iDiv

Science Strategy 2026–2034

Preamble

iDiv was funded by the Deutsche Forschungsgemeinschaft (DFG) from 2012 to 2025, through an initial Germany-wide competitive process, followed by rigorous scientific evaluations every four years. This thirteen year funding period established iDiv as a global hotspot of biodiversity science. In 2019, the three federal states, Saxony-Anhalt, Thuringia and, Saxony, through the Martin Luther University Halle-Wittenberg, Friedrich Schiller University Jena, and Leipzig University, and the federal government through the Helmholtz Centre for Environmental Research (UFZ), committed to fund iDiv into permanency from 2025 onwards, with evaluations every seven years.

This document presents the science strategy of iDiv for the first eight years of its permanency (2026–2034), in order to strengthen its position as a global leader in integrative biodiversity research, but also to respond to the societal challenges posed by biodiversity change from the local to the global level. As a collaborative research centre across three federal states, which is anchored in universities and brings together a network of research institutes, iDiv is uniquely positioned. iDiv can leverage multiple impact pathways in central Germany, as well as nationally and internationally, from conservation agencies and biodiversity related businesses to the general public, while educating and preparing a new generation of practitioners and scientists.

This strategy was developed with the participation of more than 50 principal investigators in the iDiv network, through a process that engaged an even wider group of scientists and reflected consultations with the leadership of a dozen research institutes in Central Germany. It is intended to inform iDiv members, both institutional and individual, as well as external stakeholders, and to support alignment, coordination, and early positioning for all areas of activity of iDiv. This strategy will also provide guidance for the development of a research programme for 2030-2036, to be evaluated until 2028 through a process including formal review and expert assessment.

Table of Contents

Photo: Simon Dux/Adobe Stock

Executive Summary

Our mission:
Advancing integrative biodiversity science for a biodiversity-positive future.

This strategy positions iDiv as a global leader in studying biodiversity change as a critical societal challenge.

Its mission is threefold:

(i) to understand the biodiversity of life on Earth in its complexity, functions, and interactions with people,

(ii) develop scientific knowledge for the conservation and sustainable use of biodiversity, together with the international scientific community and society, and

(iii) to advance the field of integrative biodiversity research, through scholarly contributions, education, capacity building, and the promotion of early-career researchers.

iDiv integrates excellent basic research with real-world impact, ensuring scientific insights that translate into solutions for biodiversity conservation, ecosystem functioning, and human well-being.

A unique position:
iDiv is a global hotspot of biodiversity research.

iDiv is uniquely positioned as an internationally recognised hotspot of biodiversity research that bridges disciplines, scales, and sectors. It integrates expertise across natural sciences, social sciences, and economics, supported by a large, diverse, and global research network connected through the iDiv synthesis centre. By bringing together universities and research institutes, iDiv encompasses the entire delivery chain of biodiversity knowledge, from knowledge generation to education and application. Its infrastructure enables data integration from molecular to ecosystem and socio-economic levels, while strong engagement in science-policy interfaces ensures relevance at local, national, European, and global scales. By continuing to pursue excellence in scientific research, iDiv will also synergistically strengthen the position of the three host universities for the next phase of the excellence strategy.

Five integrative biodiversity research topics.

The research agenda is structured around three core topics

- **Complexity**,
- **Functions**, and
- **People and Biodiversity**,

complemented by the two cross-cutting topics of

- **Integrative Approaches** and
- **Transdisciplinary Research**.

Together, the three core topics address key challenges such as understanding biodiversity dynamics, ecosystem functioning and stability as well as human-nature interactions. In common to all the core topics, integrative approaches emphasise causal inference, scaling from local to global processes, combining observations, monitoring, experiments, synthesis, modelling and theory, while integrating ecological, evolutionary, computational and socio-economic perspectives. Transdisciplinary research bridges these research topics with societal actors' knowledge needs and uptake. The research work programmes in each topic are closely aligned with funding opportunities (e.g., EU Horizon, ERC, national funding schemes), ensuring scalability and long-term sustainability of research activities.

Impact on society, policy, and economy: pathways to knowledge transfer.

iDiv commits to deliver tangible benefits beyond academia by informing evidence-based policy, supporting biodiversity governance, and enabling sustainable management practices. Science-policy activities will ensure engagement with policymakers and practitioners at multiple scales. The establishment of a science for business hub will promote the transfer of well-founded scientific knowledge into economic actors as well as function as an incubator for biodiversity related businesses. iDiv's outreach and science communication efforts are going to bring the research to the general public, while participatory research will support the experiencing of nature and research by citizens in Central Germany and beyond. Ultimately, iDiv aims to provide solutions for biodiversity conservation and management and support the transition to a biodiversity-positive future in line with international agreements, especially the Kunming-Montreal Global Biodiversity Framework.

Education and career development: Training the next generation of biodiversity leaders.

A central component in iDiv's strategy is the promotion of education and career development across all career stages, from undergraduate training to postdoctoral development and beyond. By embedding education within cutting-edge interdisciplinary and transdisciplinary research, iDiv trains a new generation of experts equipped to address complex biodiversity challenges. Building on the *Unibund Halle-Jena-Leipzig*, the strategy promotes student mobility and the development of joint teaching initiatives, such as the master level *iModules* and a new international joint bachelor programme in biodiversity sciences. In addition, opportunities for bringing the most recent integrative biodiversity research to the teaching of the teachers at the three universities, will enable impact on secondary education in Central Germany. At more advanced career levels, the PhD programme of iDiv will be joined by novel continued education programmes targeting biodiversity practitioners in agencies, consultancies, and senior business executives.

Delivering on our strategy: Governance, resources, and collaborative mechanisms.

The realisation of iDiv's strategy is supported by a robust governance framework anchored in iDiv e.V. and the central iDiv institutes at the three universities in addition to the UFZ departments connecting with iDiv as well as the wider network of research institutes and individual scientists in Central Germany. Resources are specifically provided to foster collaboration, innovation, and talent development through collaborative funding mechanisms, applying scientific criteria of excellency. State-of-the-art infrastructure and science services, ranging from experimental platforms and long-term monitoring systems, to the synthesis centre, provide the backbone for iDiv's integrative research.

1. Introduction

1.1 Biodiversity Change as a Societal Challenge

Biodiversity change is one of the main challenges faced by societies around the world today. Biodiversity change affects livelihoods and the economy through the degradation of the capacity of ecosystems to provide us with a range of services, including carbon sequestration, pollination, recreation and inspiration, also known as nature's contributions to people. Unlike other global challenges such as climate change – which require coordinated global action for effective responses – local community decisions on biodiversity management can yield immediate local benefits by directly shaping surrounding ecosystems, while contributing to addressing the global biodiversity crisis. Therefore, biodiversity change is truly a multi-scale challenge (Figure 1) where decisions at any given spatial scale have consequences both for that scale and interact with larger and smaller spatial scales. Consequently, reliable scientific knowledge is needed to inform management and policy decisions, including tailored knowledge for the appropriate governance scale, but also in connection with the other scales at which biodiversity change and ecosystem services processes operate.

At the global scale, countries have, under the Convention on Biological Diversity, agreed on the ambitious Kunming-Montreal Global Biodiversity Framework (KM GBF, Figure 1) with four key goals for 2050:

- Goal A: protect and restore biodiversity;
- Goal B: prosper with nature;
- Goal C: share benefits fairly;
- Goal D: invest and collaborate.

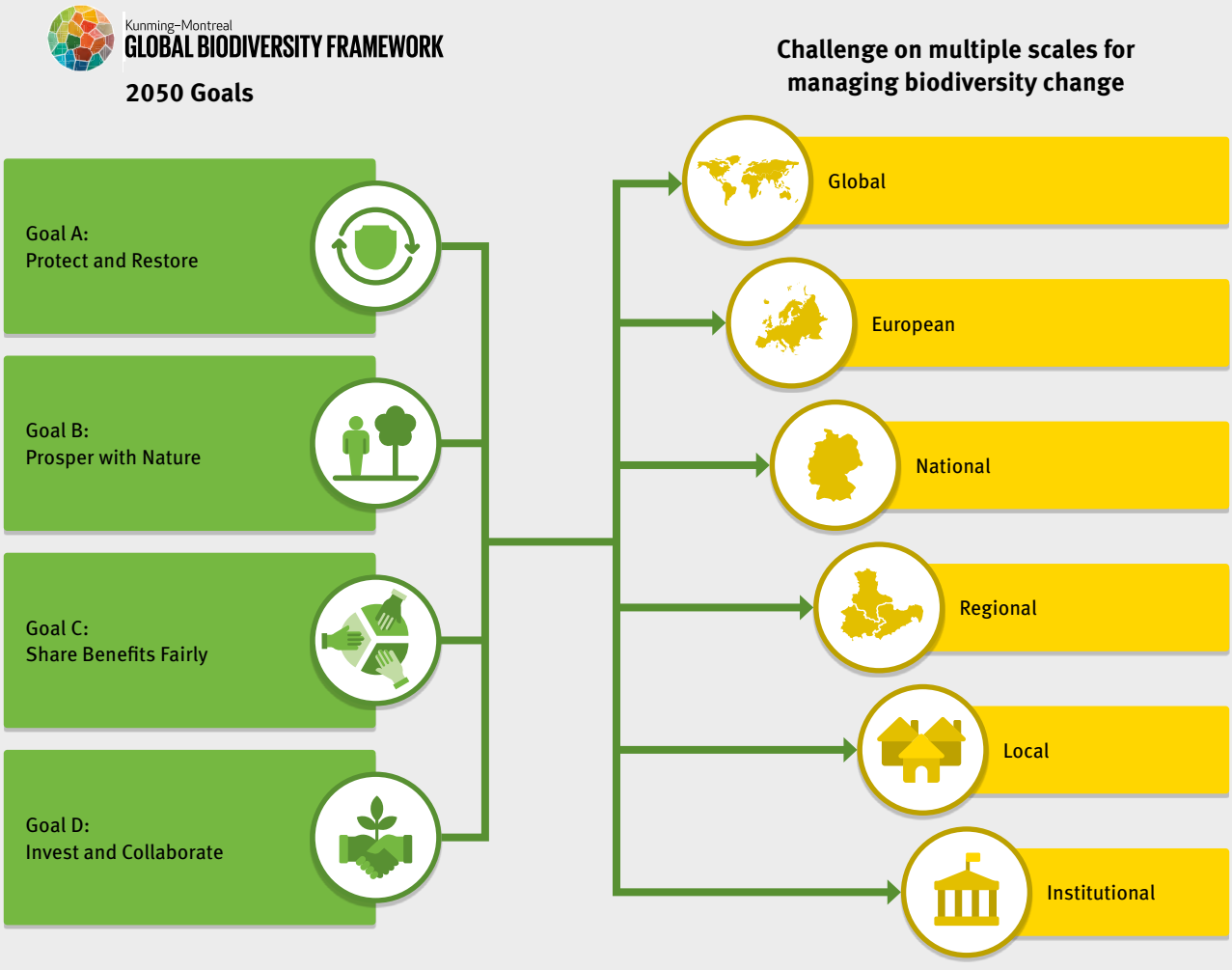

Figure 1: The Kumming-Montreal Global Biodiversity Framework across scales.

In addition, 23 action-oriented targets have been set for 2030. The KM GBF goals and targets were informed by activities and reporting from governments, non-governmental organisations, and the academic community, including iDiv members. This is both a bottom-up and a top-down process, as the KM GBF is also leading to new regional, national and sub-national biodiversity strategies, reporting and management activities. One example is the European Biodiversity Strategy for 2030, which led to the approval of the Nature Restoration Regulation in 2024, requiring member states to develop national restoration plans, the implementation of which is expected to be led by local and sub-national authorities.

The ambitious international policy goals for addressing biodiversity change have created an ever-increasing demand for scientific understanding of biodiversity change, its drivers, its impacts on people and the actions required to restore ecosystems. Meeting this demand requires a step change in biodiversity research, along with the adoption of integrative, transdisciplinary approaches.

1.2 A Hotspot in Biodiversity Science: iDiv

Solutions to the global challenge of biodiversity change are not possible from single research disciplines, at single scales, or without the collaboration between science and society. The need to develop new scientific approaches to tackle the biodiversity challenge, led to the foundation of iDiv as a DFG-funded research centre in 2012. iDiv has accomplished the original task to establish integrative biodiversity research as a new, internationally recognised scientific field and has become a **global hotspot of integrative biodiversity research**. More recently, iDiv has developed into a permanent research center with Martin Luther University Halle-Wittenberg, Friedrich Schiller University Jena, Leipzig University, and the Helmholtz Centre for Environmental Research (UFZ) as founding members. Along with its associated non-university institutes, iDiv assembles a unique scientific infrastructure, which allows us to measure, process and analyze data from molecular information to ecological observations, environmental and socio-economic variables.

The network of iDiv scientists comprises more than 300 experts for integrative biodiversity research in central Germany from more than 35 countries and trained in a range of scientific disciplines including biology, geography, climate science, computer science, geography, psychology, sociology, and economics. Based on this breadth of involved faculties and degree programmes, iDiv takes a unique position in teaching and promoting talents in integrative biodiversity from the bachelor to postdoctoral levels and beyond.

The diverse scientific, cultural and socio-economic background of its international team of researchers allows iDiv to impact science-policy interfaces at multiple scales. For example, iDiv members have been serving as co-chair and lead authors to the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), iDiv is co-hosting the European Topic Centre for Biodiversity of the European Environmental Agency (EEA) and contributing to national and regional governmental expert consultations, such as the German Advisory Council on Global change (WBGU), having also led the German National Biodiversity Assessment, Faktencheck Artenvielfalt. Through its synthesis center sDiv with its thousands of national and international guests, iDiv established a globally connected research collaboration network.

Overall, iDiv published more than 5,000 articles in peer-reviewed journals that have been cited more than 230,000 times. All three universities now rank in the top 100 universities globally of the Shanghai Ranking in Ecology. iDiv can play a key role in supporting the Unibund Halle-Jena-Leipzuig for the next phase of the Germany Excellence Strategy. This unique position provides the basis for iDiv's ambitious mission and scientific strategy.

1.3 iDiv's Mission

iDiv's Mission is threefold:

The **first aspect** of iDiv's mission is centered around excellent basic research on biodiversity, as the holistic understanding of biodiversity of life on Earth remains a major challenge for science. Three core research topics in iDiv's scientific strategy are related to *Complexity*, *Functions*, and interactions of biodiversity with *People* (Figure 2). They contribute to address Goal A of the KM GBF on protecting and restoring biodiversity.

The **second aspect** of iDiv's mission talks directly to Goal B of the GBF prospering with nature. In addition to being a leading part of the international scientific community, this requires a transdisciplinary collaboration with societal actors engaged with biodiversity change. Accordingly, the scientific strategy includes a cross-cutting topic to further develop *Transdisciplinary Biodiversity Research*.

The **third aspect** of iDiv's mission is to continue advancing the field of integrative biodiversity research. Part of this is to develop novel *Integrative Approaches* for biodiversity research as a cross-cutting topic in iDiv's scientific strategy. Another, equally important, aspect is the promotion of talents in integrative biodiversity research and management.

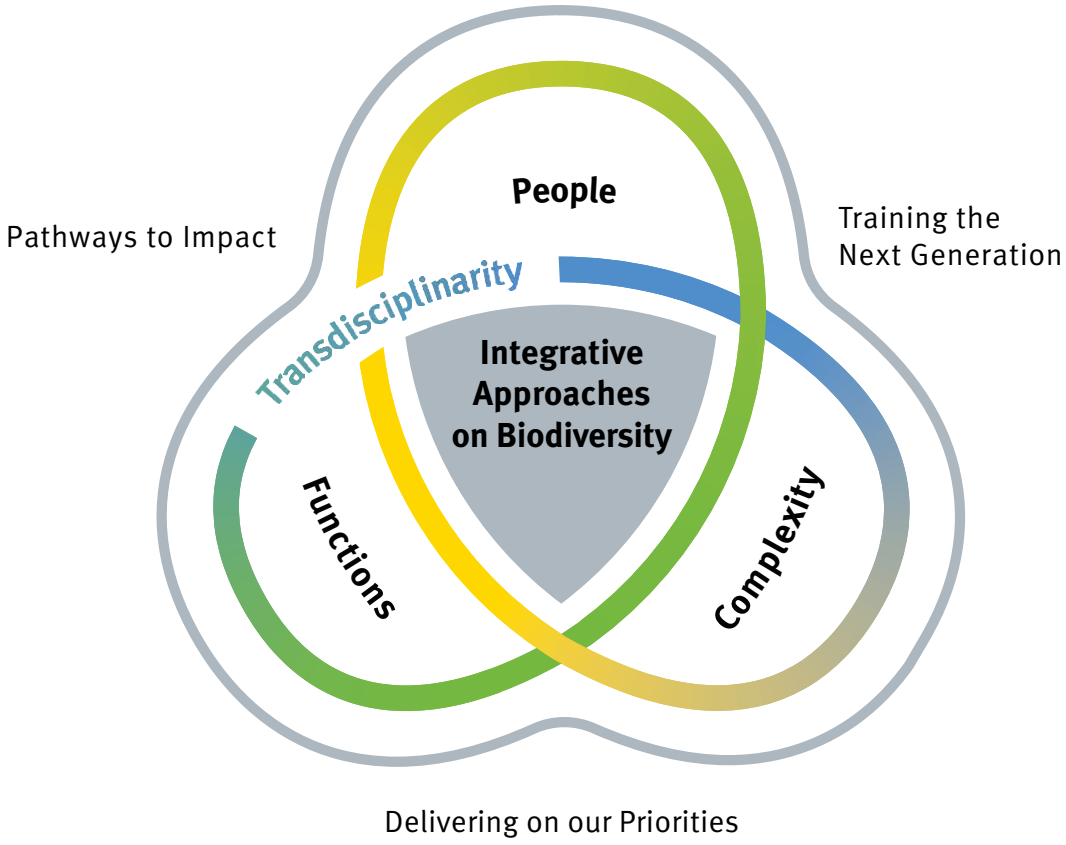

Figure 2: The five research topics of iDiv, visualised to emphasise their interconnection. The aforementioned three core research topics (*Functions*, *Complexity*, and *People*) share common *Integrative Approaches*, which itself is constantly developed as a cross-cutting topic. Additionally, all these research topics bridge boundaries with societal actors through the *Transdisciplinary* cross-cutting research topic.

2. Research Agenda

To tackle iDiv's mission requires an integrative research approach, which is why the "i" in iDiv stands for integration: **Integrative biodiversity research at iDiv** bridges traditional disciplinary boundaries by integrating expertise from biological sciences to geography, climate science, economics, social sciences, and psychology in interdisciplinary research. It synthesises diverse data types ranging from molecular information to ecological observations, environmental and socio-economic data, linking processes across different biological levels from genes to ecosystems and across multiple temporal and spatial scales. Its integrative approaches combine multiple methods, develop and synthesise theories.

iDiv's scientific strategy **takes integrative biodiversity research to a new level** by combining excellent basic research with practical relevance. To this end, we further develop the transdisciplinary approach to biodiversity research, integrating the knowledge of practitioners and iDiv scientists in mutual learning and collaborative research, to identify priorities for the conservation and sustainable use of biodiversity and to develop actionable solutions for biodiversity challenges. Our promotion of talents in biodiversity from high school students to postdoctoral researchers and beyond is tightly connected to our cutting-edge inter- and transdisciplinary research to advance careers of future leaders in integrative biodiversity.

2.1 Integrative Approaches

2.1.1 Research challenge

Addressing biodiversity change as a multi-scale societal challenge (see section 1.1) **requires an explicitly integrative perspective**. Building on its established leadership in integrative biodiversity research (see section 1.2), iDiv will further **develop a multifaceted toolbox and research platform of Integrative Approaches**. This will link **theory, datasets and synthesis, statistical and computational methods, technological innovation**, to enable predictive and scalable biodiversity science.

This research topic will be organised as a collaborative platform cutting across iDiv's research topics and structures, fostering new synergies and accelerating collaboration across disciplines. This integration of existing strengths in data analyses, modeling, experimentation, and synthesis will move iDiv further toward a coherent and strategic framework for integrative biodiversity research. Leveraging its broad expertise across ecology, evolution, informatics, economics and the social sciences, iDiv is uniquely positioned to lead this development. iDiv will consolidate and extend these strengths, manifesting iDiv as a global leader in advancing the theoretical, methodological, and inter- and transdisciplinary foundations that are required to address biodiversity change across scales in space, time, and social organisation.

2.1.2 Research goals and work programme

In line with iDiv's mission, Integrative Approaches will implement a collaborative research platform that advances theory, methods and technological innovation, and synthesis by aligning infrastructures and funding instruments. Addressing the following three goals will consolidate iDiv's leadership in integrative biodiversity research and provide the foundation for future large-scale initiatives.

Goal 1.1: Advance the theoretical foundations of integrative biodiversity science. This goal shall be reached by developing unified frameworks that reconcile context dependence with generality in biodiversity patterns and processes, and strengthen interdisciplinary integration with fields such as economics, physics, and the social sciences to advance understanding of biodiversity, ecosystem functioning, and social-ecological systems. We will broaden iDiv's theory research programme, connecting existing expertise across ecology, evolution, economics, philosophy and the social sciences, and rethinking established theoretical frameworks in the age of Big Data and Artificial Intelligence. This includes developing shared conceptual frameworks for biodiversity, ecosystem functioning, and social-ecological systems [1–3], and promoting cross-disciplinary theory building through focused working groups, synthesis workshops, and targeted recruitment (see section 5.2). Particular emphasis will be placed on identifying general principles that reconcile context dependence with generality and that support prediction across systems and scales.

Goal 1.2: Develop integrative data, methods, and modelling approaches. To achieve this, we will expand and standardise FAIR and CARE-compliant workflows for data collation, harmonisation, and management across iDiv infrastructures and databases (see section 5). In parallel, we will advance analytical and modelling frameworks that combine Big Data, Bayesian statistics, and Artificial Intelligence [4,5], which offer exciting new opportunities e.g., to capture nonlinear, hierarchical, and scale-dependent biodiversity dynamics (see section 2.4) and to improve the incorporation of uncertainty in model and scenario comparisons [6]. For example, we will advance mechanistic modelling approaches with Artificial Intelligence, building on existing iDiv strengths in trait-based and predictive ecology [7,8] by developing hybrid models that combine mechanistic and data-driven approaches. Dedicated networking platforms, method development initiatives, and training formats (see sections 4 and 5) will ensure that these tools are accessible and widely adopted across iDiv research.

Goal 1.3: Enable synthesis and generalisation across systems and scales. This goal will be reached through the integration of heterogeneous data sources and research approaches to derive transferable principles of biodiversity dynamics, and through linking local ecological mechanisms and molecular or individual organismal biological levels of organisation with regional and global patterns and species, community, or ecosystem organisational levels. We will strengthen and expand large-scale synthesis activities, e.g., by strategically leveraging iDiv funding mechanisms for coordinated database projects and for targeting integrative questions that bridge local mechanisms with macroecological patterns. A major focus will be on initiating synthesis projects that link different types of data, particularly i) novel observational data such as from metabarcoding and eDNA, participatory science, or passive acoustic or visual monitoring with AI-based species identification; ii) experimental data; and iii) historical data, e.g, from natural history and paleobiological collections [9–12].

2.1.3 On-going and planned initiatives

There are several iDiv collaborative mechanisms and structures that already facilitate data, methods and synthesis development (see section 5.2). We plan to develop a DFG CRC proposal on redundancy on biological systems to investigate how redundancy contributes to stability and adaptability across different scales and opens pathways for evolutionary innovation, contributing to address goals 1.1 and 1.2 of this research topic. We will also explore developing a CRC Transregio proposal involving the three universities on relevant causal biodiversity science, contributing to goal 1.3. Much of the emphasis on biodiversity research has been on finding causal effects and mechanisms in biodiversity dynamics. However, scaling from plot level experiments to informing national or global biodiversity policy has proved a challenge (see also Section 2.5). This CRC will take on this challenge and bring together the diversity of iDiv disciplines and approaches to develop an understanding of *Relevant Causality in Ecology* (i.e. drivers and actions that have measurable effects in real world biodiversity management and conservation situations).

2.2 People and Biodiversity

2.2.1 Research challenge

Human activities exert profound direct and indirect pressures on ecosystems, thereby altering biodiversity and the functions it supports. Despite advances in economic development and socioeconomic prosperity, these gains continue to be driven largely by anthropogenic processes that impose significant negative impacts on biodiversity. At the same time, human well-being depends on functions and services contributed by biodiversity [13]. Understanding these bidirectional relationships between human societies and the rest of nature we share the planet with is of critical importance to forge a path towards equitable and sustainable human well-being. Traditionally, biodiversity science has focused on identifying patterns and processes of anthropogenic biodiversity change, facilitating the identification of consequences of social, economic, and policy drivers. Yet, socially beneficial solutions to the biodiversity crisis remain elusive, and their effective large-scale implementation is still insufficiently addressed. Major uncertainties concern which planning and management strategies can effectively reverse biodiversity loss and the degradation of ecosystems while simultaneously enhancing positive contributions to people. The so-called "knowledge-action gap" shows that we have limited knowledge about which actions for biodiversity conservation align with people's needs and values. In particular, a better understanding is needed with respect to how people perceive biodiversity and under which circumstances they would engage as stewards for nature [14].

The research topic *People and Biodiversity* seeks complementary approaches to understand and leverage positive human-nature interactions, while supporting biodiversity conservation and restoration strategies for social-ecological systems. We address the challenge of designing responsible management and policy solutions for biodiversity conservation, ecosystem integrity, and nature stewardship. This research is grounded on interdisciplinary approaches that integrate biodiversity conservation, ecosystem services, behavioural sciences, environmental policy, environmental and ecological economics, and it puts the people in the focus of integrative biodiversity research.

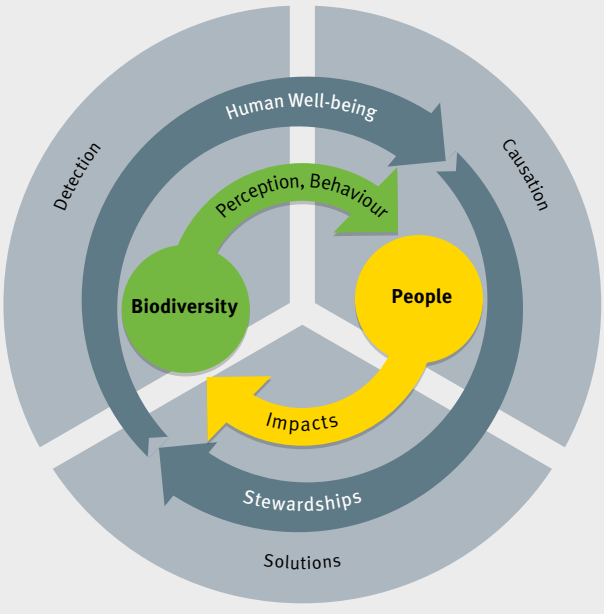

Figure 3: A framework for the research on the interactions between people and biodiversity. The research questions correspond to the different arrows between biodiversity and people. Solutions can only be developed based on a comprehensive scientific understanding of what are the needs and wants of people with respect to biodiversity and stewardship, including the detection of relationships and the identification of causality.

2.2.2 Research goals and work programme

We have set four major research goals addressing the relationships between people and biodiversity that focus on solutions to the biodiversity crisis, as well as sustainable use, stewardship and people's well-being (Figure 3). Our research programme aims to detect and quantify these relationships by inferring causal links grounded in social-ecological-economic theory, and developing evidence-based, transformative solutions that people find beneficial while also protecting nature.

Goal 2.1: Understand how people perceive and recognise biodiversity.

The scientific term "biodiversity" is familiar to only a few laypersons, and scientific measurements of biodiversity, such as species richness or effective species number, may be different from how people perceive and recognise nature [3,15]. We aim to develop rigorous measurements of biodiversity that are aligned with the perceptions of people, taking into account different senses (visual, sound, smell, feel), a sense of place, and personal memory. This forms the basis for understanding **which factors determine attitudes and behaviour towards biodiversity** of different socio-economic groups and how they respond to biodiversity policies and strategies, for example how farmers respond to payments for ecosystem services, and which interventions gain social licence and traction such that they can be effectively implemented and brought into action.

Goal 2.2: Provide causal evidence how biodiversity impacts the health and well-being of people in different natural and socio-economic environments.

Scientific evidence on how biodiversity change affects human mental, physical, and social health and subjective well-being is scattered and predominantly correlative. We aim at providing comprehensive and causal evidence that can inform biodiversity policy, environmental planning, and nature-based social prescribing interventions [16]. We will combine data from existing panels such as the LIFE Adult for health impacts and the German SOEP for self-reported life satisfaction with biodiversity observations to identify causal effects with quasi-experimental statistical methods, and implement new experimental and intervention studies in large-scale online surveys. How these effects are moderated by environmental factors, described as dose-response functions, and socio-economic factors, especially with regard to socioeconomic distribution, is key for informing effective and feasible interventions. Feeding results in biophysical assessments, participatory GIS mapping and economic natural capital valuation, we will contribute to current activities of developing ecosystem accounting frameworks at the European Union, German National Accounting, and Business levels.

Goal 2.3: Quantify policy and management impacts on biodiversity

The effects of human activities across economic sectors such as agriculture, forestry, hunting and fishing drive complex, multicausal impacts on ecosystem composition, structure, and function, with consequences that scale in space and time. The research topic will examine how management and policy decisions across various sectors exert pressures on biodiversity and ecosystem services, thereby creating a need to resolve tradeoffs that affect societies and the economy at large. Building on social-ecological perspectives and interdisciplinary research, we aim to develop and evaluate management and policy frameworks that simultaneously mitigate impacts on biodiversity and promote sustainable prosperity. These frameworks will support the implementation of instruments such as the European Nature Restoration Regulation, the Common Agricultural Policy, and sectoral policies in fisheries and forestry.

Goal 2.4: Design biodiversity stewardship solutions while generating social value, in order to bend the curve of biodiversity loss.

Effective solutions to biodiversity threats must navigate the dual challenge of conserving and restoring resilient ecosystems while addressing the diverse- and at times conflicting-ways in which people value nature and derive benefits from it [17,18]. This requires identifying opportunities to restore ecological integrity, functional complexity, and connectivity across ecosystems, thereby maximizing the ecosystem capacity to resist and adapt to ongoing and future pressures. We will advance multi-objective support tools, ecological and socio-ecological models, and scenario frameworks to investigate co-benefits between ecosystem conservation, restoration and rewilding, and the people's needs and demands for ecosystem services and socio-economic prosperity. We will develop research on how market mechanisms can be leveraged to prosper with nature, a fundamental yet largely unrealised strategy with significant potential to foster socio-ecological co-benefits. This research will design biodiversity stewardship solutions closely aligned with national, trans-national and global sustainability targets and commitments, and in line with people's preferences.

2.2.3 On-going and planned initiatives

Ongoing Citizen Science projects will both monitor biodiversity as well as assess the contribution of participation on enhanced environmental stewardship and aim to move to impact monitoring of restoration activities (e.g., FLOW – freshwater monitoring, KlimaFalterGarten – greening school grounds, MicroSafari – soil arthropods in allotment gardens, GartenDiv – flora in private gardens). Another example is PollenNet – Phenology-based pollen prediction and EEG-based allergic response assessment using AI, which utilises the iDiv platform iCyt [19].

In the on-going research training group ECO-N, 12 doctoral researchers work on doctoral projects related to people and biodiversity, in the context of forestry and soils. We will apply at DFG for the second funding phase of ECO-N, with half the number of PIs from the iDiv network, and 6 doctoral research projects that will be closely connected to this research topic of iDiv.

We plan to apply to upcoming EU Horizon calls, several of which address closely related topics, such as citizen action for nature protection and restoration, or health of ecosystems and impacts on human health, and to lead consortia in the current and upcoming Biodiversa+ calls on "Restoration of ecosystem functioning, integrity, and connectivity" and "Future sustainable socio-ecological systems".

We are planning to apply for a DFG research unit *Naturally Healthy*. This proposal builds on existing work in the Bonn lab and currently the consortium building and grant writing is supported by an iDiv seed fund for 8 months. Initial exchanges have already taken place and a submission is planned for autumn 2026.

2.3 Functions

2.3.1 Research challenge

Biodiversity change and accelerating global change pose fundamental threats to the functioning, stability, and resilience of terrestrial ecosystems worldwide. While decades of biodiversity-ecosystem functioning (BEF) research have established that biodiversity generally enhances ecosystem functioning, major uncertainties remain regarding *how*, *when*, and *at which spatial and temporal scales* these effects emerge. In particular, current theory and empirical evidence are still biased toward aboveground communities, single functions, and local scales and experiments, limiting our ability to predict ecosystem responses under increasing climate extremes and land-use change. A key challenge is to evaluate how biodiversity across trophic levels – especially belowground biodiversity – and accelerated changes in functional composition interact with environmental context, spatial heterogeneity, and community dynamics to regulate ecosystem multifunctionality and long-term stability.

The long-term objective of this research is to advance a mechanistic, scale-explicit, and operational understanding of biodiversity-based ecosystem functioning, explicitly integrating multitrophic interactions, trait-based mechanisms, automated high-frequency observations of functional behaviour, and spatial scaling. This allows moving beyond correlative patterns toward causal inference, disentangling species-identity effects from diversity-driven processes, and identifying the conditions under which biodiversity provides resistance, recovery, and insurance against disturbances. Ultimately, this knowledge is required to translate BEF theory into actionable strategies for sustainable ecosystem management, conservation, and policy, and to better quantify nature's contributions to people.

This research builds on substantial preliminary work and collective expertise. Supported by long-term experiments, coordinated observational networks, and synthesis infrastructures, iDiv has advanced this field by trait-based approaches, the integration of experimental and observational data across scales, and the use of high-resolution temporal and spatial datasets to address causality in BEF relationships. iDiv has a long-standing tradition of synthesis-driven, interdisciplinary research that leverages existing platforms, databases, and international networks to address unresolved questions at the interface of biodiversity, ecosystem functioning, and global change.

With understanding of this progress, three critical challenges motivate our research: (i) how multitrophic and especially above-belowground biodiversity regulates ecosystem multifunctionality, (ii) how biodiversity stabilises ecosystem functions through resistance, recovery, and spatial asynchrony, and (iii) how local BEF relationships scale up to landscapes and regions. Addressing these challenges motivates the following research questions.

2.3.2 Research goals and work programme

Goal 3.1: Understanding multitrophic and vertical diversity effects

Ecosystem functioning in terrestrial ecosystems emerges from interactions among plants, soil organisms, microbes, and higher trophic levels, with biodiversity effects depending on trophic structure, functional traits of component species, and abiotic context.

Biodiversity-ecosystem functioning (BEF) research has robustly demonstrated positive effects of biodiversity on ecosystem processes, yet it has largely focused on single trophic levels, particularly plant communities. Increasing evidence shows that ecosystem functioning in terrestrial systems emerges from multitrophic interactions, especially those linking above- and belowground communities. Soil microorganisms, fungi, and soil fauna regulate key processes such as nutrient cycling, carbon storage, and plant productivity, but their integration into BEF theory remains incomplete. Current knowledge indicates that biodiversity effects depend strongly on trophic structure, functional traits, and biotic context, including plant-soil feedbacks and soil legacy effects, challenging simplistic diversity-function relationships.

Extensive ongoing research on this topic includes long-term biodiversity experiments [20] , functional screenings of species [21], coordinated observational networks [22], and synthesis efforts with a strong focus on interactions within and between trophic levels, such as soil and plant biodiversity [23]. iDiv members have substantial expertise in trait-based approaches [24], soil food-web structure [25], and multitrophic datasets [26], as well as access to unique experimental platforms and databases (Figure 7). Preliminary analyses demonstrate context-dependent biodiversity effects mediated by soil communities and plant traits, underscoring the need for integrative, multitrophic frameworks [27].

We plan to address the hypotheses that (i) ecosystem multifunctionality is regulated by multitrophic, above-belowground, biodiversity, (ii) functional traits across trophic levels mediate biodiversity effects more strongly than species richness alone, and (iii)

abiotic and biotic context dependency determines when species-identity effects dominate over species diversity effects. Key questions include which components of soil food webs drive multiple ecosystem functions, how plant, animal, and microbial traits interact to control processes, and how plant-soil feedbacks modify BEF relationships under environmental change.

The research will integrate experimental, observational, and synthesis-based approaches to link biodiversity across trophic levels to ecosystem processes. Novel trait-based analyses will be applied consistently across plants, microbes, and animals, combined with high-resolution temporal and spatial data of species functional behaviour and ecosystem responses to enable causal inference. Multitrophic interaction networks and plant-soil interactions will be explicitly incorporated to identify mechanistic pathways underlying biodiversity effects.

We will provide the mechanistic foundation of the overarching strategy by embedding BEF research in realistic, multitrophic systems. It strengthens the soil biodiversity focus, integrates novel AI-based detection tools, advances causal understanding, and identifies leverage points for ecosystem management, thereby anchoring subsequent work on stability, scaling, and societal relevance.

Goal 3.2: Uncovering biodiversity-stability relationships

Biodiversity stabilises ecosystem functioning through resistance, recovery, insurance effects, and asynchrony, particularly under increasing climate extremes. Biodiversity is widely hypothesised to stabilise ecosystem functioning through resistance to disturbance, recovery after disturbance, compensatory dynamics, and insurance effects driven by asynchrony. While theoretical and empirical studies support these mechanisms, evidence remains fragmented across ecosystems, trophic levels, and stability metrics. Most studies emphasise aboveground diversity and short time frames, whereas the stabilizing role of multitrophic, above-belowground interactions and shifts in species composition under increasing climate extremes remains poorly quantified. Biodiversity-stability relationships in the face of compound extremes are poorly studied.

Biodiversity-stability relationships have been studied using long-term experiments, repeated measurements, remote-sensing analyses, and climate-manipulation studies addressing drought and other extremes [28,29]. Previous work in iDiv reveals strong collective expertise in stability metrics, time-series analyses [20], and trait-based approaches [21,24,30], as well as access to long-term datasets suitable for disentangling resistance, recovery and invariability [27,31]. iDiv has been contributing significantly to this field of research by initiating and maintaining long-term datasets (e.g., Jena Experiment, MyDiv, PhenObs, BEF-China). Initial results indicate that biodiversity effects on stability are highly dependent on the abiotic and biotic context and may differ fundamentally between resistance and recovery phases [20,27,29] .

We will test the hypotheses that (i) biodiversity enhances ecosystem stability through complementary and context-dependent mechanisms, (ii) multitrophic, above-belowground diversity plays a central but underappreciated role in buffering ecosystems against climate extremes, and (iii) functional traits and compensatory dynamics underpin biodiversity-driven stability. Key questions include how different trophic levels contribute to resistance versus recovery, which traits confer buffering capacity, and how biodiversity loss interacts with climate extremes to destabilise ecosystem functioning.

We plan to combine long-term observational data, experimental manipulations, and time-series analyses to quantify multidimensional stability metrics. The high temporal resolution of novel sensor technology – recording fast responses of both community structure and ecosystem functions – allows us to learn from short-term transient perturbations. Trait-based frameworks and causal attribution techniques will be used to identify mechanisms underlying stability responses. Particular emphasis will be placed on climate extremes and on integrating above-belowground biodiversity into stability theory.

Linking biodiversity to temporal dynamics and resilience is a prerequisite for predicting ecosystem responses under global change. We will provide the conceptual and empirical basis for defining ecosystem health, develop early-warning indicators, and translate biodiversity-driven stability into applied and societal contexts. This takes full advantage of the recent revolution in sensor technology and automated biodiversity detection.

Goal 3.3: Scaling biodiversity-ecosystem functioning relationships across space

Biodiversity-ecosystem functioning (BEF) relationships are scale-dependent, with landscape heterogeneity and spatial asynchrony enhancing ecosystem functioning and stability at larger scales. BEF relationships are increasingly recognised as scale-dependent, yet most empirical evidence is derived from local-scale experiments. Theory predicts that spatial heterogeneity,

species turnover, and asynchronous dynamics among ecosystem patches can enhance ecosystem functioning and stability at landscape and regional scales. However, empirical tests remain scarce, particularly those integrating multitrophic, above-belowground biodiversity across spatial scales and land-use gradients. However, recent studies show that we are confronted with a global reorganisation of biosphere functioning [32], calling for scale-bridging approaches.

Our planned research builds on coordinated experimental platforms [26], landscape-scale observational networks [22], wide-spread drone data [33], novel remote-sensing applications [32], and synthesis infrastructures [20,21] that allow integration of plot-level and regional data. Previous work in iDiv highlights strong experience in spatial analyses, trait-based scaling approaches, and cross-site synthesis. Preliminary findings suggest that spatial asynchrony and community turnover can compensate for local biodiversity loss, but robust, mechanistic evidence is still lacking.

We will examine the hypotheses that (i) biodiversity effects on ecosystem functioning strengthen with spatial scale, if environmental filtering selects locally well adapted and diverse communities at the patch level; (ii) landscape-level functioning depends on both local diversity and compositional turnover; and (iii) spatial insurance effects enhance ecosystem stability under environmental variability. Key questions include how local BEF relationships scale up, how land-use change alters spatial BEF patterns, and when key species and community composition versus diversity-driven processes dominate across landscapes.

The research will integrate plot-level experiments with landscape-scale observational data using spatially explicit, trait-based analyses. Species turnover, dominance patterns, and functional trait distributions will be quantified to disentangle identity and compositional effects and to assess the role of land-use type and intensity, conservation, and restoration in real-world landscapes. Combining experimental and observational data will enable causal tests of scaling hypotheses under realistic environmental conditions. Climate change will be analysed as a driver shifting the baseline of the environmental template.

We will provide the scaling and synthesis dimension of the overarching strategy, connecting local mechanisms to landscape-level ecosystem functioning and services. This ensures that insights from multitrophic diversity and stability research are translated to management-relevant spatial scales, thereby strengthening the applied and policy relevance of the overall research programme.

2.3.3 On-going and planned initiatives

The Functions topic builds on a strong portfolio of existing iDiv infrastructures and support units. Core resources include long-term experimental platforms and coordinated observational networks that enable multitrophic and spatially explicit BEF research (e.g., iForm, AquaDiva, GCEF), as well as centralised databases on biodiversity, traits, phenology, and ecosystem functions (e.g., TRY, sTability, GRoot, PhenObs). Synthesis infrastructures (mostly sDiv), flexible funding instruments (e.g., Flexpool and Support Units), and support for data management, integration, and coordination provide a strong foundation for cross-site and interdisciplinary analyses. These resources already support ongoing synthesis activities, working groups, and early-stage proposal development, and are directly aligned with milestones related to data integration, theory development, and cross-center coordination.

The topic is embedded in a diverse portfolio of externally funded projects led or co-led by iDiv members, including large-scale biodiversity experiments (e.g., BEF-China [TreeDì (GRK 2324)], Jena Experiment [FOR 5000], MyDiv), soil biodiversity initiatives (Soil BON, BioDiv4Soil, CARBONWEB), and collaborative networks focusing on ecosystem functioning, stability, and global change (BBCe, MultiSense, ECO-N, BioSmoke, Nutrient Network, Drought-Net). These projects provide substantial empirical data, long-term time series, and experimental manipulations that underpin all three Centers of Gravity. Collectively, they ensure continuity of data collection, foster within-iDiv, national, and international collaboration, and provide immediate entry points for synthesis and scaling efforts.

Building on this foundation, several major grant applications are in preparation or planned. These include (i) a DFG Research Unit on tree diversity and identity effects on microclimate buffering and nutrient dynamics (FOR MyDiv~ARBOfun) or Collaborative Research Centres (CRC/TRR; BBCe, MultiSense) focusing on multitrophic, aboveground-belowground biodiversity, and ecosystem multifunctionality; (ii) a DFG Priority Programme (SPP; BIOTURN), or coordinated international research programmes on biodiversity-stability relationships under climate extremes; and (iii) large-scale EU Horizon Europe consortia addressing spatial scaling of biodiversity effects and nature-based solutions at landscape scales. Tentative applicants include senior and early-career iDiv researchers across institutions, with preparatory phases supported by iDiv coordination and synthesis funds (e.g., Support Unit iForm).

2.4 Complexity

2.4.1 Research challenge

Biodiversity change is a multi-scale challenge that requires scientific understanding across levels of biological organisation, spatial and temporal scales, and governance contexts [34] (see section 1.1). Addressing this challenge demands an integrative perspective that reflects iDiv's core mission to understand biodiversity in its complexity and to provide knowledge for its conservation and sustainable use (see section 1.3). Within this framework, the research topic Complexity focuses on the fundamental question of how interacting ecological and evolutionary processes generate biodiversity dynamics across systems and scales.

Biodiversity patterns and their change emerge from the interplay of abiotic constraints on coexistence, biotic interactions, dispersal and movement, evolutionary processes, and anthropogenic global change. While each of these processes is well understood in isolation, a central research challenge is to explain how their interactions give rise to biodiversity dynamics that are non-linear, context-dependent, stochastic, multi-dimensional, and scale-dependent. This complexity in biodiversity patterns and processes is therefore not only a major challenge for understanding biodiversity change, but also an intrinsic feature in the generation of species, coexistence, and diversity. In particular, it remains unclear which combinations of processes dominate under different environmental conditions, and under which circumstances their interactions lead to thresholds, regime shifts, or unexpected biodiversity responses [35]. This limits our ability to anticipate biodiversity change and to provide robust knowledge for decision making across governance levels.

Advancing this research topic is essential for linking local ecological mechanisms to regional and global biodiversity patterns, and thereby for connecting scientific insight with the multi-scale policy frameworks described above. **The long-term vision is to develop a mechanistic and predictive understanding of biodiversity dynamics that enables generalisation across spatial and temporal scales as well as across biological levels of organisation. Achieving this requires identifying causal mechanisms, quantifying non-linear interactions, and integrating ecological and evolutionary processes within a unified framework.**

Building on iDiv's strengths in integrative biodiversity research (see section 1.2), a strong foundation for this effort is provided through recent advances in statistical modeling, Bayesian inference, and analytical and simulation approaches (see section 2.1). The key challenge ahead is to combine these approaches with large-scale data integration, trait-based generalisation, and coordinated experimental research in order to move from descriptive understanding toward predictive biodiversity science. In doing so, the Complexity research topic directly contributes to iDiv's mission of advancing integrative biodiversity research and supporting evidence-based conservation and sustainable use.

2.4.2 Research goals and work programme

To address the research challenges and deliver on its strategic roadmap, the research topic Complexity will establish a next-generation integrative research framework that transforms how biodiversity dynamics are understood, predicted, and managed. Building on iDiv's unique infrastructure and scientific leadership, the research topic will integrate large-scale data, mechanistic theory, and experimental systems into a predictive science of biodiversity.

Goal 4.1: Disentangle and quantify the relative contributions of global change drivers across systems and scales, while accounting for context dependence arising from environmental conditions, species interactions, and movement processes.

At the core of this effort is the expansion and integration of globally leading biodiversity databases (e.g., TRY [24,36], sPlot [37], GloNAF [38], GATEWAy [39], StoichLife [40], AVONET [41], PhenObs [42]), which will be advanced into a coherent, interoperable data ecosystem (see section 5.2). This data backbone will enable unprecedented comparative analyses across taxa, ecosystems, and spatial and temporal scales, forming the empirical basis for attributing biodiversity change, identifying scale-dependent responses, and deriving generalisable principles. These efforts will be tightly coupled with cutting-edge statistical and computational capacities provided by the iDiv Resources unit (see section 5.2), advancing Bayesian inference and dynamic modeling (see section 2.1) as central tools for capturing nonlinear interactions, feedbacks, and emergent biodiversity dynamics [43,44]. Building directly on the goal, the research topic will transform experimental and observational infrastructures into globally visible integrative research platforms (see section 5.2).

Goal 4.2: Identify the scales at which interacting drivers generate nonlinear biodiversity responses, and develop predictive frameworks and early warning indicators for anticipating rapid and potentially irreversible change.

Long-term experiments and coordinated networks, including NutNet and the iDiv Ecotron, will be further developed into large-scale, multifactorial test systems that allow the simultaneous manipulation of interacting global change drivers. These platforms will serve as critical interfaces between empirical observation and theory, enabling causal inference and rigorous testing of predictive models. Emerging infrastructures such as iCyt will open new frontiers by incorporating previously underrepresented dimensions of biodiversity, while synthesis platforms such as sDiv will be strategically expanded to accelerate global collaboration and cross-system integration.

Goal 4.3: Define key process combinations that govern community dynamics across environmental gradients, and establish generalisable biodiversity regimes that explain variation in coexistence, turnover, and stability.

To implement this vision at scale, the research topic will lead the development of major coordinated funding initiatives that establish long-term, internationally visible research structures. Planned proposals include collaborative proposals on "the consequences of biodiversity turnover" and "multisensory pollution as a new dimension of global change", which will integrate expertise across ecological theory, trait-based and dynamic modeling, large-scale data science, and collaborative experimental research. These initiatives are designed to position iDiv as a central node in global biodiversity research networks and to attract leading researchers and partners from across disciplines and regions.

Goal 4.4: Determine when and where evolutionary dynamics influence present-day biodiversity patterns, and quantify the role of eco-evolutionary feedbacks in shaping biodiversity responses to environmental change.

To achieve this goal, we will integrate trait-based data, phylogenetic data, and deep-time paleontological records to detect evolutionary signatures in contemporary biodiversity patterns. By combining Bayesian inference with dynamic and mechanistic models, we will quantify eco-evolutionary feedbacks and identify the environmental contexts under which evolutionary processes shape present-day community structure and dynamics and influence responses to anthropogenic global change. Comparative analyses across environmental gradients and geological timescales will allow us to link macroevolutionary patterns with current biodiversity dynamics and to disentangle evolutionary from ecological drivers. This approach will enable us to incorporate evolutionary processes into predictive frameworks and improve projections of biodiversity trajectories under ongoing global change.

2.4.3 On-going and planned initiatives

Together, these research goals are addressed through an integrative framework that combines Bayesian statistical inference, dynamic and mechanistic modeling, and trait-based approaches to capture the nonlinear and scale-dependent interplay among biodiversity drivers. By linking these methods with large, harmonised biodiversity databases and coordinated observational and experimental networks, this research topic aims to generalise across systems and scales, identify causal mechanisms, and enable robust prediction of biodiversity dynamics under global change, thereby supporting evidence-based decision making across governance levels.

Looking ahead, the work plan aims to shift biodiversity research from a predominantly descriptive discipline toward a fully predictive and scalable science. By systematically integrating Bayesian inference, trait-based generalisation, dynamic and mechanistic modeling, large-scale data synthesis, and coordinated experimental approaches, the research topic will uncover causal mechanisms, anticipate nonlinear transitions, and generate robust predictions of biodiversity change. In doing so, it will not only consolidate iDiv's position as a global leader in integrative biodiversity research, but also provide the scientific foundation for transformative, evidence-based biodiversity policy and management in an era of accelerating global change.

We plan several major grant applications related to the Complexity topic. Some, such as the Collaborative Research Centre MultiSense, at the University of Jena. Another initiative connects the topic Complexity to People and Biodiversity: We will apply for a DFG research unit "Sustainable fishery: maximising economic benefits while protecting biodiversity in complex food webs (SUSTAINET)". The backbone of this proposal is an ecological model of a complex marine food web, in which we integrate harvesting of selective species, with harvesting pressure driven by economic profitability.

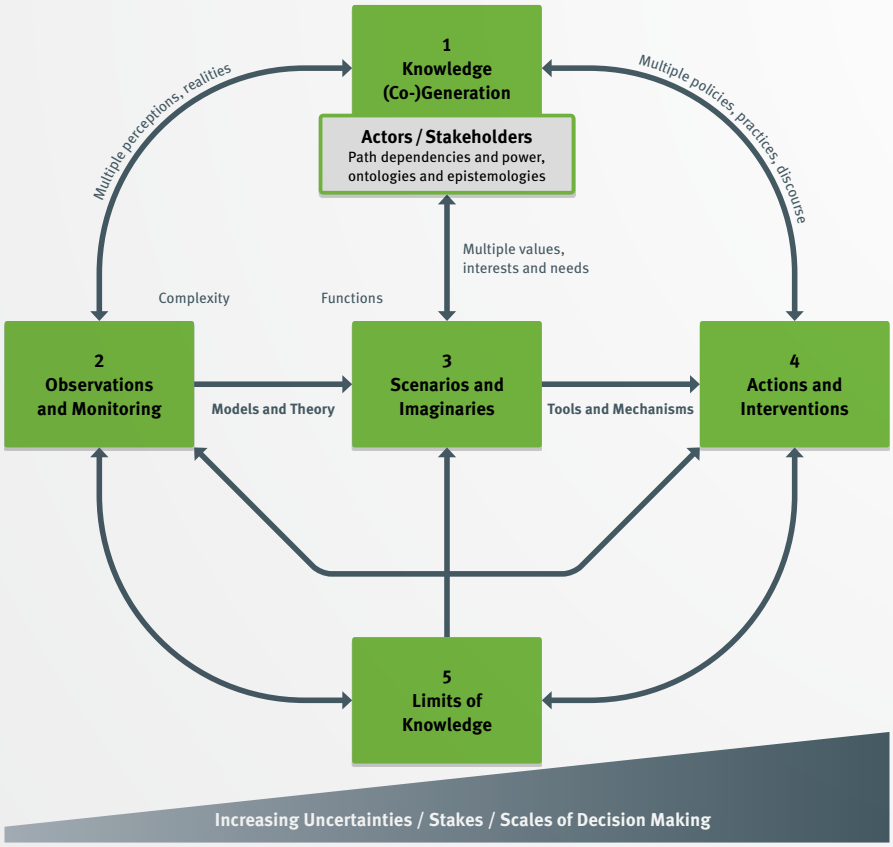

Figure 4: A framework for the holistic research programme in transdisciplinarity. Numbers represent the research questions.

2.5 Transdisciplinarity Research

2.5.1 Research challenge

A research challenge at iDiv is to develop long-term and robust transdisciplinary research that extends beyond interdisciplinary integration to include co-design with stakeholders and the uptake of scientific results by societal actors [45–48]. This challenge is critical for addressing the underlying causes and indirect drivers of biodiversity loss, as well as slowing down and preventing its devastating consequences. It aligns with the urgent goals of the KM GBF under CBD, which emphasise the need for much stronger collaboration between science, policy, and practice across the board. The focus thus goes beyond doing transdisciplinary research to researching transdisciplinarity itself, explicitly, for better biodiversity science and governance. This involves a shift from conducting research with policy relevance to researching why and how to perform such transdisciplinary research and understanding implications thereof. This will equip us with the tools to take integrative biodiversity research to a new level by combining excellent basic research with practical relevance and actionable insights.

The key themes in this research topic involve (Figure 5) the (1) co-generation of knowledge with multiple actors and stakeholders, in order to (2) improve observations and monitoring of biodiversity. Such biodiversity observations can inform the scientific understanding of biodiversity dynamics, its functions and its contribution to human well-being, including the development of biodiversity theory and models, the focus of the four other research topics in iDiv Science Strategy. Models of biodiversity and social-ecological systems can then be used (3) to develop and compare scenarios and imaginaries of how biodiversity can evolve under different policy and practice trajectories, ultimately informing the (4) actions and management interventions by actors and stakeholders involved in and affected by the transdisciplinary research. As we move from observations to actions and interventions, there are increasing uncertainties and increasing stakes of the process, often encompassing increasing scales of decision-making. Therefore it is important to address (5) epistemological issues related to the limits of scientific knowledge in this process.

2.5.2 Research goals and work programme

Goal 5.1: Advancing understanding of knowledge co-generation shaped by perceptions, methods, relationships and power dynamics.

iDiv's research has laid a significant groundwork for understanding biodiversity-relevant knowledge (co-)generation. Examples include works on Reflexivity-Situatedness Matrix, an analytical framework for transdisciplinary partnerships and transformations in biodiversity domain [49], reconciling plural knowledge systems [18], the role of science in biodiversity policy making [50], citizen science for co-generating biodiversity knowledge [10,51–53], and political and participatory dimensions of rewilding [6,54,55]. Building on these strands of work, iDiv aims to investigate systematically how varying approaches to knowledge co-generation are informed by differing perceptions, methodologies, and underlying power dynamics in multi-actor settings and the consequences thereof (including local, traditional and/or Indigenous knowledge). We will draw upon social-political theories of power and path dependence, participatory research theories, social constructivist frameworks, and methods such as stakeholder engagement, and qualitative case studies, ensuring a nuanced understanding of the complex social interactions at play.

Goal 5.2: Developing cutting-edge research on monitoring and evidence-based biodiversity management and conservation.

iDiv works extensively on biodiversity monitoring and observations (see Pereira et al. [56] on essential biodiversity variables, Kissling et al. [11] on developing European biodiversity monitoring). Going forward, iDiv aims to advance monitoring and evidence-based biodiversity management and conservation through a comprehensive integration of knowledge co-creation considerations in assessments of local ecosystems, including inventories of species, habitat quality, and existing threats. We aim to investigate key biodiversity indicators that best reflect ecosystem health at different scales. We will study how human activities and climate variability (biodiversity nexus, [57]) affect species distribution and abundance and vice versa. We will systematically analyse the link between conservation actions and the most measurable improvements. Our approach will integrate ecological monitoring frameworks, GIS-based spatial analysis, and population modelling, supported by theories from landscape ecology and adaptive management. Methods will include longitudinal field surveys, remote sensing, and statistical modelling to evaluate interventions and guide decision-making. This approach will ensure that conservation strategies are both targeted, adaptive, and robust to changes in power dynamics as studied by research question 1 (e.g., geopolitical challenges or election cycles).

Goal 5.3: Co-developing, modeling, and synthesising scenarios and imaginaries on evolution of biodiversity and well-being.

iDiv is a global research leader on using models and synthesis of available knowledge [58,59] for developing and co-developing biodiversity scenarios (globally leading works on scenarios by Pereira et al. [6,60]; Lundquist et al. [61] on the Nature Futures Framework). Under this research goal, iDiv will focus on integrating models and synthesis approaches to explore how biodiversity and human well-being may co-evolve under different scenarios and imaginaries – how visions of scientific and technological progress carry with them implicit ideas about public purposes, collective futures, and the common good. The work will aim to advance our knowledge on the dynamics between key drivers of ecological and social change, developing tools to facilitate stakeholder scenarios building, as well as consolidating existing datasets and literature as a body of reference works. Such works are then integrated with the frameworks that explore the ways people imagine their social co-existence and how they collectively shape pathways towards such imaginaries. We will draw on imaginaries theory, resilience theory, social-ecological systems frameworks, and integrative scenario development methods, combining quantitative modelling with qualitative narrative co-creation. The synthesis will involve iterative stakeholder engagement and model inter-comparisons (http://bes-sim.org) to develop a set of plausible scenarios and imaginaries for future biodiversity and well-being trajectories.

Goal 5.4: Establishing best practices to design planning, policy, and governance for biodiversity.

iDiv has extensively worked on planning, policy tools, and governance for biodiversity. Examples include works on greening the EU Common Agricultural Policy [50], multiple ways to bend the curve of biodiversity loss [62], multi-level analysis of decision-making in conservation [63], creating the vision of rapid, repeatable, reactive data workflows for policy on biodiversity [64], or advancing the IPBES framework on transformative change assessment [65]. Building on this body of work, under this research goal iDiv's work will focus on understanding the complex interactions between the state of biodiversity, actions to improve it, and governance structures. We will draw on theories of adaptive governance in socio-ecological systems and multi-level institutional analysis, combined with methods such as comparative policy analysis, qualitative case studies, and scenario-based modeling to identify effective strategies for biodiversity management.

Goal 5.5: Enhancing the understanding and communication of structural and epistemological limits of scientific knowledge in decision-making processes.

iDiv has a strong track record in understanding plural knowledge systems, values, worldviews, perceptions and the limitations of knowledge when operating within partnerships [49,66,67], in the context of multiple challenges [68,69], as well as in newly emerging initiatives such as rights of nature [70], rewilding [6], and technologies enabling improved monitoring [4,71]. Building on this track record, we will explore the structural and epistemological limits of scientific knowledge in decision-making processes, particularly in contexts where uncertainty plays a large role. We will continuously map how scientific knowledge is generated, validated, and operationalised within biodiversity policy and organisational frameworks, highlighting the points at which structural constraints and epistemic limitations emerge. Drawing upon theories of science and technology studies, epistemic governance, and decision theory, we will combine qualitative document analysis, expert interviews, focus group discussions, and modelling approaches to examine both the production and interpretation of uncertainty within real-world decision contexts.

2.5.3 On-going and planned initiatives

The research topic builds on a strong and diverse portfolio of externally funded projects that collectively advance transdisciplinary biodiversity science, monitoring, governance, and societal transformation. Core contributions stem from Horizon Europe projects, including NaturaConnect, WilDE, and TERRAMARE, PLANET4B, DAISY, and TransformERS, which develop integrated biodiversity observation systems, participatory governance approaches, and transformative pathways linking science, policy, and practice. These activities are complemented by ongoing capacity development through the current PhD graduate school. Earlier initiatives, particularly the ValuGaps project, contributed to biodiversity valuation and policy integration through collaborations with BfN, UBA, and DESTATIS. In agroecology, current Horizon Europe projects Agroecology-TRANSECT and LAFERIA extend long-term research on sustainable agricultural systems, building on CAP4GI and iDiv projects iCAP-BES and AgriDiv, thereby strengthening links between biodiversity science, land-use governance, and agricultural transformation. A major pillar of externally funded work focuses on citizen science and co-production of biodiversity knowledge across societal actors. Ongoing initiatives include VielFalterGarten, the Horizon Europe project UNP+, and the NMZB lighthouse project FLOW, alongside participatory initiatives such as KlimaFalterSchulen (BMUKN funding), MikroSafari (Uni Jena funding), GartenDiv, and the Pollen monitoring programme. These projects expand biodiversity observation while fostering societal engagement and environmental literacy. Methodological innovation is further advanced through the development of an LLM-based narrative analysis framework (resonantia.earth), enabling systematic analysis of actors, incentives, and governance dynamics in social-ecological systems. International collaboration is further developed through the project “Peace with Nature: Conflict Dynamics, Environmental Protection and Community Strategies in Colombia”, jointly with Pontificia Universidad Javeriana (Bogotá), addressing links between environmental governance, conflict dynamics, and community-based conservation, funded by the German Foundation for Peace Research (DSF).

The research topic is actively expanding its funding portfolio through a series of major grant applications that strengthen leadership in transdisciplinary biodiversity science and governance. Currently under review are the ERC Synergy Grant LEaP and the COST Action European Territorial Commons, which aim to advance transformative governance frameworks and collaborative research infrastructures across Europe. Additional proposals under preparation or review include GewässerVerbesserer, and Küstenchecker, focusing on innovative biodiversity monitoring and restoration approaches. Methodological innovation is pursued through VERA (Verifiable Evidence and Responsibility Attribution, resonantia.earth), which develops a toolchain to identify and attribute responsibility to actors shaping environmental change.

Beyond individual projects, the research agenda prioritises the development of transdisciplinary research networks and long-term infrastructures supporting biodiversity observation and knowledge integration. Planned initiatives include the establishment of Biodiversity Change networks such as EBORN, sMon collaborations with natural history societies and agencies, and contributions to the NFDI4Biodiversity framework, including the freshwater topic table and the Lebendiger Atlas. The global PhenObs network, linking botanical gardens worldwide, further strengthens coordinated observation capacities and currently extends it to herbaria. Future funding efforts are closely aligned with upcoming European calls, particularly within Horizon Europe Cluster 6, targeting science-policy support for biodiversity strategies, integrated scenario modelling for a nature-positive transition, living labs for ecosystem restoration and inclusive governance, citizen action for biodiversity protection, and One Health approaches linking ecosystem and human health. Additional opportunities are pursued through Biodiversa+ calls such as BioDivFuture, focusing on trajectories toward sustainable socio-ecological systems. Together, these initiatives position the research topic to consolidate long-term funding streams while advancing transdisciplinary innovation at the science-policy-society interface.

3. Pathways to Impact

The scientific mission of iDiv extends beyond the generation of knowledge to its application in addressing societal challenges related to biodiversity change. Recognising that biodiversity change is a complex, social-ecological phenomenon, iDiv is committed to strengthening a fruitful dialogue between science and society. This section outlines our strategic framework for societal engagement and knowledge transfer, emphasising institutional capacity, methodological rigor, and potential for incremental and sustainable change. This framework is implemented through the dedicated iDiv **Impact unit**.

iDiv's framework integrates science-policy, business engagement, science communication, and participatory research into a coherent institutional strategy. This framework will:

- Strengthen the institutionalisation of impact pathways across all research projects, including early-stage integration of societal engagement and communication planning.
- Establish measurable indicators for societal impact, aligned with the principles of transparency, accountability, and scientific integrity.
- Foster a culture in which societal engagement is recognised as a core component of scientific excellence, reflected in career development, evaluation, and funding applications.

The ultimate goal is not merely to increase visibility or influence, but to ensure that iDiv's science contributes measurably to how society understands and acts upon biodiversity.

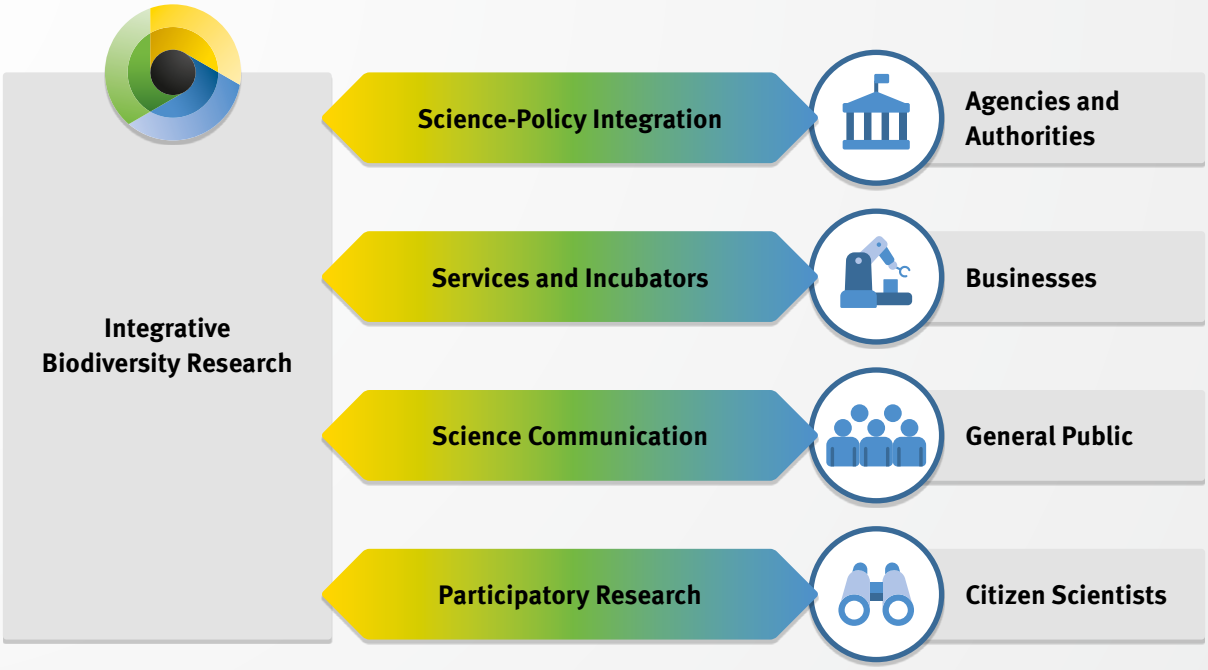

Figure 5: iDiv's strategic framework for societal engagement and knowledge transfer, linking integrative biodiversity research to four impact pathways to foster measurable societal impact.

3.1 Science-Policy Integration

iDiv has established a sustained and impactful presence in international and European science-policy processes, contributing to the development of evidence-based environmental governance. Over the past decade, researchers have played key roles in major policy-relevant initiatives, including assessments by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the European Topic Centre on Biodiversity and Ecosystems (ETC-BE), and the German national biodiversity assessment "Faktencheck Artenvielfalt". iDiv also leads the project sMon on analysing biodiversity change in Germany, coordinated EuropaBON, an Horizon 2020 Coordination and Support Action on biodiversity monitoring, and participated in the Horizon Europe Cluster on Transformative Change for Biodiversity. These contributions have demonstrably influenced policy development and have resulted, for instance, in the establishment of the European Biodiversity Observation Coordination Centre (EBOCC) as a preparatory action by the European Parliament.

To further institutionalise science-policy engagement, iDiv will strengthen its capacity to support evidence-informed decision-making through a structured, multi-level approach for the three core research topics and the two cross-cutting research topics (see section 2):

- Stakeholder Engagement: iDiv will systematically engage with policymakers and practitioners through a range of formats, including targeted policy briefs, expert workshops, stakeholder dialogues, and policy roundtables. These activities will be designed to bridge knowledge gaps, clarify scientific uncertainties, and support the interpretation of research findings in policy contexts. We aim to collaborate more closely with national bodies like the Federal Agency for Nature Conservation (BfN), the National Monitoring Centre for Biodiversity (NMZB), and with Central German authorities like the Landesamt für Umweltschutz (LAU) in Saxony-Anhalt or the Thüringer Landesamt für Landwirtschaft und Ländlichen Raum (TLLR).
- Proactive Foresight and Policy Scanning: The Science-Policy Committee, supported by iDiv's Impact unit, will expand its role in monitoring emerging policy agendas and regulatory developments. By scanning sub-national, national, and European policy landscapes, iDiv will identify opportunities for timely scientific input, enabling researchers to anticipate policy needs and align their work accordingly. The Impact unit will support iDiv scientists from all research topics in writing policy elements into their grant proposals, from one-time stakeholder events to entire policy-focused work packages.
- Capacity Building in Science-Policy Engagement: A targeted programme will be implemented to build the competencies of iDiv researchers in science-policy interaction. This includes training in policy analysis, stakeholder mapping, and the design of policy-relevant communication products. In coordination with iDiv's Education unit, the Impact unit will lead the development of a modular training curriculum tailored to the needs of early-career and senior researchers alike.

All science-policy activities will adhere to principles of scientific independence, transparency, and methodological rigor. The primary objective remains to inform, not to advocate, ensuring that iDiv's contributions serve as reliable, high-quality inputs to democratic deliberation. They will highly benefit from the knowledge developed by the transdisciplinary research topic.

3.2 Business and Biodiversity

The modernisation of economic systems toward sustainability requires a robust scientific foundation for understanding and managing biodiversity dependencies and impacts. iDiv is exploring to develop a structured approach to engage with the business sector through the establishment of a iScience4Business platform, designed to facilitate the translation of the science in the five research topics into actionable insights for industry, finance, and regulatory compliance.

iDiv envisions a platform that promotes:

- The application and improvement of scientifically sound indicators and metrics for biodiversity risk and performance, drawing particularly on the biodiversity and people and the transdisciplinary research topics, and aligned with regulatory frameworks and initiatives such as the EU Corporate Sustainability Reporting Directive (CSRD) and the Taskforce on Nature-related Financial Disclosures (TNFD).
- The provision of scientific support to businesses and financial institutions in assessing nature-related risks and opportunities, drawing on iDiv's expertise across the research topics (e.g., biodiversity monitoring, biodiversity data synthesis and analyses, economic valuation and accounting) combined with its expertise in educational and communication approaches.
- Collaborative research projects with industry and the private sector, ensuring efficiency, complementarity and scientific validity, with the engagement of scientists at different career stages in iDiv, from PhD students to senior scientists.
- The incubation of science-based spin-offs and startups, supporting the commercialisation of iDiv's research through dedicated venture support. This includes facilitating the transfer of monitoring technologies, data-driven decision tools, and sustainable land-management innovations into the marketplace to drive economic growth and job creation.

This initiative will be guided by principles of transparency and reproducibility, with the aim of promoting uptake of knowledge that is both scientifically rigorous and applicable in the private sector.

3.3 Science Communication

Science communication at iDiv plays a critical role in ensuring that findings from all iDiv research topics are accessible, accurate, and relevant to diverse audiences. Communication activities are guided by principles of scientific integrity, inclusivity, and strategic outreach. Ongoing activities include:

- The dissemination of research outputs of the five research topics through **press releases and targeted media engagement**. iDiv's research generates over 1,500 media reports annually, with coverage in leading international outlets (e.g., BBC, The Washington Post, El Mundo) and national German media (e.g., FAZ, Süddeutsche Zeitung).
- The production of **high-quality, targeted formats**. One example is the Inside Biodiversity podcast, which provides in-depth, nuanced discussions on biodiversity science and policy, reaching academia, media, nature conservation practice, and policymaking.
- The use of **social media platforms** (X, LinkedIn, Bluesky, and YouTube) to amplify research impact, engage with public audiences, and foster dialogue with stakeholders. Content is curated to reflect scientific accuracy while being accessible to non-specialist audiences, with regular monitoring of reach and engagement metrics.

To ensure our research achieves maximum real-world impact, we are modernising our approach to outreach by empowering our scientists and optimising our digital assets for broader engagement.

- Expanded Capacity Building, Reflection and Exchange: iDiv will strengthen its researchers' science communication skills through specialised training modules on strategic media engagement and plain writing, the continuation of the Communicator-in-Residence programme, and regular reflection sessions to ensure all outreach maintains rigorous standards of communicative and scientific practice.
- Strategic Content Repurposing: To maximise impact and reach new audiences, iDiv will systematically repurpose and adapt key content from other formats (e.g., the podcast) into other media formats and communication channels tailored for specific interest groups.
- Grant Proposal Support: The Impact unit will provide dedicated support to researchers in integrating science communication components into their grant proposals, ensuring that outreach elements are competitively designed and meet the increasing impact requirements of funding agencies.

All communication efforts are subject to internal quality checks. Priority is given to high-objectivity outputs over opinion-based or advocacy-oriented formats. The goal is to ensure that iDiv's science is not only widely disseminated but also accurately understood.

3.4 Participatory Research

Participatory and transdisciplinary research, including citizen science, is advanced by iDiv towards a powerful approach for addressing the complex socio-ecological challenges associated with biodiversity change. The integration of results from citizen science in decision-making processes has a widely recognised potential to influence the design, implementation and evaluation of policies [10,52,72–74]. Co-creating knowledge is also an effective measure to increase well-being of stakeholders through exposure to biodiversity, while strengthening democratic structures and concepts across societal actors. The uptake of citizen science data is particularly powerful in EU-level monitoring schemes such as the Pan-European Common Bird Monitoring Scheme (PECBMS), the European Butterfly Monitoring Scheme and the IUCN Red List. At a national level we are engaged through FLOW as a lighthouse monitoring project for the NMZB, and link closely to the National Water Strategy.

iDiv is expanding its commitment to the co-production of knowledge through structured engagement with stakeholders and citizens across sectors (see section 2.5). These efforts are embedded within the research process, with stakeholder input integrated at the stages of research design, data mobilisation, generation and interpretation, communication with decision-makers in policy and practice, and knowledge exchange. This approach enhances the relevance, legitimacy, and societal uptake of iDiv's research. As a research centre spanning three federal states in Central Germany, we recognise a special responsibility in fostering trust and participation in science. Here, we aim for joint community science and – in some projects also community restoration action – to provide a means to connect and explore sustainable futures with and for society through nature as a common good, often with a sense of place and ownership for local communities.

4. Training the Next Generation

Our ambition is to promote talents to become the future leaders and experts in integrative biodiversity research and management. This includes academic leadership (e.g., a position in an internationally renowned university), in actual biodiversity management (e.g., in an urban department of green space) or industry (e.g., as corporate sustainability expert). iDiv takes a comprehensive approach to promoting talent, starting with high school students, bachelor's and master's students, doctoral researchers, postdocs, senior scientists, and junior group leaders.

A unique feature of iDiv is that it is an integral part of the three universities Halle, Jena and Leipzig, which form the Unibund. Accordingly, teaching at the Bachelor, Master, and doctoral levels is a highly important activity of iDiv, which shall become more visible and strengthened. iDiv also has a vibrant programme to support career development at all levels, from doctoral researchers over post-doctoral researchers to junior research group leaders. Finally, we would like to explore further opportunities for continuing education for target groups outside of academia. iDiv has a dedicated **Education and Careers** unit to develop all of these activities.

4.1 Bringing Biodiversity into the Classroom

Targeted programmes for high schools and their students foster early interest and strengthen school education in biodiversity. On-going iDiv activities for high schools and students include the citizen science school project "Bodenlos" on exploring soil health, and scientific papers tailored to children in the journal Frontiers for Young Minds. We also organise school field trips at the iDiv core center and individual student internships. We aim to systematise our existing offerings for high schools into a structured programme. Additional activities could include iDiv scientists teaching directly in the classroom, combined with a field trip to one of the iDiv research groups and an internship programme that allows students to actively engage with various research projects. An activity with high leverage potential is to integrate the most up-to-date biodiversity research in iDiv in the education of prospective school teachers at the three universities.

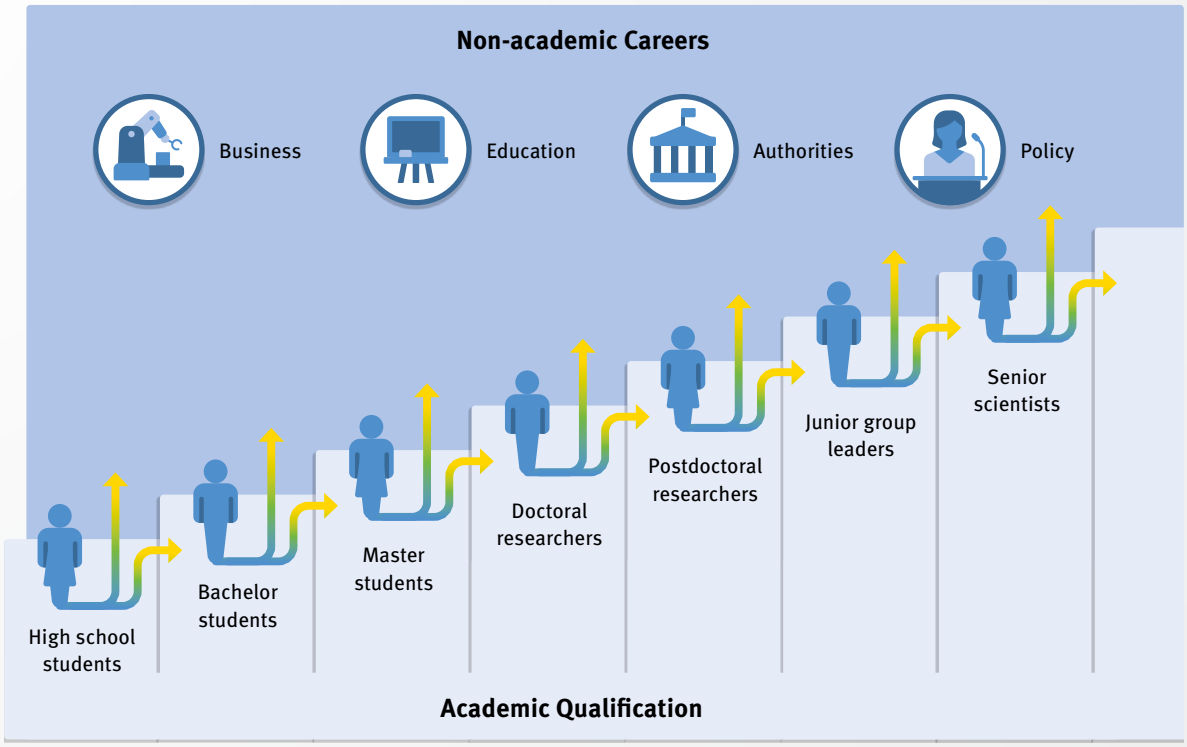

Figure 6: A comprehensive approach to promoting talent along the classic academic development pathway in constant dialogue with non-academic careers.

4.2 Towards an International Bachelor on Biodiversity Sciences

iDiv researchers are actively involved in undergraduate teaching at the three universities, in more than six faculties. They are further developing existing modules for current bachelor's degree programmes and integrating biodiversity research into the curricula. Our long-term goal is to take these efforts to a next level and develop a joint international bachelor degree in biodiversity sciences. This would be the first joint bachelor programme of the three universities in the Unibund. It would allow for easy participation from students abroad and international postdoctoral researchers at iDiv serving as lecturers. The integrative, interdisciplinary approach to teaching biodiversity, covering a wide range of disciplines including biology, geography, statistics, computer science and economics, would be unique in Germany and will prepare graduates to continue their studies in one of the biodiversity related master programmes at one of the three universities or elsewhere. The training would equip students both for a research oriented career and for the job market in areas related to biodiversity sciences, from environmental consultancies, to protected area management and biodiversity government agencies.

4.3 MSc Programmes

The three universities run Master programmes in biodiversity. At the University of Halle, the Faculty of Natural Sciences 1 – Biosciences hosts the Master's programme "Biodiversity Sciences"; at the University of Jena, the Faculty of Biological Sciences hosts the Master in "Evolution, Ecology and Systematics"; at Leipzig University, the Faculty of Life Sciences hosts the Master in "Biodiversity, Ecology and Evolution". iDiv members are the main contributors to these Master programmes. Beyond the biological faculties, iDiv members are also contributing to Master's programmes at other faculties of the three universities, including Environmental Sociology in Halle or the new Master's programme Quantitative Economics for Sustainability (QuESt) in Leipzig. Within the Unibund, students of all three universities have the opportunity to take courses in the respective other Master programmes.

In 2026, iDiv started a new teaching format in integrative biodiversity jointly at the three universities of the Unibund, namely the iModules. The objectives of the iModules are to (a) Broaden the academic scope of the master's programmes by offering content that is not currently covered; (b) Foster collaboration and exchange among students and iDiv professors and lecturers; (c) Enhance the international visibility and attractiveness of the participating Biodiversity Master's programmes by offering innovative, interdisciplinary modules. iModules are jointly offered as elective modules into the existing Master's programmes. The module contents are interdisciplinary in scope and cover topics from various iDiv research topics. For example, iDiv's first iModule "Biodiversity and Society" focuses primarily on the research topics people and transdisciplinary (e.g., how is scientific evidence translated into decision making processes; how to do economic valuation of nature based solutions) but also touches other topics such as integrative approaches (e.g., data synthesis and indicator development). iModules are developed and taught collaboratively by professors and postdocs from all three universities, ensuring interdisciplinary perspectives and the integration of various iDiv research groups.

4.4 PhD Programme

The iDiv Graduate School provides inter- and transdisciplinary training with focus on iDiv research topics (e.g., courses on biodiversity conservation, biodiversity experiments), specific methodological competencies (e.g., Bayesian statistics, data visualisation) and transferable skills training (e.g., writing policy briefs, interdisciplinary teamwork) tailored for international doctoral researchers in integrative biodiversity science. The courses and events bring together doctoral researchers from different iDiv research groups, fostering integrative networking. Courses are taught by iDiv members, postdoctoral researchers, visitors and external professional trainers. In addition, iDiv doctoral researchers benefit from individual consultation on statistics, biodiversity theory and data management, offered by the iDiv Resources Unit. The iDiv structure provides all doctoral researchers in the iDiv network with a wide range of training opportunities at iDiv core center, as well as the universities of Halle, Jena, and Leipzig, and at the UFZ. The iDiv Graduate School supports doctoral researchers in their career development inside or outside academia. To this end, we offer structured PhD Advisory Committees, internal career (peer) coaching, workshops on career planning and a mentoring programme. Advisors and mentors are also provided with supervision information and training. These resources improve supervision, shorten the time it takes to complete a PhD, and improve completion rates, and they can also help prevent conflicts.

The annual **iDiv Summer School** invites international students to iDiv, enhancing the visibility of iDiv in the scientific community. Showcasing the breadth of research at iDiv, the Summer School offers participants training in various areas of integrative biodiversity research. Each year, different iDiv scientists lead the Summer School to ensure a variety of research topics are covered. To ensure that talented individuals can participate regardless of their financial situation, iDiv offers financial support to those from the Global South.

4.5 Career Development at iDiv

iDiv's **postdoc programme** strengthens iDiv's attractiveness for talented postdocs, and is open to all postdocs in the iDiv network. It fosters skills essential for a successful career within outside academia, such as leadership, teaching, and competitive grant writing via courses, networking, and individual coaching. The close connection with the iDiv Graduate School enables joint courses for doctoral researchers and postdocs, e.g., in statistics and theory. Postdocs can also gain experience in teaching and supervision by leading courses for the iDiv Graduate School and contributing to PhD advisory committees. iDiv postdocs benefit from individual career coaching and advice, which is offered by the iDiv Education Unit staff and external coaches as well as a mentoring programme (see section 4.4).

iDiv strives to encourage internal and attract external early-career scientists to apply for funds to establish their own **junior research groups** centered around innovative biodiversity research, which matches the goals and research topics of iDiv and complements existing research with novel interdisciplinary aspects. We offer promising applicants mentorship, startup support, further training on supervision, and access to administrative support.

4.6 Continuing Education

Integrating training with transdisciplinary research, we will explore new opportunities for continuing training offered by iDiv scientists for practitioners outside of academia, such as business executives, managers, and agency employees. In particular, such training could inform about the relevance and interactions of biodiversity and their own economic activities and show how the business and finance sector can contribute to a nature's positive economy. Such training courses could help increase the transfer of iDiv's relevant expertise to businesses and the economy, supporting their necessary transformation toward increased sustainability (see section 3.2).

5. Delivering on our Strategy

5.1 The Structure of iDiv

iDiv's organisational structure directly enables its scientific strategy, by directing resources in a way that focuses on key strategic aims such as integration, education and impact, through cooperation and stakeholder engagement. It is doing so through a provision of shared resources, a science-focused and efficient administrative body and a strong science communication and public relations outlook. iDiv is, at its core and through the e.V., a cooperation of the three universities Martin-Luther-University Halle, Friedrich Schiller University Jena and Leipzig University. The fourth core cooperation partner is the Helmholtz-Centre for Environmental Research (UFZ) (Figure 7). It is through their contributions, as well as the funds committed by the three federal states Saxony, Saxony-Anhalt and Thuringia to the universities in order to financially secure iDiv's work, that the core elements of this strategy become deliverable. These institutions, as founding institutional members of the iDiv e.V., chose the organisational format of a non-profit association in 2024, after successfully cooperating as a DFG-funded research centre for twelve years.

At the core centre in Leipzig, iDiv hosts nine core professorships, funded by our host institutions, and several (usually 3 to 5) externally funded junior research groups that are supported through iDiv funds. The research programmes of our core professors and junior research groups are embedded into the research topics and thus provide a key component of iDiv's integrative nature. The research groups in the core centre are complemented by more than 250 scientists (individual iDiv members) – who have special expertise in various iDiv research fields – along with their research groups from universities and non-university research institutions throughout Central Germany. Four science-based units, Integration, Resources, Education & Careers, and Impact, and two Support Units, Administration and Public Relations, provide a range of services and shared resources that support the research by all research groups in the network.

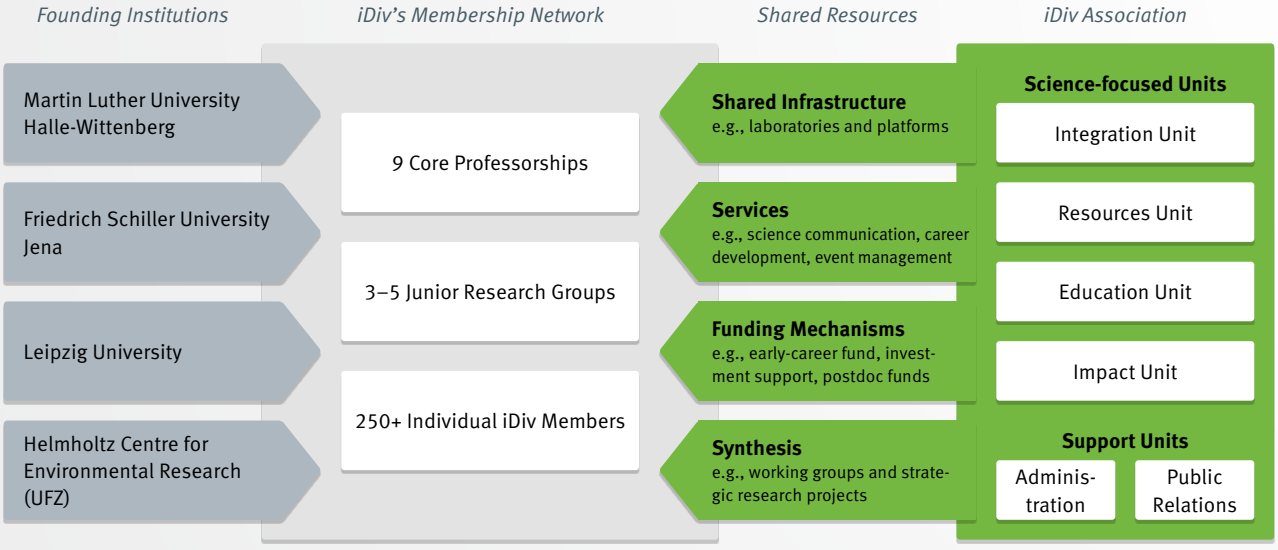

Figure 7: The iDiv institutional structure, including the founding institutional members, the membership network, and the shared resources and units under the iDiv e. V.

5.2 Resources as Collaborative Mechanisms

iDiv's structure and governance is specifically designed to leverage synergies of the unique set of research resources in the network of research institutions participating in iDiv. These resources include shared infrastructures, e.g., research buildings with state-of-the-art laboratories and platforms, a purpose-built green house, high performance computing, various experimental field sites across three federal states, and services (Figure 8). Integrative research within the research network is facilitated further by iDiv's funding mechanisms, which include a strong, internationally renowned, synthesis centre and research funding, as well as career development, focussing on inter- and transdisciplinary as well as cross-institutional cooperation. Our **Resources and Integration Units** facilitate the continuous research collaboration across the consortium, as well as the alignment of our platforms, services and databases to our scientific strategy.

iDiv's **experimental and observational platforms and databases** are integrative priority projects addressing important research gaps and with the potential for high-impact products (scientific and societal) as well as for high synergy in the consortium. Our experimental research platforms function as nuclei of collaborative research within the iDiv consortium, attract and support collaborative research of German and international researchers from outside iDiv (see e.g., Section 2.4.3), and foster the education of students and qualification theses. Having established extensive research support infrastructures, which include lab facilities, data infrastructures, and specialized expertise, we are committed to providing the technical infrastructure and support that enable our researchers across all research topics to efficiently collect, process, and analyse large-scale data. We will continue to invest in high-performance computing resources, secure data storage systems and cloud-based platforms, while providing comprehensive training and support to ensure our researchers can leverage these tools effectively and maintain our position as a leader in data-driven biodiversity research.

The **Synthesis Centre of iDiv**, hosted so more than 1,500 researchers from 68 countries in over 100 projects, collaborating on a broad diversity of biodiversity related research topics. The synthesis centre will strengthen its role in connecting iDiv researchers to national and international researchers, by issuing dedicated calls focusing on the five iDivs research topics. In addition, the synthesis centre continues to strengthen its global leadership in expanding collaborations with other synthesis centres and funding mechanisms, e.g., by leading and participating in the first ever global synthesis call on "Interactions between biodiversity and climate change" across 11 synthesis initiatives and centres. iDiv is also co-leading and advising the first steps towards a pan-Latin-American synthesis centre together with research initiatives and centres across Latin America.

To foster project-based integration and collaborations among the iDiv members, especially across its partner institutions, iDiv has created different competitive funding programmes (e.g., iDiv Postdocs, PhDs, Senior Fellows). We support novel inter- or transdisciplinary projects that are tightly linked to iDiv's strategy and mission, and solicit cutting-edge, member-driven proposals from the topical committees that are embedded within our research topics. Some projects will be supported by postdoctoral or PhD positions and integrated with our Future Leaders programme. To engage with biodiversity researchers globally, iDiv provides competitive fellowships to internationally respected biodiversity researchers for a year or less (e.g., for sabbatical visitors), where they pursue collaborative research within the iDiv community.

In addition to iDiv's integration funding mechanisms, we foster member collaboration with local committees that engage members within the founding institution's central iDiv structures (Zentrale Einrichtung). In parallel we foster science-focused topical committees directed at the key research topics of iDiv. Members interact and exchange annually at the iDiv Conference, and we rotate the location among our partner institutions. We will strengthen consortium collaborations via workshops of consortium researchers, facilitating discussions and development of novel research ideas and funding proposals. We also are actively aiming to expand our member institutions within Central Germany, e.g., with shared Junior Groups. We plan to explore widening our consortium and centre based collaborations with other relevant biodiversity research centres nationally with expertise in complimentary research fields..

The transformation of scientific research towards open science practices represents one of the most significant shifts in academic culture of our time. iDiv aims to be a world leader in this respect, exemplified by the creation of a dedicated team on Data, Code and Statistics. This team of scientists will help equip researchers with the necessary skills and tools to engage fully not only with FAIR/O (FAIR and Open), but also with also CARE (for indigenous data) and TRUST (for digital repositories) principles, assisting scientists

with in-depth curation of datasets and code. This team also designs and maintain technical infrastructure, including six public data repositories (such as the iDiv Data Portal, SoilBON), as well as metadata catalogues (e.g., EcoMeta) and data collection applications for strategic projects (e.g., PhenObs). These efforts have lead to a consistent increase in the proportion of datasets and code made public since 2012, and clear external engagement with iDiv's virtual platforms that address a global audience (e.g., the EBV Data Portal, Microbial Community Database (MiCoDa), and ›14,000 downloads from the iDiv Data Portal in 2025 alone). Going forward, priorities include the increasing mobilisation of data to the global biodiversity platforms GBIF (Global Biodiversity Information Facility) and OBIS (Ocean Biodiversity Information System), contributing to infrastructure at the national level via NFDI4biodiversity, and ongoing participation in international organisations such as TDWG (Biodiversity Information Standards) and GEO BON (Group on Earh Observations Biodiversity Observation Network).

These resources and collaborative mechanisms will significantly advance integrative biodiversity research by supporting unified theoretical frameworks, scalable models, and integrative datasets. They will enable predictive biodiversity science, bridging gaps between disciplines and between science and practice. By fostering synthesis and innovation, iDiv will generate high-impact publications, large collaborative projects, and new research infrastructures, consolidating iDiv's global leadership.

Experimental and observational platforms

Global

Soil BON: Network of ›500 soil observation sites studying soil biodiversity and functioning worldwide

PhenObs: Phenological observations in of ›530 herbaceous plant species from 19 botanical gardens in 11 countries

NutNet: Global grassland experiments with ›100 sites, in more than 25 countries manipulating nutrients, water, and disturbance

Soils4Anthropocene: Leveraging the global soil scientist community for soil biodiversity data mobilisation, field-based observations, experiments, and synthesis approaches

Regional

Biodiversity Exploratories: Landuse, biodiversity and ecosystem functions (DFG Priority Programme)

BEF-China: Subtropical forest diversity experiment on 50 ha (DFG International Research Training Group TreeDi)

MyDiv: Experiment with 80 plots of tree species with mycorrhizal fungi; other: TrophinOak

Leipzig Canopy Crane: Access to 900 adult trees of 16 temperate species on 1.6 ha in a floodplain forest

ARBOfun: Research Arboretum with 100 European tree species (5 replicates each) planted in wide spacing for root access

GCEF: Global Change Experimental Facility simulating climate change under different agricultural landuses (UFZ coordination)

iDiv Ecotron: 24 controlled mesocosms with above and belowground access

Jena Experiment: Grassland experiment on the role of biodiversity for ecosystem functioning (DFG Research Unit)

iDiv Greenhouse: Offers 12 temperature-, moisture- and light-controlled chambers and lab space for sample preparation and storage

Laboratory

iCyt: Integrative Cytomics Platform; Flow cytometry platform to quantify plankton and pollen diversity

Databases

Global

i²BON: Global data on biodiversity change with the EBV Data Portal

Earth System Data Lab (ESDL): Global data on climate, soil, disturbances and land cover

GATEWAy, FragSAD, sWorm, …: Various medium-sized data products by iDiv scientists (foodwebs, animal movement, communities, soil biodiversity, …)

AVONET: Morphological, ecological and geographical data for ›11,000 extant bird species

sPlot: Global dataset with plant community information for ›2.5 million sites

Leipzig Catalogue of Vascular Plants (LCVP): Taxonomic reference for all known vascular plants

TRY: World largest database on plant functional traits (15 million entries for 305,000 plant species)

GWD: Global database on tree demographic parameters – component of Compadre

GloNAF: Global distribution of alien plant species

PlantHub: Joint access to information on plants (TRY, sPlot, LCP, sMon, GWD, …), land-use and geo information (ESDL)

Regional

sMon: Trend analyses of biodiversity data for Germany

Science services

Informatics

iBID: iDiv Integrative Biodiversity Data Support Unit facilitates the technical operation of the iDiv Data Portal and other data repositories

DCS: The Data, Code & Statistics team offers advice and training on statistics, data governance, research data management and curation of data and code

HPC: General IT support unit and support for high-performance computing

iBarc: Support for molecular approaches to biodiversity assessment, including laboratory workflows and sequence data analysis

Figure 8: The experimental and observational platforms, databases and science services that facilitate research at iDiv.

6. Principal Investigators

List of iDiv principal investigators, their institutions, and their participation on each research topic.
× = principal investigator ☒ = leadership of the research topic

First name	Last name	Institution	Integrative Approaches	People and Biodiversity	Functions	Complexity	Transdisciplinary Biodiversity Research
Ana	Bastos	Uni Leipzig	×	–	–	–	–
Peter	Bayer	Uni Halle	×	–	–	–	–
Markus	Bernhardt-Römermann	Uni Jena	×	–	–	–	–
Aletta	Bonn	iDiv, UFZ, Uni Jena	–	☒	–	–	×
Ulrich	Brose	iDiv, Uni Jena	×	–	×	☒	–
Helge	Bruelheide	Uni Halle	×	–	☒	×	×
Jan	Bumberger	UFZ	×	–	–	–	–
Simone	Cesarz	iDiv, Uni Leipzig	–	–	×	–	–
Jonathan	Chase	iDiv, Uni Halle	×	–	–	–	–
Antonis	Chatzinotas	UFZ	–	–	–	×	–
Susanne	Dunker	iDiv, UFZ	–	×	–	×	–
Nico	Eisenhauer	iDiv, Uni Leipzig	×	–	☒	×	–
Néstor	Fernández	iDiv, Uni Halle	–	☒	–	–	×
Karin	Frank	UFZ	×	×	–	×	–
Immo	Fritsche	Uni Leipzig	–	×	–	–	–
Susanne	Fritz	iDiv, Uni Jena	☒	–	–	×	–
Christine	Fürst	Uni Halle	–	–	–	–	×
Gerd	Gleixner	MPI BGC	×	–	–	–	–
Ivo	Grosse	Uni Halle	×	–	–	–	–
Sven	Grüner	Uni Halle	–	–	–	–	×
Bernd	Hansjürgens	UFZ	–	×	–	–	–
Stan	Harpole	iDiv, UFZ, Uni Halle	×	–	–	☒	–
Jes	Hines	iDiv	×	–	–	×	×
Andreas	Huth	UFZ	×	–	–	×	–
Birgitta	König-Ries	Uni Jena	×	–	–	–	×
Markus	Lehnert	Uni Halle	–	–	–	–	×
Katja	Liebal	Uni Leipzig	–	×	–	–	–

First name	Last name	Institution	Integrative Approaches	People and Biodiversity	Functions	Complexity	Transdisciplinary Biodiversity Research
Miguel	Mahecha	Uni Leipzig	×	–	×	–	–
Manja	Marz	Uni Jena	×	–	–	–	–
Richard	McElreath	MPI EVA	×	×	–	–	–
Birgit	Müller	UFZ	–	×	–	–	–
Alexandra	Müllner-Riehl	Uni Leipzig	×	×	–	–	×
Manuela	Nowotny	Uni Jena	×	–	–	–	–
Guy	Pe'er	iDiv, UFZ	×	–	–	–	×
Henrique	Pereira	iDiv, Uni Halle	×	×	–	×	☒
Anton	Potapov	SMNG	–	–	×	–	–
Johannes	Quaas	Uni Leipzig	×	–	–	–	–
Martin	Quaas	iDiv, Uni Leipzig	×	☒	×	–	–
Marcel	Quint	Uni Halle	–	–	–	–	×
Solveig	Richter	Uni Leipzig	–	×	–	–	×
Julian	Rode	UFZ	–	×	–	–	×
Christine	Römermann	Uni Jena, SIP	×	–	–	×	–
Beatriz	Sánchez Parra	Uni Leipzig	×	–	×	–	×
Ilkhom	Soliev	Uni Halle	–	×	–	–	☒
Peter	Stadler	Uni Leipzig	×	–	–	–	–
Mika	Tarkka	UFZ	–	–	×	–	–
Franziska	Taubert	UFZ	×	–	–	–	–
Roel	van Klink	iDiv, Uni Halle	×	×	–	–	–
Alexandra	Weigelt	Uni Leipzig	–	–	×	–	–
Anja	Widdig	Uni Leipzig, MPI EVA	–	×	–	–	×
Thorsten	Wiegand	UFZ	×	–	–	–	–
Marten	Winter	iDiv	☒	×	–	–	–
Christian	Wirth	Uni Leipzig	–	–	☒	–	–
Tesfaye	Wubet	UFZ	×	–	–	–	–
Sönke	Zaehle	MPI BGC, Uni Jena	×	–	–	×	–

7. Bibliography

1. Keil, P. *et al.* (2018). *Glob. Ecol. Biogeogr.* 27, 2–13
2. Barnes, A.D. *et al.* (2018). *Trends Ecol. Evol.* 33, 186–197
3. Rozario, K. *et al.* (2025). *People Nat.* 7, 2019–2037
4. Stark, T. *et al.* (2023). *Sci. Rep.* 13, 16364
5. Körschens, M. *et al.* (2025). *Ecol. Inform.* 91, 103413
6. Pereira, H.M. *et al.* (2024). *Science* 384, 458–465
7. Weigelt, A. *et al.* (2021). *New Phytol.* 232, 42–59
8. Dyer, A. *et al.* (2023). *PLOS Biol.* 21, e3001820
9. Hartig, F. *et al.* (2024). *Trends Ecol. Evol.* 39, 280–293
10. Herrmann, T. *et al.* (2025), *Springer*, ISBN 978-3-662-69703-0
11. Kissling, W.D. *et al.* (2026). *Nat. Rev. Biodivers.* doi: 10.1038/s44358-026-00140-6
12. Bucher, S.F. *et al.* (2025). *Basic Appl. Ecol.* 88, 1–8
13. Rozario, K. *et al.* (2024). *People Nat.* 6, 180–201
14. Dube, I. *et al.* (2025). *Am. J. Agric. Econ.* 107, 1383–1405
15. Dunn-Capper, R. *et al.* (2024). *People Nat.* 6, 610–626
16. Marselle, M.R. *et al.* (2021). *Environ. Int.* 150, 106420
17. D'Alessio, A. *et al.* (2025). *Environ. Manage.* 75, 1071–1083
18. Pascual, U. *et al.* (2023). *Nature* 620, 813–823
19. Dunker, S. *et al.* (2020). *New Phytol.* 229, 593–606
20. Isbell, F. *et al.* (2015). *Nature* 526, 574–577
21. Bergmann, J. *et al.* (2020). *Sci. Adv.* 6, eaba3756
22. Guerra, C.A. *et al.* (2021). *Science* 371, 239–241
23. Eisenhauer, N. *et al.* (2026). *Nat. Rev. Biodivers.* 2, 76–91
24. Kattge, J. *et al.* (2020). *Glob. Change Biol.* 26, 119–188
25. Yi, H. *et al.* (2025). *Curr. Biol.* 35, 1870-1882.e6
26. Li, Y. *et al.* (2024). *Nat. Ecol. Evol.* 8, 2037–2047
27. Eisenhauer, N. *et al.* (2024). *Basic Appl. Ecol.* 79, 153–166
28. Mahecha, M.D. *et al.* (2022). *Nature* 612, 30–32
29. Mahecha, M.D. *et al.* (2024). *Earths Future* 12, e2023EF003963
30. Wolf, S. *et al.* (2022). *Nat. Ecol. Evol.* 6, 1850–1859
31. Nadrowski, K. *et al.* (2013). *Methods Ecol. Evol.* 4, 201–205
32. Mahecha, M.D. *et al.* (2026). *Proc. Natl. Acad. Sci.* 123, e2515835123
33. Mosig, C. *et al.* (2026). *Remote Sens. Environ.* 332, 115027
34. Pinsky, M.L. *et al.* (2025). *Nature* 638, 995–999
35. Hillebrand, H. *et al.* (2020). *Nat. Ecol. Evol.* 4, 1502–1509
36. Fraser, L.H. (2020). *Glob. Change Biol.* 26, 189–190
37. Bruelheide, H. *et al.* (2019). *J. Veg. Sci.* 30, 161–186
38. van Kleunen, M. *et al.* (2019). *Ecology* 100, e02542
39. Brose, U. *et al.* (2019). *Nat. Ecol. Evol.* 3, 919–927
40. González, A.L. *et al.* (2025). *Sci. Data* 12, 569
41. Tobias, J.A. *et al.* (2022). *Ecol. Lett.* 25, 581–597
42. Nordt, B. *et al.* (2021). *Funct. Ecol.* 35, 821–834
43. Rosenbaum, B. *et al.* (2024). *Methods Ecol. Evol.* 15, 1704–1719
44. Sporbert, M. *et al.* (2022). *New Phytol.* 235, 2199–2210
45. Adams, W.M. (2016). *Science* 353, 867–868
46. Jahn, S. *et al.* (2022). *Sustain. Dev.* 30, 343–357
47. Lawrence, M.G. *et al.* (2022). *One Earth* 5, 44–61
48. Deutsch, L. *et al.* (2025). *Glob. Environ. Change* 91, 102963
49. Soliev, I. *et al.* (2025). *Earth Steward.* 2, e70020
50. Pe'er, G. *et al.* (2025). *People Nat.* 7, 1772–1788
51. Kelly, R. *et al.* (2019). *Ecol. Soc.* 24, 16
52. von Gönner, J. *et al.* (2023). *Socio-Ecol. Pract. Res.* 5, 11–33
53. Capinha, C. *et al.* (2024). *BioScience* 74, 383–392
54. Giergiczny, M. *et al.* (2025). *iScience* 28, 113349
55. Quintero-Uribe, L.C. *et al.* (2025) *bioRxiv*, 2025.03.05.641619
56. Pereira, H.M. *et al.* (2013). *Science* 339, 277–278
57. Eisenhauer, N. *et al.* (2024). *J. Sustain. Agric. Environ.* 3, e212108
58. Borda-de-Água, L. *et al.* (2025). *Nat. Commun.* 16, 4045
59. Chaplin-Kramer, R. *et al.* (2024). *Glob. Environ. Change* 88, 102891
60. Pereira, H.M. *et al.* (2010). *Science* 330, 1496–1501
61. Lundquist, C. *et al.* (2025), IPBES, doi: 10.5281/zenodo.17530778
62. Mehring, M. *et al.* (2024). *People Nat.* 6, 1945–1959
63. Srivastava, N. *et al.* (2025). *Ambio* 55, 1039–1060
64. Groom, Q. *et al.* (2025). *Ecol. Solut. Evid.* 6, e70113
65. Soliev, I. (2026). *Encycl. Agri. Food Sys.* 6, 143-160
66. Amador-Jimenez, M. *et al.* (2024). *Environ. Secur.* 2, 47–74
67. Kühl, H.S. *et al.* (2020). *One Earth* 3, 462–474
68. Grüner, S. *et al.* (2025). *Int. J. Commons* 19
69. Rakowski, J.J. *et al.* (2025). *Annu. Rev. Environ. Resour.* 50, 159–183
70. Soliev, I. *et al.* (2025). *Environ. Res. Commun.* 7, 072001
71. van Klink, R. *et al.* (2022). *Trends Ecol. Evol.* 37, 872–885
72. Hyder, K. *et al.* (2015). *Mar. Policy* 59, 112–120
73. Hecker, S. *et al.* (2018). *Citiz. Sci. Theory Pract.* 3, 4
74. Nascimento, S. *et al.* (2018). *Citiz. Sci.*, 219-240, ISBN 978-1-78735-233-9

German Centre for Integrative Biodiversity Research Halle-Jena-Leipzig – iDiv e. V.
Puschstrasse 4, 04103 Leipzig Phone: +49 341 9733105, Email: info@idiv.de, Web: www.idiv.de
Layout: Stefan Bernhardt
Cover: Arnold Petersen/Adobe Stock (Aerial view of lush autumn forest surrounding Eisenach and Wartburg Castle, Germany)

As of April 2026 — The Executive Board, consisting of Prof Dr Martin Quaas and Dr Anne Wesemann, acts on behalf of iDiv e. V., the representative body of the German Centre for Integrative Biodiversity Research Halle-Jena-Leipzig. Leipzig University, Martin Luther University Halle-Wittenberg, Friedrich Schiller University Jena, and the Helmholtz Centre for Environmental Research GmbH – UFZ are founding institutional members of iDiv e. V.

Leipzig register of associations: VR 8088 Tax number: 231/140/34614

iDiv

German Centre for Integrative
Biodiversity Research
Halle-Jena-Leipzig

www.idiv.de