Shocking research results: Rivers and streams that temporarily dry up are found in all climates and across all continents. A dry river channel carves through the Zagros Mountains in southern Iran and spreads out across the valley floor in a silvery fan. A broad belt of lush agricultural land follows the curve of the alluvial fan.

Tsauchab River and Vlei
Vlei Lobedda, Namibia
A dry, dry channel cuts through the red dunes of the Namib Sand Sea.
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Dear members, friends, and supporters of Senckenberg,

Since its foundation in 1817, the Senckenberg Society has repeatedly faced drastic historical events – political unrest, reforms, economic crises, world wars. Supported by citizens, sponsors, and patrons, we have confronted these challenges, mastered them, and emerged stronger than ever.

The Corona pandemic marks another major turning point. The acute threat to our health has become commonplace, affecting everyone around the globe. But even at the beginning, the situation was not entirely hopeless. Science and research quickly offered solutions. People protected themselves and thus others, limited their activities and needs, and became more vigilant.

Covid-19 has taught us that the health of humans, animals, and the environment is closely linked. One Health! It is indispensable, and even vital during a pandemic, to share data, information, and knowledge – not only within the scientific community. As Open Science brings these findings into society, they also become available faster to the decision-makers and production capacities. It is our joint responsibility to understand and support these decisions.

Beyond these acute threats, which include the economic recession triggered by the pandemic and the associated social tension, we are clearly facing far greater challenges: climate change and biodiversity loss. With global warming, extreme weather events have greatly increased, with enormous burdens for those affected: we remember the tragic images of floods, fires, and heat waves in recent summers. These are not natural disasters, but, at least in part, disasters of our own making. The same applies to the dwindling biodiversity and the resulting loss of ecosystem services. Once something is lost, it is usually lost forever, and we don’t yet know what a loss of 10, 20, or even 50 percent of biodiversity means for nature and for us humans.

As systems researchers, Senckenberg scientists start here with their educational work, addressing the “big problems of humanity” in our publications, museums, exhibitions, at public events, or through our participation in international initiatives such as the Intergovernmental Panel on Climate Change (IPCC) and the World Biodiversity Council (IPBES). Senckenberg is a unique institution with its dual focus on geobiodiversity research and education. Please support us in our important tasks!

We hope you enjoy this report!

Dr. h. c. Beate Heraeus
President, Senckenberg Society for Nature Research

With the “Rivers” exhibition, Senckenberg addresses the scarcity of water as a resource as well as the diversity of rivers and streams and the threats they are facing.

SENCKENBERG ANNUAL REPORT 2021

HIGHLIGHT CALENDAR 2021

JANUARY
01
Prof. Dr. Kliment Tockner assumes his position as the SGN’s new Director General. At the same time, Dr. Brigitte Franzen starts her work as the new Museum Director.

FEBRUARY
10
Start of construction of the DNA laboratory extension and the new building for the Geochronology Laboratory at the Dresden location.

MARCH
15
Prof. Dr. Katerina Harvati from the Tübingen location is awarded the DFG’s Gottfried Wilhelm Leibniz Prize for her research on human evolution.

22
With the “Rivers” exhibition, Senckenberg addresses the scarcity of water as a resource as well as the diversity of rivers and streams and the threats they are facing.
APRIL
01
Dr. Martin Mittelbach assumes the position of the SGN’s Administrative Director.

The Senckenberg Museum Education Department celebrates its 40th anniversary.

JULY
14
Senckenberg becomes a constituent member of the Lore Steubing Institute, which serves as a link between science and applied nature conservation.

AUGUST
29
The Summer Vacation Action attracts 500 new members.

SEPTEMBER
02
With a ceremony at the Jügelhaus, the SGN sees off its long-time Director General, Prof. Dr. Dr. h. c. Volker Mosbrugger, into retirement.

22
Prof. Dr. Katerina Harvati receives an Advanced Grant from the European Research Council.

15
The Senckenberg Natural History Museum in Frankfurt opens its new topical room “Coral Reef”.

OCTOBER
01
Senckenberg Görlitz and the Technical University Dresden establish the master’s program “Organismic and Molecular Biodiversity”.

04
Start of the “Attention – Biodiversity!” action week initiated by Senckenberg and the BMBF’s FEdA initiative.

09
The 10th anniversary of the most successful citizen science project “Saxony’s Insects”.

10
For her achievements in the field of biodiversity research, Prof. Dr. Katrin Böhning-Gaese receives the German Environmental Award.

15
Groundbreaking ceremony for the Senckenberg campus at the Görlitz location.

22
The German Geological Society – Geological Association e. V. awards the Serge von Bubnoff Medal to Prof. Dr. Jan-Michael Lange.

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SENCKENBERG ANNUAL REPORT 2021
HIGHLIGHT CALENDAR 2021
NOVEMBER

18
“A Floating Classroom” – Live broadcast from the research vessel SONNE in the Senckenberg Natural History Museum in Frankfurt.

21
The Senckenberg Natural History Museum in Frankfurt celebrates its 200th anniversary.

DECEMBER

07
The Russian Ministry of Higher Education, Research, Science, and the Arts announces its continued support of the LOEWE-TBG with approximately 18 million Euros in a second funding phase from 2022 to 2024.

22 – 23
Following the initial evaluation in the spring, the second evaluation of the requested Leibniz special item of expenditure “Anthropocene Biodiversity Loss” took place at the end of the year.

THE END OF NATURE AS WE KNOW IT?

Will we have to say goodbye to the romantic idea of an intact nature as we know it? From the distant past until today, humans have severely impacted this planet on a global scale; many changes are irreversible, and the resulting societal challenges are enormous. Yet, we are only facing the beginning of the “Great Acceleration,” the rapid increase in consumption variables in the age of the Anthropocene. Most habitats have been “domesticated” – they have been modified for the greatest possible benefit to us humans. Unfortunately, these short-term benefits will harm us on the long run. We engage in immense, irresponsible overexploitation of nature, thereby promoting floods, heat waves, and forest fires whose consequences in a domesticated world amount to man-made disasters. We are fully responsible for these damages through our own actions, and we increasingly rely on large-scale technical measures: building dams, diverting entire rivers, and desalinating seawater. However, we must fundamentally rethink our relationship with nature, because sustainable solutions can only be found with, and not against, nature.

Hence, at Senckenberg, we value curiosity, innovation and responsibility. Here, we outline how we strive for a resilient institution to contribute to global efforts in safeguarding the integrity of nature.

SENCKENBERG MUSEUM FOR TOMORROW
FRANKFURT 1921-2021

A NEW AGE OF DISCOVERY

In an ever-changing world, Senckenberg strives to mitigate human impact on nature and biodiversity loss through targeted research, education, and an integrative, interdisciplinary approach to science. Senckenberg Director General Klement Tockner and Andreas Mulch, Director of Science at Senckenberg, present Senckenberg’s mission and outline its strategic goals to preserve Earth as a habitable planet.

BEING ONE SENCKENBERG

Earth is our only habitat. Our planet has been dynamic throughout its history and will continue to change. Hence, safeguarding our home in the solar system requires adapting to environments that are dynamic in time. It requires targeted research to evolve and transform society, policies, and technology to sustainably reduce and mitigate human impact on nature and to keep Earth habitable. We are well-prepared to take responsibility through advancing science and supporting solutions. Our oldest collection objects date back to 1477, and as an institution we benefit from almost 300 years of studying nature. With seven institutes located in seven states of Germany, we follow one coherent program portfolio: Being One Senckenberg is the key foundation of our collective actions. Our expertise ranges from Earth and Climate Sciences and the evolution of humans to the study of biodiversity, covering all major organismic groups as well as marine, freshwater, and terrestrial realms.

“It is a world of our making, but not of our choice”

George Monbiot

SENCKENBERG ANNUAL REPORT 2021

HIGHLIGHT CALENDAR 2021
The rapid change of our planet propels us into a new age of discovery and the relevance and urgency to explore and understand the dynamics of nature have increased immensely. Climate change, biodiversity loss, and overexploitation of the oceans are immediate consequences of collective human activities and offsetting these actions requires systemic rather than individual scientific approaches.

Understanding Earth as a well-balanced system with a long evolutionary history in which humans have become a transformative force, our research targets the manifold interactions between the biotic and abiotic world. With our global collaboration partners, we strive to balance scientific curiosity and responsibility for the future of life on this planet.

By Prof. Dr. Andreas Mulch, see on page 13

Our approach to studying our planet is systemic and increasingly interand transdisciplinary. It is fueled by curiosity and responsibility for our actions. With more than 40 million objects, our collections cover the evolution of life on Earth and demonstrate the dramatic changes of the Anthropocene. Our museums inspire more than one million people each year as visitors or online participants. Our efforts are greatly enhanced by the support of our members. As a civic society, more than 7,500 members contribute to achieving our common goals.

ADVANCING SCIENCE FOR TRANSFORMING SOCIETIES

An ever-changing demand for purpose and scientific support of societal decisions requires informed and innovative approaches to science. We need a new science economy that integrates different knowledge components: systemic knowledge that goes beyond describing the individual challenges; transformational knowledge that challenges us to be open-minded and adaptive to new types of action; orientation and solutions knowledge that permits us to provide guidance for society so that societal decisions are supported and underpinned by state-of-the-art science.

To achieve this, we continuously need to adapt our governance system towards a truly open institution – with flat hierarchies as well as novel research approaches and partnerships. We strive for a balance between curiosity and responsibility to be in phase with scientific needs and societal ambitions and to provide scientific support for sustainable decision-making.

OPENING SENckenberg AS A PARTICIPATORY PLATFORM FOR DIALOGUE

A dual crisis – rapid climate change and accelerated loss of biodiversity – highlights the fundamental role that dynamic, global networks play in generating knowledge and offering solutions to meet the resulting immense global challenges. Senckenberg will continue to broaden its regional and global networks, increase permeability across research institutions, industry, the civic sector, and governmental organizations, and promote citizen science.

STRENGTHENING OUR INSTITUTIONAL RESILIENCE IN A RAPIDLY CHANGING WORLD

Senckenberg is a vibrant, learning institution. We will remain capable of adapting to these rapid changes and serve as a pioneer in shaping future research. We commit ourselves to be transparent, and participatory decision-making to continuously improve our governance. We are committed to a research culture that values relevance and excellence and that is future-oriented, international, and interdisciplinarity.

A habitable planet Earth is the quintessential foundation for human well-being. Senckenberg feels privileged and humble to act as a steward of nature through exploring it, documenting its diversity in collections, and analyzing the past, present, and future dynamics of the Earth system. Such an endeavor requires reliable partnerships and global collaboration. Let us embark together on a journey into a new age of discovery!

By Prof. Dr. Klement Tockner & Prof. Dr. Andreas Mulch

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01 BIODIVERSITY, SYSTEMATICS, AND EVOLUTION
The focus “Biodiversity, Systematics, and Evolution” forms the basis of all of Senckenberg’s research fields, on land and in the water. Special emphasis is placed on living and extinct life forms. It is our goal to explore and understand our planet’s biodiversity – we record species, analyze their distribution, their relationships and their evolutionary connections.

Prof. Dr. Angelika Brandt heads the “Marine Zoology” department at the Senckenberg Research Institute and is a Professor for Marine Zoology at the Goethe University Frankfurt. Her research focuses on systematics, ecology, evolution and biogeography of marine macrofauna.

02 BIODIVERSITY AND ENVIRONMENT
We are investigating the increasing influence of humans on biodiversity and the environment. We are particularly focusing on 1) long-term research of species and environmental variables in observatories (Long-Term Ecosystem Dynamics) and 2) “Biodiversity Conservation” where we investigate changes in biodiversity to develop conservation and management strategies.

Prof. Dr. Peter Haase is a freshwater ecologist and head of the research station Gelnhausen, which includes the Department of River Ecology and Conservation. Within the Senckenberg research program he serves as head of the research field “Biodiversity and Environment.” In addition, he is a professor at the Faculty of Biology at the University of Duisburg-Essen.

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03 BIODIVERSITY AND CLIMATE
Within this research field, scientists investigate the multiple interactions between biodiversity and climate, in the past and present, at local, regional and global scales, including the development of future scenarios. To address these objectives, we use a wide variety of methods, ranging from geological studies to field observations and genetic analysis up to large-scale climate and vegetation models.

Prof. Dr. Katrin Böhning-Gaese is a member of the Senckenberg Board of Directors and Director of the Senckenberg Biodiversity and Climate Research Centre. In addition, she holds a professorship at Goethe University Frankfurt. She is a vice president of the Leipziger Wissenschaftsverband und die Leibniz Association.

04 BIODIVERSITY AND EARTH SYSTEM DYNAMICS
To understand the evolution of life in the Earth system with the associated biological and geological interactions as well as crises in the evolutionary history – this is one of Senckenberg’s primary missions. We study the diverse interactions among geodynamics, Earth surface processes and climate change, including the evolution of humans and our natural and cultural environmental conditions.

Prof. Dr. Andreas Mulch is a member of the Senckenberg Board of Directors and Director of the Senckenberg Research Institute and Natural History Museum Frankfurt. He is a professor in Geosciences at Goethe University Frankfurt.

Around one third of all organisms living in the oceans are still unknown. As part of a marine biodiversity monitoring project, researchers are developing “fast detection techniques” in the basis of molecular methods.

Tropical forest ecosystems are increasingly fragmented by different uses. Picture is a forest fragment of Nyungwe National Park, Rwanda, adapted to a eucalyptus reforestation and tea plantations.

Rainfall map based on over 50 weather stations installed around Kilimanjaro from 1996 onwards. Numbers indicate average precipitation in millimeters per year.

Hosting almost one fifth of the world’s coral reefs, Indonesia is a global epicenter of marine biodiversity. The interplay between landscape and sea level change creates this highly diverse environment.
Until about ten years ago, most scientists assumed that modern humans never interbred with Neanderthals. However, since the publication of the first partial Neanderthal nuclear genome in 2010, we know that this happened after all. We carry Neanderthal genes inside us!

When the first modern humans left Africa around 60,000 years ago, they encountered Neanderthals in the Middle East, with whom they mated. “In fact, the genome of all modern humans outside Africa contains about 2 to 3 percent Neanderthal DNA,” according to Prof. Dr. Cosimo Posth of the Senckenberg location in Tübingen. Further palaeogenetic studies revealed the occurrence of a previously unknown hominin group in the Altai Mountains, the so-called Denisova people. A scientific breakthrough was achieved in 2016 with the study of the oldest archaic human DNA sequenced to date: the 430,000-year-old remains from Sima de los Huesos in Spain. The mitochondrial DNA of these individuals from the middle Pleistocene resembled that of the Denisova people – their nuclear DNA, on the other hand, resembled that of Neanderthals. Now researchers think that these phylogenetic relationships are due to a gene flow from African early modern humans into Neanderthals after the latter split from the Denisovans.

The Skull of Zlatý Kůň

Based on a fossil female skull found in 1950 in a cave on Zlatý Kůň mountain near the Czech municipality of Koněprusy, a research team from the Max Planck Institute for the Science of Human History in Jena, in collaboration with scientists from the University of Tübingen and Senckenberg HEF, reconstructed the oldest known genome of modern humans to date.

They extracted DNA sampling the skull and sequenced it using various methods. Analyses of the retrieved DNA and comparisons with the genome of other human fossils yielded a surprising result: the genome belongs to a woman who lived more than 45,000 years ago and died in what is now the Czech Republic. She may have been among the earliest groups of modern humans from Africa to colonize Europe. However, the comparison of DNA sequences showed that she was not closely related to the present-day inhabitants of the continent, meaning her group died out. This fate apparently befell many populations from the early Upper Palaeolithic in Europe. As a possible cause, the researchers consider a volcanic eruption in modern-day southern Italy about 39,000 years ago, which resulted in a drastic deterioration of the climate in Eurasia, leading to a collapse of the local populations there.

Three Percent Neanderthal and Long DNA Segments

The genome of the woman from Zlatý Kůň contains three percent Neanderthal DNA, and her Neanderthal segments are longer than those of the Ust'-Ishim man from Siberia, who died about 45,000 years ago and is considered the oldest previously reconstructed genome of a modern human. The length of the Neanderthal segments is due to the fact that our genetic material is rearranged by means of genetic recombination each time we reproduce, with the DNA segments becoming shorter as successive generations pass. The longer the segments, the shorter the time between the interbreeding with our prehistoric relatives – for the Ust'-Ishim man, this is about 100 generations; the ancestors of the woman from Zlatý Kůň, on the other hand, must have mated with a Neanderthal only 70 to 80 generations ago.

Contact: Prof. Dr. Cosimo Posth
Our marine biologists visited the North Atlantic in 2021. The “IceDivA” (“Icelandic Marine Animals: Genetics and Ecology Meets Diversity in the Deep Atlantic Ocean”) expeditions are driven by the ambitious goal of gaining a better understanding of the deep-sea habitat based on a survey of organism diversity in order to be able to protect it.

Taxonomic-systematic basic research is the key...

On January 8, 2021, an international team of 21 scientists on board the research vessel “Sonne” set out on the IceDivA 1 expedition in the Atlantic Ocean. They aimed to collect deep-sea samples from the Iceland Basin to the Azores and investigate the life of the smallest organisms at depths of several thousand meters. During IceDivA 2, which started on November 5, 2021, 27 scientists on board the research vessel “Sonne” followed up on this – traveling from Emden, Germany to Las Palmas and across the Atlantic to Greenland’s southern tip into the Labrador Sea, many, to the Arctic Circle north of Iceland, past Greenland and across the Atlantic Ocean.”

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TAXONOMIC-SYSTEMATIC BASIC RESEARCH IS THE KEY...
In recent decades, an increasing narrowing of crop rotations can be observed in German agriculture – pest pressure is increasing. The lesser grain borer (Rhyzopertha dominica) is a great hazard to stored grains as its larvae develop in them and can produce great economic damage.

Global wheat harvest of around 780 million tons is expected for the 2021/2022 crop year. A large part of this will be stored – often for months. It is crucial to protect the grain from insect pests. Currently, this challenge is often met with chemical repellents such as imidacloprid, a systemic insecticide from the group of controversial neonicotinoids. However, these substances affect not only pests but also beneficial bees, wasps, and many other insects and soil organisms. Some neonicotinoids have therefore been banned for outdoor use in the EU. Nevertheless, imidacloprid has been produced on an industrial scale for three decades and is used in around 120 countries worldwide to treat sugar and fodder beets, cereals, potatoes, corn, and onions.

**FIGHTING INSECT PESTS WITH DIATOMS AND SOIL FUNGI**

In search of an environmentally friendly alternative, Prof. Dr. Waqas Wakil from the University of Agriculture in Pakistan and Prof. Dr. Thomas Schmitt from the Senckenberg German Entomological Institute in Müncheberg, together with a group of colleagues, tested in laboratory experiments whether natural substances could replace the insecticide imidacloprid in grain storage. They used diatomaceous earths (DEs) – substances derived from fossil diatoms – and the parasitic fungus *Beauveria bassiana*, which lives in natural soils and can kill insect pests.

“We tested combinations of these three protectants over different periods of time and compared how many and which insect pests survived after treatment,” reports Waqas Wakil. Test candidates included the red flour beetle (*Tribolium castaneum*), the lesser grain borer (*Phytophthora arrhizoides*), the rusty grain beetle (*Cryptolestes ferrugineus*), and the grain psocid (*Liposcelis paeta*).

**HOW DOES THE COMBINATION OF NATURAL SUBSTANCES WORK?**

DEs affect insects by absorbing lipid molecules from the insects’ surfaces through direct contact, causing their death by desiccation. In addition, the pointed crystals cause severe injuries, primarily affecting the soft-skinned larvae, but even the more robust adult animals can be damaged and die. The spores of the *Beauveria* fungus adhere to the skin of the insect pests, penetrate the host after germination and spread inside it, resulting in the death of the infected individual. In contrast, these fungi are completely harmless to vertebrates.

**PROMISING RESULTS**

The combination of the different active ingredients – “insecticide and fungus” and “DEs and fungus” – led to better results than the use of a single agent, which was to be expected. However, the researchers were surprised by the long-term effects of the preparations used. “At the beginning of the test phase, we achieved the best results against insect pests with the combination of imidacloprid and *Beauveria bassiana*. After 100 days of grain storage, this active ingredient combination was on a par with the ‘DEs and fungus’ variant. However, after more than 100 to 180 days of storage, the wheat treated with DEs and fungus showed the lowest pest infestation! Since grain is often stored for more than half a year, the natural pesticides we tested could be a valid alternative to chemical insecticides,” concludes Schmitt.

Contact us:

Prof. Dr. Thomas Schmitt

In a laboratory experiment, a team of scientists, including entomologists at the Senckenberg Institute in Müncheberg, tested the effectiveness of diatomaceous earths and a parasitic fungus in protecting grain against insect damage. Most of the crop harvested is stored for many months before consumption. During this long time of storage, the grain is under permanent risk of being attacked by pest species.
The overall goal of the BMBF Bonares Program is to improve the scientific basis for the sustain- able use and management of agricultural soils. Bonares is a major research program of the BMBF, featuring 11 project consortia. Senckenberg, along with several partners, is involved in the “BonaRes Centre” project, which develops a modeling tool for predicting the impact of soil management on agricultural productivity and essential soil functions such as water storage, nutrient cycling, or carbon storage. While the actual modeling is carried out by UFZ, Senckenberg supports the developments of the model by analyzing both the impact of agricultural practices on soil fauna and its importance for soil functions.

Agriculture research, including the impact of soil fauna on soil properties, assesses the effects of soil compaction on soil fauna, and illuminates the role of soil food webs in soil functions.

The excavation team from Schöningen dug for an average of 250 square meters per day, and the participants continued to slurry sediments for months to ensure that even the smallest stone chips, in addition to numerous individual bones, the discovery of a large accumulation of fossils from various large mammals in a situation horizon on an area of about 50 square meters came as a special surprise.

The excavation campaign was an arduous one, during which artifacts or microfauna remnants would not escape their attention.

Thousands of different, sometimes bizarre-looking animal artifacts or microfauna remnants would not escape their attention.

The Schöningen excavation site is located on the shore of a 300,000-year-old paleolake that has drifted up repeatedly. The first strata date back to the end of the Elster Age.

One of the highlights of the 2021 excavation campaign was an enormous boulder weighing around 200 kilograms, which, however, remained at the site where it was found. The team members also uncovered the almost complete skeleton of an aurochs. The documentation of the find includes a “photogrammetry” photogram and thus an essential part of his scientific life's work. The Schöningen excavation site is located on the shore of a 300,000-year-old paleolake that has drifted up repeatedly. The first strata date back to the end of the Elster Age.

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Even in cool temperate and moist climate zones, nearly 30 percent of watercourses can dry up repeatedly when taking into account small streams.

or thousands of years, people have preferred to settle near bodies of water. Rivers are part of the global water cycle, habitat for countless species, an economic factor, a transport route, an energy provider, and a place of recreation. Yet, flowing waters in particular have suffered greatly from intensive land use, resource consumption, and global warming. Winters with little snow and hot summers are causing more and more streams and rivers to dry up – at least temporarily. Even the major rivers such as the Nile, the Yellow River in China, or the Rio Grande in North America are by now drying up intermittently. This can also have dire consequences for humans, since – according to another finding of the study – more than half of the world’s human population lives in the vicinity of these drying rivers, which provide water for drinking and irrigation and serve as fishing grounds.

DRY RIVERS ARE THE RULE, NOT AN EXCEPTION
The scientists analyzed hydrological, climatic, pedological, and geological data from 5615 measuring stations and were able to show that (naturally) drying rivers are found on all continents and in all climate zones. In particularly arid regions such as India, Western Australia, or the African Sahel, this actually applies to 99 percent of all rivers. But even in cool-temperate and humid climates, almost 30 percent of flowing waters dry up repeatedly. In summary: drying rivers are a natural phenomenon. However, this fact has been largely neglected – at least from a scientific perspective. “Intermittent water bodies are globally widespread and part of our natural environment. Therefore, they should receive appropriate consideration in management measures, and uniform regulations must be established across national borders. We cannot ignore over half of all streams and accept the loss of these important habitats for humans and nature,” says aquatic ecologist Prof. Dr. Klement Tockner, co-author of the “Nature” article.

DRYING UP IS NOT ALWAYS BAD
Rivers that dry up naturally are particularly valuable ecosystems and provide habitat for a diverse fauna and flora. Their biodiversity is unique and often significantly higher than in stream sections that permanently carry water. Conversely, water bodies that dry up due to human impact are mostly species-poor, since they are also subject to other stress factors such as pollution, elevated temperatures, and habitat destruction. Against the backdrop of climate change and a steadily growing world population, the overexploitation and pollution of water bodies pose major challenges for the sustainable management of natural water resources.

The Tagliamento is one of the last great wild rivers in Europe that is still governed largely by natural ecosystem dynamics. While most of the adjacent plains are flooded in spring, large areas dry out in summer and fall. The water then flows through the massive gravel layer far below the riverbed and only resurfaces several kilometers downstream.
Beech forests are widespread in large parts of Europe. They are well-adapted to many environments and play an increasingly important role in forestry as the backbone of near-natural forest management. They also provide habitat for more than 6,000 species.

DROUGHT AFFECTS BEECHES

However, beeches suffered greatly from the dry summers of 2018 and 2019: 62 percent of beech trees sustained drought damage, and 12 percent even suffered severe damage or died. Oddly, not all of the trees in beech stands were equally affected.

GLOBAL CHALLENGES

The world holds a sufficient supply of fresh water, but it is unevenly distributed – both spatially and temporally. This poses a challenge to the international scientific community, who have to address a number of key questions across disciplines in dialogue with politics and society. Here, we should be aware that white water is a fundamental resource for us humans, it is equally valuable for the water bodies themselves with their diverse organisms and key ecosystem functions. How can we strike a balance within the context of water management? How much water of what quality does an ecosystem need in order to sustain its biodiversity and ecosystem services? And do we need fundamentally new approaches to nature conservation and environmental protection in the face of “domesticated” ecosystems?

However, the highest priority is to preserve and protect the last free-flowing streams and rivers. We also need them as reference systems to learn how natural ecosystems function. This knowledge can ultimately aid in the renovation of streams and rivers – for the protection of nature and for the well-being of us humans.

RESEARCHERS IDENTIFY GENES FOR DROUGHT RESISTANCE IN BEECH TREES

The Molecular Ecology group at the Senckenberg BiK-F has developed a method to identify drought-stress-tolerant beech trees by means of DNA analysis.

Increasingly struggling with drought: healthy and severely damaged beech (Fagus sylvatica).

SNPs PROVIDE INSIGHTS INTO DROUGHT TOLERANCE

The researchers then used this “natural experimental set-up” to investigate the genomic basis of drought susceptibility in European beech (Fagus sylvatica). In more than 200 neighboring pairs from all over Hesse, we investigated which locations in the genome showed systematic differences. We localized over 100 DNA sequences, so-called SNPs (single nucleotide polymorphisms) that correlated with drought tolerance, explains Prof. Dr. Markus Pfenniger.

Based on these markers, the researchers developed a test to quickly and inexpensively identify beech trees – even from seeds – that are better able to cope with more frequent and longer periods of drought. In addition to the LOEWE-TBG and Senckenberg BiK-F, researchers from the Justus Liebig University in Giessen, the Goethe University in Frankfurt, the Darmstadt Technical University, and Geisenheim University also participate in the study.

The next step involves implementing these findings in practical programs. Now, foresters can specifically select drought-resistant seed-producing trees and help accelerate and even monitor natural selection, thus making beech forests more resilient to climate change.

Contact us:
Prof. Dr. Markus Pfenniger

Increasingly struggling with drought: healthy and severely damaged beech (Fagus sylvatica).

Native beech trees are increasingly suffering more and more from the drought. How can we use the functions found in this test? Trust that the beech will manage it as long as we use it with some tree species? Science has worked out a solution.

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Native beech trees are increasingly suffering more and more from the drought. How can we use the functions found in this test? Trust that the beech will manage it as long as we use it with some tree species? Science has worked out a solution.
A team led by marine geologist Alexander Bartholomai at the Wilhelmshaven institute is mapping the seabed in the shallow seas and coastal zones of the North Sea and Baltic Sea together with partners from universities and public authorities. The study aims to evaluate these areas as with regard to their potential use, e.g., for fishing, offshore wind farms, and ocean current power plants with their supply lines – while at the same time preserving them as valuable natural areas.

Increasing Utilization Pressure on the Shallow Seas

Far from being “free spaces,” our offshore areas are increasingly important both economically and socially. Whether it is the construction of power plants, fishing, or the extraction of sand and gravel – the activity is having a direct impact on the benthic communities in the shallow seas and the people on the coast and leads to conflicts with environmental protection and conservation.

OSPAR, HELCOM, and the EU Marine Strategy Framework Directive of 2009 constitute regulatory frameworks dedicated to the protection of marine spaces and the improvement of their ecological condition. However, their implementation requires monitoring, assessment, and successful management of the protection and sustainable use of these marine areas, considering their dynamics. The mapping of the 12-mile zone and the countries’ Exclusive Economic Zone (EEZ) for Germany, the latter alone covers around 33,000 square kilometers with a water depth of less than 50 m where the seabed is subject to constant change due to tides and wave action and also to enormous utilisation pressure.

A Spatial Plan for the German Maritime Territory –

In 2021, the Federal Maritime and Hydrographic Agency (BfSH) presented the new spatial plan for the German coastal seas (see map on page 27). The framework is intended to reconcile the needs of all stakeholders in order to achieve a balanced structuring, development, and safeguarding of the area. Alexander Bartholomai is especially pleased that “Nature 2030” marine nature reserves have been designated as priority areas in agreement with the Federal Agency for Nature Conservation (BNF). “Our efforts really paid off,” he says.

...Is Based on Comprehensive Monitoring Milestones

For more than two decades, the “Marine Sedimentology” group has conducted comprehensive surveys of shallow water habitats by means of hydroacoustic devices. The focus is on geomorphology and substrate characteristics, which are of crucial importance for colonising marine organisms. “Together with our colleagues, we developed a guide for the standardised mapping of the seafloor in Germany’s EEZ and comprehensively recorded the habitats in the three ‘Nature 2000’ areas of the North Sea,” explains the marine geologist, and he adds, “For eight years, under the auspices of the BSH and BFN, together with the Alfred Wegener Institute, Helix University, and the Institute for Baltic Sea Research, we ‘learned’ the seabed from several ships using towed array side-scan sonars – results that have now been incorporated into the biotope maps.” (www.geomar.de)

Special attention is paid to hard substrates consisting of sand, gravel, and debris up to large boulders. Also called “geogenic reefs,” they provide a refuge for diverse benthic communities.

During their surveys, the marine researchers from Wilhelmshaven are repeatedly confronted with the degrading consequences of traveling on bottom-dwelling kites such as plaice, sole, cod, and shrimps. Since 2020, Seneckenberg has therefore been a project partner of the DAM project “Exclusion of mobile, bottom-contact fishing in protected areas of the German EEZ in the North Sea and Baltic Sea” and contributes to the protection and sustainable use of our marine ecosystems with its research.
After ten years, the time had finally arrived: In June 2016, an international sea expedition led by Senckenberg marine geobiologist Dr. Max Wisshak retrieved two settling platforms (see page 3, picture bottom right) from water depths of 46 and 127 meters – the third platform, placed at a depth of 11 meters, was presumably lost in a winter storm. The scientists’ primary goal was to determine which marine organisms are responsible for the production and breakdown of biogenic carbonates. The Senckenberg scientists were particularly interested in the bioeroders, which graze on the limestone, thus affecting its surface. Due to ocean acidification, bioerosion has already caused considerable damage in tropical coral reefs. This raises the question whether calcareous ecosystem engineers in the Arctic are facing similar threats.

RHODOLITHS IN FOCUS

The study concentrates on rhodoliths – roughly fist-sized, multi-layered spheres that were created over centuries by calcifying red algae that are commonly encountered around Spitsbergen. The carbonate nodules provide habitat for countless marine organisms. One species of clam, the wrinkled rock-borer Hiatella arctica, even hollows out the nodules’ interior to seek protection from predators there.

THE CARBONATE PRODUCERS AND THEIR COUNTERPARTS

In December 2021, the researchers presented their results: “We found a total of 56 species of lime-producing organisms, the majority of which were colony-forming bryozoans with 36 different species, followed by 11 species of serpulid tube-worms,” summarizes Max Wisshak, and he adds: “Their ‘counterparts’, i.e., organisms that break down the carbonate, are not quite as diverse, with only 30 species of such bioeroders. Almost two-thirds of these belong to the so-called ‘micro-borers’ such as cyanobacteria, green and red algae, fungi, or foraminifera. Most of the local bioerosion, however, is caused by sea urchins and chitons, which graze on the calcareous debris in search of food, scraping off some of the lime in the process. Considering all factors, carbonate production by bottom-dwelling organisms and bioerosion off Spitsbergen are nearly in equilibrium, according to the study.

Contact us:
Dr. Max Wisshak

The research submersible “Jago” descends to the polar carbonate factories. Pictured are rhodoliths and a variety of other lime-producing seafloor dwellers.

The research submersible “Jago” descends to the polar carbonate factories. Pictured are rhodoliths and a variety of other lime-producing seafloor dwellers.

INTRODUCTION

Anthropocene Change is gaining momentum, and we are just beginning to realize how many facets of biodiversity are affected. Genomics and Genomics give fundamentally new insights that continue to change the very research at Senckenberg. There is a vast range of projects going on in various places, and the following examples show their potential. The first describes a novel approach to analyze one of Germany’s oldest repositories, the “Umweltprobenbank” for a broad range of environmental samples. Modern genomic approaches allow for analysis of the large range of biodiversity facets covered by the samples. The second example sheds new light on one of our focus species, the wolf. Hybridization with domestic dogs is increasingly discussed, not only in science but also in society, and new genetic tools allow for fast and accurate identification of hybrids.

By Prof. Dr. Karsten Wesche
Since 1981, researchers have compiled more than 500,000 samples from all over Germany in the Federal Environmental Sample Bank – samples from plants, animals, and humans. They come from ecosystems in the sea, freshwater, and on land. Immediately after sampling, they are preserved in mobile laboratories and cooled to minus 150 degrees Celsius using liquid nitrogen. This also preserves the genetic material, making the samples ideal for DNA analyses.

DEEPERING THE SAMPLES BY MEANS OF GENETIC ANALYSES

The TreNDNA project "TrendDNA – Studies on Biodiversity with the Federal Environmental Sample Bank“ now aims to significantly explore this potential. The project is coordinated by the University of Duisburg-Essen. Together with their colleagues, scientists from the LOEWE Centre for Translational Biodiversity Genomics, the Senckenberg Research Institute and Natural History Museum in Frankfurt, and the Senckenberg Biodiversity and Climate Research Centre are developing new genetic methods that will extract even more information from the specimens – for example, about the insect die-off and about new invasive species. In the future, hybrids are usually removed from the wild. The newly developed genetic method allows the unambiguous identification of wolf hybrids based on environmental samples such as feces, hair, or saliva residue. In the monitoring year 2020/2021, the federal states sent 3,934 samples to the Department of Conservation Genetics in Gelnhausen for analysis. “Our new method is significantly more accurate than conventional procedures and allows the unambiguous identification of wolf hybrids even after several generations,” says Prof. Dr. Miklós Bálint, the leader of the TreNDNA project. How much dog is in our wild wolves? Modern genome analyses can now clarify this.

THE TRENDDNA PROJECT

The environmental sample bank enables scientists to travel back in time. This treasure trove of knowledge is now also available to genetic biodiversity research.

The conservation geneticists at the Gelnhausen location study the return of wolves beyond the borders of Germany, providing important scientific facts regarding this emotionally debated topic. Together with colleagues from ten European countries, they have now developed a method that can be used to clearly determine the degree of interbreeding between wolves and dogs.

In 2000, wolves successfully raised pups in the Lausitz region for the first time. The population in Germany has been steadily increasing since then, and in the monitoring year 2020/2021 consisted of several hundred individuals. The conservation geneticists at the Gelnhausen location are taking a close look at deciduous forests: Using high-throughput sequencing, the researchers are taking a close look at deciduous forests: Using high-throughput sequencing, the researchers can now clearly determine the degree of interbreeding between wolves and dogs.

Modern genome analyses can now clarify this.

HOW MUCH DOG IS IN OUR WILD WOLVES?

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For two wolf families in Saxony-Anhalt, DNA samples from the first German wolf litter born in 2000 in the Lausitz region, Germany, differ from each other regardless of breed and origin, explains the head of Senckenberg Conservation Genetics, Dr. Carsten Nowak. The result of their analyses: In Germany, the hybridization rate approaches zero – which is in line with other studies in Central and Northern Europe.

The method is intended to serve as a standard procedure in the future, enabling a comparable recording of hybridization rates throughout Europe.
INTRODUCTION

Since its foundation in 1817 knowledge transfer, dialog with society, and thrilling exhibitions have been part of the Senckenberg mission. The year 2021 has been most successful. We celebrated the 200th birthday of the Frankfurt Natural History Museum, opened new exhibitions, and advanced our dialogue with society. Public interest in our work is immense. In spite of the Corona limitations, the exhibition halls were bristling with visitors. Membership numbers of Senckenberg went up almost 10%. This success reflects two developments: first, the obviously excellent work of the Senckenberg scientists, museum, and communication teams, and second, the growing public awareness that biodiversity is important.

By Prof. Dr. Katrin Böhning-Gaese, see on page 13

200 YEARS OF MUSEUM HISTORY

On November 21, 2021, the “Senckenberg Naturmuseum” in Frankfurt, one of the world’s largest Natural History Museums, celebrated its 200th birthday! The anniversary carried the motto “Museum For Tomorrow” – because Senckenberg makes the museum fit for the future!

A BRIEF HISTORY OF THE MUSEUM AND INSTITUTE

Much has happened in the past 200 years. It started with a citizens’ society and a small natural history museum located in the city center at the Eschheimer Tor. On November 21, 1921, it opened its doors – initially for members only, but in the following year all interested citizens were given the oppor-
CONTINUED EXCAVATION IN EDMOND’S PREHISTORIC REALM

In front of the visitors, preparators unearthed nearly 10,000 teeth and bone fragments of various dinosaur species during the first excavation season in the 20-square-meter “bone bed” from Wyoming – four times as many as originally expected. As of May 2, 2021, visitors could once again attend the excavation work in person as 20 scientists from 8 research institutes set out in search of fossils and engage in conversation with them.

May 2, 2021, visitors could once again attend the excavation work in person as 20 scientists from 8 research institutes set out in search of fossils and engage in conversation with them.

TWO NEW EXHIBITION AREAS

Undoubtedly an exhibit of records – the Senckenberg Reef. On July 16, 2021, the new themed room with the tropical coral reef was opened to the public. Its central element is a 20-square-meter reef rock shaped and designed by Senckenberg preparators over a period of three years. 25,000 hours of labor went into this work of art housing a total of around 3,000 (!) individual organisms. “We want to draw attention to the existential threat these valuable ecosystems are facing due to climate change and other human impacts,” says Senckenberg Director General Klement Tockner. The exhibit was awarded over 3,000 fish. “Edmond’s Prehistoric Realm” is one of the public’s favorite exhibits. What is the state of our planet’s rivers and streams? Senckenberg explores this question in the new “Rivers” exhibition, which opened on World Water Day on March 22, 2021. Today, 90 percent of all flowing waters in Germany are in a deplorable state. Get to know our local rivers and those in far-away countries, the animals and plants that live in them, their importance as drinking water reservoirs, and much more. The exhibition’s highlights include multimedia exhibits such as an interactive water cycle and a walk-through water drop.

40 YEARS OF EDUCATION & OUTREACH

At the Frankfurt Museum

In 2021, the Natural History Museum in Frankfurt also celebrated 40 years of its education department. In 1981, the permanent position for museum education was established – the kick-off for a development toward the museum as a modern place of learning, experience, and exchange between society and science. "When can this be done? We don’t just present finished results but actively involve our visitors, let them walk the path of science and discovery themselves, and let them join in the research. In early 2021, planning started for the 20-square-meter "AHA! Science Lab" where visitors of all ages can actively participate, even meeting the scientists face to face, and experiment, touch, and try things out!"

Digital offers expanded due to lockdown

“Direct contact of our dedicated science educators with visitors is the heart of our work,” says Dr. Eva Possmann, leader of the education team. But how can interest in natural science be sparked if no one is allowed to visit the museum due to Covid? For instance, by means of a video series that was already created in 2020 during the first lockdown. 12 new episodes of the series "Museum@Schulanfang" (Museum@Children’s First Day and its offshoot for adults, "Museum@Wohntag" (Museum@Living Room) were added in 2021. Digital guided tours are now also available. The four-guide joins classrooms or digital family reunions and corporate events via live-stream from the exhibition.

Senckenberg Youth Council established

In February 2021, to the delight of the museum team in Frankfurt, a newly established representa- tive body for young adults met for the first time: the Senckenberg Youth Council. About a dozen young people are actively involved in shaping the museum and its exhibitions more attractive for the younger generation. "The impulses, opinions, and critical views of this generation are essential for us," says museum director Dr. Brigitte Franzen. They contribute their own ideas and suggestions and thus have the opportunity to help shape the museum with suggestions for exhibits and new formats in the social networks to a short podcast in which young people explain science to their peers. Contact: Dr. Eva Possmann

In 2021, the Natural History Museum in Frankfurt also celebrated 40 years of its education department. In 1981, the permanent position for museum education was established – the kick-off for a development toward the museum as a modern place of learning, experience, and exchange between society and science.

Contact us:
Dr. Brigitte Franzen, Philipe Havlik & Dr. Thorolf Müller

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CITIZEN SCIENCE GOES UNDERGROUND

More organisms live in one square meter of soil than there are people on Earth. To learn about these animals and identify them, Görlitz soil zoologists have developed the Citizen Science app “BODENTIER hoch 4,” which is even suitable for beginners.

ON A DATE AT THE NATURAL HISTORY MUSEUM

Equipped with “My Object – Senckenberg” on their Smartphone, visitors can set out on an unusual discovery tour through the exhibition, as the chat app adds character to the exhibits. Visitors decide for themselves which objects they like. But the object will only respond if it is also interested! In this way, many exciting stories and unusual perspectives of our exhibition unfold.

NEITHER PLANT NOR ANIMAL – THE KINGDOM OF FUNGI

Mushroom picking is a common pastime. But there is much more to be said on this subject, especially if the institute has a department of fungal research that studies plant pathogens. Therefore, not too many exhibitions are able to feature live mushroom cultures or have visitors watch a lemon “rot” before their eyes.

NATURE FILMMAKER HONORED

For the 11th time, the Görlitz Meridian Nature Film Award was presented on September 25, 2021. Laureates were the documentary filmmakers Ingrid and Heinz von Matthey from Waiblingen. They accepted the 2,500 Euro prize for their life’s work from Thomas Neumann, chairman of the Friends of the Natural History Museum in Görlitz. In his laudatory speech, science journalist Volker Arzt emphasized that the filmmakers’ professionalism and the use of high-quality technology always played a central role for the award winners. For example, they shot the first large-scale television production in HD technology in Germany, thereby setting a new standard.

SENCKENBERG CAMPUS EXPANDS IN THE CITYSCAPE

Under brilliant, sunny skies, the cornerstone for the new Senckenberg Research Campus at Görlitz’s Bahnhofstrasse was laid on October 15 – almost exactly one year after the groundbreaking ceremony!

The celebration was joined by Minister President Michael Kretschmer, Mayor Octavian Ursu, State Secretary Dr. Wolf-Dieter Lukas from the Federal Ministry of Education and Research, State Secretary Andrea Franke from the Saxon Ministry of Science, and Senckenberg Director General Klement Tockner, who expressed his wish that the best minds will be attracted to Görlitz in the future, since this building provides an excellent basis for this.

By Dr. Christian Düker

“Neither Plant nor Animal – the Kingdom of Fungi” was yet another exhibition conceived and implemented in-house. It addresses aspects such as the production of food, medicines and drugs, or the use of mycelial leather.

SENCKENBERG ANNUAL REPORT 2021

NEW SPECIAL EXHIBITIONS, VIRTUAL EXTENSIONS OF THE MUSEUM VISIT, AND EVENTS SUCH AS THE NATIONALLY ACCLAIMED FILM AWARD – SENCKENBERG REMAINS AN IMPORTANT AND RESPECTED GÖRLITZ INSTITUTION EVEN UNDER COVID-19.

MUSEUM HIGHLIGHTS FROM GÖRLITZ

The app “BODENTIER hoch 4” opens up completely new perspectives into the world of soil animals.
THE EVENT YEAR AT THE DRESDEN LOCATION

Due to the pandemic, our special exhibition in the Japanese Palais was only open to visitors for three months in 2021. No wonder there were huge crowds when the museum building opened its doors – for example during the Dresden Museum Night on July 24, 2021. And the workshops offered for the summer vacation were also fully booked once again.

DISCOVERING ANIMAL IMMIGRANTS

“New arrivals” such as the Chinese mitten crab, the raccoon, and the American bullfrog were the focus of the exhibition “Roaming Animals – Migration in the Animal Kingdom,” which was put on by the Senckenberg Natural History Collections Dresden (SNSD) at their museum location in the Japanese Palais from April 13 to November 28, 2021.

Under natural conditions, mitten crabs and their ilk would not occur in Germany. Like numerous other plant and animal species, they were introduced to our country, whether unnoticed or intentionally. Are they a boon or a threat to biodiversity? More than sixty original specimens, models, and casts from the SNSD’s collection represent the diversity of these immigrants and their impact on the native flora and fauna. A virtual tour also made it possible to visit the exhibition remotely – and the online offer is even available beyond the end of the exhibition.

SAVING THE PLANET WHILE PLAYING

From October 27 to 29, 2021, the SNSD hosted the Educational Escape Game “BioEconomyNow!” As agents on the planet “Horizon,” the players support the conversion of the economy from finite fossil resources to regenerative, plant-based materials. “BioEconomyNow!” was developed by the House of Science Braunschweig together with Science in Dialogue in the context of the Science Year 2020/2021 and funded by the Federal Ministry of Education and Research.

Contact us:

Prof. Dr. Willi Xylander

museum4punkt0

will be extended!

Good news for Senckenberg! The funding of the joint project “museum4punkt0” has been extended for the year 2021, and due to its spectacular results, Senckenberg Görlitz remains part of this Germany-wide association of 18 cultural institutions! Within the framework of the cooperation, museums develop and test digital applications and make them available not only for Senckenberg visitors but also to other cultural institutions, along with their collective experience regarding conception and technology as well as their practical application.

The new 2021 project phase included the launch of the eponymous app for the “BODENTIER hoch 4” portal and developed a new citizen science platform: the “Landscape Photo Portal.”

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View of the exhibition “Roaming Animals – Migration in the Animal Kingdom.” More than sixty original specimens, models, and casts from the SNSD’s collection show the diversity of immigrants in our homeland.

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Contact us:

Birgit Walker

Senckenberg makes it possible: Due to the lockdown, visitors could explore the exhibition from the comfort of their homes.

View of the exhibition “Roaming Animals – Migration in the Animal Kingdom.” More than sixty original specimens, models, and casts from the SNSD’s collection show the diversity of immigrants in our homeland.

Contact us:

Birgit Walker

Seniorpark makes it possible: Due to the lockdown, visitors could explore the exhibition from the comfort of their homes.

Contact us:

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EARTH FREQUENCY – THE NEW SENCKENBERG PODCAST

“ERDFREQUENZ” (Earth Frequency) is a podcast for people of all ages interested in science and society – entertaining, informative, and in-depth.

ERDFREQUENZ informs about facets of our Earth system: from the depths of the oceans to Himalayan peaks. From prehistoric times to modeled future scenarios, from native wolves to exotic spiders, and from species loss to global warming. Researchers from a wide range of disciplines eloquently recount adventures, encounters, surprises, successes and failures in their findings. They also give tips on how we can live more sustainably and make our own small contribution to climate protection and the preservation of biodiversity.

Senckenberg Director General Klement Tockner while recording podcast episode no. 1.

Before the “satellite event” with the Clean Ocean Laboratory, none of the crew would have thought it possible. Prior to the IceDivA2 expedition to the Labrador Sea, the “Sonne” had been equipped for this special telepresence mission. With a live broadcast from the ship, people at home could engage in a dialogue with the researchers on board and learn about everyday life on the ship and how research contributes toward climate protection and the preservation of biodiversity. In the first episode of ERDFREQUENZ, listeners learned how these phenomena manifest themselves and what frightening consequences they could have in the future. Since then, 10 more episodes have been added (as of April 30, 2022) and are available online on Senckenberg.de/erdfrequenz.

AUTENTIC SCIANCE IN FILM

A RESEARCHER ON A QUEST FOR THE ORIGINS OF HUMAN EXISTENCE

In June 2021, the final episode of our 6-part video series “Windows into Human Diversity” was posted. The short films are available on the “Senckenberg World” YouTube channel. In addition, filmmakers from Frankfurt created an exciting documentary about famous scientist Gustav Heinrich Ralph von Koenigswald, which premiered at the Koenigswald Lecture in November 2021.

Our video series “Windows into Human Diversity” tells the story of Senckenberg researcher Gustav Heinrich Ralph von Koenigswald (1902-1982). He was a passionate scientist who conducted research on Java in the 1930s and 1940s, where he discovered spectacular fossils of early humans. More than 40 professional colleagues from around the world provide insights into their research activities in the field of palaeoanthropology. You can learn how their research discipline has contributed to our understanding of human evolution and biological diversity.

Contact us: Senckenberg.de/erdfrequenz.

Senckenberg’s Director General Klement Tockner while ship-based expedition in the Labrador Sea.

Senckenberg’s Director General Klement Tockner during an inspiration session at the University of Freiburg. In June 2021, the final episode of our 6-part video series “Windows into Human Diversity” was posted. The short films are available on the “Senckenberg World” YouTube channel. In addition, filmmakers from Frankfurt created an exciting documentary about famous scientist Gustav Heinrich Ralph von Koenigswald, which premiered at the Koenigswald Lecture in November 2021.

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“A World on the Move – Shaping the Future with Museums!” was the theme of the eight Leibniz research museums’ action plan. This role fits Senckenberg to a T. Enshrined in the statutes of our society, one of our core tasks is to research, collect, provide, preserve, and communicate the acquired knowledge to the public in our museums. At the Görlitz Museum, we have been doing this since 1860; the roots of our display collection in Dresden go back as far as 1728; and in Frankfurt, we were proud to look back on 200 years of museum history on November 11, 2021. And now we are on track to continue this history.

By Dr. h. c. Beate Heraeus

As an “integrated research museum,” Senckenberg contributes more strongly to social discourse, initiates transformations and moves them forward. Our institution stands for the interplay of research, collecting, and knowledge transfer. In retrospect, it is precisely this connection that describes the success and popularity of our civic society and has given it worldwide renown beyond Germany’s borders.

The fact that we conduct research on socially relevant topics has long been known to the public. Beyond research, Senckenberg has always been concerned with making the acquired knowledge accessible to everyone and interacting with society – this is what our committees, the Friends of Senckenberg, our membership support, and many others stand for. The pandemic year of 2021 was particularly successful in this respect, as we welcomed 500 new Senckenberg members on August 29, 2021 at the end of the Hessian summer vacation! Special thanks are due to our numerous volunteers as well as the members of our Board of Trustees, chaired by the Prime Minister of Hesse, Volker Bouffier. In this committee, we share our knowledge with representatives from business and politics, with the intention that they will pass it on in their networks, support the sciences, and engage in discourse toward finding solutions to our current problems.

The Senckenberg Campus in Görlitz, whose cornerstone was laid on October 15, 2022, opens up new possibilities for research. Our colleagues in Müncheberg also have reason to rejoice, for now that the planning for the extension building has been completed, construction work will begin shortly. And the “Museum for Tomorrow” at our Frankfurt headquarters keeps us busy, as well. The complete renovation and expansion of the museum is scheduled for completion by 2035 at a cost of 316 million Euros. Therefore, we were delighted when the Hessian Minister for Science and the Arts, Angela Dorn, held out the prospect of federal and state support on April 29, 2021, and announced: “The renovation and expansion of the Senckenberg Museum as part of the joint research funding is a milestone that has the potential to boost the Rhine-Main region, as well as Hesse, for years to come. The new building will allow Senckenberg to set new standards in the fields of science and knowledge transfer [...] Senckenberg research is already performing at a world-class level – and now the Senckenberg Museum will also receive a home with international appeal.”
THE BENEFACtor OF ART AND SCIENCE: CARLO GIERSCH, MEMBER OF THE BOARD OF TRUSTEES

With their commitment, Carlo and Karin Giersch are continuing the proud tradition of their foundations. They initiated the project of the Senckenberg Ocean Species Alliance, the year visionary research project thanks to the very generous support from the Orenstein family, who were among the most generous and enduring supporters of the Senckenberg Society. Since then, the successful Frankfurt business couple founded the "Carlo and Karin Giersch Foundation at the TU Darmstadt," and in 1994 they expanded their activities to their hometown of Frankfurt am Main. Thanks to the support of private individuals, companies, and foundations, we have been able to realize numerous and diverse projects to date. These include research and exhibition programs in the field of education and outreach. In the following, we present three examples.

SUPPORT IN RESEARCH...

The project "Senckenberg Ocean Species Alliance" aims to study and understand the biodiversity of marine species. In addition to funding from the federal and state governments, Senckenberg relies on extensive fundraising – and with success, as is evident in many areas today.

... AND IN THE EXHIBITION SECTOR ...

The project "Freiraum": This space is designed for multi-perspective and transdisciplinary projects. The exhibition space will provide room for presentations and actions that broaden the visitors’ view, such as art projects. The "Freiraum" is intended as a testing ground for exhibition organizers, where different approaches can be explored, and curatorial thinking and possibilities can be further developed.

... IN THE AREA OF EDUCATION & OUTREACH ...

"Research Inspirations" is the name of a special participatory project. Together with the respective target group, new mediation formats for people with impairments are conceived and developed. This includes "research assignments" for the blind and visually impaired to enable them to visit the museum independently. Guided tours for special schools are also on the agenda. The cooperation partner is the Department of Didactics – Biology, Geology, and Earth Sciences at the University of Goethe University, the Technical University Darmstadt, the "Museum Giersch der Goethe-Universität" on the Schaumainkai, an exhibition house dedicated to local art and cultural history.

Contact: Dr. Martin Ćepić & Charlotte Hennick

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FROM KNOWLEDGE TO ACTION

Supporting the dissemination of research results to the general public, thereby raising awareness of the importance of nature research and the interests of nature – that is the mission of the Friends of Senckenberg.

DIGITAL TALKS AS A CONSTANT DURING THE PANDEMIC

Four Digital Talks were held in the context of Zoom conferences between February and June 2021. During the Digital Talks, scientists engage in mutual discussions with experts from other fields and institutions. The first two talks addressed topics that continued their talks with scientists, entrepreneurs, and head of the SBiK-F (Senckenberg Biodiversity and Natural Resources Research Institute) Prof. Dr. Jan-Michael Lange, for whose achievements in knowledge transfer, the DGGV awarded him the 2021 Serge von Bubnoff Medal on September 22, 2021 at the GeoKarlsruhe “Sustainable Earth – from processes to resources.”

A THEMED PICNIC AND A BICYCLE TOUR ALONG THE BANKS OF THE NIDDA

In the summer, we had the opportunity to put on two in-person events. On the first occasion, participants explored the course of the Nidda River on a bicycle tour together with Senckenberg scientists, learning about the positive effects of the restoration measures on site. At the invitation of Senckenberg Board of Trustees member Stephanie Prinz zu Löwenstein, about 200 people gathered for a picnic in the blooming Kontinentpark at Kleinheubach Castle. Together with the hostess, who is a private forest owner, the participants discussed the meaning of forests to us humans and – against the background of global warming – what the “forest of the future” will look like.

THE WORLD OF FORESTS AT THE SENCKENBERG NIGHT

Our forests will also be the focus of the Senckenberg Night, which had to be postponed until April 30, 2022 due to Covid-19. The charity event at Castle Park, Kleinheubach, under the title “The world of forests”, is the Digital Talk entitled “The era of DNA sequencing affects us all!” by Prof. Dr. Axel Janke from the LOEWE-TBG.

KATRINA HARVATI RECEIVES GERMANY’S MOST PRESTIGIOUS RESEARCH AWARD

On March 15, 2021, the DFG (German Research Foundation) awarded the 2021 Gottfried Wilhelm Leibniz Prize to Prof. Katerina Harvati-Papatheodorou from the University of Tübingen, Germany’s most prestigious research award. Prof. Harvati is considered a pioneer in her field and has decisively advanced the study of human forebears by combining field research with state-of-the-art computer-assisted 3D morphological imaging techniques. Her work at Senckenberg HEP and the University of Tübingen sheds new light on the evolution of humans, particularly the relationships and skills of Neanderthals. Her team was able to disprove the theory that Neanderthals were coarse creatures with limited behavioral repertoire and instead provided evidence that early modern humans had already settled there 210,000 years ago – thus, they reached Europe about 100,000 years earlier than previously assumed.

The Senckenberg Night will also be part of the Senckenberg Prizes for Nature Research and the commitment to Nature. In the summer, we will have the opportunity to put on two in-person events. In the summer, we will have the opportunity to put on two in-person events. On the first occasion, participants explored the course of the Nidda River on a bicycle tour together with Senckenberg scientists, learning about the positive effects of the restoration measures on site. At the invitation of Senckenberg Board of Trustees member Stephanie Prinz zu Löwenstein, about 200 people gathered for a picnic in the blooming Kontinentpark at Kleinheubach Castle. Together with the hostess, who is a private forest owner, the participants discussed the meaning of forests to us humans and – against the background of global warming – what the “forest of the future” will look like.

2021 SERGE VON BUBNOFF MEDAL AWARDED TO JAN-MICHAEL LANGE

Prof. Dr. Jan-Michael Lange from the Senckenberg location in Dresden has contributed greatly toward promoting the public image of the geosciences in general and the German Geological Society – Geological Association in particular. With passion, enthusiasm, and considerable emotional involvement, he advocates the communication of geoscientific issues to the general public. Jan-Michael Lange’s research focuses on Cenozoic landscape evolution, in particular the uplift and fluvial history of Central Europe. Furthermore, he works on the external effects of meteorite impacts, e.g., the Ries impact 14.8 million years ago. For his outstanding achievements in knowledge transfer, the DGGV awarded Prof. Dr. Jan-Michael Lange the 2021 Serge von Bubnoff Medal on September 22, 2021 at the GeoKarlsruhe “Sustainable Earth – from processes to resources.”

THE GERMAN ENVIRONMENTAL AWARD GOES TO KATRIN BÖHNING-GAESSE

On October 10, 2021, Federal President Frank-Walter Steinmeier honored Prof. Dr. Katrin Böhning- Gaesse with the German Environmental Award in Darmstadt. With this annual award, the German Federal Foundation for the Environment (DBU) recognizes highest commitment and achievements that contribute to the protection and conservation of our environment, now and in the future. The ecologist and head of the SBiK-F (Senckenberg Biodiversity and Climate Research Centre) has made an enormous scientific contribution in the field of biodiver- sity research and has gained an outstanding inter- national reputation. “Her work highlights the dramatic consequences of biodiversity loss for us humans and for the entire Earth-human system,” said DBU Secretary General Alexander Bonde in his laudatory speech.

September 2021: At the invitation of Princess Stephanie zu Löwenstein, 200 interested people gathered for a picnic in the blooming Kontinentpark at Kleinheubach Castle, Kleinheubach.

During a bicycle tour along the Nidda on the topic of “floodplain restoration”, the participants had the opportunity to watch the restoration process in person. During a bicycle tour along the Nidda on the topic of “floodplain restoration”, the participants had the opportunity to watch the restoration process in person. During a bicycle tour along the Nidda on the topic of “floodplain restoration”, the participants had the opportunity to watch the restoration process in person.
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The Senckenberg Gesellschaft für Naturforschung (Senckenberg Society for Nature Research) publishes a variety of series. The following list summarizes the volumes and titles published in 2021. Further information about the publications can be found at www.senckenberg.de/en/Science Senckenberg-Publications.

**SCIENTIFIC JOURNALS**
- **ARCHIV FÜR MOLLUSKENKUNDE**, Volume 150 (1–2), Dr. John M. C. Hutchinson, Dr. Heike Reise, Dr. Katrin Schniebs, Prof. Dr. Julia D. Sigwart (Editors-in-Chief)
- **ARTHROPOD SYSTEMATICS & PHYLOGENY**, Volume 79, Dr. Klaus-Dieter Klass (Editor-in-Chief)
- **CONTRIBUTIONS TO ENTOMOLOGY – BEITRÄGE ZUR ENTOMOLOGIE**, Volume 71 (1–2), Prof. Dr. Thomas Schmitt (Editor-in-Chief)
- **GEOLOGICA SAXONICA**, Volume 67, Prof. Dr. Jan-Michael Lange (Editor-in-Chief)
- **MARINE BIODIVERSITY**, Volume 51 (1–6), Prof. Dr. Pedro Martínez Arbizu (Editor-in-Chief)

**SCIENTIFIC MONOGRAPHS AND BIBLIOGRAPHIES**
- **ABHANDLUNGEN der SGN**, Volume 575, 576, Dr. Peter Königshof (Editor-in-Chief)
- **ACARI – Bibliographia Acarologica**, Volume 21 (1–3), Dr. Axel Christian (Editor-in-Chief)
- **PECIANA**, Volume 14, Prof. Dr. Willi Xylander (Editor-in-Chief)

**POPULAR SCIENTIFIC PUBLICATIONS**
- **SENCKENBERG-BUCH**, Prof. Dr. Klement Tockner (Publisher), Band 86, Claudia Hemp: A Field Guide to the Bushcrickets, Wetas and Paspy Crickets of Tanzania and Kenya
- **SENCKENBERG – natur • forschung • museum**, Band 151 (1–4), Prof. Dr. Klement Tockner, Dr. h. c. Beate Heraeus (Publisher), Thorsten Wenzel (Editor-in-Chief)

**ANNUAL REPORT**
- **SENCKENBERG 2020**, Prof. Dr. Klement Tockner (Publisher), Thorsten Wenzel (Editor-in-Chief)

**OTHER PUBLICATIONS**
- Thalheim, Klaus; Erler, Daniela; Pflug, Norbert: Die geologische Literatur über Sachsen 2011–2015

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**SCIENTIFIC JOURNALS**
- **PALEOBIO DIVERSITY AND PALEOENVIRONMENTS**, Volume 101 (1–4), Dr. Peter Königshof (Editor-in-Chief)
- **SOIL ORGANISMS**, Volume 95 (1–2), Prof. Dr. Willi Xylander, Prof. Dr. Nico Eisenhauer (Editors-in-Chief)
- **STUDIA DIP TEROLOGICA**, Volume 24 (1), Dr. Frank Menzel (Editor-in-Chief)
- **VERTEBRATE ZOOLOGY**, Volume 71, Prof. Dr. Uwe Fritz (Editor-in-Chief)

**SCIENTIFIC MONOGRAPHS AND BIBLIOGRAPHIES**
- **ACARI – Bibliographia Acarologica**, Volume 21 (1–3), Dr. Axel Christian (Editor-in-Chief)
- **MARINE BIODIVERSITY**, Volume 51 (1–6), Prof. Dr. Pedro Martínez Arbizu (Editor-in-Chief)

**POPULAR SCIENTIFIC PUBLICATIONS**
- **PECKIANA**, Volume 14, Prof. Dr. Willi Xylander (Editor-in-Chief)

**ANNUAL REPORT**
- **SENCKENBERG 2020**, Prof. Dr. Klement Tockner (Publisher), Thorsten Wenzel (Editor-in-Chief)
SENCKENBERG

The Senckenberg Gesellschaft für Naturforschung (Senckenberg Society for Nature Research, SGN) was founded in 1817. Under the roof of SGN, 7 research institutes and 3 natural history museums in Germany conduct research in bio- and geosciences. The mission of its Articles Of Association is to make science and scientific findings accessible to the public through teaching, publishing, and the natural history museums. The natural history museum in Frankfurt is one of the largest in Europe. Here are some key figures.

- **PERSONNEL**
  - 843 from 48 COUNTRIES
  - 214 Working Researchers
  - 180 Volunteers

- **MEMBERS OF THE SOCIETY**
  - 7,458
  - 92,456.24 € Donations from members

- **PUBLICATIONS IN 2021**
  - 1,236
  - 339 Scientific Journal Articles
  - 31 Scientific Book Contributions
  - 33 Scientific Books
  - 13 Scientific Books
  - 92 Magazine and popular science publications
  - 161 Scientific Lectures at conferences

- **FOUNDER APPX.**
  - 50,000
  - Facebook
  - 15,767
  - Twitter
  - 2,493
  - Instagram
  - 13,372
  - TikTok

- **COLLECTION OBJECTS**
  - 40.8 MILLION

- **NEWLY DISCOVERED SPECIES**
  - 169

- **RESEARCH INSTITUTES**
  - 2 × Institute & Museum
  - FRANKFURT AM MAIN
  - WILHELMSHAVEN
  - Institute
  - 7 RESEARCH INSTITUTES
  - 5 RESEARCH STATIONS
  - 3 NATURAL HISTORY MUSEUMS
  - Dresden / 2 × Frankfurt / Tübingen
  - Wilhelmshaven / Müncheberg / Görlitz /
  - Gelnhausen / Messel
  - with
  - SCHÖNINGEN
  - MESSEL
  - Research station
  - TÜBINGEN
  - Research station
  - GELNHAUSEN
  - Research station
  - WEIMAR
  - Research station
  - MÜNCHEBERG
  - Museum
  - Institute &
  - DRESDEN
  - Museum
  - Institute &
  - GÖRLITZ

- **APPROX. PUBLICATIONS**
  - 27,116
  - Senckenberg mentions in online and print articles

- **APPROX. VISITORS**
  - 750,000
  - Digital Visitors
  - 239,299
  - Actual Visitors
  - 226,749
  - Frankfurt
  - 5,893
  - Dresden
  - 12,836
  - Görlitz

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