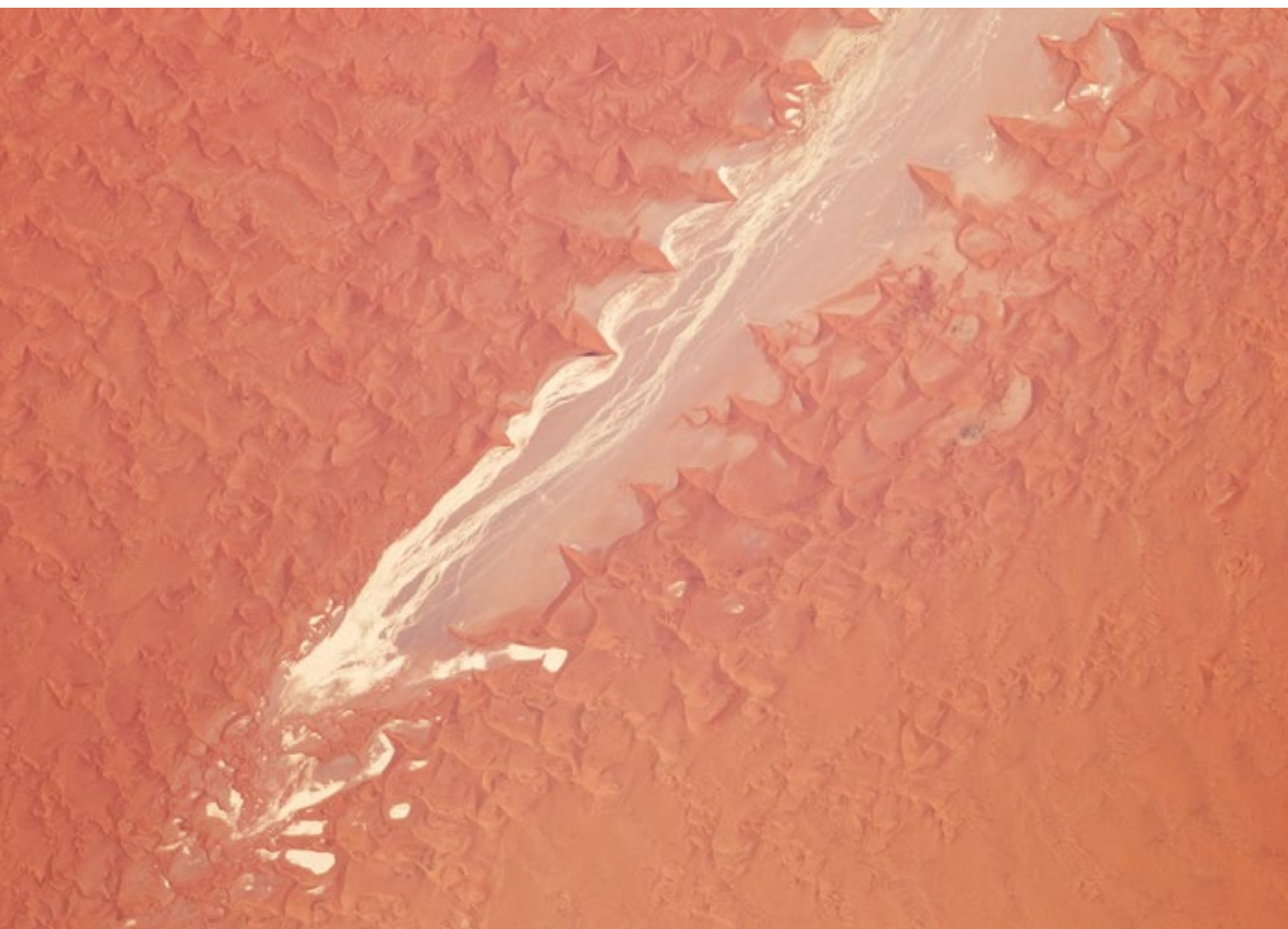


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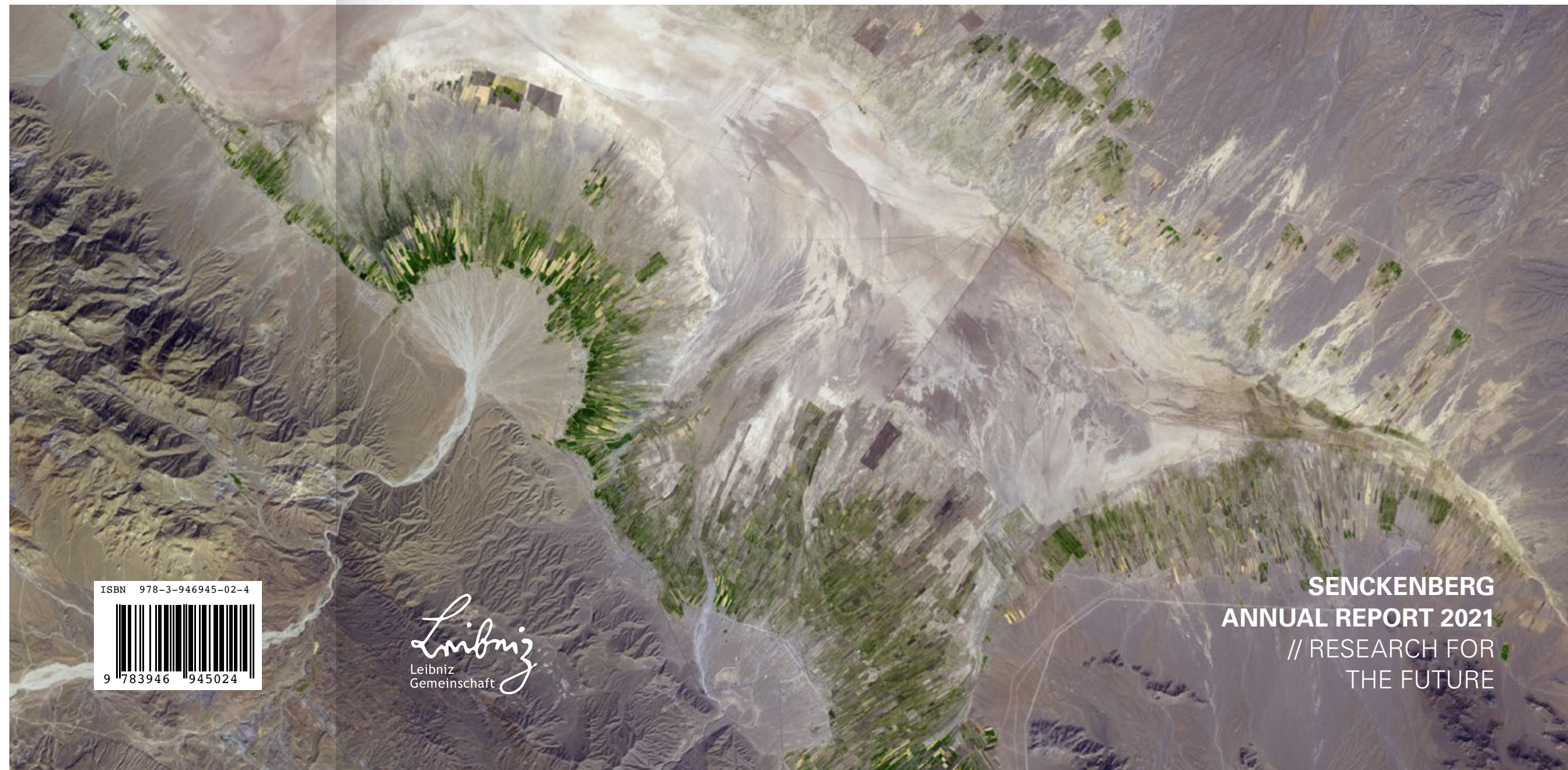
**Tsachab River and Sossus
Vlei Lakebed, Namibia**

A pale, dry riverbed cuts
through the red dunes of the
Namib Sand Sea.



**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.



SENCKENBERG
world of biodiversity

ISBN 978-3-946945-02-4



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SENCKENBERG
ANNUAL REPORT 2021
// RESEARCH FOR
THE FUTURE

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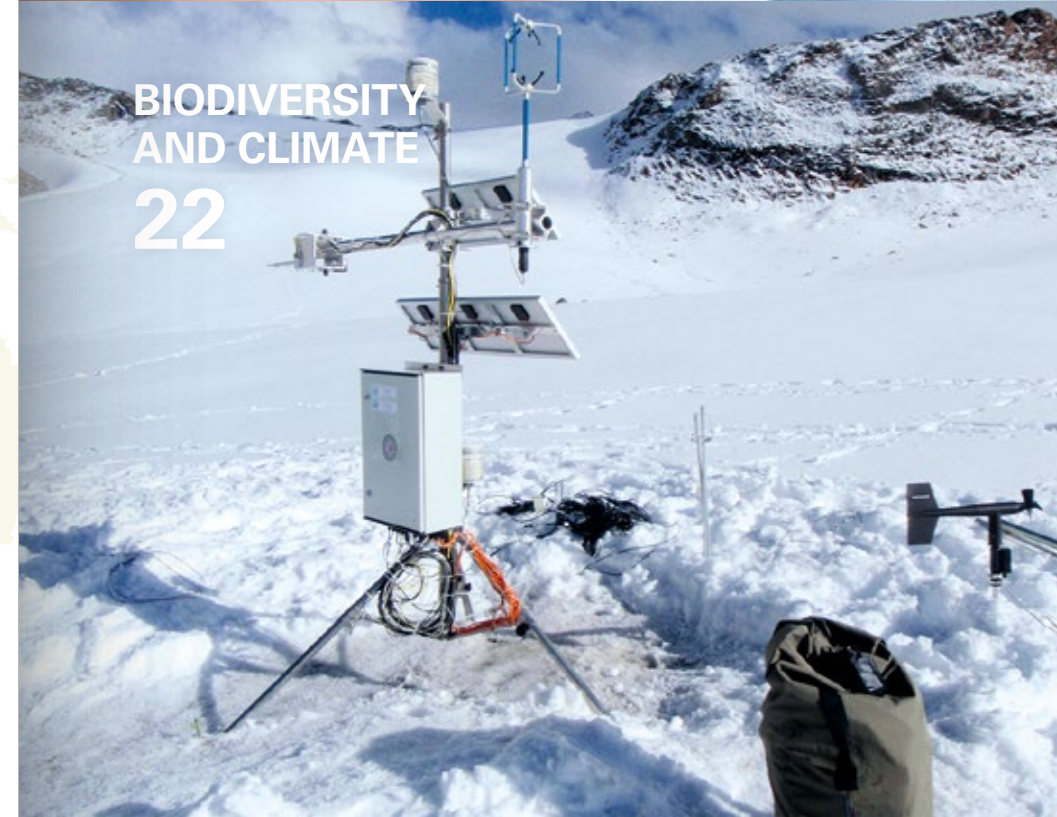
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BIODIVERSITY AND ENVIRONMENT

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BIODIVERSITY AND EARTH SYSTEM DYNAMICS

26



// FOREWORD

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

Prof. Dr. Klement Tockner
Director General, Senckenberg Society
for Nature Research



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



JANUARY

01

Prof. Dr. Klement 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.



HIGHLIGHT CALENDAR 2021

APRIL

01

Dr. Martin Mittelbach assumes the position of the SGN's Administrative Director.



The Senckenberg Museum Education Department celebrates its **40th anniversary**.



22

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



JULY

14



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

15

The Senckenberg Natural History Museum in Frankfurt opens the **new topical room "Coral Reef"**.



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.



15

The first episode of the Senckenberg podcast "**Earth Frequency**" is released.



22

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



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 FEa 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.



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 Hessian 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.

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.

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.

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

Our approach to studying our planet is systemic and increasingly inter- and 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 fair, transparent, and participatory decision-making to continuously improve our governance. We are committed to a research culture that values excellence and relevance through interdisciplinarity, internationalization, and innovation.

A habitable planet Earth is the quintessential foundation for human well-being. Senckenberg feels privileged and humbled 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

RESEARCH HIGHLIGHTS



INTRODUCTION

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

GEODIVERSITY IN ALL ITS FACETS

To study and preserve the diversity of life on earth – that is our goal. The responsible scientists present our four research fields.



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.

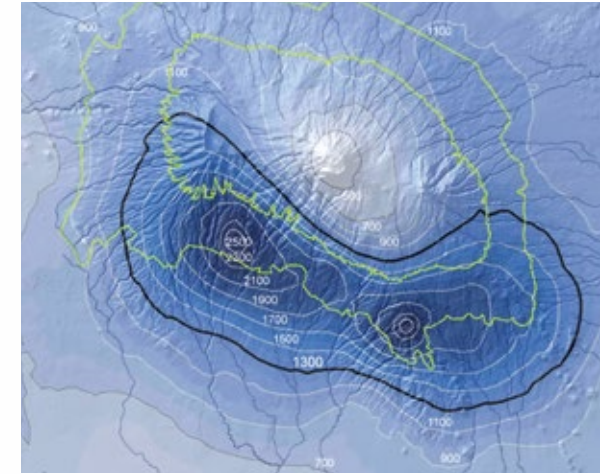


02 BIODIVERSITY AND ENVIRONMENT

We are investigating the increasing influence of humans on biodiversity and the environment. We are particularly focussing 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.



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, is Vice President of the Leibniz Association, a member of the Leopoldina.



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.

01 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” on the basis of molecular methods.

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

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

04 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.

**01 BIODIVERSITY, SYSTEMATICS,
AND EVOLUTION**

**OLDEST KNOWN
GENOME OF
MODERN HUMANS
RECONSTRUCTED**

Researchers from the University of Tübingen and the Senckenberg Centre for Human Evolution and Palaeoenvironment (SHEP), in collaboration with two Max Planck Institutes, have dated a fossil skull from the Czech Republic based on Neanderthal genes resulting from interbreeding. Palaeogeneticist Cosimo Posth is first shared author in this study.

According to earlier dating, the skull of Zlatý kůň is at least 30,000 years old; the new study concludes an age of at least 45,000 years.



Almost completely preserved: Palaeolithic female skull from Zlatý kůň.

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 HEP, 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.

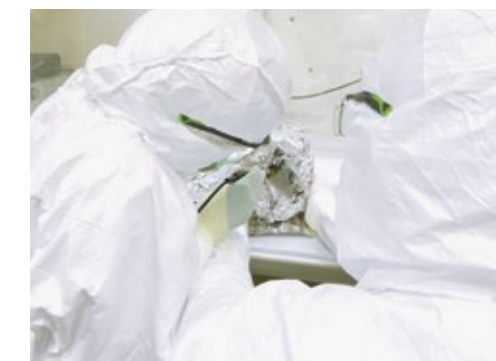
**THREE PERCENT NEANDERTHAL
AND LONG DNA SEGMENTS**

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 and 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 us: **Prof. Dr. Cosimo Posth**

Sampling in the clean room laboratory of the Max Planck Institute for the Science of Human History in Jena.



IceDivA PROJECT: THE SCIENCE WE NEED FOR THE OCEAN WE WANT

Under the motto “Creating the Ocean We Want,” the UN Decade of Ocean Exploration for Sustainable Development 2021-2030 began on June 1, 2021. International cooperation is essential to protect the ocean, and Senckenberg is part of the effort.



IceDivA2: On expedition in the northern Atlantic aboard the “Sonne”, Germany’s most advanced research vessel to date.

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 organismic 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 followed up on this – traveling from Emden, Germany, to the Arctic Circle north of Iceland, past Greenland’s southern tip into the Labrador Sea, and across the Atlantic to Las Palmas.

... TO THE PROTECTION OF THE OCEANS AND THEIR BIOTIC COMMUNITIES

“The biodiversity data we collect form the basis of well-founded protection concepts for the marine ecosystems, which face multiple threats,” says Chief Scientist Saskia Brix.

The species inventories provide information on the occurrence of so-called *Vulnerable Marine Ecosystems* such as coral or sponge gardens, allowing evidence-based policymaking, e.g., when designating marine protection zones. As a matter of course, only species already known to science are included in the Red List – undescribed species are obviously “unknown” and can therefore not be protected.

THE KNOWN, THE UNKNOWN, AND THE UNKNOWABLE

We can only protect what we know. “That is exactly why we need to continue surveying the deep-sea fauna, even as we are painfully aware that we cannot scientifically describe all the species we find in our samples – there are simply too many,” says epifauna specialist James Taylor. Over 90 percent of species occurring at depths of 3000 meters or more are still undescribed. After 150 years of deep-sea research, we must admit that the exploration of life in the world’s oceans is far from complete – it has only just begun!



Contact us: **Dr. Saskia Brix & Dr. James Taylor**

A MESSEL FLY AND ITS LAST MEAL

The Messel Pit near Darmstadt is known for many spectacular fossil finds. A newly discovered fossil fly reveals that it fed on pollen of various plants, thereby allowing inferences on foraging and feeding behavior around 47 million years ago.

An international team led by Messel researcher Sonja Wedmann has described a new species of flies from the UNESCO World Natural Heritage Site “Messel Pit.” The newly discovered species from the genus *Hirnoneura* has a body length of 11 millimeters and is 47.5 million years old. But the biggest surprise is what was found inside the fossil – flower pollen in the insect’s abdomen.

2 mm

The new fossil fly from Messel has a mass of pollen in its abdomen.



HIGH-TECH POLLEN ANALYSES ...

Finds of fossilized food remnants are extremely rare throughout the world. Using the latest palynological methods, the scientists were able to identify the pollen of plants from the sapote and olive families as well as from the modern genera of water-willow and Virginia creeper. The use of photogrammetry made it possible to highlight the pollen mass in the insect’s abdomen as a three-dimensional bulge.

... REVEAL NEW INSIGHTS INTO THE MESSEL ECOSYSTEM

The analyses provide clues about the environmental conditions of that time and the animals’ habits, their feeding behavior, and their role as pollinators in the Messel Eocene. The fossil flora around Lake Messel was primarily characterized by elements of (sub-) tropical forests. However, the stomach contents of the newly discovered fly suggest that it did not find its food in a dense, closed forest but rather fed on plants growing at the edge of the forest and along the shores of Lake Messel.

This indicates that the flies played a role in the transport of pollen and thus for the reproduction of several plant families – possibly, flies were and are even more important than bees for the pollination of tropical plants.



Contact us: **Dr. Sonja Wedmann**



TURTLES IN DANGER

In November 2021, an international team of scientists, including Senckenberg herpetologist Uwe Fritz, published the ninth edition of the atlas “Turtles of the World.” Besides detailed descriptions of all 357 turtle species, it also includes information on the at-risk status of all species and a comparison of their current and original ranges. The results are alarming: About half of the world’s turtle species are threatened with extinction. They are particularly affected by habitat loss and excessive capture for consumption and the pet trade.



Contact us: **Prof. Dr. Uwe Fritz**

02 BIODIVERSITY AND ENVIRONMENT

GRAIN STORAGE: NATURAL SUBSTANCES INSTEAD OF CHEMICAL INSECTICIDES

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 time of storage, the grain is under permanent risk of being attacked by pest species.



A 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 dia-

toms – 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 (*Rhyzopertha dominica*), 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

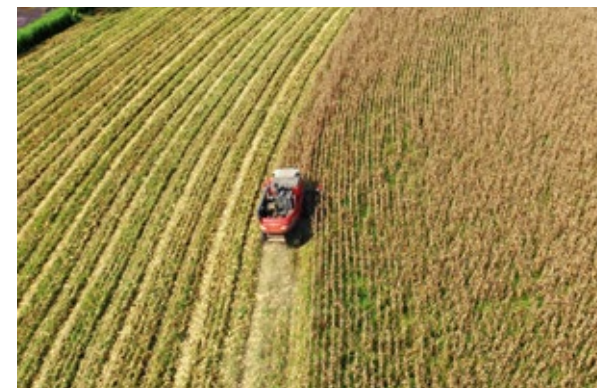
The combination of the different active ingredients – “insecticide and fungus” and “DEs and fungus”

– 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 150 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 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.

BONARES: SOIL AS A SUSTAINABLE RESOURCE FOR THE BIOECONOMY

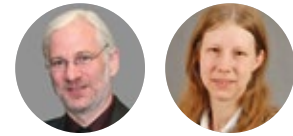
The overall goal of the BMBF BonaRes Program is to improve the scientific basis for the sustainable use and management of agricultural soils.

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 devel-

opment of the model by analyzing both the impact of agricultural practices on soil fauna and its importance for soil functions.

Analysis results from 2021 show that organic nitrogen fertilization and a reduction of tillage intensity have overall positive effects on soil fauna and also indicate a large increase in soil nitrogen due to the activity of soil organisms, especially earthworms.

In a third funding phase (2022–2025), the SGN will further examine the impact of soil fauna on soil properties, assess the effects of soil compaction on soil fauna, and illuminate the role of soil food webs in soil functions.



Contact us: **Dr. David Russell & Dr. Birgit Lang**

ARCHAEOLOGICAL EXCAVATIONS IN SCHÖNINGEN

The excavation team from Schöningen dug for fossils in 325-square-meter area, and the participants continued to slurry sediments for months to ensure that even the smallest stone artifacts or microfauna remnants would not escape their attention.



Highlight from the 2021 excavation campaign: aurochs skull

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

One of the highlights of the 2021 excavation campaign was an erratic 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 3D reconstruction based on “structure from motion” photogrammetry – several hundred individual photographs are later combined to form a 3D image that reflects the find situation or the position of the bones in space. Incidentally, the aurochs was located only about 10 meters from the site where the

skeleton of the primeval elephant cow “Nelly” was unearthed between 2017 and 2020. There, too, the work continued. In the mud residue, the team discovered several small stone chips. In addition to numerous individual bones, the discovery of a large accumulation of footprints from various large mammals in a siltation horizon on an area of about 50 square meters came as a special surprise.



Contact us: **Dr. Jordi Serangeli & Prof. Nicholas Conard, PhD**

RESEARCH EXCAVATION AT UNTERMASFELD COMPLETED: OVER 18,000 FINDS

18,250 catalogued finds, all carefully stored in collection cabinets at Senckenberg Weimar – this is the result of 42 years of excavations at the Untermaßfeld fossil site. Recently, for example, the first record of Atlantic salmon was made in the Werra sediments. These and other findings are covered in the comprehensive Untermaßfeld monograph, the fourth part of which was published in 2021.

Since 1979, the Thuringian vertebrate fossil site has been regularly excavated, its unique vertebrate finds were prepared, photographed, drawn, and documented for future generations. Four decades of excavation work yielded 14,291 catalogued finds of large mammals, more than 7,000 small vertebrate fossils, and 99 *in situ* preparations of Early Pleistocene large and small vertebrates, which are stored in over 1,000 drawers at the Senckenberg Research Station. This makes the carcass field of Untermassfeld one of the richest vertebrate fossil sites in the world, with up to 250 finds per square meter.

It is therefore not surprising that the collections of the Senckenberg Research Station for Quaternary Palaeontology in Weimar attract scientists from all over the world. Nevertheless, “After 127 months of excavation and 37 excavation periods, we are concluding our activities at this extraordinary and scientifically highly exciting site – at least for the time being,” explains Quaternary palaeontologist Prof. Dr. Ralf-Dietrich Kahlke.

However, the study of the finds and their documentation continues. Volume 4 of the Untermaßfeld monograph is a book of palaeontological superlatives. The work features twelve current studies, spectacular fossils, and new scientific findings, including the description of a complete rhinoceros skull, the oldest yak population known to date, the first record of a sand boa in Central Europe, and even feeding traces of skin beetle larvae, allowing inferences about the site’s deposition history.

The lavishly illustrated fourth volume of the series does not yet mark the end. Science is on a perpetual quest for new knowledge – and wants to share it with others. Thus, the Quaternary palae-

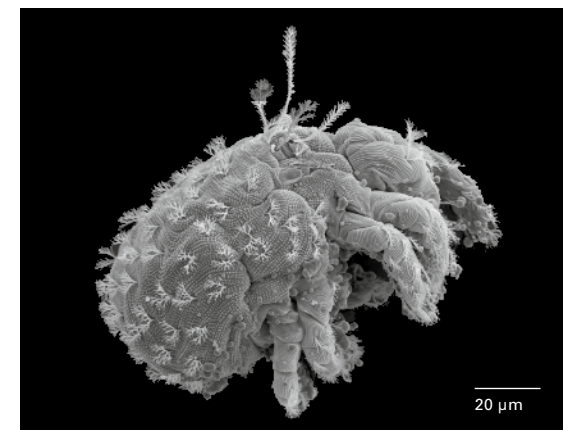


Repeated flooding accumulated thousands of skeletal elements, mostly of drowned mammals, at today’s Untermaßfeld fossil site. The center of the photo shows the world’s only complete skull with antler of the fallow deer-like *Pseudodama*, while a femur of the extinct rhinoceros *Stephanorhinus* with bite marks from giant hyenas can be seen in the background.

ontologists around Ralf-Dietrich Kahlke are already working on volume 5, which will conclude the monograph and thus an essential part of his scientific life’s work.



Contact us: **Prof. Dr. Ralf-Dietrich Kahlke**



Thousands of different, sometimes bizarre-looking animal species live in the soil, like this mite *Nanorchestes berryi*.

03 BIODIVERSITY AND CLIMATE

RIVERS WITHOUT WATER

The key message of the article published in June 2021 in the scientific journal “Nature” spread through the media like wildfire: 60 percent of the rivers and streams on Earth are intermittently drying up – across all continents and climate zones! The crux of this development: Half of the people on earth live near such temporary bodies of water and depend on them, as do numerous animal and plant species – a third of which are endangered, threatened with extinction, or have already been lost forever.

The Tagliamento is one of the last great wild rivers in Europe that is still governed by largely natural ecosystem dynamics. While much of the alluvial plain is 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.



For 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

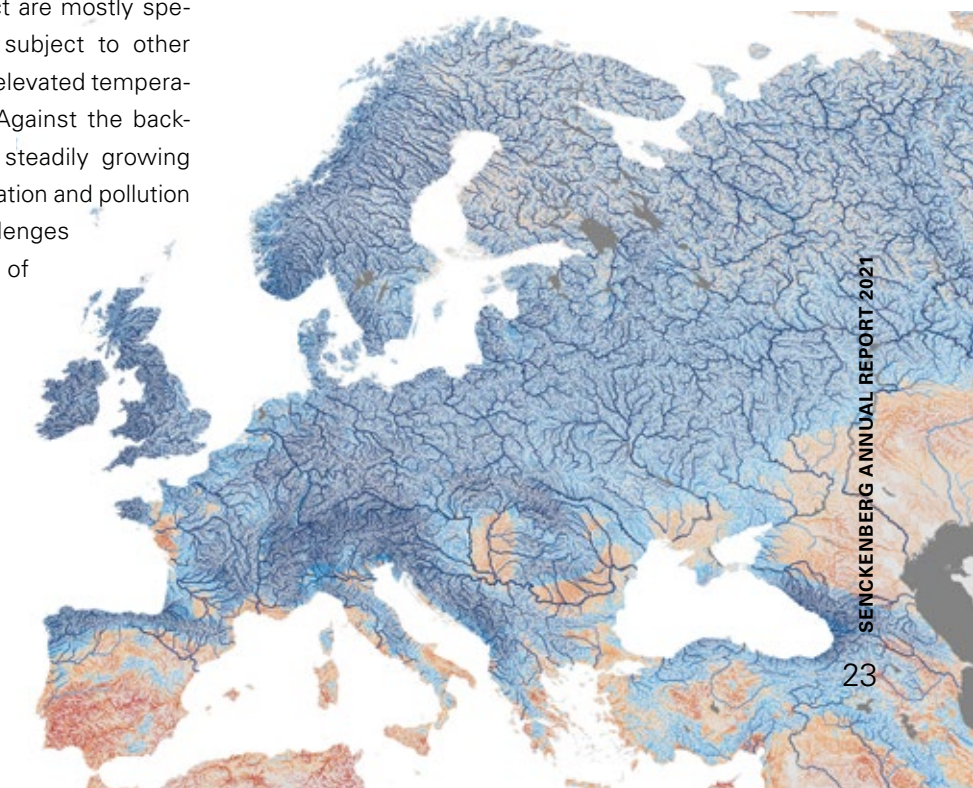
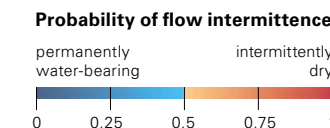
least from a scientific perspective. “Intermittent water bodies are globally widespread and part of our natural environment. Therefore, they should receive appropriate consideration in management measures, and uniform regulations must be established across national borders. We cannot ignore over half 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.

Distribution of permanently water-bearing and intermittently dry rivers and streams in Europe and parts of North Africa.

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



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 will have to address a number of key questions across disciplines in dialogue with politics and society. Here, we should be aware that while 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 renaturation of streams and rivers – for the protection of nature and for the well-being of us humans.



Contact us: **Prof. Dr. Klement Tockner**



Increasingly struggling with drought: our European beech *Fagus sylvatica*.

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.

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.



Native beech trees are apparently suffering more and more from the drought. How should foresters react to this? Trust that the beech will manage on its own or replace it with new tree species? Science has worked out a solution.

Completely healthy-looking trees stood right next to severely damaged ones. “We therefore suspected that it was not the local environmental conditions – which were identical for all trees – that were responsible for the drought damage, but rather a different genetic makeup among the trees,” explains Prof. Dr. Markus Pfenninger.

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,” says the ecologist.

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.

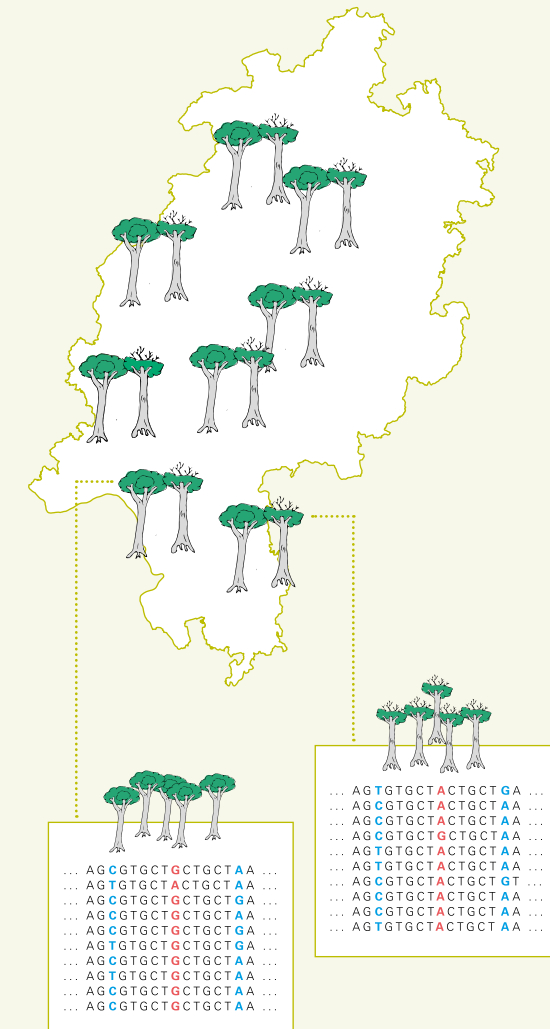
The next step involves implementing these findings in practical programs. Now, foresters can specifically select drought-resistant, seed-producing trees and help accelerate and even monitor natural selection, thus making beech forests more resilient to climate change.



Contact us: **Prof. Dr. Markus Pfenninger**

The Beech Experiment

“Experimental set-up,” or principle of the genome-wide association test: the genomes of healthy and damaged trees were compared among more than 200 pairs of beech trees in Hesse (top) to detect systematic differences. The deviations at a gene locus are shown in red (bottom).



CARBONATE FACTORIES ON THE OCEAN FLOOR

In 2006, researchers submerged three platforms in the sea off the coast of Spitsbergen to observe how quickly they are colonized, and by what organisms. The experiment focused on the buildup and breakdown of polar carbonates and on the role the world's northernmost "carbonate factories" play in the global carbonate cycle.



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

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**



INTRODUCTION

Anthropocene Change is gaining momentum, and we are just beginning to realize how many facets of biodiversity are affected. Genetics 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 analysis one of Germany's oldest repositories, the "Umweltprobenbank" for a broad range of environmental samples. Modern genomic approaches allow for analyze 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**



Storage at subzero temperatures is critical to ensure that samples retain their chemical and biological information for retrospective analyses.

THE TRENDDNA PROJECT

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

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, in freshwater, and on land. Immediately after sampling, they are prepared 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.

DECIPHERING THE SAMPLES BY MEANS OF GENETIC ANALYSES

The new 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 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. The Federal Environmental Agency is funding “TrendDNA” with 1.2 million Euros.

ENVIRONMENTAL DNA MIXTURE PROVIDES INFORMATION ON THE COMING AND GOING OF SPECIES

Using high-throughput sequencing, the researchers are taking a close look at deciduous forests: every year, many kilograms of leaves from several

locations are deep-frozen, ground up, and stored in nitrogen tanks, divided into 200 individual samples. In the past, small animals, fungi, and bacteria processed along with the samples were ignored, especially since the focus was on pollutants. Today, ladybugs, leaf wasps, and other inhabitants can be identified from this “environmental DNA mixture” – who stays, who leaves? Initial results indicate that the number of species in areas heavily impacted by humans has decreased significantly.

The Frankfurt team led by Prof. Dr. Miklós Bálint also includes Prof. Dr. Steffen Pauls and Prof. Dr. Markus Pfenninger. They are interested in genetic changes in soil animal communities and insects living on trees and their leaves. The Team is further investigating how climate change and pollutants have affected the genome of earthworms over 25 years.

TrendDNA aims to further develop and establish new methods by 2025, thereby standardizing the collection of biodiversity data from the environmental sample bank at an unprecedented scale. Reliable trend analyses are essential to identify environmental problems at an early stage and take the required measures.



Contact us: Prof. Dr. Miklós Bálint, Prof. Dr. Steffen Pauls & Prof. Dr. Markus Pfenninger

HOW MUCH DOG IS IN OUR WILD WOLVES?

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 in 157 packs, 27 territorial pairs, and 19 territorial individuals (as of November 2021).

Especially at the beginning of such a re-population, there is a higher probability of wolves mating with feral domestic dogs due to the lack of



Mother a wolf, father a German shepherd: Two puppies from the first German hybrid litter in 2003 in the Lausitz region, Germany.

How much dog is in our wild wolves? Modern genome analyses can now clarify this.

sexual partners of their own species. Theoretically, this could lead to an increasing accumulation of dog genes in the wolves’ gene pool. However, social acceptance of wild wolf-dog hybrids is low; therefore, 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 reliable detection of hybridization events even after several generations. This is made possible by the targeted selection of sites in the genome where domestic dogs and wolves

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.



Contact us: Dr. Carsten Nowak

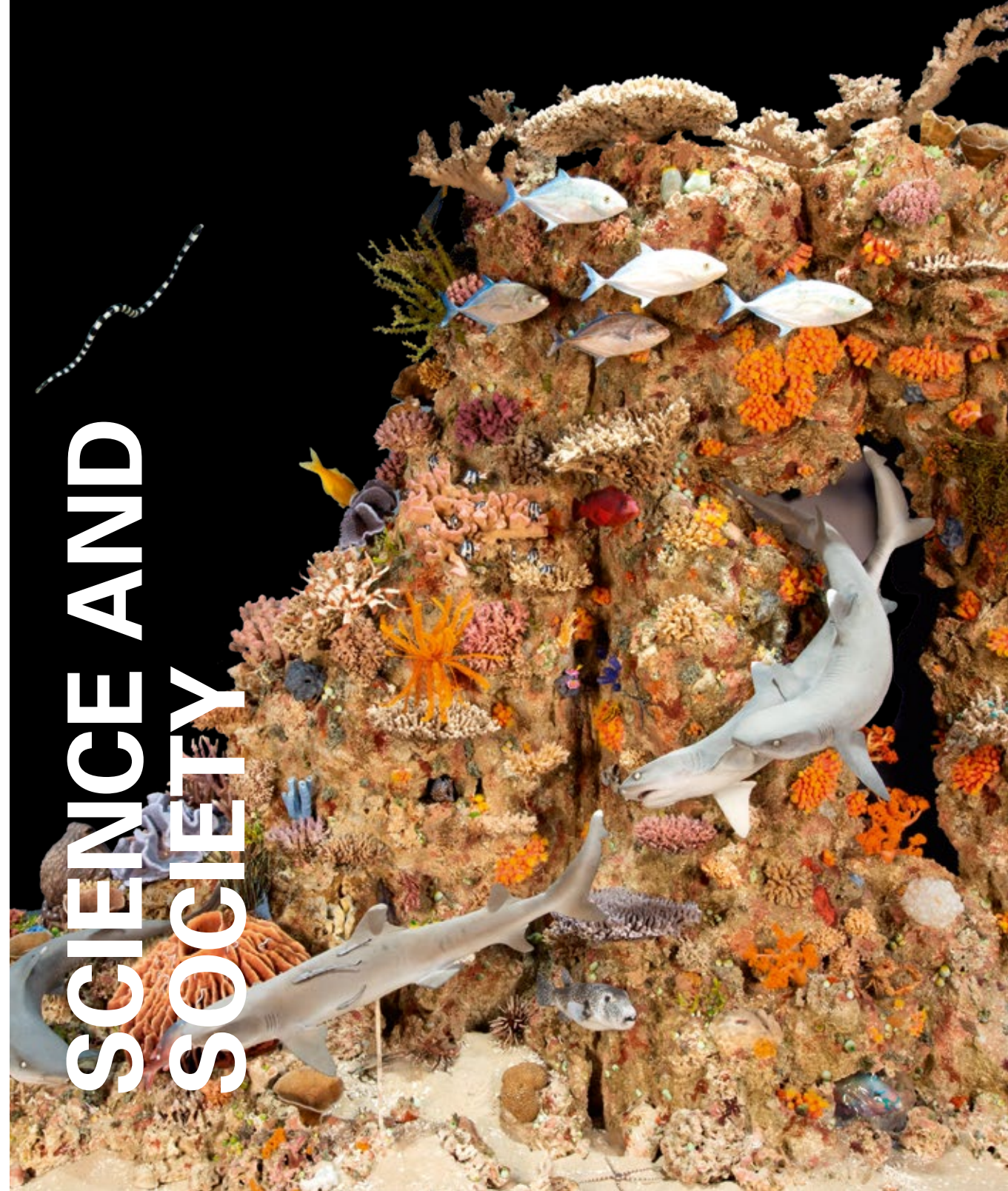




INTRODUCTION

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 exhibition, 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



SCIENCE AND SOCIETY

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!



Images of the ad campaign for the museum’s 200th anniversary.

tunity to visit the “Senckenbergianum” and marvel at curiosities from distant lands. As the display collection continued to grow, the society planned to build a new museum. After three years of construction, it was inaugurated at its present location on October 13, 1907. With the move into the new building, the museum with its collection on display was spatially separated from the research facility housing the scientific collection – effectively leading to the foundation of the research institute.

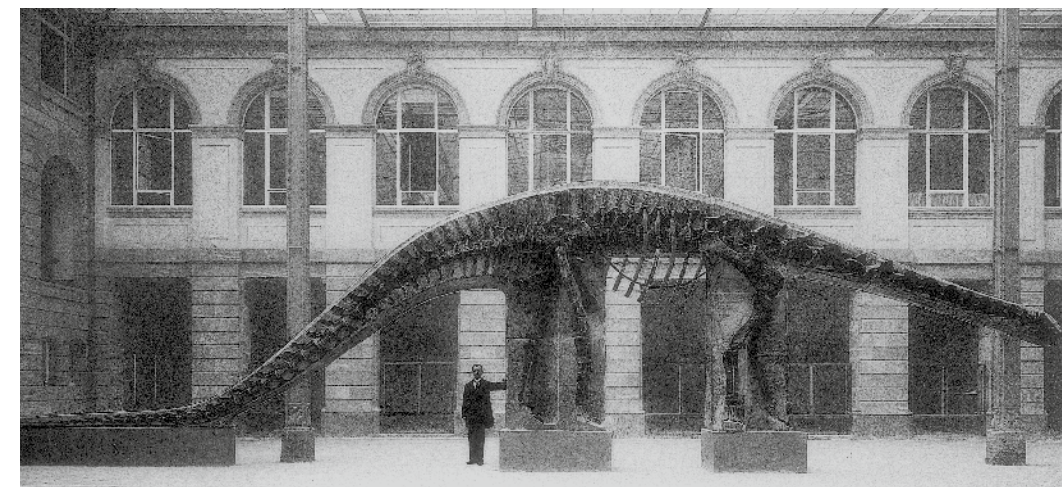
ANNIVERSARY EXHIBITION

Brush-footed butterfly, goliath beetle, hand axe, and triceratops are 4 of 20 selected objects of the decentralized exhibition ad campaign for the 200th anniversary.

Diplodocus longus, as it was displayed in the museum in 1907.

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 Eschenheimer Tor. On November 21, 1821, it opened its doors – initially for members only, but in the following year all interested citizens were given the oppor-



Each object represents a decade of museum history. Citizens encountered them as eye-catchers on colorful advertising posters around the city, in clips on social media, or on the “Museum For Tomorrow” project website. 140.000 posters were given to the visitors for free. An accompanying media guide offers digital tours through the exhibition. A hands-on station was located in the Hall of Whales and Elephants to ask the visitors about their vision for the museum’s future. In the coming years, it will become a place that tells the story of our planet and of ourselves as influencers of its history in even more exciting, educational, and fascinating ways.

CONTINUED EXCAVATION IN EDMOND’S PREHISTORIC REALM

In front of the visitors, preparators unearthed nearly 1,000 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



The excavation team uncovered over 3,000 finds in “Edmond’s Prehistoric Realm” in view of the public.



A look at the special exhibition “Rivers,” where visitors could explore the Nidda from its source to its confluence with the Main.

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.

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 faraway 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.



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

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 1991, the first 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.

“AHA?! SCIENCE LAB” IN THE MAKING

In the coming years, Senckenberg wants to convey knowledge in its museums in an even more exciting, educational, and fascinating way. How 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 200-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 Rossmannith, 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@Kinderzimmer” (Museum@Children’s Room) and its offshoot for adults, “Museum@Wohnzimmer” (Museum@Living Room) were added in 2021. Digital guided tours are now also available. The tour guides join 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 representative body for young adults met for the first time: the Senckenberg Youth Council. About a dozen young people are actively involved in making 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 visit: from suggestions for exhibits and new formats in the social networks to a short podcast in which young people explain science to their peers.



Contact us: **Dr. Eva Rossmannith**



The current “Education & Outreach” core team. However, successful outreach work is only possible with the cooperation of many other participants: colleagues from research and the museum, guides, cooperation partners, and sponsors who support the educational work.

MUSEUM HIGHLIGHTS FROM GÖRLITZ



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.

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. With interactive, lavishly illustrated identification keys and species portraits, large groups such as beetles and ants as well as millipedes, centipedes, and terrestrial isopods can be identified via tablet or smartphone. The data obtained can be used by soil animal researchers worldwide.

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



“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 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

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.

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

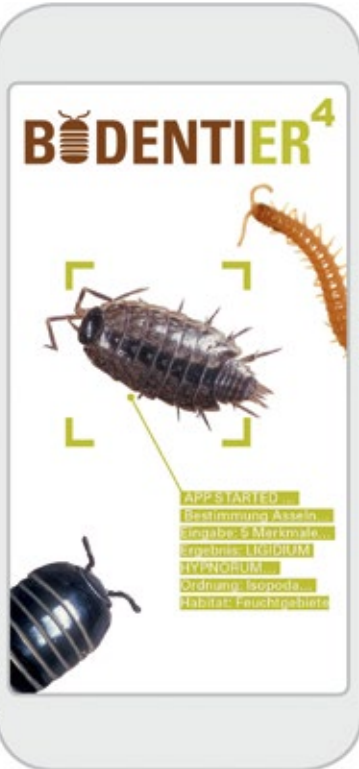
Mushroom picking is a common pastime. But there is much more to be said on this subject, especially if the institute has a department of fungal research that studies plant pathogens. Therefore, not too many exhibitions are able to feature live mushroom cultures or have visitors watch a lemon “rot” before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



Görlitz Meridian Nature Film Award: The well-wishers included State Secretary Andrea Franke (SMWK), Görlitz’s Mayor Octavian Ursu, and museum director Willi Xylander. The laudatory speech was given by the renowned science journalist Volker Arzt. (Left to right: Prof. Dr. Willi Xylander, Volker Arzt, Ingrid and Heinz von Matthey, State Secretary Andrea Franke, and Mayor Octavian Ursu).



Institute director Prof. Dr. Willi Xylander performs the symbolic hammer strike and offers a blessing for the large new Senckenberg construction project.



The app “BODENTIER hoch 4” opens up completely new perspectives into the world of soil animals.





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.”



Contact us: **Prof. Dr. Willi Xylander**

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



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.

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.

SENCKENBERG ONCE AGAIN A VACATION PASS PARTNER

To kick off the summer break, a family party was held on July 25, 2021 at the Königsufer on the Film Nights premises. Thirty dedicated Vacation Pass hosts organized the hands-on party and offered a



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



Title page of the 2021 Dresden Vacation Pass

diverse summer vacation program. The SNSD workshops were fully booked again! This time, the children could trace the geological history through Dresden’s Old Town, marvel at the mysterious nature under a scanning electron microscope, or watch our taxidermists at work.



Contact us: **Birgit Walker**

MARINE RESEARCH AT YOUR FINGERTIPS – FROM RESEARCH VESSEL TO THE LIVING ROOM

Surrounded by waves, wind, and a vast expanse of water in the middle of the North Atlantic – and yet reachable online, even via video conference?



The conference room of the research vessel “Sonne” serves as a film studio for the IceDivA2 team.

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 with great technical effort to ensure the ship could be reached via satellite. Supported by the German Federal Ministry of Education and Research, the Briese shipping company, and the Control Center for German Research Vessels, Senckenberg aimed to ap-

peal to a broad audience and offer “marine research at your fingertips” – transmitted in real time from the research vessel to living rooms at home while imparting knowledge and entertaining at the same time. The concept paid off: During 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 to a cleaner ocean. And the team shared some remarkable stories and discoveries from the bottom of the ocean several thousand meters below the surface.



Contact us: **Dr. Saskia Brix**

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.



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

ERDFREQUENZ informs about all facets of our Earth system: from the depths of the oceans to the Himalayas, 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 adventurous expeditions, encounters, surprises, successes and failures in everyday life and vividly explain the tools and methods they use to arrive at their findings. They also give tips on how we all can live more sustainably and make our own small contribution toward climate protection and the preservation of biodiversity.

Senckenberg Director General Klement Tockner kicked off the event on September 15, 2021. The internationally renowned aquatic ecologist pointed out how we humans have taken advantage of the earth and ush-



Contact us: **Adrian Giacomelli**

AUTHENTIC SCIENCE 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 (b. 1902; d. 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 palaeo-anthropology. You can learn how this research discipline has contributed to our understanding of human evolution and biocultural diversity.



6-PART VIDEO SERIES

- 01 Hominin Expansions into Southeast Asia
- 02 Origins and Life Style of *Homo erectus*.
- 03 The Largest Hominid that Ever Lived: *Gigantopithecus*
- 04 Hominin and Hominid Diversity in Southeast Asia (*Meganthropus*)
- 05 Hominin Expansions across South East Asia
- 06 G. H. R. von Koenigswald and his palaeoanthropological legacy

“What makes us human?” is the title chosen by three Frankfurt filmmakers for the documentary



G. H. R. von Koenigswald during digs on Java in 1937 – the year he found the approx. 1.5-million-year-old skullcap of “Sangiran 2”.

about G. H. R. von Koenigswald. The film is a visual reflection, a reconciliation of fact-based natural science with the poetic search for the identity of *Homo sapiens*. It visualizes with the aid of contemporary film documents, authentic photographs, and von Koenigswald’s moving correspondence with colleagues in Asia, Europe, and America. Embark on an inspiring exploration of human history: Where did humans come from? How can the rise of *Homo sapiens* be explained? And what makes us “mammals of a higher order?”



Contact us: **Prof. Dr. Friedemann Schrenk**



INTRODUCTION

“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



A GROWING CIVIC SOCIETY, A MUSEUM FOR TOMORROW, AND A NEW SENCKENBERG CAMPUS IN GÖRLITZ



The day of the groundbreaking ceremony for the new Senckenberg Campus. The certificate was signed by (from left to right) State Secretary Andrea Franke (SMWK), Saxony’s Minister-President Michael Kretschmer, State Secretary Wolf-Dieter Lukas (BMBF), the Mayor of Görlitz Octavian Ursu and Museum Director Willi Xyländer.

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.”

FUNDRAISING ACTIVITIES

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.



Fundraising supports research and exhibition projects ...

Thanks to the support by private individuals, companies, and foundations, we have been able to realize numerous and diverse projects to date. These include research and exhibition projects as well as 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 accelerate the discovery, taxonomic description, and systematic classification of new marine species. In addition, their endangered status must be assessed, accompanied by public relations and educational work. At the same time, the so-called "Red

List Assessments" will lay the foundations for the implementation of a sustainable "Blue Economy."

"Senckenberg is able to realize this ten-year visionary research project thanks to the very generous support from the Orenstein family," says Dr. Martin Čepek, head of fundraising.

... IN THE EXHIBITION SECTOR ...

The project "Freiraum" (free space) is designed for multi-perspective and transdisciplinary projects. This 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. This innovative project is made possible by the generous commitment of Volker Westerberg.



... as well as programs in the field of education ...

... AND IN THE AREA OF EDUCATION & OUTREACH

"Research Inspirations" is the name of a special participatory project: Together with the respective



... and a high level of participation by our visitors.

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 – Biological Sciences at the University of Frankfurt. A joint course is offered for students in the field of special education, who develop their own concepts for guided tours. Thanks to a cooperative grant from the Dr. Wolfgang and Sigrid Berner Foundation, the Erhard Kunert Foundation, and the Albert and Barbara von Metzler Foundation, we are able to realize this project.



Contact us: Dr. Martin Čepek & Charlotte Hemmink

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 civic foundations in their hometown of Frankfurt am Main. They have established two foundations whose programs also encompass science.

Carlo Giersch's "second career" began in 1990. Since then, the successful Frankfurt businessman and previous owner of Spoerle Electronics has devoted himself to foundation work together with his wife Karin. As early as 1990, the entrepreneurial 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 with the "Giersch Foundation." The foundations focus on the areas of science, art, culture, and pediatric and adolescent medicine – "meaningful activities that trigger a feeling of joy" for both. The supported institutions include the Goethe University, the Technical University Darmstadt, the Clementine Children's Hospital, and the Frankfurt Institute for Advanced Studies with the Giersch Science Center. The couple also donated the "Museum Giersch der Goethe-Universität" on the Schaumainkai, an exhibition house dedicated to local art and cultural history.

Their commitment did not go unnoticed: in 2009, the Gierschs were honored with the German Donor Award; the TU Darmstadt awarded Carlo Giersch the title of Honorary Senator; Goethe University also awarded Karin Giersch the title of Honorary Senator; and the Hessian Ministry of Science and the Arts thanked Carlo Giersch for his commitment by appointing him an "honorary professor."

Senator E. h. Prof. Carlo Giersch has been active on Senckenberg's Board of Trustees since its founding in 2003. "It is a stroke of luck to have people like Carlo Giersch in our ranks. He and his wife Karin are patrons with heart and passion, and they are among the most generous and enduring supporters of the Rhine-Main region," says Senckenberg President Beate Heraeus. Likewise, Director General Klement Tockner is more than impressed by the "lively activities of the Giersch Foundation to promote internationally excellent and interdisciplinary research at Frankfurt. The commitment of Karin and Carlo Giersch is exemplary, especially since it is geared towards the long term and thus the future."

Likewise, Senckenberg is a special institution for Carlo Giersch, whose significance extends far beyond the natural history museum and the city of Frankfurt: "Supporting the Senckenberg



Senator E. h. Prof. Carlo Giersch in the garden of the "Museum Giersch der Goethe-Universität".

Society with its unique museum as well as its promotion and training of young scientists has always been a concern of ours, which meshes perfectly with our foundation's intergenerational support chain – from students to university professors."

While the Senckenberg Board of Trustees initially placed its main focus on the concept of funding, the current meetings of its now 46 members – primarily public figures from politics, business, and science – also aim at a fruitful exchange of ideas as well as ideational and economic advice for the Society; a role that is tailor-made for Carlo Giersch. He is a highly esteemed advisor and debate partner, and the Senckenberg Society for Nature Research looks forward to his continued expertise and support.



September 2021: At the invitation of Princess Stephanie zu Löwenstein, 200 interested people gathered for a themed picnic in the Fürst Löwenstein Castle Park, Kleinheubach.

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. Scientists from our institute engaged in public discussions with experts from other fields and institutions. The first two talks addressed topics that concern us all: How can we curb climate change; how can CO₂ neutrality be achieved; and what does the

future of our forests look like? In May, Senckenberg Director General Klement Tockner introduced a pressing issue unfamiliar to many of us: “Rivers without water” (see page 22). Equally fascinating was the Digital Talk entitled “The era of DNA sequencing affects us all!” by Prof. Dr. Axel Janke from the LOEWE-TBG.

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



During a bicycle tour along the Nidda on the topic of “floodplain restoration”, the participants had the opportunity to watch the scientists sampling the bottom of the river.

about the positive effects of the renaturation measures on site. At the invitation of Senckenberg Board of Trustees member Stephanie Princess zu Löwenstein, around 200 people gathered for a picnic in the blooming Kontinentenpark 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 attracts people from politics, society, business, and science and engages them in mutual discussions. The evening’s highlight is the award ceremony of the Senckenberg Prizes for Nature Research and Commitment to Nature.

In addition, the Friends of Senckenberg will continue their talks with scientists, entrepreneurs, representatives of NGOs, and young members of the climate movement, always guided by the question: How do we have to rethink our world if we want to achieve the urgently needed major transformation, and how can we move from knowledge to action?



Contact us: **Heike Spiller & Simone Loewen**

SENCKENBERGERS AS AWARD WINNERS



KATERINA 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 in a virtual setting.

Prof. Harvati is considered a pioneer in her field and has decisively advanced the study of human fossils by combining field research with state-of-the-art computer-assisted 3D morphology 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 the Neanderthals. Her team was able to disprove the theory that Neanderthals were coarse creatures with a limited behavioral repertoire. Based on fossil finds from Greece, she provided evidence that early modern humans had already settled there 210,000 years ago – thus, they reached Europe about 150,000 years earlier than previously assumed.



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 e.V. (DGGV) 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 distal 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-GAESE**

On October 10, 2021, Federal President Frank-Walter Steinmeier honored Prof. Dr. Katrin Böhning-Gaese 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 biodiversity research and has gained an outstanding international 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.

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SENCKENBERG PUBLICATIONS 2021

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)

• PALAEOBIODIVERSITY AND PALAEOENVIRONMENTS, Volume 101 (1–4), Dr. Peter Königshof (Editor-in-Chief)

• SOIL ORGANISMS, Volume 93 (1–3), Prof. Dr. Willi Xylander, Prof. Dr. Nico Eisenhauer (Editors-in-Chief)

• STUDIA DIPTEROLOGICA, Volume 24 (1), Dr. Frank Menzel (Editor-in-Chief)

• VERTEBRATE ZOOLOGY, Volume 71, Prof. Dr. Uwe Fritz (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)

• PECKIANA, 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 Raspy 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)

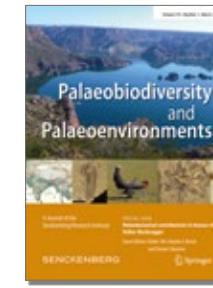
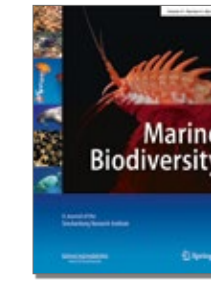
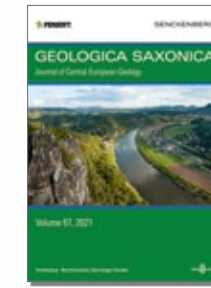
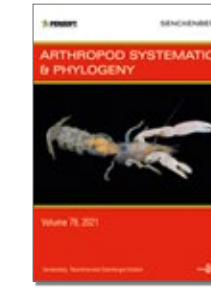
ANNUAL REPORT

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

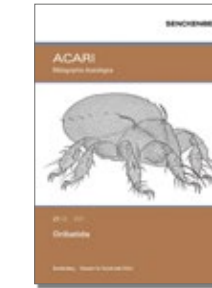
OTHER PUBLICATIONS

• Thalheim, Klaus; Eler, Daniela; Pflug, Norbert: Die geologische Literatur über Sachsen 2011–2015.

SCIENTIFIC JOURNALS



SCIENTIFIC MONOGRAPHS AND BIBLIOGRAPHIES



POPULAR SCIENTIFIC PUBLICATIONS



ANNUAL REPORT



SENCKENBERG BY THE NUMBERS



7 RESEARCH INSTITUTES
Wilhelmshaven / Müncheberg / Görlitz /
Dresden / 2 × Frankfurt / Tübingen

3 NATURAL HISTORY MUSEUMS
Görlitz / Dresden / Frankfurt

5 RESEARCH STATIONS
Hamburg / Schöningen / Weimar /
Gelnhausen / Messel

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 Visiting Researchers
180 Volunteers

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

1,236 PUBLICATIONS
IN 2021
939 Scientific Journal Articles
31 Scientific Book Contributions
13 Scientific Books
92 Museum and popular science
publications
161 Scientific Lectures
(at conferences)

**FOLLOWER
APPROX.**
50,000
19,767 Facebook
11,085 Twitter
7,493 Instagram
13,372 TikTok
(2 viral clips with
over 782,000 views)

**PRESS
RESPONSE
2021**
27,116
Senckenberg
mentions in
online and
print articles

7,944
Citizen Scientists
in **25** Citizen
Science Projects

40.8 MILLION
COLLECTION OBJECTS

169 NEWLY
DISCOVERED SPECIES

APPROX.
750,000
DIGITAL VISITORS

239,299
ACTUAL VISITORS
220,740 Frankfurt
5,863 Dresden
12,696 Görlitz

Imprint

Publisher:
Prof. Dr. Klement Tockner,
Senckenberg Society for Nature Research
// Senckenberg Gesellschaft für Naturforschung (SGN),
Senckenberganlage 25, 60325 Frankfurt am Main, Germany

The SGN is a member of the Leibniz Association.

Head of Communications:
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Credits:
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All other images:
Senckenberg Gesellschaft für Naturforschung.

Design:
CARRASCAL/DINDIN COMMUNICATION DESIGN

Printed by:
Druck- und Verlagshaus Zarbock GmbH & Co. KG

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ISBN 978-3-946945-02-4

