LEIBNIZ CENTRE
for Tropical Marine Research

ZMT

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THE GREEN WORLD OF MINISCULE CREATURES

Diving into the bacteria community

ON EXPEDITION

Hundreds of metres of lines swash around in the shallow tropical water. Attached to them are clumps of algae that sway gently in the sea swell. Anyone, like Astrid Gärdes, who dives into their tangled green leaves discovers a spectacularly colourful society of tiny creatures. "The diversity of the bacteria that live on and around the algae is incredibly high, and they are beautiful," enthuses the ZMT marine microbiologist. "These miniscule organisms are important for all the biochemical cycles in the water."

It is not by chance that the algae dangle from the line. They are macroalgae that are cultivated on the coast of Vietnam, delivering valuable carrageen for the world's food industry. The cultivation of algae is an economic factor in Vietnam and the success of the cultures is dependent on the invisible microorganisms. But as yet, it is not clear who plays which role in the bacterial community that makes its home in the clumps of algae. Which ones are the harmful populations and which the useful? "We investigate the entire community and test for probiotic activity," explains Gärdes – we, that is, the German and Vietnamese scientists involved in the joint Aqua-Weed research project; at ZMT, it is run by Astrid Gärdes and Andreas Kunzmann.

Industrious tiny workers

For this purpose, the scientists filter water in two locations off Vietnam: in a contaminated area near industrial effluents and shrimp farms, and outside the contaminated zone where the water quality is good. Both on location and in the lab, Gärdes observes under what conditions the harmful strains get the upper hand – because this is when disease breaks out in the macroalgae culture that can destroy up to 50 percent of the harvest. But it is not the main aim of the undertaking to issue warnings about this irreversible state of affairs, Gärdes emphasizes. "We want to know which of the useful bacterial strains we could artificially reinforce so that the problem doesn't occur in the first place." To do so, the researchers extract all the genetic information, the DNA, from the biomass collected in the filters and use bioinformatic methods to break it down. They end up with a cross-section of the invisible community of microorganisms. The "good" ones become more visible and the reputation of bacteria in tropical waters is improved. Many of them keep their problematic colleagues in check. >MORE

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BIT BY BIT

Sonia Bejarano – in pursuit of an ambitious goal

Saving the oceans is an ambitious goal. But Sonia Bejarano is undaunted by the dimensions of the undertaking. "Contributing a grain of sand towards protecting coral reefs is the best way of describing what I do. And I believe that if everybody makes even the smallest contribution to this great goal, it can be achieved." The reef ecologist does her bit to protect the seas in her everyday research work.

Sonia Bejarano is the head of the new Reef Systems research group at ZMT. "We want to discover how tropical coral reefs cope with the stress they are subjected to by anthropogenic impacts and environmental pollution," the Colombian scientist explains. In different regions, local and global stress factors vary and have differing effects on biodiversity and ecosystem functions. So, reef systems also respond with their own adaptation and survival strategies. "What does this mean for the people who use the reefs' resources?" asks Sonia Bejarano. "The research group wants to understand to what extent people can use the reef resources and services without forcing the ecosystems into a state of degradation from which there is no return."

Loving and understanding the oceans

Under Bejarano's leadership, the group will collect data from coral reefs off Indonesia, in the Red Sea and the Caribbean. "We'll conduct experiments on the organisms under different conditions – in the oceans and in aquaria," Sonia Bejarano explains. "But coral reefs are, of course, also an integral part of coastal societies, so we'll also try to understand how people respond to changes in ecological systems." Interviews to assess social behaviours, the exploitation of resources and recommendations for improved management are just some of the points on the new group's agenda. But whatever Sonia Bejarano does – diving, experimenting, designing projects, supervising students, writing articles – for her, everything is just a small step on the path to understanding and treasuring the oceans. "In the end, we humans have to change our perception one step at a time and, with it, our behaviour that impacts the reef systems. I would like to help do this."

Rendezvous with yellow fish

In Sonia Bejarano's case, her latest research work means renewed contact with old colleagues. Before she came to Bremen, she worked at important research institutes around the world, starting early on in Colombia. Her home country is strategically situated between the eastern Pacific and the Caribbean Sea with their different ecological and geological conditions. Perhaps she will return to the place where she discovered her love of the underwater world as a 13-year-old: on vacation in the Caribbean. Every morning she was allowed to go snorkelling from a boat with her brother, which meant being at the beach at 7am, the ZMT researcher recalls. "I remember huge clouds of yellow fish. It was so beautiful. We didn't miss out on the opportunity on a single day."

Sonia Bejarano *studied and researched in Colombia, at the University of Exeter in the UK and at the University of Queensland in Australia before working at ZMT in Bremen as a postdoc for three and a half years. Since October 2017, she has been the head of ZMT's Reef Systems research group.* >MORE

INFLIGHT RESEARCH

Flying drones over mangroves – a conversation with engineer Elisa Casella and mangrove ecologists Véronique Helfer and Martin Zimmer

What role can drones play in coastal research?

Elisa Casella: Drones carrying small multispectral cameras are already successfully employed in agriculture. Now, coastal research is also benefitting from the opportunities to observe coral reefs and beaches and the way they change over time. Traditional approaches include field measurements with the aid of GPS instruments or satellite image analysis. Drones are an additional, valuable platform that allows high-resolution data to be collected more efficiently. This technology enables us to reconstruct the environment and its changes in 3-D.

How can the drones help in mangrove forests?

Martin Zimmer: We at ZMT are some of the first to evaluate the use of drones for mangrove ecology research. In order to protect mangrove forests on tropical coasts more effectively we need to know more about the state of the system and problematic changes in its condition. But anyone who has tried to do research in mangroves knows that you have to wade knee-deep in mud. Drones can supplement this work and make it easier.

Véronique Helfer: In our research group, we specifically want to document and understand spatial patterns in mangrove ecosystems – which implies large-scale studies that we can't possibly manage just using field-based approaches. We rely on remote sensing data.

Martin Zimmer: This is where Elisa Casella's and Alessio Rovere's experience in handling drones comes in: for us mangrove ecologists, the drones offer a resolution that is intermediate between that of satellite images and field work. Only the combination of these three levels – satellite, drone, ground – allows us to prepare an effective analysis that is eventually supposed to lead to better environmental management.

What are the challenges?

Elisa Casella: The drone path from the boat to the survey area is programmed with the help of flying software, which uses the geolocation from the aircraft's internal GPS. But you have to take into account the potential influence of wind and weather. In some regions, the weather can change rapidly during the flight and the drone can drift slightly or sway from the programmed path.

Martin Zimmer: Although the camera produces accurate images of individual leaves, the swaying means that the leaf image on one photo can look different from the next, which makes precise mapping difficult. Theoretically, drones are ideal and are certainly the way forward, but practically, we are still busy learning.

Véronique Helfer: That's why we shouldn't let our enthusiasm run away with us and remember that we still need to undertake field experiments in order to investigate things on the spot. We need to make sure there is a meaningful relationship between the chemical analysis of the leaves and the spectral information to develop indicators for detecting when, where and why the system topples so that we can intervene to protect it at the right time.

Martin Zimmer: This leads to what is our real challenge: What really is a "healthy" state of the mangroves? We still don't precisely know how we can measure it. To try and answer this question we keep our feet in the mud and our heads in the sky.

The use of drones in research links ecology with geoinformatics. At ZMT the Sea Level and Coastal Changes group (E. Casella, A. Rovere et al., joint junior research group with Bremen University) and Mangrove Ecology group (V. Helfer, M. Zimmer et al.) are cooperating with the University of the South Pacific (Fiji) to test the use of drones for the mapping of mangrove ecosystems, using multispectral imagery. >MORE | >MORE

ZMT at the UN Climate Change Conference

On the sidelines of the 23rd UN Climate Change Conference (COP23) in Bonn, ZMT was involved in running discussion rounds and lectures in the EU's framework programme. Together with the CEO of UNESCO IOC, the head of ZMT's Department of Social Sciences, Anna-Katharina Hornidge, introduced a discussion on the direction and development of European marine research and its contribution to climate policy in which a policy brief was drawn up. Both ZMT coral reef expert Sebastian Ferse and Tim Rixen, head of ZMT's Carbon and Nutrient Cycling research group, talked about coral reefs affected by global climate change. >MORE

Symposium: immersion for research divers

For marine researchers, diving is an indispensable method of work. But not every scientist is a diver and knows about risk assessment, safety regulations and rescue measures. And research diving in the tropics calls for additional knowledge. The 10th conference of the German Commission for Research Diving (KFT) in Bremerhaven therefore addressed scientists with no diving experience. Exchange, innovative methods in marine research, capacity building and the implementation of German and European standards abroad as well as the most recent underwater research were the focus of the conference. The event was organised by ZMT together with the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), and the German Maritime Museum (DSM) on 2 and 3 November 2017. ZMT's diving centre is a member of KFT. >MORE

Honoured: knowledge about the flow of matter

In September 2017, Nils Moosdorf, geoscientist and junior research group leader at ZMT, received the Hermann Credner Prize from the "Deutsche Geologische Gesellschaft – Geologische Vereinigung" (DGGV). The prize has been awarded since 1960 for innovative research of international importance. Thanks to Moosdorf's work on the role of rocks in global cycling it is now possible to predict future changes in matter flows. Apart from this, his research at ZMT has also visualised cross-border flows between the land and the sea that were previously largely ignored: he investigates the role of groundwater flows into the sea – an important contribution to marine research because groundwater invisibly transports nutrients into marine ecosystems. >MORE

ELIC project enters next phase

The ZMT-coordinated ELIC project fostering German Israeli research collaboration continues to take shape. During a workshop in Eilat, scientists from Leibniz institutes ZMT, IGB, IOW, TRPOS, LIAG and the Israeli Interuniversity Institute for Marine Sciences (IUI) specified research activities and decided on equipment for new lab facilities near the Gulf of Aqaba. ELIC is based on a MoU between the Leibniz Association and IUI. >MORE

Successful: New proteomics methods

Biodiversity research is more important than ever if species conservation is to be effective. But how can we find an alternative to the predominant method of DNA barcoding to classify species more quickly and reliably? Up until the end of 2017, an alliance of three Leibniz institutes – for Analytical Sciences (IASS), Senckenberg Biodiversity and Climate Research Centre (BiK-F) and ZMT, together with TU Dortmund University – spent three years working on answers to this question. Now, a classification method has been developed that complements genetic procedures based on mass spectral data of the proteome, the complete set of proteins in a living organism. From the proteome, relationships can even be derived in species without genetic databases. Moreover, Marleen Stuhr of ZMT's Geoecology and Carbonate Sedimentology research group used a novel proteomic approach to jointly investigate the reaction of host and symbionts to environmental stressors. >MORE

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