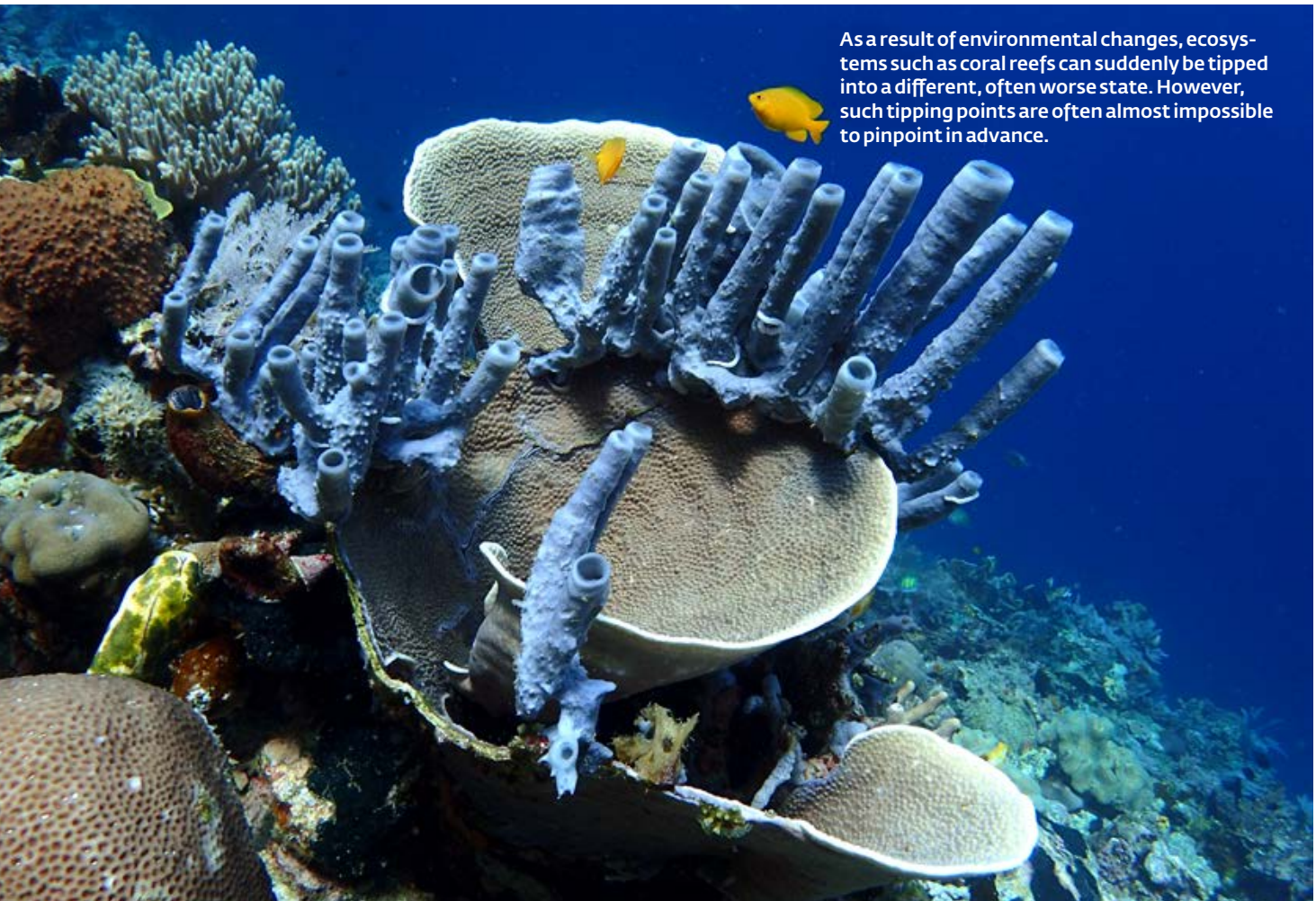
Threshold values under scrutiny

Tipping points have become a relevant concept in environmental research. The idea suggests that an ecosystem tips into a different, often worse state, as soon as a particular stressor crosses a threshold. For example, the tiniest algae can cause reef damage by growing too quickly thereby superseding the corals when the amount of nutrients in the water is too high. This implies that if an ecosystem is to remain stable, environmental stressors such as those resulting from global change should not exceed these thresholds.

Now, however, an international team led by Prof. Dr. Helmut Hillebrand, director of the Helmholtz Institute for Functional Marine Biodiversity at the University of Oldenburg, has cast doubt on whether environmental policies should be based on the concept of tipping points. In an extensive analysis published in the scientific journal Nature Ecology and Evolution, the researchers indicate that tipping points are almost impossible to identify on the basis of environmental data.

The team studied a total of 36 meta-analyses, which statistically summarize the findings from some 4,600 ecological field experiments on the impact of environmental stressors. The study is thus the most comprehensive analysis of scientific literature on global change to date. The researchers used the data to calculate how strongly a system reacts to a particular stressor. They then tested statistically whether greater stressors induce stronger reactions and whether any indicators of thresholds could be inferred from this. Although the degree of stress caused by a stressor did influence how strongly an ecosystem reacted, thresholds were detectable in only three of 36 cases, the scientists found. Further simulations showed that even small environmental changes cause a variety of reactions in ecosystems. But existing data often does not reflect these fluctuations – and therefore provides no evidence of thresholds.

The idea that ecosystems remain stable within a clearly defined range must therefore be abandoned, the researchers conclude. The focus on tipping points risks overlooking smaller and more gradual, but no less impactful changes. Scientists and policy makers should therefore pay close attention to the size and duration of random fluctuations and their possible consequences to be able to act according to the precautionary principle in the future.



As a result of environmental changes, ecosystems such as coral reefs can suddenly be tipped into a different, often worse state. However, such tipping points are often almost impossible to pinpoint in advance.

New method for EEG scans

User-friendly, comfortable and in the future almost invisible: Oldenburg brain researchers have presented a new method for long-term monitoring of the brain's electrical activity. In the Journal of Neural Engineering the team led by neuropsychologists Prof. Dr. Stefan Debener and Sarah Blum reported that their fEEGrid (flex-printed forehead EEG) device captured similar brain signals as conventional EEGs yet causes almost no inconvenience to users when worn over periods of eight hours in everyday situations. The new, flexible measuring device would enable future EEG scans to be conducted outside the laboratory – and without the unpleasant side effects often experienced by patients undergoing long-term brain wave measurement. For their study, the team conducted tests with twenty healthy volunteers. The test subjects wore the mobile EEG devices for a total of eight hours as they went about their daily activities.

Looking inside a battery

Oldenburg chemists have developed a new method to allow real-time observation of previously inaccessible activity in batteries on a microscopic level, according to a paper published in the scientific journal ChemElectroChem by a team in the Chemistry Department led by Prof. Dr. Gunther Wittstock. The technique they used is known as scanning electrochemical microscopy, or SECM. This involves slowly moving a measuring probe across the surface of a sample to collect chemical data at intervals of just a few micrometres (a few thousandths of a millimetre). The researchers developed a special measuring cell in which they could directly obtain high-resolution information about the surface of metallic lithium electrodes during charging and discharging cycles. The team paid particular attention to the extremely thin layer that forms on the surface of the electrodes. This new technique could help speed up the search for suitable materials for new generations of batteries, the researchers said.

Learning from sea cucumbers

Sea cucumbers possess a natural anti-fouling mechanism, according to paper published in the science journal Marine Drugs by a team of researchers led by Prof. Dr. Peter Schupp at the Institute for Chemistry and Biology of the Marine Environment (ICBM). The cylindrical animals can prevent other organisms from growing on them by producing special chemical compounds known as saponins. The researchers studied various species of sea cucumbers off the coast of Indonesia and Guam. They discovered that the anti-fouling effect of the substances varied according to the sea cucumber species, the concentration of the saponins and their molecular structure. The team was able to identify saponins that were particularly effective in terms of anti-fouling. This knowledge could be used to develop environmentally friendly paint that prevents organisms from growing on ships and marine measuring devices, for example. The anti-fouling paints currently in use are mostly not biodegradable and are toxic for aquatic life.

New ideas for rural areas

How to make post-school education available outside urban areas? Researchers at the University of Oldenburg are investigating this question in a sub-project of the research project InDaLE ("Innovative Approaches to Public Services"), which is funded by the Federal Office of Agriculture and Food and coordinated by the University of Hannover. The Oldenburg team led by Prof. Dr. Ingo Mose analyses examples of successful educational programmes in European countries such as Sweden and Scotland. The aim is to find out whether these approaches would also work in Germany.

A boost for digital teaching

Together with partners at the University of Vechta and the Osnabrück University of Applied Sciences, lecturers at the University of Oldenburg are developing "Open Educational Resources" for education management and inclusive education in two new projects. These free and open-access teaching and learning resources will range from individual videos to entire online courses and are aimed at education managers and students in teacher training. Each of the two projects has been awarded a grant from Lower-Saxony's Ministry of Science and Education of around 170,000 euros over a period of eighteen months.

A nanolaser made of gold and zinc oxide

Tiny particles made of metals and semiconducting materials could be used as light sources in the components of future optical computers – thanks to their ability to dramatically concentrate and amplify incident laser light. In the scientific journal Nature Communications, a team of researchers from Germany and Sweden led by Oldenburg physicists Prof. Dr. Christoph Lienau and Dr. Jin-Hui Zhong described how the process works.

For the study, the physicists produced nano-materials that combine the optical properties of metals and semiconductors. First, they took sponge-like particles of gold with a diametre of just a few hundred nanometres (one nanometre is equal to one billionth of a metre) and pores approximately ten nanometres in size. The team then developed a procedure for coating the particles with a thin layer of the semiconductor zinc oxide that penetrates the tiny pores of the gold particles.

The resulting coated particles are capable of changing the colour of incident light. If red laser light is directed at them, for example, they emit short-wave blue laser light. The colour of the light depends on the exact properties of the nanomaterial. These nanoparticles could function as tiny light sources – nanolasers so to speak – in future optical computers that compute using photons rather than electrons. Potential sites of application are ultra-fast optical switches and transistors.

Measuring the wind upstream

Wind ramps are strong fluctuations in wind speed and direction that take place within a period of less than thirty minutes. To more accurately forecast their occurrence, scientists at the ForWind Centre for Wind Energy Research and their project partners aim to measure wind speeds several kilometres "upstream" of wind farms using lasers. The team led by Prof. Dr. Martin Kühn uses the laser-based remote sensing technology lidar (light detection and ranging) to calculate distances and wind speeds. These measurements will be used to develop an "observer-supported wind energy forecast" that can be integrated into existing forecasting methods. Another goal is to improve the range and resolution of lidar devices. The necessary data is being collected in a two-year measuring campaign at the Nordergründe offshore wind farm northeast of Wangerooge. The "WindRamp" research project is being funded by the German Federal Ministry for Economic Affairs and Energy with 2.75 million euros over three years.

Monitoring ship emissions more effectively

Around 90 percent of global trade takes place along the shipping routes of the world's oceans. Shipping emissions are not only harmful for the marine environment but also for the health of people living in densely inhabited coastal regions and near ports. To measure and track these emissions more effectively in the future, a German-French team of researchers led by Oldenburg marine chemist Prof. Dr. Oliver Wurl of the Institute for Chemistry and Biology of the Marine Environment (ICBM) is developing a new monitoring network as part of the EU joint research project MATE ("Maritime Traffic Emissions: A monitoring network").

One aim of the project is to better calculate the precise dimensions of contamination events such as those resulting from shipping collisions, for example. Over the next three years the team will work to develop novel methods of automated, 24-hour tracking of pollutants such as soot, oil, sulphur dioxide and plastic debris on the sea surface and in the air. Drones and equipment from research ships will be used in conjunction with a network of profiling floats.

This measuring network will allow the researchers to meet the demand for new environmental monitoring systems to ensure compliance with international emissions regulations. The German Federal Ministry for Economic Affairs and Energy is providing the German project partners with approximately 1.6 million euros in funding.

Students' research on the coronavirus pandemic

Is social contact as important as we think it is? What new word combinations have emerged since the start of the coronavirus pandemic? Which stress factors and problems have parents had to deal with over the past few months? Around 50 students from five different faculties examined questions like these in independent research projects between June and November. The university provided 100,000 euros in funding for these projects as part of its teaching approach forschen@studium (research@curriculum). The money was used to cover material costs and also to hire students as student assistants for the duration of the projects. A total of 27 teams applied in response to the call for proposals, of which 19 were selected. Prof. Dr. Verena Pietzner, Vice President for Instruction and International Affairs, acted as patron for the initiative.

The topics of the funded projects were as varied as the students' prior knowledge and academic backgrounds, which ranged from educational sciences, social sciences, cultural studies, German studies and history to the natural and health sciences. The teams investigated questions such as how the university's energy use changed during lockdown, the potential of digital media for practice-oriented music teaching, and the consequences of pandemic-related restrictions, for international students in particular. Several teams from the international programme "European Master in Migration Studies and Intercultural Relations" (EMMIR) focused on the concept of "home" in their projects, examining how this has changed during the pandemic. Since many of the EMMIR students have already carried out their own research projects in the course of their studies, the call for proposals offered a good opportunity for them to try out new or more ambitious research methods. All the teams were assisted by one or two members of the teaching staff who provided academic supervision.

"The topics and challenges that the students dealt with in their projects varied greatly. What they all had in common was the desire to link current developments with the knowledge acquired during their studies, and thus understand them better," explained Dr. Susanne Haberstroh, Research-Based Learning Spokesperson. Promoting the passion for research was one of the main objectives of the call for proposals. The teams presented the results in a virtual poster session on 26 November to mark the annual "Teaching and Learning Day", which aims at improving knowledge exchange and experiences in higher education teaching and learning approaches.