Wissenschaftliche Kommission Niedersachsen

Research Evaluation

Biology

2021

Report

Adopted by the WKN on 8 March 2023

Öffentliche Fassung

Herausgeber:
Geschäftsstelle der Wissenschaftlichen Kommission Niedersachsen
Freundallee 9a
30173 Hannover
Tel.: 0511 120 8852
E-Mail: poststelle@wk.niedersachsen.de
Internet: www.wk.niedersachsen.de

Redaktion: Dr. Timm Haack
Hannover, März 2023

Content

Statement of the WKN

The WKN does not make a separate statement and fully endorses the recommendations of the evaluation committee. The WKN thanks the evaluation committee for the work it has done and for the meaningful, detailed report.

1 Introduction

In 2019 the Academic Advisory Commission of Lower Saxony (WKN) has decided to conduct an evaluation of biological research in Lower Saxony – almost 20 years after the initial evaluation. Taking into account the existing potential, the evaluation aims to assess the research quality of biological research and, on this basis, to make recommendations for further developing of the subject at the universities in Lower Saxony. In addition to research quality, the relevance of research, its inter- and transdisciplinary integration and its positioning on the international level will be the focus of the evaluation.

The evaluation focuses on the discipline of biology at the level of the institutes at the following universities: TU Braunschweig (TUBS), University of Göttingen (UGOE), University of Hannover (LUH), University of Hildesheim (UHI), University of Lüneburg (Leuphana), University of Oldenburg (UOL), University of Osnabrück (UOS), and University of Vechta (UVEC).

Some research areas are not represented with their full potential at some universities under evaluation. For example, Bioinformatics / Computational Biology might be part of biological institutes in some places (TU Braunschweig, Uni Göttingen), while in others, relevant units are affiliated with chemistry (Uni Hannover) or physics (Uni Oldenburg) and therefore not included. Biophysics might be part of Biology in some universities (Uni Osnabrück, Uni Hannover), while in others it is part of Physics (Uni Göttingen) and thus not part of this evaluation. Two factors have caused blind spots in this evaluation. First, the definition of biology by the ministry according to the *Hochschulkennzahlensystem*, which is aligned with teaching, has set the initial scope. Second, the organisational structure of the faculties determines whether research units are affiliated with biology or not.

Thus, the WKN ist well aware that biological research is not confined to institutes and departments of biology; it spans institutional boundaries and is often interdisciplinary in character. Medical research, agricultural science, veterinary science and forestry all form a substantial part of the research landscape of Lower Saxony. All of them integrate and apply biological methods and theories and, even when solely focusing on applied research questions, they may also comprise host research units with basic science research agenda. Furthermore, related natural science disciplines, e.g. physics and chemistry, are increasingly addressing basic biological research questions from a more theory-driven angle.

While this report focuses on the discipline of biology at universities of Lower Saxony, the WKN aims to identify themes of research that are of particular relevance for the future development of the biological sciences in Lower Saxony reaching across disciplinary boundaries. This task will be performed in an additional endeavour following the evaluation of the discipline of biology at universities.

Teaching is not central to this evaluation. Nonetheless, some aspects, such as the teaching load and the thematic connection of the courses with the research profile, are also relevant for the evaluation of research.

1.1 Procedure

The evaluation was carried out as an informed peer review by a committee of experts on the basis of written self-reports followed by on-site visits. The recommendations developed are aimed at the scientists, at the universities and at the state. The following experts are members of the evaluation committee:

Prof Dr Dr Thomas Lengauer (chairperson)
Department of Computational Biology and Applied Algorithmics, Max Planck Institute for Informatics

Prof Dr Ulrich Bathmann
Leibniz Institute for Baltic Sea Research Warnemünde

Prof Dr Anke Becker
Center for Synthetic Microbiology (SYNMIKRO), Universität Marburg

Prof Dr Dr hc Dr hc Bill S Hansson
Department of Evolutionary Neuroethology, Max Planck Institute for Chemical Ecology

Prof Dr Steffen Harzsch
Department of Cytology & Evolutionary Biology, Zoological Institute and Museum, Universität Greifswald

Prof Dr Johannes M Herrmann
Department of Biology, Division of Cell Biology, TU Kaiserslautern

Prof Dr Elisabeth Knust
Max Planck Institute of Molecular Cell Biology and Genetics

Prof Dr Arne Traulsen
Department for Evolutionary Theory, Max Planck Institute for Evolutionary Biology

Prof Dr Nicole van Dam[1]
German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Universität Jena

The site visits and hearings took place in two blocks from November 8th to 10th 2021 and from Mai 30th to June 1st 2022. Initially the second block was scheduled for the end of November 2021, but it had to be postponed due to the pandemic situation. The committee held talks with the university presidencies, the deans, the scientists of the biological institutes, and with early career scientists.

The evaluation committee would like to thank all participants for their willingness to discuss with them and thus contribute to the evaluation process.

[1] Director of the Leibniz Institute of Vegetable and Ornamental Crops (IGZ) since October 1st 2022.

1.2 Subject, criteria, indicators

Research subject

Biology is the science of life. The focus of investigation is on multiple levels of life's organisation and spans from the nanometer scale of molecules to organisms and whole ecosystems.

Over the centuries, the field of biology progressed from observation, description and classification of nature by early naturalists to the work of experimentalists and theorists with the aim to learn about causation of the inner workings of biological systems. In the 18th century the Swedish naturalist Carl von Linné invented a standardized system to name organisms, thereby formalising how life on earth can be described and classified. In the 19th century two seminal discoveries were made. The theory of evolution by natural selection published by Darwin and the work of Mendel on the principles of biological inheritance – both still form the theoretical cornerstones of biological research today.

Technological advances from physics, chemistry and computation have been and still are main drivers of biological discovery. In the 17th century modern light microscopy was invented allowing the observation of life on the cellular level. The discovery of the DNA double helix in 1953 caused the young field of molecular biology to gain tremendous momentum which lead to the invention of molecular cloning and DNA sequencing in the 1970s. This opened up the possibility to study the function of individual genes. The Human Genome Project started in 1990 as a multinational effort and can be regarded as the first "big science" attempt to solve a biological question through formation of a large international consortium backed with a multibillion-dollar public investment. The new millennium brought further technical advances in superresolution microscopy, deep and single-cell sequencing and genome editing allowing an increasingly rich and detailed view on the functioning of organisms and their constituents. To analyse these data in a meaningful way, experimental biologists rely on and make use of methods invented by computational biologists and theorists. Computational analysis and modelling are nowadays an integral part of many biological research projects.

Whereas the molecular biology revolution in the early 1950s marked the onset of discovering the inner workings of life at the smallest scales under well-controlled laboratory conditions, nowadays there is an increasing interest in taking this knowledge outside to study life in its natural context. Facing climate change and biodiversity decline, there is a pressing need for a better understanding of how life works under these changing conditions. For this to occur, (sub-) disciplinary boundaries must be overcome.

Criteria and indicators

Scientific impact is the main criterion for this evaluation. It describes the position of the institute (and its members) in its field of research and is based on the following **quality indicators**:

i) **Publications**: Publications are the decisive factor establishing the scientific impact of a research unit in its discipline. The reputation of an institute is based on the scientific output of its members. Publications differ in terms of their type (articles, data, code), their quality and their impact on the respective research field.

ii) **Third-party funds:** Third-party funds finance the research process, but can also serve as an indicator for scientific quality. This applies in particular to competitively awarded third-party funds that are allocated based on a peer review process. Because of the high standards of the selection procedure, funds from the DFG[2] and ERC[3] are of particular importance in this regard.

iii) **Research profile:** A well difined research profile is a vital feature. Spending time and resources well to address meaningful questions with the potential to bring the field forward is a sign of quality. Furthermore, it helps researchers and institutions to be recognizable, to attract the best talents and to compete for funding.

iv) **Early career development:** In addition to the number of PhDs awarded, the working and training conditions for early career researchers (ECRs) are taken into account to assess the quality of early career development.

v) **Collaboration:** Collaborations in joint projects are an essential component of research in many fields. However, they only serve the purpose for better science if there is significant added value to the research process. They should not primarily be based on opportunistic intentions. It is difficult to assess collaborations in terms of their actual significance for the scientific output. They are not an indicator of good research performance in their own right. However, successful collaborations shine through the resulting joint high-quality publications and thus contribute to scientific impact and visibility. In addition, taking the lead in collaborative research programmes (spokesperson) can be regarded as an indicator for scientific reputation. Collaborations within an institute and among institutions in the region are also taken

[2] Deutsche Forschungsgemeinschaft
[3] European Research Council

into account, as they serve to increase the coherence of the institute and, for example, can promote the establishment of a DFG-funded research unit or similar.

vi) **Knowledge transfer:** Discoveries by biological research have the potential to impact on many challenges that our society is facing today. Transfer activities therefore are of high value and are recognized accordingly. They include science communication as well as technology transfer / translation of research results.

vii) **Services to academic self-government:** Achievements in academic self-government are recognised in the evaluation, such as participation in scientific committees, service to research organizations and scientific societies and editorial work for journals**.**

Based on DFG standards, exceptional quality is denoted with the keywords *excellent* (belongs to the top 20% of comparable universities / instititutes) and *outstanding* (belongs to the top 10% of comparable universities / institutes) in this report.

I. THE CURRENT STATE OF BIOLOGY IN LOWER SAXONY

2 Technische Universität Braunschweig

2.1 Structure and general framework

2.1.1 Structure

TU Braunschweig (TUBS) is a technical university with six faculties. Its research activities focus on four core research fields: Mobility, Infections and Therapeutics, Future City and Metrology (the science of measurement).

The history of the biology department at TUBS goes back over 150 years ago. In the 1990's the research had a strong focus on cell biology of cytoskeletal dynamics, developmental biology of cell fate decisions and muscle development as well as biotechnology. The foundation of the Gesellschaft für Biotechnologische Forschung (GBF) has its origins in the biotechnology research at TUBS. The GBF was later incorporated into the Helmholtz Society and changed its strategy to focus on infection biology in 2006. It was renamed to Helmholtz Center for Infections Research (HZI). Since TUBS lacks a medical faculty the HZI diverted its cooperation activities in clinically applied research to the Medical School in Hannover (MHH). A parallel strategic change at TUBS towards strengthening research in infection, microbiology and compound research reestablished cooperations on basic research projects with the HZI. Since 2015 the biological sciences at TUBS are a central partner of the SMART BIOTECS alliance of TUBS and Leibniz University of Hannover. The alliance contributed to shape the current core research area Infection & Therapeutics of TUBS. Many of the current activities of the biological sciences at TUBS are linked to this research area.

The institutes involved are part of the faculty of Life Science. The faculty consists of the disciplines chemistry, pharmacy, psychology and biological sciences. It is the largest faculty of TU Braunschweig. The following five institutes and 16 professorships are part of the biological sciences:

- **Institute of Biochemistry, Biotechnology and Bioinformatics**
  - Biochemistry (Prof. Dr. Anett Schallmey, W2, since 10/2014)
  - Biochemistry and Biotechnology (Prof. Dr. Stefan Dübel, W3, since 10/2002)
  - Bioinformatics and Biochemistry (Prof. Dr. Karsten Hiller, W3, since 07/2016)
- **Institute of Genetics**
  - Developmental Genetics (Prof. Dr. Ralf Schnabel, C4, since 12/1997)

- Fungal Genetics (Prof. Dr. André Fleißner, W2, since 1/2014)
- Virus Genetics (Prof. Dr. Melanie M. Brinkmann, W2, since 7/2018)

- **Institute of Microbiology**
  - General Microbiology (Prof. Dr. Dieter Jahn, W3, since 7/2000)
  - Molecular Infection Biology (Prof. Dr. Michael Steinert, W2, since 4/2007)
  - Microbial Proteomics (Prof. Dr. Susanne Engelmann, W2, since 7/2013)

- **Institute of Plant Biology**
  - Molecular and Cell Biology (W3, vacant since 4/2021, recruitment in progress)
  - Biochemistry and Physiology (Prof. Dr. Theo Lange, C3, since 1/1999)

- **Zoological Institute**
  - Cellular Neurobiology (Prof. Dr. Martin Korte, W3, since 9/2004)
  - Cellular and Molecular Neurobiology (Prof. Dr. Reinhard W. Köster, W3, since 10/2013)
  - Cell Physiology (Prof. Dr. Jochen C. Meier, W2, 7/2015)
  - Evolutionary Biology (Prof. Dr. Miguel Vences, W2, since 10/2005)
  - Molecular Cell Biology (Prof. Dr. Klemens Rottner, W2, since 4/2014)

2.1.2 Personnel

Together the institutes have seven W3 professorships, eight W2 professorships and one W1 professorship. One W3 is currently vacant (succession of Ralf-Rainer Mendel, planned denomination Molecular Plant Biology). The W1 professorship is currently ranked as W2 (André Fleißner, Genetics of Fungi), but would be ranked down to W1 if the candidate leaves the TUBS. Until 2026 one W3 professorship will become vacant (succession of Ralf Schnabel, Developmental Genetics). On 01.12.2020 a total number of 197 people were employed (157.3 FTE). 15.0 FTE of professorships, 36.7 FTE of scientific personnel and 49.5 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 1.0 FTE of professorships, 51.4 FTE of scientific personnel and 3.9 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

2.1.3 Research infrastructure

The biological research units are located on **three sites** and housed in **four buildings**. Most of the units are located on the **main campus** in the central biology building and in the Braunschweig Integrated Centre of Systems Biology (BRICS) building. Three research units (Plant Biochemistry and Physiology, Applied Plant Biology, and Evolutionary Biology) are housed in a building on the **northern campus**. The building of the **botanical gardens** is the home of two research units (Plant Molecular and Cell Biology and Plant Stress Physiology and Bio-Imaging).

Major instrumentation (*Großgeräte*) is shared on the basis of a **collegiate user concept**. Research units maintain equipment of their expertise, provide advice and training. The use of this equipment by other research units is free of costs and basis for a scientific collaboration independent of the extent of the use of equipment. In case no collaboration is planned, extensive use of equipment is compensated by providing material and expertise on a mutual basis.

Major equipment for **protein biochemistry** is located in the Institutes of Biotechnology and Microbiology, whereas large equipment for **high-resolution microscopy** is mostly located in the Institutes of Microbiology and Zoology. This equipment serves mainly two research areas: the identification, characterization and purification of metabolites and compounds, and spatial and temporal high-resolution microscopy of cell and subcellular dynamics. Long-term financing of this equipment occurs by basic funding, maintenance and training is partly performed by dedicated personnel.

Access to **external major instrumentation** such as next generation sequencing (DSMZ - Deutsche Sammlung von Mikroorganismen und Zellkulturen), transcriptomics, proteomics or electron microscopy (HZI) is provided by local research institutions on the basis of scientific collaborations. In a similar manner, external partners use equipment such as mass spectroscopy or high-resolution microscopy from biological research units at TUBS based on collaborative research. In the self-report of TUBS the atmosphere among all faculty from biological research institutions in the region is described as friendly and supportive so that collaborations can easily be arranged.

Being part of a technical university is regarded as a **local advantage**, because it permits research on basic molecular, cell biological and pharmacological mechanisms in combination with biotechnological and engineering disciplines. Close cooperation between biological and pharmaceutical sciences takes place in the research center BRICS and the Center of Pharmaceutic Engineering (PVZ). This line of research also benefits from the vicinity of the HZI and the DSMZ.

The lack of a university medical faculty and the absence of a biological industry is perceived as a **local challenge**.

2.2 Research

2.2.1 Profile

The biological sciences form an integral part of the university's core research area **Infection & Therapeutics.** The dedicated research building BRICS is housing the biological research units involved and serves as a hub for collaborative research. These activities are embedded in the research alliance SMART BIOTECS to harmonize and optimize research cooperations with the LUH in Hannover. The research profile of the biological sciences at TUBS is defined by four major areas of investigation: **Systems Biology of Infection**, **Cell Biology and Cell Physiology**, **Neurodegeneration** and **Biotechnology of Therapeutics**. Furthermore, cross-discipline collaborative research with engineers of the university's core research area **Metrology** in the fields of microfluidics and optoelectronics aims for the establishment of biological lab-on-chip technologies and innovative cell culture. The **biological sciences** therefore are thought to act as **bridge** between TUBS core research areas **Infection** & **Therapeutics and Metrology**.

2.2.2 Key publications

The key research areas in infection and metabolite analysis, cell biology and neurodegeneration are represented by the following characteristic manuscripts:

Günther* T., Czech-Sioli M., Indenbirken D., Robitaille A., Tenhaken P., Exner M., Ottinger M., Fischer N., Grundhoff* A., Brinkmann M.M. (2020). SARS-CoV-2 outbreak investigation in a German meat processing plant. EMBO Molecular Medicine 12(12):e13296. * equally contributing authors

Gray A., Bradbury A.R.M., Knappik A., Plückthun A., Borrebaeck C.A.K., Dübel S. (2020). Animal free alternatives and the antibody iceberg. Nature Biotechnology 38, 1234–1239.

Mendel R.R., Hercher T.W. (2019). Harvesting Moco. Nature Chemical Biology 15: 429-430.

Lonnemann N., Hosseini S., Marchetti C., Skouras D.B., Stefanoni D., D'Alessandro A., Dinarello C.A., Korte M. (2020). The NLRP3 inflammasome inhibitor OLT1177 rescues cognitive impairment in a mouse model of Alzheimer's disease. Proc. Natl. Acad. Sci. USA. 117: 32145-32154.

Kueneman J.G., Bletz M.C., McKenzie V.J., Becker C.G., Joseph M.B., Abarca J.G., Archer H, Arellano A.L., Bataille A., Becker M., Belden L.K., Crottini A., Geffers R., Haddad C.F.B.,

Harris R.N., Holden W.M., Hughey M., Jarek M., Kearns P.J., Kerby J.L., Kielgast J., Kurabayashi A., Longo A.V., Loudon A., Medina D., Nuñez J.J., Perl R.G.B., Pinto-Tomás A., Rabemananjara F.C.E., Rebollar E.A., Rodríguez A., Rollins-Smith L., Stevenson R., Tebbe C.C., Vargas Asensio G., Waldman B., Walke J.B., Whitfield S.M., Zamudio K.R., Zúñiga Chaves I., Woodhams D.C., Vences M. (2019). Community richness of amphibian skin bacteria correlates with bioclimate at the global scale. Nature Ecology and Evolution 3: 381-389.

2.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 - 2020) the institutes acquired a total sum of **18.64 Mio €** in **third party funds**.

Collaborative research programmes with speaker function or with significant contribution (i.e. at least 25 % of projects)

Title	Funding body	Speaker
Go-Bio8 – Development of a vaccine against ticks	BMBF[4]	Michael Hust, Biotechnology, TUBS
Development of recombinant human anti-diphteria toxin neutralizing antibody for diphtheria therapy	PISC[5]	Michael Hust, Biotechnology, TUBS
Human neutralising antibodies against venom toxins of black widow spider for therapeutic purposes	PISC	Michael Hust, Biotechnology, TUBS
Molecular mechanisms of IL-33 cytokine signalung	NIH[6]	Eric Sunderberg, Emory School of Medicine, Atlanta
Sommerekzeme der Pferde	Kali & Salz GmbH	Michael Hust, Biotechnology, TUBS
Go your own way: The role of mRNA localization in the directed growth of filamentous fungi	VolkswagenStiftung	André Fleißner, Genetics, TUBS
SFB 900: Chronic Infections : Microbial Persistence and its Control	DFG[7]	Thomas Schulz, Medizinische Hochschule Hannover Melanie Brinkmann, Genetics, TUBS (subproject leader)
CDinfect - Epidemiologie und Systembiologie des pathogenen Bakteriums Clostridioides difficile	MWK[8]	Dieter Jahn, Microbiology, TUBS
SFB TRR51: Ökologie, Physiologie und Molekularbiologie der Roseobacter-Gruppe: Aufbruch zu einem systembiologischen Verständnis einer global wichtigen Gruppe mariner Bakterien	DFG	Meinhard Simon, Uni Oldenburg Dieter Jahn, Microbiology, TUBS (Co-speaker)
DiSPBiotech (SPP 1934)	DFG	Arno Wade, Particle Technology, TUBS

[4] Bundesministerium für Bildung und Forschung (BMBF)
[5] PETA international science consortium (PISC)
[6] National Institute of Health (NIH)
[7] Deutsche Forschungsgemeinschaft (DFG)
[8] Niedersächsisches Ministerium für Wissenschaft und Kultur (MWK)

ProLAB	VolkswagenStiftung	Wolfgang Kowalsky, High Frequency Technology, TUBS
Naturstoffmedizin	BMBF	Michael Steinert, Microbiology, TUBS
FraxPath	BMBF	Michael Steinert, Microbiology, TUBS
ELICIPHARM – A novel innovative approach for the optimization of pharmaceuticals	BMBF	Dirk Selmar, Plant Biology, TUBS
DeMoVit	Waldklimafonds	Robert Hänsch, Plant Biology, TUBS
Taxon-Omics (SPP 1991)	DFG	Dominik Begerow, Uni Bochum Miguel Vences, Zoology, TUBS (Co-Speaker)
Cellular Imaging of RNA C-to-U editing (SPP 1784)	DFG	Mark Helm, Uni Mainz

2.2.4 Early career development

GradTUBS is the general graduate academy at TUBS for PhD candidates across all disciplines, in which they are offered a broad complementary training ranging from science writing and presentation skill classes to language and management courses. PhDs candidates also have access to more specialized training of the HZI Graduate Academy and Biomedas (MHH).

The self-report of TUBS lists five third-party funded structured PhD programmes that are relevant for the biological sciences (DFG, EU, State of Lower Saxony / VW-Vorab). The DFG-funded programme PROCOMPAS (GRK 2223: Assemblierung von Proteinkomplexen) is the largest in size and funds (Speaker Ralf-Rainer Mendel, Plant Biology, Emeritus since 4/2021)

Postgraduates can take part in the ZEvA-certified TRAIN-academy, a structured career training program with focus on translational research in medicine. Training in academic teaching is provided through the WindH programme of TUBS. In 2020, TUBS has implemented tenure track options. Their regulation and quality monitoring for entrance level professorships is complemented by a TUBS tenure-track advisory board. Newly hired faculty take part in mandatory seminars on acquisition of third-party funding, academic teaching, management of finances, employment law, technology transfer and science communication.

A total number of **117 PhDs** and **3 Habilitations** were awarded during the reporting period.

Collaborative PhD projects were conducted with the local partners HZI and the Physikalisch Technische Bundesanstalt (PTB) and with international partners in Malaysia, Brazil, USA, Egypt and Jordan.

TUBS keeps track of their PhD and Postdoc **alumni**. Almost half of the PhD graduates remain in academic research, while an additional 38% follow offers from industry. Careers of postdoctoral graduates are more divers with about one third remaining in academic science and an additional 22% joining industrial employment.

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track*
Pathometabolism	BMBF	Andre Wegner, Bioinformatics	N/A
Supramolecular magnetic nanostructure for Biomedicine	DFG, TUBS	Aidin Lak, Virus Genetics	N/A
Microbial Infections	TUBS, DZIF, Wellcome Trust	José Borrero de Acuna, Microbiology	N/A

* Rules for a tenure-track option were recently adopted by TUBS, but were not effective at the time of installation of these junior groups.

Three early career researchers[9] received **external offers** for professorship positions (Uni Göttingen, Uni Sevilla, Uni Leipzig). All three researchers accepted the offer.

The Research Services and European Office team of TUBS supports the institutes to **attract outstanding researchers** for the biological sciences. International and national postdoctoral researchers are supported via an online training for the proposal preparation of fellowships in the Marie Skłodowska Curie Actions. The International Marketing of TUBS supports the active approach of international scientists suitable for the establishment of a junior research group. Furthermore, TUBS has established the ERC GAIN concept to support ERC applicants with information events, interview training and funding. The Agnes-Pockels-Fellowship of TUBS offers an additional source of internal funding to attract early career scientists with ERC starting grants or Emmy Noether grants.

2.2.5 Science communication and technology transfer

Science communication is supported by the central Communications and Press Service actively of TUBS. The self-report states numerous activities by the biological science research units in various formats including public lectures, a “Schülerlabor” and a weekly column in a local newspaper. Since the beginning of the SARS-CoV-2 pandemic Melanie Brinkmann (Virus Genetics) and Michael Meyer-Herrmann (HZI) have been involved in the counselling of politicians and have been explaining facts to the public in talk shows on national TV, despite exposing themselves to harsh anti-science criticism.

[9] Early career researchers: postdocs, group leaders, junior professors.

Technology Transfer: Scientists at TU Braunschweig are encouraged to file inventions to the dedicated Technology Transfer Department. Suitable inventions are re-evaluated by patent lawyers of the Erfinderzentrum Norddeutschland (EZN). It is the explicit policy of TU Braunschweig to only apply for a patent, if an income from licence fees can be expected within short time to avoid excessive costs for patent maintenance fees. Successful invention claims are therefore rare. Examples for successful transfer projects from biological research within the reporting period are:

- Norden-Vaccine (Biotechnology, start-up): all-in-one vaccine against tick-borne infectious diseases (BMBF funded).
- Abcalis GmbH (Biotechnology, start-up): animal-free monoclonal and multiclonal antibodies for research and diagnostics including a novel diagnostic SARS-CoV-2 antibody (BMWi funded).
- CORAT Therapeutics GmbH (Biotechnology, start-up): a novel human anti-COVID-19 antibody that is currently undergoing clinical phase Ib/II trials to treat moderate to severe COVID-19.
- A therapeutic single chain Fc antibodies against mamma carcinoma in clinical trials (Biotechnoloy).

2.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

The Braunschweig area is home to a variety of non-university institutions. The biological institutes consider this as an asset to help initiate research consortia or to gain access to high-end technologies. Accordingly, **research collaboration agreements** have been signed with the HZI, the DSMZ, the federal Julius Kühn Institute (JKI) for research on cultivated plants, the federal Thünen Institute for research on rural areas, forestry and fisheries (TI), the PTB and the Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM) in Hannover.

Currently, of the 14 jointly appointed professors eight are located at the HZI, five are located at the DSMZ and one is located at the PTB. Moreover, extraordinary professorships are held by two members of the HZI, and one each of the ITEM, the JKI and the TI.

Joint Professorships:

Appointee	Institution
Jörg Overmann (W3), Microbiology	Leibniz-Institute DSMZ
Ulrich Nübel (W2), Microbial Genome Research	Leibniz-Institute DSMZ
Michael Pester (W2), Geomicrobiology	Leibniz-Institute DSMZ
Yvonne Mast (W2), Applied Microbiology	Leibniz-Institute DSMZ
Laura Steenpaß (W2), Cell Biology	Leibniz-Institute DSMZ
Dirk Heinz (W3), Molecular Structural Biology	Helmholtz Centre for Infection Research HZI
Wulf Blankenfeldt (W3), Structural Biology of Proteins	Helmholtz Centre for Infection Research HZI
Theresia Stradal (W3), Cell Biology	Helmholtz Centre for Infection Research HZI
Alice McHardy (W3), Computational Biology of Infection Research	Helmholtz Centre for Infection Research HZI
Michael Meyer-Hermann (W3), Systems Immunology	Helmholtz Centre for Infection Research HZI
Marc Stadler (W2), Microbial Drugs	Helmholtz Centre for Infection Research HZI
Lothar Jänsch (W2), Cellular Proteome Research	Helmholtz Centre for Infection Research HZI
Christian Sieben (W1), Nanoscale Infection Biology	Helmholtz Centre for Infection Research HZI
Gavin O'Connor (W2), Biochemistry	Physikalisch-Technische Bundesanstalt PTB

The four core research areas of TUBS form the framework for interdisciplinary collaborations – with **Infection & Therapeutics** being the most relevant area for the biological sciences. The activities are fostered by the dedicated research buildings BRICS and PVZ – both with their own governance structure and administration. The BRICS building also hosts research groups of the partners HZI, DSMZ, PTB and the Ostfalia Hochschule. Furtmermore, HZI, DSMZ and PTB are all financing junior research groups (W1 without tenue track) in the BRICS. In 2017 the joint activities let to the foundation of a Science-Campus Braunschweig-Süd.

Internationalisation

TUBS follows an internationalisation strategy that has been audited twice by the Hochschulrektorenkonferenz (HRK). The central instrument of the internationalization process is the **Internationalization Committee**, which bundles all activities of the faculties, core research areas and their centers, the international student initiatives and the presidency. In 2018 the **International House** was founded which bundles all activities of international office, Research Services and European Office and language center.

A total of 23 international guests scientists were hosted by the biological institutes during the reporting period. Among them were three professors, four postdocs, 14 PhD candidates and two students.

TUBS offers a variety of centralised measures for **internationalisation of teaching and early career development** – some of the tailored to the needs of refugees. The universities' task force "International Teaching" is working on strategic guidelines and corresponding measures to significantly improve the English teaching in all disciplines. The current master curricula in biology and biotechnology offer about 24% of their content in English. Graduate academies and structured PhD programmes of biological sciences at TUBS are generally organized in English. In addition the introduction of an international Master curriculum related to systems biology and infection is being discussed.

The biological institutes at TUBS were involved in **20 major international research projects** during the reporting period of which ten were organized by PIs of TUBS. Most of the collaborative projects were listed for the Institute of Biochemistry, Biotechnology and Bioinformatics (n = 14) followed by the Institute of Genetics (n = 3) and the Institutes of Microbiology (n = 1), Plant Biology (n = 1) and Zoology (n = 1).

37 % of the **PhDs** completed during the reporting period were **awarded to international graduates** (43/117).

2.3 Teaching

Degree courses

The following degree courses are offered:

- Biology, Bachelor
- Biology, Master
- Biotechnology, Bachelor
- Biotechnology, Master

The total number of graduates (Bachelor, Master) of all courses was n = 171 (2018), n = 211 (2019) and n = 156 (2020).

The total number of first year students (Bachelor, Master) of all courses was n = 272 (2017/18), n = 270 (2018/19) and n = 276 (2019/20).

How research feeds into teaching

The curricula of all four degree courses include practical classes in research laboratories. Bachelor and Master students finish with a practical final thesis project. Specialized classes are offered by the non-university partners (HZI, DSMZ etc.). The Master programs offer specializations based on the research expertise of the institutes.

The self-report highlights that for several years, the biological sciences of TUBS achieved top positions in the CHE university ranking and ranked number one of the TU9 Institutes of Technology explicitly valuing the research-intense education.

Further remarks on teaching

According to the self-report, maintaining the high quality of the curricula becomes more challenging. Teaching obligations are reported to be overfulfilled in all institutes, while facing significant cuts in the number of teaching personnel (in particular loss of all "Akademischer Rat" positions).

The biosciences are the only MINT discipline that is not offered as a degree program for high school teachers by TUBS, making the highly sought subject combination chemistry/biology impossible. Thus, biological sciences training for the teaching degree program is regarded as a major untapped potential.

2.4 Strategy and governance

2.4.1 Governance

The institutes are governed by a biannually elected **institute council** formed by professors leading an independent research unit, representatives of the scientists and technical support status groups and additional consultants. The council decides about resource allocations and organizational matters that fall outside of the research unit's responsibilities (e. g. energy budget and savings, budgeting of space still to come) and identifies potentials for research collaborations and collaborative funding acquisition. An elected executive head of the council is responsible for organizing council meetings and annual reports, has signing rights and represents the respective institute in the faculty's council.

The **faculty's council** with representatives of the scientific, technical and administrative employees and students discusses and approves proposals prepared by the Dean's council in regular monthly meetings. The Dean's council itself is formed by the Dean, the Dean of Studies and complemented by one representative of each discipline forming the faculty: psychology,

chemistry, pharmacy and biological sciences. The Deanship rotates among the disciplines every two years, together with the reelection of the Dean's and faculty's council.

2.4.2 Research quality assurance and internal incentive programmes

Quality assurance

Newly employed scientists receive a copy of the rules of good scientific practice of the DFG and they have to confirm to have read the content. Good scientific practice is taught as part of the biology and biotechnology curricula. A central independent committee at TUBS is responsible to enforce the compliance with these rules and recommends measures for the faculty councils in case of breach. Incentives are not implemented to reward the adherence to good scientific practice rules at TUBS, because this is considered a natural and elementary responsibility of every scientist.

Internal incentive programmes

There are **no internal incentive programmes** specifically for research at biological institutes at TUBS.

Performance oriented funds (LOM[10]) are annually allocated to the individual faculties by the presidential board of the university. The faculty council decides about the further use of these funds to either finance overarching faculty activities or to allocate these funds to the institutes correlated to their individual budgets. Since 2016 the budget was used solely for overarching faculty purposes: reconstruction and refurbishment of the chemistry, pharmacy and physics buildings and covering for budget reductions imposed by measures of the state (Tariferhöhungen, Schuldenbremse). With the help of the performance-oriented funds, reductions of individual institute budgets could be avoided so far. Some investments in the central interest of the faculty and biological sciences could be made such as the replacement of NMR analysis in chemistry and contributions to the reconstruction of the animal facility.

[10] Leistungsorientierte Mittelvergabe (LOM): In Lower Saxony 10% of the state's subsidies are distributed based on key performance indicators in research, teaching and equality in relation to the entire finances provided by the state.

Overhead

Overhead funds acquired from third-party funding are generally split in thirds at TUBS. One third remains with the grant applicant as incentive for a successful application, one third goes to the central administration and the last third is contributed to a central pool. This central pool is dedicated to initiate, support and reward collaborative grant applications.

2.4.3 Equality and Diversity

TUBS offers a variety of central mentoring programs for female students and researchers. The PROFessorin program provides compensatory measures to value the disproportionally high engagement of female professors in committees. The institutes offer physically impaired students and employees as well as pregnant women adequate laboratory conditions with proper consulting from the university's medical doctor. If impossible, theoretical study alternatives are provided to students. Flexible working hours are granted to provide a good compatibility between family care and work including days or periods of home office. Staff meetings, talks and practical courses are scheduled during family-friendly hours.

The biological research units adhere to the general principles of "Equal Opportunities at TU Braunschweig".

For gender ratios see appendix (table 5).

2.4.4 Research data management

Research Data Management (RDM) is largely driven by a central strategy at TUBS headed by its central library. Researchers can obtain support through dedicated RDM staff (TUBS.researchdata team). All research data are acquired, handled and archived for a minimum of 10 years in accordance to the principles of good scientific practice.

Research data is archived preferably via subject specific research data repositories (e.g. PRIDE for MS-proteomics data). TUBS also offers an institutional repository. Metadata standards are used if applicable. Sequence data is deposited into ENA or NCBI databases (e.g. Genbank) and included metadata standards are used. Enzyme data is integrated into the Enzyme database BRENDA, which is a member of the German Network for Bioinformatics Infrastructure and provides suitable metadata standards. The BRENDA database originates from TUBS. Furthermore, TUBS participates in a consortium of the national research data infrastructure named NFDI4Biodiversity, which aims at improving data archiving and data integration in the field of taxonomy.

TUBS offers an institutional repository, where research data can be archived and published in accordance to the FAIR principles. To meet the different needs of researchers in the context of research data openness, the institutional repository of TUBS covers several levels of FAIR-ness ranging from strongly restricted, where only metadata of the respective dataset is made public, to completely open datasets. The degree of FAIRness is determined by the researchers. Datasets are citable via a DOI and linked to the respective research publication.

If applicable, appropriate open licenses (Creative Commons Licenses) are chosen for research datasets. According to the Open Access Policy of TUBS, research results are published preferably in Open Access journals under the Creative Commons License CC-BY 3.0 DE or an updated version thereof. Secondary publication rights (green road Open Access) are claimed for all non-Open-Access-publications.

2.4.5 Plans and perspectives

As of 6th of July 2021 a new **DFG Research Unit** (Forschungsgruppe) “DEEP-DV, Disrupt – Evade – Exploit: **Gene expression and host response programming in DNA virus infection**” (Speaker Melanie Brinkmann) has been funded and will be integrated into the core research area Infection &Therapeutics. Furthermore, TUBS plans to apply for **two more DFG Research Units** within the next years. One initiative is based on findings from *Clostridioides difficile* research and the consortium aims to investigate the **cross-talk between the infected gut and the brain**. The other DFG Research Unit initiative aims for a better understanding of the **metabolic cross-talk between host and pathogen** during an infection and wants to reveal new intervention points.

In the past years the neurobiology research units have established collaborations with engineers in the field of microfluidics and optoelectronics to establish **organ-on-chip** devices for reproducible real-time quantitative measurements of neuronal physiology and plasticity. Successful VW-Vorab funding for an interdisciplinary research group (Homeo-Hirn) was recently acquired. **Until 2024** this group aims to prepare an application for a **DFG-funded Collaborative Research Centre (SFB**) in the field of **neurometrology**, as interdisciplinary collaborative network across the TUBS core research areas Infection & Therapeutics and Metrology. It will also involve the Cluster of Excellence QuantumFrontiers and the PTB as external partner. The Homeo-Hirn steering group will prepare an application for construction of a **new research building “NeuroLab”** to be negotiated with the state in the year 2022.

Future recruiting activities will aim at **strengthening cross-sectional research fields**. The interface of **cell biology and infection** will be strengthened through recruitments to a W1 (concluded) and to a W3 (in progress) professorship within the Institute of Plant Biology. For the upcoming recruitment in Genetics (W3) within the next years, research topics at the intersection of **infection biology/neurobiology/immunology** will be considered.

The existing cooperations with regional research institutions will be maintained and further expanded to the PTB. To overcome the absence of medical expertise due to a missing medical faculty at TUBS, the establishment of an **adjunct research institute** together with the **municipal hospital** (Städtisches Klinikum Braunschweig gGmbH) will be considered together with the presidency. The prospect of combining medical research with a technical university is considered as highly beneficial for Braunschweig and could yield a complementary profile to medical research in Hannover and Göttingen.

TUBS biological sciences together with the faculty of humanities and studies in education aim to establish a **master curriculum for high school biology teachers** until 2025. With chemistry and biology as often favored combination by students in educational sciences, the lack of high school chemistry teachers in Lower Saxony can be counteracted with this goal.

The university core research area **Infection & Therapeutics** has undergone an externally monitored structured **strategy process** and will establish a **new governance** in 2022. It will be implemented with the support of the biological sciences.

3 Universität Göttingen

3.1 Structure and general framework

3.1.1 Structure

The University of Göttingen comprises 13 faculties, including the University Medical Centre (UMG). The university's profile is characterized by the following research foci: Functional Principles of Living Material, Cellular Processes and Molecular Machines, Energy Conversion, Neurosciences, Cardiovascular Research, Sustainable Use of Natural Resources, Religious Studies, Digital Transformation, Language and Cognition, and Primate Cognition.

Biological research has a very long tradition in Göttingen, going back to the 18th century when Albrecht von Haller founded the old botanical garden in 1740 a few years after the foundation of the university itself. In 1996, the Biology Faculty was created. In line with the new faculty, the three biological institutes related to the traditional disciplines zoology, botany and microbiology were formed. Important for the current research foci was that the University of Göttingen, including the University Medical Center, and eight non-university local research centers joined forces to form the Göttingen Campus providing an organizational basis for interdisciplinary research.

To date the Faculty of Biology and Psychology covers a wide range of sub-disciplines in biology and psychology. Its profile is characterized by three focal points in research and teaching: (i) Molecular Biosciences, (ii) Biodiversity, Ecology and Evolution, and (iii) Neurobiology, Cognition and Behavioral Research. The following three institutes and 33 professorships are part of the biological sciences:

- **Albrecht-von-Haller-Institute of Plant Sciences**
  - Didactics of Biology (Prof. Dr. Susanne Bögeholz, C4, since 4/2001)
  - Experimental Phycology & Culture Collection of Algae (Prof. Thomas Friedl, C3, since 2/1999)
  - Molecular Biology and Physiology of the Plant (Prof. Christiane Gatz, C4, since 10/1996)
  - Molecular Enzymology | Excellence Initiative (Prof. Dr. Kai Tittmann, W3, since 8/2008)
  - Palynology & Climate Dynamics (Prof. Dr. Prof. Hermann Behling, W2, since 10/2005)
  - Plant Biochemistry (Prof. Ivo Feußner, C4, since 8/2002)

- Plant Cell Biology (Prof. Volker Lipka, W3, since 2/2009)
- Plant Ecology & Ecosystem Research (Prof. Christoph Leuschner, W3, since 10/2000)
- Systematics, Biodiversity and Evolution of Plants (with Herbarium) (Prof. Elvira Hörandl, W3, since 10/2011)
- Vegetation and Plant Diversity Analysis including the Historical Botanic Garden (Prof. Erwin Bergmeier, C3, since 5/2003)

- **Institute of Microbiology and Genetics**
  - Applied Bioinformatics (Jun.-Prof. Jan de Vries, W1, since 9/2019)
  - Bioinformatics (Prof. Burkhard Morgenstern, C4, since 12/2002)
  - General Microbiology (Prof. Jörg Stülke, C4, since 9/2003)
  - Genetics of Eukaryotic Microorganisms (Prof. Stefanie Pöggeler, W2, since 10/2006)
  - Genomic and Applied Microbiology (Prof. Rolf Daniel, W3, since 2/2012)
  - Infection Biology (Prof. Stefan Pöhlmann, W3, since 10/2010)*****
  - Molecular Genetics (Prof. Heike Krebber, W2, since 4/2010)
  - Molecular Microbiology & Genetics (Prof. Gerhard Braus, W3, since 10/1996)
  - Molecular Structural Biology (Prof. Ralf Ficner, C4, since 10/2001)

- **Johann-Friedrich-Blumenbach-Institute of Zoology & Anthropology**
  - Animal Ecology (Prof. Stefan Scheu, W3, since 10/2008)
  - Behavioral Ecology (Prof. Julia Ostner, W2, since 8/2014)*****
  - Behavioral Ecology & Sociobiology & Anthropology (Prof. Peter Kappeler, C4, since 9/2003)*****
  - Biodiversity and Animal Evolution and Zoological Museum (Prof. Christoph Bleidorn, W3, since 10/2017)
  - Cellular Neurobiology (Prof. Martin Göpfert, W3, since 10/2008)
  - Primate Cognition (Prof. Julia Fischer, W3, since 11/2004)*****
  - Conservation Biology | Nachwuchspakt (Prof. Johannes Kamp, W2, since 8/2020)
  - Data-Driven Analysis of Biological Networks (Prof. Michael Wibral, W2 since 2018)
  - Developmental Biology (Prof. Ernst Wimmer, C4, since 9/2003)
  - Evolutionary Developmental Genetics (Prof. Gregor Bucher, W2, since 10/2013)
  - Functional Imaging Laboratory (Prof. Susann Boretius, W3, since 7/2015)*****
  - Molecular Neurobiology of Behaviour (Prof. André Fiala, W2, since 10/2008)
  - Primate Neurobiology (Prof. Hansjörg Scherberger, W2, since 12/2008)*****
  - Systems Neuroscience (Prof. Siegrid Löwel, W3, since 8/2010)

*jointly appointed with the Deutsches Primatenzentrum GmbH Göttingen (DPZ)

3.1.2 Personnel

Together the institutes have eight C4, two C3, thirteen W3 professorships, nine W2 professorships and one W1 professorship. Six professorships are jointly appointed with the DPZ (1 x C4, 3 x W3, 2 x W2). The W1 professorship will be ranked W2 from 2022. Until 2026 five professorships are scheduled to become vacant (successions of Christiane Gatz, C4; Christoph Leuschner, W3; Erwin Bergmeier, C3; Gerhard Braus, W3; Siegrid Löwel, W3). On 01.12.2020 a total number of 523 people were employed (415.4 FTE). 30.3 FTE of professorships, 76.3 FTE of scientific personnel and 126.6 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 1.7 FTE of professorships, 168.5 FTE of scientific personnel and 12.0 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

3.1.3 Research infrastructure

The majority of the biological research units are located in buildings at the **Göttingen North Campus** in proximity to the other natural science faculties, the “green” faculties (Agricultural Sciences and Forest Sciences and Forest Ecology) and close to non-university institutions (German Primate Center DPZ, MPI for Biophysical Chemistry, MPI for Dynamics and Self-Organization). With the completion of the Schwann-Schleiden Research Center at the North Campus, the molecular biosciences are now fully integrated at one single location. The infrastructure of the North Campus is regarded as a unique feature (e.g. mass spectrometry, microscopy, genome laboratory, X-ray structure analysis) with additional connection to "high-end" technologies available in the neighboring MPI for Biophysical Chemistry and the European Neuroscience Institute Göttingen. In addition, the field stations operated by the DPZ in South America, Africa, Madagascar and Southeast Asia allows for behavioral research on primates. For the operation of the research-relevant infrastructure, the faculty has reorganized its infrastructure into five methodological platforms or service units since 2016: (i) Service Unit for Proteomics, (ii) Service Unit for Metabolomics and Lipidomics, (iii) Service Unit for Microscopy, (iii) the Lab for Structural Analysis of Proteins, and (iv) the Genome Lab. The Genome Lab makes use of external services and cooperations for larger-scale sequencing projects.

Research units working mainly in the area of Biodiversity, Ecology and Evolution are located near the city center in the proximity of the Old Botanical Garden. The faculty houses several

large biological collections as well as botanical gardens, which are maintained and further developed as research infrastructures by various research units from the focus Biodiversity and Ecology. The biological collections constitute out-reach platforms.

The research environment of the North Campus with its opportunities for scientific cooperation, interdisciplinary research, joint infrastructure and technology exchange is seen as a big **local advantage**. All research foci and corresponding collaborative research projects of the faculty include non-university groups and groups from other faculties.

The fact that not all biological research units are located on one campus is seen as a **local disadvantage.** Furthermore, some of the building infrastructure is regarded as outdated and in need for renewal. Funding cuts to the university are seen as a serious threat to maintain research infrastructure that relies on up-to-date major instrumentation (*Großgeräte*), which has to be matched 50 % by university funds with substantial contribution by the faculty.

3.2 Research

3.2.1 Profile

The Faculty of Biology and Psychology combines the two basic subjects Biology and Psychology in research and teaching. The faculty has the most joint professorships and research associations with non-university institutes in Göttingen. Research in biology focusses on **three major areas**:

Molecular Biosciences with methodologically interlinked areas (macromolecular protein complexes, plant-microbe interactions, general and applied microbiology, functional genomics, functional genetics, developmental biology and plant biochemistry);

Biodiversity, Ecology and Evolution with the central topics *origin of biodiversity* (speciation, evolution, phylogeny, systematics, paleoecology), *functions of recent biodiversity in their respective ecosystems* (animal and plant ecology, ecosystem research, landscape and agroecology), and *development of sustainability strategies for the conservation of biodiversity* (sustainable land use, conservation biology, biodiversity education, education for sustainable development);

Neurobiology, Cognition and Behavior with focus on the proximate (neuronal, cognitive, physiological) and ultimate (evolutionary) basis of *perception and behaviour* (molecular, cellular, systems, and computational neuroscience as well as behavioral ecology, communication, and primate cognition including humans).

3.2.2 Key publications

Dai S, Funk LM, von Pappenheim FR, Sautner V, Paulikat M, Schroder B, Uranga J, Mata RA, Tittmann K (2019) Low-barrier hydrogen bonds in enzyme cooperativity. Nature 573:609-613 [doi: 10.1038/s41586-019-1581-9].

Hoffmann M, Kleine-Weber H, Schroeder S, Krüger N, Herrler T, Erichsen S, Schiergens TS, Herrler G, Wu NH, Nitsche A,Müller A, Drosten C, Pöhlmann S (2020) SARS-CoV-2 Cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. Cell 181:271-280.e8 [doi: 10.1016/j.cell.2020.02.052].

Grass I, Kubitza C, Krishna VV, Corre MD, Mußhoff O, Pütz P, Drescher J, Rembold K, Ariyanti ES, Barnes AD, Brinkmann N, Brose U, Brümmer B, Buchori D, Daniel R, Darras KFA, Faust H, Fehrmann L, Hein J, Hennings N, Hidayat P, Hölscher D, Jochum M, Knohl A, Kotowska MM, Krashevska V, Kreft H, Leuschner C, Lobite NJS, Panjaitan R, Polle A, Potapov AM, Purnama E, Qaim M, Röll A, Scheu S, Schneider D, Tjoa A, Tscharntke T, Veldkamp E, Wollni M (2020) Trade-offs between multifunctionality and profit in tropical smallholder landscapes. Nat Commun 11:1186 [doi: 10.1038/s41467-020-15013-5].

Rekhter D, Lüdke D, Ding Y, Feussner K, Zienkiewicz K, Lipka V, Wiermer M, Zhang Y, Feussner I (2019) Isochorismate-derived biosynthesis of the plant stress hormone salicylic acid. Science 365:498-502 [doi: 10.1126/science.aaw1720].

Kappeler PM, Pozzi L (2019) Evolutionary transitions toward pair living in nonhuman primates as stepping stones toward more complex societies. Sci Adv 5:eaay1276 [doi: 10.1126/sciadv.aay1276].

3.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 – 2020) the institutes acquired a total sum of **36.22 Mio €** in **third party funds**.

Collaborative research programmes with speaker function or with significant contribution (i.e. at least 25 % of projects)

Title	**Funding body**	**Speaker**
SFB 990: Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)	DFG	Stefan Scheu, Animal Ecology, UGOE
SFB 860: Integrative Structural Biology of Dynamic Macromolecular Assemblies	DFG	Ralf Ficner, Microbiology and Genetics, UGOE
FOR 2705: Dissection of a Brain Circuit: Structure, Plasticity and Behavioral Function of the Drosophila mushroom body	DFG	André Fiala, Zoology and Anthropology, UGOE
FOR 2136: Sociality and health in primates	DFG	Peter Kappeler, Zoology and Anthropology, UGOE

GRK 2070: Verstehen von Sozialbeziehungen	DFG	Julia Fischer, Zoology & Anthropology, UGOE
GRK 2172: PRoTECT: Plant Hazard Prevention	DFG	Ivo Feußner, Plant Sciences, UGOE
Leibniz Science Campus on Primate Cognition	Leibniz-Gemeinschaft	Julia Fischer, Zoology & Anthropology, UGOE
CAMPRO: Camelina sativa: Establishing a high quality oil crop for marginal lands	BMBF	Ivo Feußner, Plant Sciences, UGOE
Qualitätsoffensive Lehrerbildung des Bundes	BMBF	Susanne Bögeholz, Plant Sciences, UGOE
InRaps: Evaluation of novel biological seed technologies for defense against insect pests in rapeseed	BMEL[11]	S. Rietz, NPZ Innovation GmbH (NPZi)
ReSyst: Use of resynthesis line S30 for resistance improvement against the great rapeseed stem weevil, a major pest in domestic rapeseed production	BMEL	S. Lütke Entrup, Gemeinschaft zur Förderung von Pflanzeninnovation e.V. (GFPi)
Joint Lower Saxony - Israeli Research Projects: Developmental and experience-dependent neuronal plasticity: physiological and anatomical analysis of mushroom body neurons in Drosophila (UGOE, Weizmann Institute)	MWK (VW-Vorab)	André Fiala, Zoology and Anthropology, UGOE
Verbundvorhaben FLEXIZUCKER: Verfahrenstechnische, enzymatische und genomische Charakterisierung einer flexiblen Biogasproduktion mit gezieltem Einsatz von Zuckerrüben	BMEL	Marian Kazda, University Ulm
Zwanzig20 - InfectControl 2020: ANTIRES – Verbreitungswege von Antibiotika-Resistenzen in - kommunale Abwässern; and Zwanzig20 - InfectControl 2020: ANTIRES 2.0 - Etablierung eines Plasma-basierten Verfahrens zur Bekämpfung der Antibiotika-Resistenz-Verbreitung durch kommunale Abwässer	BMBF	Katharina Riedel, University of Greifswald
Microbial biofactories and production platforms / ThermoSynCon - Development of thermophilic microorganisms for syngas conversion to biobased fuels and chemicals	BMBF	Mirko Basen, University of Rostock

3.2.4 Early career development

The Georg-August-University School of Science (GAUSS) is a **graduate academy** and provides the organizational and regulatory umbrella for all PhD students in mathematics, computer sciences, physics, chemistry, geosciences, geography, biology, psychology and medicine.

[11] Bundesministerium für Ernährung und Landwirtschaft (BMEL)

Students are supervised by (and meet regularly with) their thesis advisory committees consisting of at least three members of whom at least two need to have faculty status. Within GAUSS, PhD students choose between dedicated programs, with those in the neurosciences, biophysics and molecular sciences being grouped in the Göttingen Graduate Center for Neurosciences, Biophysics, and Molecular Biosciences (GGNB). In addition, International Max Planck Research Schools, DFG Research Training Groups, and a Leibniz Graduate School are included as independent PhD programs under the umbrella of GAUSS and contribute to the curriculum. The curricula of the programs demand that PhD candidates gain academic achievements in order to collect the number of ECTS required for completing their PhD (e.g. courses in methods, professional and transferable skills, project management, good scientific practice, and participation in seminars, conferences and teaching). GAUSS offers career services for PhD students and Postdocs, basic statistical advice, travel grants, and funding for PhD students who have exceeded their individual grants due to child or home care requirements. The majority of the biological PhD students are in GGNB (264 students in 9 programs), the basic biology program of the faculty (132), in the behavior and cognition program (37), or the biodiversity and ecology program (32).

The self-reports lists five third-party funded **structured PhD programmes** that are relevant for the biological sciences on the Göttingen campus: IMPRS Genome Science, IMPRS Molecular Biology, IMPRS Neuroscience (all three Max-Planck-Society), PRoTECT: Plant Hazard Prevention (DFG GRK 2172, speaker Ivo Feußner, Plant Science, UGOE), Behaviour and Cognition (DFG, Annekathrin Schacht, Psychology, UGOE).

The university outlined transparent career paths within academia and established comprehensive support measures. The Göttingen Campus PostDoc Network is a campus-wide platform to increase the visibility and accessibility of available services for early career researchers. The Dorothea Schlözer Postdoctoral Program for Women offers fully-paid postdoctoral positions for two years to promote scientific independence, and is complemented by coaching and counselling services. The Faculty of Biology and Psychology promotes the establishment of junior research groups based on qualification positions that are connected to existing research units, but are largely structurally independent. This measure aims to provide excellent research conditions for young scientists and their involvement in research-oriented teaching at an early stage.

A total number of **329 PhDs** and **4 Habilitations** were awarded during the reporting period.

Collaborative PhD projects with non-university institutions of the Göttingen Campus were conducted under the umbrella of the GAUSS graduate school. Furthermore, 16 PhD projects

were conducted with partner institutions worldwide (USA, Canada, China, EU, Israel, Argentina).

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track
Nature Conservation	BMBF (Nachwuchspakt)	Johannes Kamp	W2 tenure-track
Applied Bioinformatics	BMBF (Nachwuchspakt)	Jan de Vries	W1 tenure-track W2
Microbial Cell Biology	Basic funds and DFG (Heisenberg professorship)	Kai Heimel	W2 tenure-track
Molecular Biology of Plant-Microbe Interactions	Basic funds	Marcel Wiermer	No
Phasmid Evolution	DFG (Heisenberg Research Group)	Sven Bradler	No
Developmental Biology	DFG (Emmy Noether Group)	Nico Posnien	No
Developmental Biology	AvH (Sofia Kovalevskaja Group)	Ufuk Günesdogan	No

Eight early career scientists received **external offers** (national and international) for professorship positions.

The self-report notes that the ‘attract-and-mentor’ strategy has a long tradition at Göttingen University. To **attract outstanding researchers** the faculty provides financial, infrastructural, and staff support and fosters early examination authorizations. The neurobiological research units are involved in the selection processes and mentoring of young scientists at the European Neuroscience Institute Göttingen (ENI-G), which is committed to the promotion of outstanding young researchers and helps them in attracting Emmy Noether Grants and ERC Starting Grants. The Developmental Biology research unit hosts one Heisenberg fellow, one Emmy Noether group, and one Sofja Kovalevskaja group in the reporting period. The Applied Bioinformatics research unit received an ERC starting grant in 2019.

3.2.5 Science communication and technology transfer

The Public Relations Department is the central unit of the university for all questions concerning internal and external **communication**. Some of the biological collections and botanical gardens are open to the public and contribute to linking the university and the public. Examples of larger collections are in Zoology and Botany, including the former Zoological Museum (Biodiversity exhibition in the new „Forum Wissen”), the Herbarium and the Collection of Algal Cultures. They are also centrally involved in the concept of

„Forum Wissen“ (e.g. with Biodiversity Museum) and, along with the digital collection database, are of central importance to the faculty for public outreach. The bioscience-oriented experimental laboratories XLAB (experimental laboratory for young people) and BLAB (Life Sciences Laboratory) are extracurricular educational institutions that serve to reach prospective students and that are learning sites for current students. XLAB is one of Germany's largest student laboratories for natural sciences and has received several awards for the underlying concept. It aims at all interested students worldwide and is intended to close the gap between school and study/research. The BLAB focuses on green life sciences and wants to create enthusiasm for scientific questions in biodiversity research among schoolchildren and promote learning with objects. Furthermore, biological research units contribute to the biennial „Night of Science” (over 25,000 visitors) at the Göttingen Campus.

Examples for **technology transfer**:

- Exploration of insecticide mode of actions with Dow AgroSciences (Cellular Neurobiology).
- Licensing and sale of various genes and strains for production of industrially relevant enzymes and compounds via the university technology transfer organization, MBM ScienceBridge GmbH (Genomic and Applied Microbiology).
- Livestock Neck Collars to reduce depredation by leopards, marketed for the benefit of livestock smallholders and wildlife conservation (Nature Conservation).
- Patent application in cooperation with Bayer CropScience „Neue Gen-Sequenzen für die effiziente Schädlingsbekämpfung mittels oraler RNAi für Phaedon spec. und andere Schädlinge“ (Evolutionary Developmental Genetics).

3.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

Institutionalized contractual **research collaborations** are usually completed at the level of the university or project-specific and not at the level of the biological institutes. The individual biological research units have diverse connections and research collaborations with universities and scientific institutions both nationally and internationally. Of note are the research collaborations within the international SFB990 (IPB University Bogor, University of Jambi, Takaluka University and Indonesian Institute of Science; all Indonesia) and IRTG2172 (University of British Columbia, Vancouver, Canada). The North German Center of Microbial Genomics (NZMG)

is another institutionalized structure (Speaker Prof. R. Daniel) that was founded in 2013 in Göttingen and includes the University of Göttingen, University of Greifswald, TU Braunschweig, Medizinische Hochschule Hannover, Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures GmbH (Braunschweig), and the Helmholtz Centre for Infection Research (Braunschweig). Currently, there are six professorships jointly appointed with the DPZ.

Centers are the nuclei for **interdisciplinary research** collaborations at the Göttingen Campus. They are also involved in graduate education and support early career scientists. All three profile-building research foci of the faculty are embedded in centers: the **Göttingen Center for Molecular Biosciences (GZMB)**, the **Center of Biodiversity and Sustainable Land Use (CBL)**, and the **Center for Systems Neuroscience (CSN)**.

Biological research units are also embedded in the following structures. The **Leibniz ScienceCampus "Primate Cognition"** was founded by the DPZ and the university to conduct interdisciplinary research. The **Campus Institute "Dynamics of Biological Networks**" aims to strengthen theoretical biological and biomedical research in Göttingen. The **European Neuroscience Institute Göttingen (ENI-G)** is currently housing six independent research groups – two independent junior groups of the faculty will be hosted there in the future.

Biological research units are also involved in the **Campus Institute Data Science (CIDAS)**, which promotes interdisciplinary exchange and activities among faculties and campus-wide.

Internationalisation

The biological institutes implement internationalization in line with the university strategy. The university's **International Office** is a central support unit for this process, e.g., providing administrative support and advisory services concerning international funding opportunities, joint research infrastructure or research collaborations. The **Welcome Centre** offers a range of support services for international guests. Each faculty has appointed an **internationalization officer** as contact person with a coordinating function. In the recruitment of academic staff, potential foreign applicants are approached specifically. The university performs demand-oriented extension of its international Bachelor and Master programs, and establishes multi-lingual curricula.

A total of 32 international **guest scientists** were hosted at the biological institutes during the reporting period (excluding PhD candidates).

Concerning the **internationalization of teaching** all master and PhD programs with a biological orientation have been implemented in English including thesis writing. Bachelor programs

offer a substantial share of the individual courses (e.g., “Fachvertiefung”) in English and the majority of bachelor thesis are also written in English. The "Master of International Nature Conservation" offers a double degree. For the program "Biodiversity, Ecology and Evolution" a double degree has been established with the universities of Rennes (France), Amsterdam (Netherlands) and Aarhus (Denmark). Efforts to make courses more attractive for international students is a focal point of study program development activities of the faculty. The faculty also provides an advisory service for planning stays abroad.

The self-report lists the SFB990 and the IRTG2172 as **major international collaborative research projects** (with Indonesia and Canada, respectively). At the level of the research units, groups are also part of large EU projects and European Research Area Networks (ERANETs).

46 % of the PhDs completed during the reporting period were awarded to international graduates (151/329).

3.3 Teaching

Degree courses

The following degree courses are offered:

- Biochemie, Bachelor
- Biologie, Bachelor
- Biologie (Lehramt), Bachelor
- Biologische Diversität und Ökologie, Bachelor
- Biologie (Lehramt), Master
- Molekulare Biologie, Master
- Neurowissenschaften, Master
- Biological Diversity, Ecology and Evolution, Master
- Molecular Life Sciences: Microbiology, Biotechnology and Biochemistry, Master
- Development, Neural and Behavioral Biology, Master
- International Nature Conservation, Master

Integrated Master/PhD programs (Max-Planck-Research Schools):

- Molecular Biology, M.Sc./PhD
- Neurosciences, M.Sc./PhD

The total number of graduates (Bachelor, Master) of all courses was n = 345 (2018), n = 370 (2019), n = 318 (2020).

The total number of first year students (Bachelor, Master) of all courses was n = 564 (2017/18), n = 485 (2018/19) and n = 530 (2019/20).

How research feeds into teaching

Students of the B.Sc. programs join a module “Fachvertiefung”, which consists of an individual practical course in one of the research groups of the faculty or in collaborating groups of the Göttingen Campus. This also includes a literature seminar and a course of “good scientific practice”. The module provides training for the Bachelor thesis research project. In some cases, bachelor students are already co-authors of scientific publications. All Master programs have mandatory individual lab rotations and the master theses are usually performed in the framework of a current research project of the hosting research unit. Master programs allow the entrance to one of the PhD programs by a fast-track option.

3.4 Strategy and governance

3.4.1 Governance

The governing bodies of each biological **institute** are the **general assembly** and the **executive board**. The board consists of 3 members of the university professor group and one member each of the scientific staff, MTV and student groups. The board elects the executive directors and their deputies of the institutes. The director represents the institute externally and manages day-to-day business. The members of the board support the management. The executive board and other invited institute members (extended board) of each institute meets at least three times per semester. The **extended board** comprises the members of the executive board plus all university professors, the equal opportunities officers, safety officers, and representatives of technology and buildings. The board suggests in consultation with the dean's office and the faculty board on fundamental questions of research and teaching as well as on the equipment, and laboratory and seminar rooms. The executive board of each institute also decides on usage regulations for joint facilities of the institute. The departments of the institute (research units) are headed by a university professor and decide on the use of the resources allocated to the department (budget, positions and rooms).

The biological institutes are closely connected to the committees of the **faculty**. The executive director of each institute is a member of the finance and structure commission of the faculty. The institutes send representatives to the faculty council, the PhD, study and the habilitation

commission of the faculty. The committees of the faculty are in turn linked to the committees of the university. The professors of the four institutes of the faculty meet about once a semester to discuss current developments with the dean's office. The dean's office consists of five members (dean, dean of studies and faculty advisor in personal union, dean of research, dean of finance and representative of psychology or biology).

3.4.2 Research quality assurance and internal incentive programmes

Quality assurance

The university has drawn up the “Rules of the University of Göttingen Governing the Safeguarding of “Good Scientific Practice” based on DFG recommendations. These rules are binding for all members of the university. The Ombuds Office for Good Scientific Practice serves as main contact point for all members of the university regarding questions and conflicts linked to good scientific practice. In addition, an Ombuds Committee at university level, and Ombuds persons (persons of trust) for each faculty and graduate program have been established.

Internal incentive programmes

The university runs a **funding program** to support the preparation of research proposal for large collaborative research initiatives (e.g., SFB, RTG or DFG Research Units). Using allocated overhead funds, the faculty will launch a **program for young academics** offering start-up funding for research proposals in 2022 (a similar program on the university level was suspended). The faculty has ended the **performance-based allocation** of funds due to severe problems with comparability of the individual sub-disciplines.

Overhead

From the DFG program flat rate (Programmpauschale 22 %), 32 % of the total overhead sum is transferred to the faculties. 29 % remain in the faculty and 71 % of the transferred overhead sum are forwarded to the research units that receive the third-party funding. The research units can freely dispose these funds in accordance with the university's financial rules. The overheads from other funding bodies are distributed within the faculty in a similar way, but only 25 % of the total overhead sum is transferred to the faculty.

3.4.3 Equality and Diversity

The university has developed an Equal Opportunities concept, appointed a vice-president for Professional Appointments and Equal Opportunities, and established a central Equal Opportunities and Diversity Unit. The strategy for personnel development and recruitment on the way to a professorship was awarded the title „Gleichstellung: ausgezeichnet!“ (Professorinnenprogramms von Bund und Ländern).

The faculty has an equal opportunity office which acts as a contact point for faculty members seeking advice. Equal opportunities officers are members of all commissions and boards (exception of the habilitation commission). The office supports individual projects and measures totaling around 90.000 € were implemented in the reporting period (including compensation for equal opportunities officers, the Dorothea Schlözer program, and the women's advancement pool). The faculty supports measures for the active recruitment of female professors and staff such as symposia, guest lectures and other targeted approaches. Measures to improve the compatibility of career and family include that board meetings and guest lectures are held at family-friendly times. Scientific support during pregnancy or parental leave is also available. The number of female professors at the faculty increased from 13 % in 2006 to 30 % in 2020.

For gender ratios see appendix (table 5).

3.4.4 Research data management

Research data management is handled according to the regulations of the DFG and to the requirements of each project. Since 2015, the conception and implementation of research data management in Göttingen is supported by the eResearch Alliance[12], providing advice, tools for the creation of data management plans, and a research data repository, which can be used to publish research data and assign DOIs. Furthermore, the GWDG provides solutions for backup and long-term archiving and centralized resources like HPC computing, SharePoint or Owncloud network drives. At the level of the institutes and individual research units, the faculty has established a working group to develop a uniform guideline and structure for data management in close cooperation with the eResearch Alliance. Each biological institute has so far at least one IT specialist taking care of the general IT services. The research units and methodological platforms have an additional demand for IT specialists. To this end, IT specialists (Fachinformatiker) are trained by the Department of Genomic and Applied Microbiology. Since the demand for analysis of large datasets is constantly increasing in the biological research units,

[12] University of Göttingen, Göttingen State and University Library (SUB), Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen (GWDG)

the faculty has installed the new departments for Data-driven Analysis of Biological Networks (M. Wibral) and Applied Bioinformatics (J. de Vries) in addition to the already existing Bioinformatic department (B. Morgenstern). In 2021/22 another new W3 professorship for Biological Data Science will be established with funds from the MWK. To meet the increasing demand for qualified doctoral researchers in this area, the faculty will also launch the new Master program „Computational Biology and Bioinformatics“ (starting WS22/23). The faculty participates indirectly in NFDI consortia via the Göttingen Campus (eResearch Alliance), e.g. the consortium NFDI4BioDiversity – Biodiversity, Ecology and Environmental Data is relevant for biological research.

3.4.5 Plans and perspectives

The three main **profile-building research areas** (i) Molecular Biosciences, (ii) Biodiversity, Ecology and Evolution, and (iii) Neurobiology, Cognition and Behavioral Research will also be the focal points of research and teaching in the near future.

The faculty will balance foci-related research with research diversity to be able to cope with new research areas, which are constantly emerging and evolving. Currently, **new large collaborative projects** (SFB, RTG, DFG Research Unit) falling into all three focal points with speaker function are at the stage of evaluation, submitted full proposal, sketch or planning. The majority of the projects of the proposed SFB 1528 „Cognition of Interaction“ (on-site evaluation 09/2021, speaker A. Gail) derive from research units of the faculty. The DFG Research Unit full proposal “Genome evolution of asexual eukaryotic organisms” (speaker E. Hörandl) has been submitted and is under evaluation. The preproposal for the RTG “Functional genetics in emerging animal model organisms reveals the diversity of gene function in development and pest control“ (speaker G. Bucher) is currently being evaluated by the DFG. In addition, further RTG and SFB proposals related to the research foci Biodiversity and Evolution and Molecular Biosciences are in the planning phase.

The currently funded **Cluster of Excellence** “Multiscale Bioimaging” (MBExC2067) is supported by one Alexander von Humboldt professorship (J. Huisken starting in 2021) and two new junior research groups (starting in 2021/22). In addition, a proposal for a new cluster focusing on cognition and behavior is in the developmental phase. The decision on proposal advancement by the presidential board is expected at the end of 2021. Furthermore, the biodiversity- and nature conservation-related biological research units are involved in developing a cluster proposal “Climate-smart Land“.

In the future, the research profile in Cognition and Behavioral Research will profit from the approved **Research Center** (Forschungsbau, finished 2025) **„Human Cognition and Behavior (HuCaB)“** combining research units from Biology, Psychology, DPZ and Medicine.

Starting in 2025 four full **professorship positions** will be vacant that are central for two of the three research areas (Braus, Gatz, both from Molecular Biosciences; Leuschner and Scheu, both from Biodiversity). To avoid gaps the faculty is currently active to fill up these open positions by third-party funded professorships (e.g., BMBF-funded "Nachwuchspakt", DFG-funded Heisenberg program). Following this strategy, the faculty recently appointed J. Kamp (Nature Conservation, Nachwuchspakt), J. de Vries (Applied Bioinformatics, Nachwuchspakt), J. Huisken (AvH professorship, starting in 2021) and K. Heimel (Microbial Cell Biology, Heisenberg professorship start in 2021). In addition, T. Ischebeck (Plant Cell Biochemistry) received a, Heisenberg grant (start in 2021).

In addition, the faculty defined **Bioinformatics and Data Science** as a priority area to cope with the increasing demand for managing and analysis of large datasets, which is also strategically required to be successful in applications for larger collaborative research projects. Bioinformatics and Data Science are therefore in the focus of new research units and future teaching programs (see also 3.4.4.).

4 Universität Hannover

4.1 Structure and general framework

4.1.1 Structure

The Leibniz University Hannover (LUH) is a technical university with nine faculties. The key research areas of the university are Biomedical Research and Engineering, Quantum Optics and Gravitational Physics, Optical Technologies, Production Engineering, and Interdisciplinary Studies of Science (*Wissenschaftsreflexion*).

The historic development of Biology at LUH is best understood against the background of the profile of the neighbouring universities, since the fields of medical sciences, medical technology (bio-)pharmacy, and human biology (sometimes referred as “red biology") have mainly been implemented in research and teaching at Hannover Medical School (MHH), the University of Veterinary Medicine Hannover (TiHo) and the TU Braunschweig. Thus, LUH has developed a strong tradition in plant biology and horticulture with many "green" professorships and institutes. Plant research at LUH is characterised by interactions between basic (molecular) and applied (horticultural) research, e.g. in plant breeding and cultivation. The research focus has been and will be subject to continuous future changes, because of profound strategic and operational rearrangements between the biological and the former horticultural institutes. These ongoing rearrangements affected almost all institutes. The intended reorganisation of Biology is to strengthen molecular and cellular biology as well as biodiversity and bioeconomy and to form an area of competence called the Bio-Eco-Sphere.

The institutes involved are part of the faculty of Natural Sciences. The faculty comprises the so called teaching units (*Lehreinheiten*) Biology, Plant Sciences, Geosciences, Geography, and Chemistry. Three biological institutes belong to the teaching unit Biology (Cell Biology and Biophysics, Microbiology, Geobotany), and three belong to the teaching unit Plant Sciences (Botany, Plant Nutrition, Plant Genetics). The following seven institutes and 16 Professorships are part of the biological sciences:

- **Institute of Cell Biology and Biophysics**
  - Cell Biology (Prof. Dr. Cornelia Lee-Thedieck, W3, since 10/2018)
  - Biostatistics (W2, vacant since 2017)

- **Institute of Microbiology**
  - General Microbiology (Prof. Dr. Thomas Brüser, W3, since 10/2009)

- Soil Microbiology (Prof. Dr. Marcus A. Horn, W2, since 4/2016)
- Cellular Microbiology (Prof. Dr. Natalia Tschowri, W2, since 10/2020)

- **Institute of Geobotany**
  - Zoological Biodiversity (Prof. Dr. Emily Poppenborg Martin, W2, since 7/2020, tenure-track W3)
  - Plant Ecology (Prof. Dr. Hansjörg Küster, C3, since 2/1998)

- **Institute of Botany**
  - Plant Physiology (Prof. Dr. Thomas Pfannschmidt, W3, since 4/2019)
  - Sulphur metabolism and abiotic stress (Prof. Dr. Jutta Papenbrock, W2, since 8/2010)
  - Biochemistry of Plant Specialised Metabolites (Prof. Dr. Jakob Franke, W2, since 1/2020, tenure track W2)

- **Institute of Plant Nutrition**
  - Molecular Plant Nutrition (Prof. Dr. Claus-Peter Witte, W3, since 10/2014)

- **Institute of Plant Genetics**
  - General and Molecular Plant Breeding (Prof. Dr. Thomas Debener, W3, 7/2004)
  - Plant Biotechnology (Prof. Dr. Jens Boch, W3, since 10/2015)
  - Plant Molecular Biology (Prof. Dr. Udo-Klaus Schmitz, W2, since 10/1995)
  - Plant Genomics (Prof. Dr. Helge Küster, W3, since 10/2008)
  - Plant Proteomics (Prof. Dr. Hans-Peter Braun, W3, since 1/2008)

- **Institute of Science Education**
  - Biology Education (Prof. Dr. Kerstin Kremer, W3, 4/2019 - 9/2021, currently vacant)

4.1.2 Personnel

Together the institutes have ten W3 professorships, and six W2 professorships (one currently C3). Two professorships are tenure-track positions, for W3 and W2 respectively (until 2025). Until 2026 two professorships are scheduled to become vacant (successions of Hansjörg Küster, C3; Udo Schmitz, W2). On 01.12.2020 a total number of 153 people were employed (117.0 FTE). 16.0 FTE of professorships, 30.7 FTE of scientific personnel and 38.1 FTE of

non-scientific personnel were funded by basic funds (Grundmittel). 25.9 FTE of scientific personnel and 3.3 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

4.1.3 Research infrastructure

Most of the institutes are located on one site in buildings on the **Herrenhausen Campus** (Botany, Microbiology, Plant Nutrition, Plant Genetics, Cell Biology and Biophysics). The Institute of Geobotany (Nienburger Straße 17) and the Institute of Science Education (Am Kleinen Felde 30) are located separately. There is a **central greenhouse** (2,080 m²) with 18 climate chambers and 18,500 m^2 of field plots for plant experiments are available at Campus Herrenhausen and around 40 ha of field space with an **experimental field station** about 30 km southeast of Hannover. The facilities are maintained by staff (basic funds) from the institutes. Major instrumentation is usually run by scientific personnel on permanent positions.

The research units hold **major instrumentation** for DNA and protein analysis, biophysics and super-resolution microscopy. The maintenance is funded mostly from core funds of the research units.

The biological institutes have access to **external research infrastructure** of the Center of Biomolecular Drug Research (structural biology, compound synthesis and characterisation), the Institute of Technical Chemistry (cell sorting), the Laser Zentrum Hannover, and the Lower Saxony Centre for Biomedical Engineering, Implant Research and Development (NIFE).

4.2 Research

4.2.1 Profile

According to the self-report, it is due to historical and regional structural reasons, that the research profile of Biology in the Faculty of Natural Sciences at LUH is primarily focused on **plant science** topics. Traditionally, zoological and animal physiology disciplines are represented by the TiHo, whereas biomedical expertise and human biology is provided by MHH. In a narrow sense, the Biology at LUH is consisting of the Institutes of Microbiology, Biophysics (since 2018: Cell Biology and Biophysics), and Geobotany, whereas the Plant Sciences historically represented a separate unit. It is therefore seen as inevitable that Biology at LUH lacks expertise that is prerequisite for a full profile in biological sciences.

Profiling projects focus on **signaling at the plant soil-soil interface** (Plant Genetics), **sustainable agriculture** in east Africa (Geobotany), **bone marrow analogs for hematological**

and musculoskeletal diseases (Cell Biology and Biophysics), and **production and transport of Limonoids and Quassinoids** (Biochemistry of Plant Specialised Metabolites).

4.2.2 Key publications

Martin EA, Dainese M, Clough Y, Báldi A, Bommarco R, Gagic V, et al.: The interplay of landscape composition and configuration: new pathways to manage functional biodiversity and agroecosystem services across Europe. Ecology Letters 22: 1083-1094 (2019). F1000 Prime recommended, top cited papers Ecology Letters 2019-2020

Baccolini C, Witte CP: AMP and GMP catabolism in Arabidopsis converge on xanthosine, which is degraded by a nucleoside hydrolase heterocomplex. Plant Cell 31: 734-751 (2019).

Raic A, Riedel S, Kemmling E, Bieback K, Overhage J, Lee-Thedieck C: Biomimetic 3D in vitro model of biofilm triggered osteomyelitis for investigating hematopoiesis during bone marrow infections. Acta Biomaterialia 73: 250-262 (2018).

Ringel MT, Dräger G, Brüser T: PvdO is required for the oxidation of dihydropyover-dine as last step of fluorophore formation in Pseudomonas fluorescens. J Biol Chem 293: 2330-2341 (2018).

Senkler J, Rugen N, Eubel H, Hegermann J, Braun H-P: Absence of complex I implicates rearrangement of the respiratory chain in European mistletoe. Current Biology 28: 1606-1613 (2018).

4.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 – 2020) the institutes acquired a total sum of **8.62 Mio €** in **third party funds**.

Collaborative research programmes with speaker function or with significant contribution (i.e. at least 25 % of projects)

Title	Funding body	Speaker
GRK 1798: Signaling at the plant-soil interface	DFG	Helge Küster, Plant Genomics, LUH
UPSCALE: upscaling the benefits of push-pull technology for sustainable agricultural intensification in east Africa	EU H2020	Emily Poppenborg-Martin, Geobotany, LUH

4.2.4 Early career development

Graduate Academy of LUH offers a broad range of courses for young academics, consisting of interfaculty courses on scientific techniques, organisational and personal skills as well as career planning and design. In the two-semester, doctorate-accompanying PhD plus+ programme, candidates acquire skills relevant to the job market and build professional networks for a further career outside the university.

The **faculty´s graduate school GRANAT** (GRAduate school of NATural sciences; implemented in 2009) ensures the quality of structured doctoral programmes as well as traditional

doctoral procedures and offers qualification courses for graduates, doctoral students and post-docs, which are specifically tailored to the needs of natural scientists, e.g. on good laboratory practice.

One third-party funded structured PhD programme was coordinated by the Biology at LUH: the DFG research training group GRK 1798 “Signaling at the plant-soil interface” (speaker Helge Küster, Plant Genomics).

A total number of **70 PhDs** and **four Habilitations** were awarded during the reporting period.

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track
Zoological Biodiversity	BMBF (Nachwuchspakt)	Emily A. Poppenborg Martin	Yes (W2 tenure track W3)
Biochemistry of Plant Specialised Metabolites	BMBF (Nachwuchspakt) DFG (Emmy Nother Group)	Jakob Toni Franke	Yes (W2 tenure track W2)
Biomimetic Nanostructured Materials for Culturing Hematopoietic Stem Cells	BMBF (Nachwuchsgruppe)	Cornelia Lee-Thedieck	n/a (W3 since 10/2018)

One early career scientists received an **external offer** for a professorship position.

4.2.5 Science communication and technology transfer

The central Department of Communication and Marketing and its „LUH Science Communication LAB“ support **science communication** at the university. Scientists get support in fulfilling their role in science communication e.g. in workshops or by the provision of experimental spaces in which they can explore formats in a protected space. The biological research units are regularly participating in the LUH "A night out with science".

LUH offers central support for **technology transfer**: a research transfer and technology contact point (“uni-transfer”) and a start-up service ("starting business"). GRANAT organises an annual one-week "School of Entrepreneurship" with a certified start-up coach of the Federal Ministry for Economic Affairs and Energy (BMWi) for those interested in starting a business from the Master's degree level onwards.

The research unit General and Molecular Plant Breeding is involved in collaborative projects with breeding companies. A molecular biological method has been developed to improve radiation-induced breeding of ornamentals for particular colour components. A joint patent has been filed.

4.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

The research unit Biochemistry of Plant Specialised Metabolites (Prof. Dr. Jakob Franke) is a member of the **Centre for Biomolecular Drug Research (BMWZ)**. According to the self-report, the BMWZ has developed into the most important cross-thematic research center for the majority of the Faculty of Natural Sciences, both in terms of topics as well as infrastructure. The BMWZ is an interdisciplinary research institute in a 22 million € new laboratory building. It was founded in 2014 and houses research groups from the fields of chemistry, biosciences and structural biology working together on topics related to natural products and drug discovery. Both scientifically fundamental and medically applicable projects are pursued at the BMWZ. Of particular importance are compounds derived from plants, fungi and microorganisms with the potential for antibacterial, antiviral and antitumor properties. The centre is a strategic partner for the MHH, the Fraunhofer ITEM, TU Braunschweig and the Helmholtz Centres in Braunschweig (HZI), Munich and Saarbrücken. The intention is to increase the number of faculty members with a background in biology in the BMWZ in a timely manner.

The research unit Zoological Biodiversity (Prof. Dr. Emily Poppenborg Martin) is part of the **Leibniz Research Centre for Transdisciplinary Rural and Urban Spatial Transformation (TRUST)**. TRUST is an university research centre for interdisciplinary collaboration between geography and social science institutes, ecology and biodiversity sciences as well as environmental planning (Faculty of Architecture and Landscape Science). The centre aims to be a focal point for questions of sustainability and transformative capacity of social-ecological systems and offers the opportunity for strategic development across disciplines of integrative research axes and projects including key thematic areas of the biological sciences, such as plant-insect interactions, ecosystem functioning research, biodiversity-driven ecosystem services and biological monitoring.

In the area of Teacher Training, the **Leibniz School of Education** serves as roof for all contributing subjects including the Didactics of Biology (Prof. Kerstin Kremer).

To strengthen and expand scientific expertise within the research spectrum, LUH has cooperation agreements with regional, national and international partners in science and industry. Close alliances were established with TU BS (Research Alliance Braunschweig Hannover) and

MHH (Leibniz Alliance Hannover). Biomedical Research and Technology plays a crucial role in both alliances and researchers from TU BS and MHH are engaged in the BMWZ. Collaborative projects with researchers of the biological units are currently in conception.

Internationalisation

The biological institutes follow the overall **internationalisation strategy** of the Faculty of Natural Sciences. An important pillar is the ERASMUS exchange program, which is aimed at B.Sc. students. Partner universities relevant for the biological institutes are currently Stockholms universitet, Universidade de Lisboa, Università degli Studi di Milano, Università degli Studi di Palermo, Universitat Autónoma de Barcelona, University of Zurich, and University of Cork.

Internationalisation measures of importance to early career development relate to **teaching** in English. In addition to the M.Sc. International Horticulture, which has been conducted consistently in English since 1997, all other curricula also contain elective modules in English. The faculty would like to increase the number of foreign students ("incomings") and for this purpose the offer of modules offered in English, especially in the master's area, is planned to be increased.

The faculty is involved in the **application** within the **European Universities Program**. Under the leadership of LUH and the Vienna University of Technology the European network EULIST (European Universities Linking Science and Technology) will primarily aim to promote joint educational programs and enable easy exchange for students. EULIST has a strong focus on the Sustainable Development Goals of the UN which connects to Eco Spheres of the faculty.

A total of 24 guest scientists were hosted by the biological institutes. Among them were six professors (AvH, DAAD, DFG funded), eight postdocs, and ten PhD candidates / students.

The self-report states the ambition to increase the number of guest scientists funded by the Alexander von Humboldt foundation and to realise major international collaborative projects in the future.

19 % of the **PhDs** completed during the reporting period were **awarded to international graduates** (13/70).

4.3 Teaching

Degree courses

The following degree courses are offered:

- Biology, Bachelor of Science (together with MHH and TiHo)
- Biology in the 2-Subjects Bachelor (together with MHH and TiHo)
- Biology, Master of Education
- Molecular Microbiology, Master of Science
- Molecular and Applied Plant Science, Master of Science
- Plant Biotechnology, Bachelor of Science (closes 2022)
- Plant Biotechnology, Master of Science
- Horticulture, Bachelor of Science (closes 2022)
- Horticulture, Master of Science (closes 2022)
- International Horticulture, Master of Science

The total number of graduates (Bachelor, Master) of all courses was n = 221 (2018), n = 242 (2019), and n = 229 (2020).

The total amount of first year students (Bachelor, Master) of all courses was n = 485 (2017/18), n = 435 (2018/19), and n = 486 (2019/20).

How research feeds into teaching

Research activities at the biological institutes feed into teaching via the integration of B.Sc. and M.Sc. theses in ongoing projects. Wherever possible, student projects are integrated into the projects of the individual research units, in order to complement third-party funded research.

Further remarks of teaching

The biological institutes are also participating y in the B.Sc. and M.Sc. Life Science as well as the M.Sc. Landscape Sciences and contributing to the B.Sc. and M.Sc. Biochemistry via “Lehrexporte”. The reorganisation of the Faculty of Natural Sciences also affects the study courses especially in the horticulture. Some courses will be terminated or replaced within the next years.

4.4 Strategy and governance

4.4.1 Governance

The complex organisation of the educational programmes, e.g. with multiple plant science *curricula* and a B.Sc. Biology run by three independent universities (TiHo, MHH and LUH) made it necessary to divide teaching activities into teaching units (*Lehreinheiten*) "Biology" and "Plant Science", with the latter largely but not completely identical to the former teaching unit "Horticulture". The rationale behind this distinction is caused by legal aspects surrounding the definition of teaching capacities between the different participating universities. It is not a reflection of the structure of biological sciences at LUH.

The governance structure of the biological institutes is characterised by their diverse history. Whereas the Institute of Botany and the Institute of Microbiology traditionally had been part of the teaching unit "Biology" (with the Institute of Botany recently switching to the teaching unit "Plant sciences"), other institutes as e.g. the Institute of Plant Nutrition or the Institute of Plant Genetics used to be (partially) part of the former Lehreinheit Horticulture (currently the teaching unit "Plant Sciences"). This is still reflected by the available resources originating from the horticultural groups (greenhouse and field resources) as well as the main teaching obligations which are largely (but not exclusively) in programmes originally initiated by the Lehreinheit Horticulture (e.g. the M.Sc. International Horticulture, the B.Sc./M.Sc. Horticulture, the B.Sc./M.Sc. Plant Biotechnology and the B.Sc. Molecular and Applied Plant Sciences).

All institutes are managed as independent units concerning the management of the core budget and the allocated resources (staff from core funding, equipment, basic funding). Their governance structures are individually regulated by institute constitutions and represented by acting directors periodically elected among the heads of the research units.

4.4.2 Research quality assurance and internal incentive programmes

Quality assurance

The rules of Good Scientific Practice are based on the recommendations of the DFG. They are laid down in the guidelines to secure Good Scientific Practice and are binding for members and relatives of the LUH. To prevent fraud and irregularities, a two-stage procedure has been established for professional self-regulation in science. In case of suspected scientific misconduct, members of the university can contact a mediator, who carries out a preliminary examination of the allegations. If the suspicion is substantiated, the case will be examined by an

independent investigative com-mission, taking into account all available evidence and hearing the persons involved. If the allegations are confirmed, the university authorities will apply relevant sanctions. Students, graduates and doctoral candidates are taught the principles of Good Scientific Practice by their scientific supervisors. The supervision of young academics is carried out in accordance with the "Guidelines for Good Supervision of Ph.D. Candidates" passed by the senate and the executive committee. To support this, the Graduate Academy and GRANAT offer e-learning courses with a final examination and certificate, following the curriculum "Good Scientific Practice" developed on behalf of the German Research Ombudsman.

Internal incentive programmes

At the level of the faculty, there are direct incentives for the acquisition of third-party funding in the form of **performance-oriented allocation** of funds, in which 15% of the global budget is currently allocated on the basis of key figures. Within the faculty itself, budgeting is also based on key figures (third-party funds, doctorates, citations).The faculty also provides targeted funding of individual measures to promote areas of strategic importance, e.g. through funding of additional junior research positions.

Overhead

No guidelines for the use of overhead funds from third-party funding were reported.

4.4.3 Equality and Diversity

The strategy and the measures with respect to gender, equality, and diversity at the biological institutes is based on the strategies at the university level. In the reporting period, there is evidence of equal participation of both genders in the completion of studies and doctorates within the faculty. However, the proportion of women after the doctorate is dropping to only 17 % of young academics in 2020. The proportion of women in professorships increased from 19 % to 26 % between 2018 and 2020. Four out of six appointments in Biology could be filled with female applicants. The faculty aims to increase the proportion of women to 33% at all academic, postdoctoral levels by 2024. To promote equality and diversity and also to increase gender and diversity competence at the faculty, the following measures have been implemented and are to be expanded:

- The W2-professorship "Cellular Microbiology" was filled from the funding programme "Professorinnen-Programm III"

- The training programme "Leadership in Science" was used to prepare female professors and experts in research and teaching for complex leadership and managerial roles
- Supervision and Peer Counseling "Qualification Module for Female Early Career Scientists"
- The "Caroline-Herschel-Programme" has been used to support young female scientists on their way to professorship
- Gender and Diversity Day (faculty in cooperation with GRANAT)
- Workshops and individual coachings offered by the Equal Opportunities Office

For gender ratios see appendix (table 5).

4.4.4 Research data management

Research data management (RDM) at the biological institutes follows the central RDM guidelines and infrastructure of LUH. The central support includes counselling, training and information by a Research Data Support Team. The infrastructure provided by LUH comprises solutions for cloud storage, data synchronisation, office applications, versioning and collaborative development of code, digital asset management and metadata management of images, documents and videos as well as a database server, data archive and repository.

Beyond resources of the LUH, the biological institutes contribute data to and make use of the Gfbio (https://www.gfbio.org/) and PANGAEA (https://pangaea.de/) as regards especially project consulting on data management plans, data quality check and curation, repository to publish data, trainings and information material, and as a networking resource with the international research community in the field of Biology.

The biological institutes plan to make active use of recently funded National Research Infrastructure (NFDI, https://www.nfdi.de/verein) consortia, in particular NFDI4Biodiversity (https://www.nfdi4biodiversity.org/), DataPlant (http://nfdi4plants.de/), and NFDI4Microbiota (https://nfdi4microbiota.de/, if funded) as well as of the German Network for Bioinformatics Infrastructure (deNBI, https://www.denbi.de), particularly for subject-specific data analysis tools and cloud computing for cross-site Big Data analytics.

4.4.5 Plans and perspectives

In response to financial cuts by the state of Lower Saxony, the presidential board of LUH decided to close down plant science units related to horticulture. Thus, the faculty is undergoing a **restructuring process** that includes the development of a **new competitive biological focus**. The future strategy aims to **interconnect different faculty disciplines**. The planned

research focus **"Biological Networks and Interactions: from Molecules and Cells to Biospheres"**, will be one approach to this new strategy, accompanied by already existing approaches of the institutes. Several research topics will be designed with the aim to connect the different faculty´s competence domains, to foster existing strengths and to initiate **new interdisciplinary research areas**, thereby developing the critical mass necessary for acquiring novel third-party funded collaborative research projects, e.g. collaborative research centers (SFB). A preproposal for a **SFB application** which will cover **biological, biotechnological and chemical aspect on terpenoids as valuable secondary metabolites** is planned to be submitted for evaluation until the end of 2021.

The following future **major research areas** are under discussion:

Interkingdom, organismal and cellular communication: Institute of Cell Biology and Biophysics, Institute of Geobotany, Institute of Microbiology, Institute of Plant Genetics; Cooperation: Institute of Horticultural Production Systems

Metabolites, drugs and compounds: Institute of Botany, Institute of Cell Biology and Biophysics, Institute of Microbiology, Institute of Plant Genetics, Institute of Plant Nutrition; Cooperation: BMWZ, Institute of Technical Chemistry, Institute of Medicinal Chemistry of the Helmholtz Center Munich, MHH

Biodiversity/ecology: Institute of Geobotany, Institute of Microbiology, Institute of Plant Genetics; Cooperation: Institute of Horticultural Production Systems, Institute of Soil Science, Institute of Meteorology and Climatology, TiHo, Institute of Physical Geography and Landscape Ecology, Institute of Environmental Planning (Faculty of Architecture and Landscape Sciences)

Cell-material interactions: Institute of Cell Biology and Biophysics, Institute of Microbiology; Cooperation: Institute of Inorganic Chemistry, Institute of Organic Chemistry, Institute of Technical Chemistry, NIFE, MHH

The **recently hired researchers** Prof. Cornelia Lee-Thedieck (ERC Starting Grant), Prof. Natalia Tschowri (Emmy Noether grant), Prof. Jacob Franke (Emmy-Noether grant) and Prof. Emily Poppenborg Martin (EU H2020 grant) are thought to **strengthen these main research areas**, which are intended to be complemented by **future calls for professorships**. The strategic and operational reorganization of biological sciences will be mirrored in the corresponding teaching activities, a process that will involve also the Institute of Didactics in Natural Sciences.

The **major research areas** will also integrate four **tenure track** (TT) **professorships** recently appointment by the faculty in frame of the tenure-track programme of the federal government (BMBF).

Biology at LUH is in a process of change and realignment and will affect almost all institutes. According to the self-report, the evaluation by the WKN is seen as an opportunity to leverage the impact of the evaluation for future hires and to inform the ongoing change process. The results of this process will be evaluated internally in 2026.

5 Universität Hildesheim

5.1 Structure and general framework

5.1.1 Structure

University of Hildesheim (Uni Hildesheim) is a foundation under public law (Stiftungsuniversität). It consists of four faculties and has its origins in an University of Education dating back to 1946. Interdepartmental focal points in research are educational sciences, cultural studies, and teacher training.

Prior to 2000, the Department of Biology was exclusively engaged in the education of biology teachers. Research activities during this time focused on ethology and entomology. In 2000, the current chair holder Prof. Dr. Horst Kierdorf was appointed and established the Hard Tissue and Bioarchaeology Research Group (HTBRG). In 2011 a second research unit (Ecology and Environmental Education) was set up by establishing a junior professorship. The successor on this position Prof. Dr. Johannes Metz is currently leading the Plant Ecology and Nature Conservation Research Group, whose research focus has shifted accordingly. In October 2020, a third research group with a focus on biology didactics was established. This unit, which is led by apl. Professor Anke Meisert, has become operational in 2021 and is therefore not included in the current report.

The biological research units form the Department of Biology and are part of the Institute of Biology and Chemistry, which belongs to Faculty 4 (Mathematics, Natural Sciences, Economics and Computer Science). The following professorships exist:

- **Institute of Biology and Chemistry**
  - Biology with focus on Zoology and Human Biology (Prof. Dr. Horst Kierdorf, C3, since 06/2000)
  - Plant Ecology and Nature Conservation (Prof. Dr. Johannes Metz, W1, since 11/2018)

5.1.2 Personnel

The institute has one C3 professorship and one W1 professorship. Both are scheduled to become vacant until 2026. On 01.12.2020 a total number of 20 people were employed (13.6 FTE). 2.0 FTE of professorships, 9.1 FTE of scientific personnel and 2.5 FTE of non-scientific personnel were funded by basic funds (Grundmittel). No personnel funded by third-party funds (Drittmittel).

5.1.3 Research infrastructure

The Department of Biology runs three labs for research and teaching: a histology and scanning electron microscopy lab, an analytical lab, and an environmental lab. In addition, a greenhouse has been erected in 2020 for experiments in plant ecology. The histology and scanning electron microscopy lab and the analytical lab are led by personnel with permanent contracts. The scanning electron microscope is occasionally also used by researchers from the HAWK University of Applied Sciences and Arts Hildesheim.

5.2 Research

5.2.1 Profile

The research conducted in the Department of Biology is an integral part of the environmental and human health related research activities at the University of Hildesheim. These areas of research are combined in a university research cluster (Potentialfeld) with contributions by the Departments of Biology, Geography, Psychology and Sports Science of the University of Hildesheim.

The research profile of the Department of Biology combines basic and applied topics in **hard tissue biology**, **ecotoxicology**, **nature conservation**, **plant ecology** and **biology didactics**.

The **Hard Tissue and Bioarchaeology** unit is undertaking research on mineralized dental and skeletal tissues of vertebrates, with a focus on humans and other mammals. The unit aims to contribute to a variety of topics including the development and structure-function relationships of mineralized tissues, the evolution and functional morphology of dental and skeletal structures, the reconstruction of living conditions and environments of past human and animal populations, and the effects of pollutants and environmental perturbations on individuals and populations.

The **Plant Ecology & Nature Conservation** research unit investigates the responses and adaptations of organisms to their biotic and abiotic environment. By identifying vulnerable points in these complex relationships, especially under climate and land-use change, the unit links ecological theory with nature conservation. The group focuses on adaptation strategies of Mediterranean plants to increasing aridity and on population dynamics of endangered central European plant species (wetland orchids). Furthermore, the unit studies related questions for arthropods and smaller vertebrates, both in Germany and Madagascar.

The **Didactics of Biology** unit has started its research in 2021.

5.2.2 Key publications

Metz J, Lampei C, Bäumler L, Bocherens H, de Meaux J, et al. (2020) Rapid adaptive evolution to drought in a subset of plant traits in a large-scale climate change experiment. Ecology Letters 23, 1643-1653.

Schüßler D, Blanco MB, Salmona J, Poelstra J, Andriambeloson JB, Miller A, Randrianambinina B, Rasolofoson DW, Mantilla-Contreras J, Chikhi L, Louis EE, Yoder AD, Radespiel U (2020) Ecology and morphology of mouse lemurs (Microcebus spp.) in a hotspot of microendemism in northeastern Madagascar, with the description of a new species. American Journal of Primatology 82, e23180.

Kierdorf, H.; Breuer, F.; Witzel, C.; Kierdorf, U. (2019) Pig enamel revisited - Incremental markings in enamel of wild boars and domestic pigs. Journal of Structural Biology 205, 48-59

Landete-Castillejos, T.; Kierdorf, H.; Gomez, S.; Luna, S.; García, A.J.; Cappelli, J.; Pérez-Serrano, M.; Pérez-Barbería, J.; Gallego, L.; Kierdorf, U., (2019) Antlers - evolution, development, structure, composition, and biomechanics of an outstanding type of bone. Bone, 128:115046.

Schüssler, D.; Radespiel, U.; Ratsimbazafy, J.H.; Mantilla-Contreras, J. (2018) Lemurs in a dying forest: Factors influencing lemur diversity and distribution in forest remnants of northeastern Madagascar. Biological Conservation 228, 17-26.

5.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 - 2020) the department acquired a total sum of **0.15 Mio €** in **third party funding**.

No **collaborative research programmes** with speaker function or with significant contribution (i.e. at least 25 % of projects) were reported.

5.2.4 Early career development

Since 2019, the Graduate Centre of the University of Hildesheim forms an umbrella structure for interdisciplinary service activities relating to the promotion of young researchers and academic personnel development. The Graduate Centre offers funding, advice, courses and other measures for specific target groups. Several other units of the University of Hildesheim offer additional funding opportunities for various needs, such as travel expenses, participation fees for specialist congresses, or funds for auxiliary staff.

In the reporting period **six PhDs** have been completed. One habilitation thesis was submitted in 2020.

The self-report lists no third-party funded structured PhD programmes.

5.2.5 Science communication and technology transfer

The research activities of the Department of Biology are communicated via the press office of the University of Hildesheim. This includes several articles in the regional, national and international media and the university's own journal (Die Relation). Research activities were also reported in documentaries (e.g. the documentary "Wilde Medizin: Die Superkräfte der Tiere" broadcasted on Arte in 2018). A staff member of the Department of Biology has repeatedly acted as temporary advisor to the WHO within the International Programme on Chemical Safety (IPCS).

5.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

Within the university, interdisciplinary research projects are conducted in cooperation with the departments of geography, psychology and sports science. Collaborative research projects on a national scale are conducted with the University of Veterinary Medicine Hannover, the Justus Liebig University Giessen, and the Senckenberg Research Institute Frankfurt.

Internationalisation

There are institutionalized cooperations with the University of Zagreb (Croatia) (M.Sc. Wildlife Health and Management) and the University of Koper (Slovenia) (M.Sc. Nature Conservation).

A total of five international guest scientists were hosted by the Department of Biology during the reporting period. Among them were one professor and four postdocs.

5.3 Teaching

Degree courses

The following degree courses are offered:

- Biologie, Polyvalenter-2-Fächer Bachelor
- Umwelt, Naturschutz, Nachhaltigkeit, Master of Science
- Lehramt HR, Master of Education

The total amount of graduates (Bachelor, Master) of all courses was n = 94 (2018), n = 69 (2019) and n = 66 (2020).

The total amount of first year students (Bachelor, Master) of all courses was n = 118 (2017/18), n = 123 (2018/19) and n = 135 (2019/20).

How research feeds into teaching

Teaching activities address both the introduction into research methods (e.g. methods of hard tissue analysis, statistical methods for field ecologists) and the involvement of advanced students into current research projects in the course of project seminars.

5.4 Strategy and governance

5.4.1 Governance

The Executive Director of both the Institute of Biology and Chemistry and the Department of Biology is Prof. Dr. Horst Kierdorf. All full-time members of the Department of Biology that belong to the status group of professors form the managing board of the Department that regularly holds meetings.

5.4.2 Research quality assurance and internal incentive programmes

Quality assurance

The university has two ombudspersons, a commission für the safeguard of good research practice and an ethics committee. Currently the university is undergoing the process of establishing the revised DFG-codex for the safeguard of good research.

Internal incentive programmes

To promote research activities, the university offers financial incentives to researchers for a number of achievements. The funding depends on the amount of third-party or contracted funding and the type of funding (if applicable). In the case of projects including overhead funds (DFG, BMBF or EU), 15% of the third-party funding (excl. overheads) are allocated to the project leaders as research incentive funds for their free disposal. For contract research, 20% of the third-party funding (excl. overheads) are granted as research incentive funds. For doctorates and Humboldt Research Fellowships, a fixed amount of 5,000 euros is paid.

Overhead

Overhead funds are used in their entirety to fund indirect costs incurred as part of the funded projects.

5.4.3 Equality and Diversity

The University of Hildesheim has a gender equality concept and a gender equality plan. It strives to achieve a balanced ratio of men and women while promoting existing potential. The plan stipulates specific targets for the share of women for each respective staff category in each of the four faculties.

To this end, a variety of human resources development measures and projects have been implemented such as conference mentoring, funds for student assistants, coaching, doctoral degree completion grants, initial grants to boost research, and pro-career mentoring for female students and graduates. Study information events are aimed at increasing the interest of women in the STEM subjects. During recruitment for professorships and other academic positions, special attention is paid to gender equality. The achievement of the gender equality targets is reviewed annually.

For gender ratios see appendix (table 5).

5.4.4 Research data management

Research data management at the University of Hildesheim is centrally organized by the university library which also provides the necessary repositories. The university has published “guidelines for dealing with research data” in 2020.

5.4.5 Plans and perspectives

The three research groups in the Department of Biology plan to continue their research activities in cooperation with national and international partner institutions. It is attempted to strengthen the research infrastructure of the department and to increase the number of qualification positions (FwN-Stellen, Förderung des wissenschaftlichen Nachwuchses) with reduced teaching load.

6 Universität Lüneburg

6.1 Structure and general framework

6.1.1 Structure

The Leuphana University of Lüneburg (Leuphana) is a foundation under public law (Stiftungsuniversität). It was established in 2005 as a result of merging the University of Lüneburg with the University of Applied Sciences North-East Lower Saxony with the aim to create a model university for the Bologna process. Four faculties cover the research priorities at Leuphana in the fields of education, culture, sustainability, and management & entrepreneurship. Biology - hereafter Ecology - is represented by the Institute of Ecology, which is embedded in the Faculty of Sustainability.

The Institute of Ecology (IE) of the Faculty of Sustainability was established in 2011, after the previously existing "Institute of Ecology and Environmental Chemistry" was divided into two separate entities. Since the last research evaluation by the WKN in 2002 the IE has increasingly focused on issues of biodiversity and its relationship to ecosystem functions and services and its applied fields such as biodiversity conservation. In recent years the topic of social-ecological research has been on the rise, such that Leuphana founded its own Social-Ecological Systems Institute (SESI) in 2020. As a result, there are now two institutes covering a range of different topics aimed at complementarity. IE and SESI have their own main focus, but are set out to undertake collaborative research across the institutes. The IE provides a component of organismically-focused biodiversity research related to species and habitat biodiversity in a global change world. In contrast, SESI focuses primarily on topics such as the relationships between biodiversity and the valuing of ecosystem services, as well as assessing other interrelationships between humans and ecosystems, including governance mechanisms for biodiversity conservation. A key strategy for the next five years is the recruitment of talented early career researchers to complement the already strong profile, particularly in the areas of soil ecology and /or zoology. The following professorships exist:

- **Institute of Ecology**
  - Ecology, esp. Animal Ecology (Thorsten Aßmann, W3, since 6/2001)
  - Ecology, esp. Sustainable Land-Use (Jörn Fischer, W2, 11/2010)
  - Ecology, esp. Landscape Ecology (vacant since 9/2020, recruitment in progress)
  - Sustainable Use of Natural Resources (Jacqueline Loos, W1, since 7/2018)
  - Ecosystem Functioning and Services (Vicky Temperton, W2, 2/2015)
  - Quantitative Methods of Sustainability Science (Henrik von Wehrden, W2, since 4/2016)

6.1.2 Personnel

The institute has one C4 professorship, one W3 professorship, three W2 professorship and one W1 professorship. The C4 professorship is currently vacant (succession of Werner Härdtle, planned denomination Vegetation Ecology & Biological Conservation). The C3 professorship of Brigitte Urban (emeritus 3/2020) is now the professorship of Henrik von Wehrden (formerly W1). The third-party funded W1 professorship will end in 2026. On 01.12.2020 a total number of 38 people were employed (29.67 FTE). 5.5 FTE of professorships, 9.65 FTE of scientific personnel and 6.22 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 1.0 FTE of professorships, 7.15 FTE of scientific personnel and 0.15 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

6.1.3 Research infrastructure

The IE has **labs** with instrumentation for plant and soil sample preparation, element/isotope analyses, pollen analysis, arthropod identification, and molecular biology. In addition, the institute has a (non-heated, with automatically adjustable window apertures) **greenhouse** (82 m^2) and an outdoor area for small-scale field and mesocosm experiments (600 m^2). The IE maintains **two field sites** (approx. 7 hectares in total) in the Lüneburger Heide, researching priority effects in grasslands as well as assisted migration and nitrogen deposition effects on heather (Calluna vulgaris). For further macro-element analyses, the institute has access to **major instrumentation** of the Institute of Sustainable Chemistry (e.g. ICP-OES). Secondary plant metabolites (e.g. phenolics, tannins) which may be relevant for herbivores are studied together with the same institute (HPLC, UV spectra of leave extracts). For root measurements in rhizotrons and other root images derived from minirhizotrons, the institute is currently **cooperating** with the **Machine Learning group** of Prof. Ulf Brefeld (Faculty of Business and Economics, Institute of Information Systems) to use their cluster for **complex image analysis** tasks, such as root segmentation using deep learning (convolutional neural networks).

The institute has five biology technicians in permanent positions (4.5 FTE) to ensure continuation and knowledge transfer across projects.

6.2 Research

6.2.1 Profile

The IE is the only institute of the Faculty of Sustainability with a biological-organismic research focus. The IE is interested in an advanced understanding of mechanisms underlying **biodiversity-ecosystem functions** (including ecosystem services) and how they are related to both global drivers of environmental change and human/social systems. The IE develops its profile in tune with the universities core topic **Sustainability**. The institute has **seven research units**, two of which have emeritus status.

The **Ecology, esp. Animal Ecology** (Thorsten Aßmann) research unit studies the variability and diversity of arthropods in space and time. Research projects deal with functional groups of arthropods (predators, herbivores, decomposers, pollinators). The spectrum of analyses ranges from diversity (incl. species, phylogenetic, and genetic diversity), phylogeography, systematic-taxonomic approaches to questions of control and regulation of ecosystem functions (incl. ecosystem engineering).

The **Ecology, esp. Sustainable Land-Use** (Jörn Fischer) research unit examines landscapes from an interlinked ecological and social-ecological perspective. Research within the group contributes to the fields of conservation biology, landscape ecology, and social-ecological systems research. The group builds a bridge between ecology and the social sciences.

The **Ecology, esp. Landscape Ecology** (emeritus Werner Härdtle) research unit main interests are a mechanistic understanding of biodiversity-ecosystem functioning relationships and how these relationships are affected by the abiotic environment. The most recent research projects had a main focus on forest ecosystems and cultural landscapes, in which mutual interactions between species in relation to total biodiversity patterns, global change drivers and ecosystem functions were analyzed.

The **Sustainable Use of Natural Resources** (Jacqueline Loos) research unit aims to uncover the relationships between humans and nature to derive insights on how to inform and shape natural resource use through ecologically meaningful and socially beneficial governance. Using a combination of quantitative and qualitative approaches the unit investigates the mechanisms that support successful conservation through formal and informal institutions, taking into account the reciprocal relationships between ecological conditions and the social system at different spatial scales.

The **Ecosystem Functioning and Services research** (Vicky Temperton) research unit spans fundamental and applied research, primarily interested in the role of functional biodiversity of plants and its effects on ecosystem functions and services as well as assembly outcomes. The

unit works in grassland and multi-species cropping and to a lesser extent tree-dominated ecosystems, with the overall goal of gaining a better understanding of community assembly during development of plant communities. The gained knowledge can be applied to the restoration of degraded landscapes. A main focus of the unit is on root-root interaction.

The focus of the **Ecology, esp. Landscape Change** (emeritus Brigitte Urban) research unit lies on environmental history, the environmental reconstruction by analysing soils and sediments to deduce abiotic factors that controlled soil and vegetation development in periods without anthropogenic impact (Pleistocene) and in recent times (Holocene) with human impact. Furthermore, the unit studies the development of sustainable land use systems of mainly agriculturally used areas, and soil ecology and interactions of soil and water related to overfertilization and pollution.

The **Quantitative Methods of Sustainability Science** (Henrik von Wehrden) research unit focusses on methods. By applying methods in a different context, the unit contributes to research on a diverse array of topics. Using statistical analysis, the unit examines patterns and mechanisms of biodiversity dynamics, ecosystem services and ecological functions of a diverse array of species. In addition, multivariate statistics are utilized to analyze data for systematic reviews on different emerging topics.

6.2.2 Key publications

Manning, P., Loos, J., Barnes, A. D., Batáry, P., Bianchi, F. J. J. A., Buchmann, N., De Deyn, G. B., Ebeling, A., Eisenhauer, N., Fischer, M., Fründ, J., Grass, I., Isselstein, J., Jochum, M., Klein, A. M. […], Temperton, V. M., Westphal, C. &. Tscharntke, T. (2019). Transferring biodiversity-ecosystem function research to the management of ‘real-world’ ecosystems. Advances in Ecological Research, 61, 323-356. https://doi.org/10.1016/bs.aecr.2019.06.009

Veldman, J. W., Aleman, J. C., Alvarado, S. T., Anderson, T. M., Archibald, S., Bond, W. J., Boutton, T. W., Buchmann, N., Buisson, E., Canadell, J. G., de Sá Dechoum, M., Diaz-Toribio, M. H., Durigan, G., Ewel, J. J., Fernandes, G. W., Fidelis, A., Fleischman, F., Good, S. P., Griffith, D. M., [...] Temperton, V.M., Varner, J.M., Zaloumis, N. P. (2019). Comment on "The global tree restoration potential". Science, 366 (6463), [7976]. https://doi.org/10.1126/science.aay7976

Kapitza, K., Zimmermann, H., Martín-López, B., & von Wehrden, H. (2019). Research on the social perception of invasive species: a systematic literature review. NeoBiota, (43), 47-68. https://doi.org/10.3897/neobiota.43.31619

Rodrigues, P., Shumi, G., Dorresteijn, I., Schultner, J., Hanspach, J., Hylander, K., Senbeta, F., Fischer, J. (2018). Coffee management and the conservation of forest bird diversity in southwestern Ethiopia. Biological Conservation 217, 131-139. https://doi.org/10.1016/j.biocon.2017.10.036

Huang, Y., Chen, Y., Castro-Izaguirre, N., Baruffol, M., Brezzi, M., Lang, A., Li, Y., Härdtle, W., Von Oheimb, G., Yang, X., Liu, X., Pei, K., Both, S., Yang, B., Eichenberg, D., Assmann, T., Bauhus, J., Behrens, T., Buscot, F., Chen, X.Y., Chesters, D, Ding […], C-D., Zhu, L., Bruelheide, H., Ma, K., Niklaus, P.A., Schmid, B. (2018): Impacts of species richness on productivity in a large-scale subtropical forest experiment. Science, 362 (6410), 80-83. https://doi.org/10.1126/science.aat6405

6.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 - 2020) the institute acquired a total sum of **4.23 Mio €** in **third party funding**.

No **collaborative research programmes** with speaker function or with significant contribution (i.e. at least 25 % of projects) were reported.

6.2.4 Early career development

Leuphana offers all doctoral and postdoctoral students a range of qualification programmes, which are primarily designed and supported by five institutional actors: The Graduate School, based on the Anglo-American model, with the task of coordinating master's and doctoral programmes, the Research Service as the central point of contact for all researchers at the university, the Academic Personnel Development as a service facility for supporting academic employees, the Equal Opportunity Office with its special funding lines for female scientists, and the Teaching Service with its university didactic certificate programme. Researchers have access to services provided by the Leuphana Graduate School. In the "Gradskills" portal, courses and events are held on career planning, on the development of cross-disciplinary scientific skills, and on non-academic career paths options. In addition, doctoral candidates can take advantage of PhD defence training and one-on-one coaching for individual skills development. The university has a qualification fund that is open to all doctoral students and postdocs, and provides financial support for conference participation, summer school formats, research stays in Germany and abroad, as well as for the organization of own conferences.

Each doctoral candidate automatically joins an existing doctoral research group, a framework for scientists of a discipline to meet regularly and exchange with each other. All doctoral candidates in ecology are members of the doctoral research group “Sustainability Science”.

The self-report lists one third-party funded structured PhD programme that is relevant for the IE. The “POST - Processes of Sustainability Transformation” programme is funded by the Robert Bosch foundation (speaker Matthias Barth, Faculty of Sustainability).

The disciplinary specialization of the doctoral students within their own research projects is flanked and framed at the Graduate School by the obligatory doctoral studies programme.

A total number of **16 PhDs** and **no Habilitation** were awarded during the reporting period.

Collaborative PhD projects were conducted within the DFG International Research Training Group 2324 TreeDì - Tree Diversity Interactions: The role of tree-tree interactions in local neighbourhoods in Chinese subtropical forests (emeritus Werner Härdtle), and with the Eberswalde University for Sustainable Development.

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track
Sustainable Use of Natural Resources	Robert Bosch Foundation	Jacqueline Loos	No
Biocultural diversity in farming landscapes of the Global South	BMBF	Jan Hanspach	No

Five early career researchers[13] received **external offers** for professorship positions (Uni Göttingen, Uni Salzburg, Uni Sussex, Uni Utrecht). All researchers accepted the offer.

The institute aims to **attract outstanding researchers** by actively contacting and head-hunting candidates, particularly women, in the field of vegetation ecology and biodiversity conservation, and encouraging them to apply to the open professorship (succession of Werner Härdtle). In addition, the institute explores options for attracting excellent candidates in the area of animal biodiversity and / or soil ecology either for a DFG Heisenberg Professorship or an Emmy Noether group. Additionally, young researchers from within the institute are actively encouraged to apply for Emmy Noether grants.

6.2.5 Science communication and technology transfer

IE works together with external stakeholders to implement research outcomes in the real world to increase sustainability and biodiversity (e.g. Grassworks, EcoCult). Transfer activities in ecology also included interactions with radio, print and TV media (e.g. Prof. Aßmann in Norddeutscher Rundfunk und ARD: “Ecosystems need diversity”, “Species diversity declines

[13] Early career researchers: postdocs, group leaders, junior professors.

in Lüneburger Heath", "Climate change reduces beetle populations") as well as regular posting of research updates and news within large research platform newsletters (e.g. the BonaRes BMBF Newsletter). Moreover, social media plattforms such as YouTube, Twitter and blogs are utilized to promote the research of the IE actively. Researchers have access to central communication structures of the university, such as the Media and Public Relations Office and the recently established position for research communication, which is located at the Leuphana Research Service. In collaboration between the Faculty of Sustainability and the Ministry of Environment of Lower Saxony, Prof. Temperton ran a workshop with a range of different administrative and conservation stakeholders on the topic of Biodiversity, Climate Change and Agriculture in May 2019.

6.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

The institute has a cooperation with the Helmholtz Center Hereon in Geesthacht (Prof. Dr. Markus Quante) to gain expertise in climate modelling and deposition of air pollutants and nutrients. Further agreements exist with the Eberswalde University of Sustainable Development, the Biosphärenreservat Elbtalaue, the Alfred Toepfer Akademie (NNA), and the Verein Naturschutzpark Lüneburger Heide (VNP).

Members of the IE are involved in the Center for Global Sustainability and Cultural Transformation (CGSC), a joint collaborative centre of Leuphana and the Arizona State University. Furthermore, the International Sustainable Development and Learning Institute (ISDL) was established to strengthen research and support of transdisciplinary learning processes for sustainable development.

Internationalisation

The university's central **International Office** supports both students in their stays abroad and teachers in establishing partnerships. These are designed for continuity and are secured by bilateral agreements. International visiting scholars are integrated into research and teaching. Through the "Academic Writing Center", researchers are supported in non-German-language publications, especially in English. Degree programmes are increasingly taught in English to attract international students.

Two international guest scientists were hosted by the IE during the reporting period. Both were postdocs with funding from the VolkswagenFoundation and from the EU Marie Skłodowska Curie programme respectively.

Researchers of the IE were involved in **two major international research projects** during the reporting period. The DFG Research Unit “BEF-China: The Role of Tree and Shrub Diversity for Production, Erosion Control, Element Cycling and Species Conservation in Chinese Subtropical Forest Ecosystems (FOR 891)“ is an international consortium researching the effect of tree diversity (including functional diversity) on ecosystem functions and erosion control (emeritus Werner Härdtle, Thorsten Aßmann). Furthermore, Werner Härdtle is participating scientist in the International Research Training Group funded by the DFG: TreeDì - Tree Diversity Interactions: The role of tree-tree interactions in local neighbourhoods in Chinese subtropical forests (GRK 2324).

6.3 Teaching

Degree courses

Teaching at Leuphana in the area of Bachelor degree programmes is divided into the study of a **major (main subject**) and a **minor (subsidiary subject)**, which is framed by the Leuphana Semester as a common starting semester for all first-year students and in a complementary study for the acquisition of interdisciplinary competencies. In addition to the study of a main subject, Master programmes at Leuphana also include a complementary study programme, which is designed to bring students together in order to deepen disciplinary as well as cross-disciplinay theories, discourse or methods.

The IE is involved in the following degree courses:

- Major Environmental Sciences, Bachelor
- Major Global Environmental and Sustainability Studies, Bachelor (*in English*)
- Minor Spatial Sciences, Bachelor
- Minor Environmental Sciences, Bachelor
- Environmental Sciences, Master
- Global Sustainability Science, Master (*in English*)

The total number of graduates (Bachelor major / minor, Master) of all courses was n = 287 (2018), n = 272 (2019) and n = 302 (2020).

The total number of first year students (Bachelor major / minor, Master) of all courses was n = 286 (2017/18), n = 302 (2018/19) and n = 325 (2019/20).

How research feeds into teaching

Members of the IE offer courses that connect to the respective research foci of the professorships, e.g. students can take part in research projects on grassland restoration sites. Restoration and or conservation research projects also feed into courses at Bachelor and Master level. Furthermore, the institute has a number of field experimental platforms (in the Lüneburger Heide for EcoCult and POEM projects) that regularly feature as sites for Bachelor and Master students to undertake their thesis research projects.

Further remarks on teaching

Full professors at Leuphana have a regular teaching load of 9 hours per week per semester, whereas junior professors cover 4 hours per week. Teaching topics cover environmental science, ecology, ecological restoration & conservation and sustainability science. To strengthen the ecological profile within the Master programme “Sustainability Science”, the IE is developing a new *Biodiversity & Conservation strand* that allows students to deepen their knowledge of biodiversity conservation and governance.

6.4 Strategy and governance

6.4.1 Governance

The IE has an institute head and a deputy head. In total, the Faculty of Sustainability is comprised of seven institutes. The dean is responsible for the strategic development of the faculty and gets elected for two years. The dean is supported by the Dean of Studies and the Dean for Diversity and Internationalization. The faculty board (Fakultätsrat) constitutes an executive organ that makes decisions for the faculty e.g. professorship appointments, changes to study programmes or institute structures. Members of the faculty boards also rotate every two years.

6.4.2 Research quality assurance and internal incentive programmes

Quality assurance

In addition to the standards of scientific organizations (such as the DFG), Leuphana scientists have to observe the rules of good scientific practice, which are laid down internally in the "Guideline for Ensuring Good Scientific Practice and for the Procedure for Dealing with Scientific Misconduct at Leuphana University of Lüneburg" (Ethics Guideline) of 2009 and in the "Guideline for an Advisory Board for Ethical Issues in Research" (Ethics Committee) of 2012.

These rules are monitored by ombudspersons for professors and scientific staff, by the Commission for the Investigation of Cases of Scientific Misconduct and the Ethics Committee. Both guidelines are currently under revision.

Internal incentive programmes

There are several funding instruments at the university level as incentives for the acquisition of third-party funding (e.g. DFG, EU, BMBF) and to provide impetus for new research activities. “Research start-up funding” with an annual budget of 500,000 Euros can be applied for to finance preliminary projects. The Graduate School has an internal funding programme with an annual budget of 100,000 Euros for young researchers. Prizes are awarded annually for research achievements, taking into account the following indicators: publications, third-party funding and perception in the scientific community (citations, reviews). Furthermore, professors are given the opportunity to take advantage of research semesters (sabbaticals) on the basis of a performance-oriented catalogue.

Overhead

Overhead funds acquired in the context of third-party funded projects to cover indirect costs, are acquired at 100% centrally by the university. Scientists with successful acquisition of third-party funds can receive a financial contribution equivalent to 25% of the acquired overhead funds from the central performance-oriented fund in relation to the respective project. This regulation applies to all areas of the university.

6.4.3 Equality and Diversity

The universities Office for Equal Opportunities offers support in fulfilling its equal opportunities mandate according to the Lower Saxony Higher Education Act. Leuphana Mentoring offers a range of further education for female academics to provide them with qualifications to enhance their individual skills. Leuphana has implemented two support programmes. The "ProScience" programme is aimed specifically at female academics in the postdoc phase who are pursuing the goal of a professorship, the "ProViae" programme supports female academics in shaping their professional careers outside the university. All female academics can participate in specific coaching and workshops as part of the annual summer school "Competence Days for

Young Academics". To promote international networking in research and teaching, young female scientists can receive funding for a stay at a foreign university or invite an international guest. These offers are part of the equal opportunities concept which was successful in the female professorship programme (Professorinnenprogramm) funded by the BMBF in 2010, 2015 and 2018.

For gender ratios see appendix (table 5).

6.4.4 Research data management

Active data management before, during, and after completion of the research process is coordinated with the Service for Research Data Management (1 FTE; permanent position) at Leuphana in accordance with the FAIR principles and in line with the development of the National Research Data Infrastructure (NFDI). Research results will be secured for at least 10 years via the technical systems of Leuphana using standard professional procedures (bitstream preservation) in line with good scientific practice. All suitable materials and data are published in a legally compliant manner and made available to third parties aiming to achieve as much openness as possible. Leuphana provides a repository embedded in its Research Information System (RIS) and guarantees connectivity through the use of international metadata standards and interoperable systems, linked data, and the best possible dissemination of (meta)data. Data is quality checked, curated and uploaded to different research repositories within larger research consortia (e.g. in INPLAMINT to the BMBF BonaRes database situated in Leipzig). For smaller projects, data is uploaded to repositories within the paper publication process. Metadata of the research data sets can be made publicly available via Leuphana`s RIS.

6.4.5 Plans and perspectives

The IE aims to continue to develop its research on **functional biodiversity** and **global change drivers** in relation to **ecosystem functions** (and services) as a means to provide a strong science evidence base for conservation and ecological restoration. A recent component of this focus is the concomitant study of social as well as ecological drivers of biodiversity restoration outcomes.

Over the next five years the aim is to continue the DFG and BMBF track record and to strengthen it, aiming for a **DFG Research Unit** with speaker function within the IE. Participation in the DFG-funded Tree-Dì project, and the BMBF-funded Grassworks project (where IE has

the lead) will be continued and participation in other **national and international large research consortia** will be pursued to increase visibility and impact internationally.

Complementary to this, **active headhunting** of talented early career researchers bringing either a **DFG Emmy Noether group**, or a **Heisenberg Professorship**, to strengthen the fields of **soil or animal ecology**, forms a key strategy for the next years. Finding an excellent candidate for the **Professorship of Vegetation Ecology and Biodiversity Conservation** will ensure continuation of this research profile in terms of third party funding, publication record and outreach to conservation practice. IE and SESI are seen as complimentary parts of expertise with their foci on functional biodiversity and social ecology respectively. This combination is regarded as rather unique.

Other important collaborations include continuing participation in further ***sDiv* synthesis research** led by the DFG Centre for Integrative Biodiversity Research *(iDiv)* in Leipzig. The IE aims to remain active in this synthesis format for moving ecology to new levels of integration and global knowledge.

In terms of teaching the IE will continue the **internationalisation of its degree programmes**, and develop an innovative and new Biodiversity & Conservation strand within the Master “Sustainability Science”.

The profile of the IE will continue to be developed in a sustainability context, aiming to provide disciplinary and interdisciplinary expertise that connects in a complementary way to research (and teaching) in other institutes of the Faculty of Sustainability. The overall aim is to provide valuable knowledge in a rapidly changing world.

7 Universität Oldenburg

7.1 Structure and general framework

7.1.1 Structure

The University of Oldenburg has six faculties. Its research and teaching activities focus on three main themes: Environment and Sustainability, Humans and Technology, and Society and Education.

Research in biology is structured into three bodies: the Institute of Biology and Environmental Sciences (IBU), the division “Biology/Ecology” of the Institute for Chemistry and Biology of the Marine Environment (ICBM) and the Department of Neuroscience (DfN). IBU and ICBM belong to Faculty V (Faculty of Mathematics and Science), while the DfN is part of Faculty VI (Faculty of Medicine and Health Sciences). Over the past 20 years, there has been an exchange of professorships and research groups between the three institutes in order to develop their scientific profiles. Based on a recommendation of the WKN evaluation of biology in 2001, several groups were exchanged between ICBM and IBU, as were biochemistry and general microbiology between the IBU and ICBM. In 2012, a total of eight professorships in the field of neuroscience were moved to the newly founded Faculty of Medicine and Health Sciences, laying the foundation for the DfN. The loss of these groups was partially compensated by implementing three new professorships in 2017 and a cooperation professorship with the Institute of Avian Reseach (IfV) in 2020. By joint professorships and contracts, IBU and ICBM cooperate closely with six non-university research institutions, the Institute of Avian Reseach (IfV), the German Center for Marine Biodiversity Research (DZMB), the Helmholtz Institute for Marine Biodiversity (HIFMB), the Alfred Wegener Institute for Polar and Marine Research (AWI), the Leibniz Centre for Tropical Marine Research (ZMT), and Senckenberg am Meer (SAM).

The following three institutes and 34 professorships are part of the biological sciences:

- **Institute of Biology and Environmental Sciences (IBU)**
  - Vegetation Science and Nature Conservation (Prof. Dr. Rainer Buchwald, C3, since 10/2005)
  - -> will be replaced by Migration Ecology (in Besetzung)
  - Aquatic Ecology (Prof. Dr. Ellen Kiel, C3, since 3/2014)
  - Applied Geography and Environmental Planning (Prof. Dr. Ingo Mose, C3, since 11/2006)
  - Plant Biodiversity and Evolution (Prof. Dr. Dirk Carl Albach, W2, since 8/2009)
  - Didactics of Biology (Prof. Dr. Corinna Hößle, W2, since 2/2009)

- Hydrogeology and Landscape Hydrology (Prof. Dr. Gudrun Massmann, W2, since 3/2010)
- Marine Biodiversity (Prof. Dr. Pedro Miguel Martinez Arbizu, W2, since 12/2001)
- Molecular Systematics (Prof. Dr. Olaf Bininda-Emonds, W2, since 3/2008)
- Animal Biodiversity and Evolution (Prof. Dr. Gabriele Gerlach, W3, since 6/2007)
- Evolutionary Genetics of Plants (Prof. Dr. Sascha Laubinger, W3, since 9/2016)
- Functional Ecology of Plants (Prof. Dr. Gerhard Wolfgang Zotz, W3, since 10/2006)
- Landscape Ecology and Environmental Planning (Prof. Dr. Michael Kleyer, W3, since 4/1999)
- Neurosensory Sciences / Animal Navigation (Prof. Dr. Henrik Mouritsen, W3, since 12/2006)
- Ecological Genomics (Prof. Dr. Arne Nolte, W3, since 3/2016)
- Sensory Biology of Animals (Prof. Dr. Michael Winklhofer, W3, since 4/2016)
- Behavioral Genomics (Prof. Dr. Miriam Liedvogel, W3, since 9/2020)

- **Institute for Chemistry and Biology of the Marine Environment (ICBM)**
  - General and Molecular Microbiology (Prof. Dr. Ralf Andreas Rabus, W2, since 10/2006)
  - Benthic Ecology (Prof. Dr. Ingrid Kröncke, W2, since 4/2016)
  - Biodiversity and Biological Processes in Polar Oceans (Prof. Dr. Bettina Meyer, W2, since 3/2014)
  - Fish Ecology and Evolution (Prof. Dr. Oscar Puebla, W2, since 10/2019)
  - Biodiversity Theory (Prof. Dr. Thilo Groß, W3, since 1/2020)
  - Environmental Biochemistry (Prof. Dr. Peter Schupp, W2, since 10/2010)
  - Biology of Geological Processes (Prof. Dr. Meinhard Simon, W3, since 10/1997)
  - Plankton Ecology (Prof. Dr. Helmut Hillebrand, W3, since 7/2008)
  - Benthic Microbiology (Prof. Dr. Martin Könneke, W3, since 6/2021)
  - Marine Conservation (in Besetzung, W3)
  - Ecosystem Data Science (in Besetzung, W3, call accepted by Murat Eren, Univ Chicago)

- **Department of Neuroscience (DfN)**
  - Cochlea and Auditory Brainstem Physiology (Prof. Dr. Christine Köppl, W2, since 10/2009, third-party funded until 3/2016)

- Computational Neuroscience (Prof. Dr. Jutta Kretzberg, W2, since 3/2009, third-party funded until 2/2014)
- Auditory Neuroscience (in Besetzung, W2)
- Neurogenetics (Prof. Dr. Hans Gerd Nothwang, W2, since 9/2007; W3 2/2018 – 1/2024)
- Biochemistry (Prof. Dr. Karl-Wilhelm Koch, W3, 10/2004)
- Visual Neuroscience (Prof. Dr. Martin Greschner, W2, since 4/2013, third-party funded until 9/2018)
- Animal Physiology and Behaviour (Prof. Dr. Georg Martin Klump, W3, since 1/2007)

7.1.2 Personnel

The institutes have three C3 professorships, sixteen W3 professorships, and fifteen W2 professorships. Three W3 professorships (Ecosystems Data Science, Marine Conservation, Sensory Physiology and Behavior (succession of Zoophysiology and Behavior)) and two W2 professorship (Auditory Neuroscience, Migration Ecology (early recruitment as a successor of the C3 Vegetation Science and Nature Conservation) are currently vacant and/or in the process of recruitment. Until 2026 one further C3 professorship (Regional Sciences) and three further W3 professorships (Landscape Ecology and Environmental Planning; Biology of Geological Processes; Biochemistry) are scheduled to become vacant. On 01.12.2020 a total number of 284 people were employed (218.7 FTE). 24.0 FTE of professorships, 54.5 FTE of scientific personnel and 48.1 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 6.0 FTE of professorships, 76.8 FTE of scientific personnel and 9.3 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

7.1.3 Research infrastructure

The three institutes are located in buildings on the **Campus Wechloy** in **Oldenburg**. The ICBM has an additional site by the coast in **Wilhelmshaven**. The ICBM has access to a marine station on the island of Spiekeroog, a time-series station in the Wadden Sea, a planktotron mesocosm facility, and is home institution of the research vessel RV Sonne. The **botanical gardens** have a public section (Philosophenweg) and a 1.5 ha non-public section dedicated to research and teching (Campus Wechloy).

Most of the **major instrumentation** is organised in core facilities and managed on the basis of user regulations (*Nutzerordnungen*). The staff running the facilities are financed from basic funds. Among the top-used facilities in biology are the central unit for technical and scientific infrastructure – featuring mechanics and electronics workshops for custom orders, as well as

a core facility for scientific computing –, an animal house facility (which will be expanded) and core facilities for high-resolution microscopy (confocal and electron microscopy).

The non-university research institutions located nearby in the northwestern region of Germany (Oldenburg, Wilhelmshaven, Bremen, Bremerhaven) are regarded as a **local advantage**. These instiutions are particularly important structural elements of the collaborative research projects in the context of the interdisciplinary research focus of Biology at UOL.

7.2 Research

7.2.1 Profile

ICBM, IBU and DfN research foci are embedded in the research landscape of the northwestern region, with various research institutions contributing expertise through joint research units. The research profile of UOL Biology consists of three research areas that are cross-linked and embedded in larger interdisciplinary networks: **Biodiversity/Evolution**, **Neurosensory Science** and **Ecology/Environment** with a special emphasis on land-sea interactions. There is a clear organismic focus, spanning from micro- to macroorganisms and including molecular and genomic as well as cellular work. Research questions aim at the greater context, e.g. animal navigation, neuroethology and marine ecosystems, but also include specifics on particular organisms. Research in biology contributes to two of the three main research topics of UOL, Environment and Sustainability, Humans and Technology, and minor contributions to the third, Society and Education.

7.2.2 Key publications

Bischoff V., Bunk B., Meier-Kolthoff J., Spröer C., Poehlein A., Dogs M., Nguyen M., Petersen J., Daniel R., Overmann J., Göker M., Simon M., Brinkhoff T., Moraru C. (2019): Cobaviruses – a new globally distributed phage group infecting Rhodobacteraceae in marine ecosystems. ISME J: 13, 1404–1421.

Günther, A., Einwich, A., Sjulstok, E., Feederle, R., Bolte, P., Koch, K.-W., Solov'yov, I.A., Mouritsen, H. (2018): Double-cone localization and seasonal expression pattern suggest a role in magnetoreception for European robin cryptochrome 4. Current Biology 28, 211–223.

Hillebrand H., Donohue I., Harpole W. S., Hodapp D., Kucera M., Lewandowska A. M., Merder J., Montoya J.M. & Freund J. A. (2020): Thresholds for ecological responses to global change do not emerge from empirical data. Nature Ecology & Evolution: 1-8.

Schlüter T., Berger C., Rosengauer E., Fieth P., Krohs C., Ushakov K., Steel K. P., Avraham K. B., Hartmann A., Felmy F., Nothwang H. G. (2018): miR-96 is required for normal development of the auditory hindbrain. Human Molecular Genetics 27:860-874.

Speth C., Szabo E.X., Martinho C., Collani S., Zur Oven-Krockhaus S., Richter S., Droste-Borel I., Macek B., Stierhof Y.D., Schmid M., Liu C., Laubinger S. (2018): Arabidopsis RNA processing factor SERRATE regulates the transcription of intronless genes. eLife 7: e37078.

7.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 – 2020) the institutes acquired a total sum **27.95 Mio €** in **third party funding**.

Collaborative research programmes with speaker function or with significant contribution (i.e. at least 25 % of projects)

Title	**Funding body**	**Speaker**
SFB 1372: Magnetoreception and navigation in vertebrates: from biophysics to brain and behaviour	DFG	Henrik Mouitsen, UOL
Cryptochrome-based Magnetic Sensing	AFOSR [14]	Eroc Warrant, Lund University, Sweden
Radical pair-based magnetic sensing in migratory birds — QuantumBirds	ERC	Peter Hore, University of Oxford, UK
Cryptochrome-based Magnetic Sensing	AFOSR	Henrik Mouitsen, UOL
Patterns of diversity in forest understory plants across Eurasia	VokswagenStiftung	Dirk Albach, UOL
BEESPOKE- Benefitting Ecosystems through Evaluation of food Supplies for Pollination to Open up Knowledge for End users.	EU-Interreg V B	John Holland, GWCT
Wholegenome duplication in plants: what is the pathway to success?	The Marsden Fund / Royal Society Te Apārangi, New Zealand	William Lee, Landcare Research, Dunedin, NZ
Patterns of introgression in Veronica spicata in three regions of Eurasia	VokswagenStiftung	Dirk Albach, UOL
Marine Research and Innovation for a Sustainable management of Coasts and Oceans [MARISCO]	Belmont Forum / BMBF	UC Santa Barbara & Nelson Mandela University, Coordinator: Helmut Hillebrand, UOL
Field potentials in the Auditory System	BMBF / NSF	C.E. Carr, U. Maryland, USA R. Kempter, Humboldt University C. Köppl, UOL

[14] Air Force Office of Scientific Research

TRR51: Towards a systems biology understanding of the Roseobacter group, a prominent group of marine bacteria	DFG	Meinhard Simon, UOL
GRK 1885: Molekulare Basis sensorischer Biologie	DFG	Karl-Wilhlem Koch, UOL
OptiMOOS	EU-EFRE, Land Niedersachsen	Hans Joosten, Greifswald
Waterbuddies	BLE[15]	M. Krause, Grünlandzentrum
switchBoard - in the eye of the observer: Visual processing at the heart of the retina	EU	Thomas Euler, Tübingen
CuliFo	BLE	E. Tannicht, BNITM
Assessment of ground- and porewater derived nutrient fluxes into the North-German Sea - Is there a "Barrier Island Mass Effect?"	MWK	T. Dittmar, ICBM
IBR: Interdisciplinary approach to functional biodiversity research	MWK	Gabriele Gerlach, UOL
FOR 2716: DynaCom – Spatial community ecology in highly dynamic landscapes: from island biogeography to metaecosystems	DFG	Helmut Hillebrand, UOL
OLE plus	BMBF	Verena Pietzner, UOL
Exzellenzcluster H4A (2.0)	DFG	B. Kollmeier, UOL Lenarz, MHH
PP 1608: Ultrafast and temporally precise information processing: Normal and dysfunctional hearing	DFG	E. Friauff, U. Kaiserslautern J. Engel, U. d. Saarlandes
The Ecology of Molecules	MWK	Thorsten Dittmar, UOL
GINT	MWK	Michael Komorek, UOL

7.2.4 Early career development

The Graduate Academy represents the central service facility of UOL for the interdisciplinary qualification and promotion of doctoral candidates, postdocs and junior group leaders. It operates at three levels: i) extending the support of PhD students towards postdocs and junior group leaders, ii) emphasizing transferable skills, increasing employability and scientific performance, iii) serving as an umbrella organisation for the Graduate Schools 3GO (social sciences and humanities) and OLTECH (science, medicine and technology).

[15] Bundesanstalt für Landwirtschaft und Ernährung

The Graduate Schools foster cooperation, exchange and joint activities among researchers from different disciplines and programmes, offer training courses close to field and qualification requirements, and support the development of UOL-wide quality standards for doctorate studies.

OLTECH is the umbrella for the doctoral programmes, structured doctoral programmes and third-party funded research training groups of Faculty V, VI and the Department of Computer Science of Faculty II - Computer Science, Economics and Law.

The self-report lists eight strucutured PhD programmes that are relevant for Biology at UOL, of which two are funded permantly by basic funds of UOL (Neurosensory Science and Systems; Environmental Science and Biodiversity), three are funded by MWK (Nano-Energieforschung, The Ecology of Molecues, Interdisciplinary approach to functional biodiversity research), and three are funded by the DFG (GRK 1885: Molekulare Basis sensorischer Biologie; Auditory Science; TRR51: Integrated Research Training Group). These biology-related PhD programmes offer courses to expand specialized scientific knowledge to improve communication skills, interdisciplinary competences (e.g. statistics, scientific writing, proposal writing and project management) and introduce awareness and rules of good scientific practice.

Nearly all ICBM PhD students are enrolled in the PhD programme “Environmental Sciences and Biodiversity”. For the PhD students of this programme, thesis committee meetings have been mandatory since 2019. This programme is closely associated with external graduate schools in the northwestern region of Germany (graduate schools *Nordverbund*) and at the University of Groningen, the Netherlands.

A total number of **79 PhDs** and **one Habilitation** were awarded during the reporting period.

Collaborative PhD projects were conducted with local partners (Institute of Avian Research, AWI Bremerhaven), national partners (Uni Göttingen, MHH, Uni Rostock, Fraunhofer Stuttgart), and international partners in the UK, Mexico, Italy, Israel, and the Netherlands.

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track
Verhalten von Tierarzneimittel in Boden und Grundwasser	Kurt-Eberhardt-Bode-Stiftung	Dr. rer. nat Victoria Burke	N/A
Auditory Neurobiology	W1 (H4A)	Jun.-Prof. Dr. Jannis Hildebrandt	N/A

One early career researcher received an **external offer** for a professorship position.

To **attract outstanding researchers** UOL aims to create a scientific environment which is appealing to young scientists and supports the faculties and institutes/departments to provide

such an environment. An in-house funded programme was set up by the UOL to attract and fund young researchers for three years to apply for an ERC Starting Grant or Emmy Noether grant. The university's science administration and ad-hoc committees are dedicated to advising and coaching young researchers in applying for such grants.

7.2.5 Science communication and technology transfer

The press & communication unit (P&C) of the presidential board supports the three insitutes in **science communication.** Research news of public interest from all fields of biology and beyond are communicated via press releases, social media channels and homepages including expedition blogs, where scientists report on their work and life on research vessels. Scientists in biology actively contribute to public outreach in a variety of formats, i.e. by giving lectures in the "Schlaues Haus Oldenburg" – a special exhibition and event venue, promoting the visibility of Oldenburg's research landscape. At ICBM, two science communicators (1.3 FTE) are available and mediate new projects, publications or other points of interest within the institute. ICBM also profits from its PR activities by its memberships in the German Marine Research Consortium and the German Alliance for Marine Research.

According to the self-report **technology transfer** is not a top priority of UOL Biology. Whenever applicable, interested scientists take advantage of UOL's office for technology transfer. Examples include two start-ups by researchers at IBU, Seedforward GmbH (who received an EXIST fellowship) and one in environmental planning (both in 2018). The Excellence Centre for Hearing Research fosters translational developments by linking to regional, non-university partners such as „HörTech" and the Fraunhofer IDMT.

7.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

UOL Biology signed **agreements for research collaborations** with eight institutions abroad:

Vanderbilt University (USA); University of California Santa Cruz (USA); Scripps Instutition of Oceanography, University of California San Diego, La Jolla (USA); Air Force Office of Scientific Research (USA); Rijksuniversiteit Groningen (NL); Royal Netherlands Institute for Sea Research (NL); Aix Marseille Université (F); Nelson Mandela Metropolitan University (South Africa).

Furthermore, agreements exist with the following insitutions in Germany:

University of Bremen; Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research; Helmholtz-Zentrum Geesthacht (HZG) – Hereon; Senckenbergische Naturforschende Gesellschaft; Leibniz Centre for Tropical Marine Research; Nationalparkverwaltung Niedersächsisches Wattenmeer; Umweltzentrum Wittbülten Spiekeroog; Humboldt University Berlin.

In total eight **joint professorships** exist in research in biology with Senckenberg am Meer, the Institute of Avian Research, the Leibniz Centre for Tropical Marine Research, and the Alfred Wegener Insitute. Two of them are new joint professorships at HIFMB, which are in the process of hiring.

ICBM as a **centre for coastal research**, along with its close scientific relationship and overlap with HIFMB, is a prominent **structure for interdisciplinary collaborative research** at UOL, including two associated working groups of IBU.

The **Research Centre Neurosensory Science** provides an important umbrella organization for all relevant research units – currently more than 35 from three schools, including all DfN units and three IBU units. Researchers are organized in five interdisciplinary sections whose PIs meet regularly to share information and discuss future developments: Molecular and Cellular Neuroscience, Behavioural and Cognitive Neuroscience, Psychoacoustics and Signal Processing, Computational and Systems Neuroscience, and Clinical Neuroscience.

The **Centre of Excellence for Hearing Research** is an interuniversity (UOL, Hannover Medical School and Leibniz University Hannover), sustainable scientific umbrella structure for the "Hearing4*A*ll" project. It is dedicated to fostering and further developing hearing research at all three sites.

Internationalisation

At the level of the university UOL has implemented a **strategy** towards a higher international visibility and offers a service for international students and scientists.There is an international office for support and a guest house. Most administrative forms are available in English. The Hanse Institute for Advanced Study in Delmenhorst, a joint venture between the federal states of Lower Saxony and Bremen, regularly hosts guest scientists of UOL in various research fields including marine sciences, biology and neurosciences. It is a strategic measure of the biological institutes to recruit international PhD students for graduate research training groups, to send PhD students to international partners for short research stays and to host international guest scientists.

In total, 23 guest scientists from 16 countries funded by the AvH Foundation, DAAD and other funding bodies visited research units in biology from 2018 to 2020. Among them were eight postdocs and 15 PhD candidates.

A number of means have been established for the **internationalisation of teaching and early career development.** OLTECH and its structured PhD programmes teach almost all courses in English and provide funds for short stays abroad for PhD students. Communication is usually in English. Furthermore, three international Master's programmes taught in English are offered (Biomolecular Medicine, Microbiology, Neuroscience) alongside two others taught largely or completely in English (Biology, Marine Environmental Sciences).

UOL Biology was involved in ten **major international research projects** during the reporting period – five of them with speaker function.

14 % of the **PhDs** completed during the reporting period were **awarded to international graduates** (11/79). In 2020, 30% of the students in the PhD study programmes "Environmental Sciences and Biodiversity" and "Neurosensory Science and Systems" were international.

7.3 Teaching

Degree courses

The following degree courses are offered:

- Biology, Bachelor
- Biology, 2-subject Bachelor
- Environmental Sciences, Bachelor
- Biology, Master
- Biology, Master of Education
- Landscape Ecology, Master
- Neuroscience, Master
- Marine Environmental Sciences, Master
- Microbiology, Master

The total number of graduates (Bachelor, Master) of all courses was n = 303 (2018), n = 321 (2019) and n = 361 (2020).

The total number of first year students (Bachelor, Master) of all courses was n = 499 (2017/18), n = 475 (2018/19) and n = 580 (2019/20).

How research feeds into reaching

Teaching in the advanced phases of Bachelor's and Master's programmes is closely related to the research activities of the lecturers. Bachelor's and Master's programmes require research projects for a final thesis, and these are often generated out of the ongoing research activities of the research units. The Master's programmes offer a broad portfolio of research modules, where students spend four to eight weeks in an active research lab. Students are typically introduced in-depth to more than one research topic. PhD students and postdoctoral researchers are often involved in supervising these student projects.

7.4 Strategy and governance

7.4.1 Governance

As IBU and ICBM are institutes belonging to Faculty V, and DfN is a part of Faculty VI, the deans of these schools are direct contact persons of the directors of these bodies of research in biology. Due to the specific structure and embeddedness, each body has its own governance structure which is defined in the order of the body. The **directors** of ICBM, IBU and DfN are elected for a term of two years and are assisted by two deputy-directors, the past director and the director to be elected. This ensures a most valuable continuity in governance. The director liaises with the faculty and is also usually a member of the **faculty council** for the duration of his/her term. The directors are assisted by administrative managers. The **department councils are** also elected bi-annually and comprise members from all status groups. The councils meet at regular intervals (synchronised with the faculty council cycles) to discuss and vote on all aspects of departmental life. At its foundation, ICBM implemented in its order a **scientific advisory board** of eight international experts representing its scientific diversity. This board visits ICBM biannually. The members are appointed by the president of UOL for four years and can be reappointed once.

7.4.2 Research quality assurance and internal incentive programmes

Quality assurance

Awareness of good scientific practice and quality control of research is introduced to students and scientists at various levels and based on UOL guidelines for good scientific practice, which are accounted for by the committee for good scientific practice and meet the latest DFG recommendations. The guidelines also contain incentives and a formal procedure for dealing with scientific misconduct. Two ombudspersons are appointed as contact persons for any request by scientists regarding issues of good scientific practice. The graduate school OLTECH offers

an introductory and compulsory course on good scientific practice. It familiarises all PhD students with issues such as authorship, plagiarism, fakes, experiments with animals and humans as well as the requirements for formal approval of such experiments. All Bachelor's and Master's students are introduced to good scientific practice, but mainly focusing on plagiarism and fakes, including consequences for misconduct in their studies. The examination boards of the courses are responsible for dealing with scientific misconduct of students within their studies.

Internal incentive programmes

There are no in-house **incentive research programmes** run by UOL Biology. On the level of the university, there are competitive programmes for junior scientists which enable them to prepare for and submit applications for an independent junior research group (ERC starting grant, Emmy Noether grant, three years) or their own position (DFG, two years).

The basis for a **performance-oriented allocation** of funds by UOL to the faculties, and further to all institutes, are the indicators set by MWK for all universities in Lower Saxony. Within the IBU, the ICBM and the DfN adjustments have been approved to make allocations to the individual research units more competitive.

Overhead

The allocation of overhead funds is fixed as follows: presidential board 50 %, faculty 20 %, and research unit 30 %.

7.4.3 Equality and Diversity

Female scientists are not yet equally well represented in higher-ranking academic positions. All three institutes of biology research are therefore actively recruiting female professors, following specific guidelines, and are in close contact with the equal opportunity officers of Faculty V and VI. These measures are coordinated with the general strategy of UOL promoting equal opportunity and gender equality. To increase the general awareness of equality and diversity, responsible and interested researchers, e.g. search committee members, of all three institutes participate in lunchtime lecture and workshop series, offered by the schools' equal opportunity offices. To further support young, and in particular female, scientists in developing their academic careers and to foster compatibility of science and family, the institutes cooperate with

the deans' offices, the graduate school OLTECH and the coordinators of collaborative research projects.

For gender ratios see appendix (table 5).

7.4.4 Research data management

The central IT services of UOL provide data storage capacities to all researchers at UOL and ensure storage of research data for at least ten years, as required by funding agencies. A centralised research data management (RDM) is still in progress. Specific systems suitable for their RDM, data analyses and service needs were set up by the institutes and within the framework of the collaborative research projects. Dedicated personnel at IBU and ICBM, in co-operation with the central computing service, is available for specific needs and also for linking generated data to other public data centres. ICBM employs a data management coordinator (0.2 FTE) who assists in data-analysis, organises data management training events and serves as a central contact for all working groups and data-management initiatives within and outside the universi-ty. Each working group at ICBM has a designated data management steward (0.00 FTE) to handle group-specific needs and know-how. Together with the institute's IT support (2.85 FTE), these form the ICBM's data-management team. This team uses a dedicated mailing-list for information exchange and holds regular meetings for discussions and training. The team has prepared the active research data management policy, which clarifies both objectives and responsibilities of ICBM and its researchers.

ICBM is a member of the Deutsche Allianz Meeresforschung (DAM) and contributes to its core area of "Data Management and Digitalisation," both on administrative level, as well as by developing solutions for the "Underway Research Data" project. DAM is participating in the development of the National Research Data Infrastructure (NFDI) and is a component of the proposal for an NFDI for Earth System Science (NFDI4Earth), which promises to be the best matching NFDI consortium for most ICBM working groups. Multiple group leaders of ICBM are also associated with HIFMB, which is a participant in the NFDI for biodiversity (NFDI4BioDiversity).

7.4.5 Plans and perspectives

ICBM

In 2022, the professorship in "Biology of Geological Processes" will become vacant (succession of Meinhard Simon). The current research thread will be kept and emphasized by re-

denominating the professorship as “Pelagic Microbiology”, corresponding to the other professorship in microbiology with an environmental focus, “Benthic Microbiology”, refilled in June 2021 (Martin Könneke). Two appointments with an emphasis on modelling and data science will represent further options for collaborations with biology research. In 2021, a junior professor in “Biogeochemical Ocean Modelling” with tenure track was appointed (Sinnika Lenartz), and HIFMB has appointed a professor in “Data Sciences” (Murat Eren).

ICBM aims to obtain a **DFG Research Unit** on “Biogeochemical processes and ocean/Atmosphere exchange processes at marine Sea Surface layers”. A full application has been submitted in 2021 with two units in biology participating. As a follow-up, and elaborating on the graduate school The **Ecology of the Molecules** (EcoMol), a **new SFB** on this topic is in preparation. Submission of the preproposal is planned in 2022. It will encompass the great majority of the research units of ICBM, but other research units of IBU, HIFMB and the MPI of Marine Microbiology in Bremen as well.

ICBM is pursuing the preparation of an application for a **Cluster of Excellence** in the next round of the Excellence Initiative on the **topic of biodiversity in marine and coastal systems**. This initiative will include ICBM research units, but also IBU, HIFMB, AWI, ZMT and SAM.

IBU

IBU has recently developed a future strategy that will allow further development of coordinated research activities in the areas of i) **Animal Navigation** and ii) **Biodiversity & Environmental Sciences**. The research area Animal Navigation acquired a SFB and will further strengthen a potential application for the **Excellence Initiative** next year. Two new professors will be appointed in the fields of “Animal Ecology” and “Entomology” in 2021 and 2026 (an earlier appointment is sought). The professorship in “Animal Ecology” will address research questions related to the migration behaviour of vertebrates in an ecological context. The professorship in “Entomology” will broaden the research area “Animal Navigation” to include invertebrates and is therefore an important milestone for the Excellence application. In addition to this, active recruitment of junior groups that come with competitive funding (e.g. Emmy Noether) has started during the first funding period of the SFB. The additional space for hosting all these groups might be provided by a **new building**, for which the spokesperson of the SFB 1372 has agreed to take the lead in preparing an application. Also, existing and future groups of the ICBM/HIFMB and DfN will potentially contribute to the research area **Animal Navigation**, e.g. groups studying the migration behaviour of whales or groups studying the biochemical basis of magneto-receptors in the retina.

Two DFG Research Units are major contributors to the research area **Biodiversity & Environmental Sciences** (FOR DynaDeep: spokesperson Gudrun Massmann, IBU; FOR DynaCom: spokesperson Helmut Hillebrand, ICBM). To strengthen this research area and to prepare it for future applications for **collaborative research projects**, professorships in “Plant Vegetation Ecology and Conservation” as well as “Soil Ecology” will be established in 2023 and 2025, respectively. The professorship in “Plant Vegetation Ecology and Conservation” is an essential part for biodiversity research at UOL and will also foster interactions with the ICBM (dynamic processes in coastal vegetation). The professorship in “Soil Ecology” will bridge the interactions between biological groups and groups working in geology, hydrology and chemistry at IBU and ICBM.

Taken together, IBU envisions having two strong research foci. For this, IBU plans to strategically fill all future professorships to support these areas. In addition, all new appointments are aimed to guarantee the continuation and future development of the study programmes in “Biology”, “Landscape Ecology” and “Environmental Sciences” at UOL.

DfN

DfN is currently hiring two professors: a W3 in “Sensory Physiology and Behaviour” (successor to Georg Klump, who retires in 2022) and a new W2 in “Auditory Neuroscience”. Both appointments will strengthen and consolidate the area of **hearing research**, which offers a combination of basic neurobiology, technical state-of-the-art development as well as linguistic and clinical research that few other locations worldwide can match. A new initiative for a future **Cluster of Excellence** is currently being explored. Together with research units in medical physics and neuroscience at the University of Bremen, there is also a growing critical mass, e.g. for a **Research Training Group**, in the area of **computational neuroscience**. DfN is aiming to strengthen this further with the new W2 professorship that was advertised with a clear focus on computational auditory neuroscience. With two new (of a total of seven) research units, several more new hirings at IBU as well as the continued build-up of Faculty VI, the next few years will also be a period of establishing new collaborations that are expected to spark fresh research initiatives.

8 Universität Osnabrück

The University of Osnabrück (UOS) was founded in 1974 and has its roots in a University of Education. The university is organised into nine departments and conducts research and teaching in the humanities, social sciences, natural sciences, law and economics. Since 2017 the university develops its research profile along six key research strands: i) Digital Society – Innovation – Regulation; ii) Integrated Science – from Single Molecule to Systems; iii) Cognition: Human – Technology – Interaction; iv) Mathematical Structures and Models: v) Human-environmental networks; vi) Migration Societies.

8.1 Structure and general framework

8.1.1 Structure

Biology at UOS was founded in 1976 and covers the whole spectrum of biological disciplines. Its research programme focusing on molecular and cellular membrane biology has been continuously funded by SFBs since 1984. In 2011, the current SFB 944 “Cellular Microcompartments” was installed and an application for a research building was launched. The Research Center for Cellular Nanoanalytics (CellNanOs) was opened in 2018 as a dedicated research building to house the major instrumentation infrastructure for molecular life science research. Interdisciplinary activities of the Biology together with Chemistry and Physics initiated within the CellNanOs were the basis of the university’s key research strand “Integrated Science” that started in 2017. A new international and interdisciplinary master programme “Nanosciences” was implemented together with Chemistry and Physics in 2019, closely followed by an international master programme in biology in 2020.

The Biology of UOS is part of the Department of Biology and Chemistry. It includes 19 biological research units consisting of 15 professorships and four independent research groups. The following 15 professorships are part of biology:

- **Department of Biology**
    - Biochemistry (Prof. Dr. Christian Ungermann, W3, since 10/2005)
    - Didactics of Biology (represented by Dr. Florian Fiebelkorn, W3, since 10/2016)
    - Biophysics (Prof. Dr. Jacob Piehler, W3, since 4/2008)
    - Botany (Prof. Dr. Sabine Zachgo, W3, since 10/2007)
    - Genetics (Prof. Dr. Jürgen Heinisch, W3, since 1/2003)
    - Microbiology (Prof. Dr. Michael Hensel, W3, since 1/2009)

- Neurobiology (Prof. Dr. Roland Brandt, W3, since 2/2002)
- Ecology (Prof. Dr. Christian Kost, W3, since 8/2016)
- Plant Physiology (Prof. Dr. Nico Dissmeyer, W3, since 7/2019)
- Structural Biology (Prof. Dr. Arne Möller, W3, since 1/2020)
- Animal Physiology (Prof. Dr. Kerstin Bartscherer, W3, since 4/2021)
- Behavioural Biology (Prof. Dr. Chadi Touma, W3, since 7/2016)
- Zoology (Prof. Dr. Achim Paululat, W3, since 4/2004)
- Molecular Cell Biology (Prof. Dr. Joost Holthuis, W2, since 1/2012)
- Molecular Cell Biophysics (Prof. Dr. Katia Cosentino, W1, since 6/2019)

8.1.2 Personnel

The department has thirteen W3 professorship, one W2 professorship and one W1 professorship. The W3 professorship Didacts of Biology is held by Prof. Susanne Menzel-Riedl, who has been elected president of the university in 2019. The professorship is currently represented by Dr. Floria Fiebelkorn. The W3 professorship Animal Physiology has been vacant during the reporting period and was represented by Dr. Thomas Krüppel. Until 2026 three professorships are scheduled to become vacant (W3 Didacticts of Biology, W3 Genetics, W1 Juniorprofessorship Molecular Cell Biophysics). On 01.12.2020 a total number of 241 people were employed (170.98 FTE). 15.0 FTE of professorships, 41.31 FTE of scientific personnel and 69.27 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 42.65 FTE of scientific personnel and 2.75 FTE of non-scientific personnel were funded by third-party funds (Drittmittel).

8.1.3 Research infrastructure

The biological research units are located together in buildings on the Campus Westerberg, with the **botanic garden** in close proximity.

The **CellNanOs building** offers ~1000 m² of laboratory space and is designed for the operation of different types of **microscopes** and other **major instrumentation** (mass spectrometry, flow cytometry) shared within the department. Additional laboratories for chemical synthesis, surface micro- and nanofabrication, as well as experimental laser setups offer infrastructure for collaborative method development with chemists and physicists. A major part of the lab space can be freely allocated to junior groups and/or interdisciplinary teams with specific demand in instrumentation.

The DFG-funded **Integrated Bioimaging Facility (iBiOs)** serves as the core facility for fluorescence and electron microscopy (EM) techniques. It is specialized on live cell super-resolution microscopy based on single molecule imaging, structured illumination (SIM) and spectroscopy (FLIM, FCS). The EM unit was recently equipped with a transmission electron microscope (TEM) for cryogenic single particle analysis. It is accompanied by a new computer cluster for high-througput image analysis. There is a dedicated image data management facility. Furthermore, a new mouse facility was built in the course of appointing a new professorship as head of the Behavioural Biology unit.

The facilities are managed, operated and further developed by scientific staff on permanent positions. User fees were established to ensue maintenance of the instrumentation infrastructure. In the coming years, substantial challenges to maintain the funding of the infrastructure, in particular investments into updated equipment are expected.

The self-report describes **local advantages** for biology at UOS. The discipline of biology is represented in its entire spectrum by professorships, but at the same time compact enough so that collaborative networks are established easily. The profile in molecular and cellular membrane biology has been developed over a long period of time since 1984 and allowed for the integration of major instrumentation infrastructure for molecular life science. The key research facilities are run by permanent staff. The integration of Chemistry and Physics into the CellNanOS building is seen as favorable for interdisciplinary collaboration. Joint research initiatives can be initiated with the life science institutes at the University of Münster, which is about 50 km away. The UOS own kick-off funding programmes is seen as opportunity for new interdisciplinary initiatives.

The following **local challenges** are described in the self-report. Gathering the criticial mass required for setting up specialized research initiatives is highly challenging. A research-oriented medical school promoting collaborations is not available in Osnabrück. Likewise, academic research institutions (MPI, Helmholtz, etc.) in the field of molecular life sciences are lacking. Furthermore, the minimum basic endowments of the research units in conjunction with high undergraduate teaching load as well as the teaching obligations due to a relatively high number of teacher students is mentioned as a challenge. Moreover, high-level major instrumentation infrastructure raises considerable maintenance costs that have to be covered by a relatively small group of scientists.

8.2 Research

8.2.1 Profile

Since its early days, UOS Biology has a strong focus on **molecular and cellular membrane biology**, which that has been continuously funded and shaped by three consecutive SFB initiatives. The SFB 944 “Physiology and Dynamics of Cellular Microcompartments” (since 2011) focuses on the principles of dynamic, nanoscale organization of biomolecules into functional entities, which were conceptualized as “**cellular microcompartments**”. While still strongly focused on membrane biology, the perspective goes beyond membrane proteins and integrates membrane organization as well as emerging concepts such as protein condensates. Since the SFB entered its final funding period, a new initiative with a research focus on “Functional Plasticity Encoded by Cellular Membrane Networks” emerged from the much more detailed understanding of how in particular the membrane environment controls cellular processes. In turn, several projects focusing on lipid homeostasis and membrane identity were intrigued by the plasticity of membrane networks with respect to lipid composition and collective membrane properties. The new SFB initiative will thus focus on unravelling how **functional plasticity** is achieved at **different scales** by the interplay of these two features. The SFB 944 and the CellNanOs building with its research programme for interdisciplinary method development were the basis for the UOS Research Profile “Integrated Science: From Individual Molecules to Complex Systems” as part of the UOS 2020 initiative. Moreover, Biology at UOS is involved in the university’s preparations for the coming federal excellence strategy. A future joint initiative aims at understanding the principles of how plasticity is achieved in biology at different scales and how this knowledge can potentially fuel the concepts of plasticity in cognitive sciences and artificial intelligence.

During the past ten years the resarch focus was further expanded by investigating how **evolution** shapes **molecular and cellular processes** to generate adaptive structures and novel phenotypes on an **organismal level**. The plant resources of the Botanical Garden enabled the establishment of basal land plants as novel model organisms. Biodiversity research in the Botanical Garden determines hotspots of endangered German wildflower species and their protection. Research within the university’s interdisciplinary graduate school EvoCell addresses questions at the interface between cell and evolutionary biology.

8.2.2 Key publications

Schoppe J, Mari M, Yavavli E, Auffarth K, Cabrera M, Walter S, Frohlich F, & Ungermann C (2020) AP-3 vesicle uncoating occurs after HOPS-dependent vacuole tethering. The EMBO J 39(20):e105117, doi: 10.15252/embj.2020105117.

Wilmes S, Hafer M, Vuorio J, Tucker JA, Winkelmann H, Löchte S, Stanly TA, Pulgar Prieto KD, Poojari C, Sharma V, Richter CP, Kurre R, Hubbard SR, Garcia KC, Moraga I, Vattulainen I, Hitchcock IS, & Piehler J (2020) Mechanism of homodimeric cytokine receptor activation and dysregulation by oncogenic mutations. Science 367(6478):643-652, doi: 10.1126/science.aaw3242.

Kehl A, Göser V, Reuter T, Liss V, Franke M, John C, Richter CP, Deiwick J, & Hensel M (2020) A trafficome-wide RNAi screen reveals deployment of early and late secretory host proteins and the entire late endo-/lysosomal vesicle fusion machinery by intracellular Salmonella. PLoS Pathog 16(7):e1008220, doi: 10.1371/journal.ppat.1008220.

Dadsena S, Bockelmann S, Mina JG, Hassan D, Korneev S, Razzera G, Jahn H, Niekamp P, Müller D, Schneider M, Tafesse FG, Marrink SJ, Melo MN*, & Holthuis JC* (2019). Ceramides bind VDAC2 to trigger mitochondrial apoptosis. Nature Commun. 10, 1832.

Preussger D, Giri S, Muhsal LK, Oña L, Kost C (2020) Reciprocal fitness feedbacks promote the evolution of mutualistic cooperation. Current Biology. 30(18): P3580-3590.E7, doi: 10.1016/j.cub.2020.06.100.

8.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 – 2020) the department acquired a total sum **18.53 Mio €** in **third party funding**.

Collaborative research programmes with speaker function or with significant contribution (i.e. at least 25 % of projects)

Title	Funding body	Speaker
TubInTrain Researcher	EU	Universita degli Studi di Milano, Italy
SFB 944: Physiology and Dynamics of Cellular Microcompartments	DFG	Christian Ungermann, Biochemistry, UOS
Twin Tweezers: Development of two-beam optical tweezers	EU-EFRE	Ionovation GmbH
Uptake of Escherichia coli and Salmonella in plants.	BMEL[16]	Sven Jechalke, Julius-Kühn-Institut
Infect-ERA IV Call - IntraBacWall - Deciphering the structural patterns of the peptidoglycan and host response in infections caused by intracellular bacteria.	BMBF	Michael Hensel, Microbiology, UOS
Hijacking cell signalling pathways with magnetic nanoactuators for remote-controlled stem cell therapies of neurodegenerative disorders	EU	Institut Curie
Future Labs Digitalization - Future Lab Agriculture	MWK (VW-Vorab)	Joachim Hertzberg, Computer Science, UOS
National wildflower protection network WIPs.De	Bundesamt für Naturschutz	Sabine Zachgo, Botany, UOS

[16] Bundesministerium für Ernährung und Landwirtschaft

Genetic conservation areas for wild celery species (Apium and Helosciadium) as part of a network of genetic conservation areas in Germany (GE-Sell)	BMEL	Julius-Kühn-Institut, Quedlingburg
Tools for gathering survey data in Germany	BMU[17]	Florian Jansen, Uni Rostock
Insect-friendly Günztal - low-intensity grasland managemet in well-connected habitat networks	BMU	Peter Guggenberger-Waibel, Stiftung Kulturlandschaft Günztal
SORLA-FIX Identifying and treating SORL1-associated Alzheimer's disease	BMBF	Arne Möller, Strucutral Biology, UOS

8.2.4 Early career development

ZePrOs is the Centre for PhDs and Postdocs of UOS and provides general training. The SFB 944 comprises an integrated research training group (speaker: Achim Paululat) offering a structured programme for research-related education to PhDs students working on topics related to the SFB (~80% of all PhD students of UOS Biology).

The interdisciplinary graduate school EvoCell (speaker: Christian Kost) has been funded within the UOS 2020 initiative and addresses questions at the interface between cell biology and evolutionary biology. Its interdisciplinary programme involves six groups, two of them outside UOS Biology. EvoCell aims to become a DFG-funded prorgamme in the future. Likewise, the initiative Nano/Bio funded via the UOS research profile "Integrated Sciences" pursues an interdisciplinary research programme and aims to submit a draft to the DFG in 2021.

A total number of **34 PhDs** and no **Habilitations** were awarded during the reporting period.

Collaborative PhD projects were conducted with partners at universities in Germany (Halle-Wittenberg, Münster, Bielefeld, Freiburg, Berlin, Oldenburg, Siegen), Norway (Oslo), and the UK (London).

Independent junior research groups:

Name of research group	Funding body	Head	Tenure track
Molecular Cell Biophysics	UOS basic funds	Jun-Prof. Dr. Katia Cosentino	No
Molecular Membrane Biology	UOS basic funds	Dr. Florian Fröhlich	No
Molecular Infection Biology	UOS basic funds	Dr. Caroline Barisch	No
Cellular Communication	UOS basic funds	Dr. Ayelén Gonzalés Montoro	No

[17] Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit

Two early career researchers received **external offers** for professorship or lecturer positions respectively (HS Mittweida; Luther College, University of Regina, Canada). Both researchers accepted.

UOS Biology focuses on **attracting outstanding researchers** who fit into its research initiatives. This is based on active head hunting at PI level as well as mentoring support for composing competitive funding applications (e.g. DFG Heisenberg Professorship). Since core funds or suitable tenure-track positions for attracting outstanding researchers are not available, granting support is limited to the funding periods of collaborative research grants. In several recent cases, this resulted into potential candidates moving to other institutions that were able to provide long-term support.

8.2.5 Science communication and technology transfer

The department runs its own online magazine called “UOS-Bio life” to promote scientific outreach to (potential) students and the general public. Science communication and outreach activities are also organisied withtin the framework of the SFB 944 and are integrated into the proposal of the new SFB draft proposal. The botanical garden hosts exhibtions to convey plant biodiversity research. UOS Biology scientists contribute to public engangement activitivies on the university level (Campus Night, Wissensforum) and are involved in the regional group of Scientists for Future (S4F).

Concerning **technology transfer** UOS Biology pursues method-oriented technological development. All activities are supported by the joint technology office of UOS and HS Osnabrück (TIM). Examples for transfer projects within the reporting period are:

- Development of a dual laser tweezer microscope funded by the N-Bank (Microbiology, Ionovation GmbH).
- The EPO patent application “Graphene-induced energy transfer for the quantification of the structure and dynamics of biomolecules”, C. You, J. Piehler (Biophysics).
- The patent Viability test for plant seeds: Deutsches Patent- und Markenamt, 20.12.2019, S. M. Hassen, S. Bhattacharya, K. Mummenhoff (Botany).
- The Start-up “Seedalive” (Botany) supported by the BMWi, the European Social Fund and the Seedhouse Accelerator.

8.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

Given the lack of local research institutions outside UOS with focus in life sciences, joint appointments with external institutions have not been pursued. Several joint professorships have been appointed within the framework of interdisciplinary research centres CellNanOs and the Institute of Environmental Systems Research of the university. Prof. Dr. Christian Kost, head of the Ecology Division of UOS Biology was appointed in 2016 and has been associated with the Institute of Environmental Systems Research. Prof. Dr. Arne Möller, was appointed as Head of Structural Biology based on a professorship from Physics that was redesigned to fit the profile of the Research Centre CellNanOs.

Two **interdisciplinary research centres** are relevant to biological research at UOS. **The Institute of Environmental Systems Research (IUSF)** is focusing on research and teaching on understanding changes in environmental systems, the problems ensuing from these changes, and finding potential solutions for dealing with them, using systems analysis and a focus on formal, quantitative and conceptual methods. IUSF represents the conceptual centre of the UOS' Research Profile "Human-Environment-Networks". **The Research Centre CellNanOs** was founded in 2018 based on the research programme of the CellNanOs building and the Research Profile "Integrated Science" to promote interdisciplinary development of bioanalytical techniques with utmost spatial and temporal resolution. The 40 members of the Research Centre cover all research units of UOS Biology as well as chemistry, physics, mathematics and cognitive sciences.

Internationalisation

UOS Biology aims to promote a stimulating academic environment by increasing the level of international staff at all levels. Three PIs have been recruited from abroad since 2012 and four international senior scientists with independent research programmes are members of the department.

A total of eight international guest scientists were hosted by the department during the reporting period. Among them were four professors, three post-docs and one PhD student.

Concerning the **internationalization of teaching**, the **master programmes** introduced in 2018 are fully taught in **English**. The central **International Office** of UOS promotes international visibility and advertisement of the programmes and supports candidates. A **collaboration** with **Utrecht University** was initiated to offer student exchange within a new **international bachelor programme** "Molecular and Biophysical Life Sciences". Since 2016, UOS

Biology organizes an annual DAAD-funded **Summer School** “Biomembranes and cellular microcompartments”, offering 16 international Master students the opportunity to acquire an integrated perspective on biomembrane research and become acquainted with new technologies at the interface of nanoscience and cell biology. After cancellations due to Covid-19, the Summer School will resume in 2022.

The department was involved in **five major international research projects** during the reporting period. Research units involved were Structural Biology, Neurobiology, Biophysics, and Microbiology.

21 % of **PhDs** completed during the reporting period were **awarded to international graduates** (7/34).

8.3 Teaching

Degree courses

The following degree courses are offered:

- 2-Subject Bachelor
- Vocational Education, Bachelor
- Education, Bachelor
- Biology, Bachelor
- Biology: From Molecules to Organisms, Master (English, since 2018)
- Nanosciences: Materials, Molecules & Cells, Master (English, since 2018)

The total amount of graduates (Bachelor, Master) of all courses was n = 302 (2018), n = 283 (2019) and n = 286 (2020).

The total amount of first year students (Bachelor, Master) of all courses was n = 431 (2017/18), n = 404 (2018/19) and n = 409 (2019/20).

How research feeds into reaching

Final Bachelor and Master projects are fully integrated into the actual research projects of the research units. Two Master programmes have been recently reaccredited, which was used to align and integrate them better to the research activities. The joint Master programme “Nanosciences: Materials, Molecules & Cells” together with chemistry and physics (formerly: “Material Sciences”) was re-designed to match the interdisciplinary activities in the context of the

Research Centre CellNanOs and the new initiatives within the Research Profile “Integrated Science”.

8.4 Strategy and governance

8.4.1 Governance

Governance structure of UOS Biology is provided by the Department (*Fachbereich*) of Biology/Chemistry that also includes the Institute of Chemistry. Headed by the **dean** of the Department, executive decisions are made by the **department council** (*Fachbereichsrat*). The **dean's council** constituted by the dean, pre-dean, pro-dean, study dean and the director of the Chemistry Institute decide on the distribution of the budget and other resources of the Department. The Biology **study commission** decides on student affairs and distribution of the budget for improving study quality (*Studienqualitätsmittel*). After negotiations during 2020, the Institute of Chemistry will be merged with UOS Biology to account for the closer cooperation and two jointly to be appointed professorships (W2, W1) that should span the two disciplines and support the interdisciplinary initiatives of the CellNanOs.

8.4.2 Research quality assurance and internal incentive programmes

Quality assurance

The ZePrOs provides an obligatory course on good scientific practice. The culture of good scientific practice is integral part of supervision and mentoring programmes of the graduate schools. This includes early training in research data management in the framework of the imaging facilities. Representatives in the university library responsible for quality assurance in the context of research data and for open access publication are available. Quality assurance in doctoral studies is systematized via an obligatory “Individual Development Plan” (IDP), which is the central (development) agreement between the doctoral candidate and the supervisor. A similar, yet optional scheme applies for postdoctoral researchers. Research consultants advise on all questions relating to third-party funding applications and ensuring good scientific practice. Starting in 2020 UOS has commited to implementing in a legally binding way the DFG-Kodex for Safeguarding Good Scientific Practice. The new rules will replace of the guidelines for good scientific practice already in place.

Internal incentive programmes

The department runs an **internal incentive programme** to reward grant applications from young investigators and postdocs with a general sum of 5 T€ per application, independent on the success. Furthermore, diverse support schemes to support young investigators and postdocs has been established within the framework of the SFB. On the level of the university, UOS Biology has profited from additional incentive funding in the framework of the UOS 2020 initiative including participation in three university research profiles and securing funding of the graduate school EvoCell. The university runs a central incentive system for research, through which, for example, junior researchers and initial applications as well as the development of research potential are funded.

The **performance oriented allocation** (LOM) of funds at UOS in general is based on the numbers in the states' *Hochschulkennzahlensystem* for first-year students, graduates, doctorates, and third-party funds, which are used for the distribution of funds to the departments. At department level, personnel is permanently allocated to the divisions and the yearly funds available are distributed equally (~20 T€/division) to ensure basic infrastructure for research and teaching. Further funds of the departments are allocated to general maintenance, and to fulfil commitments for newly hired PIs.

Overhead

The overhead funds passed to the department from UOS (50%) are fully transferred to the corresponding research unit thus providing an incentive for grant acquisition. The research units that are actively using the infrastructure of the CellNanOs additionally contribute via their overheads (max. 10%) to support infrastructure.

8.4.3 Equality and Diversity

Central mentoring programmes are offered by ZePrOs or the equal opportunity office for scientists at all career levels. The equal opportunity office ensures monitoring of the UOS´ gender and diversity goals. UOS offers support to provide family-friendly conditions like child care facilities and special financial support for female scientists. UOS has been approved to participate in the federal professorial programme in 2018. The equality concept for the entire university presented as part of this programme received a correspondingly positive assessment. As member of the DFG, UOS decided on targets for equality and has a gender equity policy in place.

UOS Biology works together with the equal opportunity office of the university and further develop equal opportunity plans, which provide a guideline to further promote female scientists. UOS Biology aims to increase the percentage of female professors to 40% in the next 8 years by hiring highly qualified women for the upcoming positions in Genetics (2026), Neurobiology (2027), and Zoology (2029). By the use of active recruiting, Kerstin Bartscherer was successfully appointed as W3 in Animal Physiology. Presently, five research units are headed by young female scientists.

For gender ratios see appendix (table 5).

8.4.4 Research data management

UOS Biology actively pursues the development of suitable infrastructures for research data management (RDM). With the high demands emerging from advanced imaging techniques and their rapidly increasing application in the context of SFB 944, a dedicated research data management project (INF) was already initiated during its second funding period. Supported by funding from DFG and UOS, a suitable storage platform compatible with the constantly increasing amount of data was set up in the CellNanOs building and a user interface for the management and documentation of imaging data based on the open source OMERO software was established (S. Kunis, K. Bernhardt, A. Müller, M. Hensel). In the third funding period, a further integration of this data management system into the iBiOs analysis infrastructure is being implemented. This system will be supplemented with electronic lab notebook (ELN) and cross-connections to other platforms to cover the whole data generated during daily research. The integration of DeepLearning methods for the automatic addition of metadata is being sought. The strategies and tools built up for imaging data at CellNanOs will be blueprints for further developing the general data management infrastructure at UOS in close collaboration with the University’s Library and the Central IT-Facility. Overarchings guidelines for RDM at UOS have recently been defined.

The iBiOs Facility, including data management, is connected to imaging networks in Germany and internationally. S.Kunis leads the working group for “Image analysis and image data management” in the German BioImaging Network (GerBi) and regularly organises meetings of a national working group of microscope facilities on the topic of research data management in microscopy (RDM4mic). This resulted in the transregional proposal I3D:bio for the developing concepts and infrastructure for RDM (S. Kunis, K. Bernhardt), which has been submitted to the DFG for approval. Based on this work a joint NFDI application "NFDI4BioImage" with significant participation from Osnabrück is currently being prepared for submission in September 2021.

8.4.5 Plans and perspectives

The coming five years will be dedicated to implementing of the **new initiatives** (SFB application “Functional Plasticity Encoded by Cellular Membrane Networks”; biodiversity research; evolutionary cell biology). Beyond further strengthening the visibility in the field of **membrane biology**, profiling via the new **interdisciplinary graduate schools** in conjunction with the new **international master programmes** aims to enhance the attractiveness of UOS Biology for students and researchers. New appointments of the W3 professorships for Genetics, Neurobiology, and Zoology (2027-2029) will give the opportunity to strategically strengthen established and new initiatives including the potential application within the **Excellence Strategy** 2027.

9 Universität Vechta

9.1 Structure and general framework

9.1.1 Structure

The University of Vechta emerged from a College of Education and was granted university status in 2010. The university's main focus is on teacher training for primary and secondary schools (Grundschule, Hauptschule, Realschule, Oberschule), social sciences, social work, philosophy, and gerontology. It is organised in three faculties.

Biological research at Vechta started a few decades ago in a small unit. Research activities were driven by individual personalities like Heinrich E. Weber with studies on blackberry (Rubus) systematics. Personnel restructuring led to the professorships in physics and chemistry not being filled again after their retirement. Due to the strong demand for students with teaching degrees, the university changed priorities towards teacher training and away from research in natural sciences. Today biology and six other subject units constitute the Faculty for Natural and Social Sciences, in which biology, together with physical geography, is the only natural science subject at the University of Vechta. There is no biological institute as such, but a biology subject unit – it consists of three research units.

The following professorships are part of the biology unit at the University of Vechta:

- Biology (with focus on Botany) and its Didactics (Prof. Dr. Norbert Pütz, C4, since 10/2000)
- Didactics of Biology (Prof. Dr. Michael Ewig, W2, since 10/2014)

In addition, the Zoology research unit is headed by apl. Prof. Dr. Markus Böggemann.

9.1.2 Personnel

The biology unit has one C4 professorship and one W2 professorship. Until 2026 none of the professorships will become vacant. On 01.12.2020 a total number of 15 people were employed (12.0 FTE). 2.0 FTE of professorships, 6.9 FTE of scientific personnel and 2.8 FTE of non-scientific personnel were funded by basic funds (Grundmittel). 0.3 FTE of scientific personnel was funded by third-party funds (Drittmittel).

9.1.3 Research infrastructure

In the self-report the laboratory infrastructure is described as very limited at the University of Vechta. There are hardly any laboratory instruments for “up to date” research. There is no molecular biology equipment on site.

Major instrumentation funded by the Ministry of Niedersachsen are (Initiative of Zoology unit):

- 2013 Scanning Electron Microscope: Acquisition of research equipment by Niedersächsisches Ministerium für Wissenschaft und Kultur: Jeol NeoScope JCM-6000 benchtop SEM with Leica EM CPD300 and Sputter Coater Jeol JFC-1200 (121.500 €)
- 2015 Autoclave: Acquisition of research equipment by Niedersächsisches Ministerium für Wissenschaft und Kultur: Autoklav Systec DX-23 (ca. 11.500 €)

Both instruments are used in teaching and research.

There is no organisational structure nor dedicated personnel for research infrastructure. For teaching purposes there is access to the Biologische Anstalt Helgoland, Eifelhaus Nettersheim, Zoo Osnabrück; laboratory for genetics Uni Osnabrück (for one module only), „außerschulische Lernorte“ (out-of-school learning places) in the region like farms, food production plants, or other facilities.

9.2 Research

9.2.1 Profile

Research interests in biology at the University of Vechta mainly focus on **teaching biology** with innovative methods and by addressing diverse learners, **ecological research in rural areas** and **polychaete systematics and ecology**.

The **Biology (focus on botany) and didactics** research unit investigates survival strategies of geophilic systems and their adaptation potential (geophytes) (since 1985), and in the context of didactic research, problem-oriented teaching. Research is carried out on concepts for improving biology teaching at secondary level I and aims to place network thinking in the foreground in the sense of society-oriented problem solving.

The research activities of the **Didactics of Biology** research unit focuses on teaching biology. Research projects are conducted on the effects of the application of plain language (“Leichte Sprache”) in biology teaching on knowledge and motivation, and on the effects of natural objects properties on students’ interest in plants and animals.

The focus of the research unit **Zoology** is on the taxonomy of polychaetes (Annelida). The projects aim towards a better understanding of polychaete diversity using samples from different sites (German Bight, Iceland, etc.). More recently, the group has focused on the aquatic and terrestrial organisms of the Vechtaer Moorbach. This long-term monitoring project aims to document the ecological status of the river and to improve renaturation measures.

9.2.2 Key publications

Mülhausen, J. & Pütz, N. (2020) Neue Mysterys im Biologieunterricht – 9 rätselhafte Fälle zu Nachhaltigkeit und Ökologie. Friedrich Verlag GmbH, Hannover, 121 S.

Purschke, G.; Böggemann, M. & Westheide, W. (Eds.) (2019-20) Handbook of Zoology. Annelida, Volume 1 to 3. De Gruyter.

Schaller, M.; Steenken, S. & Ewig, M. (2020) Leichte Sprache oder Standardsprache? Welche Texte bevorzugen Schüler/-innen im Biologieunterricht? – Eine explorative Interviewstudie. Zeitschrift für Didaktik der Biologie (ZDB) - Biologie Lehren und Lernen, 24, S. 14-28.

Böggemann, M. (2019) Klasse „Polychaeta“ – Vielborster. In: Klausnitzer, B. (Ed.) Stresemann - Exkursionsfauna von Deutschland. Band 1: Wirbellose (ohne Insekten) (9. Aufl.), Springer Spektrum, S. 310-351.

Lorenz, K. P., Kolkmeyer, C.A. & Gansloßer, U. (2019) Comparison of the Social Behaviour of Intact and Neutered Female Domestic Dogs (*Canis Lupus Familiaris*): Questionnaires and Case Studies. Journal of Dairy and Veterinary Sciences 12(2), DOI: 10.19080/JDVS.2019.12.555835.

9.2.3 Third-party funding and collaborative research programmes

During the reporting period (2018 - 2020) the research units acquired a total sum of **4,000 €** in **third party funding**.

No **collaborative research programmes** with speaker function or with significant contribution (i.e. at least 25 % of projects) were reported.

9.2.4 Early career development

The activities to support early career researchers are bundled in the university’s Graduate Centre as an inter-faculty, central institution. The Graduate Centre has been established in 2019 to meet the constantly evolving requirements for supporting junior researchers and for staff development.

No **PhDs** and no **Hablilitations** have been awarded during the reporting period.

9.2.5 Science communication and technology transfer

The University of Vechta operates a transfer office in the Department for Research Development and Knowledge Transfer (Referat Forschungsentwicklung und Wissenstransfer) to support transfer activities and cooperation. The biology unit was involved in a project “Meer Davon – Berlin liegt an der Nordsee” at the Science Shop in Cloppenburg in the framework of the “Wissenschaftsjahr 2016/17 Meere und Ozeane”. The research project on the implementation and effects of use of plain language in biology teaching is part of the BMBF project BRIDGES: the BRIDGES project team interacts with partners from school level and school administration in presenting and discussing the results of the (sub-)project(s).

9.2.6 Collaboration, interdisciplinarity and internationalisation

Collaboration and interdisciplinarity

The BRIDGES project comprises two interdisciplinary research working spaces (“Forschungswerkstätten”) concerning the topic of inclusion, in which colleagues from the didactics of several school subjects are working together on the improvement of inclusive teaching and learning settings.

Internationalisation

The University of Vechta maintains cooperation agreements with academic institutions abroad to provide a formal framework for cooperation in the fields of research and teaching. The International Office of the University of Vechta provides a corresponding service for staff and students. Concerning biological research, international cooperation in the field of polychaete studies is reported to be well established.

9.3 Teaching

Degree courses

The following degree courses are offered:

- Biology, Bachelor of Arts (combined studies)
- Biology, Master of Education (secondary school)
- Biology, Certificate (secondary school, Realschulen)
- Science Teaching Biology, Bachelor of Arts (combined studies)

- Science Teaching Chemistry, Bachelor of Arts (combined studies)

The total number of graduates (Bachelor, Master) of all courses was n = 102 (2018), n = 120 (2019) and n = 89 (2020).

The total number of first year students (Bachelor, Master) of all courses was n = 174 (2017/18), n = 179 (2018/19) and n = 147 (2019/20).

How research feeds into teaching

Research results from the BRIDGES project are implemented in the teaching of pre-service teacher students at the BA and MA level as there are explicit trainings in the finding of language barriers in biology texts and the translation into plain language.

Further remarks on teaching

Biology at the University of Vechta is a subject in the study programme Bachelor Combined Studies (Bachelor of Arts CS) and fulfils several functions: On the one hand, it should enable students to take up a subject-specific MA study programme at other universities following the BA, but on the other hand, it should also qualify students for the teaching profession at Hauptschulen and Realschulen, or 'Oberschulen', respectively. Biology can be combined with a variety of other subjects. The bachelor programme with the subject biology has a free admission in contrast to many other universities, the total number of students has remained constant for years at well over 200. In the master level, biology contributes to the Master of Education programme for secondary schools. Biology is the most popular choice for students who study Natural and Social Sciences as an Interdisciplinary School Subject at primary school (Sachunterricht) with again about 200 students. Due to limitations in laboratory and equipment, the teaching programme focuses on a multifaceted biology that is close to nature instead of focusing on molecular biology or biotechnology. Besides qualifying for the teaching profession, students are taught a basis of knowledge and competences for professional fields where knowledge of nature, the environment and biodiversity is important.

9.4 Strategy and governance

9.4.1 Governance

The biology unit is part of the faculty of natural and social science. It discusses all aspects of studying and teaching in the commission of the study subject (Studienfachkommission). A

speaker who is elected by all members of this commission represents the biology unit. The speaker is advisory member of the faculty council.

9.4.2 Research quality assurance and internal incentive programmes

Quality assurance

Vechta University is currently developing its good scientific practice policy in accordance with the Guidelines for Safeguarding Good Research Practice of the German Research Foundation.

Internal incentive programmes

On university level there are numerous **incentive programmes** for research, such as measures of performance-oriented allocation of funds, funding for the development of research proposals to the German Research Foundation (DFG), funding for small research projects, funding for visiting scientists, scholarships for PhD thesis and habilitation thesis, sabbatical terms, and start-up funding for joint research projects.

The university allocates **performance-oriented funds** for research of about 70.000 € per year. The indicators are acquisition of external funds, PhD and habilitation supervisions and publications.

Overhead

Overheads are distributed to central university budget, to the project manager and to an institute - if applicable - according to a distribution key of 50:40:10.

9.4.3 Equality and Diversity

The University develops its own diversity strategy to increase equal opportunities in higher education and to ensure that university admission and academic success does not depend on the cultural or social origin of the students. The University of Vechta has been successfully audited by the Diversity Audit of the Stifterverband. In addition, it has been successfully participating in the audit family-friendly university since 2013.

For gender ratios see appendix (table 5).

9.4.4 Research data management

The “Referat für Forschungsentwicklung und Wissenstransfer” has established a central service for research data management. Scientists can seek advice from a research data manager in all phases of research projects such as planning, studying, analysing, documenting, and archiving data. RDM is integrated in biology in international cooperation projects (polychaete studies).

9.4.5 Plans and perspectives

Future developments will focus on two fields. The first field is **educational science and research in didactics**. In this field, collaborations will be continued and new joint projects developed, e.g. with colleagues in natural and social sciences aiming towards an interdisciplinary school subject, school pedagogy and media didactics. The foundation of the institute BERGVINK to study inclusion and participation in the educational biography will provide a basis for these activities. The second field to be developed further is about **ecology, sustainability, and regional land management schemes**. The recently established Juniorprofessorship “Bioeconomy and Resource Efficiency” is integrated in the research cluster "Sustainability-oriented transformation research in rural areas". The recruitment process for this position is expected to be completed soon. A closer cooperation with a research institute focusing on ‘Sustainability Transformation in Rural Areas’ is stated as a perspective. The biology unit could offer an ecological viewpoint to the study of regions with intensive agriculture and to the development of practice-oriented solutions to regional challenges in rural areas.

In a longer time perspective, the **establishment of a natural science teaching and research unit**, e.g. with a focus on a school subject "natural science" at lower secondary level is considered. The aim would be to bundle additional competences and create space for joint research projects.

According to the self-report, the teaching load under the current framework is a hindrance to increasing the research output, which would be needed to develop a larger biology unit with more positions.

II. EVALUATIONS AND RECOMMENDATIONS

10 Technische Universität Braunschweig

Summary TUBS | Evaluations and Recommendations:

The overall scientific performance of TUBS biology is excellent. The four major research areas (biotechnology and therapeutics; cell biology and cell physiology; neurodegeneration; systems biology of infection) are convincingly chosen based on current strengths and allow for room for further development. The research profile is developed in tune with the university's strategic research foci (Infection & Therapeutics; Metrology). This is a very effective and sensible strategy to pursue for a medium-sized biology.

- ➔ In order to increase the coherence and visibility of the overall profile the unifying research themes should be strengthened.
- ➔ TUBS biology should also provide an environment for strong individuals to pursue excellent research outside those themes to obtain complementarity.
- ➔ The university should consider measures to keep top-performing scientists that are currently on W2 professorships.

The structural organisation of TUBS biology is functional. The institutional structure aligns with teaching needs, whereas the research activities are carried out along the four overarching themes supported by interdisciplinary centres (BRICS, PVZ, and the intended NeuroLab). The relatively small biological institutes gain critical mass through numerous connections with local scientific partner institutions. The collaborations with the non-university institutions are effective and exemplary.

- ➔ The committee recommends to foster the bonds to the non-university partners and develop new strategic partnerships.

Plant biology is in a change process at TUBS.

- ➔ The committee sees a lot of potential through bridging molecular and organismal biology to understand plants in their (changing) natural context.
- ➔ In collaboration with the Thünen Institute and the Julius Kühn-Institute, the research area plant adaption to stress should be developed with regards to resistance to climate change.
- ➔ The theme host-pathogen interactions holds a lot of potential – this line of research should be developed by connecting with the Thünen Institute, the DSMZ and the Pharmaceutical Biology Institute of TUBS.

The vacancies of key professorships in Genetics and Botany impose a risk for the future scientific competitiveness of these fields.

- ➔ In collaboration with its non-university partners, TUBS should make an effort to attract the strongest candidates for these positions.

TUBS biology has brought forth several highly accessed databases (BRENDA, AthaMap and Pathoplant)

- ➔ The operation and further development of these databases need to be secured in a sustainable manner.

Continued on next page

TUBS biology is pursuing numerous transfer activities. A particular highlight are the spin-offs of the Biotechnology research unit that are based on pioneering human antibody engineering. The vacant Bioengineering professorship (W3, based in Faculty 4) is set to provide important engineering expertise for TUBS biology and is especially critical for teaching in biotechnology.

- ➔ The bioengineering profile of this professorship should be sustained and TUBS biology should be involved in the appointment that is led by Faculty 4.

TUBS biology operates several key technology platforms. The research infrastructure of the BRICS can be rated as outstanding.

- ➔ The sustainable funding and maintenance of the major instrumentation and technology platforms is of paramount importance.
- ➔ The committee supports the idea to unite and finance the platforms as part of a DFG *Gerätezentrum*.
- ➔ TUBS should ensure follow-up funding for this research infrastructure beyond its intended funding period.

The new interdisciplinary research network in neurometrology is very original and combines the local strength in neurobiology, metrology and quantum technology. A new research building (NeuroLab) is planned to provide a common infrastructure.

- ➔ The commission strongly supports these plans and recommends that the state of Lower Saxony supports the development of an internationally visible and competitive neurometrology centre in Braunschweig.

TUBS biology has been very successful in training PhD students and provides a supportive environment for early career training. With respect to DFG Research Training Groups the potential is not exhausted yet.

- ➔ TUBS biology should aim to attract more DFG funded PhD programmes – the planned organ-on-chip theme as part of the neurometrology research initiative seems promising.

Structured bioinformatics training for all disciplines appears to be lacking at TUBS.

- ➔ TUBS biology should implement a systematic approach towards teaching bioinformatics and data analytics from early on.

The support for Postdocs seems less well organised and could be improved.

- ➔ A postdoc programme within the faculty of life sciences should be implemented to provide a framework for coordinated career support and networking opportunities.

The internationalisation efforts of TUBS would benefit from long-term strategic measures:

- ➔ Degree programs in biology offered in English.
- ➔ Bilingual childcare on campus to support international scientists with families.
- ➔ Effective dual-career support in cooperation with non-university research institutions and local industry partners.

TUBS biology aims to establish a Master program for teacher training (Lehramt Gymnasium). The committee is in support of this plan.

- ➔ The necessary ressources should be made available to implement it.

10.1 Structure and general framework

Biology at TUBS is part of the faculty of Life Sciences and organised in five institutes. The institutes vary in size and have five (Zoological Institute), three (Institute of Biochemistry, Biotechnology and Bioinformatics; Institute of Genetics; Institute of Microbiology) and two (Institute of Plant Biology) professorships appointed. The committee considers the structural organisation of biology at the TU Braunschweig as functional. During its visit, the commission experienced a refreshing spirit of team effort, synergism and collegiality among the faculty members. The institutional structure aligns with teaching needs in the biological study programmes. Concerning biological research, the relatively small institutes gain critical mass through numerous connections with scientific partner institutions in the Braunschweig area (HZI, DSMZ, JKI, TI, PTB) and Hannover (ITEM). It is therefore very important for biology at TUBS that those collaborations continue to be lively and resilient. This has been achieved in the past by appointing joint professorships (14 in total, see 2.2.6) and through shared infrastructures, such as the BRICS, which serves as a bridge to local research institutions. Joint graduate academies (Biomedas, HZI International Graduate School) integrate graduate students in the wider scientific landscape of TUBS biology. The committee recognises the collaborations with the non-university institutions as effective and exemplary. It recommends to foster these bonds and develop new strategic partnerships.

10.2 Research profile and research impact

The biological research units at TUBS are a main contributor to the university's core research area Infection & Therapeutics (disease etiology, organ models, new medical drugs, compound formulation). Metrology (Nano-LEDs, Nano-electronics and -magnetism, superconducting quantum sensors) is another core research area of TUBS. It is becoming increasingly relevant for interdisciplinary research programmes headed by biological researchers in the field of neurobiology. Thus, the research profile of TUBS biology has been developed in tune with the university's strategic research foci over the last years and the institutes aim to further build on that. The committee considers this as a very effective and sensible strategy to pursue for a medium sized biology – especially with regards to acquiring competitive third-party funding to tackle important questions at the interface of disciplinary boundaries. Nonetheless, the commission notes that that there should be enough room for research units to follow out-of-the-box projects. Furthermore, teaching in biology demands its own canon of subjects, which does not necessarily reflect the research strengths only (a circumstance that is not exclusive to TUBS, of course). The Evolutionary Biology unit of the Zoological Institute is exemplary for a research group that flourishes extremely well outside the university`s core research areas. It

is therefore paramount to i) further strengthen the unifying research themes to increase the coherence and visibility of the overall profile, and to ii) provide an environment for strong individuals to pursue excellent research outside those themes to obtain complementarity.

Research in the biosciences at TUBS centres around four main foci: biotechnology and therapeutics, cell biology and cell physiology, neurodegeneration, and systems biology of infection. Another field of research is plant adaption to stress. With regards to the quality of research, the committee considers the overall performance of TUBS biology as excellent. The four major research areas are convincingly chosen based on current strength and allow for room for further development. This positive impression is also reflected by the competitive research funding acquired. In the reporting period TUBS biology together was granted 18.64 Mio. EUR of third-party funding (1.243 Mio. EUR / prof.) – of which 46 % were from the DFG. More recently, the collaborative projects HomeoHirn (VW-Vorab) and a DFG Research Unit on host response to DNA virus infection were also funded, illustrating the competivetivness of neurobiology and infection research at TUBS. Biotechnology, the original trademark of TUBS biology, is still a central part of the research profile. The work on antibody biotechnology yielded several spin-off companies that tackle current disease challenges, reflecting the impact of TUBS biology on local innovation efforts.

While the four main foci are well established and have a perspective, the future of the research line in plant adaption to stress seems less clear. This seems partly due to the change process that the plant biology institute is undergoing following the vacancy of the C4 professorship (“Eckprofessur”, succession of Ralf Mendel). The committee sees potential for developing the research area *Plant Adaption to Stress* with regards to resistance to climate change. This would allow for addressing fundamental biological questions that are also relevant for EU’s strategic goals, thereby opening the possibility to apply for Horizon Europe funding programmes (Food, Bioeconomy, Natural Resources, Agriculture and Environment). In this regard, it would be of particular importance to foster the collaborations with the relevant non-university institutes, the Thünen Institute and the Julius Kühn-Institute.

The plan of TUBS to define health engineering as a future defining theme fits well with current local strengths and provides opportunities for further expansion. With pharmaceutical research focusing on compounds, biological research providing biologicals (such as therapeutic antibodies) as well as live model systems, and together with engineering (process technology), TUBS has already a wealth of complementary strengths at hand. According to TUBS, the missing piece in the puzzle is a local partner for medical sciences and clinical research. TUBS

biology's strategic plan is to team-up with the Klinikum Braunschweig, one of the largest hospitals in Northern Germany (1499 beds, over 500 clinical doctors)[18]. The long-term goal is to strengthen medical research locally, thereby building a "Technical University Medicine" with a research profile complementary to the existing university hospitals in Göttingen and Hannover. To this end, TUBS biology pursues the goal of building an An-Institut with the Klinikum Braunschweig to provide a site for clinical oriented research. University medicine and its connections with local partners is currently under evaluation by the *Medizinausschuss* of the WKN. The question what role the Klinikum Braunschweig might play for TUBS biology goes beyond the scope of this evaluation and might be addressed in due course. However, the committee wants to stress the point that a potential build-up of a local partnership should not be at the expense of the existing collaborations of TUBS biology with the MHH. On the contrary, the proximity of the MHH (60 km), one of the leading university hospitals in Germany, provides vast opportunities for collaborations in clinically oriented research and translational activities for biological researchers based at TUBS and could be further expanded.

The committee identified some **challenges and potential risks** for TUBS biology:

The committee noticed that some of the top performing scientists are appointed on W2 professorships, which imposes the risk that they might accept calls from competing universities in the future. TUBS should have a plan at hand to keep them.

The vacancies of key professorships in Genetics and Botany impose a risk for the future scientific competitiveness of these fields. TUBS, together with its non-university partners, should make an effort to attract the strongest candidates for these positions.

The long-term preservation of biological data is a common challenge for scientific institutions worldwide and not exclusive to TUBS. However, the committee stresses that a sustainable data and software management strategy is paramount. TUBS biology is the origin of several highly accessed databases: BRENDA[19] (enzymes), AthaMap[20] (transcription factor and small RNA target sites in the *A. thaliana* genome) and PathoPlant[21] (plant-pathogen interaction). The operation and further development of these databases that serve the community well need to be secured in a sustainable manner – also beyond retirement of the initial founders.

---

[18] According to the Klinikum Braunschweig, its 21 clinics, 10 independent clinical departments and 7 institutes, covers almost the entire spectrum of medical subjects. https://klinikum-braunschweig.de/

[19] https://www.brenda-enzymes.org/

[20] http://www.athamap.de/

[21] http://www.pathoplant.de/

10.3 Collaboration and interdisciplinarity

The committee is impressed with the local collaborative network at TUBS, in particular within the focus area Infections & Therapeutics. The new collaborative research network in neurometrology that originated from the Insitute of Zoology together with the BRICS (systems biology), PVZ (pharmaceutical engineering), and LENA (nanometrology) of TUBS is regarded as extremely promising. The committee supports the initative to acquire an SFB with this interdisciplinary research programme. Partners of the consortium beyond TUBS include the HZI, the MPI for Multidisciplinary Sciences in Göttingen (formerly MPI Biophysical Chemistry and MPI Experimental Medicine) and the University of Lübeck and should help to gain critical mass. The plan to obtain funding for a neurometrology research center building is viewed very positively as such an infrastructure should foster the interaction between the research groups from neurobiology, physics, engineering and biomedicine. The ministry should support this endeavour with appropriate means.

Plant biology is in a change process at TUBS. Given that this discipline can contribute much to answering important questions regarding plant response to climate change and access to food and natural resources under changing environments, the collaborations with the JKI and the Thünen-Institute should be fostered. By teaming-up with those strong partners, the committee sees a lot of potential for the Plant Biology Institute to bridge molecular and organismal biology to understand plants in their (changing) natural context.

The biology at TUBS relies on the financial support by the university and the state to cover for shared costs that arise through third-party funded infrastructures. The sientific infrastructure together with joint professorships form the backbone of current and future collaborative research programmes with local non-university partners. Those ties are of particular importance for the biological institutes to gain critical mass for third-party funded programmes. All parties involved need to make sure that the financial framework is favourable to maintain and further develop the research foci of TUBS biology.

10.4 Early career development and teaching

TUBS biology is very successful in training PhD students, with 7.8 PhD graduations / Prof. in the reporting period. Furthermore, TUBS biology has implemented a systematic follow-up on the careers of their alumni PhD students and Postdocs, which is very useful for internal evaluation of post-graduate training. In the reporting period, TUBS biology had the speaker function in one DFG Research Training Group (GRK2223: Assemblierung von Proteinkomplexen, since

2016). Since the GRK2223 ended in 2021, TUBS biology should attract more DFG funded PhD programmes. The committee sees very good prospects for funding of a GRK with an organ-on-chip theme that is planned by the Zoological Institute as part of the neurometrology research initiative.

The committee got the impression that the environment for PhD students of TUBS biology is very supportive. The GradTUBS seems to provide an effective umbrella for graduate training. In comparison, the support for Postdocs seems less well organised and could be improved. The establishment of a postdoc programme within the faculty of life sciences providing a framework for coordinated career support and networking opportunities is therefore highly recommended. This should also include the election of a postdoc representative that could serve as an ombudsperson in case of dispute.

The committee welcomes the plans of TUBS to increase the number of courses taught in English and recommends to implement a master program that is entirely taught in English. The university has to provide the necessary infrastructure (for example for examination regulations and administration issues). This would not only attract more international students, but also enable international candidates for professorships to take up teaching more easiely. Biology of TUBS benefits from strong local partnerships with non-university research institutes to attract international PhD students. The committee encourages TUBS to include undergraduate teaching in a comprehensive strategy to attract international talent at all career stages.

The committee acknowledges the internationalisation efforts of TUBS. However, to attract and keep the best international talents, internationalisation should be developed long-term with a range of advanced measures: All degree programs in biology should be offered in English on the Bachelor and Master level. Furthermore, bilingual childcare is a big plus when competing for excellent international scientists with families. The committee recommends to elicit the possibilities to establish a bilingual *Kindertagesstätte* on Campus. This should be complemented with an effective dual-career support – in cooperation with non-university research institutions and local industry partners. Of course, all administrative forms should be bi-lingual to give non-German speakers an easy start.

The committee stresses the importance of bioinformatics education, which is relevant for all biological disciplines. Therefore, TUBS biology should have a systematic approach towards bioinformatics teaching from early on, which is not obvious yet. The committee welcomes the plan to establish a new English Master degree course in “Biology and Bioinformatics”.

TUBS biology strives to establish a Master study programme for teacher training in biology (Lehramt Biologie Gymnasien) and therefore sees the need for a *Biologiedidaktik* professorship. The motivation is that the possibility of studying the combination of biology and chemistry

(which is not possible at TUBS at the moment) will attract more students in educational sciences to studies these programmes. This would help to ease the lack of chemistry teachers in Lower Saxony. The committee acknowledges the need for highly qualified teachers in biology and chemistry and the important role they serve to educate future generations of students. If TUBS biology becomes further engaged in training prospective teachers, this should be implemented in a way that strengthens also the overall profile of biology and does not weaken the research-oriented Master programmes. From this point of view, an increase in resources would be recommended.

11 Universität Göttingen

Summary UGOE | Evaluations and Recommendations:

The scientific performance and the impact of UGOE biology is rated as outstanding – research excellence on an international level is the benchmark for future developments.

- ➔ UGOE biology should aspire to further initiate and lead collaborative research programmes in the future.
- ➔ The number of ERC grants should be increased – promising individuals should be scouted, encouraged and supported at all career levels.
- ➔ Successors for professorships that become vacant within the next five years should be appointed early and strategically within the scope of the main research areas.

The institutes are mainly structures serving teaching needs. The three main research areas (Molecular Biosciences; Biodiversity, Ecology and Evolution; Neurobiology) are overarching and have been developed very successfully in conjunction with the campus partners. The committee sees room for improvement regarding the following aspects:

- ➔ Stronger integration of molecular and organismal research in the plant sciences aiming for a multilevel understanding across scales.
- ➔ To this end, the links between the main research areas “Molecular Biosciences” and “Biodiversity, Ecology and Evolution” should be fostered.
- ➔ A connection of biodiversity and ecosystem ecology with socioeconomy within the Göttingen Campus should be aimed for.

UGOE biology is embedded in the Göttingen Campus providing excellent opportunities for collaborations and the joint use of infrastructure and equipment – this is a unique selling point for the life sciences to attract international talent and funding.

- ➔ UGOE biology should maintain its coherent organizational structure and make use of the exceptional environment of the Göttingen Campus.
- ➔ The committee encourages UGOE biology to explore potential for collaborations with other universities in Lower Saxony.

The technology platforms of UGOE are a true asset – their long-term maintenance is a financial and structural challenge, especially beyond the retirement of the current principal investigators.

- ➔ The state should further engage in financing major instrumentation required for building or maintaining scientific competitiveness.
- ➔ The university should have a mechanism in place that ensures the continuation of a technology platform beyond retirement of its head.

The outdated building infrastructure of university buildings and a shortage of space are major challenges and pose a substantial threat for future developments, the thriving of early career scientists and the recruitment of top researchers.

- ➔ The university and the state government should act immediately to ensure that biological research is housed in competitive building infrastructure.

Continued on next page

UGOE biology attracts and promotes promising young researchers.

- ➔ Efforts should be made to continue the strong track record of attracting grantees of ERC, Emmy Noether and Sofja Kovalevskaya awards and to build suitable career perspectives for the awardees.

The biological data science activities and initiatives of the Göttingen Campus are impressive. The plans to start a new Computational Biology and Bioinformatics Master / PhD program address a pressing need and are the right step for training the next generation of experts in this cross-sectional field.

- ➔ The bioinformatics units are encouraged to further join forces to gain maximum impact and visibility.

The outreach of UGOE biology is highly commendable and the approach taken with the new Biodiversity Museum is very convincing.

- ➔ These efforts deserve sustained support by the university and the city of Göttingen.

Overall the committee got a very positive impression of the support services and training opportunities that are being offered. Half of the PhD students have an international background. There appears to be room for improvement with regards to standardization of the programmes on offer.

- ➔ It is highly recommended that the same standards apply to all programmes, so that PhD students can experience the same level of assistance.
- ➔ Administrative procedures should have the character of a service focusing on the needs of students and postdocs in support of a successful career. The respective awareness should be raised and administrative staff should be trained accordingly.

11.1 Structure and general framework

The three biological institutes reflect the subjects of core biology and mainly provide administrative structures for teaching, whereas the centres institutionalise the research activities of UGOE biology. The research profile is characterized by three main research areas that are embedded in interdisciplinary research centres: the Göttingen Centre of Molecular Biosciences (GZMB), the Göttingen Centre of Biodiversity and Sustainable Land Use (CBL), and the Center for Systems Neuroscience. The centres bundle research across faculties (Biology and Psychology, Medicine, Chemistry, Physics, Forest Sciences, Agricultural Sciences) and also include units from non-university partners of the Göttingen campus (MPIs, DPZ). These different levels of organisation (institutes, centres) seem to work well and take into account that many topics cannot be investigated within the boundaries of traditional disciplines.

Within a short distance the Göttingen Campus provides outstanding opportunities for collaborations and the joint use of infrastructure and equipment. This concentration of outstanding researchers and infrastructure in the life sciences is a unique selling point to attract international talent and funding. However, this advantage is strongly challenged by outdated building infrastructure of university buildings and a shortage of space. In particular junior group leaders wishing to expand their research groups find themselves greatly slowed-down. Since the building situation is a dramatic threat for the continuous development of the university and will take years to improve, it is necessary to act as early as possible. This is not a problem exclusive to Göttingen[22]. However, the committee wants to stress that this aspect strongly hampers the recruitment of top researchers (e.g. the vacant professorship in Biological Data Science) and imposes a substantial threat to maintaining research excellence on an international level.

The majority of UGOE biology is located on the North Campus, close to the other natural science faculties, the Forest and Agriculture faculties, and the non-university partners. Research units working in the area of biodiversity, ecology and evolution are located near the city centre and the historic botanical garden. As a long-term perspective, it would be advantageous to integrate these units in buildings on the North Campus as well. The museums, botanical gardens and collections are a great asset of UGOE biology – for research, teaching and outreach. The historic botanical garden offers an ideal platformfor engaging the public with the biological sciences and is therefore of particular value for outreach activities. The committee recommends to find a creative solution for maintaining the historic botanical garden without tying up too many financial and human resources of the faculty. Together with the relevant stakeholders, the university and the city of Göttingen should develop a solution. The opening of a new

[22] Wissenschaftsrat: Probleme und Perspektiven des Hochschulbaus 2030, Postitionspapier, Köln, 21.01.2022

Biodiversity Museum until 2024 in central Göttingen are highly commendable and should be further promoted by the university. The approach to showcasing biodiversity to make science accessible to the public is very convincing and well thought-out. The Biodiversity Museum and its activities deserve broad and sustained support and may provide ideas for activities that can also be hosted by the botanical garden in an adapted format.

UGOE biology has five technology platforms hosting major instrumentation (Proteomics, Metabolomics & Lipidomics, Microscopy, Structural Analysis of Proteins, Genome Lab). These technology platforms are organised in a decentralised manner and are anchored in research projects – they do not represent mere service units. This is advantageous, because it ensures that the personnel share scientific ownership and should have an intrinsic motivation that the methods stay up-to-date. In this context, the committee wants to point out the challenge to maintain competitive technology platforms long term. Currently, the university (and in effect the faculty) needs to finance 50 % of the investment for major instrumentation (DFG Großgeräte). The relatively high counter-financing required is an obstacle for UGOE biology to renew the pool of state-of-the-art equipment. The commission recommends that the state should finance a larger share for major instrumentation proposals (*Gegenfinanzierung*). It seems sensible to separate this “Länderanteil” from competing needs in the budgeting and reserve it only for large-scale equipment. This would allow for easier replacement of the expensive technology and help to maintain competitive platforms for collaborative research projects long-term. Technology platforms and the expertise of people running them are a true asset. Thus, there should also be a mechanism in place that ensures the continuation of a platform in case the scientific head has retired.

11.2 Research profile and research impact

Given the strong scientific environment, research excellence on an international level should be the benchmark for UGOE biology. The committee takes the view that this standard is fulfilled in conjunction with its campus partners.

The scientific performance and the impact of UGOE biology is outstanding. The profile is characterized by three main research areas i) Molecular Biosciences, ii) Biodiversity, Ecology and Evolution, and iii) Neurobiology, Cognition and Behavior that are carried by high performing research units and are embedded in the outstanding environment of the Göttingen Campus. The commission recognizes the successes in research of UGOE biology that are measurable through the acquisition of 36.22 Mio EUR third-party funding in the reporting period. The main

funding agency by far is DFG (65%), followed by federal funding (14%). In the reporting period, the scientists of UGOE biology acquired 1.098 Mio EUR per professor.

The DFG-funded collaborative research programmes document the performance of UGOE biology and are of profile-defining importance. In addition to the impressive number of DFG initiatives in which scientists from the biological institutes serve as speakers, members of the UGOE biology contributesubstantially to several other initiatives in Göttingen, highlightingthe bridging function of biological research units with neighbouring disciplines. Research units that fall within the Molecular Biosciences are involved in the SFB 860, GRK 2172, and the EXC 2067. Within the main research area Biodiversity, UGOE biology leads the SFB 990. Within the main research area Neurobiology, Cognition and Behavior, research units are involved in the SFB 889, the FOR 2136, the GRK 2070, and the FOR 2705. A new SFB 1528 “Cognition of Interaction” (speaker Alexander Gail, DPZ) has been granted at the end of 2021.

Building on the past success, UGOE biology should aspire to further initiate and lead collaborative research programmes in the future. Furthermore, funding by the ERC has been relatively sparse in the reporting period. UGOE certainly holds the potential to be successful on this level. The committee recommends to support strong individuals on all career levels to apply for ERC grants. This would further strengthen the visibility and profile of UGOE biology.

Within the next five years five professorships will become vacant that are central for two of the three main research areas of UGOE biology (3.1.2). It is therefore paramount to plan the succession strategically, recruit actively and – if possible – make us of early appointments (*vorgezogene Neuberufung*).

11.3 Collaboration and interdisciplinarity

The capacities for cooperation on the Göttingen Campus are excellent, and UGOE biology is an integral part of this interdisciplinary network. Noticeable, the successful collaborative research projects reach across disciplinary boundaries and institutions. The research profile of UGOE biology is developed along themes and not by institutional affiliation. This works well in Göttingen, because the distances are short and the joint appointments with non-university institutions (DZP, MPIs) provide consistency. Members of the three biological institutes contribute in many ways and are bridging points for collaborative research initiatives between the UMG and the non-university partners. In the future, the members of the biological institutes should aim to occupy the “driver’s seat” in new research initiatives as often as possible and are encouraged to take the lead (i.e. speaker function) in collaborative research programmes.

So far, institutionalised collaborations with other universities in Lower Saxony fall within the field of microbiology. UGOE biology contributes to the Northern German Centre for Microbial Genomics (Uni Göttingen, TU BS, MHH, Greifswald; since 2013), and is a partner in the TRR 51 “Ecology, Physiology and Molecular Biology of the Roseobacter Clade” (Uni Oldenburg, TU Braunschweig; 2010 - 2021). The committee encourages the research units of UGOE biology to explore whether there is more potential for collaborations with other universities in Lower Saxony.

To gain a multilevel understanding of biological systems, the integration of computational, mathematical and experimental approaches holds huge potential. In this regard, the committee welcomes that UGOE biology (Siegrid Löwel, Michael Wibral) is part of the Campus Institute for Dynamics of Biological Networks (CIDBN), a transdisciplinary institute above faculty level bringing together groups from the university, the UMG, the DPZ and the MPI for Dynamics and Self-Organization. Its aim is to advance theory-driven paradigms and to expand computational and data science in the life sciences on the Göttingen Campus. The institute can also serve as a hub for training biologists and to attract new talents – both will be very beneficial for biological research in Göttingen.

11.4 Early career development and teaching

With 10 PhD degrees per Prof. awarded in the reporting period, UGOE biology has the highest output of PhD graduates among the participating institutions within this evaluation. The outstanding scientific environment of the Göttingen Campus with a plethora of opportunities for exchange and access to high-end technology are certainly pulling factors for attracting PhD students – almost half of them internationals. The postgraduate training in the biological sciences is embedded into the GAUSS graduate academy, which acts as an umbrella for the dedicated programmes that focus on themes. Overall the committee got a very positive impression of the support services and training opportunities that are being offered. However, the standards for the quality of support and mentoring seem to vary between the different graduate programmes. It is therefore highly recommended that the same standards apply, so that PhD students can experience the same level of assistance irrespective of the programme they joined.

The 12-year limit for employment (“12-Jahres-Regel”, Wissenschaftszeitvertragsgesetz (WissZeitVG)) may impose a challenge for postdocs that are on the route to establishing their own independent careers. The university administration should do its best to maximize the time

available to scientists within the framework of the legislation. Along these lines, administrative procedures should have the character of a service focusing on the needs of students and postdocs in support of starting a successful career.

The committee welcomes the plans to start a new Computational Biology and Bioinformatics Master / PhD programme. This is very timely and the right step to populating the next generation of qualified experts in this cross-sectional field. It is also a logical step against the background of the Data Science priority area of the university (Campus Institute Data Science) and the foundation of the Campus Institute for Dynamics of Biological Networks (CIDBN).

With regards to third-party structured programmes, the committee encourages UGOE biology to keep up the good track record with regards to DFG Research Training Groups (GRKs). UGOE has all the prerequisites to lead and contribute to the planned GRK “Gönomix: Functional genetics in emerging model organisms” (Zoology). Research units of UGOE biology will also contribute to the planned GRK “Curiosity” by the Institute of Psychology**.**

12 Universität Hannover

Summary LUH | Evaluations and Recommendations:

Biology has not been developed as a coherent field of research at LUH, but rather is structured along an artificial separation into “green” and “red” biology that follows teaching needs and not research strengths. Currently, LUH biology goes through a difficult change process that lacks consistency and direction due to tensions between the different levels of organization (institutes, faculty, presidium).

- ➔ Immediate action is required to start a mediation process aiming for a new strategy.
- ➔ An advisory board should be installed and provide guidance over an extended period of time.
- ➔ All parties involved should work together towards a coherent research profile.
- ➔ The strategy should give the promising young PIs a key saying, and make use of the expertise and proven strengths of the senior PIs.
- ➔ LUH biology should take the initiative and formulate a clear concept for the future.

The complex organisational structure with seven institutes is not comprehensible.

- ➔ The institutional structure of LUH biology needs to be reorganized to allow for an efficient governance and the building of a coherent profile.

Although there are strong research groups at LUH biology, the overall scientific performance falls short. The amount of third-party funding acquired is relatively low and there are no DFG-funded coordinated programs with speaker function currently running. The potential is not exploited effectively.

- ➔ A coherent profile with few but well-developed foci that are based on existing expertise should increase the visibility and competitiveness.

LUH biology received a number of high-profile grants for young PIs (one ERC starting grant, two Emmy Noether grants, one EU H2020 grant) highlighting that talents can be attracted.

- ➔ It will be of utmost importance to give those top performing young researchers a perspective at LUH.

Structured training in bioinformatics and biological data science for all disciplines was not recognisable.

- ➔ This cross-cutting theme should be developed systematically – the concept should also include relevant partners within the Hannover area.

On the level of the graduate students and postdocs the environment is interactive and cooperative. LUH biology provides a functional and supportive framework for training PhD students. There may be room for improvement regarding the following aspects:

- ➔ Election of a PhD representative.
- ➔ Implementation of a structured onboarding for postdocs.
- ➔ Administrative procedures offered in English.
- ➔ Sufficient funds for hardship and open access publications.
- ➔ Support offered for experimental work during pregnancy.

The committee found LUH biology in a state of upheaval. The institutes currently go through a difficult change process that appears to be inconsistent and lacks direction due to tensions at various levels. The committee recognized the following reasons for the current situation:

- Biology has not been developed as a coherent field of research, but rather along an artificial and outdated separation into “green” and “red” biology that follows teaching needs and not research strengths.
- The long-standing focus on teaching and research at LUH has been on horticulture – the strategic decision to close this division and to re-organise the plant sciences led to frictions that so far have impeded identifying consistent future lines of research and moving forward in developing LUH biology in a productive manner.
- The different levels of hierarchy (president, faculty, institutes) still lack common ground for devising a sustainable strategy. The obvious lack of consensus leads to frustration and prevents the staff in biology from building a team spirit and synergistic interactions.

As the extent of the problem only became clear on site, much time was spent understanding the situation. The following recommendations are based on this process, but can only be of general nature due to time constraints. In addition, some aspects are discussed in detail thereafter. The committee has the following main recommendations:

- The situation requires **immediate action**: a mediation process has to be started leading to a strategic development plan.
- The **young principal investigators** should be given a key saying in the future strategy, without tying them up with moderating and administrating the change process. Their main focus should be on propelling their research.
- The **senior researchers** should support this process by contributing their long-standing expertise and drawing on their existing and proven strengths. The higher levels of the hierarchy should rely on the potential of their faculty to identify future lines of research in a synergistic manner, rather than imposing topics that are not rooted in the research strengths of LUH biology.
- The university should install an **advisory board** to provide guidance on the future strategy of LUH biology and to support a productive change process. The board should act over an extended period of time.
- The dichotomy of “plant science and biology” is artificial and needs to be overcome. All parties involved should work together towards a **coherent research profile**.
- The scope of the envisioned research area “Bio-Eco-Sphere” covers most of biology and is far too broad. LUH biology should aim to **develop not more than three highly visible research foci**. Those could be integrated in interdisciplinary research centres in cooperation with local or regional partners.

12.1 Structure and general framework

There are currently seven institutes. Three of them are very small with only two (Cell Biology and Biophysics; Geobotany) or even one professorship (Plant Nutrition). The plant sciences distribute over four institutes (Plant Genetics; Botany; Geobotany; Plant Nutrition). Furthermore, the institutes belong to two different “teaching units” of the faculty (“Biology”, “Plant Sciences”) that also have dependencies with two other universities (MHH, TiHo). This complex organisational structure is no longer comprehensible from today's perspective and hinders a focused development towards a visible profile. Furthermore, the structural organisation of individual institutes does not appear logical, i.e. the Zoological Biodiversity research unit is part of the Institute for Geobotany. The complex organisational structure hampers an efficient governance of the impending change process and needs to be optimized. Before deciding on a new structure, it should be decided what function it will serve in a new strategy for research and for teaching. The following main models are conceivable with varying degrees of dependencies to others:

A: Institutes mainly serve research foci, teaching is done in conjunction with partners (MHH, TiHo) in an overarching teaching structure.

B: Institutes serve teaching needs, research is organised in research centres in conjunction with partners.

Model A could be developed from the current situation by consolidating the institute structures and uniting all professorships in a coherent concept for a new research profile. The dependencies with regards to teaching would prevail. Attractive Master programmes could ensure that sufficient numbers of prospective researchers stay at LUH.

Model B would be equivalent to the situation at TUBS and the University of Göttingen. The institutes are organised and equipped for teaching full biology programmes. Research is organised in (interdisciplinary) research centres with local partner institutions. The research foci arise from those centres. This would require additional professorships or take about a decade when counting on positions to become vacant. The advantage would be that biology gains more weight as a unit and at the same time makes use of the scientific environment in Hannover to gain mass for collaborative research projects.

With regards to research and teaching, the committee takes the view that LUH biology should not see itself in competition with MHH or TiHo. In contrast, the strengths of the local scientific environment should be utilized to raise the profile of LUH biology.

12.2 Research profile and research impact

LUH biology has a long-standing tradition in plant research. In the course of the restructuring process within the faculty, LUH biology aims to develop a new profile. A clear and unifying research theme has yet to be developed. The institutes acquired a total 8.62 Mio EUR third-party funding in the reporting period, which is relatively low given the size of LUH biology (0.539 Mio EUR per professor). The main funding by far is from federal sources (*Bund*, 42%), followed by the DFG (29%). Of note, LUH biology received a number of high-profile grants for young PIs (one ERC starting grant, two Emmy Noether grants, one EU H2020 grant) highlighting that talents can be attracted.

A main challenge to address is finding a common ground for a new profile. The committee got the impression that the university leadership, the faculty and the members of the institutes have extremely diverging views on how to develop LUH biology in the future. However, the parties involved are in agreement that the focus should be broader and that LUH should be able to offer full biology degrees independently of MHH and TiHo.

The committee strongly advises that LUH biology needs to **take the initiative** and leading role to formalize (i.e. write) a **clear concept**, which will have an effect in two ways: firstly, it will help to unify and create an identity for the community of researchers. Secondly, the concept will bring forward arguments to the university leadership why capacities and personnel are needed. The basis for this concept needs to be a strong cohesion and team spirit among all members of LUH biology. All research units should be involved and commit to this task.

LUH biology presented its ambition to build a broader biology by strengthening the underrepresented research areas in “red biology” (Zoology, Human / Cell Biology). Four main research foci are in discussion under the thematic umbrella “Biological networks and interactions: from molecules to biospheres”: i) Interkingdom, organismal and cellular communication, ii) Metabolites, drugs and compounds, iii) Biodiversity / Ecology, iv) Cell-material interactions. The committee takes the view that four research foci are too many for the size of biology at LUH and that the umbrella theme is far too broad. The committee strongly recommends to aim for fewer but well-developed foci that are based on existing expertise. This will increase the visibility and help to attract students and talented researchers. The committee is aware that the change process cannot simply rely on generational change – it would take too long and might leave valuable resources on the sidelines. This is why it is important to convince all present PIs to commit to this change and help to build a new profile. This process should smartly utilise the proven expertise and strengths of the established PIs. A top-down process pushing new topics that are cross with current research directions is unlikely to yield a lasting positive effect.

The plan to connect with other disciplines of the faculty (chemistry, geosciences) can be fruitful. There are also plenty of opportunities on offer to integrate biological research with (bio) engineering and (regenerative) medicine within in the Hannover research landscape. However, there is already unused potential within LUH biology that – once a restructuring of the institutes has been done – can serve as a base to develop a new profile. In particular, the Institute for Botany, Institute for Plant Nutrition and Institute for Plant Genetics would benefit from combining their strengths. This is why a clear concept developed by LUH biology is a paramount task. Instead of providing "services" to other disciplines and dilute its resources, LUH biology should define its identity first and built strategic partnerships that help to raise its own profile.

At the time of the site visit, the profiling process was not optimally conceptualized. For this to occur, the **communication** between the different levels of organization (research units / faculty / university leadership) needs to be improved. It should be based on **trust**, it should be **constructive** and it should aim to agree on **common goals** for the next 10 years.

12.3 Collaboration and interdisciplinarity

The committee stresses the importance of bioinformatics and biological data science for the future competitiveness of biological research. This cross-cutting theme should be developed systematically – starting with a concept that should also include other partners within the Hannover area. The L3S Research Center of LUH would be a natural partner in this scheme.

At the time of the site visit, there was only one third-party funded collaborative research programme running, in which LUH biology has a leading role - the EU-funded UPSCALE.

The committee takes the view that LUH biology should aspire to initiate and lead more collaborative programmes that will help to develop a visible profile. The critical mass might be achieved with local partner institutions in the Hannover area or beyond. A prerequisite is a clear concept to strategically build a new profile, a supportive environment that backs the initiatives and a competitive infrastructure that allows the leading PIs to implement their ideas.

12.4 Early career development and teaching

The committee highly appreciates the recent recruitment of several impressively strong young PIs, three of which (75 %) are female. They have a proven track record of achievements (Emmy Noether grants, ERC starting grants, EU H2020 project) and show outstanding potential in their respective fields. As outlined above, they find themselves in an environment that

can be at best described as complicated, which threatens the successful development of this new generation of scientific leaders.

With 4.4 PhD degrees per Prof. in the reporting period, LUH biology and the faculty provide a functional and supportive framework for training PhD students. The committee got the impression that on the level of the graduate students and Postdocs the environment is interactive and cooperative.

Based on feedback by early career scientists, there might be room for improvement that the committee wants to point out. The university should check whether the funds for hardships and open-access publications are sufficient. Furthermore, the university and the faculty should question whether the support to continue experimental work during pregnancy is adequate. For example, if health and safety rules do not allow certain types of laboratory work, funds for student helpers who carry out experiments on behalf of the pregnant scientist could be a measure to prevent a career slow-down.

The committee encourages to elect a PhD representative of the biological sciences that can advocate for the interests of post-graduate students. A self-organisation of the PhD students will help to make their cases heard and the subject more visible.

LUH biology had the speaker function in the GRK 1798 (Signaling at the plant-soil interface) from 2013 – 2019. The committee strongly encourages LUH biology to acquire DFG-funded research training groups in the future.

According to the information provided, postdocs do not seem to go through structured on-boarding. The committee recommends to implement such procedures that could also be part of a structured postdoc careers programme tailored for the biological sciences.

The university administration should ensure that all contracts and forms are also available in English to help internationals at the beginning of their time at LUH.

13 Universität Hildesheim

Given the background of the university and its focus on teacher training, biological research cannot be assessed by the standards of this evaluation. The committee gives the following remarks and suggestions:

The infrastructure and resources are very limited in Hildesheim. There are only two regular professorships following different and very specific research foci (hard tissue biology; plant ecology and nature conservation) so that a critical mass for a substantial profile cannot be reached. There are no relevant non-university research institutes that could be partners to increase the capabilities. Nevertheless, the hard tissue biology unit is highly productive and gains international visibility in a very specialized field. Given the limited resources and the high teaching load, it will be a major challenge to attract a successor for H. Kierdorf with a competitive track record.

The early career scientists seem to cherish the good atmosphere and the support of their supervisors. The majority of PhD students graduate with a Dr. rer. nat., indicating they qualified through a biological research project rather than didactics research. The focus on nature conservation with a Masters program seems to be an attractor for students to choose Hildesheim. The committee is concerned that the mentoring, advising and career development of PhD students is not structured, and happens rather on a personal non-formalized level. Furthermore, the PhD students appear to be involved in a lot of independent teaching, raising concerns whether they are left alone with too many duties that should be the responsibility of the faculty. The PhD positions are established through basic funds. One possibility to broaden the research portfolio in Hildesheim would be to use these positions to establish junior group leaders, who could acquire third-party funding for PhD students instead.

The following remark has been also given to the University of Vechta

Since the major task of biology at Hildesheim is its involvement in teacher training (Grund-, Haupt-, Real-, Oberschulen) the question should be asked how – in general – small universities with this focus can accommodate the natural sciences in a way that allows for a productive and competitive research agenda. Furthermore, it should be noted that future teachers studying at universities with a narrow focus on teacher training are neither exposed to the whole breadth of biological research, nor experience working with state-of-

the-art methods and instrumentation. Considering the role of state-of-the-art scientific approaches to solve societal problems, for example in vaccine development, the committee considers it essential that future teachers can actively interact with basic scientific research underpinning these applications. The committee is convinced that with such a narrow research focus the quality of the next generation teachers is at risk.

➔ The committee strongly advises the ministry to reflect on the situation of biology at Hildesheim and to devise an overarching structural concept for Lower Saxony that considers how the need for thorough science-directed teacher training and competitive biological research can be implemented in a satisfying manner.

14 Universität Lüneburg

Summary Leuphana | Evaluations and Recommendations:

The committee is impressed by the performance and the research scope of the Institute of Ecology (IE). The quality of research focusing on sustainability is excellent and competitive on an international level. The main research areas (trait-based functional biodiversity; legacy effects; land management effects on biodiversity) are convincingly chosen and provide opportunities for future developments.

- ➔ The university should continue this specialized path of biological research.
- ➔ The IE should aim for initiating and leading DFG-funded Research Units and Research Training Groups to extend its research activities over the next years.
- ➔ The strong interconnection with the social sciences is a win for both sides, but should be developed with care such as to not dilute any of the existing strengths in ecological research.

There are no opportunities for collaborations with non-university research institutions locally, limiting the possibilities for shared infrastructures and joint appointments.

- ➔ The IE should further strengthen its collaborative network for new research consortia.
- ➔ The university should support the IE to build a controlled environmental facility (Ecotron) in Lüneburg.
- ➔ The state should aim to develop the local scientific environment by attracting non-university research institutions to the region.

IE is an attractive place for young researchers with an interdisciplinary mindset. The strategy has been a success. Early career scientists are receiving offers from international universities.

- ➔ The IE should continue its strategy of serving as an “incubator” for talented young researchers.
- ➔ The number of PhDs students graduating from Leuphana appears to be low. It should be considered how the Master programs can feed better into the research agenda of the IE, e.g. through the conception of a Master/PhD program.

The mandatory education in ethics, critical thinking and data literacy at Leuphana is exemplary. The committee is particularly impressed with the structured education in methods by the *Methodenzentrum.* There is no natural science faculty and Leuphana takes its own approach to undergraduate teaching that does not compare with other universities offering biology degrees.

- ➔ The pros and cons of the Leuphana model of education should be clearly communicated, so that aspiring biologists can make an informed decision where to study.

14.1 Structure and general framework

The Institute of Ecology (IE) is part of the Faculty of Sustainability – the first of its kind in Germany providing the structural framework for research and teaching in this area of study. With six professorships the institute is relatively small-sized and achieves its impact trough a clear research focus and an interdisciplinary approach.

The IE is in close exchange with the Social-Ecology Systems Institute (founded in 2020). Both address common topics related to land management effects and ecosystem functions and services. This outreach into social sciences is a characteristic of biological research at Leuphana. Since there is no natural science faculty and a main focus of Leuphana is on social and cultural sciences, this is a sensible and convincing concept of developing biology in a rather non-conventional way in alignment with the locally existing strengths.

There are no non-university research institutions of relevance for biological research in Lüneburg. The committee got the impression that the IE is well connected with partners in Germany and abroad and is able to compensate the lack of partner institutions closeby. In the long run Leuphana and the state should aim to strengthen the local research environment by attracting non-university partners. This would be an important step for the long-term competitiveness.

Concerning research infrastructure, the IE would benefit from an extension of the existing capabilities through the building of an Ecotron[23] research infrastructure on site. This would allow to study the mechanisms behind functional biodiversity outcomes under varying conditions with regards to global change.

14.2 Research profile and research impact

Leuphana has a clear vision for biological research. It aims to focus on basic research in a specialized field (ecology) that is embedded in a wider context (sustainability). By providing and attractive environment, a breeding ground for talented young researchers is developed. The concept includes that the talents eventually continue their careers elsewhere and form a worldwide alumni network that will radiate back to Leuphana beneficially in the long run.

The committee is impressed by the performance and the research scope of the IE. The members of the institute are very productive and publish in high-ranking journals. The committee

[23] A facilty to study ecosystem processes in a controlled environment.

rates the quality of research as excellent and competitive on an international level. In the reporting period the institute was granted 4.23 Mio. EUR of third-party funding (0.846 Mio. EUR / prof.) – of which 39 % were from the Bund and 18 % from the ERC. Members of the institute are involved in DFG-funded coordinated research programs (FOR 891, GRK 2324, and recently FOR 5375) and have acquired an ERC Consolidator Grant (Jörn Fischer).

The research focus areas of the IE (trait-based functional biodiversity; legacy effects; land management effects on biodiversity) are convincing and the committee sees very good opportunities for future developments. Building a bridge from natural to social science as part of the research strategy is very ambitious and should be developed with care so that the existing strengths are not diluted.

The committee encourages to continue along the path for biological research that Leuphana has chosen. It is therefore advisable to keep the focus on sustainability strong. Given the potential, the IE should aim for initiating and leading DFG-funded Research Units and Research Training Groups to extent its research activities within the next years. Furthermore, junior PIs coming with their own funding, e.g. Emmy Noether group leaders, should be attracted.

14.3 Collaboration and interdisciplinarity

By linking ecological and social research, biology at Leuphana is crossing disciplinary boundaries in many projects. The IE seeks collaborations to complement its own strength, which seems to work, e.g. with the Helmholtz Center Hereon in Geesthacht (climate modelling) and the TU München (microorganisms). The numerous involvements in coordinated research programs show that the members of the IE are well connected and established in their respective fields of research.

14.4 Early career development and teaching

Leuphana and the IE offer a supportive environment for PhD students. The committee noted a strong team spirit and a positive atmosphere among the junior scientists. In the reporting period 3.2 PhD degrees were awarded per professor. It was noticed that PhD candidates joining the IE are mostly graduates from other universities. This shows that the IE is an attractive place for young researchers to start their careers.

The fact that early career scientists received international offers for professorships is a sign of quality – talented PhD students, postdocs and junior PIs are attracted and thrive at the IE. The

influx of externals is very positive and enriching. However, the committee also wants to express some concerns that the fraction of students educated at Leuphana who start a PhD project at the IE seems relatively low. The committee recommends to consider the conception of a structured Master/PhD program based on the research strengths of the IE.

The committee is impressed that the undergraduate curriculum includes mandatory education in ethics, critical thinking and data literacy. This could be become a role model for other universities. Especially the structured education in methods by the *Methodenzentrum* led by Henrik von Wehrden is exemplary.

The committee agrees that there is a place within the scientific landscape of Lower Saxony for a university with a different approach to research and teaching in biology, such as Leuphana. With its way of doing things differently – more comparable to the approach of Anglo-American and Dutch universities – Leuphana might be the right fit for many ambitious students and researchers that want to commit to ecology research in an innovative and interdisciplinary environment. Nevertheless, students need to be well informed about the limits and possible shortcomings of such an approach. Parts of the committee want to express their concerns that without a natural science faculty the education in the basic sciences falls short, so that it is not comparable with a biology study program offered by a university with a full set of natural science professorships. The committee recommends that the advisory service for prospective student (*Studienberatung*) should inform about this in a nuanced way.

15 Universität Oldenburg

Summary UOL | Evaluations and Recommendations:

UOL biology follows a clear strategy with conceptional planning. The research profile is characterized by very concise and clear foci of the three institutes implemented within the university's main biological research areas (Biodiversity and Evolution; Neurosensory Science; Ecology and Environmental Sciences). Over the last 20 years UOL made an impressive transition from a weak to one of the strongest locations for biological research in Lower Saxony with international visibility. The overall scientific performance of UOL biology is outstanding.

- ➔ The commission highly appreciates the commitment of UOL biology to organismic biology and sees this emphasis as a very valuable part of the research landscape in Lower Saxony that should be pursued further.
- ➔ The Cluster of Excellence iniative in animal navigation should be pursued. The prospective new research building would be a centerpiece for this highly successful line of research.
- ➔ The committee recommends to take a more systematic approach to the development of data science as an integral part of research and teaching. Data scientists across UOL should connect and build a network.

The structural organisation of UOL biology is functional, the two institutes (IBU, ICBM) and the department (DfN) are connected and share a community spirit. The research is well embedded in the research landscape of North-Western Germany – eight joint appointments with the non-university partners ensure continuity.

- ➔ The committee recommends to continue making use of the research landscape in the North-Western region of Germany and to further strengthen these bonds through joint appointments and collaborative networks.

The shortage of space and outdated buildings pose a major challenge. The committee considers this as a potential threat for the continuation of the very positive development of UOL biology and for the future recruitment of talented scientists.

- ➔ The university and the state should be committed to providing adequate building infrastructure to ensure that biological research at UOL can continue to thrive.

UOL biology is involved in and is partially leading coordinated research programs that cross disciplinary boundaries to physics, modelling, chemistry and medicine (animal navigation, marine ecosystems, neurosensory science, hearing research).

- ➔ The committee encourages UOL biology to further connect with other disciplines to drive their research forward in an innovative manner.

The environment for PhD education is supportive and students have the opportunity to join one of the structured PhD programmes. The committee sees room for improvement regarding the following aspects:

- ➔ The total number of PhDs awarded is relatively low. Building on the research strengths and the collaborative spirit at UOL, the committee recommends to develop a strategy for educating more PhD students in the future.
- ➔ The committee strongly advises that the participation in a structured PhD program should be mandatory for all PhD students. This would enrich the students' training experience and provide an important tool for quality assurance.
- ➔ PhD students should receive equal pay. The funding of PhD students via stipends that pay less should be matched to remove inequalities with students on contracts. The state should support this by granting positions rather than stipends.

15.1 Structure and general framework

The three institutes of UOL Biology in their current form (Department for Neuroscience, Institute of Environmental Sciences, Institute for Chemistry and Biology of the Marine Environment) are the result of a reorganization process that started 20 years ago following a recommendation of the previous WKN evaluation. The structural organization is functional, serves the research profile well and connects biological research with partners in the Oldenburg area. The ICBM links biology with marine science in North-Western Germany and beyond, whereas the DfN is part of the Faulty of Medicine and Health and contributes to the successful focus in hearing research. The committee got the impression that there is a very positive corporate spirit among the biologists, despite the fact that they are affiliated with three different institutes in two faculties.

UOL biology is embedded in and makes use of the research landscape in the North-West, as evidenced by numerous joint professorships associated with Helmholtz (AWI, HIFMB), Leibniz (ZMT Bremen), Senckenberg and the Institute for Avian Research. The strategic planning for new professorships involves the non-university partners, which has been well received by the committee. UOL is the home institution of the research vessel RV Sonne, which is owned and funded by the German federal state. ICBM does not have priority access to the vessel, but its worldwide missions increase the visibility of the institute in marine science. With its relatively large size (34 professorships) and the non-university partners in the area, UOL biology is in an advantageous position for running competitive research consortia.

A major challenge identified is a shortage of space and outdated buildings. The committee sees this as a potential threat for the continuation of the very positive development that UOL biology has been taken over the past 20 years. At the moment the positive atmosphere and the cooperative spirit of sharing compensates for many of the shortcomings. However, the university and the states should not rely on this and should be committed to providing adequate building infrastructure to ensure that biological research at UOL can thrive.

The plans for a new animal navigation research building are consistent with the scientific achievements in this field in Oldenburg and are highly supported by the committee. Nevertheless, this building would not solve the general shortage for space. If the opportunity to provide more space would arise in the future, the committee recommends not to separate the research units of the three institutes, so that the productive exchange that is a characteristic of UOL biology can continue.

15.2 Research profile and research impact

The research profile of UOL biology is characterized by very concise and clear foci (Biodiversity and Evolution; Neurosensory Science; Ecology and Environmental Sciences). The committee is impressed that UOL biology follows a clear strategy with conceptional planning for the next five years and beyond. It is fair to say that over the last 20 years Oldenburg has made the development from a weak location for biological research to an asset for Lower Saxony with international visibility. The committee rates the overall scientific performance of UOL biology as outstanding. In the reporting period UOL biology was granted 27.95 Mio. EUR of third-party funding (0.9 Mio. EUR / prof.) – of which 58 % were from the DFG. Members of UOL biology are involved as speakers in seven coordinated research programs (incl. DFG funded SFB1372, TRR51, GRK1885, FOR2716, FOR5094). The work of Henrik Mouritsen on the mechanisms of animal navigation is of particularly high impact. Helmut Hillebrand (marine science) and Georg Martin Klump (neuroscience) are motors of their respective fields. Meinhard Simon has made seminal contributions to marine microbiology in the course of his career. With his retirement due in 2022 a key driver of marine science in Oldenburg needs to be replaced. Furthermore, the commission highly appreciates the commitment of UOL biology to organismic biology and sees this emphasis as a very valuable part of the research landscape in Lower Saxony.

Together with its partners and collaborators UOL biology aims for excellence in the fields of animal navigation and marine science. The committee strongly supports these ambitions and sees very good opportunities for the animal navigation initiative in the context of the German Excellence Strategy of the Federal Government and the States, since it is supported by an SFB, an ERC Synergy Grant (with Peter Hore, Oxford) and a prospective new research building. The marine science initiative also has a very promising perspective, but in the light of very recent appointments, the timing might not be conducive to preparing an independent proposal to the German Excellence Strategy led by UOL biology at this stage. The existing Cluster of Excellence in hearing research (Hearing4all, UOL and MHH) will apply for a third funding period – the committee is convinced that the DfN of UOL biology will continue to be of high value for the future of this successful flagship project.

The committee sees room for improvement in the field of biological data science at UOL. The committee highly recommends to take a more systematic approach to the development of data science as an integral part of research and teaching. There should be a consistent education provided in all curricula and all data scientists at UOL should connect and built a network.

15.3 Collaboration and interdisciplinarity

UOL biology offers prime examples of interdisciplinary research that adds genuine value to the scientific process: Finding mechanisms of animal navigation (quantum physics, neuroscience, animal migration) at IBU, marine science at ICBM (biology, chemistry, physics, social science), hearing research at the DfN (neuroscience, physics, medicine) and more. The success of this approach is evident by the number of third-party funded research consortia and the resulting research output. The committee encourages UOL biology to further connect with other disciplines to drive their research forward in an innovative manner.

The science of UOL biology is well integrated in the North-West of Germany. The close connections to the non-university research institutions and the positive development of the scientific landscape (founding of the HIFMB) are important factors for the competitiveness of UOL Biology. Currently, there are eight joint professorships appointed – mostly following the *Jülicher Model* (four with AWI, two with Senckenberg, one with the Leibniz ZMT Bremen, one with the Institute for Avian Research / Vogelwarte Helgoland). Furthermore, collaborative agreements exist with the universities in Bremen and Groningen.

The committee recommends to continue to make use of the research landscape in the North-West and further strengthen these bonds through joint appointments and collaborative networks.

15.4 Early career development and teaching

In the reporting period with 2.5 PhD degrees awarded per professor, which places UOL biology at the lower end in Lower Saxony in terms of numbers (App., Table 2). The committee recommends to develop a strategy for educating more PhD students in the future, building on the research strengths and the collaborative spirit at UOL. This should go along with maintaining a high quality of training. For this to judge, a systematic follow-up on the career paths of alumni is advisable.

The overall environment for PhD students is supportive and offers opportunities for training within the OLTECH graduate academy. Eight structured PhD programs relevant for PhD students from biology were running during the reporting period – three of which are funded by the DFG (see 7.2.4.). However, the committee noticed that not all PhD students are part of a structured program (with advisory committee), because the participation is voluntarily. The committee strongly advises that participation should be mandatory. The reporting responsibilities that are part of such programs are an important tool for quality assurance. Furthermore, the PhD

students may use training opportunities that extend beyond their own research project more readily, which is an important part of qualifying for alternative career paths.

PhD students on stipends are financially worse off than their colleagues who were offered to sign a contract. This is not a problem exclusive to Oldenburg, but the committee wants to point out that this inequality of students is not acceptable. The committee therefore recommends to consider how the PhD funding could be matched. The state of Lower Saxony should refrain from funding PhD programs using stipends and should commit financially to remove this inequality.

16 Universität Osnabrück

Summary UOS | Evaluations and Recommendations:

Biology at UOS has been developed very successfully with a strong research focus on molecular and cellular membrane biology. This line of research is competitive on an international level, as evidenced by a track record of publications in highly reputable journals and the attraction of substantial third-party funding. The overall scientific performance of UOS biology is rated as outstanding. A new SFB initative aims to continue the success in the coming decade.

- ➔ The committee stresses the importance of data analysis, modelling and methods development for the new iniative and recommends to develop these aspects as integral part of the research agenda.
- ➔ The further integration of organismal and evolutionary biology expertise into the main research focus on membranes is highly recommended. The different perspectives should provide mutual benefits.

The organisational structure as one Department of Biology is functional and a good fit. The new building housing the interdisciplinary CellNanOs research center is the centrepiece of UOS biology. The research infrastructure with state-of-the-art microscopy organized in the Integrated Bioimaging Facilty (iBiOs) provides the base for competitive research in membrane biology.

- ➔ The university and the department need to consider how to deal with rising maintenance costs for the expensive research instrumentation that is indispensable for the main research focus on membranes. This could become a challenge for the relatively small-sized department, so options for future funding need to be conceived.

The interdisciplinarity of UOS biology is very high through integration of chemistry and physics within the main research focus. At the same time, there are no opportunities for collaborations with relevant non-university research instittutions locally.

- ➔ The future success of UOS biology relies on a critical mass of excellent researchers “in house”. Therefore, the recruitment and the retaining of talents from a diverse background is of high importance.
- ➔ The committee strongly encourages the university to establish more tenure-track positions within UOS biology to offer talented junior PIs a long-term perspective.
- ➔ Closer collaboration with the university and the Max-Planck-Institute in Münster should be considered.

UOS biology provides a functional and supportive environment for PhD students. Two research training groups (integrated within the SFB and the university-funded EvoCell) offer structured programs in line with the respective research themes. There is still room for improvement in terms of total number of PhDs awarded.

- ➔ The committee encourages UOS biology to aim for a DFG-funded research training group based on the EvoCell program.

With respect to professorships UOS biology is far from reaching gender balance.

- ➔ The committee recommends UOS biology to continue the active recruiting of female candidates for vacant professorships.

16.1 Structure and general framework

UOS biology is organized in a departmental structure including all relevant professorships. There are no institutes as such. This organizational structure is a good fit for UOS biology. The centerpiece of UOS biology is the new CellNanOs building housing research units from biology, chemistry and physics providing an interdisciplinary research infrastructure with state-of-the-art microscopy to drive the main research focus in membrane biology. The CellNanOs is one of currently five interdisciplinary research centers of the university. The funding by the university is subject to a positive evaluation by an external committee every five years and can run indefinitely. This allows for a long-term perspective and at the same time ensures a regular quality check.

With regards to communication the relatively small size of UOS biology (19 research units in total) is perceived as an advantage by the research community in Osnabrück – this is in accordance with the cooperative spirit and the positive atmosphere noted by the committee.

The opportunities for partnerships with non-university research institutions are relatively sparse in Osnabrück. This is a challenging situation with regards to attracting talents and gaining critical mass for large research consortia. UOS biology's answer to this structural disadvantage is a clear research focus developed over the last decades and the opportunity for promising scientists to occupy W3 professorships relatively early, and W1 professorships with tenure-track option.

With long-term funding through SFBs, UOS biology was able to built an impressive research infrastructure with major instrumentation, such as a new cryo-electron microscope for single particle analysis, organized in the Integrated Bioimaging Facility (iBiOs). There is no doubt that this instrumentation is increasing the possibilities to address relevant scientific questions and raising the competitiveness of UOS biology. However, the committee is concerned about the long-term costs of running the highly advanced microscopes (maintenance, repairs, energy). These costs could impose a burden for the relatively small-sized UOS biology that does not have the opportunity to run such equipment in partnership with non-university partners. The university and the department should develop a concept to maintain these research infrastructures long-term.

UOS biology runs a botanical garden, which is financed with a dedicated and fixed amount of funds. The amount of financial support provided by the city has been constant over the last years. Grants are acquired and used to improve the quality of the garden, which is part of the national wildflower conservation network. The committee recommends that the funding of the

garden should be inflation-adjusted to ensure a sustainable adequate maintenance of this important infrastructure.

16.2 Research profile and research impact

UOS biology has a clear and strong focus on molecular and cellular membrane biology. The research is competitive on an international level, which is evident by decades of DFG funding of SFBs. The committee rates the overall scientific performance of UOS biology as outstanding. In the reporting period UOS biology was granted 18.53 Mio. EUR of third-party funding (1.32 Mio. EUR / prof.) – of which 66 % were from the DFG. Members of the department frequently publish in high-ranking journals. To name a few, Christian Ungermann is an internationally renowned world leader in membrane biology – as speaker of the SFB, he has shaped the coherent membrane-based research focus at UOS. Jacob Piehler is an internationally highly recognized scientist and driver of the biophysics focus at UOS and spearheads the microscopy of the CellNanOS building.

A new SFB with the working title “Functional Plasticity Encoded in Membrane Networks” will be under evaluation in fall 2022 – a success will be vital for the continuation of the remarkable CellNanOs research center as well as the future development of this line of research in Osnabrück. The committee stresses the importance of data analysis, modelling and methods development in this context. It highly recommends to develop these aspects within the planned consortium as integral part of research and thus going beyond an issue of infrastructure. The committee encourages UOS biology to pursue further coordinated funding initiatives beyond this SFB. Plans for a Cluster of Excellence initiative with the working title “Plasticity, Adaption and Points of no Return” were communicated by UOS biology and the university – however the impression of a rather immature status of the initiative provided no basis to support the case at the time of the on-site visit of the committee.

Compared to the membrane biology focus, the organismic research appears to be rather on the periphery. The committee welcomes the ambition to further integrate research units with a focus on organisms into the new SFB. The research on membranes can benefit enormously from bringing in organismal and evolutionary biology expertise, since the diversity of biological systems can be informative when working towards identifying new concepts and principles. Thus, the committee highly recommends to foster the integration of organismic research, evolutionary biology and ecology into the main research focus.

16.3 Collaboration and interdisciplinarity

The interdisciplinarity of UOS biology is very high. The university has built six interdisciplinary profile lines across the different departments that provide seed funding for bottom-up projects aiming for coordinated programmes. UOS biology is involved in three of those profile lines (integrated science; cognition; human-environmental networks). The CellNanOs research centre is a tremendous success story that is based on interdisciplinary strength of biologists, physicist and chemists. The committee highly recommends to complement this portfolio by integrating bioinformaticians and data scientists into the research agenda.

Members of UOS biology (Ecology research unit) are also involved in a second research center, the Institute of Environmental Systems Research (IUSF).

The EvoCell research training group is another example of interdisciplinary research at UOS and focuses on cellular mechanisms of evolutionary innovation and complexity and unites research units from biology, environmental systems research and physics. The university-funded program aims to become a DFG-funded research training group – an ambition that is supported by the committee.

Given that there are no Max-Planck-, Helmholtz-, or Leibniz-Institutes in Osnabrück, UOS biology does not have the opportunity for joint appointments or collaborations locally. The committee recommends to elicit, whether closer collaboration might be possible with Münster (60 km), where the WWU (with medicine) and the Max-Planck-Institute for Molecular Biomedicine are located.

16.4 Early career development and teaching

The committee got the impression that the support structures and the training opportunities for PhD students are functional. The atmosphere among the early career scientists appears to be very positive – the scientific environment with its modern facilities, state-of-the-art instrumentation, short ways and approachable PIs were named as major advantages.

With 2.4 PhD degrees awarded per professor in the reporting period, UOS biology is at the lower end in Lower Saxony in terms of numbers (App., Table 2). The committee recommends to UOS biology to conceive a strategic plan for increasing the number of PhD students educated, which should, however, go along with maintaining a high quality of training. A systematic follow-up on the career paths of alumni should be implemented to judge the quality of the PhD training provided over the years.

UOS biology currently runs a research training group that is funded by DFG, and the PhD program EvoCell that is funded by the university. The latter has not been successful in a recent round of selections by the DFG. The committee encourages UOS biology to try again to acquire a DFG funded research training group based on a revised EvoCell concept.

Within the reporting period, UOS biology had four independent junior groups. Their support is based on third-party funding. Since there is a shortage of tenure-track positions for young PIs, UOS biology does not have the means to offer a perspective to the most promising young PIs. Since the university recognizes biology as the strongest division in basic research at UOS, the committee strongly encourages the university leadership to consider the establishment of more tenure-track positions within biology. This would be a vital instrument to ensure that the most successful and promising talents can be kept long-term. Since UOS biology relies on gaining critical mass by itself, recruiting and keeping the best talents is paramount for future success.

The university offers seed funds to develop projects for a competitive grant application such as ERC starting grants. The committee recommends that those project start-up funds should be accompanied by profound mentoring – ideally by a scientist with a relevant track record of successful grants acquisitions.

UOS biology is far from reaching gender balance. This could also impose a threat for future third-party funded collaborative research initiatives, where equal opportunities for women scientists and diversity in general are paramount prerequisites in addition to research excellence. The committee acknowledges and welcomes the fact that UOS biology is aware of this and has taken steps to increase the number of female professors. Active recruiting to fill vacant professorships with female candidates is a measure taken by UOS that is well received by the committee.

Members of the department are engaged in the teacher training degree program. The committee got the impression that there is an overall positive attitude towards the task, that the interaction with the students is appreciated and that the university has a strong interest in a genuine and sound scientific education for future teachers. However, concerns were voiced that the high teaching load and the effort required for experimental training is not recognized adequately by the state. The committee encourages the state to reconsider the mode of the *Kapazitätsberechnung* for teacher training with substantial laboratory work load. UOS biology relies on having sufficient personnel to continue the successful research agenda and provide high-quality teaching for all students at the same time.

17 Universität Vechta

The commission does not see itself in a position to assess the research performance of biology at Vechta. Under the given circumstances, biological research that can meet current university standards is hardly possible. Major structural deficits were found:

- There is not even a remotely adequate infrastructure to conduct research projects.
- The number of personnel is insufficient and the staff scientists wear themselves out in teaching.
- The scientific environment is not suited to offering PhD students in biology the research and training experience they deserve.

The efforts and motivation of the scientists to maintain biological research activities against this background deserve highest recognition. Nevertheless, with the resources available, no thorough, science-led research training seems possible. The committee sees a danger that graduate students will not be able to receive adequate training.

Both regular professorships at Vechta focus their research on didactics. The committee does not make any statements about the quality of research in biology didactics, as this is not within its remit. This field of research has been evaluated by the WKN in 2016[24].

The following remark has been also given to the University of Hildesheim

Since the major task of biology at Vechta is its involvement in teacher training (Grund-, Haupt-, Real-, Oberschulen) the question should be asked how – in general – small universities with this focus can accommodate the natural sciences in a way that allows for a productive and competitive research agenda. Furthermore, it should be noted that future teachers studying at universities with a narrow focus on teacher training are neither exposed to the whole breadth of biological research, nor experience working with state-of-the art methods and instrumentation. Considering the role of state-of-the-art scientific approaches to solve societal problems, for example in vaccine development, the committee considers it essential that future teachers can actively interact with basic scientific research underpinning these applications. The committee is convinced that with such a narrow research focus the quality of the next generation teachers is at risk.

[24] WKN: Forschungsevaluation der Berufswissenschaften der Lehrerbildung und der Erziehungswissenschaft in Niedersachsen (2016).

➔ The committee strongly advises the ministry to reflect on the situation of biology at Vechta and to devise an overarching structural concept for Lower Saxony that considers how the need for thorough science-directed teacher training and competitive biological research can be implemented in a satisfying manner.

18 Biological sciences in Lower Saxony

In summary, biology in Lower Saxony is in an impressive condition. The committee found institutes with excellent and outstanding research, with convincing profiles, highly motivated scientists and sees very promising prospects for further successful development. The research landscape is diverse and has links to medicine, engineering, physics, chemistry, marine research as well as environmental and sustainability sciences. It is noteworthy that Lower Saxony also has a distinct organismic biology. Together with strong institutes focussing on molecular (cell) biology and in partnership with non-university partners, there is great potential for further developing integrated concepts to understand life across scales in a changing world.

Given its increasing importance for the scientific process, the committee sees room for improvement in implementing biological data science as a cross-cutting theme in research and teaching in Lower Saxony. The committee has also identified problematic cases that call for action. Biology at the University of Hannover requires substantial restructuring and a new strategy based on existing strengths to make use of its potential in the future. The smaller universities with a focus on teacher training (Hildesheim, Vechta) neither have the resources nor the scientific environment to build a competitive profile in biological research. The state should reconsider its concept on how and where teacher training and research activities in biology can be aligned and integrated.

The committee identified the following common challenges:

Buildings and energy

Lack of (modern) working space is a strong limitation for recruiting talents and retaining top scientists. The condition of university buildings has been under debate at the national level[25] for some time. The problems arising from outdated buildings and the challenges of how to solve them are not exclusive to Lower Saxony, but it certainly affects its biological institutes to varying degrees. While the buildings in Braunschweig and Osnabrück are mostly in very good condition, the serious situation in Oldenburg and especially in Göttingen threatens the competitiveness of the biological institutes. Furthermore, the rising energy costs could pose an overwhelming challenge in the near future that could deplete universities financially and put energy-consuming research (e.g. in greenhouses and climate rooms) at risk.

[25] Wissenschaftsrat: Probleme und Perspektiven des Hochschulbaus 2030, Postitionspapier, Köln, 21.01.2022

Sustaining technology platforms

Technology platforms and the expertise of people running them are a true asset for biological research in Lower Saxony. The committee is in favour of the model that those platforms are anchored in research projects, so that the technology, the methods and the expertise stay scientifically up-to-date. It is very important for the competitiveness of biological research that the platforms are sustained and further developed ba experts when the head of the respective unit leaves. This could become a particular challenge, for instance, if a free W3 professorship is transformed into a tenure-track position with fewer staff members. This problem could be solved by adding institute/department-wide shared *Funktionsstellen* for running and actively developing shared platforms and centralised facilities.

Teacher training

The committee considers it a critical disadvantage that, in comparison to the situation at large research universities, students at smaller universities with a narrow focus on teacher training do not experience the whole range of biological research and lack the chance of being exposed to leading-edge methods and instrumentation. This is a shortcoming – especially in light of the key role of science in addressing the big challenges of our time – that is posing a risk to the quality of future teachers (irrespective of the type of school they aim to qualify for). The curriculum therefore has to include courses exposing future teachers to scientific methodology, critical evaluation of results and how science-based knowledge is achieved. This can best be taught by involving the students in experimental work. The state should therefore aim to revise its overall structural planning in a way that science-directed teacher training can benefit from a strong biological research environment. Furthermore, the committee encourages the state to reconsider the mode of the *Kapazitätsberechnung* for teacher training for those subjects in which a substantial laboratory training is part of the curriculum. Biology relies on having sufficient personnel to continue successful research and also needs the means to provide high-quality teaching for all students. It was not clear to the commission why Braunschweig is the only location that does not offer or is not allowed to offer teacher training in biology. TUBS biology seems well suited to do this and the committee supports the plans to offer the respective master program.

Equal pay

State-funded PhD stipends providing lower incomes and no social security than employment contracts are an out-dated funding instrument that does not meet current standards. The committee therefore recommends that PhD students should be employed and thus subject to social security contributions and replace scholarships. Payment of PhD students should be based on contracts. Equal pay must be the norm.

18.1 Research landscape

In total there are 118 professorships in biology that fell within the scope of this evaluation (a further six professorships were unoccupied). The largest sites are Göttingen (n = 33) and Oldenburg (n = 31), followed by a mid-field consisting of Hannover (n = 16), Braunschweig (n = 15) and Osnabrück (n = 14). There are three smaller sites with Lüneburg (n = 5), Hildesheim (n = 2) and Vechta (n = 2). Although UGOE and UOL appear similar in size in this regard, this impression should be taken with care. It should be noted that biological professorships appointed at the University Medical Centre Göttingen were not included in this evaluation, whereas the Department of Neuroscience of the Faculty of Medicine and Health Sciences of UOL was included. When considering the total personnel (FTE ,1.12.2020) Göttingen (415.40 FTE) is almost twice as big as Oldenburg (218.70 FTE), followed by Osnabrück (170.98 FTE), Braunschweig (157.30 FTE), Hannover (117.00 FTE), Lüneburg (29.67 FTE), Hildesheim (13.60 FTE) and Vechta (12.00 FTE).

UGOE, TUBS, UOL and UOS have professorships covering the full spectrum of biological sub-disciplines and are able to offer undergraduate courses in biology plus more specialized options on the master level on their own. Thus, those four universities can be regarded as sites with a fully developed biology, whereas the other four sites are either more focused / specialized or rely on other institutions to gain the full spectrum of biological sub-disciplines. The latter is the case for LUH, where a cooperation in teaching with MHH and TiHo complements the capacities. The units of biology at the smaller universities has a different role compared to the larger sites and aligns with the profile of these universities. In Hildesheim and Vechta the focus is clearly on teacher training and research associated with science education. In Lüneburg, biology is essentially ecology embedded in the overall profile in sustainability sciences.

The non-university scientific environment provided by Max-Planck, Helmholtz and Leibniz research institutes has a major influence on the opportunities for biological research at the universities. It allows for the joint appointment of top researchers, and the shared usage of major

instrumentation gives access to leading edge technology and methods. Furthermore, students benefit from the rich environment through graduate programs. This is exemplary in Göttingen, Braunschweig and Oldenburg where the collaboration with non-university institutes is an integral part of the success. Not all universities have this local advantage and two sites would benefit from a further enrichment of its scientific surroundings. The state should strive to strengthen the non-university structures in Osnabrück and Lüneburg through establishment of associated institutes. In the long run, the growth potential at both locations cannot come from within the university alone and should be broadened by developing surrounding structures.

18.2 Research profile and scientific themes

It is noticeable that overarching centers are of increasing importance for the research profile, whereas the institutes, which often follow the denomination of the biological subdisciplines, function primarily as structures for teaching. The centers have the advantage that they can include research units from other disciplines or even groups from non-university partners (such as the BRICS of TUBS or the HIFMB of UOL for example). The rationale behind this trend is rather obvious: to leverage the power of tackling scientific questions by integrating different disciplines, and to gain critical mass for coordinated research programs. However, the trend of building more interdisciplinary centers (and their success) brings up the question to policy makers and funding organisation where biological research starts and ends as a distinct category and which indicators are suitable to evaluate its scientific success/progress.

For this evaluation, there is no general answer to the question whether the research profile of biology is developed best in overarching research centers or not. This depends largely on the specific situation on site, the strategy of the university, the scientific environment and also the recent history that could impose path dependencies.

Considering the profiles and strengths of biological research that fell within the scope of this evaluation, four unifying thematic areas can be identified in Lower Saxony[26]:

i) biodiversity, ecology, evolution (UOL, UGOE, Leuphana)
ii) neurobiology (UGOE, UOL, TUBS)
iii) molecular and cellular biology (UOS, UGOE, TUBS),
iv) microbiology and infection biology (TUBS, UGOE, UOL)

[26] LUH is undergoing a substantial change process, but has strong individual units who fall within the thematic areas i), iii) and iv).

From the state's perspective, these areas offer ample opportunities for synergies between the different locations of biological research in Lower Saxony.

Two universities possess successful thematic areas of particular importance for their profile that are unique in Lower Saxony: marine science in Oldenburg, and biotechnology with its links to engineering and pharmaceutics in Braunschweig. The lack of redundancy also means that the state should be interested in keeping those areas strong in the future, since they are valuable for the scientific landscape and also relevant for knowledge transfer into society and industry.

Besides the focus on themes, one should also consider the different scales of biological research. The committee sees a lot of (if not the most) potential to develop biological research in Lower Saxony by fostering the integration of organismal and molecular biology. This strategy would build on the proven strengths in those areas in Lower Saxony and should be developed in conjunction with the non-university partners. It could bring together and integrate molecular research and advanced microscopy with questions related to biodiversity, ecology, and evolution and would aim at a better understanding of organisms outside in the real world in their changing environment.

18.3 Research quality

Overall, the committee was impressed by the quality of the biological research in Lower Saxony. Differences among universities were mainly driven by the focus – e.g. mostly teaching (Vechta, Hildesheim), the size and topical breadth of each university (see above), and the potential to have joint professorships with close-by MPI, Helmholtz, Leibniz, and other extramural research institutes (which are lacking in Osnabrück and Lüneburg). The committee was impressed by the improvements implemented in Oldenburg over the last 20 years. At Hannover University, the committee saw an urgent need for mediation/intervention to bring biology research on a coherent track**.**

It is noteworthy that the quality of research in Göttingen, Oldenburg and Osnabrück is predominantly outstanding, which also becomes evident by the leadership in SFBs and other DFG-funded programs (see below). The research quality in Braunschweig is excellent and the prospects for future innovation (neurometrology, biotechnology) are very promising. For the small to mid-sized locations it is important to find the right balance between focus and diversity of scientific topics in the portfolio. This has been achieved well so far at the aforementioned universities.

Of note, the number of ERC grantees seems relatively low in Lower Saxony against this strong background in research and calls for a higher engagement in acquiring these prestigious awards to further drive the successful lines of research and further increase the visibility.

18.4 Collaboration, interdisciplinarity and internationalisation

Within the reporting period (2018-2020) biologists in Lower Saxony were involved in numerous collaborative research programs and were leading five SFBs as speakers: SFB 990 (UGOE), SFB 860 (UGOE), SFB TRR 51 (UOL), SFB 1372 (UOL), SFB 944 (UOS). Only one of them started recently in 2019 (SFB 1372: Magnetoreception and navigation in vertebrates). The other four SFBs are about to reach the end of their final funding period and it is therefore of major importance that the promising new initiatives that are under way will succeed. Biology in Lower Saxony certainly holds the potential to further lead joint research consortia in the future.

Lower Saxony delivers many examples for successful interdisciplinary science with a major contribution by biologists. TUBS is an innovative hub for linking biology with medical research (infection biology and therapeutics) and with engineering and physics (neurometrology). Göttingen Campus provides vast opportunities for collaboration. Since the campus partners provide resources and expertise on data science and scientific computing, biologist can benefit from and contribute to the Campus Institute for Dynamics of Biological Networks. UGOE biology is also in a privileged position to link to forest and agricultural sciences. Being in one faculty with psychology and holding joint appointments with the DPZ, biologists at UGOE have strong connections to neuroscience and cognition research. At UOL animal navigation, marine science and hearing research are prime examples how biologists team-up with scientists from other disciplines to pursue common research questions. At UOS the Center for Cellular Nanoanalytics research building is the home of interdisciplinary research on membranes that has been developed successfully for many years. At Leuphana ecology intersects with the social sciences following a distinct interdisciplinary approach.

Internationalization of research is driven by university structures such as international offices and support measures are implemented in most places. However, there is still much room for improvement with regards to internationalization of teaching, early career support and administration. These aspects do not apply to biology alone, but since its research community is very international, universities with an advanced internationalization strategy are in a better position to attract the best international talents. Master's courses should always be entirely in English in order to be internationally visible. This will require active welcome structures on site for international Master and PhD students as well as postdocs. Furthermore, international students and researchers with children will appreciate multilingual childcare on campus, which is rarely on offer. The administration staff must be proficient in English and should be aware that

internationality is a key aspect of scientific research that should be supported by university services. Although it is understandable that legal documents must be in German, this does not prevent the universities from offering (non-legally binding) English translations. Administration should be pragmatic and focus on the needs of students and researchers.

18.5 Early career development

Overall the committee found well developed structures offering general support for PhD students at the universities – often implemented as graduate academies such as GradTUBS at TUBS, GRANAT at LUH, GAUSS at UGOE, OLTECH at UOL and ZePrOS at UOS. Specific PhD training in the biological sciences is offered in PhD programs – some of them funded by the DFG, while others are funded by the ministry or through general university funds. The committee wants to stress that participation in some form of a structured program should be mandatory for all PhD students, since it provides an important tool for quality assurance. The universities and the faculties should also make sure that that the same standards apply to all programs on offer, so that all PhD students can receive the same high-level training experience. As mentioned above equal pay should be the norm and PhD students should be funded through contracts and not stipends.

The committee welcomes that all universities are increasing their efforts to enhance the chances of female scientists to attain professorship positions. For the reporting period under evaluation (2018 – 2020), the ratio of females was 70% for Bachelor/Master graduates, 53% for PhD graduates, 50% for Habilitands, and 26% for Professors. Within the group of professors only 23% of W3/C4 professorships are occupied by female scientists. This illustrates that there is still a long way to go until a gender balance is reached at the top of the scientific hierarchy. In order to be competitive in the future, the universities should put more effort into recruiting female (tenure track) professors at all levels. Although these numbers reflect a three-year snapshot and not a single cohort over time, it is fair to say that the undergraduate programmes attract sufficient numbers of prospective female scientists and that the bottleneck for a career in science is likely to be after graduation with a PhD. Thus, measures to increase female leadership in biology will probably be most effective when targeting the postdoc and early PI phase, however, the role model of female leadership should be conveyed as early as possible. In addition, the active recruitment of female talents for senior positions would help to strengthen the scientific profile and increasing the fraction of female professorships. To this

end, the universities should be open to modifying the conditions of appointment – including the possibility to have part-time contracts for professors.

In a wider concept, it is strongly advisable to see a high degree of diversity (cultural, ethnic, social, educational) among students and scientists as a big advantage to foster an environment of creativity and scientific progress. Thus, the universities and their faculties and biological institutes are encouraged to actively promote a welcoming and inclusive environment for all.

19 Conclusions and future prospects

Overall, biological research in Lower Saxony is in excellent condition and makes important contributions to basic research and transfer to society. With Göttingen, Braunschweig, Oldenburg and Osnabrück, the state has outstanding locations with internationally competitive research, high visibility and complementary strengths. The connections to local non-university partner institutions is of increasing importance and part of the success. It should be of great interest to the state that the scientific environment for biological research stays functional and be further enriched with additional research institutes (or branches thereof) of the Max Planck Society, Helmholtz Association, Leibniz Association or Fraunhofer society, in particular in Osnabrück and Lüneburg. Furthermore, the state and its university leadership need to make sure that biological research, which is a beacon at the locations mentioned above, can rely on competitive infrastructure and modern buildings to keep thriving in the future. Hannover needs to overcome its structural problems as to allow the talented and productive (young) scientists to enfold their full potential. Lüneburg is a place of innovative thinking and the clear focus on biodiversity and sustainability research is enriching the scientific landscape. The future of biological research in Hildesheim and Vechta is less clear and should be discussed further in the context of the requirements and expectations for teacher training and research in didactics and biology respectively.

In brief, the ultimate goal in biology is to understand organisms, how they work, and how they cope in the world. Lower Saxony is in an excellent position to bridge the molecular with the organismal scale and to investigate life in its natural and changing context. For this to be achieved, investments into innovative structures for bringing together experimentalists, field researchers, modelling experts and theorists seem appropriate.

20 Appendix: Biology in Lower Saxony (Tables)

Table 1: Personnel

Entire field of biology across all faculties

	Professor-ships occupied[1]	Professor-ships available[2]	Personnel in total[3]	Scientific Personnel, basic funds[4]	Non-scientific personnel, Basic funds[5]	Scientific per-sonnel, 3rd party funds[4]	Non-scientific personnel, 3rd party funds[5]
TU Braunschweig	15	16	157.3	36.7	49.5	51.4	3.9
Universität Göttingen*	33	33	415.4	76.3	126.6	168.5	12.0
Universität Hannover	16	16	117.0	30.7	38.1	25.9	3.3
Universität Hildesheim	2	2	13.6	9.1	2.5	0.0	0.0
Universität Lüneburg	5	6	29.67	9.65	6.22	7.15	0.15
Universität Oldenburg	31	34	218.7	54.5	48.1	76.8	9.3
Universität Osnabrück	14	15	170.98	41.31	69.27	42.65	2.75
Universität Vechta	2	2	12.0	6.9	2.8	0.3	0.0

1) occupied Professorships on 1.12.2020 (W1, W2, W3, C2, C3, C4)
2) available Professorships on 1.12.2020 (W1, W2, W3, C2, C3, C4)
3) full time equivalent, FTE (1.12.2020)
4) Scientific personnel without professorships, FTE (1.12.2020)
5) Non-scientific personnel, FTE (1.12.2020)
*) including professorships jointly appointed with the Deutsches Primatenzentrum GmbH Göttingen (DPZ)

Table 2: Research

	Profes-sorships[1]	3rd party funds[2] (Mio EUR)	PhDs[3]	Habilita-tions[3]	3rd party funds/Prof (Mio EUR)	3rd party funds/Prof p.a. (Mio EUR)	PhDs/Prof	PhDs/Prof p.a.
TU Braunschweig	15	18.64	117	3	1.243	0.414	7.8	2.6
Universität Göttingen	33	36.22	329	4	1.098	0.366	10.0	3.3
Universität Hannover	16	8.62	70	4	0.539	0.180	4.4	1.5
Universität Hildesheim	2	0.15	6	0	0.075	0.025	3.0	1.0
Universität Lüneburg	5	4.23	16	0	0.846	0.282	3.2	1.1
Universität Oldenburg	31	27.95	79	1	0.902	0.301	2.5	0.8
Universität Osnabrück	14	18.53	34	0	1.324	0.441	2.4	0.8
Universität Vechta	2	0.004	0	0	0.002	0.00067	0	0

1) occupied Professorships on 1.12.2020 (W1, W2, W3, C2, C3, C4)
2) Thirs party funds 2018-2020
3) Total number 2018-2020

Table 3: Third-party funds 2018-20 (x 1000 EUR)

	DFG[1]	EU[2]	ERC[3]	Bund[4]	State of Lower Saxony re-search fund-ing[5]	Funding by other states[6]	Corporations[7]	Founda-tions[8]	other
TU Braunschweig	8501	471	0	5174	2807	0	778	236	675
Universität Göttingen	23595	801	122	5061	1841	512	882	1849	1555
Universität Hannover	2528	117	434	3625	1043	0	170	25	679
Universität Hildesheim	0	0	0	0	73	0	9	34	34
Universität Lüneburg	355	0	744	1664	649	0	0	759	54
Universität Oldenburg	16139	556	1318	3910	2214	11	1034	1311	1458
Universität Osnabrück	12182	586	0	2977	1669	350	6	689	75
Universität Vechta	0	0	0	0	0	0	4	0	0

1) Deutsche Forschungsgemeinschaft
2) Europeab Union (without ERC)
3) European Research Council
4) Federal funding (e.g. Bundesministerium für Wissenschaft und Forschung)
5) State funding for research projects (e.g. VW-Vorab)
6) Funding from other federal states (Länder) for research projects, as long as they are awarded competitively

7) Funding from corporations
8) Funding from foundations (excl. VW-Vorab)

Table 4: DFG funding 2018-20

	Professor-ships[1]	DFG funding[2] (x 1000 EUR)	DFG funding/Prof (x 1000 EUR)	DFG funding /Prof p.a. (Tsd EUR)
TU Braunschweig	15	8501	567	189
Universität Göttingen	33	23595	715	238
Universität Hannover	16	2528	158	53
Universität Hildesheim	2	0	0	0
Universität Lüneburg	5	355	71	24
Universität Oldenburg	31	16139	521	174
Universität Osnabrück	14	12182	870	290
Universität Vechta	2	0	0	0

1) occupied Professorships on 1.12.2020 (W1, W2, W3, C2, C3, C4)
2) Third party funds 2018-2020 (EUR)

Table 5: Gender

	Professorships[1]		Habilitations[2]		PhDs[2]		Graduates[2]	
	total	female	total	female	total	female	total	female
TU Braunschweig	15	3	3	2	117	65	538	322
Universität Göttingen	33	9	4	0	329	162	1033	669
Universität Hannover	16	5	4	3	70	39	692	462
Universität Hildesheim	2	0	0	0	6	6	229	161
Universität Lüneburg	5	3	0	0	16	11	861	622
Universität Oldenburg	31	9	1	1	79	42	985	700
Universität Osnabrück	14	2	0	0	34	18	871	656
Universität Vechta	2	0	0	0	0	0	311	264
Lower Saxony total 2020	**118**	**31**	**12**	**6**	**651**	**343**	**5520**	**3856**

1) occupied Professorships on 1.12.2020 (W1, W2, W3, C2, C3, C4)
2) total number 2018-2020

Table 6 – First year students and graduates in biology 2018-2020

First year students	**2017/2018**	**2018/2019**	**2019/2020**
Total number (Bachelor / Master)	2829	2673	2888
Graduates	**2018**	**2019**	**2020**
Total number (Bachelor / Master)	1825	1888	1807