



Leopoldina
Nationale Akademie
der Wissenschaften

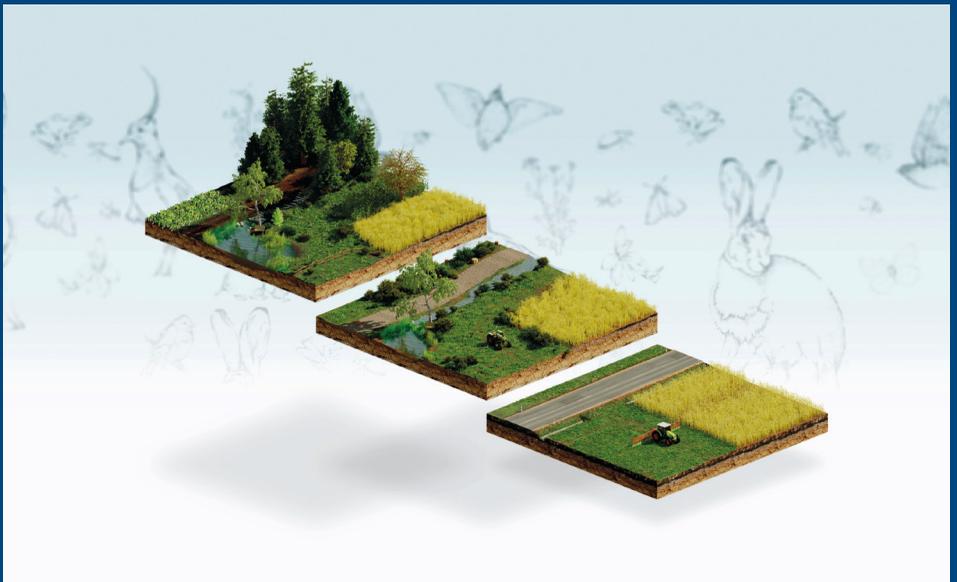
NOVA ACTA LEOPOLDINA

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Biodiversity and the Future of Diversity

**Programme and Abstracts
of the Lectures held at the Annual Assembly
23rd to 25th September 2021 in Halle (Saale)**

Published by Gerald Haug, President of the Academy



**German Academy of Sciences Leopoldina –
National Academy of Sciences, Halle (Saale) 2021**

NOVA ACTA LEOPOLDINA

Abhandlungen der Deutschen Akademie der Naturforscher Leopoldina

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Thanks

We would like to thank the Wilhelm and Else Heraeus Foundation for the generous support to implement a programme for students which allows selected secondary school students to attend the Leopoldina Annual Assembly – this year in virtual form.

**WILHELM UND ELSE
HERAEUS-STIFTUNG**



We would like to thank the Leopoldina Akademie Freundeskreis e. V. (Friends of the Leopoldina Academy) for financing the Leopoldina Prizes for Junior Scientists.



Programme

The language of the Ceremonial Opening is German. Simultaneous translation into English will be provided.

Friday, 24th September 2021

9:00 – 12:30 | Ceremonial Opening

Welcoming Speech

Regina Riphahn ML, Nürnberg

Vice-President of the Academy

Awarding Prizes

Cothenius-Medal

Carus-Medal

Schleiden-Medal

Mendel-Medal

Leopoldina Prize for Junior Scientists

Georg-Uschmann-Award for History of Science

Opening Speech

Gerald Haug ML, Halle (Saale)

President of the Academy

Welcoming Address via video

Anja Karliczek

Federal Minister of Education and Research

Welcoming Address

Reiner Haseloff

Prime Minister of the State of Saxony-Anhalt

Awarding of the Order of Merit of Saxony-Anhalt to

Past President Prof. Dr. Jörg Hacker

Reiner Haseloff

Prime Minister of the State of Saxony-Anhalt

10:45 – 11:30 | Break

Distinction

**Awarding the Early Career Award 2020 and Lecture by
the Laureate**

12:30 – 13:30 | Lunch Break

Session I | **Biodiversity Monitoring and Data Collection**

Moderator:

Ulf-Ingo Flügge ML, Cologne

13:30 – 14:15

Inaugural Lecture

Biodiversity and People in the Anthropocene

Katrin Böhning-Gaese ML, Frankfurt am Main

14:15 – 15:00

Reframing Biodiversity from the Data

Up: Challenges from Plant Data Semantics

Sabina Leonelli, Exeter (Great Britain)

15:00 – 15:45

Local Seeds and Global Needs: Ethnobotany,

Agroecology, and the History of *in situ*

Conservation of Crop Diversity

Helen Curry, Cambridge (Great Britain)

15:45 – 16:15

Break

Session II | **Rewilding and Renaturation**

Moderator:

Miguel Vences ML, Braunschweig

16:15 – 17:00

Rewilding the Earth, Rewilding our Lives

Harry W. Greene, Ithaca (NY, USA)

17:00 – 17:45

**Back to what? Renaturation in Mecklenburg-
Western Pomerania**

Martin Wilmking, Greifswald

18:15 – 19:30

Members' General Assembly (by separate invitation)

20:15 – 21:15

Evening Lecture

Moderator:

Gerald Haug ML, Halle (Saale)

President of the Academy

Biodiversity – Impact and Change

Christian Wirth, Leipzig

Saturday, 25th September 2021

Session III | Biodiversity – The Perspective of the Humanities

Moderator:

Thomas Lengauer ML, Saarbrücken

9:00 – 9:45

**Collecting, Organizing, and Explaining Diversity:
On the History of Biodiversity Research *avant la lettre***
Kärin Nickelsen ML, Munich

9:45 – 10:30

Biodiversity and Complexity under Global Change
Ulrich Brose, Leipzig

10:30 – 11:15

Languages Threatened with Extinction
Manfred Krifka, Berlin

11:15 – 11:45

Break

Session IV | Biodiversity and Plant Protection

Moderator:

*Ulla Bonas ML, Halle (Saale)
Vice-President of the Academy*

11:45 – 12:30

**Plant-associated Microbial Communities and how their
Members Serve the Host**
Paul Schulze-Levert ML, Cologne

12:30 – 13:15

The Influence of Crop Protection on Biodiversity
Urs Niggli, Frick (Switzerland)

13:15 – 14:15

Lunch Break

Session V | Food and Health

Moderator:

*Thomas Krieg ML, Cologne
Vice-President of the Academy*

14:15 – 15:00

World Food System and Biodiversity Conservation
Joachim von Braun ML, Bonn

15:00 – 15:45

The Microbiome and its Importance for Human Health
Michael Wagner ML, Vienna (Austria)

15:45 – 16:30 **Land Use and Species Communities in Ecosystems
– on the Need for Large-Scale Field Research**
Wolfgang Weisser, Freising

16:30 – 17:00 | **Break**

Session VI | **Diversity as a Societal Goal**

Moderator:
Susanne Renner ML, Munich

17:00 – 17:45 **The Dark Side of Biodiversity – Reciprocal Effects
between Humans and Soil Biodiversity**
Nico Eisenhauer, Leipzig

17:45 – 18:30 **Giving the Future a Chance: Psychological
Processes that Guide Attention Beyond the Here
and Now**
Elke Weber ML, Princeton (NJ, USA)

18:30 | **Closing Remarks**

Robert Schlögl ML, Berlin
Vice-President of the Academy

20:00 – 22:00 | **Dinner (by separate invitation)**

Abstracts of the Presentations

Scientific Session I – Biodiversity Monitoring and Data Collection

Inaugural Lecture

Katrin Böhning-Gaese ML, Frankfurt am Main

Biodiversity and People in the Anthropocene

In the Anthropocene, the age of humans, there is a dramatic acceleration of many social and ecological processes. The consequences are biodiversity loss, climate change and pollution, – all of which are symptoms of humans overusing the Earth. According to the World Biodiversity Council IPBES, of the estimated 8 million species on Earth, one million are threatened with extinction. We are at the beginning of the 6th great mass extinction in Earth's history. Biodiversity is the basis of human life. The consequences of the decline of biodiversity are thus losses in ecosystem services and the undermining of achieving the sustainability goals. What can be done? Given the importance of the biodiversity crisis for human well-being, we need a major transformation of society, i.e. the fundamental system-wide transformation of politics, the economy, civil society and also science. For the agricultural landscape in Germany, where species declines are particularly high, this means 1. the greening of agriculture, 2. fundamental changes in agricultural policy, the promotion of implementation and technology development, and 3. changes in trade and markets, in purchasing and consumption behaviour towards food from biodiverse production and a diet with less meat, as well as changes in research and education. Through swift action by society as a whole, together with the expansion of protected areas and the promotion of renaturation, the decline in biodiversity can be halted and biodiversity can increase again.

Reframing Biodiversity from the Data Up: Challenges from Plant Data Semantics

Historically and conceptually, the study of biodiversity has been closely associated with the attempt to understand and preserve what Darwin aptly characterised as the “endless forms most beautiful and most wonderful”. Thus, biodiversity is typically defined within evolutionary and conservation biology, and taxonomic nomenclatures arising from these domains inform more consumption-related research such as plant breeding and gene editing for food, drugs or fuel production. I consider taxonomic challenges that emerge in relation to contemporary efforts to produce, disseminate and re-use data about plant traits, where concerns about conservation and consumption are unavoidably intertwined. This is often referred by curators and participants in plant data infrastructures as the question of plant data semantics. The effort to share phenomic data about crops across different locations, and between high-resourced and low-resourced research environments, places in sharp relief the complexity and diversity of biological and environmental characteristics as well as of the methods used to generate and process data and the goals, skills and expectations of the stakeholders involved. I argue that the attempt to articulate semantic differences among plant varieties and methods of data collection, sharing and analysis is generating new ways to develop and communicate biological knowledge, including a reframing of the study of biodiversity.

Helen Curry, Cambridge (Great Britain)

Local Seeds and Global Needs: Ethnobotany, Agroecology, and the History of *in situ* Conservation of Crop Diversity

Various disciplines have sought in recent decades to develop accounts of the agricultural practices of Indigenous peoples. These include ethnobotany, agroecology, and agricultural anthropology. Since the 1980s, this research has often been linked to conservation work, for example the promotion of local farming methods or tools as means of maintaining biodiverse forests or preventing soil erosion.

In this presentation, I explore the influence of research on Indigenous agriculture on the conservation of global crop diversity. I discuss how social scientists developed new narratives about the past and present of Indigenous cultivation, and used these to sustain arguments about the most desirable futures for farming, both within and beyond Indigenous communities. These researchers' accounts of both the past and the future of agriculture typically centered on particular crop varieties: the locally adapted varieties, or landraces, thought to have been traditionally cultivated but widely understood to be endangered as a result of agricultural intensification. As a result, the research of ethnobotanists and agroecologists contributed to new interest in and approaches to protecting those same varieties, and ultimately forged a lasting link between local acts of cultivation and global conservation concerns.

Session II – Rewilding and Renaturation

Harry W. Greene, Ithaca (NY, USA)

Rewilding the Earth, Rewilding our Lives

Today we face enormous challenges in the face of our impact on Earth systems, including global climate change, the looming potential for attendant social disruptions, and the loss of biological diversity as a result of still-increasing human populations and resource consumption. The fate of numerous other species is in doubt if we cannot find ways with which to coexist, and this problem is often most acute with respect of large and otherwise dangerous animals – in the end it comes down to whether they have value to us, either instrumentally or in terms of which has often been called intrinsic worth. In North America in particular, intrinsic values of wildlife often have been presented as a sort of cosmic truth, such that justification for a hands-off approach to wildlands is assumed to be ethically and scientifically appropriate. I will show instead that a mind-set in which we are part of rather than disjunct from nature is consistent with both science and ethics, and that a combination of European traditions of “land sharing” with a modified vision of North American “land sparing” is our best option for coexistence with giant herbivores and dangerous carnivores. Viewing humans and other species as ecological interactors offers our best hope for rewilding Earth as well as our own lives.

Back to what? Renaturation in Mecklenburg-Western Pomerania

Renaturation aims to achieve the restoration of near-natural habitats and their ecosystem services after human intervention. But “restoration” is a misleading term because renatured ecosystems always differ from the original systems before the interventions occurred. In Mecklenburg-Western Pomerania, Germany’s most sparsely populated state, history and particularly the designation of large, protected areas at the end of the GDR have created a special tract of land that has been subject to continuous renaturation measures over the past 30 years in forests, on grasslands, along coastlines and especially on peatlands. But what distinguishes renatured ecosystems from natural ones? Which ecosystem services (e.g. carbon storage, biodiversity, groundwater recharge or nutrient retention) are affected and how? We will take a short journey through time and, based on a selection of examples, will discover how much “old” there is in “new” – and whether we should perhaps speak honestly about the “creation of novel ecosystems” rather than about renaturation.

Evening Lecture

Christian Wirth, Leipzig

Biodiversity – Impact and Change

Our view of biodiversity has changed in several ways since the 1990s. *Role*: In the face of the global biodiversity crisis, the question of what happens to ecosystems that suffer from a loss in diversity came to the fore. How many species and which ones are needed for a forest to function? What are the underlying mechanisms? These questions mark a paradigm shift: biodiversity not only responds to the environment, but shapes it as an actor, providing services from which we benefit. *Revolution*: In the same period, molecular and the digital revolutions have made biodiversity and its fate visible on a previously unknown scale. We are unravelling new facets, e.g., genetic, structural and functional diversity, and we are expanding our scales of observation from the microbiome of a teaspoon of soil to the richness of tree species in the Amazon basin. This enables scientific breakthroughs, but also creates new paradoxes. We see much more than we understand. *Time*: Time is working against biodiversity research because it is losing its object of study and because today's findings are hardly valid in a +2 °C world. We must learn to think dynamically about biodiversity. *Perception*: Dwindling, beautiful, interesting, and now also useful: our relationship to biodiversity is changing fast. *Action*: Despite all of the scientific challenges, we know enough to act. It is generally known how to protect and increase biodiversity; so that it pays off for us, too.

Session III – Biodiversity – The Perspective of the Humanities

Kärin Nickelsen ML, Munich

Collecting, Organizing, and Explaining Diversity: On the History of Biodiversity Research *avant la lettre*

The diversity of the Earth's flora and fauna became the subject of scientific study long before the term "biodiversity" was coined in the second half of the twentieth century. During the eighteenth century, an abundance of floral works started to appear, with a local, regional, national, or even imperial focus, ranging from mere catalogs of species to richly illustrated coffee-table volumes. The nineteenth century then saw an additional focus on the historical development of species, their distribution across geographical regions, and the close interaction between plant diversity and the activities of humans. The paper will provide a survey of the investigation of biological diversity in this period and show how the study of biological diversity was driven by both academic and economic interests.

Biodiversity and Complexity under Global Change

The world's ecosystems are currently undergoing global environmental change that is dramatically reshaping biodiversity and ecosystem functions in most places. Under this ongoing change, understanding which ecosystems are most vulnerable and how to mitigate the effects of human impacts on biodiversity remains a scientific challenge. An important aspect of the vulnerability of communities to global change is the complex structure of their interaction networks, which link all coexisting populations through their predator-prey interactions. In general, not all species are equally vulnerable to external disturbances. In part, these differences can be explained by their position in the trophic network. For example, species at high trophic levels perceive many aggregate effects cascading through food webs and are most vulnerable to secondary extinction, even if their direct response to the disturbance was weak. This consequence of global change is particularly problematic because high trophic level species also exert strong control over the multitrophic ecosystem function of natural communities. Different drivers of global change have different impacts on biodiversity and ecosystem functioning. For example, global warming poses a strong threat to the persistence of high trophic level carnivores. Interestingly, eutrophication also undermines the persistence of these high trophic level species, but the processes differ, leading to the surprising finding that global warming and eutrophication may partially cancel each other out as two of the main drivers of global change. Research on complex species communities under global change highlights new challenges and offers solutions to address the consequences of global change on biodiversity and ecosystem functioning.

Languages Threatened with Extinction

Biological diversity and linguistic diversity are closely link with one another. Regions with a high biodiversity – the Amazon basin, New Guinea, or central Africa – also have an abundance of spoken languages. Thus, a decline in biodiversity is closely related to a decline in cultural diversity. Languages disappear proportionally faster than biological species. In my lecture, I provide an overview of the past and current linguistic diversity that exists in the approximately 7,000 languages still spoken today. Through a selection of examples, I will show that this linguistic diversity is essential in understanding human language ability itself and the connection between language and society. I will partly draw on my own research on the Daakie language, spoken on the island of Ambrym, Vanuatu. I will then go into the causes and forms of the rapid loss of linguistic diversity, the attempts to stop or even reverse this loss, and the documentation of this disappearing diversity through research projects and in archives such as the Endangered Languages Documentation Program. Finally, I will show how the loss of indigenous languages goes hand in hand with the disappearance of biological knowledge that has been acquired over many generations and is preserved in the lexicon of these languages.

Session IV – Biodiversity and Plant Protection

Paul Schulze-Lefert ML, Cologne

Plant-associated Microbial Communities and how their Members Serve the Host

Healthy plants in nature are colonized by multi-kingdom microbial communities including bacteria and fungi, termed the plant microbiota, which promote plant growth and health. Our work focuses on the root microbiota and aims at a deeper understanding of the mechanisms underlying the establishment of root-associated microbial communities and their beneficial functions for the host. We have established systematic culture collections of the root microbiota of the crucifer *Arabidopsis thaliana* and the legume *Lotus japonicus*, allowing us to culture the majority of bacterial and fungal taxa associated with healthy roots of these two plant hosts. We then compose defined consortia, called synthetic communities (SynComs), from the isolated root commensals and reconstitute the root microbiota in co-cultivation experiments with germ-free plants to study physiological microbial community functions in laboratory environments. This enabled us to demonstrate that the bacterial root microbiota is crucial for the survival of the plant in natural soil by protecting the host against harmful fungal root endophytes. In iron-limiting soils, we show that the bacterial root microbiota is important for plant iron nutrition via a mechanism dependent on the secretion of the plant-derived coumarin fraxetin into the rhizosphere. We propose that the bacterial root microbiota, stimulated by secreted coumarins, is an integral mediator of plant adaptation to iron-limiting soils. Our experiments have also revealed an unexpected host specificity of the root microbiota.

The Influence of Crop Protection on Biodiversity

Plant protection ensures yield and quality in arable farming and in horticultural crops. Potential yield losses due to harmful organisms are between 17 and 40 %. This is reduced with direct chemical, biological or physical plant protection and with indirect preventive, system-related measures.

Intensive, micro-economically optimised, and internationally competitive agriculture is multi-causally altering landscapes and habitats, reducing the diversity of natural habitats and agroecosystems, and thus negatively impacting the biodiversity of many species groups. In addition, climate change is also negatively affecting biodiversity.

The decline of biodiversity in agricultural landscapes is striking. Direct and indirect effects of plant protection products are documented by numerous scientific studies in Germany and in other European countries. The application of plant protection products (insecticides, fungicides, herbicides) represents a significant influencing factor in the complex overall system of factors with mostly significant negative effects. They can cause direct toxic effects on non-target organisms and indirectly reduce food and habitats of a wide range of organisms.

In April 2019, the Scientific Advisory Board of the National Action Plan for Plant Protection proposed six measures: Appropriate standardized long-term monitoring, reviewing the registration process, strengthening positive and negative incentives to reduce the use of PPPs in practice, promoting integrated farming practices, organic farming and breeding of resistant varieties, and expanding CAP measures toward diverse landscape elements.

Session V – Food and Health

Joachim von Braun ML, Bonn

World Food System and Biodiversity Conservation

A food system that serves the health of people and the planet depends on biodiversity, but the current food system itself is a major factor in biodiversity reduction and species loss, thereby undermining its own objective. The issue needs to be addressed with a sense of urgency due to its irreversibility. Following a descriptive account of food systems, I will review the developments in biodiversity loss as a result of food system features, i.e. related to land use, crop technologies, soil management, aquatic and livestock systems, and ecosystem mismanagement. Influences of consumer demand and changes in dietary habits are considered, as well as links to climate change. Economic consequences of non-sustainable food systems are reported on, alongside the role of biodiversity loss in that context. The talk will conclude by providing options for biodiversity conservation policies, while also identifying conflicting goals and drawing on the related UN Food Systems Summit and the UN Biodiversity Conference, both taking place in 2021.

Michael Wagner ML, Vienna (Austria)

The Microbiome and its Importance for Human Health

No abstract available.

Land Use and Species Communities in Ecosystems – on the Need for Large-Scale Field Research

Human land use is the main driver of the current biodiversity decline. Plot-level experiments can help to understand the effect of particular management measures on biodiversity, but the composition of a local ecological community is also determined by processes that take place on a larger spatial scale. Moreover, it takes some time for a community to respond to land-use change. Finally, in plot experiments, it is difficult to determine the most important factors influencing biodiversity under real-world conditions. For this reason, it is necessary to combine plot experiments with large-scale and long-term field research. This lecture will present the DFG priority programme “Biodiversity Exploratories”, which has been conducting such field research since 2006. After an introduction to the study design, exemplary results will be presented that have improved our basic understanding of the assembly of biotic communities and that help to understand the effects of human land use on biodiversity in more depth. Many of the results were only possible because of the experimental design and the cooperation of many working groups within the priority programme. Correlative findings must ultimately be supported by experiments and this is a major challenge for future field research. Germany is participating in the development of a large European infrastructure for terrestrial ecological research, but this infrastructure will only be successful if the experience of the Biodiversity Exploratories and other studies are incorporated into the experimental design.

Session VI – Diversity as a Societal Goal

Nico Eisenhauer, Leipzig

The Dark Side of Biodiversity – Reciprocal Effects between Humans and Soil Biodiversity

Global environmental changes affect soil organisms, which are responsible for a plethora of ecosystem functions and services in terrestrial ecosystems. However, we know remarkably little about the effects that the multiple, partly interacting, anthropogenic drivers of global change have on soil biodiversity and the functioning of ecosystems. It is particularly important to understand how our management decisions will influence biodiversity and ecosystem services under future climate conditions. Non-intensive agriculture and nature conservation are suggested in order to maintain higher levels of biodiversity and a more sustainable provision of ecosystem services. However, empirical evidence for the dark side of biodiversity, i.e. soil biodiversity, is scarce. Here, I present insights from a local experiment, a global synthesis, and a novel soil monitoring initiative. These studies suggest that low-intensity land-use for cropland and grassland may indeed benefit soil organisms and buffer detrimental climate effects. The consequences of biodiversity change on an ecosystem are especially significant when human activities decrease soil biodiversity. The new SoilBON initiative is an international soil monitoring program based on essential biodiversity variables that can act as a standardized warning system for how successful nature conservation measures are in protecting soil biodiversity and ecosystem services.

Giving the Future a Chance: Psychological Processes that Guide Attention Beyond the Here and Now

We humans are creatures of bounded rationality and finite processing capacity, and it is understandable that we thus focus attention first on the here and now. And yet, many individual and social issues (from sufficient pension savings, to healthy eating, to sustainable living on our planet) require increased attention to the future costs and benefits of possible courses of action.

Climate change is the most recent and arguably the most urgent and difficult challenge for individual and collective decision making. To make wise decisions we need to fully and justly weigh the immediate and certain costs and benefits of action (be it business-as-usual or greenhouse gas mitigation efforts) against their delayed, risky, and often disputed costs and benefits. Psychological theories from prospect theory to hyperbolic discounting and query theory predict that the future costs of business-as-usual and the future benefits of Green House Gas mitigation efforts will get short thrift. I present three interventions that have been shown to focus greater attention on future consequences and thus provide entry points for interventions that allow for better balance between short-term and long-term goals and objectives in our daily decisions.

Venue

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