



FOOD FOR THE FUTURE

Towards sustainable nutrition worldwide

ON EXPEDITION

The figures for fish caught around the world are falling – as the statistics published by the United Nations' Food and Agriculture Organisation (FAO) over recent years have revealed. But in the future, food from the ocean will be more important than ever if we are to meet the protein requirements of a growing world population. So far, shrinking catch figures have been compensated by farming. "Aqua- and mariculture are responsible for a general increase in fish production figures," explains ZMT marine ecologist Andreas Kunzmann. "But aquaculture in its current form has an acceptance problem." Aquaculture's poor reputation worldwide has a lot to do with the same problems we know from monocultures and industrial livestock farming on land. Kunzmann and his working group "Experimental Aquaculture" are therefore searching for new, effective and sustainable ways forward.

Model for the future: Integrated Multi Trophic Aquaculture (IMTA)

"In nature, there is always interaction between species; none is ever completely alone. IMTA is an attempt to learn from nature and replicate it in aquaculture." (Andreas Kunzmann, head of WG Experimental Aquaculture)

The approach: By cultivating selected species together, a mini-food chain is created. The one's waste product is the other's nutrition source. The fish is fed and everything it does not eat or that dissolves in the water is ingested by other species. "For example, an ideal IMTA consists of fish, algae, mussels and sea cucumber," says Kunzmann. "A good household of foodstuffs-compatible species that can be found in all climate zones." This not only means a reduction in the pollution caused by increased nutrients in the water; the advantage for the environment is also an advantage for the farmer. Feed is expensive and too much of it currently gets wasted in the dissolved state. Moreover, the farmer can harvest the various organisms several times a year. ZMT social scientists are also involved in IMTA research, trying to discover what could make the model attractive to families and village communities on tropical coasts that have previously lived off fishing. Concurrently, Kunzmann and his team are experimenting with a number of Leibniz institutes on the aquaculture of jellyfish as part of the "Food for the Future" project. "They seem to be the beneficiaries of climate change and we want to discover whether they can be cultivated to deliver protein." [>MORE](#)

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TIPPING POINTS

ZMT Programme Area 1
»Aquatic Resource Use and Protection«

How is the world going to change? There is no doubt that global warming will change the conditions in the marine environment. But where and how? What will happen to fish stocks? Will the systems we know reach tipping point? What will constitute sound usage strategies for marine resources?

“Programme Area 1 Aquatic Resource Use and Protection aims to find a balance between supporting novel uses of aquatic resources with the protection of those resources by following interdisciplinary and transdisciplinary approaches in fisheries resource management and sustainable aquaculture production.” (Mirta Teichberg, spokesperson PA 1)

“Humboldt Tipping” is the title of one of many projects in ZMT Programme Area 1 investigating socio-ecological systems that are reaching tipping points due to possible climate-related disruptions of the ecosystem food webs. The aim of this overarching collaboration between German and Peruvian partners is to understand tipping point scenarios of the Humboldt Current Ecosystems and to develop governance strategies for improving adaptation to future ecological impacts.

Consequences for the value-added chain

Quite specifically, it addresses one of the world’s major upwelling systems, the northern part of the Humboldt Current off Peru, which ZMT scientist Matthias Wolff has been studying for many years. “Our big worry is that, due to the rise in the temperature and changes in the wind fields of the Humboldt Current, the upwelling of nutrient-enriched waters is becoming weaker and may lead to a breakdown of the very productive food chain.” This

would impact Peruvian industrial fisheries, which extract between five and seven million tonnes of anchovy biomass from the system every year, mainly for producing fishmeal. The world market price for fishmeal would increase if the fishery collapsed with dramatic effect on the aquaculture sector, says Wolff. “The entire value-added chain would be affected.”

“In Germany and other European countries, we largely meet our fish and protein requirements with imports. People in the tropical belt are dependent on our needs. One of the reasons for our research in PA 1 is to take on global responsibility.” (Achim Schlüter, spokesperson PA 1)

Apart from simulating models around the industrial anchovy fishery off Peru, the ZMT scientists will also address the potential change in coastal and island systems off both Peru (Bay of Sechura and Independencia) and Ecuador (Galápagos). Here, cultivation of the Peruvian scallop, eco tourism and fish derived from artisanal fishing all depend on a well-functioning Humboldt Current System. “Together with colleagues involved in the project from Kiel, Hamburg and Peru, we are effectively studying all these areas in order to simulate future tipping point scenarios – and investigate everything from the biogeochemical cycle in the ocean over resource utilisation practices through to the functioning of the value-added chains,” says Wolff. The researchers combine their new data with the coastal system models that ZMT produced 10 to 15 years ago in cooperation with the Peruvian Marine Institute, IMARPE. “These are good reference models which we can dock onto to finally identify the important system changes.” [>MORE](#)

“Humboldt Tipping” is a research project funded by the BMBF until 2022 involving the universities of Kiel, Hamburg and Bremen, GEOMAR Helmholtz Centre for Ocean Research Kiel and the Instituto del Mar del Perú (IMARPE). Subproject 4 is being coordinated by the Department of Theoretical Ecology and Modelling at ZMT.



FROM FISHER TO FARMER?

Small-scale fishery meets aquaculture – observations on structural change with ZMT postdocs Lotta Kluger and Aisa Manlosa

How are fishermen on tropical coasts faring?

Lotta Kluger: Fish migrate when the conditions in their environment deteriorate. And fishers trail after the fish. That's nothing new. But due to extreme weather events – such as El Niño in Peru – and modern social media networking, this animal and human mobility is getting a new dynamic. Decades of ZMT research along the Peruvian coast are the living proof. Climate change will probably result in increased migration. Mobile resource users seem to be more resilient to resource volatility. On the other hand, the fact that they suddenly crop up wherever there is something to be caught puts enormous social pressure on local resources and fishers.

Aisa Manlosa: In the Philippines, households that depend on small-scale capture fisheries are threatened by various factors. A widely shared perception in the area I study is that excessive use of commercial feeds in large-scale intensive aquaculture operations combined with unsustainable water disposal practices contribute to the pollution of natural waters. This is compounded by indiscriminate disposal of domestic wastes into rivers and the sea. Along with illegal fishing practices, these are negatively affecting aquatic species and livelihoods.

Is aquaculture an answer?

Aisa Manlosa: I study the institutional change that is happening with the transition from fishing to aquaculture in the Philippines. At the moment, it's not the fishers who are generating new income from aquaculture, but rather landowners or those who have capital. Fishers typically do not have the capital to invest. Moreover, the transition to aquaculture may entail a shift in deeply ingrained practices. For instance, one fisherman commented that

fish farming involves waiting to harvest whilst capture fisheries provide food and income in a day. There are, however, a few who have fully shifted to aquaculture.

Lotta Kluger: Aquaculture farmers have to plan ahead. So, the transition from fisher to farmer means thinking differently. That is part of the problem in Northern Peru where fishers had started cultivating scallops in a large bay in the early 2000s. But when a coastal El Niño hit in 2017 and the salt content of the coastal waters was changed by the heavy rainfall, 95 percent of the cultivated scallops died. This ruined the fishers who had specialised in this monoculture but were not financially secure enough to cope with such a disaster.

What kind of support would the change require?

Lotta Kluger: Long-term planning and the negotiating skills a farmer needs are something you can learn. But in Peru there is no governmental support for fishers to do retraining courses that would enable them to be better prepared in case of a future scallop die-off. Our research at ZMT on ecological and social dynamics is therefore not only geared to predicting possible consequences but also to providing policy advice.

Aisa Manlosa: The conversations I am having with Philippine fishers show that some are interested in transitioning to aquaculture despite all the challenges. If all the necessary resources, including training, social knowledge sharing, technology, and materials were available, it is likely that aquaculture, particularly mariculture, would be a viable option. Policies and effective local implementation would be needed to make sure the shift is sustainable and not harmful to the environment. [>MORE](#)

AISA MANLOSA (Department of Social Sciences) works in the project "Food for the Future" (BMBF-funded) coordinated by Andreas Kunzmann (see p. 1) in the Philippines, LOTTA KLUGER (Department of Theoretical Ecology and Modelling) is involved in the project "Humboldt Tipping" (see p. 2). [>MORE](#)

Georg Forster Award Winner at ZMT

ZMT's long-term collaboration partner, Professor Mohamed Ali Farag from Cairo University in Egypt, has been granted a prestigious Georg Forster Research Award by the Alexander von Humboldt Foundation. On



the strength of the award, which goes to high-profile researchers from developing countries and transition economies to establish collaborations with German colleagues, the renowned pharmacologist will return to ZMT and the Leibniz Institute of Plant Biochemistry (IPB) in Halle to work on soft corals. [>MORE](#)

ZMT workshops worldwide

Continuing education – knowledge exchange – scientific cooperation for more sustainability. Numerous ZMT workshops invigorate its collaborations with partners in the tropics.



Zanzibar November 2019: The first ZMT Workshop "Seagrass for Life", a collaboration with the Institute of Marine Science of the University of Dar es Salaam and the Zanzibar Fisheries Research Institute, supported by students of the ISATEC Master's course (ZMT in cooperation with Uni Bremen), brought together more than 60 scientists, seagrass farmers, fishermen, teachers and school pupils. They discussed and learned the value of restoring seagrass beds in Zanzibar's coastal waters. [>MORE](#)

Berlin January 2020: "The Blue Sector at the Crossroad - Moving Aquaculture into more Sustainable Waters" was a workshop to promote interdisciplinary exchange amongst

Leibniz institutes and related organisations (NGOs). It was run by ZMT and the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) in Berlin. Three focus groups discussed the role played by fresh water and sustainably managed marine aquacultures in the world's growing need for protein. [>MORE](#)

Bremen February 2020: The winter school "Ocean Governance for Sustainable Marine Ecosystems" – a five-day intensive programme run by ZMT and the International Ocean Institute Deutschland (IOI) – enabled some 25 international junior researchers to come together to develop solutions for the sustainable protection and governance of the oceans. [>MORE](#)

Zanzibar March 2020: Together with the Food and Agriculture Organisation of the United Nations (FAO), the National Institute of Aquatic Resources in Denmark (DTU Aqua) and the Institute of Marine Sciences (IMS) in Zanzibar, ZMT has organised a two-week training course on evaluating fish stocks in line with the UN's sustainability goals. [>MORE](#)

ZMT's digital future

With its DigiZ Initiative, ZMT is taking another step towards establishing data science and expanding its digital infrastructure. This is being made possible by permanent funding of approximately €500,000 per year granted by the Federation and Federal State. In the future, the wealth of heterogeneous field and research data from marine tropical habitats, which has been collected at ZMT for almost 30 years, will be evaluated and processed further using modern data science techniques. Systematically linking social scientific and marine scientific data can give rise to new insights of transdisciplinary relevance. Moreover, the new data infrastructure facilitates access to ZMT's research results both for academia in partner countries and for various stakeholders in politics, industry and society. For this, two new working groups "Data Science and Prediction" and "Research Data Management" are currently being established. The added value generated by the data will additionally reinforce ZMT's partnerships. [>MORE](#)

ZMT on YouTube

Follow the ZMT team on a research expedition or while diving through a coral reef.

