A NEW DEPARTURE WITH AFRICA

Interdisciplinary research in Zanzibar

Zanzibar – the name evokes images of sun-baked beaches under tropical palms. The stream of tourists visiting the East African island off the coast of Tanzania is increasing continually. Giant hotels are being built, one next to the other. “Zanzibar is one of the fastest growing tourist regions in the Indian Ocean,” says Hauke Reuter of ZMT. And this is a development that is not exclusively positive. “Coastal resources are used intensively by the people.” Changes in the marine ecosystems are the result. ZMT has now started to address important interdisciplinary research issues in this region – together with local partners.

DOWN TO THE VERY LAST SHELL

Zanzibar’s underwater world is a highly-desirable destination for many divers. The same areas are also used by fishermen. “Everything that can be eaten or turned into cash is collected in the coastal waters, even the shells which are sold to tourists,” explains Hauke Reuter who heads ZMT’s Spatial Ecology and Interactions working group. He has been involved in ZMT’s collaboration with the Institute of Marine Science (IMS) at the University of Dar es Salaam since it was launched in 2009. The exploitation of resources is not only causing ecological problems on the island but also latent social conflicts between diving tourism and fishing.

WORKING TOGETHER

Both sides are determined to investigate the regional situation from a natural as well as a social scientific perspective. IMS is Tanzania’s national centre for coastal research. “Our partners want to work together with us to close gaps in knowledge, train junior researchers and eventually use current research data for better regional management,” Hauke Reuter emphasises. Consequently, since the beginning of 2013, there has been a drive to promote exchange with all departments at ZMT – now focussing on the international graduate school SUTAS (Sustainable Use of Tropical Aquatic Systems), headed by Matthias Wolff. During the most recent expedition to Zanzibar in February, the ZMT team and their partners identified research fields for doctoral students who will examine the social and ecological conditions from different points of view.

In the long run, ZMT will be able to compare the research data from Zanzibar with other areas of the world. For the modeller, Hauke Reuter, the benefits of the new initiative with African partners are enormous. “You can understand Zanzibar as a model region to describe issues that will affect ever more tropical coastal regions.”

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ON EXPEDITION

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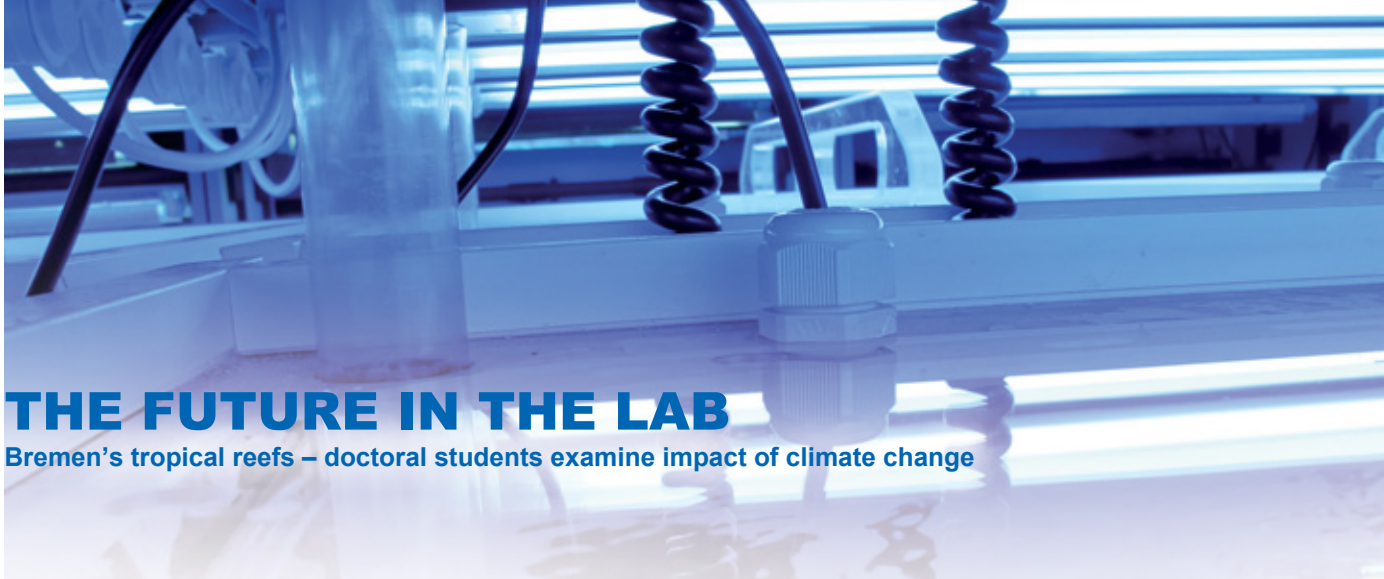


THE FUTURE IN THE LAB

Bremen's tropical reefs – doctoral students examine impact of climate change

In May, wet sand arrived in Bremen. But what the container was transporting was not sand from the nearby North Sea, but almost a tonne of sediment seething with microorganisms from its natural habitat in tropical coral reefs. ZMT had ordered this natural reef sand for the marine experimental facility, MAREE, where it now covers the floors of 24 new experimental tanks in which independent reef ecosystems – so-called mesocosms – are ready for researchers to investigate.

Two of ZMT's young researchers are particularly enthusiastic about the new acquisition. Marine biologist, Friedrich Meyer, set up the 24 independent ecosystems using the living sand which soon generates a natural microenvironment in the aquaria. "This facility will help us to study individual organisms as well as the matter fluxes in reef communities."

Corals and calcifying algae are the first inhabitants of the new experimental aquaria. Twelve mesocosms contain five different species of red and green calcifying algae. In each of the others there are five different coral species living together. Flow conditions and temperature remain stable while the lighting imitates the diurnal light cycle. According to Friedrich Meyer, this is important because "we want to reproduce the physical and biochemical processes under stable natural conditions." The marine biologist knows that research outcomes in the field are clouded by riverine input, algal blooms and fisheries. "In the mesocosms we can manipulate the specific environment under controlled conditions depending on the research question – a huge advantage."

Friedrich Meyer and carbonate sedimentologist André Wizemann are using the long-term experiment for their doctoral theses. Friedrich is studying the physiology of the organisms, André the structure of their calcareous skeletons. "We want to discover the effects of ocean acidification and the increase in organic carbon in water on the organisms that build their skeletons from calcium carbonate," André explains. To do so, he places segments of the mesocosm inhabitants under the scanning electron microscope.

> *"We can now manipulate specific environmental conditions in the lab."*

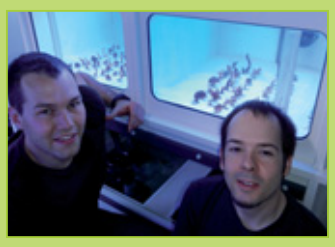
SIMULATED COLLAPSE

Once the corals and algae have acclimatised to their laboratory world, the future begins: in various experimental setups, the young scientists change either the carbon dioxide or organic carbon in the water, or both at once. They thus simulate the impact of climate change, overfishing or human coastal use. How do communities and individual organisms react when the pH level is reduced and the ocean acidifies? What happens when the level of organic carbon in the water increases – when there are not enough fish to feed on the algae, or when sewage input increases? "Finally, we combine the growing availability of inorganic and organic carbon in both the coral and the algal communities," says Friedrich. And what happens? Do the effects trigger a collapse or do they cancel each other out?

It is certainly no secret that environmental change has caused an imbalance in the underwater world and its reefs. But how the future scenario will begin in detail – this is something André Wizemann and Friedrich Meyer will soon be able to say much more about. **> READ MORE**

DOCTORAL STUDIES AT ZMT

Friedrich Meyer holds an MSc in Marine Biology from the University of Bremen and has been working on his doctorate in ZMT's Department of Ecology since May 2011. He spent much of 2012 on field and lab work in Mexico and Australia, focussing on the effects of availability of organic carbon and ocean acidification. **André Wizemann** completed his MSc in Biology in Tübingen before becoming a doctoral student at ZMT where he is part of the Geoecology and Carbonate Sedimentology working group. He is investigating the impact of environmental change on calcifying organisms with a focus on productivity and the microstructure of calcium carbonate shells and skeletons.



FRAGILE WORLDS

Human and marine inhabitants of tropical coastlines may be dependent on the coral reef habitat for quite different reasons. Marion Glaser and Sebastian Ferse discuss the problems and opportunities of coexistence.

What are the conflicting interests that clash at coral reefs?

Ferse Tropical coral reefs are very susceptible to disturbance. The reason for this sensitivity is that they are adapted to extreme, but stable conditions, in particular to nutrient-poor waters. The ecosystem survives on multiple specialisations, symbioses and interactions between different organisms, and by recycling nutrients. This makes the habitat so complex that it reacts to external influences like a house of cards: take out the wrong card and the entire structure collapses.

Glaser People are dependent on coral reef ecosystems in many different ways. In our current research area – the coral archipelago southwest of South Sulawesi in Indonesia – the population relies on fishing. We have identified more than 20 types of fishing – from bomb fishing for local trade to live catch fishing for luxury restaurants and the international ornamental fish trade. In addition, aqua- and mariculture are important to Indonesia, as is diving tourism. The poorest people use material from the reef for building houses. When the ecosystem breaks down due to overfishing, for example, this dependency is so all-embracing that people become impoverished and fishing businesses move elsewhere. The social system is closely linked to the ecosystem.

How can coexistence in the coral reef habitat work?

Glaser Marine protected areas are only respected if the coastal population and ecosystem users get compensation and find other sources of income. Otherwise illegal grey areas start emerging where much less sustainable practices take place, completely uncontrolled. If you want to protect reefs you have to involve the population affected.

Ferse For its part, the reef only benefits if there is a stable social system with control mechanisms and rules for promoting sustainability. It is important that nutrient inputs from humans are kept to a minimum. Furthermore, key species which guarantee the functioning of coral reef ecosystems should not be removed.

What sort of knowledge is indispensable for conservation?

Ferse In order to understand ecological dynamics you have to know, for instance, how individual reefs are connected with one another. Where do the fish larvae come from? Where do the larger fish migrate to? It is important to know about these processes if you want to combine ecosystem use and conservation. They allow you to identify key areas in the system.

Glaser When it comes to social dynamics you have to discover who the driving force is in the social, and informal, power structure. Who has the say? Who has to be involved in transformation processes? Is it possible to introduce sustainable innovations that benefit the local population? Indonesia is made up of more than 17,000 islands and has a problem with energy supplies. Could power be generated in the ocean – using algae or tidal power plants? At the same time, you have to look carefully at special local cultural features – what is important and why? So, sustainable management means understanding both the ecological and social dynamics and their interaction. That is the basis of social-ecological systems analysis.

Science for the Protection of Indonesian Coastal Ecosystems

Social scientist **Marion Glaser** heads ZMT's Social-Ecological Systems Analysis working group to which coral reef ecologist **Sebastian Ferse** is affiliated. Both researchers are involved in the project "Social drivers of coral reef resilience and their social-ecological repercussions" within the German-Indonesian research collaboration, SPICE III. **> READ MORE**

AWA

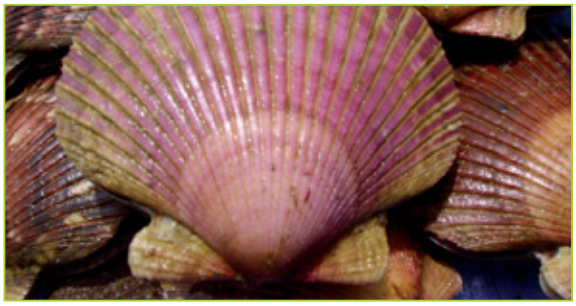
Research for fisheries management off Africa

Off the coast of West Africa fish are becoming scarce. The stocks of many species of commercial fish are seriously threatened – especially the important "Bonga shad", a herring-like species. Research on the stocks, life cycle and habitat of this fish aims to help improve sustainable fisheries management. Together with African, French and German research institutes, ZMT is taking part in the collaborative project AWA, "Ecosystem approach to the management of fisheries and the marine environment in West African waters." This new project is funded by the Federal Ministry of Education and Research (BMBF) until 2017. AWA research at ZMT – such as that on fish productivity – is being led by Werner Ekau. ZMT is also providing training in the context of the project. **> READ MORE**

SASCA

New tasks in Peru

"Sustainability analysis of scallop culture in Sechura Bay", or SASCA, is the title of a new ZMT project in Peru. Together with colleagues from Universidad Agraria La Molina in Lima, scientists are homing in on scallops. They are intensively cultivated in the bay off Sechura and exported overseas, with a turnover of more than a hundred million dollars a year. The research task here is to provide more knowledge on the opportunities and risks of cultivation. Will scallop production survive the conditions caused by the climate phenomenon El Niño? Will it change the ecosystem? Between now and the end of 2015, field research, symposia and workshops are planned. Future scenarios will be modelled and recommendations for action drawn up. SASCA is financed by the German Federal Ministry of Education and Research and coordinated by Matthias Wolff at ZMT. **> READ MORE**



ZMT FACES

Leticia Bigeyo Neke Kuboja from Tanzania will arrive for a six-month stay at ZMT in June. She has been awarded a fellowship by the United Nations and Japan's Nippon Foundation and will join the Resource Management working group. Her research will focus on the impact of marine protected areas on the conservation and sustainable management of marine resources as well as on the diverse effects of climate change on fish habitats, fisheries and biodiversity in Tanzania.

Starting in July, Leibniz-DAAD Fellow **Arif Wibowo** from Indonesia will join the Mangrove Ecology working group at ZMT to evaluate the data collected during six months of fieldwork on Sumatra. At ZMT he will undertake the morphological and molecular genetic analysis of the fish larvae he has brought back from the flood areas.

PUBLICATIONS

Continental Shelf Research, Special Issue
Scientific results of the LANCET project:
Land-Sea Interactions in Tropical Ecosystems of Hainan, China
Continental Shelf Research, Vol. 57, April 2013.
Guest Editors: T .C. Jennerjahn et al.
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Articles
Sustainable Livelihoods Approach in tropical coastal and marine social-ecological systems: A review
D. Ferrol-Schulte, M. Wolff, S. Ferse and M. Glaser, 2013. Marine Policy, 42, 253-258. **> READ MORE**

What makes them follow the rules? Empirical evidence from turtle egg harvesters in Costa Rica
R. Madrigal, A. Schlüter and M. C. Lopez, 2013. Marine Policy, 37, 270-277. **> READ MORE**

2012/2013

ZMT participates in German-South African Year of Science

What opportunities are there for marine research in and with South Africa? How can bi- and multilateral cooperation with international partners promote marine science in South Africa? Cape Town in December 2012 and Bremen in April 2013 were the venues for two intensive workshops addressing these very questions. As part of the German-South African Year of Science, the events were organised by Werner Ekau on behalf of ZMT in collaboration with ACCESS, South Africa's Applied Center for Climate and Earth Systems Science. More than 60 scientists from Germany, South Africa, Namibia, Angola, Mozambique, France and Norway took part in the drive to elucidate the main challenges and important tasks for the future. Their common objective is to intensify marine research cooperation along the coasts of Southern Africa in order to understand more about conditions and changes and to ensure the long-term ecological stability of the coastal region. The participants are drawing up an initial concept paper for two major research projects, due to be completed by the end of June. **> READ MORE**

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