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A SPOTLIGHT ON THE FUTURE RESEARCHERS

ABSTRACTS

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Unravelling the microscale mechanisms driving particle degradation in the ocean

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The sinking of organic particles to the ocean depths is the main driving force of the biological pump, the process responsible for the export of more than 50 Gt of fixed CO_2 annually and one of the major fluxes in the oceans' carbon cycle. Yet, the mechanisms determining the magnitude of the pump remain poorly understood, limiting our ability to predict this carbon flux in future ocean scenarios. Current ocean models assume that the biological pump is governed by the competition between sinking speed and degradation rate, with the two processes independent from one another. In this talk, I will demonstrate that contrary to this paradigm, sinking itself is a primary determinant of the rate at which bacteria enzymatically degrade particles in the ocean. By combining video microscopy and microfluidic experiments to directly observe and quantify bacterial degradation of individual organic particles in flow, I will demonstrate that even modest sinking speeds of 8 meters per day can enhance degradation rates more than 10-fold. I will further discuss the molecular mechanism behind the sinking-enhanced degradation, as well as possible ways by which bacteria can slow the sinking of particles. Finally, using the results obtained from a mathematical model, I will show that the flow associated with sinking is a major contributor to the observed magnitude of the vertical carbon flux in the ocean, and will outline major open questions in the field.

The coastal-deep sea conveyor at the eastern Levantine Basin

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Sediment trap dataset and ^{234}Th profiles, measured at the DeepLev observatory, reveal that POC and PN export at the highly oligotrophic Levantine Sea is dominated by lateral transport from the nearby margin, in association with winter storm events. Three-year observations suggest that these intermediate nepheloid layers (INL) operate at multi-depth, with silt-to-clay size PM transported at water depths of about 100-500m, while a finer fraction (colloidal) arrives also at deeper water. The shallow NIL is triggered by winter storms, manipulated by coastal flash floods and shelf resuspension and assisted by cross-shore currents, which allow the arrival of PM at a distance as far as 50 km within about 10 days. The deeper INL (colloids) could be related to density currents running down submarine canyons that cut the nearby continental slopes. Our observations highlight the importance of winter storm events in the C budget of marginal seas like the Levantine Basin. This further suggests that the anticipated increase in extreme weather events due to the on-going climate change should have an impact on this coastal-deep sea conveyor and on C export in the Levantine Basin and similar marginal marine basins.

Carbon sequestration in the deep-anoxic Black Sea

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With growing concerns about the escalating levels of atmospheric CO_2 and their adverse effects on global climate, the imperative for sustainable carbon sequestration solutions has never been more critical. Rewind is mitigating global warming by accelerating the natural process of organic matter burial and preservation at the bottom of the sea. This is accomplished by collecting agriculture and forestry residues and transporting this biomass for storage in the deep Black Sea, thereby sequestering the carbon. The euxinic (anoxic and sulfidic) conditions in the deep Black Sea favour organic matter preservation rather than decomposition. In-situ decomposition experiments involving various organic materials were conducted in three distinct euxinic water bodies: Lake Kinneret (Israel), the Black Sea (Georgia), and Selker Noor (Germany). The decomposition of the organic materials was quantified by determining changes in dry-weight over time. Our results demonstrate significant variation in decomposition rates of the organic materials, contingent upon both the specific properties of the organic material itself and the prevailing site conditions. Wood exhibited the slowest decomposition rate across all three sites. In the Black Sea, wood decomposition was minor (4% after 3 months, followed by no mass loss between 3-11 months). The minor degradation of wood and other organic materials within the Black Sea, coupled with the persistent stratification of the Black Sea that hinders the ascent of inorganic decomposition byproducts, engenders a protracted process of carbon sequestration spanning hundreds to thousands of years.

Long term Monitoring Program (NMP) in the Gulf of Eilat: Insights and impact

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The Gulf of Eilat/Aqaba is a unique marine ecosystem of exceptional ecological and economic importance. The remarkably biodiverse reefs in the Gulf are threatened by increased anthropogenic perturbations, including global (ocean warming and acidification) and local (pollution, destructive tourism, intensive coastal development and rapid urban expansion of Eilat and Aqaba at the northern tip of the Gulf. In response to these mounting concerns, the National Monitoring Program (NMP) at the Gulf of Eilat was established and operating since 2004 at the Interuniversity Institute for Marine Sciences in Eilat with support from the Ministry of Environmental Protection. The NMP team of monitoring professionals, continuously collects data using standardized methods and creating a robust database of ecological, biological, physical, and chemical information. The ongoing monitoring dataset includes continuously real-time meteorological and physical parameters along with inter-annual variability parameter dataset. This long-term initiative spans a wide temporal and spatial scale, provides insights into inter-annual patterns and trends and enabling the assessment of the Gulf's "health" and the ecological consequences of various anthropogenic and environmental factors. All data collected by the NMP are publicly accessible via the NMP website (https://iui-eilat.ac.il/Research/NMPAbout.aspx). Beyond its scientific contributions, the NMP supports data-based decision-making for sustainable development in the Gulf of Eilat. It serves as a reliable foundation for future research endeavours and policy formulation, ensuring the preservation of this precious marine environment for generations to come.

Taxonomic and functional diversity of microbial communities in the Gulf of Aqaba (Red Sea) over seasonal time-scales

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Phytoplankton in oligotrophic oceans account for >30% of marine primary production. Among marine phytoplankton in oligotrophic habitats, diatoms form a key group. The Gulf of Aqaba/ Eilat (GoA) is an oligotrophic basin which exhibits marked seasonal variations; it is stratified and nutrient-limited during summer similar to oceanic gyres ecosystems, and nutrient-richer during winter due to cooling and ensuing deep vertical-mixing. However, the microbial diversity inhabiting the GoA, particularly diatoms, and the emergent succession patterns across seasonal transitions remain poorly defined, limiting our understanding of the ecology of this ecosystem. To mitigate this knowledge gap, we sequenced the 18S and 16S gene markers using for eukaryotes and prokaryotes, respectively, during 2-years. We found a seasonal signal for both eukaryotes and bacteria, with respect to species diversity and community composition. In addition, we assigned eukaryotic sequences to functional groups following published trait-based datasets. We found that nano-autotrophs were the main group in the GoA, mainly during winter mixing, and heterotrophs were enriched during intense spring bloom in 2022. Finally, for diatoms we undertook analyses of cooccurrence networks that considered both biotic and abiotic factors in shaping the spatial distributions of species. We showed that main families like Thalassiosiraceae altered their interactions from high connectivity with bacterial groups in summer, to a segregated bacterial interaction during winter mixing. This ongoing study provides both a baseline information on the microbial diversity and functional role of microbial communities in the GoA as well as new understanding on community succession across seasonal gradient in subtropical ecosystems.

Functional characterization of Hexacorallia phagocytic cells

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Phagocytosis is the cellular defence mechanism used to eliminate antigens derived from dysregulated or damaged cells, and microbial pathogens. Phagocytosis is therefore a pillar of innate immunity, whereby foreign particles are engulfed and degraded in lysolitic vesicles. In hexacorallians, phagocytic mechanisms are poorly understood, though putative anthozoan phagocytic cells (amoebocytes) have been identified histologically. We identify and characterize phagocytes from the coral *Pocillopora damicornis* and the sea anemone *Nematostella vectensis*. Using fluorescence-activated cell sorting and microscopy, we show that distinct populations of phagocytic cells engulf bacteria, fungal antigens, and beads. In addition to pathogenic antigens, we show that phagocytic cells engulf self, damaged cells. We show that target antigens localize to low pH phagolysosomes, and that degradation is occurring within them. Inhibiting actin filament rearrangement interferes with efficient particle phagocytosis but does not affect small molecule pinocytosis. We also demonstrate that cellular markers for lysolitic vesicles and reactive oxygen species (ROS) correlate with hexacorallian phagocytes. These results establish a foundation for improving our understanding of hexacorallian immune cell biology.

Elucidating the relationship between cell cycle regulation and viral infection in marine diatoms

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Diatoms are a diverse group of eukaryotic phytoplankton, contributing ~20% of the photosynthesis on Earth and forming the base of marine food webs. Distributed across a wide range of oceanic regimes, from coastal to offshore waters, diatoms translate diverse environmental signals to efficiently regulate cell cycle progression and cellular growth and division in the water column. Diatoms are also infected by viruses, which are considered as catalysts of ecological and biogeochemical transformation in marine microbial communities. While there is substantial evidence that viruses can impact the cell cycle in mammalian and plant systems, how virus infection might regulate cell cycle progression in diatoms is unknown. Here, using the bloom-forming, centric diatom, *Chaetoceros tenuissimus* and the RNA virus, CtenRNAV, along with a range of techniques for cell cycle analysis and synchronization, we are exploring the interaction between viral infection and cell cycle regulation in diatoms. Initial results show an increase in the relative fraction of cells in S phase during viral infection, suggesting that cell cycle progression is modified in infected cells. As S phase is the DNA synthesis phase of the cell cycle, this observation raises the possibility that infection with CtenRNAV induces this shift to provide an increase in cellular materials such as nucleotides and amino acids which might be utilized by the virus. These findings highlight possible impacts of viral infection on cell cycle progression in diatoms, advancing our understanding of how viruses might interface with diatom bloom dynamics in the ocean.

Unveiling the microbiome of *Rhopilema nomadica*: Seasonal and tissue specific variations and cross-species insights

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Jellyfish blooms are a worldwide phenomenon, impacting marine ecosystems and human activities on a broad scale. Jellyfish blooms often disappear rapidly, with the causes of their demise mostly unknown. To test whether microbial pathogen may contribute to bloom demise, we characterize the microbiome of *Rhopilema nomadica*, the most common jellyfish in the Eastern Mediterranean Sea. We assessed microbiome changes during multiple seasons and stages of the bloom and examined these changes in light of natura variability across jellyfish tissues, sizes and sexes. Our study reveals that *R.nomadica microbiome* is less complex than the surrounding seawater, with a low number of dominate taxa. Interestingly, seasonal changes were observed. While the winter bloom was dominated by Tenacibaculum, early summer bloom was characterized by Simkaniaceae and late bloom showed strong shift toward Unclassified Rickettsiales and Endozoicomonas, accompanied with significant diversity decrease. Endozoicomonas is prevalent cnidarian bacteria, however, their exact role is still unclear. While often seen as symbiotic, some studies suggest they might be commensal or even pathogenic. Remarkably, strains sharing identical 16S sequences with *R. nomadica* were discovered in other jellyfish and in low abundance in seawater. This suggests a potential transfer of populations between these organisms via free-living bacteria. Finally, no bacterial compositional changes were found between visibly healthy and unhealthy jellyfish. While no clear pathogen was identified, the high abundance of Endozoicomonas and Rickettsiales at the end if the bloom prompts questions about their response to environmental factors or host physiology, and their potential to transition between symbiotic and pathogenic roles.

Coral immune system at the base of the bleaching phenomena

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Climate change and rising global ocean temperatures create new challenges for coral reefs. Elevated water temperatures can cause coral bleaching, in which coral host cells lose their symbiotic algae. Without their symbiotic partner, the coral will starve and die. Previous research on coral heat stress induced bleaching found that different immune genes were differentially regulated and suggested immune activation. Yet it is still uncertain if the immune response is a consequence of bleaching or of the heat stress itself. To test this, we have used two model systems for hexacorallian: *Exaiptasia diaphana* – which can be reared with and without symbiotic algae, Symbiodiniaceae, and *Nematostella vectensis* - which lacks symbiotic algae. We examined the effect of increased temperature on phagocytic activity, as an indication of immune function, using flow cytometry. Our data shows that immune cell activity increases during heat stress, while small molecule pinocytosis remains unaffected. We observed an increase in cellular production of reactive oxygen species with increasing temperatures. We also found that the cellular immune activity was not affected by the presence of the Symbiodiniaceae. This suggests that immune activity observed in heat-stress induced bleaching in corals is a fundamental and basic response independent of the bleaching effect. We also showed that immune activation is enough to induce algae expulsion. These results establish a foundation for improving our understanding of hexacorallian immune cell biology, and its potential role in coral bleaching.

Closing the gaps in freshwater diazotrophy across the global ecospace

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New evidence and previous estimations indicate that dinitrogen fixation by diazotrophs may play a central role in the freshwater biosphere along the ecological scales. And yet little is currently known on freshwater DIAZOTROPHY, namely the diversity, abundance and N2 fixation rates across the global freshwater ecospace, while even less is known on the environmental factors that control them. This research closes the knowledge gaps related to freshwater diazotrophy: from the abiotic factors that control diazotrophs abundance, diversity, and activity at the global scale. Achieving this global objective was done by sending a custom-made kit to 91 research groups from 68 countries that sampled 230 freshwater locations across the world. These samples were analysed for diazotrophs abundance, diversity and N2 fixation rates as well as organic carbon, nitrogen and various nutrients. Sampling across the world was carried during April-May 2023, thus springtime at the northern hemisphere and autumn at the southern hemisphere. A few unicellular diazotrophs hotspots (>15 x107 cells L-1) were apparent across the freshwater ecospace. Corresponding measurements of N2 fixation rates indicate relatively low values (<4 nmol N L-1 d-1) at the northern hemisphere, yet few regions with exceptionally high values (>50 nmol N L-1 d-1) were apparent at Northern US and Spain. Overall, this global research generates new insights on the environmental factors that control N fixation and its significance of freshwater diazotrophy to new N production across the freshwater ecospace.

Abundant Sulfitobacter marine bacteria protect *Emiliania huxleyi* algae from pathogenic bacteria

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Emiliania huxleyi is a unicellular micro-alga that forms massive oceanic blooms and plays key roles in global biogeochemical cycles. Mounting studies demonstrate various stimulatory and inhibitory influences that bacteria have on the *E. huxleyi* physiology. To investigate these algal-bacterial interactions, laboratory co-cultures have been established by us and by others. Owing to these co-cultures, various mechanisms of algal-bacterial interactions have been revealed, many involving bacterial pathogenicity towards algae. However, co-cultures represent a significantly simplified system, lacking the complexity of bacterial communities. In order to investigate bacterial pathogenicity within an ecologically relevant context, it becomes imperative to enhance the microbial complexity of co-culture setups. *Phaeobacter inhibens* bacteria are known pathogens that cause the death of *E. huxleyi* algae in laboratory co-culture systems. The bacteria depend on algal exudates for growth, but when algae senesce, bacteria switch to a pathogenic state and induce algal death. Here we investigate whether *P. inhibens* bacteria can induce algal death in the presence of a complex bacterial community. We show that an *E. huxleyi*-associated bacterial community protects the alga from the pathogen, although the pathogen occurs within the community. To study how the bacterial community regulates pathogenicity, we reduced the complex bacterial community to a five-member synthetic community (syncom). The syncom is comprised of a single algal host and five isolated bacterial species, which represent major bacterial groups that are naturally associated with *E. huxleyi*. We discovered that a single bacterial species in the reduced community, Sulfitobacter pontiacus, protects the alga from the pathogen. We further found that algal protection from *P. inhibens* pathogenicity is a shared trait among several Sulfitobacter species. Algal protection by bacteria might be a common phenomenon with ecological significance, which is overlooked in reduced co-culture systems.

Jellyfish swarm impair the pretreatment efficiency and membrane performance of seawater reverse osmosis desalination

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Circumstantial evidence has suggested that jellyfish swarms impair the operation of seawater reverse osmosis desalination facilities. However, only limited information is currently available on the pretreatment efficiency of jellyfish and their effects on reverse osmosis (RO) membrane performance. Here, we have comprehensively tested the pretreatment efficiency of a dual-media gravity filter and cartridge micro-filtration following the addition of jellyfish into the feedwater. Concurrently, the fouling propensity and performance of the RO membranes were examined. We show that the jellyfish demise resulted in seawater eutrophication that triggered a significant increase in bacterial biomass (~50-fold), activity (~7-fold), and release of transparent exopolymer particles (~5-fold), peaking three days after the addition of jellyfish into the feedwater. In parallel, a significant reduction in permeate water flux was recorded (~10%) while trans-membrane pressure sharply increased (15%), reaching the operation pressure limit of our system (75 bar) after five days. At the conclusion of the experiments, the membrane surface was heavily covered by large chunks of organic-rich material and multilayered biofilms. Our results provide a holistic view on the operational challenges of seawater reverse osmosis desalination (SWRO) desalination triggered by jellyfish swarms in coastal areas. Following the above, it can be inferred that freshwater production will likely be halted three days after drawing the jellyfish into the pretreatment system. Outcomes from these results may lead to the development of science-based operational protocols to cope with growing occurrence of jellyfish swarms around the intake of SWRO desalination facilities worldwide.

Sleepless sea: Artificial light at night impairs sleep and increases neuronal dna damage in reef fish

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Pervasive artificial light at night (ALAN) perturbs the physiology and behaviour of marine animals worldwide. Sleep is a vital evolutionarily conserved metabolic state essential for brain health. Sleep is highly regulated by light entrainment, but no research to date has examined the effect of ALAN on sleep in marine animals. Here, we defined sleep in the coral-inhabited damselfish Chromis viridis and deciphered ALAN's impact on social interactions, sleep architecture, and neuronal health. Employing machine learning tracking of fish schools, we discovered that ALAN hinders homing behaviour and increases nocturnal aggression and feeding. Furthermore, exposure to ALAN reduced sleep duration and quality. These sleep disturbances were associated with increased DNA damage in the sleep- and memory-related brain region, the dorsal pallium, but not in visual brain regions. Our findings introduce a model that correlates ALAN-dependent sleep alterations with brain health in reef-dwelling tropical fish. Hence highlighting the ALAN escalation potential threat to the marine ecosystem. The Gulf of Aqaba/Eilat, if managed correctly, can become a critical case study for both the harmful influences of ALAN as well as recovery.

Deciphering nutrient limitation of microbial community in the Eastern Mediterranean Sea

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Nutrient limitation is fundamental in marine ecosystems, shaping phytoplankton dynamics and nutrient cycling. The Eastern Mediterranean Sea (EMS), characterized by unique biogeochemical features, behaves like ocean gyres, and offers an intriguing yet understudied backdrop for investigating nutrient limitation. For two years, we conducted systematic nutrient enrichment bioassays at our EMS time-series station, using alkaline phosphatase activity (APA), chlorophyll-a (Chl), and biomass as responses. Our sampling included periods of extreme nutrient depletion and a period of relatively high ambient nutrient concentrations. When changes in biomass (cell counts) were examined we observed nitrogen and phosphorus (N&P) co-limitation only in October-2020, with no significant changes between treatments until 'Storm Carmel' (December 2021), when the only-P treatment resulted in substantial increase. In contrast, using Chl changes of the community, increased Chl after 48h appeared in most N&P treatments, indicative of N&P co-limitation. This occurred even when there was excess nitrate in the water column. Notably, after winter mixing (2021-2022), reduced APA suggested reduced P-stress while summer witnessed an increase in APA, implying P-limitation. It is suggested that this apparent contradiction could be explained by cyanobacteria's P-storage strategy and their known time-delay between P uptake and cell division. In this chronically P-depleted ecosystem, the nature of nutrient limitation (P vs. N&P) depends on whether cell growth or increased productivity is the response, and on the stoichiometric flexibility of C:N:P for the different phytoplankton groups. Understanding the changing response to nutrient limitation bioassays is providing valuable new insights in microbial processes in oligotrophic marine ecosystems.

An integrated hydrological model for Lake Kinneret Watershed – a tool to simulate the effects of future trends of climate change and watershed management

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Over the past two decades, Lake Kinneret Watershed (LKW) has suffered from decreasing water availability, due to longer and more frequent drought years and increasing exploitation of freshwater. These trends are expected to intensify due to climate change trends, as well as population growth. Our study aims to better evaluate hydrological processes in the LKW, and to examine the long-term effects of climate change scenarios, changes in groundwater extraction, and water management actions on its water resources. The surface and groundwater systems are simulated using two model types, SWAT and MODFLOW, which will be then coupled to formulate a comprehensive hydrological model for the LKW. In addition, a separate MODFLOW model is used to evaluate flow trends of the Hermon aquifer, which supplies via its significant springs most of the freshwater to the LKW. The surface model is calibrated by comparing observed and calculated monthly flows of the LKW's main springs and streams. Application of MODFLOW to the Hermon aquifer reveals new findings about flow mechanisms and we successfully simulate the discharge in its main springs. When the integrated model will be calibrated, several scenarios of climate and watershed management will be simulated and the effect on the flows of the LKW's main streams will be evaluated. By that, we aim to provide new insights about the hydrological processes of the LKW, and to give reliable estimations of future trends for the water authorities, that will allow efficient management and preservation of the hydrological system.

Estimating the ecological impact of a recent marine petroleum contamination in the Eastern Mediterranean

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Marine petroleum pollution events are highly frequent worldwide and especially in coastal environments and around shipping lanes. An example for such event was the recent petroleum pollution that occurred in the Israeli Mediterranean waters during February 2021, impacting the entire Israeli coastline. In this study we estimate the ecological impact of the oil spill by combining three main sources of information: spatiotemporally explicit oil concentrations, spatially explicit estimated biodiversity data, and taxon-specific sensitivity to oil toxicity. Using this integrated modelling framework, we provide estimates for the extent of direct mortality as a result of this event, and discuss possible long-term impacts. We highlight the uncertainties related to our estimates and discuss the broader implications of our findings.

Evidence for in-situ methanogenesis and methanotrophy in dry permafrost soils

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Microbial methane production in permafrost soils has been traditionally related to wetland sediments, thermokarst-lakes and in seasonally thawed active permafrost layers. Conversely, dry upland permafrost-soils, such as the boreal forest zone, which covers large parts Alaska, Canada and the northern contiguous USA - are regarded as an atmospheric methane sink without active production of methane. To gain better understanding of methane dynamics in this unsaturated soil, we sampled three cores (two during summer, one winter) of upland talik in yedoma permafrost soils, located in Fairbanks North-Star, Alaska. We performed geochemical and microbial profiles and show talik (thaw bulb) development leads to large methane production and emissions in dry upland environments. Eddy-covariance indicated annual methane emissions were almost three times higher, compared to wetland emissions. About 70% of emissions occurred in winter. We measured dissolved CH_4, CO_2 and O_2 concentrations and stable carbon isotopic composition ($d^{13}C$) of $CH_4$and CO_2. In addition, we utilized ^{16}S amplicon-based sequencing and qPCR of mcrA (methanogenesis) and pmoA (methanotrophy). Our data shows the occurrence during summer of methanogenesis and anaerobic methanotrophy at deeper depths. At shallower depths, methane is subject to oxidation during migration through soils to the atmosphere when aerobic methanotrophs are active in unfrozen surface soils. During winter methanogenesis was also observed at the lower depths. However, in contrast to summer, anaerobic methanotrophs were not observed and methane oxidation by aerobic-methanotrophs was significantly lower. These findings highlight the potential important role of permafrost upland soils, in methane emissions and impact on climate change.

Insights from stem cell transplants and wound healing

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Coral reefs, crucial for both global biodiversity and economies, are facing unprecedented threats from climate change, resulting in recurrent mass bleaching events and coral degradation. Our research focuses on harnessing the regenerative potential of stem cell transplants to bolster coral resilience, focusing on stem cells in the context of wound healing and regeneration. We hypothesize that hexacorallian house stem/progenitor cells with the capacity for efficient in-vivo transplantation, offer a promising avenue for coral restoration. Using transgenic fluorescent reporter-tagged *Nematostella vectensis*, we transplanted these putative stem/progenitor cells into wild-type animals. This allowed us to meticulously track these cells and their progeny through fluorescent microscopy. To assess their effectiveness, we induced controlled wounds by decapitating the animals and closely monitored the migration of transplanted stem cells towards the incision site. We observed their behaviour during the natural regeneration process. Our preliminary findings provide encouraging evidence that stem cell transplants hold significant potential for enhancing coral recovery. Our research uniquely intersects the realms of coral resilience and wound healing. By unravelling the critical role of stem cells in regeneration, we aspire to develop species-independent cell transplantation techniques within hexacorallians, potentially bolstering the heat tolerance of coral reefs. Through this novel approach that bridges coral resilience and wound healing, we aim to deepen our comprehension and support for coral recovery in the face of mounting threats. Ultimately, our research endeavours to contribute to the preservation and restoration of these invaluable ecosystems, ensuring the well-being of marine life and coastal communities on a global scale.

Jellyfish active swimming vs. passive drift

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Jellyfish pose significant threats to tourism, clogging desalination and power plants, and impacting ecosystems including fisheries. Understanding their swimming and swarm behaviour is crucial for science-based sustainable coastal management. Although commonly considered as passive drifters, jellyfish actively swim, displaying mean horizontal speeds comparable to the currents. Jellyfish active swimming is considered an important survival mechanism, increasing swarm formation and thus successful fertilization, and reducing stranding probability. Despite its importance, it is often neglected, and its effects remain unclear. Our objective is to understand the significance of jellyfish passive drift vs. active swimming on jellyfish propagation, dispersion, and swarm behaviour. Our methodology combines numerical modelling and drone-captured video observations of jellyfish orientations and trajectories. We reconstructed jellyfish swimming trajectory by using their orientation and velocity magnitude. A biased correlated random walk model optimized using data science techniques was used to characterize jellyfish active swimming. The model was integrated into a Lagrangian particle tracking framework, incorporating passive drift to simulate the full jellyfish trajectories. Our model exhibits a strong resemblance to the observed jellyfish trajectories. Our results indicate that although jellyfish active swimming is often neglected, it serves as an important surviving mechanism to avoid stranding. Next, we plan to study swarm formations and distribution along the Mediterranean coast, focusing on the Israeli coastline using specific regional velocities from a high-resolution General Circulation Model.

Inorganic & organic nitrogen uptake by phytoplankton during periods of strongly contrasting nitrogen availability in the Eastern Mediterranean Sea

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In the ultra-oligotrophic Eastern Mediterranean Sea (EMS) dissolved organic nitrogen (DON) may be critical for sustaining primary productivity, particularly during periods of nitrate and ammonium depletion. Urea is a component of DON and a known bioavailable form of organic nitrogen. I examined the potential availability and in-situ uptake rates of urea compared with ammonium and nitrate for EMS phytoplankton. Uptake rates of these three nitrogen forms were measured during two contrasting seasons: 1) Autumn 2021 during an extreme period of nitrate depletion (July 2020-November 2021) and 2) Winter/Spring 2022 after injection of excess nitrate to the photic layer. Uptake rates, after additions of urea, nitrate, or ammonium (Range 0-2 µM) for 48 hours of incubation, were estimated from concentration decreases and related to changes in chlorophyll a, and bacterial abundance. In all the experiments, the highest potential uptake rates were measured for ammonium with lower and similar rates obtained for urea and nitrate. Generally, there was an increase in chlorophyll a after the addition of each nitrogen and P. In-situ uptake rates at ambient N concentrations were assessed by 15N trace uptake experiments conducted over a 4-hour period. When inorganic nutrients were highly depleted (Autumn 2021), urea was the major nitrogen species utilized. After winter mixing, the in-situ uptake rates for all N species increased and were similar confirming that nitrate is an important substrate when abundant. We demonstrate that when dissolved inorganic nitrogen is depleted, the microbial communities of the EMS can use urea (and probably other DON compounds).

Textbook invasion – the rise and fall of *Diadema setosum* in the Mediterranean Sea

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The Eastern Mediterranean Sea is a marine biodiversity hot spot characterized by high levels of endemism. However, continuous introductions of invasive species pose a threat to this unique ecosystem. *Diadema setosum*, a conspicuous echinoid of Red Sea and Indo-Pacific origin, recently invaded the Mediterranean Sea. *Diadema* are broadly recognized as environmental engineers, capable of altering the structure and composition of entire benthic communities and are thus regarded as fundamental ecological components. Here we summarize two decades of research on *D. setosum* in the Mediterranean Sea, from its initial appearance in the Levantine basin in 2006, through its accelerated population growth (population outbreak), to a most recent mass mortality event. We combine data from the literature and citizen-science reports, with a regional-scale sampling effort, scrutinized with molecular and histological methodologies, to provide the most comprehensive account of the species' invasion dynamics and dispersal patterns in the Mediterranean Sea, with special emphasis on the Israeli coastline. We conclude with an updated account of the ongoing mass mortalities of *D. setosum* that are rapidly spreading in the Eastern Mediterranean and currently cover an area of over 1500 km off southern Turkey, Greece and Cyperus. This work features a unique and comprehensive case study of marine bio-invasions, providing a detailed, step-by-step account of the invasion process – from arrival, through establishment, to proliferation, and a potential population collapse.

Symbiotic firmicutes of marine macroalgae: A potential source of natural products for drug discovery

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Symbiotic Firmicutes of marine macroalgae are excellent producers of novel natural products with good therapeutic properties. Nonetheless, only a limited number of macroalgae Firmicutes have undergone investigation to identify their bioactive chemical compounds. Combining traditional bioassay-guided isolation procedures and modern “omics” tools to identify biosynthetic gene clusters (BGCs) producing active compounds in microorganisms results in the quick and accurate identification of bioactive molecules generated by the microbes. Hence, the ongoing study combines bioassays, genomics and metabolomics to analyse the biological, genomic and chemical potentials of unexplored Firmicutes associated with macroalgae in Israeli coastal areas. A sample of a highly invasive macroalga, *Asparagopsis taxiformis*, collected from an Israeli coast, was swabbed and plated on agar plates. Single bacteria were identified by 16S rRNA sequencing, and the Firmicutes among the isolates were cultivated in optimised growth media to generate natural products. Cultures were extracted using liquid-liquid, solid-phase, and resin extraction methods. Four Firmicutes isolated from *A. taxiformis* produced secondary metabolites extracted for further analysis, and three showed potential antibacterial properties when co-cultured with six marine and two pathogenic bacteria. We expect to isolate and chemically characterise new bioactive compounds from these Firmicutes, which could potentially become “leads” for future pharmaceutical drugs.

Ruppin Coastal and Estuarine Observatory (RECO): A decade of coastal oceanographic data collection and education

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Ecological systems show high variability over time and space. Often, the response of the ecosystem to environmental and anthropogenic forcing is slow and nonlinear. Therefore, modern understanding of ecosystems, predictions of future trends, and management decisions must all rely on collecting long-term time series of environmental and biotic data. Monitoring changes in coastal ecosystems is of special interest due to their complex dynamics and their tight interactions with humans and anthropogenic waste. The Levant (Eastern Mediterranean) is a warm, saline basin, and one of the most oligotrophic regions of the world oceans, making it a natural laboratory for studying future seas under global warming and acidification scenarios. Ruppin Coastal and Estuarine Observatory (RECO), established in 2014, is a Long-Term Ecological Research (LTER) station on the east Mediterranean coast (Michmoret, Israel). RECO monitors the local coastal ecosystem and the effect of the nearby Alexander estuary. For the past decade, we have been collecting weekly CTD, chlorophyll, flow cytometry, and eDNA samples from coastal and open water stations. Collaborative research is possible using the LTER infrastructure, with data dissemination through an open-access website. The LTER platform also provides an opportunity to combine scientific research and science education of undergraduates at the Faculty of Marine Science.

Continuous determination of dissolved inorganic carbon fluxes from pumping suspension feeders

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Understanding the carbon cycle in the Anthropocene era is crucial. Coastal and benthic environments play a vital role in the marine carbon cycle, with benthic suspension-feeding organisms serving as key players in carbon cycling and sequestration. Nevertheless, direct measurements of respiratory CO_2 excretion rates by these organisms are lacking, likely due to the analytical challenge of measuring small changes in inorganic carbon concentrations relative to their high ambient levels. Here, we propose a straightforward method for continuously measuring dissolved inorganic carbon (DIC) fluxes from pumping suspension feeders. The method is based on simultaneous measurements of the pH in the water inhaled and exhaled by the studied organism using commercially available pH optodes. pH measurements are translated into DIC concentrations using concurrent measurements of the local alkalinity, temperature, salinity, and pressure. The difference between the DIC inhaled and exhaled (ΔDIC, µmol L-1) is multiplied by the pumping rate Q (L hr-1) of the studied organism to calculate the DIC mass flux mediated by that organism (hereafter, DMF in units of µmol ind.-1 hr-1). To test the feasibility of our method, we conducted a field experiment in which DIC mass fluxes were measured for three marine sponge species (N=15-18 per species) using the continuous pH-based method. The resulting DMFs were compared with direct (but discrete) DIC measurements. The DMF values obtained using the continuous, pH-based method were comparable but higher than the DMF values obtained using direct DIC samples but lower than DMF estimates based on concurrent measurements of dissolved oxygen removal. The proposed method provides a robust and continuous assessment of DIC fluxes from pumping suspension feeders in coastal systems but is limited by the sensitivity of the optodes and depends on the constancy of the alkalinity concentration between inhaled and exhaled water.

Differential colonization and succession dynamics of marine bacteria on different plastic polymers - an experimental approach

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During the past decades since plastic was introduced to the world, marine microorganisms have been adapted for life on marine plastic debris, forming unique plastic-attached microbial communities. To date, little is known about the colonization and succession processes that take place on plastic surfaces in marine environments and how the composition of the plastic-attached microbiome is affected by the plastic polymer type. To address this knowledge gap, we examined the colonization and succession dynamics of marine bacteria on four common plastic polymers - PE, PP, PS, and PET, in comparison to glass and wood in a controlled seawater system under different temperatures. Using a simple experimental design, coupled with a long-read 16S rRNA metabarcoding pipeline and a set of complementary data analyses, we characterized the temporal trends in the composition of the bacterial microbiome which has been developed on different surfaces over a period of 2 – 90 days. By applying weighted gene co-expression network (WGCNA) analysis, we established co-occurrence networks and identified genera with specific succession signatures, significant enrichment on specific plastic polymers and/or with strong intra-genus connections. Among them, members of genus Alcanivorax were significantly enriched on either PE or PP plastic surfaces as early as 2 days post- inoculation. Alcanivorax colonization preference to polyolefins was confirmed in colonization assays with pure Alcanivorax strains. We believe that our research approach presented here may contribute to the understanding of how plastisphere communities are being formed and help in the identification of taxa with specific adaptations to plastic surfaces.

Sources of marine carbonyl sulfide identified by their sulfur isotopic values

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Oceanic emissions of carbonyl sulfide (COS), act as important precursors for stratospheric sulfate aerosols, which regulate Earth's radiation budget. COS is also used as a proxy for the removal of atmospheric CO_2 by terrestrial plants, which regulates Earth's climate. The oceans are the largest natural source of COS. Yet, large uncertainties are associated with the magnitude of oceanic COS emissions. Thus, better constraints on the COS budget are needed for reliable climatic models. Sulfur isotope measurements of COS were recently used to constrain tropospheric COS budget estimates. However, published measurements of S isotopes of aquatic COS are currently scarce. As far as we know, currently, such measurements were only published previously by us. We present here, a full data set of S isotope ($\delta^{34}S$) measurements of marine COS from The Mediterranean, Red, and North Seas, and from the Atlantic Ocean. We used a water-air equilibrator to sample COS in the gas phase, and preserved them in Silitek-treated canisters for later analysis in the lab, using a GC/MS-ICPMS. COS in surface water show $\delta^{34}S$ values in the range of -4 to 20‰. We use the spatial and temporal changes in S isotopes of COS to identify the isotopic values of different sources of COS, including the production of COS in the sediment, photoproduction, light-independent production, and hydrolysis. These new findings will help to constrain the ocean-atmosphere COS flux and create an improved COS budget isotopic mass balance for COS-based GPP models and stratospheric sulfate models.

Bioconcentration and lethal effects of gas-condensate and crude oil on nearshore copepod assemblages

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Hydrocarbon pollution has become a major concern in the Eastern Mediterranean Sea (EMS) due to the accelerated maritime traffic and the establishment of gas platforms. To assess the toxicity of petroleum pollutants on zooplankton, we carried out microcosm experiments, simulating different spill scenarios of gas-condensate and crude oil. Our study is the first to compare the effects of gas-condensate and crude oil on the coastal copepod assemblages of the Mediterranean Sea. We performed two independent experiments exposing natural coastal copepod assemblage to a simulated surface slicks of gas-condensate and crude oil at five levels (0, 50, 250, 500, 100ppm). Our results showed that the bioavailability of the dissolved LMW-PAHs (low molecular weight polycyclic aromatic compounds) of gas-condensate is higher than crude oil, resulting in two times higher mortality level of the copepods. The LMW-PAHs bioconcentration factor (BCF) was 1-2 orders of magnitude higher in copepods exposed to gas-condensate than in those exposed to crude oil. The median lethal concentration (LC50) was significantly lower in calanoid compared to cyclopoid copepods, suggesting that calanoids are more susceptible to gas-condensate and crude oil pollution. Overall, the studied coastal copepod assemblages showed a relatively high tolerance to petrochemical pollution, which increases the risk of bioconcentration and biotransfer of toxic petroleum hydrocarbons in the EMS pelagic food web. Our results highlight the need for mitigation measures to reduce petrochemical pollution in the EMS.

Algal exudates promote conjugation in marine roseobacters

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Horizontal gene transfer (HGT) is a pivotal mechanism driving bacterial evolution, conferring exceptional adaptability within dynamic marine ecosystems. Among HGT mechanisms, conjugation mediated by Type IV secretion systems (T4SSs) plays a central role in the ecological success of marine bacteria. However, the triggers that initiate conjugation events in the marine environment are not well understood. Abundant marine bacteria known as Roseobacters, commonly associated with algae, carry multiple T4SS-encoding plasmids. These bacteria often rely on algal compounds for growth. Algal compounds therefore attract bacteria and promote colonization, including attachment to algal cells. Bacterial proximity, cell-to-cell contact, and attachment, foster HGT. Hence, we hypothesized that algal exudates, acting as chemoattractants for bacteria, may function as cues promoting bacterial HGT. Our study highlighted that the genomic location of the T4SS affects its functionality. Bacteria with chromosomal-encoded T4SS do not execute conjugation, while those with plasmid-encoded T4SS do. Additionally, we investigated the impact of algal exudates on bacterial conjugation dynamics. We found that while algal exudates enhance plasmid transfer through conjugation, they do not influence the transcription of conjugative machinery genes. These findings suggest that bacterial responses to algal hosts evolved to increase the chances of successful conjugation with compatible partners. Moreover, as specific algae attract distinct bacterial populations, they shape potential partners for genetic exchange, potentially influencing bacterial evolution in the marine environment.

Capture of zooplankton by site-attached fish: striking dynamics under different flow speeds and angles of approach

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Consumption of zooplankton plays a vital role in the functioning of productive benthic communities, such as coral reefs and kelp forests. Many planktivorous fish in those habitats are site-attached, foraging on drifting zooplankton while maintaining their position against the currents, where the supply of prey is continuously renewed. Yet, little is known about the feeding characteristics of those fish and their dependency on flow speed and the angle (relative to flow) from which the prey arrives. Here we describe the key attributes of the strikes and “reactive distance” (defined as the distance between the fish and prey at the moment of strike initiation) in four common species of site-attached coral-reef fishes. Using a flume with 3D video cameras, we measured the distance, speed, and angle of the fish’s strikes and estimated their reactive distance under different flow speeds and angles of approach. Overall, all species shared similar trends despite inter-specific differences in absolute values. The distance and angle (relative to flow) of the strikes significantly decreased with increasing flow speed. Interestingly, reactive distances decreased with increasing flow speed, exhibiting a threshold above which a change in striking strategy occurred, as previously suggested by McFarland and Levin. Surprisingly, striking speeds remained nearly constant under different flow speeds but were significantly faster at wider angles of approach. The latter indicates that the fish actively determine their striking speed based on the prey’s path, suggesting a cognitive ability to modulate the speed and distance of the strikes in order to precisely intercept their moving targets.

Exploring marine natural products for targeted colorectal cancer therapy

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Colorectal cancer (CRC) is a malignant tumor affecting the large intestine, encompassing the colon and rectum. In 2020, it accounted for 1.9 million new cases and 0.9 million deaths worldwide, ranking as the second most common cancer in women and the third most common in men. Conventional CRC therapy often leads to severe side effects and drug resistance, prompting the need for safer, innovative treatments. Historically, natural sources, particularly plants, have played a crucial role in traditional medicine for various diseases. In recent decades, marine natural products (MNPs) have emerged as potential therapeutic agents, yet their application in cancer treatment, especially for CRC, remains limited. This study aims to identify marine-derived natural products with anti-cancer properties. We extracted natural compounds from marine sources, specifically algae and marine bacteria, using chromatographic methods. Mass spectroscopy provided precise chemical composition identification of these extracts. We evaluated the biological activity of these compounds in vitro, utilizing colorectal cancer cell cultures. Our investigation revealed that exposing colorectal cancer cells to extracts from the red seaweed *Asparagopsis taxiformis* resulted in a dose-dependent reduction in cell viability. Further studies are crucial to elucidate the structural properties of these active compounds and understand the molecular mechanisms by which they act on colon-origin cancer cells. This research contributes to the discovery of marine-derived compounds with anti-cancer potential and offers innovative strategies for cancer treatment.

Differential evasion of bacterioplankton phylotypes from sponges, the ultimate filter feeders

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Marine bacteria play a crucial role in the microbial plankton community, the marine food web, and the microbial loop, and are major drivers of all marine biogeochemical cycles. A delicate balance between growth and mortality shapes the structure and function of these microbial populations. In benthic environments, the grazing on planktonic microorganisms by benthic suspension feeders can shape the microbial community composition and control benthic-pelagic coupling. Sponges (Porifera) are considered non-selective filter feeders and the ultimate bacterivores among benthic suspension feeders. We studied the ability of different bacterioplankton phylotypes to evade capture by three coral reef demosponge species (*Theonella swinhoei, Diacarnus erythraeanus*, and *Crella cyathophora*) using a combination of direct in situ sampling and environmental DNA techniques. Surprisingly, while the overall filtration efficiency of bacterioplankton by all sponge species was high (>80%), some bacteria phylotypes were captured with much less efficiently than others. Moreover, the ability of particular bacterial phylotypes to evade filtration varied depending on the species of sponge. This variability suggests that the prey's properties play a critical role in determining its ability to avoid filtration. From a broader perspective, we discovered that this differential filtration leads to decreased bacterial diversity, ultimately affecting the composition of the bacterioplankton community in the reef overlying water.

Cell size increase as an indicator of phosphorus limitation in natural calcifying phytoplankton (Coccolithophores) populations

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Coccolithophores (Haptophyta) are unicellular calcifying phytoplankton that produce a cell-wall, the coccosphere, composed of multiple calcium carbonate plates, the coccoliths. Coccolithophores are abundant phytoplankton, contributing through photosynthesis to the production of organic carbon and the drawdown of atmospheric CO_2. Calcification (coccolith biosynthesis), on the other hand, releases CO_2 in the short term and stores carbon in coccoliths in the long term. Thus, coccolithophores play a key role in the global carbon cycle. For this reason, many studies have addressed the production of organic and inorganic carbon (calcification) and cell morphometry in coccolithophores, namely their modifications by environmental factors, including nutrient limitation. In this study we investigated the physiological and morphological response of coccolithophores during yearly surveys in the Gulf of Aqaba/Eilat (Red Sea) and the Eastern Mediterranean. These are both ecosystems characterized by marked seasonal variations in nutrient availability. We found that during seasonal periods characterized by primarily phosphorous (P) limiting conditions, validated with manipulation experiments with native communities, coccolithophore cells are significantly larger. Large cells are expected to have higher inorganic carbon to organic carbon ratios, namely if associated with heat stress, unbalancing the role of coccolithophores towards release of CO_2. Curiously, these results using native population validate early physiological measurements in batch cultures, but not in continuous cultures, which questions current views on the physiological state and processes of nutrient flux towards cells at sea. From a practical viewpoint our results further indicate that for certain ecosystems, coccolithophore cell size may serve as a bioindicator for P limitation.

Long term monitoring programs, from sampling to policy makers- the Lake Kinneret example

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Routine evaluation of the state of an aquatic ecosystem is crucial for water resources that provide multiple ecosystems services and are essential for drinking water. Reliable assessment of aquatic ecosystems requires comprehensive monitoring efforts and needs to ensure an accurate picture of the physical, chemical and biological components of the ecosystem. Monitoring programs need to account for immediate and future objectives and maintain consistent sampling methodology while being adaptive. It is essential that the information gained from the monitoring is conveyed to policy makers to serve the decision-making process. The Lake Kinneret monitoring program started in 1969, following the establishment of the National Water Carrier, is one of the longest and complex freshwater monitoring programs in the world, and is funded by the Israel Water Authority (IWA). The main objectives of the program are to monitor lake water quality, to observe and predict long-term changes and to identify the processes that affect it. The program encompasses multiple aspects of this complex ecosystem and provides information on key processes, measures overall ecosystem health based on key indicators and assesses long-term effects of management actions and environmental change. Many components have not undergone changes since the initiation of the program but it has been expanded and adapted to new phenomena, concerns and objectives and new technologies are constantly incorporated. The information from the program have been at the base of advice provided to the IWA and continuous efforts are made to improve the way the information is used in the decision-making process.

Using dark diversity to disentangle the effects of protection and habitat quality in marine protected areas

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Protected area performance is usually evaluated by comparison to control sites. Nevertheless, disparities in species richness between protected areas and control sites may also arise from hard-to-quantify gradients in habitat quality. We suggest that using dark diversity, i.e., the assemblage of species that fit the site's biogeographical and environmental conditions but are locally missing, can disentangle the confounding effects of protection and habitat quality on biodiversity. Using Marine Protected Areas (MPAs) and control sites across the Mediterranean Sea, we first show that fish dark diversity decreases with protection efforts but is independent of habitat quality. We then demonstrate how comparing dark diversity, observed richness, and the site-specific species pool between MPAs and control sites can assist in quantifying the effect of protection while accounting for the difference in habitat potential to harbor biodiversity. Thus, while observed richness conflates protection and habitat quality, dark diversity captures the effect of protection more directly and should be used more broadly to assess MPA performance. When comparing dark diversity in MPAs and control areas, we found that MPAs tend to fulfill a higher degree of their potential to hold diversity than the unprotected control areas, confirming the benefits of these Mediterranean MPAs.

Coral and boring bivalve symbiosis: Does coevolved mutualism support the resilience of coral reefs or does parasitism threaten their future?

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The boring bivalve *Leiosolenus lessepsianus* is an obligatory species-specific symbiont of the coral *Stylophora pistillata* in the northern Gulf of Eilat/Aqaba. Due to the obvious effect of weakening the coral host skeleton, this association is usually considered parasitic. However, few studies have suggested that some aspects of this concealed symbiosis may be beneficial to corals. In this study, we performed histological examination of the coral host and its boring bivalves, to elucidate the reproductive cycles of the two symbiotic associates. In addition, the annual reproductive cycle of corals with and without boring bivalves was studied and compared. These observations were subsequently compared with a previously unpublished, similar dataset, acquired five decades ago. Our findings suggest the presence of co-evolved reproductive traits between the associated partners. Despite notable shifts in the timing of reproductive peaks for both the bivalve and the coral, their synchrony has endured over time. Notably, the bivalves initiate their reproductive phase several weeks prior to the coral hosts. Upon the onset of coral reproduction, a reduction in its calcification rate is expected, consequently leading to a decrease in its growth rate. This specific timeframe might be advantageous for the juvenile bivalves to undergo metamorphosis and growth. This process seems to alleviate competitive pressures arising from the need to keep pace with the coral's growth through decalcification. This study is part of a wide, long-term project, aiming to better understand the long-debated coral-bivalve symbiotic relationship, uncovering potential co-evolved processes affecting the health of coral reefs. Thus, we expect to contribute novel and crucial data for better assessment of the coral reef health, resilience, and stability.

Heterotrophic diazotrophy from a river to a lake: Lifestyle and contribution to N_2 fixation

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The study of heterotrophic N_2 fixation in freshwater environments has received less attention compared to marine and terrestrial ecosystems. Freshwater ecosystems exhibit higher heterogeneity due to frequent ecological disturbances, making them a complex and dynamic environment for studying the N_2 fixation process. Here, we measured N_2 fixation in the Jordan River - Sea of Galilee Lake continuum, during the summer and winter times. Rates, abundances, and diversity of free-living heterotrophic diazotrophs were compared to those associated with aggregates. We found a high range of diazotrophs from 8x106 to 215x106 cells L-1, accounting for up to 8% of total bacteria. N_2 fixation ranged from 0.01 to 1.9 nmole N L-1 d-1, ascribed mostly to heterotrophic diazotrophs in the river (>38%), while phototrophic bacteria were major N_2 fixers in the lake (>19%). During the winter the highest N_2 fixation rates per cell were observed on aggregates in the lake during the winter (1500 attomole N cell-1 d-1). Heterotrophic diazotrophs were diverse and varied between a river and a lake. In contrast to the diverse heterotrophic diazotrophs, the specie Cylindrospermopsis was the main phototrophic diazotroph. The main environmental factors, such as C:N and N:P ratios, control the diversity of free-living diazotrophs. However, these factors do not influence the diversity of diazotrophs on aggregates at all. The environmental heterogeneity between sites and seasons is potentially modulating the occurrence and relative importance of specific groups of the microbiome community, which in turn affects the contribution of diazotrophs to the N cycle in the freshwater continuum.

Near-bottom patterns of zooplankton and phytoplankton over shallow and deep coral reefs observed with underwater imaging system and pumps

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The discovery of deep, mesophotic coral reefs, where light is dimmer than in shallow reefs but plankton concentrations are similar, has raised the question of the balance between the contributions of autotrophic vs. heterotrophic pathways to the productivity of those reefs. The commonly accepted notion is that mesophotic corals gain a higher proportion of their nutritional needs heterotrophically (plankton predation) compared with the dominance of photosynthesis-based pathways in the shallow reefs. If true, a comparison between mesophotic and shallow reefs that are similar in total coral abundance, the decline in plankton concentration across the benthic boundary layer should be steeper in the mesophotic reefs. To test this hypothesis, we measured the concentrations of zooplankton and phytoplankton at different altitudes above the bottom in Red Sea reefs that differ in depths but are similar in coral cover. For that, we used a novel underwater microscope (Scripps Plankton Camera [SPC]) and a matching vertical array of underwater pumps, together with simultaneous measurements of current velocity, temperature, and pressure. Each SPC deployment lasted 2-3 days, during which images were acquired at a rate of 10 frames/s. The pump arrays typically sampled plankton for 1 hr, only during the day. The numerous plankton images acquired with SPC were processed using a custom-built Machine Leaning program. A strong seasonality and substantial changes in plankton concentrations during the day were observed, as well as steep declines across the benthic boundary layers, at all depths. However, the declines were steeper over the shallower than deeper reefs. Hence, our findings do not support the alleged claim that heterotrophic feeding is stronger over mesophotic reefs. Possible explanations, other than the similarity in plankton consumption at different depths, include differences in the types of corals and the overall decline in the abundance of planktivorous fish.

Towards high spatial resolution map of grain size distribution along the Israeli continental shelf based on multibeam backscatter data

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Grain size distribution along the continental shelf has far-reaching implications from the spread of ecological habitats to infrastructure planning and is therefore of interest to academics and governmental agencies. The spatial distribution of the grain size along the Israeli shelf is dynamic and was shown to be affected by occurrences e.g. the damming of the Nile in the mid-1960s. Conventional methods to map grain size distribution are based on interpolation of grain size analysis from discrete sediment samplings (where these can be obtained). This method is greatly lacking, particularly in areas where there are large spatial variations and where sampling is challenging because the sediments are very coarse or adjacent to hard substrates. To overcome these problems, we use backscatter data of the R/V Bat-Galim multibeam from recent years. For this data, we applied a mathematical correction using the observed backscatter angular response, in locations where grain sizes were sampled and analysed. The normalized backscatter angular response is verified and cross-checked to reliably represent the seafloor characteristics to the extent that we are now able to characterize sediments in the range between silt and clay with the precision of a single Phi value and up to gravel and submerged rock surfaces. Our current goal is to apply this method to existing multibeam surveys from recent years to produce an unprecedented, detailed map of the grain size distribution of the Israeli continental shelf.

Seasonal variability of internal waves in the Gulf of Eilat/Aqaba

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Internal waves play a role in the transport of key commodities (plankton, larvae, nutrients) from the open waters onto the coral reef and coastal habitats in the GoE. Using a WireWalker equipped with an RBRconcerto CTD we study the seasonal variability of internal waves in the upper 150 m near the northern end of the Gulf. The WireWalker is purely mechanical and profiles continuously, with wave energy driving the buoyant profiler downward. On reaching the deepest user-specified sampling depth, it free-ascends along its suspension cable (aka profiling wire), nearly completely decoupled from mooring motion. The RBRconcerto CTD was programmed to work in Directional mode: with fast sampling in the Ascending direction and a slow sampling rate while descending. The fast-sampling speed applied to each upcast was 8 Hz. The slow sampling speed applies to each downcast was 1Hz. We deploy the WireWalker for 10-21 days during different seasons with varying stratifications. During the summer, when the water column in the Gulf is stratified, large-amplitude (few tens of meters) tidally-forced internal waves with a dominant period of ~12 hours are observed in the Gulf. Waves with much higher frequencies superimposed on the 12-h period waves are evident. In contrast, during winter, internal waves are nearly absent. During the transition seasons, internal waves are visible only at the base of the thermocline.

Polarimetric computer vision and deep learning method for spatio-temporal water surface waves and celerity's reconstruction in laboratory conditions

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Accurate and cost-effective sea state measurements, in terms of spatio-temporal distribution of water surface elevation (water waves), is of great interest for scientific research and various engineering, industrial, and recreational applications. To this end, numerous measurement techniques have been developed over the years. None of these techniques, however, provide near-real-time spatio-temporal data. Utilizing Deep Learning (Artificial Neural Networks) approach and latest advances in polarimetric imaging technology, we have developed a remote sensing methodology for laboratory implementation. Inferring surface elevation, slope and waves' celerities with high accuracy, from polarimetric data of artificial light source reflection from the water surface. The methodology is being developed further in ongoing research by improved supervised data collection of larger variety of monochromatic wave trains, improving the Signal to Noise Ratio (SNR) in larger sampling area obtained by in house developed artificial light source. In addition, we utilize Bayesian optimization algorithm for hyperparameters tuning for the deep learning of the collected data. We demonstrate the ability of the deep network, trained on monochromatic wave trains data, to produce high-resolution and accuracy reconstruction of the 2D water surface slopes of a JONSWAP spectrum wave field propagating at arbitrary angle relative to the polarimetric camera optical axis. Hence, mimicking the complex open sea wind driven wave field with arbitrary camera location. To obtain the spatio-temporal water surface elevation from slopes map we apply the surface-from-gradient fields algorithm, aided by the data acquired by resistance type wave gauges, this to obtain optimal temporal integration coefficient. Furthermore, we present capability to reconstruct the surface waves celerities directly, without assuming simplified dispersion relation. The method's performance is demonstrated to provide dense estimate of the water surface, efficiently and accurately reconstructing wave field parameters across the full range of wave lengths. We also discuss in detail the techniques for selection of optimal ANNs hyperparameters and the use of spatial filters to improve the signal-to-noise ratio while maintaining adequate spatio-temporal resolution, maturing the methodology for implementation as laboratory waves measurement tool.

Gaping behavior of the spiny oyster *Spondylus spinosus* measured in situ over an annual cycle with micro tiltmeters

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As principal suspension feeders in many benthic habitats, bivalve molluscs play a pivotal role in benthic-pelagic coupling, provide essential ecosystem-services, and serve as an important biomonitoring tool. Bivalves actively pump water through their modified gills for feeding and respiration. Wider valve gaps correlate with higher filtration rates, while closed valves indicate inactivity. Therefore, valve gaping behavior has garnered extensive research, but due to methodological constraints, this research was limited to short-term laboratory or intertidal settings. This study introduces a novel approach for prolonged in-situ monitoring of bivalve gaping activity utilizing high-resolution, off-the-shelf, tilt data loggers. Naturally buoyant tilt sensors were attached to specimens of the non-indigenous spiny oyster, *Spondylus spinosus*, in front of Mikhmoret, Israel, and recorded the valve gaping angle spanning a comprehensive timeframe of 17 months. We also used time-lapse photography and environmental sensors to investigate potential correlations with environmental variables. Our findings indicate that on average (±95% confidence interval), the bivalves were open 69.6 ± 10.4% of the time, with an average gaping interval of 23.35 ± 12.24 minutes. The data unveiled notable diurnal and seasonal patterns, with increased activity during nighttime and throughout the spring and summer. Intriguingly, the gaping behavior of neighboring individuals was uncorrelated and was only weakly correlated to environmental parameters. We suggest that the bivalve's gaping behavior is mostly affected by intrinsic and highly local processes, potentially biological origin (e.g., fish movements). Our innovative monitoring methodology offers a valuable tool for long-term environmental monitoring.

Organic pollutant mixtures in micro-estuaries: effects of geochemical conditions and flow regime

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Israeli coastal streams drain into the Mediterranean Sea through micro-estuaries, coastal water bodies that are permanently or periodically open to the sea. Estuaries serve as buffer zones between fresh and sea water, creating physical and chemical gradients that may limit their mixing. Recent studies have indicated that estuaries face a chronic pollution stress yet knowledge on temporal dynamics and geochemical conditions effects is very limited. In this study the water column and bed sediments of three typical micro-estuaries (Kishon, Alexander and Lachish) were sampled monthly and screened for ~2,500 organic pollutants and metabolites during the dry season of 2022. Although similar in basic morphological characteristics, our geochemical measurements reveals that the three estuaries differ in their flow regime (i.e., baseflow conditions and connectivity to the sea) which enables a better comprehension on factors governing the transport and fate of organic pollutants. Overall, 274 pollutants were detected and quantified in all water and sediment samples composed of 48% pharmaceuticals and personal care products, 38% pesticides and 14% industrial chemicals. A general decrease in pollutants appearance and accumulative concentration over time was measured in all micro-estuaries. In my presentation I will discuss the recognition of factors influencing the dispersion of pollutants along the estuaries and through the water-sediment continuum. Such knowledge may help refine toxicity experiments, predict stress factors and promote techniques for the attenuation of pollutants removal.

Incorporating human-wildlife interaction into marine spatial planning: a study case of guitarfish along the Israeli Mediterranean coast

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Human-wildlife interactions are crucial in shaping our understanding of nature and can significantly impact efforts to conserve endangered species and their habitats. As human activities continue to expand in the marine environment, encounters between humans and marine wildlife are expected to rise. Addressing and incorporating these interactions into conservation plans can provide valuable insights and bolster conservation efforts. In this study, we utilized the Marxan software to analyze data from the MECO citizen science project, focusing on two guitarfish species, the blackchin guitarfish (*Glaucostegus cemiculus*) and the common guitarfish (*Rhinobatos rhinobatos*), along the Mediterranean coast of Israel. Our objective was to identify areas of high probability for human encounters with guitarfish species while considering the specific activities conducted during these interactions. Our findings revealed that human activities varied across different areas during guitarfish encounters. By incorporating human activities as conservation targets in the Marxan analysis, in addition to guitarfish distribution data, we observed no significant shifts in the location of areas marked for conservation. However, the total area of these conservation zones increased significantly. This approach demonstrates how incorporating data on human-wildlife interactions can enhance conservation modeling efforts. Moreover, our study highlights the significance of including a social dimension in conservation planning, offering a fresh perspective on the process. By integrating human-wildlife interaction data, conservation strategies can be better tailored to specific locations and activities, facilitating more effective protection for guitarfish species and their habitats.

Zooplankton seasonal vertical migration in an optimality-based plankton ecosystem model

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(1) GIGABLUE

Several species from various zooplankton taxa perform seasonal vertical migrations (SVM) of typically several hundred meters between the surface layer and overwintering depths, particularly in high-latitude regions. We use OPPLA (OPtimality-based PLAnkton ecosystem model) to simulate SVM behavior in zooplankton in the Labrador Sea. Zooplankton in OPPLA is a generic functional group without life cycle, which facilitates analysing SVM evolutionary stability and interactions between SVM and the plankton ecosystem. A sensitivity analysis of SVM-related parameters reveals that SVM can amplify the seasonal variations of phytoplankton and zooplankton and enhance the reduction of summer surface nutrient concentrations. SVM is often explained as a strategy to reduce exposure to visual predators during winter. We find that species doing SVM can persist and even dominate the summer-time zooplankton community, even in the presence of Stayers, which have the same traits as the migrators, but do not perform SVM. The advantage of SVM depends strongly on the timing of the seasonal migrations, particularly the day of ascent. The presence of higher (visual) predators tends to suppress the Stayers in our simulations, whereas the SVM strategy can persist in the presence of non-migrating species even without higher predators.

Surprising widespread *Cymodocea nodosa* occurrence along Israel's Mediterranean coast

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Cymodocea nodosa is a temperate seagrass that grows in shallow and sheltered waters of the Mediterranean. Although it is found in both the western and eastern basins, it was thought to be absent from the extremely warm and salty waters along the Israeli coastline, the most eastern part of the Mediterranean Sea. We conducted methodical, seasonal, towed-diver surveys along the Mediterranean coast of Israel recording position, depth, presence/absence of *C. nodosa*, seabed characteristics and habitat complexity. We used general additive models (GAMs) to understand how the combination of depth, latitude (space), and season (time), explained the distribution of local meadows. We then compared the habitat affinity of these Israeli meadows with other sites in the Eastern Mediterranean by conducting a systematic literature review and using Species Distribution Models (SDMs). Underwater surveys unveiled the extensive distribution of *C. nodosa* over a narrow depth range of 8-21m (peak occurrence at 14m) in exposed habitats. These locations are distinct from other Eastern Mediterranean populations, in which *C. nodosa* is found in shallower and sheltered habitats. SDMs confirm the increase in the geographical range also reflects an increase in realized niche breadth into higher values of temperatures, salinity and current velocity. Considering that the eastern tip of the Mediterranean is a climate change hotspot, finding *C. nodosa* populations surviving these harsh conditions holds implications for seagrass conservation and restoration in the entire Mediterranean. However, the low density of observed meadows suggests that these populations require careful monitoring to prevent local extirpation.

Long-Term (2002–2021) trend in nutrient-related pollution at small stratified inland estuaries, the Kishon SE Mediterranean case

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Nutrient pollution may negatively affect the water quality and ecological status of rivers and estuaries worldwide, specifically in stratified and small inland estuaries. We present a long-term, two-decade data set of dissolved inorganic nutrient concentrations, chlorophyll-a (chl-a), dis-solved oxygen (DO), and potentially toxic algal cell concentrations at the Kishon River estuary (Israel) as a case study for assessing nutrient ecological thresholds in such type of estuaries, prevalent along the Mediterranean coast of Israel. In-situ measurements and water samples were collected at 3 permanent stations at the lower part of the estuary every March and Octo-ber/November in 40 campaigns over the years 2002 to 2021. In spite of an improvement in nutrient loads and concentrations as recorded over the last 2 decades, the nutrient and chl-a levels at the Kishon estuary surface water represent mostly a ‘bad’ or ‘moderate’ ecological state, considering the recommended thresholds discussed in this study. It is suggested to develop a combined suite of nutrient and biological variables for assessing Good Environmental Status (GES), considering the relatively high residence time of such small, low-flow estuarine water bodies.

Marine oligotrophication due to fine sediments and nutrient starvation caused by anthropogenic sediment and water retention in large rivers: the Nile damming case

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In the last two centuries, human activities have radically reduced the transport of suspended sediment and water to marine systems, mainly in the northern hemisphere, while complete sediment retention has been reported for the Nile River after the construction of the Aswan High Dam (AHD). Here, we present changes in the inner-shelf sediments most exposed to the pre-AHD flood plume in the distal part of its littoral cell as a predictor of the ecological response to large river fragmentation. Substantial reductions in fine (15-40%) and increases in coarse (~8 fold) sediment accumulation rates, increases in CaCO3 (~50%), decreases in autochthonous and total organic carbon (OC), and changes in the benthic foraminiferal assemblage toward more OC-sensitive species suggest an enhanced oligotrophication trend. Reduced nutrient fluxes, OC accumulation, and the coarsening of the shelf sediments inhibit the retention of “blue” carbon. Combined with fast climate warming and salinization, river fragmentation may have essential implications for the Eastern Mediterranean ecosystem via benthic oligotrophication processes.

Desalination brines as a potential vector for CO_2 sequestration in the deep sea

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Freshwater scarcity, driven by population growth and climate change, is increasingly mitigated by seawater desalination, globally. As an energy-intensive process, desalination is a substantial source of atmospheric CO_2. Nevertheless, desalination may hold a potential for ocean-based atmospheric carbon removal. Here we describe, for the first time, the carbonate chemistry of desalination brines near the submerged marine outfalls of a large desalination plant, their unique CO_2 buffering capacity, and potential for deep sea carbon sequestration. We show that reverse osmosis acts as a carbon concentration factory and that the high-density brine plumes could create a vector for long-term CO_2 removal to the deep sea below the seasonal thermocline. At present desalination capacity, we estimate that Desalination Assisted Carbon Concentration (DACC) and Carbon Dioxide Removal (CDR) could potentially remove 3.8 Mton CO_2/year globally, with a negligible contribution to ocean acidification. This mechanism partially mitigates the high carbon print associated with desalination.

Biogenic silica and diatom fluxes in the eastern levantine basin, mediterranean sea

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The marine silica cycle is coupled with the ocean carbon pump via the productivity and fate of diatoms that use dissolved silica for the production of their opaline (biogenic silica; BSi) skeletons. Up to date, little is known about the silica cycle in the ultraoligotrophic and silica depleted Eastern Levantine basin (ELB), in the Mediterranean Sea. Here we show and discus the first, time-series measurements of BSi and diatom fluxes in the ELB. The data was obtained from 180 m and 1300 m deep sediment traps from the DeepLev moored station, 50 km offshore Haifa (1500 m seafloor depth). Our data shows that BSi and diatom fluxes in the ELB are the lowest reported from the world's oceans. Diatoms constitute approximately 10% of the annual flux of organic carbon (POC) from the surface water, most all of it in the winter and spring. Diatoms' contribution to the POC flux in the summer and autumn is negligible. Moreover, increase in BSi and diatom fluxes with depth and high fraction of benthic diatom species at the DeepLev station show that lateral transport from the shelf constitute a major fraction of the diatom and BSi fluxes to the seafloor in the open sea. The results of this study characterize yet unknown features of the poorly understood silica cycle in the ELB but also highlight the role of the silica cycle in an oligotrophic endmember in the ocean and the margins deep-sea links therein

Are last centuries changes in sedimentation regime off the Israeli coast anthropogenic induced?

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Submarine canyons serve as important sediment transport conduits from littoral zones to the deep sea. Such canyons can be major geohazards for submarine infrastructure, warranting a good understanding of their past and current behavior. Here, we present a study of the geological history and the recent activity of the Nahariya submarine canyon, the longest of a system of ~15 small blind canyons located in the eastern Mediterranean Sea, offshore Israel. Two piston cores retrieved from the middle and outlet of the canyon, were the focus of a multi-proxy study aiming to characterize sediment transport and deposition along the canyon between the Last Glacial and present. Both cores reveal a sequence of homogenous sediment of upper last glacial age, which are capped by an unconformity overlying by fine laminated sediment dated to the last ~200 years. Thus, the deglacial and Holocene intervals are absent from the record. Evidence for down canyon sediment transport are abundant and include mud clasts with disordered ages, as well as broken shells of dead benthic foraminiferal species of shallow marine habitats, which are abundant throughout both cores. We conclude that the history of Nahariya submarine canyon includes a period of sediment accumulation that lasted until the last deglaciation. Thereafter, the canyon was dominated by an erosive regime that persisted throughout the Holocene. Sediment accumulation resumed ~200 years ago. We suggest that the recent resumption of sediment-accumulation is a result of anthropogenic amplification of on-land soil erosion and a wet period that persisted in the region and enhanced land to sea sediment transport.

Quantification of differential grazing on dominant microbial prey by sponges

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Microorganisms, particularly bacteria, are vital for the marine ecosystem. Key groups accounting for over 70% of bacterial cells include Synechococcus (Syn.) and Prochlorococcus (Pro.) cyanobacteria along with the heterotrophic clade SAR11 (most abundant bacteria). Within reef ecosystems shifts due to daily and seasonal changes affect bacterial communities and subsequently their predation by suspension feeders. Sponges are benthic suspension feeders that actively pump water through their bodies to capture microorganisms from the surrounding water. Their grazing can alter the microbial community in ambient water and impact benthic-pelagic coupling. This study aims to quantify the differential retention of microbial prey by two species of sponges: *Diacarnus erythraeanus* and *Theonella swinhoei*. We examined if and to what extent diurnal and seasonal changes affect the differential retention of sponges at the level of prey phylotype, using an interdisciplinary approach that combines in situ techniques (InEx method), Flow Cytometry, Fluorescent In Situ Hybridization (FISH), and next-generation analyses. Our results suggest that Syn. was effectively removed throughout both seasons and day-night cycles without variation (Average RE% 93.28% +- 2.05%). However, Pro. removal exhibited differences between seasons, especially in the case of *T. swinhoei* (August average RE% 91.75% +- 2.4%, March average RE% 31.4% +- 18.4%). Surprisingly, our results showed higher numbers of large eukaryotes (LEuk) expelled by the sponge compared to their concentration in the ambient water (*T. swinhoei* average RE% -13.7% +- 24.2%). This study helps us better understand how the microbial community composition is influenced by the grazing of sponges under changing conditions (diurnal, and seasonal).

Climate change impact in the Eastern Mediterranean Sea: Trends and extremes

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The sea surface temperature rise due to global warming has triggered rapid iceberg melting and increased condensation of clouds. Each process projecting a far-reaching regional and global consequences including sea surface temperature drop during storms, marine heatwaves, sea level rise, and increase in intensification and rate of recurrence of storm weather events.In this study, we analyzed 3 decades of sea surface temperature and instantaneous water surface elevation recorded by two buoys moored in separate locations in the Eastern Mediterranean Sea, two kilometers off the Israeli coastline. Additional long-term measurements of sea level rise from several stations along the Israeli coastline were also integrated into the analysis. Our findings reveal occurrences of sea surface temperature drop events following storms and marine heatwaves. We identified positive trends in sea level and in sea surface temperature rise. Furthermore, the last two decades have been characterized by storm intensification. The sea surface rise was correlated against the measured sea surface temperature trends obtained by the buoys and compared to Copernicus and NOAA reanalyzed models demonstrating models significantly miss the observed trends.

Reef building corals show resilience to the hottest marine heatwave on record in the Gulf of Aqaba

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Coral reefs are facing rapid deterioration, primarily due to a global rise in seawater temperature. In conjunction, the frequency and intensity of extreme high temperature events, known as marine heatwaves (MHWs), are increasing. The Gulf of Aqaba (GoA) in the northern Red Sea is home to corals known for their thermal resilience, yet concerns have been raised regarding the potential for MHWs to put this coral refuge at risk. In summer of 2021, the hottest MHW so far occurred in the GoA, with sea surface temperatures peaking at 31°C and persisting above the local summer maximum for 34 days. To assess the physiological response of the corals *Stylophora pistillata* and *Pocillopora damicornis* to this event, we analyzed the monthly content of host and symbiont proteins, carbohydrates, and lipids, pre-, during, and post the MHW, as a proxy for metabolic stress. We found that the MHW was not fatal to either species and did not induce bleaching, based on algal densities and chlorophyll content. Species-specific responses were detected. In *S. pistillata*, host protein content decreased (33%) at the onset of the MHW (August) compared to pre-MHW levels (July). Algal symbionts of *S. pistillata* were unaffected by the MHW in their maximal photosynthetic efficiency (Fv/Fm) and exhibited higher carbohydrate levels (+34%) at the end of the MHW (September) compared to its onset. In contrast, no significant catabolic response was detected in *P. damicornis* host or symbionts, and the maximal relative electron transport rate (rETRmax) of symbionts was 37% higher during the MHW than the annual average. These results highlight the remarkable ability of common GoA corals to withstand extreme thermal anomalies, underscoring the global significance of this coral refuge.

Characterizing extra-cellular polymeric substances from 5 microalgae species toward industrial use

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There is a growing need for eco-friendly and renewable alternatives to conventional colloids on a global scale. This field is highly incentivized, with an estimated market size of 12 billion USD in 2020 and a compound annual growth rate (CAGR) of 8.1% until 2030. Colloids are generally bulky molecules that are insoluble in a substance but are suspended in it, altering its properties. For instance, saccharides and proteins can create hydrogels with water. My research aims to find new alternatives to traditional colloids using microalgae polysaccharides (Phycocolloids). Adding Phycocolloids can complement existing algae farms' products and increase profitability by allowing them to use their raw product as a biorefinery and extract multiple products. Numerous microalgae species release polysaccharides into their environment, and my research will focus on five potential species. I will manipulate their growth conditions to try and increase the amount and variety of polysaccharides in the growth medium, making substance extraction easier.

Additive manufacturing approach for LED based illumination cultivation systems

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Microalgae and other photosynthetic microorganisms are a source of versatile products such as pigments, lipids and carbohydrates. Although photosynthetic organisms' cultivation techniques have evolved and improved, a vast amount of research is still needed to achieve a better understanding of these organisms including their biochemical and molecular mechanisms. Today there is a growing need for affordable, flexible and easy to control research systems. Additive manufacturing revolutionized design and development processes as it became widely available, allowing design freedom, complexity at lower costs, rapid prototyping, customization, and personalization. The emergence of open-source designs and electronics components combined with 3D printing applications can improve and reduce the development time for new cultivation methods. Our work describes several culture systems that can be mounted on an orbital shaker or positioned on a shelf (e.g., flasks and cell culture plates). It is based on several low-cost commercial off-the-shelf components for low production cost, simplicity, design flexibility allowing controllable light conditions. All the systems are based on RGB programmable light-emitting diodes (LEDs) that allow easy programming of different light patterns, intensity, and duration.

New insights on the microbial journey from the sea to the atmosphere and back

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Marine bioaerosols, composed of both local and long-range transported microorganisms, may have important implications on global processes such as nutrient and carbon cycling, as well as on marine ecology. However, the mode of marine microbes' transmission into the atmosphere, their atmospheric dispersal, and impact on the marine environment are poorly understood. Previous studies indicate selectivity in microbial emission, speculated to be linked with the marine surface microlayer (SML), emphasizing the need to better understand its involvement in shaping the aerial community. Here I will present our findings on the links between the community composition of the SML in comparison to the surface water below, and the marine bioaerosols across a gradient of latitudes in the Pacific Ocean. In addition, I will further describe our findings on aerial infection mechanism. Our findings show a clear trend of transition in microbial communities between the three environments. We further explore and discuss the bioactivity, represented by the rRNA transcripts, showing similarities between the SML and aerobiome. Our findings contribute to improving clarity in the emission mechanisms of primary biological aerosols and provides a window to the marine bioaerosol research field, advancing our understanding of how microbial communities impact the marine environment.

Environmental impacts of global chronic oil pollution on marine ecosystems - Preliminary results

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Chronic oil pollution is globally widespread, mainly caused by anthropogenic contributions such as ship-discharges, oil and gas infrastructures and pipelines, as well as by natural seepages from seafloor hydrocarbon reservoirs. Crude oil is the main source for Polycyclic Aromatic Hydrocarbons (PAHs), a chemical group that is known for its toxic, mutagenic, and carcinogenic effects on marine biota. Thus, chronic oil spills have a continuous and destructive effects that generate an extensive damage to the marine environment. While the locations of the pollution are well known, their effect on a global perspective had not been studied. In this study, we bridge this knowledge gap by developing a quantitative method to evaluate the impact of oil spills on marine ecosystems based on a global data-driven quantitative approach. We analyze the intersections between distribution patterns of oil slicks aggregation areas and marine species native habitat range, and estimate the environmental impact. We use data from scientific literature and official organizations data bases, including International Union for Conservation of Nature (IUCN), AquaMaps.org, ECOTOXicology Knowledgebase (ECOTOX), SeaAroundUs.org and more. This approach considers ecological parameters, such as species richness, conservation status, species-specific sensitivity to PAHs exposure and trophic level. Our preliminary results highlight the Indo-Pacific region and the red sea as hotspots for environmental impacts of oil spills on the marine environment. Our approach leads the way to better understanding of the true impacts of hydrocarbon pollution on a global scale, that, in turn, can support sustainable management and protection of marine and coastal environments.

Marine Bioblitz: Biological monitoring of marine nature reserves in the Israeli Mediterranean Sea

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Marine ecosystems are facing increasing anthropogenic pressures, and as a result marine nature reserves are becoming more important for conservation. Reserves also facilitate the rehabilitation of commercial fish populations. This work presents the results of ongoing biological monitoring of Israeli marine reserves in comparison to control areas. Underwater visual surveys were conducted between 2015 and 2023 to quantitatively characterize fish and benthos communities of rocky habitats in and outside the reserves. Fish biomass and abundances of large individuals and commercial specimens were higher within Rosh Hanikra-Achziv – the oldest, largest, and longest-enforced reserve, compared to its control area. Over the years, a clear increase in the abundance and biomass of groupers - predatory and highly commercial species - was also observed in other reserves. Specimens of the grouper *Epinephelus marginatus* reached breeding size only inside Rosh Hanikra-Achziv reserve. Benthos surveys produced updated inventory lists of algae and invertebrates. Algae covered 40%-90% of the rocky bottom. The most abundant invertebrate taxa were sponges (only native species), bryozoans, and bivalves (only invasive species). The effect of the reserves and the observed differences in the structure of fish and benthic communities between sites, depths, and seasons highlight the need for sufficiently large and well-managed marine reserves along the entire depth and north-to-south gradients.

Post-larval processes reduce the diversity of coral reef fish communities

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Understanding how marine diversity is maintained is critical for determining its trajectory under future threats. In coastal marine communities, dispersal generally occurs during the larval phase. Therefore, adult diversity is the outcome of both larval supply and post-larval processes that may affect species differently. However, the difficulties in obtaining species-level abundance estimates of marine larvae have thus far precluded comparisons of diversity across life stages, severely limiting our knowledge of how adult diversity is maintained. Here, we used a novel dataset of species-level larval abundances of Red Sea coral reef fishes, featuring 4,120 individual larvae from 194 species, and compared their diversity to that of the adults. Adult abundances were positively associated with larval abundances and a planktivorous diet but negatively correlated with adult body size. Concomitantly, the larval community was more even than the adult community, and the adult community was significantly less even than expected under random structuring processes. Taken together, our results illustrate that while larval supply holds an important role in determining adult diversity, post-larval processes increase the numerical dominance of particular species. We show the effects of community-wide post-larval processes for the first time and demonstrate that they act to decrease the diversity of adult coral reef fish, elucidating the ecological bottlenecks linking larvae and adults.

Air water interactions along the Dead Sea rift

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Rifts, tectonic depressions, stretches along continents and typically collect a wide variety of waterbodies, including wetlands, lakes, terminal lakes and locked seas. Here we exploit the waterbodies along the Dead Sea Rift, which vary by geo-climatic settings (from humid Mediterranean to hyper-arid), water depth, water salinity, etc., by simultaneously measuring surface heat, gas and momentum fluxes using Eddy Covariance towers. These waterbodies are subjected to similar radiative forcing. We show that in the two desert waterbodies differ significantly by surface heat flux partitioning: In the Gulf of Eilat (extension of the Red Sea), the evaporation rate is three times larger than in the Dead Sea (a hypersaline terminal lake), this is due to the effect of water salinity in reducing water vapor pressure. In the two northern waters (Lake Kinneret and Agmon Hula), which resides in the more humid, Mediterranean region, the evaporation rate is suppressed by humidity, in comparison to the Gulf of Eilat. These two waterbodies differ by their depth, which determines the dynamics of evaporation, surface heat fluxes and thermoregulation. We analyze the role of the timing of the Mediterranean Sea Breeze on evaporation rate. This observational setup, of concurrent measurements of air-water interactions along the gradients within the Dead Sea Rift provides a rare opportunity to quantify various aspects of water management policies, the formation of rocks within these waterbodies, the effect of local micrometeorology and synoptic scale circulation on the waterbodies and their surroundings.

The Dead Sea sinkhole pools: a source of microbial diversity in an extreme environment

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The continuous desiccation of the Dead Sea has created thousands of sinkholes along the declining shoreline. The color, size, and salinity level of the sinkholes vary significantly, which generates a unique forever changing aquatic habitat. This unique environment provides an ideal setup for studying microbe adaptation to a changing environment at the molecular level. In this study, we aim to identify the specific abiotic factors that affect the dynamics of microbial communities via metagenomic analyses. To achieve this goal, we seasonally sampled eleven sinkholes near Ein Gedi, and performed chemical and metagenomic analyses on the water samples. The chemical composition of the sinkholes, as well as the density of water in the sinkholes, differed between pools and significantly changed throughout the year. Furthermore, the area of the sinkholes was continuously altering, and the density correlated with the sinkhole surface area. Metagenomic data showed that the microbial communities in the sinkholes are composed of various bacteria, archaea, and eukaryotic microorganisms, as well as DNA and RNA viruses. The most abundant archaeal group in the sinkholes is Halobacteriota, and the most abundant bacterial group is Proteobacteria. A clear annual cycle was observed, in which archaea groups were more prevalent in the summer and bacteria groups were more prevalent in the winter. Preliminary data also suggest that the distribution of cyanobacteria and cyanophages is limited by salinity levels. These results demonstrate that the sinkholes are a unique habitat containing various microbial communities affected by the level of salinity.

Can deep-sea settled plastic litter be resuspended? The investigation of the seafloor plastic bags from Eastern Mediterranean

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Plastics have become one of the most serious pollutants in the aquatic environment, as well as the Levantine Basin, in which plastic litter has been ubiquitously found on the seabed. The major mechanisms that drive the spatial distribution and long-term settlement of marine plastics is still under debate. Although many studies have assumed that biofilms are the prevailing factor that changes the buoyancy of the light polymer that plastic litter consist of, little is known about the part it plays in driving the transportation of this kind of waste in the highly oligotrophic area of the Eastern Mediterranean. In order to better understand the adhesion features of the bottom litter, we measured the weight of the organic and mineral tissue adhered on seabed plastic bags which were collected as part of the National Monitoring Program, and tested bags' net-buoyancy. The results show that about 32% of bottom litter from the continental-shelf (80 and 200m depth) was associated with macro-biota, while over 95% of those from the continental-margin (500m depth) and deep-sea (1100 and 1300m depth) were only covered by thin biofilms. With this low level of adhesion, around 50% of deep-sea bags could float again in the seawater buoyancy-test during the cruise. Thus, it is suggested that plastic bags settled on the deep-sea basement is possibly connected to sediment, and they could be resuspended by bottom turbidity currents and further redispersed into the basin. This study paved way for understanding the transportation trajectory of bottom plastics in the Eastern Mediterranean.

Tracking photosynthesis on multiple time scales using a combined set of an optical bench and a quadrupole mass spectrometer

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Photosynthesis is a critical step in biomass production of aquatic microorganisms. It is comprised out of several different mechanisms operating along a diel cycle. During the day, light energy is absorbed by photosynthetic units which excite electrons through photochemistry and use them to synthesize reducing equivalents and energetic rich compounds. These compounds will be used in carbon dioxide assimilation into precursors of sugars. In the dark, the precursors will be synthesized into carbohydrates and glycogen through the gluconeogenesis pathway. In order to understand photosynthesis kinetics, and especially the light dependent reactions, a simultaneous inspection of biochemical processes in various time scales is required. Photochemistry occurs on timescales of microseconds; electron transport, energy rich molecules synthesis on the scales of seconds, and carbon assimilation on scale of minutes to hours. It is possible to track the majority of these processes in-vivo with non-invasive techniques such as gas exchange measurements and absorption spectrophotometry. A combined system with a quadrupole mass spectrometer and an optical bench spectrophotometer/fluorometer has been constructed and is designed to sense low densities of photosynthetic microorganisms and low concentration of dissolved gasses in-situ. One example for use of such a system is to interpret the ecophysiology of Harmful Algal Blooms (HABs). Cyanobacteria is a nuisance in freshwater bodies, deteriorating water quality and threat human health with toxic metabolites. The major reasons for a bloom generation are warm water temperatures and access to essential nutrients. The combined gas exchange/spectrophotometer system holds a great promise in generating a mechanistic model towards understanding the physiology of cyanobacteria. It can shed a light on the resilience of its photosynthetic apparatus to environmental stress, and to elucidate on its advantage to bloom on the expense of other phytoplankton groups. It can therefore provide a deep explanation to photosynthesis physiology of cyanobacteria in a larger context of natural environmental conditions and fresh water ecology.

Molecular insights into the chemosynthetic microbiome of Levana Cave (Ayyalon cave system)

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Levana Cave is a part of the Ayyalon cave system located near Ramla, Israel. These caves sustain an aquatic chemosynthetic ecosystem fueled by oxidation of hydrogen sulfide. Initial microscopic observations demonstrated a diverse bacterial assemblage, including filamentous sulfur oxidizers similar to Beggiatoa. We investigated the Levana prokaryotic community using amplicon sequencing of the 16S rRNA gene. The taxonomic novelty of the Levana Cave prokaryotes was substantial, as the average top-hit identity for the biofilm and sediment bacterial operational taxonomic units (OTUs) was 92% and 89%, respectively, and only 80% for archaea. Bacteria were more abundant but less diverse in the biofilm than in the sediments. Sulfur-oxidizing bacteria, Thiobacillus, Thiothrix (filamentous bacterium related to Beggiatoa), and Thiovirga, encompassed up to 80% of amplicons. In the sediment, the most abundant OTUs (22% amplicons) were weakly related to Arcobacter. The putative sulfur oxidizers were less abundant and accounted for up to 5% of amplicons. Four other OTUs related to Nitrosomonadales (4.5% amplicons) were found only in sediment. The fourth-most abundant OTU (2.5% amplicons) had as low as 89% identity to the sequence of the sulfate-reducing thermophilic bacterium Thermodesulfovibrio. 3% of amplicons belonged to nitrite-oxidizer Nitrospira, which can fix inorganic carbon and consume organic molecules. Archaeal sequences were found exclusively in the sediment sample and comprised 27 OTUs. The putative ammonia oxidizers Nitrosopumilus and Nitrososphaera encompassed together 75% of archaeal and 1.5% of prokaryotic amplicons overall. These results lay a foundation to a deeper meta-omics study of the functional repertoire of the Levana microbes and bacteria-facilitated processes in the aquifer.

Pore-water geochemistry of the Cape Fear mass transport deposit

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Submarine mass transport deposits (MTDs) are subaqueous slides of unconsolidated sediment produced after slope failure. Such is the Cape Fear MTD, a complex of several MTDs that occurred throughout the geological past, located near the eastern coast of the United States. A cruise to the Cape Fear MTD, aimed at studying the formation of MTDs and their effects on margin morphology was conducted in June, included seismological and geochemical data collection. Studying pore water biogeochemistry, in this case, allows for a better understanding of diagenetic processes, marine surface-water interface and may reveal any special geochemical properties MTDs might yield. Expanding the typical foci from sulfate and methane or major elements, we include an extensive analysis of pore water extracted from nine cores at different locations of the Cape Fear MTD. We measured total alkalinity (TA), dissolved inorganic carbon (DIC), nutrients, and major and trace elements. Preliminary results show some defined trends for various locations around the MTD. For example, a decrease in Cl/Br ratio from 683 to 782 in one location, and 683 to 720 in another, suggesting a possible effect of the salt diapers present withing the MTD. Also, TA and DIC increase along with decrease in $SO_4^{(2-)}$,$Ca^{(2+)}$ and Mn, in most locations, indicating a possible saturation of carbonates in the pore water and possibly $Ca(Mn,Mg)CO_3$ precipitation. Saturation in carbonate is not thought to be due to fluid advection but may relate to oxic and post-oxic conditions influenced by biochemical activity, seen through comparing the TA and DIC changes.

Ecotoxicological impacts of desalination plants on corals: how to balance freshwater supply and Coral Reef Conservation?

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Coral reefs are exceptionally diverse marine ecosystems that influence the livelihoods and food security of millions of people in coastal communities. Many arid and semi-arid countries with significant coral reef coverage face severe water scarcity and rely on desalination for freshwater production. However, desalination produces brine effluent, which includes various chemical additives such as coagulants and antiscalants. Brine discharge can pose a threat to coastal environments and especially to benthic fauna and flora. Coagulants, usually based on metal salts, and antiscalants, comprised of polyphosphonates or polymer-based materials, are commonly released with the brine. Considering the geographical overlapping of reefs and water-stressed countries, it is crucial to determine the ecotoxicological effects of brine and related additives on corals. This study evaluated the impacts of coagulants (Al- and Fe-based) and antiscalants (polymer- and polyphosphonate-based) on corals. While the coagulants did not significantly affect the corals' physiology, polyphosphonate-based antiscalant induced enhanced bacteria abundance and oxidative stress in the hard coral *Montipora capricornis* and the soft coral *Xenia umbellata*, while the soft coral *Litophyton* sp was more sensitive to polymer-based antiscalant. Our results suggest that mechanisms of oxidative stress and microbiome alterations could be harnessed as biomarkers of brine exposure. We stress that it is imperative to select coagulants and antiscalants with minimal impact on the receiving environment, while reducing the concentrations of these additives to minimize the environmental footprint of desalination plants on coral reefs.

A molecular investigation of Xeniid pulsation: Coral behavior mechanisms revealed through regeneration

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The unique, hypnotic pulsation of xeniid corals has fascinated scientists since Lamarck. However, the neural mechanism of repetitive pulsation in these animals, likely to be controlled by a pacemaker, has never been investigated. As such, *Xenia umbellata*, a fast-growing Red Sea octocoral, was developed as a laboratory model to explore the mechanism of pulsation in xeniid octocorals. Our recent study has revealed that this organism possesses rapid regenerative abilities. During oral disc regeneration, the pulsation behavior develops in stages, indicating stepwise regeneration of the pacemaker. By utilizing this feature of behavior development throughout regeneration, we set out to reveal aspects of how *X. umbellate* performs this unique behavior. Using transcriptomic and immunohistochemical analysis, we have explored the molecular mechanism of pulsation, as well as the structural development of the neuromuscular system. Using differential expression analyses, candidate ion channels, neurotransmitters, and transcription factors were identified that correlate with the development of pulsation behavior, and the likely location of the pacemaking unit was identified. Our research should open the door to a deeper understanding of pacemaker functioning in these intriguing corals.

Comparative analysis of epiphytic bacterial communities across the seaweed phyla. insights from the Mediterranean Sea, Israel

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The relationships between epiphytic bacteria and marine macroalgae (seaweeds) are intricate and complex. However, knowledge about the community structure, interactions, and functions of these epiphytic bacteria is still limited. This study aimed to shed light on these relationships by describing and interpreting the associations between epiphytic prokaryotes and seaweeds from the rocky intertidal site in the Levantine Basin, the Mediterranean Sea. We analyzed the communities hosted by 29 seaweed, from all three seaweed phyla (Chlorophyta, Rhodophyta and Ochrophyta - Phaeophyceae). The 16S rRNA gene amplicon sequencing revealed that microbial communities were often were often specific to host. Niche breadth index analysis highlighted that high taxonomic ranks showcase unique affinities and a potential specialization for seaweed host phyla (39% specialists), whereas some generalists were found (13%). Function predictions with Tax4fun2 indicated uniform functionality among the epiphytes, despite the marked taxonomic variability, implying resilience to disturbance based on functional redundancy. Ultimately, this study concludes that the epiphytic bacteria associated with seaweed are highly influenced by host taxonomy, potentially due to shared morphological attributes among genetically closer members and/or the potential coevolution of specific strains alongside the seaweed hosts.

Mining social media for vital Elasmobranch information in data-poor regions and conflict zones: The Gaza Strip as a case study

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A huge gap in environmental information exists in conflict regions where access to scientists ranges from unsafe to impossible. Previously unknown knowledge of Elasmobranchii presence, composition, and distribution can provide valuable fisheries information regarding the exploitation of elasmobranch species and for creating comprehensive conservation strategies. However, the diversity, ecology, behavior, and many other characteristics of these species in conflict zones remain virtually unknown, which is a major cause for concern. Traditional species assessments rely on in-situ observations, market surveys, and regulatory authorities forcing fisheries to self-report their catch. Conflict areas present a unique challenge, lacking formal regulation or scientific access. Here, we report the first use of social media monitoring for the extent of the Elasmobranch fishery in the Gaza Strip (east Mediterranean), a conflict region previously lacking any information. Our database consists of 3 years of daily reported catch from 16 fish stores and social media fishery-related influencers in the Gaza Strip. We collected 1530 data points belonging to 4619 individuals of 20 species. The analysis of the data sheds light on previously unknown temporal, spatial, and seasonal trends in elasmobranch catch distribution and relations to changes in the access to maritime areas due to local conflict escalations. We demonstrate this approach as a relatively accurate and inexpensive data mining procedure, allowing the quantification and normalization of multiple observations of caught and targeted fish into a uniformed geo-spatial-temporal system- making it a prime candidate for future endeavours in other data-poor regions and conflict zones in coastal areas.

Ecological insights into the resilience of marine plastisphere throughout a storm disturbance

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Research about marine plastisphere (the community living on the surface of plastic debris) paid little attention to the ecological mechanisms governing prokaryotes versus eukaryotes, and even less to their resilience under extreme conditions. Our research elucidated the community succession, ecological mechanisms governing the assembly, and resilience to environmental perturbations of different kingdoms in the plastisphere. We examined the succession of the prokaryotic and eukaryotic communities on artificial plastic nets in the seawater from the Gulf of Aqaba over 35 days. A robust local storm revealed the alterations and recovery of the communities before, during, and after this disturbance. Data from 16S and 18S rRNA sequencing and microscopic analyses decrypted the plastisphere diversity, community assembly, and stochasticity, followed by further analyses of functional and co-occurrence networks for the prokaryotic group. Prokaryotic and eukaryotic communities underwent exact opposite ecological mechanisms. While determinism driven by a robust environmental selection dictated the prokaryotic community assembly, stochasticity prevailed when this condition was relaxed. Interestingly, resilience against disturbance was observed in prokaryotes but not in eukaryotes. The decrease in compositional, functional diversity and network complexity in the prokaryotic community was reversed, presumably due to the niche specification and high dispersal. Niche specification following perturbation was evident in some bacteria by selected functions associated with plastic degradation, stress response, and antibiotic resistance. Contrarily, eukaryotes decreased in diversity and were dominated by the commonly found Chlorophyta towards the later successional period. Novel findings on marine plastisphere during perturbation encourage the integration of this aspect into prediction research.

First steps in exploring fish larval development in the Levantine deep-sea

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Little is known about the biota of the deeper part of our oceans due to its inaccessible location and harsh conditions. This study aims to overtake these limitations by obtaining knowledge on the larval development of deep-sea fishes that utilize the upper surface layer for their dispersal and early life development. During December 2022, fish eggs were collected from the offshore surface layer of the Israeli Mediterranean Sea above bottoms of 1000-1300 m and using horizontal hauls of Manta net, 300 µm mesh. The fish eggs were taken to the laboratory and were documented and measured every nine hours. Images were used to create an ongoing database, and growth rate comparisons were made for the different specimens. After mortality, each egg's DNA was extracted separately, and its barcoding gene (COI) was amplified to obtain species-level taxonomic identification. The final results were based on 17 of the 29 collected fish eggs with reliable matches of three species: *Brama brama* (11 eggs), *Polyprion americanus* (4 eggs), and *Chauliodus sloani* (2 eggs). This study's preliminary results regarding spawning seasonality, egg morphology, and lecitotrophic larval development of these three cryptic and rare species are undoubtedly novel. This promising potential for investigating the early life history of deep-sea fishes will be further pursued during this study, with an overarching goal to improve our knowledge of this less-explored oceanic zone.

The uninvited hitchhiker - *Styela plicata* seasonal reproduction and distribution along the Israeli Mediterranean coasts

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Colonial and solitary invasive ascidians (Chordata, Ascidiacea) are gathering attention due to their negative impact on coastal environments. The solitary ascidian *Styela plicata* was first observed along the coasts of Israel 2014. It is considered cosmopolitan with an unknown origin and is known for its ability to create large aggregations on marine infrastructure. To investigate the life cycle of *S. plicata* along the Mediterranean coast of Israel, we examined the seasonal reproduction patterns and population structure of three populations over two years. Each season, I measured individuals in the field, prepared samples for histology, and monitored oocyte release under laboratory conditions. Furthermore, spatial surveys were conducted at 30 sites along the coast. Differences in reproduction patterns were found between seasons and sites, with high reproductive outputs observed during the winter for all sites. *S. plicata* is currently restricted to marinas and ports, and has an impressive ability to survive the extreme environmental conditions that characterize the Mediterranean coast of Israel with salinity of 40 ppt and sea surface temperature reaching 33 ˚C. Such data is important to provide reliable predictions regarding *S. plicata*'s potential to spread to additional regions, and to provide essential data for its mitigation and control.

Thermal vulnerability and ecological impacts of the sea urchin *Diadema setosum* Invasion on the Israeli Mediterranean rocky reef

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Climate change and bioinvasions are major drivers of ecosystem change, and the Israeli Mediterranean coast is a hotspot of both. The biodiversity on Israeli rocky reefs has been severely transformed by these processes with increasing loss of native species and gain of thermophilic alien ones. Recently, an invasive Indo-Pacific urchin, *Diadema setosum*, has become abundant along the Israeli coast. Our study aims to quantify the distribution of Diadema, define its thermal tolerance to seawater temperatures, and assess its grazing rate. While our surveys have revealed clustered populations of tens of individuals in some locations, we cannot yet conclude they are highly abundant. To evaluate the urchin's thermal vulnerability, temperature performance experiments were conducted at the IOLR flowthrough indoor mesocosm structure over a 15-36°C temperature range. Oxygen consumption and food assimilation by the urchins were used as proxies for stress levels caused by temperature, while the Gonad-Somatic Index (GSI) was calculated to assess impact on reproduction potential. We found an increase in oxygen consumption when measured after 7-day exposure. Incubation at day 14 reveals some recovery, suggesting a potential acclimation capacity. In a summer grazing rate experiment performed in an outdoor flowthrough mesocosm system, boulders covered with turf were exposed to two *D. setosum* density levels and two temperature levels. Boulders with higher density level at current summer temperatures treatment were completely grazed after one month. These results indicate that the tropical invasive urchin is resilient to future climate warming and has the potential for high impact on the reef community.

The national monitoring program of Israel's southeastern Mediterranean seawater: Goals and scientific perspectives

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The rational and objectives of the National Monitoring Program (NMP) of Israel's Mediterranean water, performed by the IOLR, is designed based on: 1) the Ecosystem Approach (EcAp) for Good Environmental Status (GES) of the Mediterranean Sea based on Ecological Objectives and indicators (in line with the EU Marine Strategy Framework Directive, MSFD), 2) Climate Change indicators and 3) Operational oceanography measures regarding environmental risks. It is funded by the ministries of 'Environmental Protection' and 'Energy and Infrastructure' by virtue of a governmental decision in December 2018, but was, de facto, initiated and operated decades earlier. The program was developed over time in terms of its methodologies, sampling efforts, spatial coverage and food web scales. The NPM cover a large spatial area (~24,000 km2) of different habitats: the littoral, continental shelf, slope, bathyal, atmosphere, river estuaries, benthic and pelagic. It also addresses the potential impacts of land-based sources or marine infrastructures on the marine environment. To this end, the NMP covers large temporal scales (several orders of magnitude) and implement diverse monitoring methodologies and infrastructures (e.g., from molecular to remotely operated vehicles and research vessels) and complex logistics. It is a dynamic program that adapt current needs and revised methodologies. The annual scientific reports include five main volumes that are being reviewed by representatives from the Israeli academy (Climate Change and Hydrography; Marine Pollution; Biodiversity; Marine Litter; Sedimentology). Data is reported to the Israel Marine Data Centre (https://isramar.ocean.org.il/isramar2009/) and UNEP/MAP Secretariat/MED POL Programme database and is mostly available to academic purposes.
In this session, we will present the main rational of the NMP in Israel's Mediterranean water, highlight several key insights that were drown from it in recent years, and discuss some of its further needs.

Impact of combined seawater warming and triazine-type herbicide pollution on the physiology and potential toxicity of the dinoflagellate *Alexandrium minutum*

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Coastal phytoplankton communities are often exposed to multiple anthropogenic stressors simultaneously. Here, we experimentally examined how temperature increase (20-26 °C) and triazine-type herbicides pollution (500 ng terbutryn L-1), both recognized as emerging stressors, affect the abundance, physiology and selected saxitoxin gene expression in the toxic dinoflagellate *Alexandrium minutum*. The results show that A. minutum is more susceptible to terbutryn pollution with increasing temperatures, resulting in a significant decline in its abundance (~80%) and photosynthetic activity (~40%), while saxitoxin gene expression increased (1.5-2.5-fold). This suggests that in warming polluted coastal areas where *A. minutum* is often found, saxitoxin poisoning may occur even in the absence of a massive bloom. Our results recommend the development of science-based monitoring practices for algal dissolved toxins in coastal waters and estuaries, supporting environmental policies under warming and contaminated coastal regions.

Mitochondrial DNA content decreases from larvae to adulthood

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Most molecular biomarkers and methods used to evaluate aging (e.g., telomere length), are laborious, have low throughput, and yield conflicting results regarding coral aging. Recent studies have revealed declining mitochondrial DNA copy numbers (mtDNA-CN) with chronological age in mice, fish and humans. The specific mechanism controlling this decline remain largely unknown, although age-related decline in mitochondrial function has long been considered a hallmark of aging considering mitochondria vital role in energy production. We explored the potential of mtDNA-CN as a biomarker for aging and health in a fast growing, presumably 'short-lived' scleractinian coral—*Stylophora pistillata*. Mitochondrial DNA was quantified across *S. pistillata* age groups and from colony center to periphery. We designed a TaqMan assay specific for *S. pistillata* mitochondrial and nuclear genes, which allowed absolute quantification of mtDNA-CN per cell using droplet digital PCR (Bio-Rad). We found the highest mtDNA content in *S. pistillata* larvae, followed by week-old settled individuals (spats), and adult colonies. The colony periphery (growing branch tips) and spats were not significantly different, while the oldest area of the colony, near the center, had the lowest number of mtDNA-CN per cell. We did not find a significant effect of colony size on mtDNA content at the colony periphery or center. These findings assert expected differences in energy demands within the colony and across age groups: actively swimming larvae have high energy demand, and spats and colony edges experience high cell proliferation accompanied by mitochondrial proliferation, compared to the center of the colony.

Chemosynthetic symbionts of deep-sea clams in the Eastern Mediterranean cold seeps are metabolically versatile

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Symbioses between invertebrates and microbes hallmark chemosynthetic marine ecosystems, such as deep-sea gas seeps. Most host groups are typically found in either shallow or deep waters, but lucinid clams (Lucinidae) are found in both environments, often hosting genetically similar Ca. Thiodiazotropha symbionts (Gammaproteobacteria, Chromatiales, Sedimenticolaceae). These symbionts display a large arsenal of metabolic functions, including carbon fixation using the energy of hydrogen sulfide (H_2S) oxidation, but they can also oxidize organic substrates such as formate and methanol to gain energy. Only shallow-water Thiodiazotropha is known to fix dinitrogen. The interplay between these functions is not fully understood. We thus collected Lucinoma kazani hosts from the brine pool habitat at the Palmahim disturbance, at a depth of 1150 m, and assembled high-quality symbiont genomes using both the long Oxford Nanopore and short Illumina reads, assessed transcriptome, and proteomes, to better understand the metabolic potential of these organisms. For the first time, we observed the presence of the gene cluster needed for diazotrophy in deep-sea symbionts, however, it was not expressed, suggesting that N_2 fixation may be inactive and rudimentary. We detected high expression of genes needed to gain energy from sulfur oxidation, crucial in this chemosynthetic environment. Pathways for methanol and formate usage were expressed, indicating a broad range of substrates for energy conservation. Our findings highlight the key traits these microbes maintain to support the nutrition of their hosts.

Mitigating climate change impacts on Lake Kinneret ecology

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Lake management actions are required to restore and conserve a lake ecosystem that is being threatened by climate change and anthropogenic pressures. Increased air temperatures, reduced precipitation and nutrient loading are anticipated to induce cyanobacteria blooms. As some cyanobacteria species might produce toxins, their bloom can endanger lake ecosystem services. The ecosystem of the sub-tropical Lake Kinneret is undergoing such changes and simulations project that these changes will continue to affect the phytoplankton species composition, endangering lake ecosystem services. Following five consecutive drought years, lake level dropped, and the Israeli Water Authority launched a project to introduce desalinated water from the Mediterranean Sea into the lake. This presents a number of unique management alternatives. In this study, using lake models, we examined a number of management options under climate change. The alternatives included were: (1) changes in management of the basin, (2) introduction of desalinated water into the lake, (3) increasing the flow of the Joran River into the lake by delivering the desalinated water to a point further north in the watershed, (4) hypolimnetic withdrawal of water from the lake, and (5) maintaining the lake at low versus high level. To account for prediction uncertainty we utilized an ensemble of two 1D hydrodynamic-biogeochemical lake models along with 500 realizations of meteorological conditions as forcing data. Results suggest that introducing more natural waters through the Jordan River, and thus increasing nutrient flow, is a viable management option that may counteract climate change effects. However, these results are accompanied by considerable uncertainty and the models do not account for possible impacts of spatial heterogeneity in the lake.

14 years of Mediterranean rocky reefs ecological monitoring: trends, surprises and lessons learned

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To both capture the natural variability in space and time and the allow detection of human-mediated impacts on the marine environment, long-term time series of ecological and environmental data across several sites and spatial scales are required. Anecdotal surveys and observations have shown that Israeli rocky reefs have gone through dramatic ecological alterations already during the 1980-90s but consistent monitoring of the ecosystem began only in 2009 by IOLR, focusing first on the intertidal vermetid reefs and then also on shallow reefs. Monitoring includes seasonal ecological surveys in four core sites, monthly water sampling, and hourly temperature logging. Results show strong seasonally in community structure, with highest diversity during winter-spring indicating that summer may be too thermally stressful for many native species, as confirmed by lab experiments. Inter-annual analysis revealed (1) total and rapid collapse of a dominant invasive mussel, Brachidontes pharaonic, in 2016, and then a slow recovery, (2) short, minute, recovery episodes of the endemic reef-building vermetid, *Dendropona anguliferum*, (3) strong fluctuations in cover of the vermetid *Vermetus triquetus*, and an invasive macroalgae, (4) the appearance of several new invaders such as a large African mussel and a large solitary vermetid snail, and (5) the outbreak of several subtidal habitat-forming macrophytes as well as the lionfish. Vermetid reefs also suffer from prolonged desiccation events that lead to massive macroalgal bleaching and invertebrate mortality. The accumulated evidence suggests that these rocky reefs may be experiencing increasingly warm and unstable environmental conditions due to climate change that are reflected in continuous tropicalization.

Tracing authigenic magnetite precipitation in methanogenic sediments of the Eastern Mediterranean using stable isotope probing

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In a traditional view of organic carbon degradation in sediments, methanogenesis is the terminal process, transforming organic matter to methane. However, in many sites around the world intensive microbial iron reduction was observed in the deep methanogenic sediments. Here, we focus on the potential for authigenic magnetite precipitation during this process. In a study site in the Eastern Mediterranean, 20 km east of Acre offshore at a water depth of 90 m, an association was found between geochemical profiles and magnetic parameters, suggesting authigenic magnetite formation in these sediments. In the current study we test this suggestion using a geochemical approach. This is by performing incubation experiments with these sediments, and Yarkon Estuary sediments, with labelled iron oxides and following their reduction and precipitation as magnetite. Preliminary results suggest authigenic magnetite precipitation, but further work is needed to quantify its significance. The results have implications for better understanding of diagenetic processes in sediments and the use of marine sediment in paleomagnetic dating.

Sea urchin mass mortality in the Red Sea and Western Indian Ocean

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Echinoderms are characterized by boom-and-bust fluctuations, where extreme population declines may be regarded as mass mortality events (MME). Major die-offs of echinoid populations may lead to large-scale algal outbreaks as these key herbivores are removed. On coral reefs, algae proliferation may lead to coral degradation, as the fast growth rate of algae outcompetes that of corals. Here, we report a regional-scale MME of *Diadematidae* echinoids in the Red Sea and Western Indian Ocean – *Diadema setosum, Echinothrix calamaris* and *Echinothrix diadema*. Starting January 2023, we observed a significant decline of up to 100% in these species' populations in the Northern Gulf of Aqaba (GoA). Additional mortalities were later observed on the coasts of Egypt, and as far south as the Gulf of Oman. In July 2023 mass mortalities of *Echinothrix diadema* were first observed off Reunion Island in the Western Indian Ocean, exhibiting the same pathologies as the Red Sea mortalities. Mass mortalities of diadematoids were also observed in land-based recirculating seawater systems, suggesting a water-born agent as the cause of mortalities. Moreover, symptoms characterizing moribund individuals were highly similar to those documented in the Caribbean *D. antillarum* 2022 MME, caused by a waterborne scuticociliate pathogen. Molecular evidence from the Red Sea mortalities imply that the current MME is potentially caused by the same waterborne pathogen. The collapse of diadematoids as a major grazing force may lead to a severe, regional-scale phase-shift from a coral-dominated reef to an algae-dominated system, threatening coral communities on unprecedented scales.

Predicting benthic litter zones and sources in marine protected areas

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Marine Protected Areas (MPAs) are globally recognized as exceptional tools of biodiversity conservation and habitat preservation. This form of protection, however, does not constitute a barrier against other impactful pressures arising from within and beyond their boundaries, like the growing issue of marine anthropogenic debris. Highlighting the susceptibility of MPAs as legislative instruments to this ecological threat is imperative for urgent regulatory action. In this study, underwater SCUBA transect surveys were conducted during the summer of 2020 at the Cape Greco MPA in Cyprus, to record benthic anthropogenic debris at 45 sites encompassing various depth, slope, habitat, recreational activity and MPA zone gradients. A combination of Geographical Information System (GIS) and statistical modeling techniques were then applied to predict the most plausible drivers and sources of benthic debris' spatial distribution. The benthic litter distribution was predicted to form hotspots in shallow waters along the eastern section of the MPA, where recreational activities are most pronounced. The study's results highlight the need for MPA management strategies to enhance regulation of human activities beyond current extractive (fishing) practices. This includes stringent enforcement of anti-pollution measures, so that environmental, societal, and cultural goals of MPAs may be achieved.

The potential of the Sea of Galilee (Israel) algae to serve as a new source for microbial pesticide

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Our study explores the potential of compounds and extracts isolated from Lake Kinneret algae to combat two significant plant pathogens: *Clavibacter michiganensis*, the causal agent of tomato bacterial canker, and *Plasmopara viticola*, the causal agent of grape downy mildew disease. Algal isolates were obtained from the Israeli National Culture Collection (INCCA, The Kinneret Laboratory, IOLR) and were cultivated under controlled conditions. Algal biomass was extracted using organic solvents. Subsequently, the crude extracts were tested against the pathogens to determine the minimal inhibitory concentrations (MICs). The crude extract of the green algae M1, which demonstrated the lowest MICs of 100 ppm and 10 ppm against *C. michiganensis* and *P. viticola*, was selected for further investigation. This encompassed flash column fractionation and metabolite identification using LC-MS/MS, employing *C. michiganensis* as the model organism for bio-assay guided fractionation. The identified commercially available compounds (names are confidential) did not exhibit a strong inhibition against *C. michiganensis*. However, they demonstrated significant inhibition of *P. viticola* zoospores at 25-50 ppm. When sprayed onto grapevines to assess their potential as protective pesticides, these compounds achieved up to 80% inhibition of downy mildew disease in both seedling experiments and field trials.

Israel's monitoring program at the Gulf of Eilat, questions revealed by data

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Israel's monitoring program at Eilat collects data on a regular schedule since 2004. This stability and longevity stems from enduring support of the Ministry for Environmental Protection and results in a coherent database that is hard to achieve with more common research funding options. It is a data-driven program, which means we collect as much data as we are able regarding as many habitats and processes as we can. The data is then processed into time-series that are examined individually or in tandem with other data to form an expanding and evolving tapestry of the interwoven processes and conditions in the Gulf. Data-driven programs are relatively rare in the academic world but have significant advantages to decision makers, and greatly support question-driven research. The rationale is that when questions are known, there is often a way to get answers. But, how can we know we have a complete picture and how can we address the questions we are not – yet – aware of? Only when we know SOMETHING can we begin to investigate and study it. That is, perhaps, the unique role of long-lasting wide-range collection schemes, i.e., monitoring programs. While the program itself is based on accumulated knowledge from many decades of earlier research in Eilat, it now provides the up-to-date status report on what we think we know. Furthermore, looking at changes over time, scaling up to two decades of regularly collected data, illuminates some of the knowledge gaps that we face. Below are three questions that will demonstrate this: 1) Does recruitment limit coral cover in Eilat's monitored reef sites? 2) What is the greater concern – higher summer sea surface temperatures or warmer winters? 3) How will changes in the frequency of deep vertical mixing affect primary production and algae growth? There are other questions we know of, and we know there are many questions we are not aware of. So, I invite anyone and everyone to make use of the data we collect and apply your brainpower and expertise and make this collaborative effort.

All female crayfish for sustainable biocontrol

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Snail control in aquaculture and control of snail vectors implicated in animal and human diseases are global challenges. Potential biocontrol agents could be species of crayfish, which are known to be voracious predators of snails. However, at present, the use of crayfish as biocontrol agents is limited due to their invasive nature. A promising candidate biocontrol agent is the Australian redclaw crayfish, *Cherax quadricarinatus*, a key species in the aquaculture industry. However, the downside of using this species for biocontrol is that *C. quadricarinatus* aquaculture escapees – being highly robust, fast growing, and ferocious omnivores – have become invasive, establishing feral populations around the world. Here we suggest the production of monosex *C. quadricarinatus* populations that open two exciting biotechnology applications—as a possible sustainable solution for snail control and as a means to improve yields and management in crayfish aquaculture, without the inherent danger of establishing invasive populations of aquaculture escapees. *C. quadricarinatus* was tested as a snail eradicator, with females having superior efficiency in snails predation. Thus, setting possible advantage for developing economically feasible and non-labor-intensive biotechnology for the production of all-female *C. quadricarinatus* populations. To this end, we leveraged the naturally occurring intersexuality in *C. quadricarinatus* populations to produce female-biased populations. Females bearing only the W sex chromosome isolated from such populations using W and Z-specific genomic markers were found to be reproductive when bred with WZ intersexuals. Resulting in 100% female progenies (including 50% WW females) establishes all-female producing brood stock. Without any genomic intervention, such populations are suggested to be utilized both for sustainable aquaculture and to fight harmful snails damaging aquaculture, agriculture, and human health.

Exploring the transcriptomic basis of algal resistance to lytic viral infection

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Phytoplankton blooms are transient events of exceptionally high primary productivity that play key roles in marine biogeochemical cycles. These blooms are terminated by lytic viruses and yet reoccur annually, suggesting some resistant cells survive the infection. Despite the ecological importance of this host-virus arms race, antiviral mechanisms are understudied in phytoplankton. Here, we used a model system of the ubiquitous bloom-forming algae *Emiliania huxleyi* and its giant virus, *E. huxleyi* virus (EhV), to study these interactions and resistance mechanisms. We created an extensive transcriptomic dataset during a viral infection time course, covering the stages of population demise and the recovery of a resistant subpopulation. Our analysis unveiled prominent transcriptome plasticity in host cells during viral infection and a unique profile of the recovered populations that gained resistance, distinct from their susceptible predecessor. This transcriptional profile is highlighted by the induction of genes with homology to canonical immunity systems conserved in bacteria, plants, and humans, such as Toll-interleukin-1 receptor domains. Next, we tracked the transcriptomic patterns of the resistant cells in a single-cell resolution to understand how resistance emerges in the population. Defining the transcriptomic markers of viral infection and resistance will provide a meaningful tool to assess the dynamics of host response during natural *E. huxleyi* blooms in the ocean and can shed light on how resistance emerges in the population.

Jellyfish-pair method for an in-situ measurement of jellyfish swimming velocity

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Tracking individual jellyfish from a fixed drone provides information about their propagation velocity, which is the sum of the seawater velocity and the jellyfish swimming velocity. Therefore, using a drone to measure the jellyfish swimming velocity requires additional measurements of the water velocity at the time and vicinity of the jellyfish. Obtaining such measurements can be challenging. Potential tools such as acoustic Doppler velocimeter (ADV), acoustic Doppler current profilers (ADCP), and current drifters are difficult to install, release, and operate, especially when the water velocity must be measured near the jellyfish individual. To overcome this obstacle, we developed the jellyfish-pair method. Each jellyfish pair provides a non-intrusive measurement of the horizontal water velocity near the location and time of the jellyfish. The method is based on measuring the horizontal body orientation and the propagation velocity of two jellyfish relative to the drone frame of reference. A vector summation results in an elegant formulation of the horizontal water velocity from which the jellyfish swimming, relative to the water frame of reference, can be calculated. We have tested the accuracy of the method by computer simulations and applied it in-situ on >1100 jellyfish during three campaigns in June and July 2020. We found that the horizontal swimming velocity of Rhopilema nomadica near Haifa Bay is 11 +/- 3.3 cm/s. The new method will be presented, the simulation results will be discussed, and the impact of such swimming velocities will be analyzed.

Not just carbon: biodiversity and carbon credits for restoration of the marine animal forests

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This perspective presents an inventive approach, based on the terrestrial realm, for the restoration and conservation of Marine Animal forests (MAFs). MAFs are characterized by sessile invertebrates (corals, sponges, Bivalves, etc.), forming complex 3-dimensional structures, providing habitat, refuges, and nursery beds for a diverse range of species. These biodiversity hot spots are facing threats from human activities and climate change. Coined “Biodiversity-Carbon credits,” our approach integrates biodiversity enhancement and carbon sequestration, offering a practical and novel solution to address the urgent restoration needs of the MAFs. Emphasizing the pivotal ecological role of MAFs, this perspective underscores the urgency of incorporating these often-overlooked habitats into broader environmental restoration objectives. By merging biodiversity and carbon credits, we introduce a holistic and pragmatic strategy that contributes to the ongoing discussion on sustainable marine restoration. Our proposal aligns with global biodiversity goals, introducing a unified measure that concurrently enhances biodiversity and promotes carbon sequestration within the MAF ecosystems. This integrated strategy not only fills a critical gap in current restoration discourse but also represents an actionable and effective path for MAF restoration. This perspective advocates integrating biodiversity and carbon credits as a practical and transformative approach to MAF restoration. We believe this perspective provides valuable insight, contributing to the global collective efforts for effective marine restoration. The integration of biodiversity and carbon credit is not just a theoretical concept but a practical and urgent necessity, encouraging diverse stakeholders to engage in comprehensive restoration efforts and contribute to a more sustainable marine environment.

Diverse microeukaryotic assemblages inhabit the chemosynthetic ponds of Levana Cave (Ayyalon cave system)

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Levana Cave is a part of the hypogenic Ayyalon cave system located near Ramla, Israel. Hydrogen sulfide is present in high concentrations in Levana Cave ponds (~5 mg L-1), fueling chemosynthetic productivity, which leads to the development of a bacterial biofilm at the pond surface. Whereas some data on the diversity of prokaryotes exists, little is known about microeukaryotes that inhabit this rarely studied habitat. We investigated the Levana Cave eukaryotes using amplicon sequencing of the 18S rRNA gene together with a cultivation-based approach. Eukaryotes were more abundant and diverse in the biofilm than in pond sediments. Amplicon sequencing revealed 75 eukaryotic OTUs from 12 phyla. Ciliates, stramenopiles, and amoebozoans dominated the biofilm community, while fungi prevailed in the sediments. Among microscopic Metazoa, Nematoda and Gastrotricha were detected by metabarcoding and observed in enrichment cultures, while Rotifera were only observed in cultures. By now, we isolated 14 clonal cultures of protists, all from the biofilm. For eight of them, we obtained sequences of the 18S rRNA and/or Cox1 genes. *Uronema* sp. (Ciliata), *Cochliopodium* sp., *Stenamoeba* sp., and *Vannella* sp. (Amoebozoa), *Bicosoeca* sp. (Stramenopiles) are previously undescribed species, with closely related sequences obtained elsewhere. Two stramenopiles and one heterotrophic Cryptophyta strain are at least new genera based on the marker gene phylogeny, without any closely related sequences outside the Ayyalon cave system. These results provide the basis for an in-depth investigation of the role of microeukaryotes in rarely studied terrestrial chemosynthetic habitats, as well as their biogeography and evolution in caves.

Single-cell characterization of coral immune cells

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Stony corals are pivotal for coral reef ecosystems yet are globally threatened with climate change and have drastically decreased in coverage. However, corals of the Red Sea are widely known to have higher tolerances to thermal stress than counterparts in other regions of the world. Due to this, understanding their resiliency and immune mechanisms is essential. Despite the anthropogenic stressors corals worldwide now face, much is still unknown about their innate immune system and how it is being impacted by a changing environment. Regardless of the numerous transcriptomic studies on innate immune responses in corals, little work has been conducted on the cellular level; only recently were immune cells characterized in stony corals. However, doubt still remains on whether these phagocytic cells can truly be classified as immune cells. To address this, single-cell sequencing was used on functionally identified phagocytes in Red Sea-native stony branching coral *Pocillopora damicornis* and revealed corresponding immune gene upregulation upon exposure to various stimulants, as well as multiple subpopulations that align with morphological observations. Beyond toll-like receptor signaling and tumor necrosis factor receptor pathways upregulation, we also showed that these cells are distinct form those undergoing nonspecific dextran-induced pinocytosis, also referred to as cellular drinking. This combined functional and molecular description of stony coral immune cells is the first of its kind and provides novel insight to the coral innate immune system, and a platform by which to study resiliency methods in these Red Sea corals compared to their vulnerable counterparts across the globe.

Cross-shore material exchange by a submesoscale eddy

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Cross-shore material exchange plays significant roles in pollution spread from or to coastlines, as well as in myriad ecological and biogeochemical processes. Mesoscale currents have limited effects on cross-shore material exchange. Submesoscale (<10km size) currents are in principle more capable of cross-shore motion and exchanges, but very limited observational evidence exists of such effects. We report on observations of a submesoscale (7 km radius) cyclonic eddy which has rolled up from a meander of the East Mediterranean boundary current offshore of Israel. The eddy transported with it the high Chlorophyll concentration of the nearshore environment to distances of at least 50 km offshore into the ultra-oligotrophic East Mediterranean Sea. The eddy was targeted, tracked, and measured from multiple observational platforms: satellites, a glider, the Mediterranean Explorer research vessel with various instruments, 25 tracked drifters, an Unmanned Aerial Vehicle, and more, for periods of up to 3 weeks. Based on this dataset, we describe the life cycle of the eddy, processes related to its birth and ultimate demise offshore, and its capacity for offshore material transport.

The planktonic microbiome of a coral reef in the Gulf of Aqaba: diel and seasonal dynamics

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Microbes are integral to reef ecosystems, serving as primary producers, shaping food web interactions, and facilitating nutrient recycling. Although reef organisms influence the biological and chemical conditions in their surrounding water, the diversity and functional role of microbes within these waters remain poorly defined. Our research investigates the diel and seasonal dynamics of microbes in coral reef waters (~1.5m from reef) in the Gulf of Aqaba, with open sea and sandy habitat serving as controls. We use methods including flow cytometry and metabarcoding, targeting all three life domains: Archaea, Bacteria, and Eukaryotes, and analyse contextual biogeochemistry. Initial findings from February 2023 show that DOC concentrations in reef waters averaged 65 µmol C L-1 and exhibited a diel pattern; gradually decreasing between 9pm and 3pm followed by an increase from 3pm to 9pm. In control waters, concentrations reamained stable at 60 µmol C L-1. Heterotrophic eucaryotes were up to 40% more abundant in reef waters, while the density of photoautotrophs was 5-50% lower. Both groups were more abundant during the night. Bacteria counts in control waters were stable at ~3×105 cells mL-1, whereas numbers within reef waters were lower, ranging from 1-3×105 cells mL-1, declining during the day and increasing at night. We also detected a yet unidentified microbial population inhabiting reef waters at densities up to 5 times that seen in control waters. These preliminary findings highlight the unique microbial dynamics of reef waters and emphasize the importance of further exploration to understand the broader implications for the reef ecosystem.

Revising a lost knowledge: ichthyoplankton communities in the Israeli Mediterranean coast

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The general knowledge regarding the diversity and spatiotemporal distribution in the Israeli Mediterranean ichthyoplankton is remarkably scarce, almost absent. To overcome these knowledge gaps, neuston ichthyoplankton have been sampled above the coastal, shelf and bathyal waters of the Eastern Mediterranean coasts of Israel, an oligotrophic basin prone to a continuous invasion of tropical biota. To obtain species-level taxonomy, we used DNA-based methods of molecular identifications at both single species and whole community levels. Our results have uncovered the presence of 137 species which constitutes one third of the total local Osteichthyes fauna, evidencing the significant diversity of neuston ichthyoplankton. In addition, we showed that neuston communities can provide new knowledge regarding the presence of cryptic or rare species, with the ability also to reveal the presence of new non-indigenous species, by documenting fish larvae of three unreported species for the Mediterranean Sea. Last, we posit that ichthyoplankton biomonitoring in surface water layer can complement any traditional fish biodiversity surveys throughout the marine environment.

Statoliths and statocysts of *Rhopilema nomadica* to estimate jellyfish age

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Jellyfish swarms of the invasive scyphomedusa *Rhopilema nomadica* occur along Mediterranean Israeli coasts, in large summer swarms, but also in the winter. Impacts of this species on crucial ecosystem services underlines the need to understand the formation of these swarms and the population dynamics. A key parameter needed to study the medusae is the age of the individuals, and their rate of growth. In this study we studied jellyfish grown in the laboratory and sampled at sea in different seasons and examined the statoliths and statocysts to characterize these jellyfish. Statoliths are biological crystals contained within statocysts in the 8 sensory organs, the rhopalia, situated in the bell. We employed light microscopy and image processing software to count statoliths and to establish statolith sizes and morphological parameters and a scanning electron microscope to increase our resolution. Abundances of statoliths per statocyst, the distribution of shape parameters and statolith size distribution were all found to be good markers for characterization of jellyfish from different seasons. The results indicate that in each season there is a great similarity among jellyfish, but there is a clear difference between the populations sampled in different seasons. The morphological differences between statoliths in spring and those in summer, and the comparison to laboratory-grown jellyfish, suggests a relationship between environmental conditions and statolith morphology. The morphology of the statoliths in the winter lead us to propose that these jellyfish have survived from the previous summer, enabling us to estimate their age.

The use of biomedical tools in marine frontiers: Immunity and stem cell transplantation for corals

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We will present how we transformed human-orientated immunology research into comparative immunology approaches. Focusing on two projects that sprout from Flow Cytometry-based methods to separate and sort coral cells. The first project will describe our cellular and functional characterization of coral and anemone immune cells, focusing on the phagocytic cell population. We demonstrate that corals and anemones have immune phagocytic cells, which are different from digestive and pinocytosis cells. Moreover, our data demonstrate that immune activity is upregulated in heat stress. With the increase in temperature, there was a simultaneous increase in phagocytic activity. Suggesting the immune system at the base of the bleaching effect. The second project is the development of stem cell transplantation for Hexacorallians. Our aim is to develop the transformation of resilience through stem cell therapy, using stem cell transplantation. We currently succeed in *Nematostella vectensis* as a model for corals because it has transgenic lines that we can follow upon transplantation in live animals. Using this, we could follow in vivo mCherry-positive cells in transplanted animals for up to 2 months. Using confocal microscopy and flow cytometry, we showed the integration and proliferation of the transplanted cells into the tissue. Additionally, we showed cell integration using PCR and qPCR. Using serial transplantation, we showed the longevity of our candidate-enriched stem cells. Finally, we showed that the candidate stem cell transplantation can rescue animals from a leather chemotherapy treatment. The specific projects are funded by: ERC, NSF-BSF, Revive & Restore.

Candidate stem cell isolation and transplantation in Hexacorallia

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Stem cells are the base for cell therapy due to their ability to self-renew, differentiate into other cell types, and live throughout the life of an organism. The initial cell therapy was bone marrow transplantation; bone marrow that contains stem cells is transferred from a healthy donor into a sick recipient to transfer the healthy genotype. This therapy approach may be possible in corals, where there is genotypic variation in heat tolerance that influences survival during increased water temperatures due to anthropogenic global warming. However, we first need the ability to reliably isolate and transplant stem cells in Hexacorallia, which includes stony corals and sea anemones. In this work, we used the sea anemone *Nematostella vectensis* as our model for candidate stem cell transplantation, as it is the only hexacorallian species that has fluorescent-tagged transgenic strains. We established cell transplantation to show that there are cell populations exhibiting the functional characteristics of stem cells. We showed that a subpopulation of cells from *N. vectensis* can be transplanted from donor to recipient, are long-lived and self-renewing, can proliferate, differentiate and integrate into the recipient, and rescue recipient animals treated with lethal doses of chemotherapy. Lastly, we showed that this subpopulation can be enriched by sorting, using species non-specific cell markers, and that similar subpopulations of cells can be isolated from other hexacorallians, including stony corals. This lays a foundation for the possibility of stem cell-based therapy in Hexacorallians.

Lake-water-temperature regulation under diurnal and seasonal scales of environmental forcing, Agamon Hula, Israel

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Diurnal and seasonal cyclic changes of environment forcing are derived from Earth's rotations, and results in varying heat exchange between the lake and the atmosphere, and changes in stored heat i.e.- water temperature regulation. These cycles are interfered by few-days-long atmospheric circulation. Yet, knowledge gaps prevail regarding the governing factors controlling thermoregulation of lakes under various cycles of atmospheric forcing. Here, we examine the impact of environmental forcing on the thermoregulation of a shallow lake (Agamon Hula, Israel) by continuous direct measurements for almost two years. These observations are analyzed using the heat balance equation, which we solve analytically. We express the steady-state temperature, derived by solving the heat equation for negligible change of stored heat, found controlled by the environmental forcing. The relation between water and steady-state temperature was described by a ratio between the lake thermal response time (linearly depends on lake depth), to the timescale of the forcing. We approve the significance of this ratio by explaining the resemblance and discrepancy between measured water temperature and steady state for the seasonal and diurnal cycle, respectively. This occurs due to a significantly smaller thermal response time with respect to seasonal forcing, as opposed to a similar thermal response to diurnal forcing. Measured results from a few-days-long intense wintertime cyclone reveled decreased diurnal forcing, related to variation in the specific environmental forcing. This reduced diurnal cycle lasted 3-4 days, therefore yielding a resemblance between steady state and water temperature.

Insights from long-term ecological research of the Eastern Mediterranean Sea (EMS)

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The Eastern Mediterranean Sea has been subject to major environmental changes: the completion of the Aswan Dam in 1965, the building and widening of the Suez Canal, and climate change causing surface waters to become warmer and saltier compared to other marginal seas. These processes have resulted in changes to the entire food web. In view of these processes, the Morris Kahn Marine Research Station initiated in the year 2015 long-term ecological research programs, including an oceanographic time series station. Amongst our results, we recognize from the data three states of the base of the food web: from famine to feast; a new bacterial sediment pollution indicator system; new reports of alien species in the rocky reef ecosystem; and the prevalence of a vast array of coastal apex predators, their activities and their ailments. In addition, our open-source scientific database has promoted ecosystem protection in designating a new marine protected area, as well as fishery management decisions. Predicted scenarios of surface oceans under climate change foresee warming, longer periods of thermostability with declining nutrients and increased frequencies of major storms, which make our role in monitoring these processes essential.

Experimenting the influence of temperature and salinity on the potential distribution of the non-indigenous ascidian *Phallusia nigra*

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The global shipping network plays a crucial role in influencing global change by facilitating bioinvasions and species distribution. The ascidians form a significant part of the hull fouling of ships, thus move between different environmental conditions with the essential ability to cope with these fluctuations. *Phallusia nigra* is a widely distributed solitary ascidian common in tropical waters at shallow depths and is considered non-indigenous in the Mediterranean Sea. This study aims to understand the ability of non-indigenous and native ascidians to adapt to changing environmental conditions. For this, a comparison between three different populations of *P. nigra* are done, both native (Red Sea) and invasive (Mediterranean Sea and Singapore). Initially, artificial fertilizations were done from all populations to culture *P. nigra* under laboratory conditions, a protocol designed for this study. Later, using 3-month-old juveniles, a stress experiment was conducted for four weeks, with three different salinities (35, 40, 43 [PSU]) and three different temperatures (16, 25, 31 [°C]) creating nine treatments of all combinations. During which survivability was evaluated three times a week, and blood flow current direction was measured once a week. The most significant factors for survival were salinity for the Mediterranean Sea population and temperature for the Red Sea population. Additionally, individuals from the cold treatments (16[°C]) did not survive at all, from all populations. Results of the current study will be a base for developing future species distribution models under different global change scenarios.

The motion of fish eggs relative to the surrounding water and its implication to mass transfer

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Pelagic fish eggs rely on mass transfer with the surrounding water for oxygen supply, a process that is critical for the development of the fish embryos. Past studies of oxygen supply assumed that there is no relative motion between the egg and the surrounding water, implying that diffusion is the only process that governs mass transfer. However, our initial observations have shown that regardless of the flow conditions, fish eggs are vertically oriented with the heavy embryo at the bottom and a light oil globule at the egg top. We therefore hypothesize that eggs move relative to the surrounding water due to the non-uniform density distribution. If this is true, the relative motion of the egg will enhance mass transfer into the fish eggs by decreasing the thickness of the solute boundary layer, where oxygen flux occurs. Our preliminary measurements show that under periodic flow conditions, the change in the eggs' location precedes the change in the eggs' orientation, a phenomenon which doesn't occur when analyzing analytically the motion of the water in the absence of eggs. Next, we aim to quantify the magnitude of the relative motion under a wide range of ambient flow conditions experienced in different areas in the sea. The existence of a relative motion, if exists, will imply that previous studies have underestimated the mass transfer into fish eggs.

Seasonal and tissue variation in the epiphytic microbiome of the marine red macroalgae *Asparagopsis taxiformis*

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The red macroalgae *Asparagopsis taxiformis*, initially discovered on the Israeli Mediterranean coastline two decades ago, has emerged as a prominent invasive species. It thrives along the northern Israeli coastline throughout the year. *A. taxiformis* has gained attention due to its composition of bioactive natural products, which have demonstrated antimicrobial, anticancer, and methane gas reduction properties in previous studies. These products serve as a defence mechanism against predators and harmful bacteria. It is hypothesized that the epiphytic bacteria may play a role in the production or inductions of these bioactive compounds. This study aims to investigate the epiphytic microbiome of *A. taxiformis*, with a focus on identifying any seasonal or tissue-specific patterns. This study aims to uncover the diversity of the epiphyte microbiome of *A. taxiformis* on a seasonal basis, as well as differences associated with Specific alga tissue. *A. taxiformis* samples were collected and swabbed for DNA identification at different seasons and from different tissue within the *A. taxiforims* thallus. DNA extraction was performed, followed by amplification of metagenomic sequencing markers targeting the 16S rRNA gene for prokaryotes and the 18S ribosomal DNA for eukaryotes. Next-generation sequencing was then conducted to analyse the prokaryote and eukaryote communities within *A. taxiformis*.

All-female monosex in the freshwater prawn *Macrobrachium rosenbergii* - New ecological and aquaculture avenues

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Crustacean monosex culture is an environmentally and economically required farming strategy. The development of a biotechnology for all-female production enabled, for the first time, mass-production of all-female freshwater prawns (*Macrobrachium rosenbergii*). Sex reversal of WZ females through manipulation of the androgenic gland sexual switch and crossing with non-transplanted WZ females leads to production of WW homogametic females. WW females bred with ZZ males gave rise to the production of all-female offspring. All-female culture demonstrates superior performance in terms of total yield, uniform body size, feed conversion ratios and survival rates, at higher stocking densities than those traditionally practiced in the field. It might also prevent aquaculture escapees from establishing invasive populations. Here we report the first commercial-scale high *density M. rosenbergii* all-female grow-out showing remarkable agricultural performance and efficiency. Moreover, the availability of *M. rosenbergii* monosex populations is not only advantageous for aquaculture mass production but also for the use of prawns as biological control agents. Prawns are voracious predators of pest freshwater snails and crustaceans. The possible use of non-breeding monosex prawn populations poses them as excellent biocontrol agents against invasive and pest species without the hazard of the prawns themselves to establish invasive populations that could harm the environment and its natural biodiversity. We will discuss *M. rosenbergii* as biocontrol agent with respect to the treatment of aquaculture pest snails and invasive crustaceans. Furthermore, strictly monosex populations could serve as safely monitored biocontrol agents in aquaculture, and an additional crop on their own, as a win-win sustainable solution.

Couplings between nitrogen and iron in methanogenic sediments

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Methane (CH_4) production in freshwater sediments is one of the main sources for global methane emissions. As a potent greenhouse gas, studying the natural controls on its fluxes from sediments is crucial for better understanding methane cycles. One control over methane release to the atmosphere is the presence of available electron acceptors for methane oxidation. Methane can be oxidized through aerobic or anaerobic oxidation by sulphate (SO_4^{2-}), iron (Fe(III)) oxides, manganese (Mn(IV)) oxides, nitrate (NO_3^-) and nitrite (NO_2^-). Previous work had shown the potential of NO_3^- to serve as an electron acceptor for anaerobic oxidation of methane (AOM), mainly in enrichment incubations and wastewater sludge, while there are only few examples of research done on natural fresh-water sediments. In these highly reduced methanogenic sediments nitrite and NO_3^- are not supposed to be present, unless they are produced by anaerobic ammonium (NH_4^+) oxidation. Surprisingly, measurable concentrations of NO_3^- (2.1-2.5 µM) and NO_2^- (0.8-1.1 µM) have been observed in deep sediment profiles of lake Kinneret (LK), indicating their in-situ production and potential use as electron acceptors for methane oxidation as well as other processes. This proposed research aims to quantify the sink and source processes of NO_2^- and NO_3^- in LK methanogenic sediments, and their relation to the methane cycle. Using experimental lab-work techniques and in-situ profiling, preliminary investigation shows the potential for a cryptic NO_3^- and NO_2^- cycle in their production by anaerobic ammonium oxidation and consumption by methane and Fe(II) oxidation or anammox.

Assessing fish recruitment in the Eastern Mediterranean Sea using Standard Monitoring Units for Recruitment of Fish (SMURF)

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The complex marine coastal habitat provides a vital refuge and feeding ground for juvenile fish during their transition from a pelagic habitat to a demersal habitat. However, anthropogenic pressures in a densely populated coastline may threaten this vital ontogenic stage of recruitment. To enhance our understanding of fish recruitment in the Israeli coastal region, this study will explore the effectiveness of applying Standard Monitoring Units for Recruitment of Fish (SMURF). This method relies on the natural tendency of settling juvenile fish to congregate and seek shelter around and within physical structures, by providing SMURFs as available artificial habitats. For this research, 15 SMURFs will be strategically deployed at three locations along the Israeli coastline between Tel Shikmona, Haifa, and Michmoret, with five units submerged at 3 m depth at each site. Monthly collections of the SMURFs will allow for assessing the spatiotemporal abundance and diversity of fish larvae colonizing the SMURFs, offering valuable insights into recruitment patterns and trends. Bimonthly, water samples will be collected from each site to compare its fish eDNA with the catch of the SMURFs. This study aims to rigorously evaluate the SMURF applicability for monitoring fish recruitment in the Mediterranean, potentially advancing our understanding of the dynamic of both native and alien species. The results of this study can affect marine conservation efforts and management in this ecologically vulnerable region.

Radium isotope study of the hydrothermal groundwater discharge into the meromictic Lake Kivu

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Lake Kivu is a deep meromictic lake, located along the western branch of the East African Rift, at the foot of Nyiragongo volcano. It has a shallow mixolimnion (~65 m) and a deeper monimolimnion, subdivided into separate water layers by several picnoclines. The deep lake holds very large volumes of both CO_2 and CH_4, which makes it a potential 'killer lake' in a case of lake overturn. This was unfortunately demonstrated in the gas eruptions of Lake Monum and Lake Nyos in 1984 and 1986, respectively. Lake stratification is maintained via the discharge of hot springs at depth, enhanced by recent warming of surface water. In a field campaign during September 2022, we sampled a water column profile, as well as onshore fresh and hydrothermal springs for Ra isotopes. Deep water (400 m) shows relatively low ^{226}Ra activities, while relatively high ^{228}Ra activities (2000 and 100dpm m-3, respectively). Considering the much shorter half-life of ^{228}Ra (5.75 yr, compared with 1600 yr of ^{226}Ra), isotope budgets suggest a quite low ^{226}Ra activity and 226Ra/228Ra ratio in discharging groundwater (0.42, compared with ~20 in onshore hydrothermal springs). This probably implies that the travel times of the discharging hydrothermal groundwater are no more than a few years (velocities of km/yr). Future research in the lake (planned during 2024-2027) will focus on the radionuclide activity in sub-lacustrine discharge, with anticipated implications to (1) lake meromixix age, and (2) variability in discharge, which could affect lake stability.

The anthropogenic impact on modern sedimentary records offshore Haifa Bay, Israel

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Flooding events, turbidities, wave action, adsorption/desorption, biological processes and anthropogenic activities influence transport, resuspension and settling of heavy metals (HMs) in bays and their eventual transport to the open sea. Haifa Bay (HB), is a case study of an industrialized bay and a hotspot of HM pollution since the early 20th century. The history of HM fluctuations along with changes in sediment transport regime due to anthropogenic local and regional activities were investigated during this study. Six short cores were collected along the 60 m isobaths, west of HB and one core ca. 50 km NW at 1400 m bottom-depth. The ^{210}Pb dated cores were analyzed for particle size distribution, major and trace element concentrations and Pb stable isotope ratios. Clear trends were observed between northern cores with relatively constant concentrations of HMs throughout the cores, and southern ones displaying a sharp decrease at the upper few cm correlated with Al decrease and Ca increase. Lead stable isotope ratios did not point to anthropogenic sources and mostly reflect variations in sediment supply, distance from shore, and atmospheric dust. Cores are dominated by a mixture of natural terrigenous suspension and atmospheric deposition in different ratios. Record is mostly impacted by anthropogenic activities as the erection of the Aswan Dam and construction and expansion of the Haifa-Port breakwater, limiting transport of fine sediment from the Nile River and Qishon stream, respectively. Sediment traps and plankton nets are currently studied as potential scavengers for the “missing” HMs.

Biological filtration at the micron and submicron scale: Recent advances and knowledge gaps

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The scientific exploration of biological filtration by suspension feeders like sponges, bivalves, and tunicates has a rich history, marked by significant advancements in previous generations. However, recent breakthroughs in methodologies such as computational fluid dynamics, flow cytometry, advanced separation techniques, high-throughput chemical analysis, next-generation sequencing, high-resolution videography, improved microscopy, and in situ approaches are now revolutionizing our comprehension of how these organisms filter micron and submicron particles, colloids, and dissolved organic matter. In this presentation, I will provide a brief overview of recent discoveries that demonstrate how suspension feeders can effectively remove certain micron and submicron-sized particles while other particles of comparable size can evade capture. I will also briefly present the latest research on dissolved organic matter feeding, which is now recognized as the primary food source (>90% of the diet) for sponges, and will highlight new findings indicating that feeding on dissolved organic carbon is not exclusive to sponges and is dependent on quality and concentration. While these recent advancements are significant, they also reveal gaps in knowledge and methodology, particularly regarding the mechanisms behind the capture (and evasion) of microorganisms and particles of all sizes, the process by which metazoans consume dissolved organic compounds during the brief passage of water through the filtration apparatus, our ability to accurately measure and track submicron particles, and the need for a comprehensive framework to study the capture of micron and nanoscale particles by suspension-feeding organisms. In conclusion, this talk will highlight recent progress and emerging challenges in the study of biological filtration at the micron and submicron scale, emphasizing the need for interdisciplinary collaborations and the development of new methodologies to advance our understanding of this critical ecosystem process.

Intrinsic and not extrinsic factors control the short-term metabolic rate of the sponge *Ircinia variablis*

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Sponges are organisms that unidirectionally pump large quantities of water through their perforated body. The sponge body comprises filtration units, or aquiferous modules, drained into a single exit or orifice called an oscolum. High-resolution continuous measurements of dissolved oxygen in the water inhaled and exhaled by coral reef sponges, in situ, revealed high variability in oxygen removal and a distinct diurnal pattern with a nighttime removal of about twofold higher. To measure the factors controlling the short-term variability of sponge metabolism, we placed together in the lab six *Ircinia variabilis* sponges in pairs. We simultaneously measured the pumping rate and oxygen removal from a total of 35 oscula pairs over 18 to 24 hours under different food levels and temperatures. Surprisingly, in the lab, we could not detect any pattern in the paired oscula's metabolic parameters (pumping, oxygen uptake, and respiration), and their metabolism was not correlated at any of the time intervals tested (seconds to days). Within each osculum, oxygen removal was independent of the pumping rate, suggesting that both parameters should be simultaneously measured to determine sponge respiration rate. Moreover, there was no correlation between sponge metabolic rate and the dissolved or particulate food concentration nor with temperature. These results suggest that over the short term, intrinsic factors within each sponge module, rather than extrinsic factors, control *I. variabilis* individual's' metabolic rates.

Measuring seasonal diversity in the Gulf of Eilat/Aqaba with environmental DNA

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Environmental DNA (eDNA) is an innovative molecular that allows ecologists to measure biodiversity accurately and thoroughly. In this study, eDNA was used to study how seasonal shifts affect biodiversity in the Gulf of Eilat/Aqaba (GoE/A). Sampling was done by collecting biomass from artificial substrate from two sites every three months. Samples were extracted and underwent COI (Cytochrome c oxidase subunit I) barcoding. The sequences were analyzed for diversity among marine invertebrates. Preliminary results from bioinformatic processing in 47 samples resulted in 28,773 Amplicon/Unique Sequence Variants (ASVs). ASVs are clustered sequences that differ by a single nucleotide, allowing for higher resolution in identifying different taxa. Taxonomic classification is currently in progress and full results will be presented. This research uses eDNA sampling to supply the first annual baseline of biodiversity in the GoE/A, and provides a new understanding of the effects of seasonal changes on biodiversity.

Recurrent association between Trichodesmium colonies and calcified amoebae in the Red Sea

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Colonies of the N_2-fixing cyanobacterium Trichodesmium spp. constitute a consortium with multiple microorganisms that collectively exert ecosystem-level influence on marine carbon and nitrogen cycling, shunting newly fixed nitrogen to low nitrogen systems, and exporting both carbon and nitrogen to the deep sea. Here we identify a seasonally recurrent association between puff colonies and testate amoebae through a two-year survey involving over 10,000 Trichodesmium colonies in the Red Sea. This association was most commonly found in near-shore spring populations. Microscopic observations revealed consistent amoebae morphology throughout the study, and both morphological characteristics and 18S rRNA gene sequencing suggested that these amoebae likely belong to the species *Trichosphaerium micrum*, a testate amoeba that forms a $CaCO_3$ shell. Co-culture of *T. micrum* and Trichodesmium in the laboratory suggests that the amoebae are feeding on heterotrophic bacteria and not Trichodesmium, which adds a consumer dynamic to the complex microbial interactions within these colonies. Sinking experiments with fresh colonies found that the presence of calcifying amoebae decreased colony buoyancy. As such, this novel association may accelerate Trichodesmium sinking rates and facilitate carbon and nitrogen export to the deep ocean. Amoebae have previously been identified in Trichodesmium colonies in the western North Atlantic (Bermuda and near Barbados), suggesting that this type of association may be wide-spread. This association may be a new critical facet of the microbial interactions that underpin the fixation and fate of carbon and nitrogen in the present and future ocean.

Shifts in the Dead Sea water sources during the Holocene: Insights from uranium isotopes

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The populated south Levant region at the desert fringe is drought-sensitive to the warming climate. Hydroclimate studies of past warm periods may help to picture future scenarios. The DSDDP sediment core from the center of the Dead Sea, provides a detailed history of alternating wet and dry intervals over the last ~220 ka. Halite precipitation indicative of aridity was identified in the DSDDP core throughout the Holocene, with the thickest halite deposition occurring in the early Holocene. Here, we aim to investigate shifts in water sources to the Dead Sea during the relatively dry Holocene by analyzing $^{234}U/^{238}U$ activity ratios of authigenic minerals in the core sediments. Our preliminary results show that the most significant fluctuation in the $^{234}U/^{238}U$ ratios occurred between ~11 and 10 ka, which coincides with the thick halite deposition. During this period, the $^{234}U/^{238}U$ ratios plummeted from ~1.4–1.5 to ~1.0, reflecting a significant shift of water sources from the north and west (Jordan River and Mediterranean-sourced rainfall, $^{234}U/^{238}U$: ~1.5–1.7) to the eastern and southern catchments and flash floods ($^{234}U/^{238}U$: ~1.0–1.2). A similar trend of decreased $^{234}U/^{238}U$ ratios was observed from ~8 to 7.6 ka, characterized by intermittent halite precipitation, following a relatively wet period (~9.5–8.3 ka) coincident with the sapropel event 1 in the eastern Mediterranean. Moreover, we harmonized the lake levels deduced from the conservative porewater Mg2+ concentrations of the DSDDP core with those reconstructed from onshore records, by considering two Mg inventories—north and south basins of the Dead Sea. We further utilized a dual isotope mixing model and the total water discharge corresponding to the inferred lake levels to determine the water budget of different source. The findings indicate that during dry intervals, the Jordan River runoff reduced to ~100 to 300 million m3/y, and the contribution from the Jordan River to the Dead Sea falls to ~12—40%, considerably less than the present-day level of ~70%.

You shall not pass! (undetected): ARMS as a novel monitoring tool for early detection of non-indigenous marine invertebrates

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The incessant invasion of Non-Indigenous Species (NIS) poses a great threat to marine ecosystems, triggering biodiversity loss and ecosystem imbalances. The Israeli Mediterranean, due to its proximity to the Suez Canal – a major conduit for international maritime traffic and a pathway for numerous Erythraean species entering the Mediterranean Sea – is particularly susceptible to NIS. Hance, vigilant monitoring and early detection strategies for NIS is crucial for maintaining local habitats. Autonomous Reef Monitoring Structures (ARMS) were developed as a novel and powerful benthic monitoring platform. ARMS unique structure mimics the microhabitats found in complex underwater hard substrates. This configuration attracts a diverse array of marine organisms, both native and alien, providing a comprehensive snapshot of the local fauna. The uniform design of the units offers a standardized and non-destructive approach for assessing benthic community structures and biodiversity. ARMS analysis, combining traditional taxonomic methods with advanced genetic tools such as DNA barcoding and metabarcoding, significantly enhances species detection and identification capabilities. Here, ARMS were deployed at six sites along a north-to-south gradient of the Israeli Mediterranean coast, capturing biodiversity at astonishing resolution over three consecutive years. This study reveals the pronounced presence of NIS from all phyla, with a particular emphasis on crustaceans and ascidians – two of the most dominant phyla represented on the units. ARMS usage unveiled the presence of newly introduced species to the Mediterranean Sea and Israeli waters, showcasing the remarkable potential of ARMS as a biodiversity monitoring tool, and its ability to provide early detection of NIS.