) need to be taken into account when investigating the impact of OA on CWC in the future.

Molecular Diversity of Sponges of Guadeloupe

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Sponges are important players of the aquatic ecosystem, but notoriously difficult to identify. The sponge fauna at Guadeloupe (a group of islands in the Eastern Caribbean Sea) is relatively understudied. In 2015 a French expedition collected sponges from several different locations around the islands from depths of 60 to about 900 meters. A total of 219 samples were sent to the LMU Munich for further investigations. Here we aim to assess and compare the sponge biodiversity in Guadeloupe after molecular species identification. Molecular species identification is attempted with a 28S fragment of the ribosomal DNA, which has been shown useful for sponge molecular taxonomy. Initial results produced 138 genotypes of predominantly Demospongiae, but also Hexactinellida and Homoscleromorpha. To extrapolate a more in-depth view on the potential species diversity from the genotypes, we compare the results of three different molecular species delimitation algorithms (ABGD, PTP, and GMYC). Initial results will be presented.

Genomics for species delimitation in *Tethya* (Porifera: Demospongiae)

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Species-identification in sponges has traditionally been based on morphological characters, often with unclear variability within and between species. In addition, commonly used DNA barcoding markers, such as mitochondrial or ribosomal loci, repeatedly contradicted morphologically defined species, which frequently occur as paraphyletic or polyphyletic in gene trees.
Here we approach the problem of species delimitation in demosponges using genomics. We aim to discover species-specific sets of orthologous loci, using the emerging demosponge-model taxon *Tethya* as a test case.
We use Illumina and Oxford Nanopore sequencing to *de novo* assemble nuclear genomes for several *Tethya* species that we culture in our research aquaria and supplement those with species sampled in the Maldives to search for suitable markers. The ultimate aim is to develop a more broadly applicable genomics-based sponge species identification assay. Here, first results, problems and possible solutions will be discussed.

Treading thin lines: delineating species boundaries in the speciose *Acropora* coral genus

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Improving coral taxonomy is crucial for accurate physiological, ecological or population genetic studies of these keystone organisms as well as for effective management and conservation of the ecosystems they inhabit. However, in coral genera such as *Acropora*, the combination of high intra-species variability and extensive inter-species similarity makes species delimitation and identification particularly difficult, an intriguing case that provides an interesting training ground to propose and validate new taxonomic practices. In order to assess the congruence between independent approaches for species boundaries delineation, we sampled three tabular *Acropora morphospecies* that live in sympatry around Sesoko Island (Okinawa, Japan): *A. bifurcata*, *A. cytherea* and *A. hyacinthus*. From a set of 40 individuals, DNA sequences were acquired and analysed through haplowebs (a novel species delimitation approach that identifies groups of diploid individuals sharing a common allele pool) for three independent nuclear loci and for the mitochondrial control region (CR). As an independent source of information, mating trials were performed in lab during the spawning season to test for cross-fertilization success. Classical morphological identifications were complemented with quantitative morphometric analyses. Finally, a conspecificity matrix was built to compare the different species delineation and to provide an assessment supported by evidence arising from morphology, molecules and reproduction.

Calcinea (Porifera: Calcarea) of the Maldives

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Biodiversity of coral reefs environments is threatened by global warming and ocean acidification.Yet, the biodiversity of many coral reef organisms is still unknown, even for potentially impacted groups like calcareous sponges (Class: Calcarea). In order to increase our knowledge about the diversity and distribution of Calcarea in coral reef ecosystems in the Maldives, which to this day is only cursorily researched, recently collected samples (127 specimens) of the subclass Calcinea were analyzed in an integrative taxonomic approach by combining morphological and molecular methods. Out of 36 discovered OTUs, at least nine new species were described. The high number of different species reported here make the Maldives a biodiversity hotspot for calcareous sponges.

Molecular Biodiversity of Iranian Persian Gulf Sponges

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Despite their importance, our knowledge of the biodiversity and phylogeography of Persian Gulf sponges is largely unexplored. Such knowledge, however, is necessary to better understand those patterns and processes that generated and maintained sponge diversity in this waterbody and to create a foundation for future exploration of the marine natural resources in this area. Recently, several expeditions resulted in the so far largest sponge collection of the Persian Gulf, which now led towards the most comprehensive molecular taxonomic inventory of Persian Gulf sponges to date. We analyzed a total of over 140 samples molecularly and identified over operational taxonomic units (OTUs) based on 28S and CO1. Additional molecular comparison with the Red Sea sponge fauna indicate a strong differentiation and high levels endemism between the Persian Gulf and the Red Sea respectively, supporting earlier estimations for other marine taxa.

Bringing light into the dark — The role of nocturnal dissolved organic matter (DOM) release on current and future coral Reefs

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Dissolved organic matter is increasingly recognized to play a crucial role in element cycling and overall ecosystem functioning on coral reefs. Benthic primary producers such as corals and algae release a substantial part of their photosynthetically fixed carbon as DOM and this release is positively correlated to the availability of light. Conversely, while benthic cyanobacterial mats (BCMs) and turf algae release large amounts of DOM during the day, a similar or even twice the amount was found to be released at night. This nocturnal DOM release is hypothesized to be the result of incomplete organic matter degradation and fermentation under hypoxic conditions. DOM release rates of BCMs and turf algae as well as oxygen microprofiles during the day and at night are presented. Including these nocturnal release rates in a DOM budget on the study site on Curaçao, Southern Caribbean, leads to an increase in DOM release of 123% over a 24 h cycle. Moreover, the quality of this nocturnally released DOM appears to differ substantially with a higher C:N ratio compared to DOM released during the day. Bioassays with natural bacterial communities further revealed that night exudates are taken up faster, yet day exudates support higher bacterial growth. Given the current decline of coral reefs world-wide and the concomitant rise of BCMs and turf algae it is crucial to further investigate the role of nocturnal DOM release and to include it in biogeochemical models to better understand and predict current and future changes on coral reefs.

MaRHE Center: the Marine Research and High Education Center in the Maldives. An overview of its infrastructure and research activities.

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MaRHE Center is a scientific campus located in the Republic of Maldives andin particular in Magoodhoo Island, a small island inhabited by approximately 800 people, located on the south-eastern region of Faafu Atoll, about 140 km south of the capital Male. Opened in 2010 thanks to an agreement signed between the Government of the Republic of Maldives and the University of Milano-Bicocca (Italy), the Center represents a perfect place where to attend high education courses for students of bachelor and master degrees and conduct researches in several fields such as marine ecology and biology, sustainable use of marine resources and human geography. MaRHE Center, surrounded by the ocean and rich coral reefs, has a total area of almost 3,200 square meters and includes classrooms, teaching and research labs, accommodation for students and teachers, areas for services and leisure activities, a fully equipped diving center and a traditional diving boat for all the field activities and trips around the Atoll. The purpose of the presentation is to provide an overview of the infrastructure, logistics and research activities performed at MaRHE, which in the last decade has already hosted several hundreds of international students and researchers that met and shared their skills and discoveries, all supported by a warm local hospitality offering a unique and unforgettable experience.

Recovery capacity and physiology of Kimberley corals after unprecedented bleaching

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Ocean warming is one of the major threats to coral reefs today and leads to global mass bleaching events of increasing severity and frequency. In 2016, a marine heatwave caused unprecedented bleaching in the extreme macrotidal Kimberley region in northwest Australia. We report both recovery and the extent of coral mortality six months after the peak bleaching as well as the physiological mechanisms underlying both heat tolerance and recovery capacity of these corals. Coral cover and health from both heat-tolerant intertidal (IT) and heat-sensitive subtidal (ST) environments were investigated via photo-quadrat analyses. Samples of Acropora aspera were collected from both environments during and after the bleaching event and assessed for symbiont density, chlorophyll a and energy reserves (lipid, protein and carbohydrate). Despite being exposed to similar heat stress during peak bleaching (4.6 degree heating weeks), bleaching was more severe in the subtidal than intertidal. Furthermore, ST corals had a much lower recovery capacity with 71% mortality whereas 91% of IT corals were visibly healthy after six months of recovery. Analyses of symbiont dynamics confirmed visually observed differences in bleaching susceptibility and severity. Only bleached IT corals catabolized energy reserves during bleaching, demonstrating that maintaining energy reserves during bleaching cannot guarantee survival. This suggests that other factors influenced the low recovery capacity of ST corals. However, the fast recovery of IT corals gives hope for reef habitats that suffered from extensive mortality during the 2016 bleaching event in the Kimberley. These findings demonstrate that corals from extreme temperature environments can provide important insights into the mechanisms underlying coral heat tolerance.

Microplastic mapping in sponges

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Plastic is flooding in our oceans, threatening marine life on each trophic level. Smaller the particles, larger the number of affected organisms. The small particles are known as microplastics and are ubiquitous at sea. Now, you are wondering: "Why sponges?". Sponges are important reef sessile animals filtering at very high capacity tons of seawater. While doing so, it is very likely that they accumulate microplastics in their aquiferous system and/or their tissue. Thus they might act as temporary microplastic sinks, which could be eventually used as bioindication for local plastic pollution. They might as well be threatened by this plastic uptake. Since very little is known on the interaction between microplastic and sponges, it is necessary to ask ourselves: how do sponges cope with microplastic pollution? This is the question driving this research project, aiming to identify which plastic type goes where. Results from this research may have a direct impact on coral reef health and environmental conditions.

The effects of microplastics on growth and health of major reef-building corals

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Tropical reef systems are transitioning to a new era in which they are increasingly affected by the multiple effects of anthropogenic impacts and global climate change. Lately, microplastics have been identified as an emerging threat to many marine organisms, and chronic exposure is associated with decreased uptake of natural prey, energy deficits, leading to reduced growth and fecundity in many marine organisms. Also, the keystone species of tropical coral reefs, hermatypic zooxanthellate corals, have been observed to frequently interact with different kinds of microplastics, but, little is known about its long term effects. Therefore, a series of lab experiments was conducted to assess the effects of chronic microplastic exposure on growth and health of key coral species. Multiple physiological responses (i.e. growth, health, symbiont properties, and photosynthetic performance) were measured in laboratory experiments, applying different concentrations of microplastics. The studies showed that microplastics caused reductions in growth rates as well as signs of compromised coral health. Our findings provide first evidence that chronic exposure to microplastics has a negative impact on major reef- building corals, especially affecting sensitive species. It is likely that the negative effects of microplastics will, together with commonly occurring stressors of global change, influence coral assemblies also under natural conditions and pose an additional stressor to coral reefs.

A multi-proxy coral-based reconstruction of environmental dynamics influencing Miri-Sibuti Coral reefs National Park in Borneo (Malaysia)

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Global climate change and local anthropogenically induced stresses put coral reefs in a crisis. The Maritime Continent, consisting of many humid tropical insular states in Southeast Asia, has undergone fast economic development and urbanization in the past 40 years. Borneo has experienced the highest levels of deforestation among all humid tropical regions of the world due to unsustainable and damaging logging practices and widespread oil palm cultivation. In addition, further dramatic forest loss was increased by droughts and wild fires caused by climate extreme events like the El Niño of 1997/98. These cleared areas leave soil prone to erosion. Changes in sediment load running off into the coastal waters are of big concern for tropical marine and terrestrial environments. A better understanding of the effect and magnitude of global climatic changes and local human impacts affecting marine ecosystems is needed to develop better management strategies for their protection. Here, we reconstruct the spatio-temporal dynamics of sea surface temperature, salinity and light availability based on a multi-proxy approach of paired stable isotope (oxygen, carbon) and Sr/Ca measurements on coral cores from three sites in Miri-Sibuti Coral Reefs National Park, Borneo, Malaysia. Our results reveal long term changes of rising sea surface temperature and increase of atmospheric CO_2 uptake in the ocean water, as well as a distinct seasonality in all tracers, reflecting combined effects of sea surface temperature, river runoff and light intensity. Paired Sr/Ca and oxygen isotope analysis enabled the reconstruction of the oxygen isotopic composition of the seawater, related to freshwater runoff into the coral reefs. Carbon isotopes indicate reduced photosynthetic activity of symbiotic zooxanthellae during the wet season. We asses the suitability of coral proxies for climatic and environmental reconstructions by cross-validation with satellite derived SST and salinity data. Our study provides first baseline data on environmental variability affecting coral reefs in a previously under- investigated region of Southeast Asia under increasing human pressures.

Assessing seasonal dynamics in climate parameters from Mid-Holocene Caribbean reef corals, Bocas del Toro, Panama

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Coral reefs around the world are suffering from severe degradation due to human impact and climate change, especially increased water temperatures and ocean acidification. One of the main issues of climate research is to estimate the amount of anthropogenic influence on climate change. This requires rich data sets, which extend far beyond the instrumental record. Coral geochemical proxy archives provide excellent high-resolution reconstructions of several climate parameters (e.g. sea surface temperature, salinity, river run-off, precipitation dynamics) and photosynthetic activity of the coral itself.

Caribbean reefs are counted among the most endangered reef ecosystems, which is why extensive research still has to be conducted. Here, we investigate subfossil ($\sim$6000-7000 B.P.) *Siderastrea* sp. and *Diploria* sp. corals from a pristine, recently discovered Mid-Holocene Caribbean reef, which is located on Island Colón, Bocas del Toro, Panamà. Mid-Holocene atmospheric carbon dioxide concentrations and tropical seawater surface temperature were elevated compared to modern conditions. Model scenarios and proxy data indicate lower seasonality in the tropics, a stronger northward shift of the Intertropical Convergence Zone (ITCZ) and a weaker El Niño-Southern Oscillation (ENSO) than today. The latter both are possible consequences of today's climate change and therefore, this time period reflects a potential future scenario. The unprecedented fossil site gives us the rare and crucial opportunity to study these ancient seasonal and multi-decadal dynamics and the response of corals to natural and anthropogenic changes. To evaluate, if the sampled coral heads can fulfill their high potential for palaeoclimate reconstruction, various methods for diagenesis detection have been applied and will be presented (XRD, 2D-XRD, thin section analyses, SEM, cathodoluminescence).

Coral records reveal that abrupt intensification in winter monsoon was the direct trigger of the Akkad empire collapse in 4 ka

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Akkad empire in ancient Mesopotamia was established in the flat alluvial plain between the Tigris and Euphrates Rivers around 4.6 thousand years ago (ka). Akkadian could succeed in the development of agricultural system utilizing the winter Mediterranean rainfall. Archeological evidences and paleoclimate reconstruction shown that climate change seriously affected on the collapse of Akkad empire in 4.2$\pm$0.2ka. Speleothems and sediment cores revealed the abrupt aridification in western Asia was one of the factors that influenced collapse of Akkad empire. Intensification of winter monsoon might have reduced rainfall in Mesopotamia via southward migration of Mediterranean rainfall belt. However, there are no direct evidences to show monsoonal changes and seasonal migration of Mediterranean rainfall belt in 4ka. Here, we present the monthly-resolution sea surface temperature (SST) and oxygen isotope in seawater (δ18Osw) records in 7 different time-windows from 4.3ka to the present for reconstruction the migration of Mediterranean rainfall belt, by using 6 fossils and 1 modern coral skeletons collected in the Gulf of Oman. Our results suggested that both SST and δ18Osw in winter around 4.0ka were lower than in other time windows. The reduction of SST and δ18Osw in winter would have been induced by cold and wet air flow from Mediterranean due to intensified winter Indian monsoon around 4.0ka. We suggest that the abrupt southward migration of Mediterranean rainfall belt would have seriously affected the collapse of Akkad civilization around 4.0ka.

How massive Porites corals from different settings in the central Indian Ocean respond to prolonged thermal stress

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Coral Sr/Ca calibration studies indicate that growth rates of seemingly healthy corals are negatively affected by the current rise in sea surface temperatures. However, the reef setting has a tremendous effect on the susceptibility of corals to warm temperature anomalies. Here, we present coral Sr/Ca data from three modern core tops drilled from living massive *Porites* corals from two different reef settings — open ocean and lagoon — at the Chagos Archipelago (tropical Indian Ocean). Chagos lies at the eastern margin of the Seychelles-Chagos thermocline ridge and features open-ocean upwelling. In situ temperatures have been recorded by a network of temperature loggers starting in 2006. High-resolution satellite temperatures closely track the logger data, except during periods of intense open ocean upwelling and cooling. Two cores were collected from a patch reef in the lagoon of Peros Banhos, characterized by high mean temperatures and low temperature variability. An open ocean core was collected at the outer reef slope of Diego Garcia, which experiences large temperature fluctuations related to open ocean upwelling. The open ocean core shows clear seasonal cycles in Sr/Ca closely tracking the satellite temperatures. The Sr/Ca records from the two lagoon corals show very good reproducibility. Between 2007 and 2010, Sr/Ca tracks satellite temperatures. However, between 2003 and 2006 the Sr/Ca curves are almost flat and annual coral growth rates are very low. During these years, warm sea surface temperatures and coral bleaching have been observed at Chagos. We therefore think that the observed reduction in coral growth rates is a response to prolonged warming events, adding to the growing evidence that seemingly healthy corals are affected by thermal stress. Further, the high correlation between the Sr/Ca records of the two lagoon cores suggest that this effect is not limited to single coral colonies, but may affect the entire reef setting.

Sea surface temperature reconstruction at Europa Island (SW Indian Ocean) from coral trace element geochemistry

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The global climate is strongly influenced by the sea surface temperatures (SST) of the tropical oceans. However, the instrumental observations of SST face several challenges due to limited data density, time length, and data quality issues associated with different measurement tools and techniques since measurements began. This holds especially for the tropical oceans. Coral geochemical proxy archives can provide natural, precisely-dated, high- resolution reconstructions of SST and therefore can fill an important knowledge gap in our understanding of the tropical oceans. Here, we investigate Porites sp. corals from a 28km^2 sized atoll named Europa Island (22°22'S, 40°20'E) located in the southern Mozambique channel in the southwestern Indian Ocean. Europa Island has minor local human impact and therefore is an ideal location to examine natural climate variability from massive corals. Two cores were drilled in 2013 on the eastern reef slope of the island at depths between 12-15m. We analyzed two cores at bimonthly resolution for their Sr/Ca ratios, and used the inverse relationship between Sr/Ca and SST to reconstruct past SST between 1970 and 2013. To evaluate the SST reconstructions from these geochemical signals, we correlated the proxy dataset with several instrumental SST products and in situ measurements. Next to the temperature reconstruction using the Sr/Ca proxy, we also evaluated the new tandem SST proxys Sr-U following DeCarlo et.al. (2015), which suggest to reduce the impact of vital effects, during the coral biomineralization process. By using X-rays on the coral cores, we examined anomalies of the skeletal density as well as the calcification rates, starting from 1911 until 2013. In addition, we investigated regional teleconnections, within the Mozambique Channel. We find a highly significant correlation between Sr/Ca and instrumental SST products, whereas the time series of Sr- U does not correlate with SST. Sr-U does, however, reflect multi-year average mean annual absolute SST well. Spatial correlations reveal SST at Europa Island generally reflects local climate variability in the Mozambique Channel. Reconstructed SST over the last 42 years is dominated by interannvariability with a warming trend of 0.61$\pm$0.2°Cin close agreement with instrumental data (0.44$\pm$0.07°C). Furthermore, we observe a correlation between the reconstructed SST and regional precipitation, as well as air temperatures over parts of East Africa and South Madagascar.

Genetic study of the *Millepora alcicornis-Symbiodinium* association within and between both sides of the Atlantic

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It is well-known that calcified corals (Scleractinians and Hydrocorals) are relevant reef components providing a multitude of ecosystem services (e.g., three-dimensional structures that generate microhabitats, or coastal protection). The hydrcoral *Millepora alcicornis* is considered one of the most prominent and ecologically relevant reef builders in both sides of the Atlantic. Previous studies addressing its genetic structure have solely considered the molecular diversity of the host from one single gene, and little attention has been given to its associated endosymbionts. Here, we use a powerful multi- locus analysis, for both *M. alcicornis* and its associated symbionts (*Symbiodinium* sp.), to disentangle the genetic relationships within and between their populations from both sides of the Atlantic (Caribbean and Macaronesia). COI and 16S-rDNA regions were selected for the host tissues, and 23S-rDNA and ITS regions for the symbionts. Phylogenetic analyses confirm the high genetic variation of this hydrocoral, establishing the Caribbean as the origin of the recently established colonies in the Canary Islands (East Atlantic). *Symbiodinium* sp. results varied according to the different molecular marker used, suggesting that two clades may cohabit in the same colony. But most importantly, we found a genetic mismatch between the two components of the holobiont. Particularly, the genetic relationships of the symbionts do not follow the same pattern of their host (hydrocorals from the Canary Islands were phylogenetically related to the western Atlantic, but their symbionts were more related to Cape Verde). Hence, *M. alcicornis* may have a “horizontal” symbiont acquisition from the environment, or the ability to change its internal symbiont composition according to the environmental conditions. Such an outcome is essential to survival under current scenarios of global warming, which are promoting shifts in the distribution of species even across oceans.

Environmental and Biological controls on Na/Ca ratios in scleractinian cold-water corals

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Sodium to calcium (Na/Ca) ratios in calcitic marine carbonates have been shown to serve as a new promising tool in paleoceanography to reconstruct seawater salinities (Wit et al., 2013; Mezger et al., 2016; Bertlich et al., 2018). Here we present Na/Ca ratios measured in various scleractinian cold-water corals (CWC, *Lophelia pertusa, Desmophyllum dianthus, Madrepora oculata, Enallopsammia* sp., *Dendrophyllia* sp.) collected from a large salinity range (30.1 PSU to 40.5 PSU). Our results reveal no apparent salinity dependent sodium incorporation as observed by previous studies in calcitic foraminifera. In particular, CWCs growing at 35 PSU show maximum Na/Ca ratios and distinctively lower Na/Ca ratios at higher and lower salinities. Interestingly, Na/Ca ratios show a significant inverse correlation with seawater temperature. A comparison with Na/Ca data from the warm-water coral *Porites* spp. and the bivalve *Mytilus edulis* supports this correlation, which indicates similar controls on the incorporation of sodium into these aragonitic species. We suggest that temperature dependant enzyme activity and solubility effects may account for such a behaviour. However, large interspecies variability of Na/Ca ratios limits applicability as a proxy for seawater temperature. Intraspecies variability is probably caused by changes of the calcification rate controlling the amount of possible incorporation spaces into the aragonite lattice as well as seasonality effects. Further research could provide a new temperature proxy that is usable in at least three different marine calcifiers.

Carbon and nitrogen acquisition of two zooxanthellate octocorals from shallow and mesophotic coral reef ecosystems

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Octocorals represent, after reef-building scleractinian corals, the most abundant macrobenthic group on many reefs worldwide. They have however received little attention compared to scleractinian corals, thus no studies characterized their physiological performance along the bathymetric gradient. Here, we investigated the nutritional strategies of two soft coral species sampled in the Red Sea (Eilat, Israel) at two different depths (8 m and 40 m deep). Using stable isotope tracer experiment, we quantified the acquisition and assimilation of photosynthetic carbon and inorganic nitrogen (i.e. ammonium and nitrate) within the coral symbiosis, and followed the translocation of these nutrients between the symbiotic partners (i.e. *Symbiodinium* and coral host). Overall, this study highlights species-specific capacities, with a higher ability of deep corals to acquire inorganic carbon for one of the two species. This strategy may represent an asset possibly accounting for the high abundance of zooxanthellate octocorals in upper mesophotic reefs.

Seeking resistance on coral reefs: sub-lethal temperature stress and high flow conditions save coral reef species from thermal stress

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Tropical coral reefs are one of the world's most biodiverse and valuable marine ecosystems, but are globally in decline due to the effects of anthropogenic impacts and related changes in climate. Anomalous increases in sea surface temperature can disrupt the unique symbiotic relationship between reef building corals and *Symbiodinium*, often leading to bleaching and ensuing mortality. The bleaching threshold of hard coral species seems to be set by a number of different extrinsic and intrinsic factors. In particular, corals have the potential to change their thermal limit through exposure to sub-lethal, or chronic temperatures in combination with a number of different environmental conditions. Resistance to successive high temperature events will allow organisms to overcome conditions that would often result in adverse outcomes such as mortality and disease. The precise capacity for acclimatisation and survivorship of different coral species to extrinsic environmental factors is however unknown. Here, we experimentally show that coral species classified as 'winners' and 'losers' in the face of a changing climate, have differing responses to sub-lethal temperature regimes and flow conditions. Specifically, high flow conditions coupled with a pre sub-lethal temperature treatment, significantly impacts the mechanisms that underpin thermal tolerance and stress responses in an important reef building coral, previously classified as a 'loser' in the face of a changing climate. Our results demonstrate that environmental variables such as flow conditions, coupled with intrinsic species differences, can have large effects on bleaching tolerance and subsequent mortality on reefs. If these parameters can be classified at reef scales, there lies scope for identifying reef areas which may be more tolerant to future changes in climate.

Variation of reef fish functional diversity from a National Park in Central Mexican Pacific

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We explore functional diversity (FD) of reef fish from National Park Islas Marietas (IMNP) in central Mexican Pacific, an area characterized by small coral patches, large environmental variability and a recent tourism popularity. Our aim was to detect variability in FD through years (2011-2017), seasons (cold-warm) and ENSO events (cold-warm phase) and to identify the principal variables related to fish functional composition. FD was evaluated with indices based on a multidimensional approach, using species/abundance data and six functional qualitative traits; fish data was obtained from an extensive bimonthly monitoring effort of underwater visual census (n=204 sites out of 1020 transects). We tested differences in indices and functional entities (FE's) composition between periods, years and ENSO events with analysis of variance; additionally, we performed multiple regressions with principal benthic components and variables related to ENSO (Temperature, thermal anomalies). Our results revealed a high number of FE's (77) for the IMNP compared to that reported for the whole Tropical Eastern Pacific. We found statistical differences in most FD indices and FE's composition in the interaction of Period x Years and between ENSO events. The relation of reef fish and environmental variables was low and significant for only some benthic components (hard corals, turf and macroalgae; $R2>0.20$); there was no relation between fish FE and thermal anomalies or temperature, that could be due to a delayed response of reef fish to small scale environmental measures. Overall, our study showed that fish diversity from the IMNP is highly variable and despite indices, such as taxonomic or functional richness can return to similar values after ENSO periods, there can also be loss of FE's, and high values beyond showing increase or recovery of diversity could mean the temporal presence of fish FE's as part of the ENSO effect on other sites.

Coral reef health associated with hotels in Phuket, Thailand

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Coral reefs over the world are under many kinds of threat, climate change, pollution, and etc. This study purposed a new way to improve local coral reef protection: the corporation between NGO and hotels. In Thailand, many hotels have their own private beaches. In this condition, the protection strategies could be conducted throughly if hotel are willing to get involved. We used the health sign and coverage of coral as the condition estimation of coral reefs. In total 12 locations, including, 7 private beaches, 3 semi-open beaches, and 2 open beaches, were compared. Our results show that in general all locations have similar coral genera composition. In contrast, the health condition and disease types are really site specific. In private beaches group, 3 reefs have top health condition among all locations and the hotels have some conservation or environmental friendly programs. Compare with private beaches, reefs in other two groups are more variable. In summary, though we cannot exclude the effects of site specific reef developing history and environment difference, we suggest that hotels could be a new way of helping local reefs.

Reconstructing past environmental conditions in the Caribbean using massive *Siderastrea siderea* corals, Almirante Bay (Bahía Almirante), Bocas del Toro, Panama

Oliver Voigt

Global warming and climate change have taken a devastating influence on corals all over the world resulting in bleaching events and reef damage. In the Caribbean, sea surface temperatures (SSTs) have risen more significantly than average global temperatures over the last decades (Fowell et al. 2016). Our study area in Almirante Bay (Bahà Almirante) in Bocas del Toro, Panama, located in the western Caribbean is also strongly affected by human impact such as tourism, (over)fishing, shipping traffic, urbanization, sedimentation and others. These anthropogenic stressors had a significant negative impact on coral's health and the nearshore marine environments (Seemann et al. 2013). Besides increased turbidity with river run-off and erosion due to deforestation for plantations, seasonal temperature stress affects this semi-lagoon system and its corals (Seemann et al. 2013). The marine system changed radically over the last two decades because of pollution, nutrient and pesticide discharge (Seemann et al. 2013). As a consequence, coral reef diversity has declined. Since coral reefs are unique and highly valuable (e.g. important function as coastal protection, human resource providing food and possible pharmaceuticals, ecosystems offering shelter for many marine species and enable high biodiversity) a better understanding of coral responses to human impact and climate change is necessary in order to facilitate their protection. Here we present measured coral growth rates, skeletal density and calcification rates based on X-ray analysis with the CoralXDS software (Carricart-Ganivet and Barnes 2007). We analyzed seven coral cores of massive Siderastrea siderea taken by G. A. Heiss und R. R. Leinfelder in July 2010 from several sites across varying environments in Almirante Bay (Bahía Almirante) in Bocas del Toro, Panama. Our results will inform subsequent geochemical analysis to reconstruct environmental conditions over the past decades and a comparison with mid-Holocene Siderastrea and Diploria corals.

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Consumer grade drone and GIS technologies to map and monitor threatened coral reef environments in Faafu Atoll, Republic of the Maldives

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The Maldivian islands are unique for their geographic position, a chain of atolls in the middle of the Indian Ocean, and the coral reefs biodiversity. This unicity makes Maldives coral reef environments extremely fragile to global climate change effects (acidifications, the rise of surface temperature and sea level rise) and anthropogenic impacts. Use of satellite remote sensing data can be extremely useful in monitoring and assess those impacts but in some case, the spatial resolution is too coarse especially for the structure of the Maldivian coral reefs. The newly affordable consumer-grade drone can fill this gap for mapping coral reefs at a scale between a scuba or snorkelling surveys and satellite images derived maps. In our study, we collected high-resolution images using a commercial drone (DJI Phantom 4) along different sectors of reefs surrounding inhabited, uninhabited islands of the Southern Faafu Atoll. The acquired data were processed in order to map the extension and the composition of shallow lagoons habitat, from the beach to the reef crest. In addition, high-resolution images (1,5 cm/pixel) were collected in situ, at selected locations, in order to realize a 3D model of shallow reef communities using Structure from Motion algorithms. These 3D optical models will be used as the first step of a 3 years monitoring campaign addressed to observe the 3D structural complexity changes of the reef after the 2016 bleaching event. The whole study will focus on the integration of multi-scale maps to investigate, on a multi-temporal scale, ecological and geomorphological shifts in the study area and to figure out relationships with human activities (agriculture, land reclamation, new infrastructure) and pressures related to global climate changes.

Monitoring and assessing a 2-year outbreak of the corallivorous seastar Acanthaster planci in Ari Atoll, Republic of Maldives

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Outbreaks of the corallivorous crown-of- thorns seastars have received increasing attention due to their negative impacts on coral reefs in the Indo- Pacific Ocean. However, outbreaks in remote and dislocated islands are still poorly understood. This study aims to begin filling informational gaps regarding outbreaks of *Acanthaster planci* in the remote islands of the central Ari Atoll, Republic of Maldives. The population of *A. planci* was monitored during three periods over 2 years (2015-2016) to evaluate variations in abundance and to characterise size structure and feeding behaviour. The outbreak appeared to be severe and active throughout the entire study period. The size structure analysis revealed a multimodal distribution dominated by individuals between 20 and 30 cm, suggesting that the outbreak may have resulted from a few nearby mass spawning events. Additionally, the most abundant live coral was *Porites*, which was also the most consumed genus; however, the electivity index showed a preference for corals of the genera *Favites* and *Pavona*. Finally, we also highlighted the need for more geographically extended surveys to better understand local patterns regarding outbreaks of *A. planci* in the Republic of Maldives.

Using the mustard hill coral (*Porites astreoides*) as an indicator of early conservation success in the Caribbean

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The establishment of marine protected areas (MPAs) is a primary conservation tool used to protect declining coral reef ecosystems. The measurable benefits of protected areas may take years to become apparent to conservation managers, requiring routine monitoring and benthic habitat information. Due to differences in life history, habitat preference, symbiont types, or unknown processes, some Scleractinian species are more resilient to local community collapse and can rapidly colonize disturbed areas. The brooding coral, Porites astreoides, is abundant in disturbed areas of reef that have been impacted by bleaching events, storm damage, and anthropogenic impacts. The mechanism that enables this tolerance to environmental stresses is currently unknown. As an early successional species, I propose that the mustard hill coral can be used as an early indicator of conservation success in recently established Caribbean MPAs. The coral reefs of Grenada have experienced high levels of anthropogenic disturbance. To combat this decline, the Grenadian government has been working to establish a network of marine protected areas to reach its biodiversity conservation targets for Aichi 2020. A total of four 30m transects were photographed at half meter intervals across four sites (two protected, two unprotected) in Grenada as well as the island of Carriacou; and repeated after four years. A preliminary analysis of mustard hill coral size, and abundance to date has shown that observed colonies were more abundant and smaller in size within the MPAs when compared to unprotected sites. Analysis of the site surveys following four years of reef protection is currently underway.

Influence of environment on white plague disease on shallow and mesophotic coral reefs (Poster)

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Outbreaks of the white plague (WP) disease on Caribbean coral reefs have caused regional declines of living coral in recent times. Detailed ecological disease data due to monitoring efforts have primarily focused on shallow coral reefs. However, in the U.S. Virgin Islands, coral WP disease prevalence tends to be higher on mesophotic coral reefs than on shallow reefs, and may be inhibiting coral reef recovery after environmental disturbances. In this study, we investigated WP monthly and annual patterns on mesophotic coral reefs in the U.S. Virgin Islands, and the influence of abiotic and biotic environmental factors on disease prevalence using Bayesian inference with generalized linear mixed-effect models. WP prevalence was recorded monthly or every two or three months between 2012 and 2015 at 13 different reef sites (shallow, mid-depth, and mesophotic reefs) across the south shelf of St. Thomas. WP disease prevalence was higher on mesophotic than on shallow or mid-depth reefs and tends to increase during the beginning of the rainy season (June-August). Higher levels of water turbidity, elevated temperature (and DHW), and higher percent cover of corals, sand, algae and cyanobacteria, increased WP prevalence. Considering turbidity was the most important factor on the prevalence of WP on coral reefs, we hypothesize that sediment/ particulate matter could be a WP vector or reservoir. In addition, elevated temperature and thermal stress accumulation allowed for the long- term persistence of WP disease on mesophotic reefs but not on shallow reefs, indicating a possible temperature threshold for WP occurrence.

The influence of water flow on the responses of scleractinian corals to ocean acidification (Poster)

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Ocean acidification (OA), a decrease in ocean pH and shift in its carbonate chemistry caused by the anthropogenic increase in atmospheric pCO_2 and its subsequent dissolution in seawater, constitutes one of the main threats to the future of scleractinian corals. Despite the growing number of studies addressing OA impacts, many questions about the sensitivity of corals to these changes in ocean chemistry are still being untangled. Especially the crossed effects of other physical variables with increased pCO_2 remain barely explored. Water flow has been shown to modulate coral metabolism and energetics and affect colony survival. Yet, this physical parameter is seldom investigated conjointly with climate change stressors. Nonetheless, water flow appears to have the potential to increase the capacity of some corals to cope with environmental stress, which is potentially associated with a modulation of the photosynthesis of their photosymbionts. In order to elucidate the underlying mechanisms, the role of water flow in modulating the corals response to OA stress is investigated here under laboratory conditions. We hypothesized that OA would deteriorate the health condition of the holobiont, but that this effect would be mitigated under elevated water flow conditions. Therefore, the branching acroporid coral *Acropora muricatais* exposed to different water flow regimes and pCO_2 treatments. Photosynthetic efficiency is measured in hospite using pulse amplitude modulated fluorometry to assess the response of the coral holobiont to the experimental conditions. Due to the strong feedbacks between the coral host and its symbionts, this approach allows a health assessment of the holobiont. This study will further elucidate the role of water flow in modulating the photophysiology of corals and its potential to alleviate OA impacts on corals health, contributing to our understanding of the effects of climate change stressors on coral reefs.

Uptake of microplastics in hermatypic corals (Poster)

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Plastic litter is nowadays ubiquitously present in ocean waters and particularly microplastics (particles < 5 mm) are recognised as an emerging anthropogenic pressure. Especially interactions like handling and ingestion, are associated with various dangers and suspension feeders, such as many corals, might be affected in particular. However, little is known about species specific effects, and whether some life history traits promote the impacts of microplastic exposure. Therefore, the goal of the present study was to assess feeding rates of representative hermatypic zooxanthellate corals on microplastics, in order to evaluate the hazard potential of microplastics on corals. Specifically, this thesis aims (I) to quantify corals' feeding on microplastics, (II) to record visible reactions of the corals, and (III) to elucidate the capability for adaptation in corals on microplastics. Feeding experiments were conducted with the species *Acropora muricata*, *Porites lutea*, *Pocillopora verrucosa*, and *Heliopora coerulea*. Feeding rates on microplastics were compared to those on natural food (*Artemia* sp. cysts) and coral reactions were visually assessed. In order to identify potential adaptations, feeding rates were compared with those of corals that had been pre exposed to microplastics for 15 months. The results showed that corals fed more on *Artemia* sp. cysts than on microplastics. Further, corals more frequently exhibited reactions (i.e. mucus production and eversion of mesenterial filaments) in the presence of microplastics. However, there were no signs for adaptation to microplastic exposure. The results suggest an underlying discrimination process, which is most likely triggered by leached chemical stimuli of the *Artemia* sp. cysts. Though, corals that exhibited energetically costly defence reactions, may in turn incur negative effects on their energy budget. This study makes a contribution towards estimating the resilience capacities of coral reefs in the face of increasing pollution with microplastics and provides critical information on the hazard potential of microplastics on corals.

Protein prediction in microbial sponge symbionts (Poster)

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Like many members of the phylum Porifera (sponges), the tropical marine sponge *Lendenfeldia chondrodes* (a.k.a. common blue aquarium sponge, CBAS) houses a diverse community of bacteria, which most likely act as symbionts. In this study, we carried out comparative proteomic analyses of these putative bacterial symbionts, in order to learn how these bacteria contribute to their environment and how their lifestyles differ from those of free living bacteria. The study originated from prior completely assembled genomes of symbionts, spanning six species and four phylotypes. The genomes were compared against an extensive range of reference genomes, encompassing over 1000 binomially described bacterial species with appropriate phylogenetic affiliation to our symbionts. Only complete reference genomes were included. Putative proteins were predicted by gene annotation with the COG (clusters of orthologous genes) database. To complement the proteomic analysis, secretomes were investigated to find out about the carbon sources the symbionts are able to utilize. Currently, efforts are also underway to isolate and cultivate the bacteria ex hospite, both by standard plating techniques and in-situ cultivation methods. Our analysis suggests, that the examined sponge symbiont bacteria and their lifestyles differ significantly from those of reference species. There are also significant differences between the members of the symbiont community, which become especially evident when looking at more closely related taxa. Our results are supporting the presence of syntrophic networking and division of labor inside the host environment.

Rapid Ecosystem Service Assessment for Coastal Habitats in the Eastern Red Sea (Poster)

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Rapid Ecosystem Service Assessment (RESA) is a tool that can give initial estimates of the monetary value of ecosystem service (ES) flows inside of a study area based on habitat mapping and the value of previously studied habitats. This method combines existing spatial information of habitats within a study area (in hectares) with monetary values derived from existing literature on services provided by these habitats ($/ES flow/hectare/year.) We applied RESA to several sites of interest along the Saudi Arabian coast of the Red Sea with the goal of gaining a preliminary estimate of the potential monetary value of an ecosystem. Ground-truthed remotely sensed data was used to map and calculate the area of habitat types in five areas of interest along the west coast of Saudi Arabia. We then used valuation studies from The Economics of Ecosystems and Biodiversity (TEEB) database to determine a range of monetary values of services provided by a range of marine habitats in our case study areas. This first assessment estimates the monetary value of ecosystem services provided by coral reefs in these areas. This information is being used to inform more detailed in-situ measurements of marginal changes in ecosystem service flows on coral reefs in the Red Sea. While RESA involves many assumptions, this method provides decision makers with a quick, low-cost estimation of the monetary value of ecosystems, which can provide guidance in marine policy and planning.

Widespread sponge *Hyrtios erectus*: Genetic diversity in the Indo-Pacific?(Poster)

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Cryptic species and species complexes are often found in sponge genera. That means on species level the taxonomy of sponges can get quite complex. In this thesis it was asked if genetic variations in the sponge *Hyrtios erectus* are location-dependent. This sponge is thought to be one of the most widely distributed sponges, based on morphology. The material included 165 individuals of the entire Indo-Pacific area including the Red Sea and the Great barrier reef. PCR, on the 28S region (D-region) and one ITS region of ribosomal DNA, was used to create sequences which (1) got supplemented by sequences of the database of the LMU and GenBank, (2) where aligned, (3) used to generate Maximum likelihood trees with rapid bootstrapping. In both trees, the group of sponges from Saudi Arabia presented itself as a monophyletic group. Since the Holotype is from the Red Sea, these sponges are classified as *Hyrtios erectus*. All other sequences are grouped together regardless of their geographical origin and can be clearly distinguished from this group. Consequently, they may not belong to this *Hyrtios* species and thus form their own. In the Indo-Pacific there may be many sponges that are misclassified as a single species in terms of genetics.