Biodiversity of Earth's islands in peril

Life on Earth's islands can be described as vast biodiversity concentrated in a small area. Islands only comprise seven percent of Earth's land surface, but they are home to 20 percent of all plant and animal species. In the journal "Global Ecology and Conservation," biogeographer Professor Severin Irl from Goethe University and colleagues describe the current state of biodiversity. It makes for alarming reading.

The authors of the article, who see themselves as the international mouthpiece for endemic species, suggest concrete measures for avoiding further extinction.

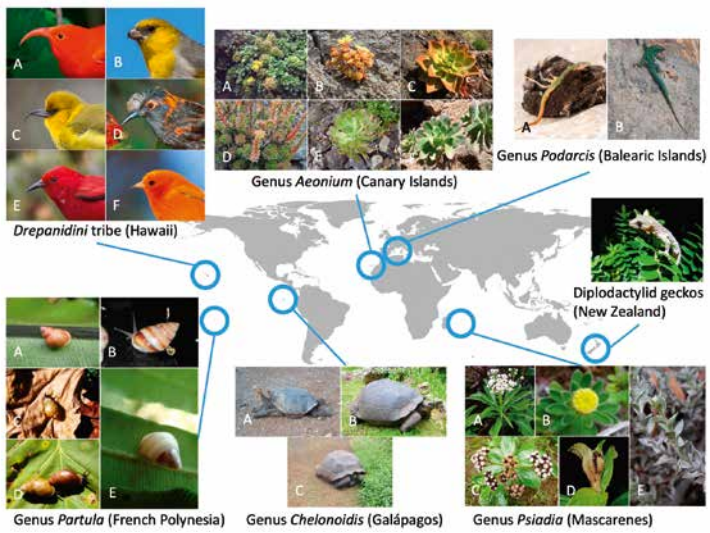


Figure from: Fernández-Palacios et al. 2021

Island biodiversity is in great peril.

The authors, all board members of the Society of Island Biology (SIB) founded in 2020, describe how island ecosystems are under great pressure due to human actions. Isolation from a continent has led to the development of unique plant and animal species, known as endemic species, that exist only on a particular island or archipelago. The pressure they are experiencing results from the overexploitation of ecosystems, the destruction of habitats through, for example, agriculture, as well as from the introduction of alien species and climate change. Island species, however, are often less able to adjust to changes than species on a continent. More than 800 species have become extinct in the past 400 years. "If this trend continues, islands will carry the bulk of extinct species in the future," says Severin Irl.

They say that a complete inventory of the species on islands is required as a starting point. The fact that such data often simply do not exist makes it difficult to develop appropriate nature conservation concepts. Any such measures, the article states, ought to take the needs of the local people into consideration, who should act as the custodians of biodiversity and work with scientists to develop the necessary capacities.

Alliance for the future: Helmholtz Centre and Goethe University

Goethe University and the Helmholtz Centre for Environmental Research in Leipzig have set themselves the goal of advancing water research and concluded a corresponding cooperation agreement. Joint research projects are planned, and both institutions will train early career scientists in interdisciplinary environmental research. "In particular, our Faculty of Biological Sciences and the Helmholtz Centre research unit 'Chemicals in the Environment' both have expertise that complements each other perfectly. In terms of research strategy, we are united, on the one hand, by the goal of bringing environmental research and health research closer together in the 'One Health' approach and of further linking it with biodiversity research on the other," says Professor Enrico Schleiff, president of Goethe University. Climate change will pose even greater challenges for the sustainable management of water, a resource already scarce and at risk. These are the challenges that the two research institutions want to address within their strategic partnership. The Helmholtz Centre for Environmental Research in Leipzig looks at the complex interactions between humans and environment in exploited and disturbed landscapes, in particular densely populated urban and industrial metropolitan areas as well as near-natural landscapes. Research on the conservation of the natural foundations of human life and biodiversity is one of Goethe University's key research areas.

Reading and speaking follow a similar rhythm

When we read, our gaze moves over the text in a certain pattern. This pattern resembles – to a surprisingly high degree – the rhythm of spoken language, as a team of researchers, with the significant involvement of Goethe University, has discovered. Their research results were published on 6 December 2021 in the journal "Nature Human Behaviour".

An international team of researchers, in which Goethe University was significantly involved, discovered in the course of a meta-study with 14 different languages that the temporal structure of reading is almost identical to the dominant rhythm of spoken language. It can be concluded from this that the processing of written and spoken language are far more similar than previously assumed. Other research institutions involved were the University of Vienna, the Ernst Strüngmann Institute in Frankfurt, New York University, the Max Planck Institute for Empirical Aesthetics, also in Frankfurt, and the University of Salzburg.

Languages and writing systems are central elements of human communication. For thousands of years, writing systems have enabled us not only to share information face to face but also to store it in a tangible form and make it permanently available. "Reading is one of humanity's most fascinating cultural achievements," says lead author Dr Benjamin Gagl, who until recently was a research associate at the Institute of Psychology at Goethe University. "Spoken language also influences reading. Until now, however, little has been known about the common underlying mechanisms of reading and spoken language," explains Gagl, himself a psychologist.

Photo: Shutterstock/Wavebreakmedia

Recent research shows that the rhythm of reading resembles that of speaking.

Together with an international team led by Professor Christian Fiebach, Gagl explored these mechanisms by comparing the temporal structures of reading with those of spoken language. This revealed that the rhythmic sequences of eye movements when reading and the dominant rhythm in speech signals are almost identical. These findings shed new light on the interface between written and spoken language.

https://tinygu.de/language-rhythm

Six of the most-cited researchers work at Goethe University

Of the 6,600 researchers in the world most cited in scientific publications, six work at Goethe University. This was determined by the 2021 "Web of Science" citation ranking. Those whose publications are often cited have also made ground-breaking discoveries. That is why the frequency of citations – especially in the natural sciences and medicine – is an indication of the scientific significance of a publication as well as of the author's standing in the scientific community. The most frequently cited professors at Goethe University are Ivan Đikić (Biochemistry II), Stefanie Dimmeler (Medicine), Petra Döll (Physical Geography), Stefan Knapp (Pharmacy), Sibylle Loibl (Medicine) and Stefan Zeuzem (Medicine).

Excellent research on the environment and sustainability

Cultural anthropologist Kathrin Eitel and biologist Christian Schwerer were awarded the Frankfurt Prize for Environment and Sustainability 2021 for their theses. In her dissertation "Recycling Infrastructure, Practices of Waste Handling in Phnom Penh," Kathrin Eitel portrays vividly, the committee said, how waste enters nature in a city landscape. Eitel argues for a recycling economy that would enable the metropolises of the Global South to develop sustainably. In his doctoral thesis, Christian Scherer examined the origin, fate and impact of microplastics in inland waterways ("Mikroplastik in Binnengewässern – Herkunft, Verbleib und Wirkung"). The award committee commended his comprehensive account of this phenomenon from its source to its effects. Advancement awards went to sociologist Anita Kalustian, bioscientist Jasmin Thal and environmental scientist Jonas Wallraff.

Research Training Group on "Resolution of Inflammation" continues

Funding of the German Research Foundation's Research Training Group "Resolution of Inflammation" at Goethe University will continue for another four and a half years. The group, which was set up in 2017, focuses on the relatively recent discovery that the resolution of inflammation is also actively controlled by the body. Research will be conducted into how this happens at cellular and molecular level – and why it sometimes fails. For a long time, it had been assumed that although an inflammation process was actively initiated by the body following injury or chemical stimuli, its resolution occurred as a result of the gradual death of the immune cells and the dilution of inflammatory signal substances. Research Training Groups work on interdisciplinary research projects and provide a training framework for early career researchers.

The Celts and Romans operated mines in the Montafon

Could "Montafon" actually be derived from the word for "mining mountain" in Montafun dialect? Archaeologists at Goethe University have discovered that mining already took place in the 39-kilometre-long valley in Vorarlberg, Austria, in late Celtic and Roman periods.

The history of mining in the Montafon is evidently long and continuous. As research has shown, ore deposits were exploited for centuries, beginning as early as the late-Celtic period. But it was previously unknown that there were activities inside the mountain as early as Celtic and Roman periods. This new discovery makes the mining district one of the most remarkable in the Alps. "We did not expect this," says Rüdiger Krause, professor of prehistory and early history at the Institute for Archaeological Sciences at Goethe University. Archaeological research in the past years had already shown that the small mining area of Bartholomaeberg is a very exciting and special research region, which has yielded many finds and features from mine dumps, old surfaces and bogs, and from which samples have been recovered and numerous data obtained. However, archaeological sources on Roman mining in the Eastern Alps were previously unknown. The new excavations in the Knappagruaba in September, in which students were involved, revealed a small sensation: traces of early mining were clearly visible on surface areas, consisting of heaps of waste rock, round shafts hewn into the rock, and indications of deeper lying iron ore veins. For the first time, it was possible to uncover archaeological features from mining in the Roman period, which are unique not only for this small mining area but for all the Eastern Alps. Two backfilled mining shafts that had been dug near an area of mineralisation were excavated to three metres below the surface. These are evidenced on the rock surface by fissures containing iron oxides and quartz veins, forming what is referred to as the "iron cap" – the oxidation zone of an ore vein. Ram core drilling will be used to determine how deep the shafts extend underground.

Photo: Rüdiger Krause/Goethe-Universität/Montafon-Projekt

During excavation work at Bartholomaeberg, Frankfurt archaeologists uncovered something surprising.

From machine learning to machine teaching: Volkswagen Foundation funds interdisciplinary AI research

The Volkswagen Foundation is donating approximately €10 million to research into how artificial intelligence will affect society. Goethe University was successful with an application that focuses on developments within education.

"From Machine Learning to Machine Teaching (ML2MT) – Making Machines AND Humans Smarter" is the title of the project submitted by economist Professor Oliver Hinz together with colleagues from various other disciplines. The scientists were inspired by the success of learning machines, a prime example being the board game "Go" in its computer version "AlphaGo Zero". Their project aims to achieve a better understanding of how humans and machines can gain new knowledge through symbiotic interaction in collaborative human-AI systems. The following researchers are involved in the project: Professor Oliver Hinz (Economics, GU (project leader)), Professor Yee Lee Shing (Developmental Psychology, GU), Professor Loriana Pelizzon (Economics, GU) and Professor Tobias Tröger (Law, GU; both also at the Leibniz Institute for Financial Research SAFE, Frankfurt/Main), Professor Gernot Rohde (University Hospital Frankfurt and GU), Professor Kristian Kersting (Computer Science, TU Darmstadt), Professor Hendrik Drachsler (Computer Science, GU, and Leibniz Institute for Research and Information in Education, Frankfurt/Main).

Photo: Shutterstock/pinkeyes

What effect does the use of AI have on society? An interdisciplinary project looks at developments in education.

New discovery in the treatment of COVID-19

The Institute of Medical Virology at Goethe University and the School of Biosciences at the University of Kent have succeeded in identifying new points of attack for the treatment of COVID-19. During an infection, the coronavirus reprogrammes host cells so that they produce new viruses. In the process, the metabolism of the infected cell is also altered. Professor Jindrich Cinatl and his team had already shown in earlier projects that the affected cells process glucose differently from non-affected cells. It has now been revealed that an infection also causes changes in the pentose phosphate pathway. Active substances that interfere with virus-induced metabolism changes could be a starting point for new treatment options. "Targeting virus-induced changes in the host cell metabolism is an attractive way to interfere specifically with the virus replication process," says Professor Cinatl.

https://tinygu.de/COVID-treatment

€2.7 million for inclusive education research

Germany's education system is to become more inclusive. This requires qualified specialists and good diagnostics. Since 2017, the Federal Ministry of Education and Research has funded scientific projects in the field of inclusive education as a separate priority in its Framework Programme for Empirical Educational Research. The first funding phase was about training educational professionals, and the second will be concerned with diagnostics. Goethe University has again been successful – with four collaborative projects and a meta project.

The development of new concepts and material for the training and (continuing) education of staff in the education system was at the forefront of the Ministry of Education and Research's funding guidelines "Qualification of Educational Professionals for Inclusive Education" ("Qualifizierung der pädagogischen Fachkräfte für Inklusion"). This development work was to be based on scientific principles and conducted at different locations. The first phase comprised 20 individual and 18 collaborative projects, five of which involved Goethe University. In addition, Professor Dieter Katzenbach and Professor Michael Urban, Frankfurt educational scientists, secured a meta project, which was responsible for networking, transfer and research at meta level – for example on the state of research worldwide. A central website was set up that can be found at www.qualifizierungs-inklusion.de, and a peer-reviewed online journal entitled "Qfl" – Qualification for Inclusion – was also established (www.qfi-oz.de). Special events brought together not only those involved in the project but also other stakeholders from practice, administration and politics.

Photo: Shutterstock/Krakenimages

For inclusion in the education system to be successful, staff must be well-trained.

This diverse and successful work can now be continued for another five years: the Federal Ministry of Education and Research has pledged a further €1.7 million for the meta project alone, with an overall sum of €2.7 million allocated to Goethe University. This second funding phase is entitled "Support-related Diagnostics in Inclusive Education" and thus focuses on diagnostics. The meta project team working with Professor Katzenbach and Professor Urban will above all devote itself to establishing and maintaining a contact point for all those involved in education. In addition, research findings, along with the products and material developed by the projects, are to be made accessible to people outside the scientific community too. The four collaborative projects under the leadership of Goethe University are headed by Dr Julia Gasterstädt and Professor Vera Moser (who leads two projects), both from the Institute of Special Education, and by Professor Ilonca Hardy from the Institute of Elementary and Primary Level Education.

Cooperation with FIAS

Starting in 2022, Goethe University and the Frankfurt Institute for Advanced Studies (FIAS) will intensify and expand joint research projects and the exchange of scientific knowledge. A new cooperation agreement was signed in November 2021. Since FIAS was founded in 2003, the university and the institute have been collaborating in interdisciplinary basic research in the natural sciences, life sciences, neurosciences and computer sciences. "The contract gives us the freedom to conduct even more interdisciplinary research and to design our projects to answer questions relevant to both partners," said Professor Enrico Schleiff, president of Goethe University, about the alliance. For example, there are plans to explore technical and content-related topics concerning high-performance computing in the natural and life sciences within the Goethe Center for Scientific Computing.

https://tinygu.de/FIAS-collaboration

Sandra Ciesek receives additional funding for her research – and the Hessian Culture Prize

Virologist Professor Sandra Ciesek has been awarded €1.4 million by the Federal State of Hessen as part of a LOEWE top professorship. These funds and the generous support of the Willy Robert Pitzer Foundation have made it possible to retain Ciesek, a leading physician, at Goethe University. The funds will support an additional professorship at the Institute of Medical Virology, and after five years the foundation will finance another five years with €1.75 million. In addition, Sandra Ciesek was awarded the Hessian Culture Prize by Volker Bouffier, Prime Minister of the Federal State of Hessen, for her contribution to science communication. The laudatory speech was given by her colleague, virologist Professor Christian Drosten from Charité. They were both acknowledged as "University Teacher of the Year" in the spring. Ciesek and Drosten feature regularly in the award-winning NDR podcast "The Coronavirus Update." In his speech, Drosten said that it was "a great stroke of luck" that Ciesek had agreed to step into the public eye despite her extensive workload. "With her keen and discerning approach, she always gets to the heart of the matter – with the same care and empathy that distinguish her as an experienced physician who has worked with patients for many years."

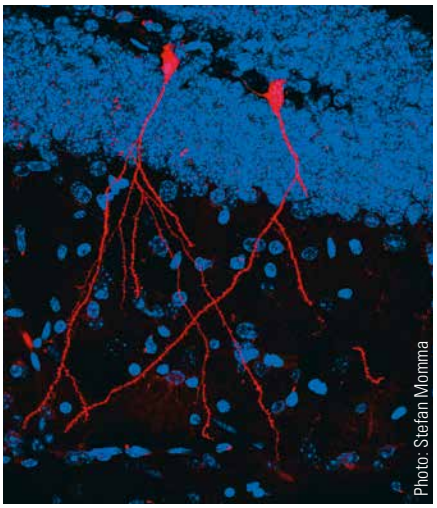
Photo: Universitätsklinikum

Virologist Sandra Ciesek was awarded the Hessian Culture Prize.

By capsule through the bloodstream

Bacteria in the intestine pack biomolecules into capsules and transport them via the bloodstream to various organs in the body, where they are absorbed and processed. This has now been shown for the first time by a team of researchers from Goethe University, FAU (University of Erlangen-Nuremberg) and the University of California in San Francisco.

It is estimated that there are 1.3 bacterial cells for each human cell. Their genetic diversity is correspondingly large. All intestinal bacteria together have 150 times as many genes as humans. The intestinal bacteria's metabolic products have a variety of effects on our body. For example, they train our immune cells, control metabolic processes in the body and regulate how often intestinal mucosa cells renew themselves. The bacterial metabolites act on the cells of the intestinal mucosa via direct contact. But how do such bacterial substances travel to peripheral organs, such as the liver, kidney or brain? It was assumed that small capsules (membrane vesicles), released by bacteria into their environment, were the means of transport. An international research team led by Dr Stefan Momma from the Neuroscience



Looking into the brain of the transgenic mouse: nerve cells that have absorbed protein from intestinal bacteria glow red.

Centre of Goethe University, Professor Claudia Günther from FAU (University of Erlangen-Nuremberg) and Professor Robert Raffai from the University of California has now investigated in mice how bacteria distribute their metabolic products in such vesicles. For this purpose, the researchers colonised the intestines of mice with E. coli bacteria, which produced a specific type of gene scissors (Cre) and released these into their environment via vesicles. The mice cells contained a gene for a red fluorescent protein, which could be activated by the Cre gene scissors (Cre/LoxP system). The result: in the subsequent examination of the mouse tissue, the bacterial vesicles had been absorbed by individual cells in the intestine, liver, spleen, heart and kidneys as well as by immune cells. Even individual nerve cells in the brain glowed red. Stefan Momma: "Particularly impressive is the fact that the bacteria's vesicles can also overcome the blood-brain barrier and in this way enter the brain – which is otherwise more or less hermetically sealed. And that the bioactive bacterial substances were absorbed by stem cells in the intestinal mucosa shows us that intestinal bacteria can possibly even permanently change its properties." The newly established research method will help to better understand the influence of intestinal bacteria on diseases and could support the development of innovative forms of drug or vaccine delivery.

https://tinygu.de/intestinalbacteria

CERN: Goethe University participates in first particle collisions after reconstruction

After ten years of preparation and three years of reconstruction, the new ALICE detector at the CERN particle accelerator in Geneva has delivered first data. This demonstrated that the reconstruction – led, among others, by Professor Harald Appelshäuser from Goethe University – was successful.

Scientists from 30 countries participated in the reconstruction. Its purpose is to investigate an extremely hot and dense state of matter called quark-gluon plasma that prevailed in the Universe microseconds after the Big Bang. It is created when the atomic nuclei of lead from the large LHC accelerator at CERN collide with great energy and break down into their elementary components for a brief moment. With ALICE, insights can be gained into how the Universe as we know it today once evolved. The accuracy of its results had previously been limited by the number of collisions that took place at the LHC and that ALICE was able to record. The reconstruction, which took ten years of preparation and also involved

Goethe University helped develop ALICE detector.

Goethe University, has significantly expanded these capabilities. After the successful trial run at the end of November 2021, the measuring campaign, which will last until 2030, can soon begin. "This is an important milestone for the entire ALICE collaboration," said a delighted Harald Appelshäuser, professor at the Institute of Nuclear Physics at Goethe University.

Goethe University is new partner in National High-Performance Computing Alliance

Goethe University became part of the National High-Performance Computing Alliance at the end of October 2021. The Joint Science Conference (GWK) approved the "NHC South-West Alliance" for ten years. The project will receive funds of €124 million. The alliance covers three federal states, Hessen, Rhineland-Palatinate and Saarland, with facilities at Goethe University, Johannes Gutenberg University Mainz, Technical University of Kaiserslautern and Saarland University. €45 million are earmarked for the future development of high-performance computing at Goethe University, whose own contribution is €30 million. With this decision, the Joint Science Conference is also underlining Goethe University's excellent performance in the area of green IT, for which the Frankfurt team led by Professor Volker Lindenstruth is responsible. https://tinygu.de/high-performance-computing

New insights into black hole

Using complex supercomputer calculations, Dr Alejandro Cruz Osorio and Professor Luciano Rezzolla from Goethe University, together with an international team of scientists, have succeeded in developing a theoretical model of the morphology of the jet of the giant galaxy M87. The jet consists of a gigantic beam of particles ejected from the galaxy. The images from these calculations are an unprecedented match with astronomical observations and confirm Einstein's theory of general relativity.

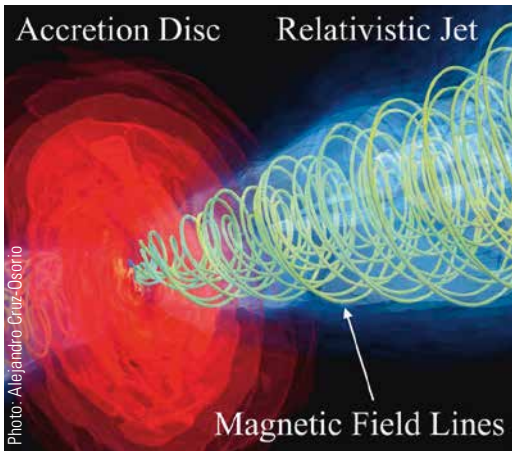
The galaxy Messier 87 (M87) is located 55 million light years away from Earth in the Virgo constellation. It is a giant galaxy with 12,000 globular clusters, making the Milky Way's 200 globular clusters appear modest in comparison. A black hole of six and a half billion sun masses is harboured at its centre. It is the first black hole for which an image exists, created in 2019 by the international research collaboration Event Horizon Telescope.

This black hole shoots a jet of plasma at near the speed of light, known as a relativistic jet, on a scale of 6,000 light years. The tremendous energy needed to power this jet probably originates from the gravitational pull of the black hole, but how a jet like this comes about and what keeps it stable across the enormous distance is not yet fully understood.

Theoretical physicists at Goethe University, together with scientists from Europe, the USA and China, have now modelled the region from which the jet is ejected, the accretion disc, in great detail. For this they used highly sophisticated three-dimensional supercomputer simulations. The result was a model in which the values calculated for the temperatures, the matter densities and the magnetic fields correspond remarkably well with what was deduced from the astronomical observations. This represents "further important confirmation that Einstein's theory of general relativity is the most precise and natural explanation for the existence of supermassive black holes in the centre of galaxies," says Professor Rezzolla.

On this basis, scientists were able to track the complex motion of photons in the curved spacetime of the innermost region of the jet and translate this into radio images. They were then able to compare these computer-modelled images with the observations made using numerous radio telescopes and satellites over the past three decades.

https://tinygu.de/giantgalaxyM87



Along the magnetic field lines, the particles are accelerated so powerfully that they form a jet out of M87 which is 6,000 light years in length.

Supporting top athletes even more individually

How can top athletes get more individual support? That is what a new project by Giessen University, German Sport University Cologne and Goethe University is investigating.

Being successful in professional sport requires consistent and hard training, carefully preparing yourself mentally for competitions, mastering techniques, taking care of your own health and knowing yourself well. Scientists at Giessen University, Goethe University and the German Sport University Cologne have joined forces in the research project "Individualised Performance Development in Sports" to provide scientific support for professional athletes in Germany in the coming years. The consortium will look at the topic from the perspective of different disciplines to better understand and explain how individual performance develops. Here, scientists will work closely with both coaches and athletes. The Federal Institute of Sport Science is funding the project for an initial four years with a total of €2 million.

Goethe University is involved in two subprojects. The Movement and Exercise Science working group led by Professor Karen Zentgraf focuses primarily on individual diagnostics in training and movement science. Computer scientist Professor Lena Wiese is working on a data management system. To bring together and evaluate complex, discipline-specific diagnostics as well as training and competition data from professional associations, the development of an integrated database system is planned.

Princeton University and HEC Paris now also rely on LiveX

Numerous top European universities have already made their decision and are using the LiveX stock market simulation software for digital and interactive knowledge transfer in the area of financial markets and securities trading. As of late, the world's leading business school, HEC Paris, has also been using LiveX to train its students in stock market scenarios. With elite Princeton University as the second new user, Goethe University's simulation programme has now established itself for the first time on the US market too.

In contrast to simple stock market simulation programmes, LiveX simulates real stock market events in all their complexity and provides all important market models. LiveX thus enables universities and institutions in the financial sector to realistically reproduce the world of securities trading when training traders, staff and students.