Module manual for the master´s programme

Biodiversity and Ecosystem Health

- Version 24th August 2026 -

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List of abbreviations

CP	Credit Points
E	Elective
EC	Exercise course
Ex	Excursion
FW	Framework for staged and modularised study programmes at the Johann Wolfgang Goethe University Frankfurt am Main of 30th April 2014 as amended on 22nd December 2020
L	Lecture
MM	Mandatory Module
N. N.	Nomen Nominandum, unnamed person
P	Practical course
PC	Participation certificate
S	Seminar
SoSe	Sommer semester/term
SWS	Semester hours per week
UD	University Department
WS	Winter semester/term

Overview study programme

	1st Semester	2nd Semester	3rd Semester	4th Semester
1st half of the lecture period	Basic module (15 CP)	Elective module BEH-Div-n or BEH-Eco-n or optional module (15 CP)	Elective module BEH-Div-n or BEH-Eco-n or optional module (15 CP)	Master's thesis (30 CP)
2nd half of the lecture period	Elective module BEH-Div-n or BEH-Eco-n or optional module (15 CP)	Elective module BEH-Div-n or BEH-Eco-n or optional module (15 CP)	Research roject (15 CP)	

Basic Module (Mandatory module)

<table>
<tr><td rowspan="2">BEH-Basic</td><td rowspan="2">Biodiversity and Ecosystem Health</td><td rowspan="2">Mandatory module</td><td colspan="2">15 CP (450 hours, h)</td></tr>
<tr><td>Hours of presence
10,5 SWS / 158 h</td><td>Self-study
292 h</td></tr>
<tr><td colspan="2">Module assignment</td><td colspan="3">M.Sc. Biodiversity and Ecosystem Health / FB 15</td></tr>
<tr><td colspan="2">Applicability of the module for other degree programmes</td><td colspan="3"></td></tr>
<tr><td colspan="5">Content</td></tr>
<tr><td colspan="5">The basic module "Biodiversity and Ecosystem Health" focuses on basic knowledge, advanced content, and scientific methods of the topic complexes biodiversity and ecosystem health.

The contents of the basic lecture are fundamental theoretical concepts from the areas of biodiversity research, evolutionary biology, ecology, ecotoxicology, conservation biology and social-ecological research, which allow a scientific understanding of biological processes of global change. They are reflected and focused on by a theoretical exercise accompanying the lecture.

Parallel to the basic lecture, the students participate in practical exercises in which they learn and apply basic methods related to the respective lecture contents. Those students who are well acquainted with some methods due to corresponding focal points in the Bachelor's degree support the knowledge transfer as student experts. Exercises on species knowledge and ecological topics will partly take place in the field.

Soft skills, such as scientific writing, scientific English, the use of programmes and databases, as well as presenting and reflecting on scientific content, will be taught in exercises through appropriate practical tasks, discussions, short presentations and short protocols.

Within the framework of the lecture series, research topics are presented by working groups that offer elective modules.</td></tr>
<tr><td colspan="5">Learning outcomes / Competence goal</td></tr>
<tr><td colspan="5">In this module, students acquire theoretical knowledge of biodiversity, evolutionary biology, ecology, ecotoxicology, conservation biology and social ecology for a scientific understanding of biological processes of global change. For this purpose, they acquire basic practical skills for research in these scientific fields as well as basic skills that are indispensable for scientific work.

Through the basic lecture "Biodiversity and Ecosystem Health", students understand the basic and advanced biological backgrounds of current challenges of global change. Interdisciplinary, advanced topics are also important. Through the associated theoretical exercises, they deepen their knowledge.

Through the practical exercises, the students gain insights into scientific research on various topics and apply different methods under guidance. They repeat theoretical knowledge from the basic lecture, supplement this knowledge with applied aspects and reflect on it through insights into scientific research. Student experts acquire teaching and leadership skills.

Through the lecture series, students receive an overview of current research on biodiversity, evolutionary biology, ecology, ecotoxicology, conservation biology and social ecology of the working groups involved in the study programme so that they can specifically set personal priorities for further study in the elective area and the master's thesis.

After completing this module, the participants are familiar with the basic knowledge and current research concepts of the above-mentioned subject areas, as well as the principles and requirements of good scientific practice and occupational safety. They are also able to acquire missing knowledge and skills independently.</td></tr>
<tr><td colspan="2">Participation requirements for the module</td><td colspan="3">None</td></tr>
<tr><td colspan="2">Recommended prior knowledge</td><td colspan="3">None</td></tr>
<tr><td colspan="2">Teaching offer</td><td colspan="3"></td></tr>
<tr><td colspan="2">Teaching formats</td><td colspan="3">Lecture, exercises</td></tr>
<tr><td colspan="2">Exam language</td><td colspan="3">English</td></tr>
<tr><td colspan="2">Modul duration</td><td colspan="3">One semester. The module takes place as a block within the first seven weeks of the winter semester.</td></tr>
<tr><td colspan="2">Frequency of the offer (offering period)</td><td colspan="3">Each winter semester</td></tr>
<tr><td colspan="2">Module coordinator</td><td colspan="3">Prof. Dr. Meike Piepenbring</td></tr>
<tr><td colspan="2">Semester-long certificate</td><td colspan="3"></td></tr>
<tr><td colspan="2">Certificate of attendance</td><td colspan="3">Active participation in the practical exercises.</td></tr>
<tr><td colspan="2">Course credits</td><td colspan="3">Tests, short protocols and short presentations in the exercises</td></tr>
<tr><td colspan="2">Module examination</td><td colspan="3">Form of examination (Scope/duration)</td></tr>
<tr><td colspan="2">Components of cumulative module examination</td><td colspan="3">Written exam in the basic lecture: Contents of the basic lecture, 120 min</td></tr>
</table>

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Biodiversity and Ecosystem Health (basic lecture)	L	3	6	X			
Biodiversity and Ecosystem Health (theoretical exercises)	EC	1,5	2	X			
Biodiversity and Ecosystem Health (practical exercises)	EC	4	4	X			
Lecture Series	L	2	3	X			
Total Sum		**10,5**	**15**				

Elective courses

BEH-Div-n Biodiversity and Evolutionary Biology

BEH-Div-1 Biodiversity and Evolution of Flowering Plants

BEH-Div-1	Biodiversity and Evolution of Flowering Plants	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
This module consists of a lecture, a seminar and a practical component with guided excursions, offering an in-depth introduction to the diversity and evolution of flowering plants (angiosperms). Students acquire theoretical and methodological knowledge in the fields of plant systematics, phylogeny, morphology, molecular evolution and plant biogeography. Selected fossil evidence is included, where relevant, to illustrate important evolutionary transitions. The course covers the diversity, systematics and phylogenetic relationships of vascular plants, focusing on both morphological and molecular perspectives. Particular attention is paid to patterns and processes of trait evolution, plant geographical and molecular trait complexes, and the interpretation of these traits in an evolutionary framework. Other topics include plant diversity in the context of global environmental change, including human influences, climate change and their consequences for ecosystem functions and services. Aspects of biodiversity conservation, management and sustainable use of plant resources will also be discussed.				
Learning outcomes / Competence goal				
Lecture and seminar: By attending the lecture and actively contributing to the seminar, students will become familiar with selected groups of flowering plants, and will understand their evolution, biogeography and economic importance. They will acquire a profound understanding of plant diversity and will be able to recognize key morphological characteristics. Students will understand the role of major drivers of plant evolution and will be able to explain the theoretical principles and methodological approaches used in phylogenetic reconstruction. They will be able to analyse and interpret morphological and molecular traits within a systematic and evolutionary framework, and to evaluate the historical and ecological processes underlying the origin and distribution of plant diversity. Furthermore, students will be able to assess how human activities and climate change influence current patterns of plant diversity and ecosystem function, and they will understand associated challenges in nature conservation. They will be capable of critically reading and discussing scientific literature on plant diversity and evolution and of presenting their findings effectively in both oral and written form. **Practical course**: By participating in the practical course, laboratory sessions and field excursions, students will deepen and broaden the theoretical knowledge gained in the lecture and seminar on plant diversity and evolution. They will develop the ability to recognize and describe the diversity, morphology and systematic relationships of major groups of flowering plants in both natural habitats and scientific collections. Students will be able to apply a range of methodological approaches used in plant systematics and evolutionary biology, including fieldwork techniques, morphological investigations, ecological assessments and taxonomic identification. They will competently use tools such as scientific plant collections, and will be able to document and interpret morphological traits in a comparative framework. Students will also acquire practical skills in molecular biology relevant to evolutionary research, including DNA isolation, sequence analysis and the integration of molecular and morphological datasets. They will be able to reconstruct phylogenies, date phylogenetic trees and analyse trait evolution using appropriate analytical methods. Through guided field excursions, students will learn to record plant diversity in situ, evaluate ecological conditions and relate field observations to broader biogeographical and evolutionary patterns. They will understand the drivers of current changes in plant diversity, including human impacts and climate change, and will be able to discuss implications for conservation and management. By the end of the module, students will be able to synthesise theoretical and practical knowledge to interpret the origin, distribution and dynamics of plant diversity. They will be capable of critically analysing scientific literature, conducting independent observations and analyses, and presenting their results effectively in oral and written formats				
Participation requirements for the module		Successful exam of the basic lecture of the basic module.		
Recommended prior knowledge		Interest in biodiversity and its recording		
Teaching offer				
Teaching formats		Lectures, seminar, practical exercises, excursions		
Exam language		English		
Modul duration		One semester. The module takes place as a block within the second half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Prof. Dr. Stefan Wanke		
Semester-long certificate				
Certificate of attendance		Regular attendance and active participation in the seminar and the practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		

Components of cumulative module examination				**Written exam in the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Seminar presentation: approx. 25 minutes + discussion** (weighting of the grade 50%)			
Subject focus				Organismic diversity			
Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Diversity and Evolution of Plants	L	2	3		X		
Diversity and Evolution of Plants	S	1	2		X		
Diversity and Evolution of Plants	P	10	10		X		
Total sum		**13**	**15**				

BEH-Div-2 Evolutionary Genomics of Vertebrates

BEH-Div-2	Evolutionary Genomics of Vertebrates	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
The lecture, seminar and practical course offers the opportunity to sequence, assemble, annotate and publish a complete vertebrate (fish) genome starting from the tissue. Selected aspects of genome sequencing, assembly and annotation, phylogeny, genomics and evolution will be covered. The course thus introduces the topic of biodiversity genomics. The complete genome of a vertebrate will be sequenced, assembled and annotated using NGS techniques (mostly PacBio) starting from tissue. The first step will be the phylogenetic and population genetic analyses and interpretation of the genome data. In the last week, the whole course will work on the first steps to publish the data in a peer-reviewed journal ('paper writing'). However, co-authorship can only be granted to those students who successfully bring the genome to publication in the weeks following the course together with the supervisor. So far, four genomes have been published in this way since 2018. The lectures begin with an introduction to the general topic and the specific questions to be addressed in field of the genomics and evolution. In parallel, there is an introduction to NGS data, UNIX and the scripting language PYTHON to be able to successfully modify existing programmes. Various scientists from the Biodiversity and Climate Research Centre (BiK-F), the LOEWE Centre for Translational Biodiversity Genomics and the University will give guest lectures in their special fields (e.g. retroposon, bioinformatics, adaptation, phylogeography) and provide insights into current research.				
Learning outcomes / Competence goal				
After completing the module, students will be able to sequence, assemble, and annotate genomes on their own. They'll also gain practical insights into using NGS data. Interaction with various scientists will provide a broader perspective on current research in the field.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module.		
Recommended prior knowledge		Knowledge of bioinformatics (e.g., via the module "Biosequence Informatics").		
Teaching offer				
Teaching formats		Lectures, seminar, practical exercises		
Exam language		English		
Modul duration		One semester. The module takes place as a block within the second half of the lecture period of the winter semester.		
Frequency of the offer (offering period)		Each winter semester		
Module coordinator		Prof. Dr. Axel Janke		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and the practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **protocol of the practical course: approx.** 30 pages (weighting of the grade 50%)		
Subject focus		Evolutionary Biology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Evolutionary Genomics of Vertebrates	L	2	3	X			
Evolutionary Genomics of Vertebrates	S	1	2	X			
Evolutionary Genomics of Vertebrates	P	10	10	X			
Total sum		**13**	**15**				

BEH-Div-3 Integrative Biodiversity Research in Zoology

BEH-Div-3	*Integrative Biodiversity Research in Zoology*	Elective courses	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture component: This module provides an advanced introduction to species-level biodiversity research, focusing on how species are discovered, delimited, compared and understood as the fundamental units of biodiversity. Students engage with the conceptual foundations and modern practices of integrative taxonomy, including species concepts, diagnostic characters, formal description standards, and the logic of species delimitation. The lecture and seminar explore systematics, morphology, ecology, and evolutionary context across selected animal groups, with teaching anchored in current Senckenberg research. Methods for documenting biodiversity—from field collection techniques and ethical considerations of sampling to specimen preparation, imaging (including 3D anatomical reconstruction), DNA barcoding, and data management in natural history collections—are presented using newly collected material and museum holdings. Additional topics include the history and philosophy of taxonomy, how museums operate as research infrastructures, phylogenetic and biogeographic reasoning, and the role of taxonomy in conservation and policy. **Practical course**: The practical component deepens the knowledge gained in the lecture and seminar by providing hands-on experience with contemporary approaches in integrative biodiversity research. Working with material from active research programmes, students apply methods for sorting, documenting, identifying and revising species and higher taxa using case studies from Senckenberg's curated collections, including isopods, polychaetes, insects, meiofauna and other groups. Practical exercises cover species description workflows, morphological character analysis, 3D imaging, DNA barcoding, bioacoustics, biogeography, and biodiversity monitoring. Students learn core techniques for field sampling, ethical collecting, and developing and curating collection databases. Excursions or field components may be offered at suitable locations outside Frankfurt to provide direct experience with survey methods and in-situ biodiversity assessment..				
Learning outcomes / Competence goal				
Lecture and seminar: Students will gain a clear understanding of how species are recognised, delimited and studied using integrative approaches. They will be able to explain the principles of taxonomy and systematics, describe the strengths and limitations of major methodological tools, and interpret multiple lines of evidence in species-level research. Students will develop secure command of core concepts, terminology, and standards in species description, zoological nomenclature, and museum-based research. They will be able to characterise selected animal groups and understand the scientific role, value and operation of natural history collections. **Practical course**:Students will acquire hands-on experience in laboratory and analytical methods used in integrative biodiversity research. They will be able to independently document, identify and compare species using morphological, molecular and imaging techniques. They will gain practical experience in ethical collecting, specimen handling, and the curation and evaluation of scientific collections.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		General knowledge of zoology is an advantage.		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses, excursions		
Exam language		English		
Modul duration		One semester. The module takes place as a block within the second half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Prof. Dr. Julia Sigwart		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and the practical course. Active participation in the seminar is through an oral presentation and participation in the discussions. Active participation in the practice includes scientific drawings.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course: approx.** 10-15 pages (weighting of the grade 50%)		
Subject focus		Organismic Diversity		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Integrative Biodiversity Research in Zoology	L	2	3		X		
Integrative Biodiversity Research in Zoology	S	1	2		X		
Integrative Biodiversity Research in Zoology	P	10	10		X		
Total sum		**13**	**15**				

BEH-Div-4 Biosequence Informatics

BEH-Div-4	Biosequence Informatics	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: Through lecture and seminar, selected topics and methods from molecular evolution, functional gene and genome analysis and phylogenetic tree reconstruction are addressed from a bioinformatics perspective. The expansion of high-throughput DNA sequencing and the associated availability of comprehensive genomic sequence information from almost any organism means that biological sequences increasingly dominate the database of evolutionary analyses. Full exploitation of the information content of the data and correct interpretations are inextricably linked to four questions: How does one process, organise and analyse datasets from high-throughput DNA sequencing with FAIR principles in mind? How do DNA sequences and the proteins encoded in them change over time? What can we learn about their evolutionary history and function from comparing present-day sequences? What assumptions and (evolutionary) concepts underlie common bioinformatic sequence analysis algorithms, and how can these influence the analysis results? **Practical course**: The practical course takes place in a computer laboratory. Using genome or transcriptome sequencing data, students will learn the basic processing of molecular sequence data using a scripting language, such as Bash or Python, the management of raw and metadata in databases, the analysis of genomic and transcriptomic shotgun sequence datasets using current software, and the assembly and annotation of genomes and/or transcriptomes. The performance of phylogenetic, phylogenomic and functional analyses is taught and practised by building on these data.				
Learning outcomes / Competence goal				
Lecture and seminar: Students learn the essential concepts of analysing biological sequence datasets from genomics and transcriptomics. They are familiar with the flow of information from the sequence read to the comparative analysis of genomes and gene sets. They are familiar with basic concepts in processing and managing biological sequence data. They know relevant algorithmic approaches in analysing biological sequences against a functional and evolutionary background. They can assess potential but also limitations of comparative genome analyses. In addition, they learn to critically examine current work in the field of bioinformatics sequence analysis. **Practical course**: Students learn the essential concepts of analysing biological sequence datasets from genomics and transcriptomics against an evolutionary background. After successfully completing the module, the students are familiar with web-based project documentation. They can perform flexible problem-oriented data processing with the help of a scripting language. In addition to the use of bioinformatics standard tools for processing and managing biological sequence data sets, the students learn to assemble small and simply structured genomes independently and to analyse them according to given functional and evolutionary questions.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module.		
Recommended prior knowledge		Being comfortable with computers is an advantage.		
Teaching offer				
Teaching formats		Lectures, seminars, and practical courses		
Exam language		English		
Modul duration		One semester. The module takes place as a block within the first half of the lecture period of the winter semester.		
Frequency of the offer (offering period)		Each winter semester		
Module coordinator		Prof. Dr. Ingo Ebersberger		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and the practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course: approx.** 20-30 pages (weighting of the grade 50%)		
Subject focus		Evolutionary Biology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Biosequence Informatics	L	2	3			X	
Biosequence Informatics	S	1	2			X	
Biosequence Informatics	P	10	10			X	
Total sum		**13**	**15**				

BEH-Div-5 Mycology

BEH-Div-5	*Mycology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and the seminar provide theoretical knowledge on diverse topics of mycology. Fungi and fungus-like organisms are presented with their diverse morphological structures, lifestyles, interactions and phylogenetic lines of evolution. Special emphasis is placed on understanding the functions of fungi in ecosystems and the importance of fungal diversity for the robustness and resilience of biotic communities in times of global change. The following topics are covered: Morphology and systematics of diverse systematic groups of fungi and fungus-like organisms (protozoans and relatives of algae), ecosystem functions provided by fungi (destruents, mycorrhizal fungi, parasites), asexual fungi, fungi causing damage (poisonous fungi, plant parasites - phytopathology, human-pathogenic fungi, building mycology, etc.) as well as beneficial fungi (edible mushrooms, medical applications, food technology, building materials, etc.). **Practical course**: The practical course includes practical work in the field (excursions) and laboratory for a better understanding of fungal diversity and to expand the theoretical knowledge in mycology taught in the lecture and the seminar. The focus of the practical course is on fungi with their diverse ecological functions, morphological structures and phylogenetic lines of evolution. The methodological spectrum covers fieldwork, ecological observations and analyses, identification work, light microscopy, scientific drawings, taxonomy, and dealing with microfungi in culture, i.e., microbiological methods. In addition to direct observations of the diversity of fungi in nature, samples from the field are analysed using "environmental DNA (eDNA)", i.e. “metabarcoding”, to detect hidden species and the biodiversity of entire ecosystems. These data allow comparisons of fungal communities at different sites and analyses of the ecological functions of fungi.				
Learning outcomes / Competence goal				
Lecture and seminar: After attending the lecture and the seminar, students will be familiar with important groups of fungi and know their ways of life, morphological characteristics and interactions with other living organisms. They will understand this complexity as a result of evolutionary processes. Students will be able to explain why fungi and their diversity are indispensable for the robustness and resilience of ecosystems. In addition, they will be able to evaluate useful aspects of fungi and the importance of fungi as harmful organisms. **Practical course**: After completing the practical course, students can recognise, characterise and determine important fungal groups, genera and species based on macro- and microscopic features. They are familiar with the forms and functions of fungi in nature and can assess both the benefits and possible damage caused by fungi in the anthropogenic environment. By working with microfungi, they become familiar with topics and methods of microbiology. By working with eDNA, module participants learn about modern methods for analysing fungal diversity and can assess the strengths and weaknesses of traditional vs. modern research approaches.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		Botanical knowledge (e.g., by the module "Diversity and Evolution of Plants")		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses, excursions		
Exam language		English		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the winter semester.		
Frequency of the offer (offering period)		Each winter semester		
Module coordinator		Prof. Dr. Meike Piepenbring (responsible) and Prof. Dr. Imke Schmitt		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and the practical course. Active participation in the seminar is given through a lecture and participation in the discussions. Active participation in the practical course includes scientific drawings.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 120 min (weighting of the grade 50%). **Protocol of the practical course:** approx. 20 pages (weighting of the grade 50%)		
Subject focus		Mycology / Organismic Diversity		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Mycology	L	2	3			X	
Mycology	S	1	2			X	
Mycology	P	10	10			X	
Total sum		**13**	**15**				

BEH-Div-6 Paleobiology and Environment

BEH-Div-6	*Paleobiology and Environment*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: Lecture and seminar serve to convey and discuss factual knowledge and theoretical foundations in palaeobiology and evolution of vertebrates, morphology and anatomy, as well as functional morphology and evolutionary ecology of mammals and humans. In detail, the following topics are covered: Evolution of vertebrates, the origin of mammals, comparative anatomy, morphology and adaptation of mammals (skeleton, skull, dentition), morphometrics and functional analyses of the mammalian masticatory system, habitats and food resources, ecology of Africa, evolutionary ecology of early hominids, palaeoanthropology, actualistic comparisons and modelling in palaeobiology. **Practical course:** In the practical course, students gain an integrative understanding and expand the theoretical factual knowledge imparted by the lecture and seminar in the subjects of vertebrate evolution and palaeobiology, ecology, evolutionary morphology and anatomy, as well as functional morphology and evolutionary ecology of mammals and humans. During the first three weeks parallel to the lecture, the following topics are covered: Evolution of vertebrates, the origin of mammals, comparative anatomy, mammalian morphology and adaptation (skeleton, skull, dentition), morphometrics and functional analyses of mammalian dentition, habitats and food resources, ecology of Africa, evolutionary ecology of early hominids, palaeoanthropology, actualistic comparisons and modelling in palaeobiology. Day excursions (UNESCO World Heritage fossil site Grube Messel) are integrated into the basic practical course. During the following three weeks, students work in one of the ongoing research projects of the Departments of Palaeoanthropology, as well as Messel Research and Mammalogy at the Senckenberg Research Institute and Natural History Museum Frankfurt, with a focus on the academy project ROCEEH, palaeoanthropology and primatology, mammal evolution and morphometrics, palaeoclimate reconstruction, savannah ecology or Messel research. The methodological spectrum includes morphological and ecological analyses, collection work, microscopy, 3-D topometry, image analysis techniques, programming in R, modelling, and taxonomic and construction morphology applications.				
Learning outcomes / Competence goal				
Lecture and seminar: Students will be theoretically familiar with the basics of vertebrate palaeobiology and evolution and palaeoanthropology, be able to distinguish morphological and ecological factors in the evolution of tetrapods, and assess the relationship between mammalian diversity and functional and constructional morphological evolutionary processes as a function of ecological parameters. **Practical course:** The students will be practically familiar with the basics of vertebrate evolution and palaeobiology and palaeoanthropology, know significant methods for the analysis of morphological and ecological factors in the evolution of vertebrates, as well as be able to discuss and interpret function- and construction-morphological evolutionary processes in consideration of ecological parameters.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses, excursions		
Exam language		English		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Apl. Prof. Dr. Ottmar Kullmer, PD Dr. Krister Smith		
Semester-long certificate				
Certificate of attendance		Active participation in the practical course includes the completion of exercises.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Seminar talk**: 30 min (weighting of the grade 50%). **Protocol of the practical course: approx.** 20 pages (weighting of the grade 50%)		
Subject focus		Evolutionary Biology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Paleobiology and Environment	L	2	3			X	
Paleobiology and Environment	S	1	2			X	
Paleobiology and Environment	P	10	10			X	
Total sum		**13**	**15**				

BEH-Div-7 Specialised Phytopathology

BEH-Div-7	*Specialised Phytopathology*	Elective courses	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The module chooses an organismal approach to different disciplines and links aspects of ecology, biodiversity, evolutionary biology, genetics, genomics and physiology by taking an in-depth look at an ecologically significant group. The module includes a lecture and a seminar to teach and discuss theories and facts about the ecology, diversity and evolution of oomycetes, a neglected group of eukaryotes that represent an important pillar in terrestrial, limnic and marine ecosystems worldwide as destructors, pathogens and parasites. The following topics are covered: Ecology and evolution of oomycetes, molecular and ecological host-pathogen interaction, and diversity of organisms (both in terms of hosts and oomycetes). Furthermore, evolutionary aspects of complexity development, reduction, and ecological redundancy are addressed. **Practical course:** The practical course, divided into field and laboratory parts, deepens and expands the contents taught in the lecture and seminar. The focus is on the ecology and diversity of oomycetes in their interaction with other organisms, especially with plants and algae. The method spectrum includes ecological fieldwork in Germany and/or in other European countries, with corresponding experimental designs, collections, observations and analyses, if necessary, experiments in the field and the laboratory, light microscopy, if necessary, chemical (e.g. HPLC) investigations, molecular biological investigations (nucleic acid extraction, PCR, sequencing, molecular phylogenetic or population genetic analyses), genomics, if necessary S1 work (PCR cloning, vector design, transient expression).			
Learning outcomes / Competence goal				
Lecture and seminar: After completing the module, students will be familiar with important groups of oomycetes and other microorganisms, especially those interacting with plants and algae, and will be able to characterise them. They will have acquired a comprehensive knowledge of the ecology, evolution and diversity of oomycetes and host-pathogen interaction. They know the basic ecological, (molecular)biological and evolutionary theoretical background of host-symbiont interaction and ecological redundancy**.** **Practical:** After completing the module, students will be familiar with important groups of oomycetes, especially those that live in pathogenic symbiosis with plants and algae. They will be able to address and characterise the most important groups of oomycetes, as well as characteristic representatives of them. They have a good overview of the ecology and evolution of oomycetes in general and of a selected group in particular. They can plan projects at the interface between field and laboratory and critically examine the possibilities and limitations of different research methods.			
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, and practical courses		
Exam language		English		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Prof. Dr. Marco Thines		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and in the practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions. Active participation in the internship includes writing short protocols.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam in the lecture:** Contents of the lecture and the seminar, 60 min (weighting of the grade 50%) **Protocol of the practical course:** approx**.** 20 pages (weighting of the grade 50%)		
Subject focus		Mycology / Organismic Diversity		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Evolution and Ecology of Oomycetes	L	2	3		X		
Diversity and Interaction of Oomycetes	S	1	2		X		
Ecology, Diversity and Evolution of Oomycetes	P	10	10		X		
Total sum		**13**	**15**				

BEH-Div-8 Herpetology

BEH-Div-8	Herpetology	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Selbststudium 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and the seminar provide theoretical knowledge on diverse topics of herpetology – the study of amphibians and reptiles. The lectures will cover the evolutionary history and systematics of these vertebrate groups and will go, in chosen taxa, into more detail regarding morphology and physiology (such as adaptations to terrestrial and aquatic environments, toxicity and colour evolution), systematics and evolution, behavioral ecology (reproduction, parental care, communication, and predator-prey interactions), and conservation biology (threats, such as habitat destruction, climate change, and disease as well as management strategies). Both lecture and seminar will have a strong emphasis on current research, and different experts will be invited for guest lectures. In the seminars, participants deepen their knowledge by reading scientific articles, taking turns presenting them, and engaging in critical discussions of their content. **Practical course:** The research-oriented practical course includes both fieldwork and laboratory exercises to enhance the understanding and application of the theoretical knowledge presented in the lecture and seminar. Field excursions focus on local amphibian and reptile diversity and their different life-stages. Excursions to (for example) the Senckenberg museum and the Frankfurt Zoo expand the knowledge to the worldwide herpetofauna and provide insights into the work with collections and ex-situ breeding programs. During projects in the field and/or the animal house, the students learn how to collect data on amphibian behaviour and communication. In the lab they learn how to analyze their field data and how to use different computational tools for phylogenetic and taxonomic research. Additional laboratory work will focus on amphibian skin samples. Using methods such as histology, RNAseq, and spectrometry, topics like toxicity, sex pheromones, colour evolution and skin diseases are covered.				
Lerning outcomes / Competence goal				
Lecture and seminar: By the end of the lecture and seminar, students will be able to explain and critically discuss the evolutionary history, systematics, and key biological traits of amphibians and reptiles, including their morphological, physiological, and behavioral adaptations. They will be able to analyze how these traits relate to ecological interactions such as reproduction, communication, and predator–prey dynamics, and evaluate threats affecting these groups. **Practical course:** After completing the practical course, students will be able to design and conduct basic field and laboratory investigations in herpetology, including the collection and documentation of data on amphibian and reptile diversity, life stages, and behavior. They will be able to apply observational and experimental methods to study communication and ecological interactions, and use analytical tools to interpret field data in a systematic and scientific manner. In the laboratory, students will have gained experience with phylogenetic analysis, bioacoustics, RNA sequencing, and histology in order to better understand various aspects of the biology of reptiles and amphibians (e.g. skin structure, coloration, toxicity related glands, communication, and disease). Students will also be able to integrate field and laboratory data to describe species, assess biodiversity (including cryptic species), and draw evidence-based conclusions relevant to systematics and conservation.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		A general knowledge of zoology and evolution is advantageous		
Teaching offer				
Teaching formats		lectures, seminars, practical courses, excursions		
Exam language		English		
Module duration		1 semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		each summer semester		
Module coordinator		Prof. Dr. Lisa M. Schulte (responsible) and Dr. Evan Twomey		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and practical course. Active participation in the seminar is given through a lecture and participation in the discussions.		
Course credits		none		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**written exam of the lecture:** Contents of the lecture, 60 min (weighting of the grade 50%). **protocol of the practical course:** approx. 20 pages (weighting of the grade 50%)		
Subject focus		Organismic Diversity		
Event overview				

	Teaching formats	SWS	CP	Semester			
				1	**2**	**3**	
Herpetology	L	2	3		X		
Herpetology	S	1	2		X		
Herpetology	P	10	10		X		
Total sum		**13**	**15**				

Elective modules

BEH-Eco-n Ecology and Ecosystem Health

BEH-Eco-1 Diversity, Behavior and Ecosystem Functions of Birds and Mammals

BEH-Eco-1	***Diversity, behavior and ecosystem functions of birds and mammals***	**Elective course**	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and seminar convey theoretical knowledge and provide a comprehensive overview of the theoretical foundations and important methods of organismic and trait-based biodiversity and ecosystem research, with a particular focus on animal behaviour (e.g., animal movements) and ecosystem functions (e.g., seed dispersal) of birds and mammals. The lecture also covers the influence of abiotic and biotic factors on animal movement, ecological communities and ecosystem functions. Furthermore, the consequences of human impacts on ecosystems are addressed, and their consequences for regional and global conservation priorities and the preservation of functional ecosystems are discussed. In the seminar, students briefly present current research questions and publications from the subject area and discuss these with their peers. **Practical course:** The practical course includes ornithological excursions and ecological fieldwork (e.g., observations of frugivorous birds along a land-use gradient) as well as statistical modelling (e.g., modelling of animal movements). The course and the student projects that are conducted as part of the practical focus on animal movements and ecosystem functions of birds and mammals. The practical teaches key statistical methods in biodiversity and ecosystem research (including ANOVA, linear regressions, and trait-based analyses). Modelling exercises, data analyses and visualizations are done by the students using the software R. The fieldwork part of the practical is taught outside of Frankfurt (usually five days of field excursion).				
Learning outcomes / Competence goal				
Lecture and seminar: The lecture and seminar provide students with an overview of movement ecology, community ecology and functional ecology. After completing the course, the students have a solid and structured knowledge of the mentioned contents, know the relevant technical terms of ecological research, can use them correctly and relate them to other subject areas of biodiversity and ecosystem research. **Practical course:** After completing the practical course, the students have basic knowledge of ornithological fieldwork and statistical modelling and are capable of using key statistical methods of biodiversity and ecosystem research in the R software. After completing the module, students are able to design and carry out a research project in biodiversity and ecosystem research and analyse the collected data quantitatively.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses, excursions		
Exam language		English		
Module duration		One semester. The module takes place as a block within the second half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Prof. Dr. Thomas Müller (responsible) and PD Dr. Eike Lena Neuschulz		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the lectures, seminar and the practical course. Active participation in the practical course includes the completion of exercises.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Seminar presentation:** 10 minutes (weighting of the grade 50%) **Student project report:** max. 10 pages (weighting of the grade 50%)		
Subject focus		Ecology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Diversity, Behavior and Ecosystem Functions of Birds and Mammals	L	2	3		X		
Diversity, Behavior and Ecosystem Functions of Birds and Mammals	S	1	2		X		
Diversity, Behavior and Ecosystem Functions of Birds and Mammals	P	10	10		X		
Total sum		**13**	**15**				

BEH-Eco-2 Plant Evolutionary Ecology and Global Change

BEH-Eco-2	*Plant Evolutionary Ecology and Global Change*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lectures and seminars: The lectures and seminars serve to convey theoretical knowledge in the research field of the evolutionary ecology of plants, both in general and in the context of global change. The following topics are covered: (i) Spatial structure of intraspecific phenotypic variation; (ii) Causes of trait variation (e.g., evolutionary forces, phenotypic plasticity, maternal effects, epigenetics) and the effects of abiotic and biotic factors on plant fitness; (iii) Consequences of phenotypic variation for adaptation of plant populations (e.g., phenotypic evolution and adaptation in the context of global change, functional diversity, evolutionary agriculture, conservation and restoration); (iv) Experimental and data analysis methods (e.g., from experimental plant ecology, ecophysiology, quantitative genetics, population genetics, ecological genomics, evolution experiments, herbarium research). In the seminars, this knowledge is deepened by reading scientific articles, with participants taking turns to introduce the articles and critically discussing the content of the articles. **Practical course**: The practical course consists of an experiment with a concluding symposium as well as workshops on experimental design and data analysis and visualisation. In the practical course, participants choose an evolutionary-ecological research topic, design an experiment in the greenhouse or climate chambers, and carry it out. Ecological and physiological measurement methods are applied, and the data collected are statistically evaluated. Participants present their results in a public symposium and write a protocol about their experiment. In workshops with homework, basic concepts of experimental design, as well as skills for data analysis and visualisation in the statistical programme R, are taught.				
Learning outcomes / Competence goal				
Lectures and seminars: Students will be familiar with plant evolutionary ecological research after completing the lectures and seminars. **Practical course:** Students will be familiar with plant evolutionary ecological research and with the effects of global change on plant populations. After completing the practical course, students will be familiar with classical evolutionary ecological experiments and with selected ecological and physiological methods. Participants will have gained experience with data analysis in evolutionary ecology and with presenting results orally.				
Participation requirements for the module		Successful examination of the basic lecture of the basic module.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, and practical courses		
Exam language		English		
Module duration		One semester. The module takes place as a block within the second half of the lecture period of the winter semester.		
Frequency of the offer (offering period)		Each winter semester		
Module coordinator		Prof. Dr. Johannes Fredericus Scheepens		
Semester-long certificate				
Certificate of attendance		Regular and active participation in seminars and practical courses. Active participation in the seminars is attested through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Seminar presentation:** 20 minutes (weighting of the grade 50%) **Protocol of the experiment in the practical:** 15-30 pages (weighting of the grade 50%)		
Subject focus		Evolutionary Biology / Ecology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Plant Evolutionary Ecology and Global Change	L	2	3	X			
Plant Evolutionary Ecology and Global Change	S	1	2	X			
Plant Evolutionary Ecology and Global Change	P	10	10	X			
Total sum		**13**	**15**				

BEH-Eco-3 Evolutionary and stress ecology and environmental analysis

BEH-Eco-3	*Evolutionary Ecology and Environmental Analytics*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		

Content

Lecture and seminar: The lecture and seminar provide theoretical factual knowledge on environmental stressors and evolutionary ecological processes in aquatic systems. In addition, the fundamentals of analysing and evaluating chemicals and their mixtures in the environment are taught. As an interdisciplinary module, it combines various sub-areas of basic limnological and evolutionary ecological knowledge with modern approaches to aquatic ecological assessment and the investigation of multiple stressors. It also provides an introduction to modern environmental analysis and assessment methods for pollutant mixtures. The module imparts factual knowledge, which is then deepened in the practical module using various case studies and an interdisciplinary approach.

Lecture: Specialised knowledge of aquatic ecology and evolutionary ecology is imparted, taking into account multiple environmental stressors. The following topics are covered in detail: basic terms and concepts of limnology, stress ecology, evolutionary ecology and toxicology, genetic adaptations and selection, natural and anthropogenic conditions (eutrophication, water acidification, pollution, climate change), methods of remediation and restoration of water bodies, taxonomic and molecular methods of monitoring aquatic communities in accordance with the EU Water Framework Directive, monitoring of flowing waters with invertebrates and fish, weight-of-evidence studies, biomarkers and sediment monitoring, methods of evolutionary ecology and assessment models.

The second part of the lecture covers methodological aspects of the chemical analysis of environmental contaminants (target and non-target analysis) and modern methods of mixture assessment. This includes the use of databases, approaches to identifying risk drivers by combining chemical-analytical and bioanalytical methods with balancing approaches, statistical methods and impact-oriented analytics.

Seminar: Current topics focusing on new findings and principles in the fields of stress ecology, evolutionary ecology and environmental analysis.

Practical course: The application- and research-oriented internship is designed to lead to a better understanding and expansion of the theoretical knowledge taught in the lecture and seminar in the areas of evolutionary ecology, stress ecology and environmental analysis in aquatic systems. The internship focuses on teaching the general approach and specific technical procedures for a comprehensive and interdisciplinary assessment of multiple stressors in aquatic systems using methods from the fields of ecology, evolutionary ecology and toxicology, bioanalytics, environmental analysis and assessment. The module also emphasises the acquisition of media literacy.

The internship is divided into four thematic blocks, most of which are held at Goethe University, with a smaller excursion also taking place at the Environmental Research Centre in Leipzig:

(a) a multi-day excursion focusing on aquatic ecology/environmental science and a visit to the Helmholtz Centre for Environmental Research (UFZ) in Leipzig and Magdeburg (b) environmental stressors and evolutionary ecology, (c) environmental analysis, (d) film course on media literacy in science.

The first part of the internship (approx. 5 days) includes an excursion to pollution and research hot spots in Saxony-Anhalt, including sampling for later experimental investigations in Leipzig and Frankfurt. For part of the group, this is followed by a 14-day laboratory internship at the UFZ. The basics of environmental analysis, in particular organic environmental pollutants, including sampling, sample preparation and analysis using LC and GC-MS, as well as data evaluation and mixture assessment, will be taught.

At the same time, a subgroup at the University of Frankfurt will investigate local adaptation processes in ecologically significant amphipods in flowing waters. Due to their distinct population structure within water networks, amphipods are particularly suitable for analysing evolutionary adaptation on small spatial scales. By combining population genetic approaches (including COI barcoding) with experimental exposure studies, population-specific responses to key stressors of global change are recorded. The aim is to identify evolutionary mechanisms and intraspecific vulnerabilities and to derive overarching implications for nature conservation.

In the third part of the internship, multiple stressors are investigated both in the field and in the laboratory using important ecological and ecotoxicological proxy organisms *(Danio rerio, Daphnia magna, Gammarus* spp., *Caenorhabditis elegans*) and current monitoring approaches are discussed (e.g. environmental sample bank, lake sediments as archives for historical pollution and biodiversity patterns). In this part of the internship, conclusions about the prevailing aquatic site factors are drawn from the analysis of invertebrate communities (macrozoobenthos). In addition, sample material collected by the students from the field will be further examined in the laboratory for multiple stressors. The laboratory experiments include the investigation of the interaction of chemical and abiotic stressors. Methodologically, the students will carry out acute toxicity studies, biomarker and behavioural analyses, and eDNA investigations. In addition, approaches to statistical evaluation and modelling based on the collected data will be presented and applied. The final part of the internship is dedicated to media literacy, together with a television journalist (Wolfgang Kübel) and other communication experts who will teach the basics of science communication. After camera training, students will write their own script for a film or social media post on the topic of the internship (accompanying parts 2 and 3 of the internship) under supervision. In addition, they will practise appearing in front of the camera in interview situations.

Learning outcomes / Competence goal

Lecture and seminar: Upon completion of the lecture and seminar, students will be familiar with the theoretical fundamentals of limnoecology, including multiple environmental stressors and evolutionary ecology. They will also be able to distinguish and evaluate the physical and ecological functioning of standing and flowing waters, compare ecosystem relationships and processes in aquatic ecosystems (including ecosystem functions and ecosystem services), evaluate the importance of water and evolutionary ecology in the context of multiple environmental stressors, and interpret different forms and consequences of anthropogenic impacts. Students are familiar with the theoretical principles of chemical analysis of environmental contaminants (target and non-target analysis) and modern methods of mixture assessment, and are able to apply balance concepts.

Students have the ability to communicate in writing and orally in a subject-specific and audience-oriented manner, including the use of techniques such as visualisation, presentation and moderation.

Practical course: After successfully completing the internship, students will have broad methodological knowledge in the areas of aquatic and evolutionary ecology, stress ecology and environmental analysis, and will be familiar with the current approach to assessing flowing water ecosystems using biological and chemical analytical methods. They will be able to reliably plan appropriate investigations, master the methods to be used and independently evaluate and present the results obtained. In addition, practical laboratory work will deepen their

scientific and independent work using internationally standardised methods. This will provide them with the necessary practical and theoretical knowledge to interpret the relationships between the water situation with its chemical, physical and structural conditions and the biotic communities. Students have acquired media skills and are familiar with the basics of science communication. After completing the internship, students have the ability to communicate in writing and orally in a subject-specific and target-group-oriented manner, also using techniques such as visualisation, presentation and moderation of (environmental) scientific content.	
Participation requirements for the module	Successful exam of the basic lecture of the basic module
Recommended prior knowledge	Basic ecotoxicological and chemical knowledge (e.g., through the module "Environmental Toxicology and Chemistry").
Teaching offer	
Teaching formats	Lectures, seminars, practical courses and excursions
Exam language	English
Module duration	One semester. The module takes place as a block within the second half of the lecture period of the summer semester.
Frequency of the offer (offering period)	Each summer semester
Module coordinator	Prof. Dr. Henner Hollert & Jonas Jourdan
Semester-long certificate	
Certificate of attendance	Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.
Course credits	None
Module examination	**Form of examination (Scope/duration)**
Components of cumulative module examination	**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Internship report in the style of a scientific manuscript:** approx. 15–25 pages (weighting of the grade 50%)
Subject focus	Evolutionary Biology / Ecotoxicology / Ecology

Event overview

	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Evolutionary Ecology and Environmental Analytics	L	2	3		X		
Evolutionary Ecology and Environmental Analytics	S	1	2		X		
Evolutionary Ecology and Environmental Analytics	P	10	10		X		
Total sum		**13**	**15**				

BEH-Eco-4 Aquatic Ecology

BEH-Eco-4	*Aquatic Ecology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and seminar teach theoretical knowledge of limnology. The focus is on linking all sub-areas of limnological and aquatic ecological basic knowledge concerning water protection, the management of water quality, and the state of water bodies. In detail, the following topics are dealt with intensively: Water as a habitat, hydrobiology, discharge components, characteristics of standing and flowing waters, chemical-physical factors in waters, substance balance or substance cycles, nutrient distribution, lake and flowing water types, zoning of waters, biotic communities and colonisation of water bodies, food chains or food webs in limnic systems, ecosystem functions and ecosystem services, plankton, neuston/pleuston, benthon, nekton, anthropogenic (material and hydraulic) pollution and renaturation of water bodies, water body structure mapping and biological water quality assessment, macroinvertebrate community analyses, EU Water Framework Directive and management concepts for water bodies. **Practical course:** The practical course should lead to a better understanding and expansion of the theoretical knowledge in water ecology taught in the lecture or seminar. The focus of the practical course is to teach the general approach as well as the specific technical procedures and methods for a comprehensive assessment of inland waters. In the practical course, a comprehensive faunistic inventory and limnological assessment of various low mountain range waters is carried as part of excursions, whereby polluted as well as particularly near-natural and worthy-of-protection sections are recorded. The methodological spectrum considered includes the planning, implementation and evaluation of chemical and biological sampling and the graphical processing and statistical validation of the results. Based on the recording of the current water body status (current status), deficient water body sections are identified, and measures for their revitalisation are formulated in order to guarantee important ecosystem functions and ecosystem services.				
Learning outcomes / Competence goal				
Lecture and seminar: After completing the lecture and seminar, students will be theoretically familiar with the basics of limnology, will be able to distinguish and assess the physical and ecological functioning of standing and flowing waters, will be able to compare ecosystem relationships and processes in different aquatic ecosystems, will be able to assess the role of aquatic ecology in relation to environmental protection and will be able to interpret the different effects of impairments. **Practical course:** After successfully completing the practical course, the students are familiar with the current procedure of assessing flowing water ecosystems. They can reliably plan corresponding investigations, master the methods to be used, and independently evaluate and present the results. They thus have the necessary practical and theoretical knowledge to be able to interpret connections between the water situation with its chemical, physical and structural conditions and the biocoenoses.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module. **This module is taught in German**. Therefore, German language skills are required.		
Recommended prior knowledge		Knowledge of inorganic and organic chemistry		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses and excursions		
Exam language		German		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		PD. Dr. Matthias Oetken		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** 20 - 30 pages (weighting of the grade 50%)		
Subject focus		Ecology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Aquatic Ecology	L	2	3		X		
Aquatic Ecology	S	1	2		X		
Aquatic Ecology	P	10	10		X		
Total sum		**13**	**15**				

BEH-Eco-5 Conservation Biology

BEH-Eco-5	*Conservation Biology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and seminar teach theoretical knowledge about conservation biology and applied ecology. The following topics are covered: Introduction to conservation biology as a scientific discipline, basics of biodiversity research, the value of and threats to biodiversity, nature conservation as an instrument for the conservation of biodiversity - nature conservation management (e.g. protected areas, biotope protection, species protection, restoration ecology), national and international legal bases for nature conservation, methods for nature conservation assessment. **Practical course:** As a supplement to the lecture and seminar of the same name, the practical course includes practical tasks as an integrative combination of theoretical communication of factual knowledge, practical testing and consolidation in the laboratory and in the field (excursions). The focus of the course is on the application and implementation of theoretical nature conservation knowledge in order to answer nature conservation questions. This includes the formulation of nature conservation questions, the development of a suitable study concept, the collection of relevant data, the evaluation and the nature conservation interpretation. The results are discussed in the context of nature conservation management for biodiversity conservation and with relevant stakeholders (e.g. land users).				
Learning outcomes / Competence goal				
Lecture and seminar: After completing the lecture and seminar, the students will be theoretically familiar with the scientific foundations of biological nature conservation. Furthermore, the students will be able to explain the complexity of biodiversity, its threats and the importance of its protection. After completing the module, the students will know the effectiveness and the background of nature conservation instruments and the associated methods. They will also be familiar with the most important legal foundations of nature conservation. **Practical course:** After completing the practical course, the students will be familiar with the scientific principles of biological nature conservation and have the methodological background for the complete processing of nature conservation issues and their implementation. Students can present nature conservation results and critically discuss the contents.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses and excursions		
Exam language		English		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Dr. Karen Hahn		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** Max. 10 pages (weighting of the grade 50%)		
Subject focus		Ecology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Conservation Biology	L	2	3		X		
Conservation Biology	S	1	2		X		
Conservation Biology	P	10	10		X		
Total sum		**13**	**15**				

BEH-Eco-6 Parasitology and Infection Biology

BEH-Eco-6	*Parasitology and Infection Biology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and seminar teach theoretical knowledge in parasitology and infection biology. The focus of the courses is to impart current knowledge on significant pathogens and parasites (parasitoses, zoonoses), special interactions in the host-pathogen/parasite interaction, strategies of pathogens/parasites in the infestation and manipulation of the respective end hosts, intermediate hosts and vectors, special features of the immune response and defence, pathology, genetics and epidemiology in parasitic infections, as well as prevention and control of parasites and their vectors or intermediate hosts. In addition, the course teaches the basics of the metabolic-physiological functional systems. Evolutionary, ontogenetic and ecophysiological aspects are also presented. **Practical course:** The practical course is an integrative combination of theoretical imparting of factual knowledge, practical testing and deepening of the basics of ecological parasitology, infection biology and animal physiology. The course provides up-to-date knowledge and practical skills on important pathogens and parasites (parasitoses, zoonoses), special interactions in the host-pathogen/parasite interaction, strategies of pathogens/parasites in infestation and manipulation of the respective end hosts, intermediate hosts and vectors, special features of the immune response and defence, pathology, genetics and epidemiology in parasitic infections, as well as prevention and control of parasites and their vectors or intermediate hosts. In addition, the course teaches the basics of metabolic-physiological functional systems and evolutionary, ontogenetic and ecophysiological aspects. Parts of the practical course can be offered in the context of fieldwork (excursions) at suitable locations outside Frankfurt, possibly outside Germany and the lecture period.				
Learning outcomes / Competence goal				
Lecture and seminar: After completing the lecture and seminar, the students have acquired a comprehensive knowledge of the globally significant pathogens, parasites and parasitoses of humans as well as of farm and wild animals, with a particular focus on the host-pathogen/parasite interaction, their life cycles and transmission mechanisms. They have a secure, structured and comprehensive knowledge of the abovementioned teaching. They know the relevant technical terms of parasitology, infection biology and epidemiology and can use them purposefully and securely. The students can scientifically work on topics such as the identification, description, distribution, transmission and spreading ability of pathogens/parasites using classical, molecular, experimental, and field-based methods. **Internship:** Upon completion of the internship, students will have acquired a comprehensive knowledge of the globally significant pathogens, parasites and parasitoses of humans as well as livestock and wildlife, with a particular focus on host-pathogen/parasite interaction, their life cycles and transmission mechanisms. They have a secure, structured and comprehensive knowledge of the abovementioned teaching. They know the relevant technical terms of parasitology, infection biology and epidemiology and can use them purposefully and securely. The students can scientifically work on topics such as identifying, describing, distributing, transmitting, and spreading the ability of pathogens/parasites with classical, molecular, experimental and field-based methods.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module. **This module is taught in German.** Therefore, German language skills are required.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses and excursions		
Exam language		German		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the winter semester.		
Frequency of the offer (offering period)		Each winter semester		
Module coordinator		Prof. Dr. Sven Klimpel		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** 15-20 pages (weighting of the grade 50%)		
Subject focus		Ecology		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Parasitology and Infection Biology	L	2	3			X	
Parasitology and Infection Biology	S	1	2			X	
Parasitology and Infection Biology	P	10	10			X	
Total sum		**13**	**15**				

BEH-Eco-7 Ecotoxicology

BEH-Eco-7	*Ecotoxicology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		

Content

Lecture and seminar: The lecture and seminar teach theoretical knowledge in ecotoxicology. General and in-depth specific knowledge about the behaviour and effects of chemicals in the environment, their effects on organisms and biocoenoses, and the assessment of the risk they pose to ecosystems are imparted.

The following thematic focal points are dealt with: Production and release of pollutants, pathways of pollutants into ecosystems, the behaviour of pollutants in environmental compartments, long-range transport of chemicals, persistence and abiotic transformation, the fate of pollutants in terrestrial and aquatic ecosystems, toxicokinetic and toxicodynamic, uptake and accumulation of pollutants, distribution, transformation and excretion by organisms, Characterisation of poisoning, mechanisms of action and concentration-response relationships, biological test methods, effect characterisation at different levels of biological integration (including ecosystem functions and ecosystem services), environmental risk assessment of chemicals, threshold values and their derivation, biomonitoring and bioindication, case studies of pollutant effects.

Practical course: The research-oriented practical course is intended to lead to a better understanding and expansion of the theoretical factual knowledge in the subject of ecotoxicology imparted by the lecture and seminar. The practical course focuses on teaching the general procedure and the specific technical procedures and methods for analysing possible environmental hazards and risks caused by chemicals.
For selected test substances, the procedure of an environmental risk assessment is taught through practical tasks. For this purpose, the students are instructed to plan corresponding experimental work, carry it out, evaluate it, and statistically validate their results. The experiments include in vitro and in vivo test procedures with animals, plants and microorganisms, from which mechanism-specific activities (modes of action), toxicological parameters and effect thresholds are to be derived. In addition, substance reports on the tested substances investigated are to be prepared based on literature and database research, including determining representative exposure levels in the environment. The results of the impact analysis and the researched exposure level serve as a basis for assessing the environmental risk for the investigated test substances.
The methodological spectrum considered in the practical course includes the planning, implementation and evaluation of newly developed and already standardised in vitro and in vivo test procedures according to OECD and DIN/ISO guidelines, the analysis of structural, physiological and developmental biological parameters in the test organisms taking into account molecular methods, the graphical processing and statistical validation of the results, the implementation of literature and database research and the preparation of substance reports for risk assessment.

Learning outcomes / Competence goal

Lecture and seminar: Students acquire general and in-depth specific knowledge on the behaviour and effects of chemicals in the environment, their effects on organisms and biotic communities, and the assessment of the risk they pose to ecosystems, including the influence on ecosystem functions and ecosystem services.

After completing the lecture and seminar, the students have a comprehensive knowledge of the production and release of pollutants, their entry pathways into ecosystems, the behaviour in environmental compartments, and the long-range transport of chemicals. They can estimate the persistence and abiotic transformation of pollutants and assess their fate in terrestrial and aquatic ecosystems. They master the principles and in-depth knowledge of toxicokinetic and toxicodynamic. They can describe the uptake and accumulation of pollutants, their distribution, transformation and excretion by organisms, and characterise poisonings concerning their underlying mechanisms of action and concentration-response relationships. They acquire the necessary knowledge of the various biological test methods and their application in ecotoxicological research and routine, including regulatory practice. The principles and special design of environmental risk assessment of different groups of chemicals are mastered, as well as the basics of deriving threshold values for environmental chemicals. The students acquire in-depth knowledge of the basic procedures of biomonitoring and bioindication, which are exemplified by case studies of pollutant effects.

Practical course: During the practical course, the students acquire extensive knowledge of the current procedure of an environmental risk assessment of chemicals and try it out on practical examples. They can reliably plan corresponding test series, master the methods to be used, can select and apply suitable test procedures and are able to evaluate, statistically validate and interpret the results obtained independently. They thus have the necessary practical and theoretical knowledge to conduct an environmental risk assessment for chemicals and critically question the corresponding results.

Participation requirements for the module	Successful exam of the basic lecture of the basic module. **This module is taught in German**. Therefore, German language skills are required.
Recommended prior knowledge	Knowledge of inorganic and organic chemistry.
Teaching offer	
Teaching formats	Lectures, seminars and practical courses
Exam language	German
Module duration	One semester. The module takes place as a block within the second half of the lecture period of the winter semester.
Frequency of the offer (offering period)	Each winter semester
Module coordinator	Prof. Dr. Jörg Oehlmann
Semester-long certificate	

Certificate of attendance				Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.			
Course credits				None			
Module examination				**Form of examination (Scope/duration)**			
Components of cumulative module examination				**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** 25-40 pages (weighting of the grade 50%)			
Subject focus				Ecotoxicology			
Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Ecotoxicology	L	2	3	X			
Ecotoxicology	S	1	2	X			
Aquatic Ecotoxicology	P	10	10	X			
Total sum		**13**	**15**				

BEH-Eco-8 Environmental Toxicology and -Chemistry

BEH-Eco-8	*Environmental Toxicology and -chemistry*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		

Content

Lecture and seminar: The lecture and seminar teach theoretical knowledge in environmental toxicology and chemistry. The contents of the module are taught in a combination of traditional lectures and seminars with expert lectures and modern teaching methods. For example, goal-oriented project work in small teams is used, in which the writing, oral presentation, and defence of a third-party funding proposal before a selection committee is simulated.

Lecture: History of environmental pollution, important substance groups, substance properties, distribution and effects of chemicals in the environment depending on their structure and properties, exposure and effect assessment for organisms using environmental chemistry and effect-based methods, levels of ecotoxicological effects (molecular effects, cell, individual to ecosystem, including ecosystem functions and ecosystem services), quantification of environmental risk including uncertainty analysis, in vitro systems and mechanism-specific bioassays, marine ecotoxicology, weight-of-evidence concepts, adverse outcome pathway (AOP), sediment assessment strategies, alternative methods to animal testing.

Seminar: The seminar addresses changing current focus topics on the behaviour of organic compounds in the environment and the effects of chemicals and different environmental compartments on in vitro test systems and organisms, their extrapolation to the population and community level using complex experiments and mathematical models.

Practical course: The research-oriented practical course intends to understand better and expand the theoretical knowledge in environmental toxicology and chemistry taught in the lecture-seminar module. The practical course focuses on teaching the general procedure and the specific technical procedures and methods for analysing possible environmental hazards and risks from complex mixtures, such as wastewater or sediments.

The module teaches the procedure of an environmental risk assessment for selected wastewater/sediments in practical exercises using a case study as an example. For this purpose, the students are instructed to plan corresponding experimental work, carry it out in the context of field trips, evaluate it, and statistically validate their results. The experiments include effect-based methods (EBM) with a focus on mechanism-specific toxicity, in vitro and in vivo test procedures with animals, plants and microorganisms, from which mechanism-specific activities (modes of action), toxicological parameters and effect thresholds are to be derived and the exposure situation evaluated. Test procedures with bacteria, algae and animals at individual and population levels; acute and mechanism-specific test procedures (cytotoxicity, teratogenicity, dioxin-like, endocrine and genotoxic effects; histology, biomarkers, genomics and proteomics; mutagenicity tests and Ah receptor agonists will be taught.

The methodological spectrum considered in the practical course includes the planning, implementation and evaluation of newly developed and already standardised in vitro and in vivo test procedures. Knowledge of important DIN,

ISO, OECD methods and GLP are taught, and alternative methods to animal experiments are discussed. In addition, statistical evaluation methods are applied, and prospective damage potential calculations are carried out. The design and implementation of retrospective monitoring and the evaluation of complex data sets (a combination of laboratory and field data) are also dealt with in a case study in the form of a role-play.

Learning outcomes / Competence goal

Lecture and seminar: Students gain insights into the transformation and transport processes of chemicals in the environment depending on their chemical and physico-chemical properties and environmental conditions. They should acquire the competence to estimate and assess eco-chemical processes. The aim is to assess the exposure of organisms in soils and waters based on knowledge of the distribution and transformation mechanisms of pollutants. The students will further gain insights into the effects of environmental chemicals on organisms and in vitro test systems. They will learn to assess the effects of chemicals individually and in combination with other xenobiotics and natural influencing factors. They will also apply mathematical modelling for effect prediction on in vitro systems, individuals (QSAR) and risk assessment for populations and communities up to ecosystem functions and ecosystem services. The aim is to combine eco-chemical and ecotoxicological results and to be able to assess them prospectively using mathematical models.

Furthermore, the critical handling of integrated concepts such as weight-of-evidence strategies, adverse outcome pathway strategies and alternative methods to animal experiments should be learned. As a learning outcome and competence, graduates should acquire the ability to understand ecotoxicological effects and environmental chemical processes and the resulting exposure of organisms and be able to apply this understanding in their studies. They should be able to develop strategies to investigate and evaluate ecotoxicological effects and the behaviour of environmental chemicals. After completing this module, the students should also be able to communicate in a subject- and addressee-related manner, both verbally and in writing, about the topics they are working on, using techniques such as visualisation, presentation and moderation independently. They thus have the necessary practical and theoretical knowledge to conduct an environmental risk assessment for chemicals and critically question the corresponding results.

Practical course: After completing the practical course, the students are familiar with the current procedure of an environmental risk assessment of complex environmental samples. They can reliably plan the corresponding series of investigations, master the methods used, and select and apply suitable test procedures. They can independently evaluate, statistically validate and interpret the results obtained. The students should also learn how to present their experiments' findings graphically and interpret the content. They should learn how to critically discuss the experimental findings with the help of current international literature and how to present them scientifically as a poster/role play. Thus, they have the necessary practical and theoretical knowledge to conduct an environmental risk assessment for complex environmental samples and critically question the corresponding results.

Participation requirements for the module	Successful exam of the basic lecture of the basic module.
Recommended prior knowledge	Knowledge of inorganic and organic chemistry.
Teaching offer	
Teaching formats	Lectures, seminars, practical courses and excursions

Exam language	English
Module duration	One semester. The module takes place as a block within the second half of the lecture period of the winter semester.
Frequency of the offer (offering period)	Each winter semester
Module coordinator	Prof. Dr. Henner Hollert and Dr. Sabrina Schiwy
Semester-long certificate	
Certificate of attendance	Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.
Course credits	None
Module examination	**Form of examination (Scope/duration)**
Components of cumulative module examination	**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** approx. 30 pages (weighting of the grade 50%)
Subject focus	Ecotoxicology

Event overview

	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Environmental Toxicology and -chemistry	L	2	3	X			
Environmental Toxicology and -chemistry	S	1	2	X			
Environmental Toxicology and -chemistry	P	10	10	X			
Total sum		**13**	**15**				

BEH-Eco-9 Zoo- and Wildlife Biology

BEH-Eco-9	*Zoo- and Wildlife Biology*	Elective course	**15 CP** (450 hours, h)	
			Hours of presence 13 SWS / 182 h	**Self-study 268 h**
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		M.Sc. Umweltwissenschaften / FB 11		
Content				
Lecture and seminar: The lecture and seminar serve to impart theoretical knowledge on relevant topics in zoo and wildlife biology. The focus is on imparting current knowledge on: the fundamentals of zoo animal biology, species conservation work in zoos, animal ethics and husbandry conditions, enrichment and training, population biology and conservation breeding programmes, educational work and communication processes, enclosure design, veterinary aspects and methods of zoo and wildlife research (e.g. behavioural research, microbiome analyses, bioacoustics, environmental psychology research methods). **Practical course**: The internship includes practical work at Opel Zoo Kronberg and/or other zoos and/or in the field on current zoo and wildlife biology issues, as well as in-depth excursions to explore specific topics (including conservation breeding programmes and species conservation work, zoo education). The course conveys theoretical knowledge about modern, AI-supported research methods in zoo and wildlife biology and their practical application. The internship covers the following topics, among others: behavioural research, bioacoustics, environmental psychology and microbiome analyses. The excursions can be offered at suitable locations outside Frankfurt, possibly also outside Germany and outside the lecture period.				
Learning outcomes / Competence goal				
Lecture and seminar: Upon completion of the lecture and seminar, students will be thoroughly familiar with the scientific fundamentals of zoo and wildlife biology. They will have a solid, structured and comprehensive knowledge of the course content, be familiar with the relevant technical terms used in zoo and wildlife biology, and be able to apply them confidently. Students will learn and be able to apply methodological approaches in zoo and wildlife research. **Practical course**: Upon completion of the internship, students will be familiar with the practical aspects of the scientific fundamentals of zoo and wildlife biology. They will learn about various modern methods of behavioural research. In addition, they will gain practical experience in the field of environmental psychology. Upon completion of the module, students should be able to design and carry out a scientific research project themselves and statistically evaluate the data collected.				
Participation requirements for the module		Successful exam of the basic lecture of the basic module.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Lectures, seminars, practical courses and excursions		
Exam language		English		
Module duration		One semester. The module takes place as a block within the first half of the lecture period of the summer semester.		
Frequency of the offer (offering period)		Each summer semester		
Module coordinator		Prof. Dr. Paul Dierkes		
Semester-long certificate				
Certificate of attendance		Regular and active participation in the seminar and practical course. Active participation in the seminar is given through an oral presentation and participation in the discussions.		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Components of cumulative module examination		**Written exam of the lecture**: Contents of the lecture and the seminar, 60 min (weighting of the grade 50%). **Protocol of the practical course:** approx. 30 pages (weighting of the grade 50%)		
Subject focus		Organismic diversity		

Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Zoo- and Wildlife Biology	L	2	3		X		
Zoo- and Wildlife Biology	S	1	2		X		
Zoo- and Wildlife Biology	P	10	10		X		
Total sum		**13**	**15**				

Optional Module (mandatory module)

BEH-Optional	***Optional Module***	**Mandatory module**	**15 CP** (450 hours, h)	
			Hours of presence depending on the chosen activities	**Self-study** depending on the chosen activities
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		-		
Content				
For the optional module, single or multiple modules, as well as other activities, can be chosen from the following possibilities for a total of 15 CP: - Elective courses of the **master's programme Biodiversity and Ecosystem Health** that have not been studied before, and other modules/courses that are smaller than 15 CP and offered by lecturers of the department. - Lectures, seminars, tutorials or practical courses of **other master's programmes at Goethe University** with subject-related relevance to the master's programme Biodiversity and Ecosystem Health - CPs acquired at another **university in Germany or abroad** with subject-related reference to the master's programme Biodiversity and Ecosystem Health (e.g. in the context of ERASMUS studies, workshops, summer schools) - A **professional internship or research internship** in Germany or abroad carried out under the guidance of a Ph.D. scientist. The content of these activities must be related to the master's programme, Biodiversity and Ecosystem Health. However, they must not be covered by an elective module of the programme and must not be directly related to a master's thesis (subject to approval! See below). - **Excursion** under the guidance of a scientist with a doctorate (with protocol) (subject to authorisation if the field trip does not take place as part of the following module) - **University language course** - Workshops on key competencies (**soft skills**) for further scientific development and other subject-related further training courses				
Learning outcomes / Competence goal				
Depending on the selection, students acquire the following competencies: - deepening of subject-specific knowledge (knowledge of species, specialized knowledge, knowledge of methods, ecological experience, ...) through broad content and/or methodological orientation - acquisition of interdisciplinary knowledge - individual profile formation - career-relevant orientation and qualification - extension of academic general education - intercultural competence - language skills - locating the own subject studies in the context of other scientific disciplines - acquisition of competencies in the field of interdisciplinary and non-specific key qualifications - acquisition or deepening of key competencies (soft skills)				
Participation requirements for the module		The participation requirements specified for the respective modules apply.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Result from the offer		
Exam language		Result from the offer		
Module duration		Result from the offer		
Frequency of the offer (offering period)		Result from the offer		
Module coordinator		Prof. Dr. Henner Hollert (responsible), Dr. Sabrina Schiwy		
Special notes		Recommendations of modules offered by Goethe University that can be used for the optional module are published on the website of the master's program. Suppose one or more modules are to be taken that are not among the recommendations. In that case, an informal application must be submitted in advance to the module coordinator so that it can be checked whether the subject-related reference is given. This also applies to business and research internships, excursions, and other activities not included in the list on the homepage. In the case of lectures in which coursework and/or a module final examination is scheduled, these services must be provided. Written examinations must be passed. Lectures without a module final examination cannot be credited under the optional module. In the case of activities for which certificates without CP indication are issued, the following rules apply for guidance (not binding): 1 CP corresponds to a workload of 30 hours (attendance and self-study). 1 SWS lecture corresponds to 1.5 CPs		

				1 SWS seminar corresponds to 2 CPs (extensive preparation) 1 SWS practical course corresponds to 1 CP (with protocol) One week of field/laboratory/operational internship (Mon-Fri, 8 h each) corresponds to 2.5 CPs if a protocol is prepared.			
Semester-long certificate							
Certificate of attendance				Result from the offer			
Course credits				Result from the offer			
Module examination				**Form of examination (Scope/duration)**			
Module final exam				Result from the offer. Grades do not impact the overall grade for the master's degree.			
Event overview							
	Teaching formats	**SWS**	**CP**	**Semester**			
				1	**2**	**3**	**4**
Event name	[diverse]	…	…	X	X	X	
Event name	[diverse]	…	…	X	X	X	
Total Sum		…	**15**				

BEH-Optional Biodiversity and Sustainability Field Excursion

BEH-Optional	Exkursion zu Biodiversität und Nachhaltigkeit *Biodiversity and Sustainability Field Excursion*	Option for optional module	**3 -15 CP** (90-450 hours, h)	
			Contact time 2-13 SWS / 28-182 h	**Independent study 62-268 h**
Assignment of the course		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Availability of the course for other degree programs		M.Sc. Environmental Sciences / FB 11		

Content

At the center of this module is a major field excursion lasting from a few days up to four (five) weeks, usually to a European or non-European destination. The specific excursion destinations are selected and announced each year by the excursion leaders.
This module combines preparation through a seminar, training in field ecological methods, intensive fieldwork, and follow-up work. Content topics include, for example:
- Introduction to the broad systematics and diversity of plants, animals, and fungi in different ecosystem types
- Evolution of key traits and functional adaptations to extreme habitats (e.g. coral reefs, desert habitats) and particular environmental conditions (e.g. heat, drought, fire, salinity)
- Ecosystem science (terrestrial and/or aquatic systems) as well as fundamentals of biogeography
- Ecotoxicology and ecosystem health

Preparatory seminar: In this seminar, the excursion is prepared: each participant works on a topic relevant to the excursion and presents it as a subject talk, followed by a discussion. In the seminar, fundamentals, current research, and conservation-related challenges are presented on the basis of publications and critically discussed as a group.
Excursion: The practical part comprises field demonstrations, students' own analyses of ecosystems, local factors (soil, climate, etc.) and/or biological diversity at various sites in the field.
This may include:
- Recording of biodiversity (transect surveys, vegetation surveys, inventories)
- Application of monitoring concepts and ecological assessment
- Preservation of biological material for further analyses (morphological, molecular biological)
- Observation and analysis of local aspects of biodiversity, sustainability, and ecosystem health

Follow-up seminar: The aim of the follow-up seminar is to review and reflect on the experiences gathered during the excursion and to produce a first draft of a report (excursion report).
Organization: In addition to these activities, students are expected to make an organizational contribution.

Learning outcomes / competency goals

Students acquire an integrated understanding of biological diversity, ecological relationships, and biogeographic patterns in a European or non-European context. They are able to recognize and identify organisms from various major groups in their natural habitat and to classify them within ecosystem-related and evolutionary contexts. Through the combination of preparation, fieldwork, and follow-up, students develop methodological and scientific competencies for a professional or academic career.
Preparatory seminar: Through independently researching and presenting a specialist topic, students are able to critically search for, evaluate, and prepare scientific sources.
Excursion: Through direct observation, field ecological surveys, and the processing of collected material, students are able (examples):
- to recognize organisms from various major groups (plants, animals, fungi, and others) in different ecosystem types, describe them morphologically, and classify them taxonomically,
- to recognize functional adaptations of organisms to extreme or particular environmental conditions (e.g. drought, heat, fire, salinity) and explain them in an evolutionary and ecological context,
- to record biodiversity methodically (e.g. transect surveys, vegetation surveys, faunal inventories) and assess it ecologically,
- to apply monitoring concepts and assess their significance for nature conservation and resource management.

Follow-up seminar:
By producing a written excursion report, students are able to structure and document the observations, data, and experiences they have gathered, reflect on them critically, and place them in a scientific context.
Organization: In addition, through an independent organizational contribution, they have gained insight into the practical organization of scientific fieldwork.

Prerequisites for participation in the course	Successful application for one of the excursion places, possibly suitability for tropical conditions, among other requirements depending on the excursion
Recommended prior knowledge	Species identification skills
Courses offered	
Teaching / learning formats	Seminar, excursion
Language of instruction / examination	German or English
Duration of the course	Flexible, announced by the organizer The number of credit points is adjusted depending on the length of the excursion (3 excursion days = approx. 1 CP). The follow-up seminar may or may not be part of the module. All organizational details will be announced in good time at a mandatory preliminary meeting. Participants pay a reasonable contribution towards expenses.

Frequency of offering (offering cycle)	At least once a year
Course coordinator	Prof. Dr. Stefan Wanke
Assessments during the semester	
Proof of participation	Regular and active participation in both seminars and during the excursion. Active participation in the seminars is demonstrated through participation in the discussions.
Coursework	Short talks, short reports, and other assessments depending on the excursion
Module examination	**Examination format (scope/duration)**
Components of the cumulative module examination	None

Course overview

	Teaching / learning format	**SWS**	**CP**	**Subject semester**			
				1	**2**	**3**	**4**
Preparatory seminar	S	1	2		X	X	
Excursion (approx. 3-33 days)	E	1-11	1-11		X	X	
Follow-up seminar	S	0-1	0-2		X	X	
Total		**2-13**	**3-15**				

Research Project (Mandatory module)

BEH-FP	Research Project	Mandatory module	total 450 hours (h)	
			Hours of presence variable	**Self-study** variable
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		-		
Content				
The module comprises a practical course and the working group seminar to provide the student with the essential theoretical principles and experimental techniques of the discipline intended for the master's thesis in such an intensive way that the master's thesis can be successfully completed within the available time frame. In the practical part, methodological preparatory work for the master's thesis can be carried out, such as establishing research methods, cultivating or keeping the organisms studied, or familiarizing oneself with the organisms of study areas or collections (in the case of faunistic, floristic or systematic studies).				
Learning outcomes / Competence goal				
After completing the module, students will be theoretically and practically familiar with the basics of the chosen subfield directly related to the master's thesis. The research project protocol should be written in direct connection with the research internship. It should describe background information, working hypotheses, methodological notes, preliminary results and a concept for the master's thesis.				
Participation requirements for the module		min. 60 CP (basic module; three elective modules or two elective modules and the optional module)		
Recommended prior knowledge		-		
Teaching offer				
Teaching formats		Seminar, practical courses		
Exam language		English or German		
Module duration		One Semester (second half of the semester)		
Frequency of the offer (offering period)		every semester, also during the lecture-free period		
Module coordinator		Prof. Dr. Meike Piepenbring		
Semester-long certificate				
Certificate of attendance		Active participation in the practical exercises		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Module final exam		**Research protocol:** ca. 30 pages		
Module grade		Grade of the protocol		

Event overview

	Teaching formats	SWS	CP	Semester			
				1	**2**	**3**	**4**
Research internship in a working group of the student's choice	P	13	13			X	
Working group seminar	S	1	2			X	
Total sum		**14**	**15**				

Master's thesis (Mandatory module)

BEH-MA	master's thesis	Mandatory module	Total 900 hours (h)	
			Hours of presence variable	**Self-study** variable
Module assignment		M.Sc. Biodiversity and Ecosystem Health / FB 15		
Applicability of the module for other degree programmes		-		
Content				
As part of the master's thesis, the student works on a question independently, comprehensively and in depth according to scientific methods within a given time. The work can be experimental, empirical or analytical. The results must be summarized in a written master's thesis in scientific publication style.				
Learning outcomes / Competence goal				
The students demonstrate their ability to work comprehensively and in-depth on a scientific problem with practical application of appropriate research methods. They are able to write a thesis in scientific publication style.				
Participation requirements for the module		Min. 75 CP. The module "Research Project" must be successfully completed.		
Recommended prior knowledge		None		
Teaching offer				
Teaching formats		Master's thesis		
Exam language		English or German		
Module duration		One Semester (6 Months)		
Frequency of the offer (offering period)		Every semester, also during the lecture-free period		
Module coordinator		Prof. Dr. Meike Piepenbring		
Semester-long certificate				
Certificate of attendance		None		
Course credits		None		
Module examination		**Form of examination (Scope/duration)**		
Module final exam		Master's thesis (ca. 40-100 pages)		
Module grade		Graded master's thesis		

Event overview

	Teaching formats	**SWS**	**CP**	**Semester**			
				1	2	3	4
Mastert hesis	Thesis	30	30				X
Total Sum		**30**	**30**				