



HEADING FOR THE ARABIAN SEA

Research expedition to an ecologically critical zone

ON EXPEDITION

Six weeks on the German research vessel *Sonne* – since summer 2023, a ZMT team helmed by biochemist Tim Rixen has been preparing for the research cruise that will set off from Mauritius on 7 January 2024 heading for the Arabian Sea. The expedition is led and coordinated by the University of Hamburg.

An impending ecosystem change

On average, a ZMT team goes on an expedition on board a research vessel every two years. This time, the international team from ZMT, together with colleagues from six German universities and research institutes including the National Institute of Oceanography (NIO) in Pakistan, is investigating a critical zone in the Arabian Sea known as the oxygen minimum zone (OMZ) which presses on the coasts of India and Pakistan from the open sea in the northern Indian Ocean. “We think that the concentration of oxygen in the OMZ is decreasing and consequently changing the composition of species in the marine ecosystem,” says Rixen. “This, in turn, could lead to what is known as a regime shift that has a long-term impact on ecosystem services.” Which means, amongst other things, on carbon dioxide (CO₂) storage and the emissions of gases that impact the climate like methane (CH₄) and so-called laughing gas (N₂O). CH₄ and N₂O tend to be formed preferentially when biomass decomposes under low-oxygen conditions.

More data – more insights

Oxygen minimum zones in the ocean are the result of complex processes that interlock and interact. How are they changing under the influence of climate change? Particularly with regard to its regional significance, this question is unanswered. “Even the global climate models don’t provide any clear information on this point,” explains Rixen. In 2022, he was part of an international team that charted the current state of research on the oxygen minimum zone in the Arabian Sea. “We have been investigating this zone in the context of international projects since the mid-1990s,” says Rixen. The last time ZMT visited the area was in 2007 when it discovered that the oxygen minimum zone had expanded significantly. Subsequently, piracy endangered the security of the region and made it almost impossible to undertake research expeditions in the Arabian Sea. “Now the situation is much easier, and we urgently need new data to see how the OMZ has responded to climate change in the last 17 years,” says Rixen.

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SOCIETAL IMPACT

A transformative role for research

The world is changing – and so is science. Against the backdrop of such complex global challenges as climate change, pandemics and resource scarcity, more than ever, societies need science to provide information and support. The question as to how science can be conducted responsibly is certainly not new. Yet, firmly integrating societal responsibility as a controllable and verifiable element into excellent research for sustainable development is no easy matter.

“ZMT is active at the European level in the Coalition for Advancing Research Assessment (CoARA) and co-leads an international team that is called upon to outline new assessment criteria for a transformational role for research – an important step towards research that incorporates the responsibility to work for societal change.”

Raimund Bleischwitz, Scientific Director of ZMT

Enhancing the societal impact of research – how?

But how can societally responsible research for the benefit of sustainable development be taken on board by excellent science – as an inherent motive and element of all research practice? How can such research have an impact on society that can be planned in advance and recognised subsequently, for example at evaluations? In order to find answers to these questions, ZMT is not only contributing to CoARA but also participating in the federally-funded project *LeNa Shape* that was launched in 2021. At German research institutions and a number of universities, the project seeks to understand how research processes and projects in general have

to change with regard to their quality, impact and the researchers' motivation if they are to live up to a new principle of responsibility and accountability.

ZMT – an illustrative institute

“Together with the Leibniz Centre for Agricultural Landscape Research, ZALF, we are initially reflecting on the research processes at our own institutes,” says natural and social scientist Sebastian Ferse of ZMT, “because as institutes that operate internationally in the Global South, whose research is key to achieving some of the UN's sustainability goals, we ourselves are basically ideal illustrative material.” In various workshops and case studies, research processes will be carefully examined and compared in terms of short-term results such as publications and policy papers as well as long-term impacts, for example on ecosystem services. The analyses will serve to identify chains of effect which are more likely to have a societal impact. They will facilitate the structured planning of research processes regarding the intended impacts and ultimately identify indicators for the sustainable impact of societally responsible research.

“These analyses are also very valuable for ZMT's Office for Knowledge Exchange (OKE),” says Annette Breckwoldt of OKE, where information and practical examples come together to shape collaborations between ZMT researchers and non-scientific stakeholders from politics, industry and the NGO sector in the tropics and Germany. “Only by understanding our own positionality as researchers can we responsibly initiate and sustainably develop collaborations.”

ZMT co-leads the first CoARA working group for reassessing research together. [>MORE](#)

Additional information on the ZMT sub-project of *LeNa Shape* - Research in societal responsibility - design, impact analysis, quality assurance. [>MORE](#)

WORKING TOGETHER

The four ZMT laboratories are growing together under a new dual leadership: Donata Monien and Silvia Hardenberg on more teamwork and efficiency

All ZMT laboratories – the marine experimental facility (MAREE), the chemistry, biology and geology labs – are now working together under your joint leadership. How does this benefit research at ZMT?

MONIEN: Experimental research at ZMT is usually not limited to a single discipline. We always have overlaps. For example, if we keep aquatic organisms at the MAREE under certain experimental conditions – affecting light, temperature, nutrients or CO₂ content – then we also need to control the chemistry of the water. This is done in the chemistry lab.

HARDENBERG: On the other hand, biological analyses undertaken during the experiment, such as determining photosynthetic activity, measuring the size of organisms or tissue analysis are the domain of the biology lab. And to use the scanning electron microscope you would have to contact our geology lab. In the past all of these steps had to be taken individually.

MONIEN: We have now replaced this complicated coordination process in experimental research with a much leaner structure. As a result, our scientists and our international visiting researchers can plan and conduct their experiments much more efficiently.

HARDENBERG: And it starts with the simplest details: Our scientists can now contact both of us via a joint email address, we both have an overview of all the experimental fields, processes and projects, and we work together closely. This makes it much easier to run experiments, which are increasingly conducted in an interdisciplinary way as a result of ZMT's new Programme Areas. The same also applies to resource management.

What does the new structure under dual leadership mean for the technical team?

MONIEN: The technical staff have always worked together, but the coordination required for overarching projects was very time-consuming. It was time to get rid of the formal hurdles and create a joint experimental area in line with working reality.

HARDENBERG: The technical staff have moved closer together and can now work more flexibly. Pragmatic cooperation has generated a greater feeling of togetherness. For example, when we have to shovel vast amounts of sand into aquatic tanks for a MAREE experiment, we can quickly count on many helping hands from our 18-person team.

ZMT is set to move into a new building. What prospects for future activities will result from merging the labs?

MONIEN: We have now organised the existing infrastructure in such a way that it is ideally suited to the interdisciplinary research undertaken within ZMT's Programme Areas and also fits the technical team. In the new building, we hope for a laboratory area that is properly connected which is indeed planned in order to make better use of spatial resources.

HARDENBERG: We envision several functional areas within the one experimental laboratory where the technicians will work – enabling work across short distances, fast coordination and effective cooperation.

As co-heads of the Experimental Marine Laboratories at ZMT, Donata Monien focuses on geochemical analysis while Silvia Hardenberg contributes her knowledge of aquatic biology to the team leadership. [>MORE](#)

Market for ship recycling



Things are happening in the raw materials industry: more than 20 million tons of scrap steel from the demolition of cargo and passenger ships will come onto the global market every year from 2033. This is the finding of an analysis carried out by ZMT that was revealed at a symposium in Bremen held by the Maritime Cluster Northern Germany at the beginning of November 2023. The study "Ship recycling in Bremen", presented by ZMT's director Raimund Bleischwitz, outlined the options and recommendations for action for sites in Northern Germany and emphasised the steel industry's growing demand for recycling material for climate-friendly production processes. [>MORE](#)

Dialogue in the Caribbean

Heads of state and high-level delegates from the Small Island Developing States (SIDS) in the Caribbean met at the end of September 2023 in Grenada for a two-day conference on climate change. One active participant was ZMT mangrove ecologist Martin Zimmer who was invited by the UNFCC Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). Zimmer shared new research results and scientific findings in a keynote speech and took part in the lively discussion on topics including possible adaptations to climate change and climate justice. "There is a great need for innovative approaches to ecosystem (re-)establishment," Zimmer concluded. "Moreover, it is essential to involve local actors and communities from the very beginning and for the whole duration of such projects, an approach which reflects the vision and mission of ZMT." [>MORE](#)

Overfished coral reefs

What is the state of fish stocks and fish diversity on the world's ocean reefs? In order to find an answer to this question, an international research team employed a new approach to evaluating a dataset of fish observations, environmental

conditions and management status of more than 2,000 coral reef sites worldwide. The results of the study were published in *Nature Communications*. "At nearly two-thirds of the sites, there is more fishing than the stocks can reproduce in biomass - so there is overfishing," says Sebastian Ferse, a reef ecologist from ZMT who was one of the authors of the study. However, it is possible, he notes, to develop tailor-made management approaches that take both fishing and ecological objectives into account. [>MORE](#)

The Ocean - an ally for climate protection



"The ocean is our partner in the fight against climate change," says ZMT director Raimund Bleischwitz. That is why ZMT supported two public campaigns for ocean issues on two different stages at the end of 2023. It signed the *COP28 Dubai Ocean Declaration* and took part in the new *World Ocean Review*.

In the run-up to the annual United Nations Framework Convention on Climate Change (UNFCCC) more than 40 international organisations in the fields of marine sciences, politics and philanthropy signed the *COP28 Dubai Ocean Declaration*. The latter calls on the world's heads of state and governments to recognise the crucial importance of marine research and observation for understanding the ongoing global climate changes and to substantially extend and improve their support. [>MORE](#)

The eighth *World Ocean Review (WOR)*, published in November 2023, is entitled "The ocean as a climate saviour?". With scientific input from ZMT and many more institutes, the report explains the role of the ocean in the Earth's carbon cycle. Amongst other things, it also points out the enormous importance of the oceans for climate protection and the vital role that blue carbon ecosystems such as mangrove or seagrasses play in carbon sequestration. [>MORE](#)