Master Ecology, Evolution, and Conservation
Institute of Biochemistry and Biology
University of Potsdam

Module Manual

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Please check file updates on the EEC webpage

https://www.uni-potsdam.de/de/moen/modulhandbuch.html

and consult the "Vorlesungsverzeichnis" that you find online in the PULS-system of the University of Potsdam:

https://puls.uni-potsdam.de/qisserver/rds?state=verpublish&publishContainer=vvzpdfindexstgdoc&stgkz=EEC

The Institute of Biochemistry and Biology at the University of Potsdam is largely responsible for the curriculum of the international Master program in Ecology, Evolution, and Conservation. This module manual is updated every semester and available from the webpage:

https://www.uni-potsdam.de/en/moen/module-manual.html

The program closely connects to current research activities at the institute. In this way, we achieve a high practical relevance of the study contents and an early participation of the students in the current research of the working groups at the university. Five cooperating research areas characterize our interdisciplinary profile:

1. **Vegetation ecology and scientific nature conservation**
2. **Aquatic ecology and ecological modelling**
3. **Animal ecology and human biology**
4. **Biodiversity research / General and special botany**
5. **Evolutionary ecology and evolutionary biology / Special zoology**

1. Curriculum overview

This section provides a first overview about the structure of our master program. The curriculum is divided into individual modules, which are in turn composed of individual courses (i.e., lectures, seminars, practical courses and excursions). Almost all courses are taught in English. During the first two semesters, among other things, we aim to balance the level of knowledge of all students in the three main topics of ecology, evolution and nature conservation. We also value highly a solid deepening of existing knowledge in the areas of experimental design, data collection and statistics, where profound methodological competence will be essential for all fields of activity of our graduates.

The Master program in *Ecology, Evolution, and Conservation* consists of the following modules with in total 120 credit points (CP):

Table 1: Overview of modules and credit points

Compulsory modules I and II	12 CP
Electives from area A and B	66 CP
Elective specialization module	12 CP
Master thesis	30 CP
Total	**120 CP**

In more detail, these modules are:

- Compulsory module 1 (6 Credit Points = CP): State of the Art in Ecology, Evolution, and Conservation, and compulsory module 2 (6 CP): Experimental design and data analysis (in sum: 12 CP). Note that statistics are a major part of compulsory module 2.
- 6 elective modules from area A. Area A includes courses offered by the Institute of Biochemistry and Biology (in sum: 36 CP)
- 5 additional electives (which you have not chosen yet) from area A **or** from area B. Area B comprises courses offered by the Faculty of Science (in sum: 30 CP)
- 1 specialization module to prepare the Master thesis (12 CP)
- Master thesis (30 CP). Topics for master theses closely relate to current research topics in the respective working groups at the Institute of Biochemistry and Biology.

Based on the two compulsory modules 1 and 2, we offer a broad range of elective modules, which can be assembled according to individual interests (Fig. 1). In doing so, we strongly rely on intellectual freedom and individual self-responsibility in the compilation of the modules and the specialization each student strives to achieve.

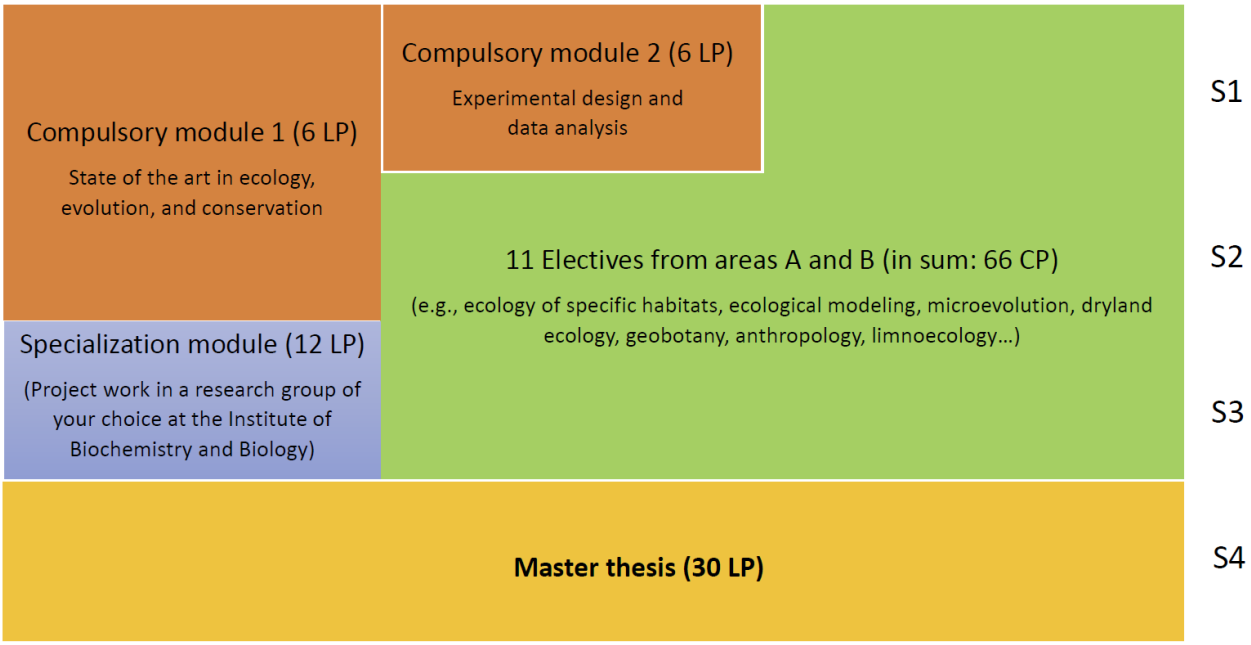

Fig. 1: Overview of the study plan: This is a general scheme for the master program in 4 semesters (S). This scheme applies if you start taking courses in the winter semester. If you start in the summer, the order of the compulsory modules is reversed.

2. Module list

This section provides the module list according to the official study and examination regulations for the master program in *Ecology, Evolution, and Conservation*. You may search for the module abbreviations (e.g. BIO-O-WM1) online in the so-called "PULS-system" (= electronic module administration system) of the University of Potsdam. In PULS, you find quite general module descriptions. Actual course details are specified further on in this manual (Section 4).

Table 2: Module list with credit points (CP)

Module abbreviation	**Module name**	**CP**
I Compulsory modules (*12 CP*)		
BIO-O-KM1	State of the art in ecology, evolution and conservation	6
BIO-O-KM2	Experimental design and data analysis	6
II Electives area A (*36 CP*)		
BIO-O-WM1	Organismic ecology	6
BIO-O-WM2	Basics of ecology	6
BIO-O-WM3	Concepts of ecology	6
BIO-O-WM4	Applied ecology	6
BIO-O-WM5	Data acquisition and analysis	6
BIO-O-WM6	Experimental ecology	6
BIO-O-WM7	Biodiversity research	6
BIO-O-WM8	Ecology of specific habitats I	6
BIO-O-WM9	Ecology of specific habitats II	6
BIO-O-WM10	Aquatic environmental ecology	6
BIO-O-WM11	Conservation biology	6
BIO-O-WM12	Applications of nature conservation	6
BIO-O-WM13	Biology of plants and fungi	6
BIO-O-WM14	Ecology of mammals	6
BIO-O-WM15	Theoretical ecology and ecological modelling I	6
BIO-O-WM16	Theoretical ecology and ecological modelling II	6
BIO-O-WM17	Interactions ecology, evolution, and genetics	6
BIO-O-WM18	The Central role of evolutionary biology in biosciences	6
BIO-O-WM19	Microevolution/Conserving the evolutionary process	6
III Electives area B (*30 LP*)		
BIO-B-WM10	Genome Research and Systems Biology B	6
BIO-B-WM11	Molecular Biology B	6
BIO-MBIP01	Algorithmic and mathematical Bioinformatics	6
BIO-MBIP02	Statistical bioinformatics	6
BIO-MBIP03	Bioinformatics of biological sequences (evolutionary genomics)	6
BIO-MBIP04	Analysis of Cellular Networks	6
BIO-B-KM1	State of the art in biochemistry and nolecular biology	6
MAT-MBIP05	Introduction to theoretical systems biology	6
BIO-MBIP06	Constraint-based Modeling of cellular networks	6
BIO-MBIW01	Data Integration in Cellular Networks	6
BIO-MBIW02	Advanced methods for Analysis of Biochemical networks	6
BIO-MBIW07	Integration of cellular layers and systems	6

BIO-MBIB01	Introduction to databases and practical programming	
BIO-MBIB03	Programming expertise	6
BIO-BRM17a	Current problems and modern methods in plant genetics and	6
GEW-B-WP01	Vertiefungsmodul Geologie I	6
GEW-B-WP05	Vertiefungsmodul Geophysik I	6
GEW-RCM03	Data analysis and statistics	6
GEE-TV3	Globaler Wandel – Die Erde als System	6
GEE-KL	Klimatologie	6
GEE-GV03	Ökosystemleistungen	6
GEE-GV09	Numerik und Simulation	6
GEW-GIS1	Grundlagen der Geoinformationssysteme	6
GEW-RCM01	Remote Sensing of the Environment	6
GEW-RCM02	Earth System Science	6
INF-1010	Grundlagen der Programmierung	6
MATVMD834a	Stochastic Processes	6
MAT-M3	Fortgeschrittene Probleme der Geowissenschaften	6
PHY_131d	Simulation und Modellierung	6
PHY_541c	Aufbaumodul Statistische und nichtlineare Physik	6
MATBMD130	Basismodul Programmieren	6
IV Electives (specialization module, *12 LP*)		
BIO-O-VM1	Plankton ecology	12
BIO-O-VM2	Animal ecology	12
BIO-O-VM3	Human biology	12
BIO-O-VM4	Ecological microbiology	12
BIO-O-VM5	Microbial ecology	12
BIO-O-VM6	Biodiversity of land plants and fungi	12
BIO-O-VM7	Geobotany	12
BIO-O-VM8	Methods in conservation biology	12
BIO-O-VM9	Modelling in plant ecology and nature conservation	12
BIO-O-VM10	Arid-zone research	12
BIO-O-VM11	Data analysis, modelling, and theory in community ecology	12
BIO-O-VM12	Evolutionary biology	12
Sum of all compulsory modules and electives: 90 CP		

Individual courses yield credit points from 1-6 CP. Credit points gained in individual courses can then be assigned to one of several possible modules among the 19 elective modules in area A. The rule is that each module must finally contain 6CP to be completed. This system achieves maximal flexibility and a customized study focus for students. Section 3 explains how to assign course contents to the 19 modules.

Course list / module title	LP	Assessor (Prüfer/in)	BIO-O-WM1: Organismic ecology	BIO-O-WM2: Basics of ecology	BIO-O-WM3: Concepts of ecology	BIO-O-WM4: Applied ecology	BIO-O-WM5: Data acquisition and analysis	BIO-O-WM6: Experimental ecology	BIO-O-WM7: Biodiversity research	BIO-O-WM8: Ecology of specific habitats 1	BIO-O-WM9: Ecology of specific habitats 2	BIO-O-WM10: Aquat. Conservation biology	BIO-O-WM11: Conservation biology	BIO-O-WM12: Appl. nature conservation	BIO-O-WM13: Biology of plants and (fungi	BIO-O-WM14: Ecology of Mammals	BIO-O-WM15: Theoretical ecology – 1	BIO-O-WM16: Theoretical ecology – 2	BIO-O-WM17: Interaction ecology –	BIO-O-WM18: The central role of evol. biology –	BIO-O-WM19: Microevolution
Experimental plankton ecology	6	Weithoff	1				1	1		1	1	1										
Lake microbiology	6	Grossart		1	1		1	1	1	1	1	1										
Basics in limnoecology	6	Weithoff	1	1	1					1	1	1										
Aquatic ecology	6	Weithoff			1					1	1	1										
Wetland eco-hydrology	6	Pusch				1				1	1	1										
Molecular microbial ecology	6	Dittmann	1	1				1														
Geomicrobiology	6	Wagner	1					1	1													
Astrobiology	6	de Vera			1					1	1									1		
Geobotany	6	Heinken	1			1			1	1	1			1	1							
Vegetation ecology of central Europe	6	Heinken	1			1			1	1	1			1	1							
Ecology of the mediterranean vegetation	6	Kummer	1			1			1	1	1				1							
Taxonomy and biodiversity of fungi and lower pl	6	Kummer	1	1					1						1					1		
Biogeography	6	Schmitt	1			1														1		
Plant ecology	6	Jeltsch	1	1	1		1	1	1						1							
Dryland ecology	6	Blaum	1			1	1	1		1	1		1									
Crop plants and domestic animals	6	Heinken	1			1									1	1						
Scientific nature conservation	6	Jeltsch			1	1			1				1									
Regional and applied nature conservation	6	Jeltsch				1			1	1	1			1								
Conservation genetics	6	Fickel		1	1		1													1		
Behavioural ecology	6	Eccard	1	1	1	1										1						
Experimental animal ecology	6	Eccard	1			1	1	1								1						
Anthropology basics	6	Scheffler	1			1										1						
Anthropology advanced	6	Scheffler	1			1	1									1						
Macroecology and global change	6	Zurell				1							1	1								
Quantitative conservation biogeography	6	Zurell				1							1	1								
Basic theoretical ecology	6	Klauschies		1	1												1	1				
Advanced theoretical ecology	6	Guill			1												1	1				
Ecological modelling with computer simulations	6	Jeltsch				1							1				1	1				
System ecology and evolution	6	Tiedemann	1	1	1															1		
The central role of evolutionary biology in biosci	6	Tiedemann																			1	
Microevolution/Conserving the evolutionary pro	6	Tiedemann																				1
Terrestrial palaeoecology	6	Herzschuh	1	1	1															1		
Analysis of high throughput sequencing data	6	Kappel (Lenhard)					1													1		
Bioimage analysis and extended phenotyping	6	Kappel (Lenhard)					1													1		
Genetic and genomic basis of evolutionary chang	6	Barlow (Hofreiter)																		1		

Aquatic ecology
Microbial ecology
Plant and landscape ecology
Applied ecology
Theoretical ecology
Evolutionary biology

3. Assignment from course contents to modules

Table 3: The matrix explains which courses you may assign to which of the 19 modules from area A (A = offered by the Institute of Biochemistry and Biology). The vertical column lists the courses. Each vertical entry yields 6 CP and may include a mixture of lectures, seminars, and practical field or lab courses. The horizontal row lists the modules as in Table 2. Modules are credit point "containers" filled with actual course contents. For example, the 6 CP you gain from taking the courses in "Experimental plankton ecology" can be assigned to either one of the modules BIO-O-WM1, BIO-O-WM5, BIO-O-WM6, BIO-O-WM8, BIO-O-WM9, or BIO-O-WM10. You may not assign CPs to several modules at the same time.
Note: The color legend gives a first orientation. Actual course content may include several subjects, e.g. a combination of aquatic and terrestrial ecology or topics from both fundamental and applied ecology.

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4. Course contents

The sections below are for compulsory modules (4.1), electives from area A (4.2) and area B (4.3), specialization modules (4.4) and facultative courses (4.5).

4.1 Compulsory modules I and II

BIO-O-KM1: State of the art in ecology, evolution, and conservation	Number of credit points (CP): 6
Module type:	Compulsory
Content and objective of module:	**Content:** Reinforcing knowledge and overview of trends in research in the disciplines ecology, evolution and conservation **Qualification goals:** Students will learn about specific topics and ongoing research in the three disciplines ecology, evolution and science based conservation. The three lectures cover all aspects of these disciplines, plants and animals, and build on pre-knowledge. The module reinforces principles and current knowledge. The lectures cover a wide range of topics, e.g. food webs, biological invasions, ecological relationships between species, global biodiversity patterns, variation and selection, coevolution, species concepts, global change, population dynamics and viability. Students will get an in-depth knowledge of ecology, evolution and science-based conservation, as well as insights into modern developments of methodology and current research in these three disciplines. They will be trained in interdisciplinary thinking and approaches.
Module examination:	*Written exam (180min)*
Independent study time (in hours (h)):	60

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture State of the Art Ecology	2	-	-	-	
Lecture State of the Art Evolution	2	-	-	-	
Lecture State of the Art Conservation	2	-	-	-	
Excursions offered by the IBB	30 h (=1CP)	Certificate	Excursions offered by the IBB		

Offered:	Winter semester (lecture SOTA Evolution), summer semester (lecture SOTA Ecology, lecture SOTA Conservation), Winter and Summer semester (excursions)
Prerequisite for taking the module	Pre-knowledge of basic ecology is essential, pre-knowledge of basic mathematics (i.e. how to interpret equations) is advised
Teaching units:	IBB

BIO-O-KM2: Experimental design and data analysis	Number of credit points (CP): 6
Module type (mandatory or elective):	Mandatory
Content and objective of module:	**Content:** Mathematical and conceptual foundations of statistical data analysis **Qualification goals:** Students learn about experimental study design and the appropriate statistical methods for analyzing different types of data. The first half of the course builds a solid foundation, covering an introduction to statistical analysis and the most important basic tests: t-test, one-way ANOVA, chi-square test, linear regression and correlation, and non-parametric equivalents of these tests. Additionally, common issues such as how to test data for normality and different data transformations are covered. The second half of the course starts with an introduction to statistical analysis using the software package R. This program is used for an array of more challenging and advanced approaches: multiple regression, two-way ANOVA, mixed effects models, logistic regression, principal component analysis, and cluster analysis.
Module examination (number, form, scope):	*Written exam (120 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture	2		Lecture		
Exercises	2		Exercises		

Offered:	Winter semester (lectures/exercises)
Prerequisite for taking the module	Some pre-knowledge of basic mathematics (i.e. how to interpret equations) is advised
Teaching units:	IBB

4.2 Electives (6LP) from Area A

Background colors in the headers of the course content descriptions coarsely indicate subject areas as in Table 3 (Section 3): blue = aquatic ecology; red: microbial ecology; green = terrestrial ecology; purple = applied ecology; orange = theoretical ecology; yellow = evolutionary biology.

Color code is for a first orientation. Actual course content may often comprise several subject areas as well as fundamental and applied ecology.
→See the last row of each course table and Table 3 to which module you can assign your credit points.

Experimental plankton ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** The participants study in small groups of 3-4 students modern themes in plankton ecology (phytoplankton and zooplankton). We will address actual research questions by using a broad set of techniques such as fluorescence microscopy, flow cytometry, PAM-fluorometry etc. Typical topics are ecophysiology, competition, maternal effects, behavioural ecology or meta-community ecology. The work is directly connected to ongoing research in the group and provides a deep insight into practical work in aquatic ecology. A seminar is included to further discuss the research questions. **Qualification goals:** The students learn to plan, conduct and analyse experiments, to discuss their results and to write a scientific protocol.
Module examination (number, form, scope):	*Protocol (15 pages)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical Course: Plankton Ecology Seminar included	6	Active participation in the seminar			6

Offered:	*Winter semester*
Prerequisite for taking the module	*None*
Teaching units:	IBB, PD Dr. Guntram Weithoff
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM5: Data acquisition and analysis BIO-O-WM6: Experimental Ecology BIO-O-WM8/9: Ecology of specific habitats I or II BIO-O-WM10: Aquatic environmental Ecology

Lake microbiology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This course aims to address the many different theoretical and practical aspects of aquatic microbial ecology. The course will be a combination of intense lectures to provide the necessary background knowledge on molecular, physiological and ecological aspects as well as practical field and lab work to get a good hands-on experience. In the field, we will measure selected physical and chemical variables to better evaluate the environmental and biological context of the microorganism community in the respective aquatic environments. In the lab, we will run question-related experiments addressing genetic, physiological and biochemical aspects in microbial ecology. Theoretical and practical exercises will be performed to introduce into the fascination of the microbial world. All students will work on ongoing scientific research projects of the Aquatic Microbial Ecology group at IGB and will get a good insight into a scientist's daily work. This course offers many opportunities to get exposed to field work, intensive hands-on training in generating and analyzing useful microbiological and ecological data. The course takes place at Lake Stechlin. **Qualification goals:** The students learn basic and modern themes in lake microbiology. They understand complex food web structures and dynamics and their response to their environment.
Module examination (number, form, scope):	*Protocol (15 pages)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lake microbiology (practical course)	6				3

Offered:	Summer semester
Prerequisite for taking the module	*None*
Teaching units:	IBB, Prof. Dr. Grossart
Assignable to PULS-module	BIO-O-WM2: Basis of ecology BIO-O-WM3: Concepts of ecology BIO-O-WM5: Data acquisition and analysis BIO-O-WM6: Experimental Ecology BIO-O-WM8/9: Ecology of specific habitats I and II BIO-O-WM10: Aquatic environmental Ecology

Basics in limnoecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This module provides a solid introduction into all fields of limnology. It starts with the origin and distribution of freshwater systems, their characteristics and their biological components. Based on this, themes around eutrophication, food webs, seasonality and effects of climate change will be presented. Furthermore, selected applied issues such as limnology of reservoirs, EU Water Framework Directive, acidic mining lakes will be included. Microscopical exercises on phyto- and zooplankton complement this module **Qualification goals:** The students learn basic and modern themes in limnology. They understand complex food web structures and dynamics and their response to environmental change
Module examination (number, form, scope):	*Written exam of 90 min*
Independent study time (in hours (h)):	105

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Aquatic Ecology I	2				3
Aquatic Ecology II plus Microscopical Exercises	3				3

Offered:	*Winter semester, microscopic exercises in summer semester (Grundpraktikum Limnologie)*
Prerequisite for taking the module	*None.*
Teaching units:	IBB, PD Dr. Guntram Weithoff
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM2: Basics of ecology BIO-O-WM3: Concepts of ecology BIO-O-WM8/9: Ecology of specific habitats I and II BIO-O-WM10: Aquatic environmental Ecology

Aquatic ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** In this module, a field course is combined with lectures broadening the knowledge in aquatic ecology. In the field course, the students sample a lake and analyse relevant biological and chemical parameter. These data will be used to ecologically characterise the study lake. Lectures on river ecology, applied river ecology, wetland ecology and marine ecology complement this module. A short 3-days "Field course in fundamental limnology" provides an intense hands-on style introduction into limnological field work. The students choose from the offered courses/lectures below to accumulate 6 CP. **Qualification goals:** The students learn extended themes in limnology. They understand complex aquatic systems and learn to combine field data with theory and concepts.
Module examination (number, form, scope):	*Written exam (90 min)*
Independent study time (in hours (h)):	105

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Limnological field course (practical course) OR	3			Protocol (ca. 10 pages)	3
Lecture River ecology OR	2				2
Lecture Applied river ecology OR	2				2
Field course in fundamental limnology (practical course) OR	2				1
Lecture Marine ecology	2				2

Kombinationsmöglichkeiten je nach PULS-Modul für **insgesamt** 6 LP:

BIO-O-WM3: Es ist entweder V+S oder V+Ü oder V+Ü+P oder P+S zu belegen.

BIO-O-WM8/9: Es ist entweder V+S oder V+Ü oder S+Ü oder V+P oder P+S zu belegen.

BIO-O-WM10: Es ist entweder V+P oder P+S oder V+Ex zu belegen.

Offered:	*Summer semester*
Prerequisite for taking the module	*Recommended is knowledge on Aquatic Ecology e.g. from module Basics in Limnoecology*
Teaching units:	IBB, PD Dr. Guntram Weithoff
Assignable to PULS-module	BIO-O-WM3: Concepts of ecology BIO-O-WM8/9: Ecology of specific habitats I and II BIO-O-WM10: Aquatic environmental Ecology

Wetland eco-hydrology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** The module presents the specific features of wetlands from the point of view of several disciplines, as geo-ecology, hydrology, biology and ecology. The module hence explains fundamental hydrological mechanisms, as interactions between ground water and surface water, generation of water discharge and flooding dynamics in river floodplains, as well as methods to measure key variables. Also, important ecological processes and characteristic habitat conditions for biota are presented, including vegetation patterns, and the preconditions for the high biodiversity often found there. In addition, case studies are presented on the hydrological and ecological functions of wetlands, as well as on the options for sustainable human use and management. Also, techniques of remote sensing are shown that may be used to analyze the features and functions of wetlands. Based on this, approaches for the assessment of the various ecosystem services available in wetlands are explained. The lecture is supplemented by excursions to regional wetlands in the lowlands of the rivers Havel and Nuthe/Nieplitz. **Qualification goals:** 1. Specific competence - Students dispose of specific knowledge and insights into the characteristics of wetlands in several regions. They are able to recognize the structure and functions of wetlands in terms of their general and local specific features. 2. Methodological competence - Students are able to analyze and assess a wetland by use of various disciplinary methods, and elaborate development scenarios for it. For that, students are familiar with selected measurement techniques in hydrology and ecology and with remote sensing approaches. 3. Professional competence - Students are able to structure a disciplinary question of wetland eco-hydrology, and to draft a well-founded disciplinary study on this. They are able to assess the functions and possible sustainable human uses of wetlands, as well as restoration options.
Module examination	*Combined exam consisting of reports on the field courses and on the remote sensing seminar (c. 10 pages) and of a written test (90 min)*
Independent study time (in hours (h)):	120

Courses (type of teaching)	Contact time (in semester-hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture: Fundamentals of the hydrology and ecology of wetlands and river floodplains (Bronstert & Pusch)	1	-	-		
Field course: Regional features of wetlands and measurement methods (Francke)	1	-	-		
Field course: Physical habitat mapping of streams (Pusch)	1	-	-		
2 Day excursions: Wetland Eco-Hydrology (Bronstert)	1				
Seminar and exercise course: Remote sensing applications (Brosinsky)	1				

Offered:	*Summer semester (at least every 2 years)*
Prerequisite for taking the module	Recommended: Hydrology of surface waters
Teaching units:	IBB / Geoecology, PD Dr. Pusch
Assignable to PULS-module	BIO-O-WM4, BIO-O-WM8, BIO-O-WM9, BIO-O-WM10

Molecular microbial ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** The lecture Molecular Microbial Ecology gives an overview about the adaptation of microorganisms and the structure of microbial communities in their habitats. A special focus is given to molecular techniques used for the analysis of complex microbial communities, methods aimed to detect activities of microorganisms in situ and microbial genomics and metagenomics. The lecture will cover the role of microorganisms in biogeochemical cycles and the interaction of microorganisms in symbioses and biofilms. In the seminar, original articles complementing topics and molecular technologies introduced in the lecture will be presented and discussed. In the practical tutorial the students will get hands-on experience of molecular techniques for the analysis of microorganisms in their habitats and of microbial communities. **Qualification goals:** 1) Scientific competences: Students - Have a basic understanding of molecular microbial techniques - Have an overview about microbial habitats and metabolic cycles - Know microbial key organisms in different habitats - Have profound knowledge about microbial interactions and biofilms - Have knowledge about adaptation of microorganisms in extreme habitats 2) Method competences: Students - Know to develop strategies for the analysis of microorganisms in their habitats aimed to understand their metabolic roles - Know principal techniques for the analysis of microorganisms in situ and of microbial communities - Can develop and compare alternative strategies for the analysis of microorganisms and microbial communities and can estimate advantages and disadvantages of techniques - Can put experimental data obtained during a practical course into a broader scientific context and critically discuss their scientific insights - Can relate experimental data to roles of microorganisms in a habitat-specific or metabolic context 3) Action competences: Students - Can present scientific contents related to microbial ecology in an oral or written form - Can design experiments related to microbial ecological questions - Can develop strategies to work on complex problems in collaboration with partners - Utilize feedback provided in scientific discussions or after presentations to improve their work and its interpretation - Can perform experiments according to safety rules in microbial laboratories
Module examination (number, form, scope):	*Written exam (90min)* *and Protocol (15 pages)*
Independent study time (in hours (h)):	80

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture Molecular Microbial Ecology	2	-	-	1 written exam (90 min)	3
Seminar Molecular Microbial Ecology	1	-	-		1
Practical tutorial Molecular Microbial Ecology	2	-	-	1 protocol (15 pages)	2
Offered:	*Every summer semester*				
Prerequisite for taking the module	*Recommended is knowledge on Basic Microbiology and Molecular Biology*				
Teaching units:	IBB, Prof. Dr. Dittmann				
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM2: Basics of ecology BIO-O-WM6: Experimental Ecology				

Geomicrobiology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Basic knowledge of geomicrobiology in terrestrial deposits is taught: The lecture gives an introduction into the world of microorganisms, their importance in global material cycles and biological-geological interactions in relevant habitats. This knowledge will be deepened in the seminar on the basis of selected case studies from current literature. In the practical course (block course) the basic techniques for the investigation of microorganisms are applied to a concrete example. **Qualification goals:** • Basic understanding of microbial life in the geological environment • Prerequisite and limitation of life (sprocesses) in sedimentary deposits • Significance for global material cycles • microbiological and geoscientific fundamentals for the study of life in geological habitats • Introduction to the most important microbiological analysis methods.
Module examination (number, form, scope):	*Written exam (90min)*
Independent study time (in hours (h)):	135

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture and seminar	2	-	Presentation with handout		
Practical course	1	-	Protocol		

Offered:	*Summer semester*
Prerequisite for taking the module	*None*
Teaching units:	IBB / GFZ, Prof. Dr. Wagner
Assignable to PULS-module	BIO-O-WM1, BIO-O-WM6, BIO-O-WM7

Astrobiology	**Number of credit points (CP): 6**
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** Astrobiology: a general overview; habitability of planets from geologic/biologic/ecophysiologic and ecological point of view; guidelines of planetary simulation experiments with microorganisms in the lab; planetary analogue field site experiments in Polar Regions/Deserts/ at high altitudes; space experiments on satellites and the International Space Station (ISS); Planetary Protection; Research on Biosignatures/Bio-Traces; space mission concepts **Qualification goals:** - Efficient and successful literature research - Team work on a selected astrobiological topic - Oral Presentation - develop innovative new ideas for astrobiological experiments (in space, in the lab and in the field)
Module examination (number, form, scope):	*Oral presentation exam (15min + up to 30min discussion) and Protocol (up to 15 pages)*
Independent study time (in hours (h)):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture ASTROBIOLOGY	2	-	-		3
Seminar ASTROBIOLOGY	2	-	-		3

*Optional: comments (pls keep short!)**	
Offered:	*End of Wintersemester (2-weeks block course in March)*
Prerequisite for taking the module	*Recommended is knowledge on BIOLOGY, GEOMICROBIOLOGY, ECOLOGY, EVOLUTION AND NATURE CONSERVATION*
Teaching units:	DLR, Dr. de Vera
Assignable to PULS-module	BIO-O-WM3: Concepts of ecology BIO-O-WM8: Ecology of specific habitats I BIO-O-WM9: Ecology of specific habitats II BIO-O-WM17: Interactions ecology, evolution, and genetics

Geobotany	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** In this module the relationship between abiotic site conditions (climate, soil and land use) and the present vegetation is taught in theory and practical view, using the example of the Alps. **Qualification goals:** The students will be able to recognize key factors for phytodiversity and their conservation, deepen their knowledge of plant species. They learn to conduct vegetation records and statistical analyses for basic ecological questions. Based on literature research the students are able to present geobotanical topics in an appropriate way. Through teamwork in the practical field course they are able to develop and present scientific facts.
Module examination (number, form, scope):	*Oral presentation (30min)*
Independent study time (in hours (h)):	80

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Seminar / lecture Geobotany	2			*Oral presentation (30min)*	
Practical field course flora and vegetation along the gradient of site conditions	4 (block, Alps)			*Project report (ca. 20 pages)*	

Offered:	*Every year (summer semester)*
Prerequisite for taking the module	*Recommended is basic botanical knowledge, especially in plant species characteristics and determination*
Teaching units:	IBB, PD Dr. Heinken
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM 4: Applied ecology BIO-O-WM 7: Biodiversity research BIO-O-WM 8: Ecology of specific habitats 1 BIO-O-WM 9: Ecology of specific habitats 2 BIO-O-WM 12: Applications in nature conservation BIO-O-WM 13: Biology of plants and fungi

Vegetation ecology of Central Europe	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** In this module the main features of the vegetation of Central Europa as a result of site conditions on the one hand, and vegetation and land-use history on the other hand are taught. **Qualification goals:** The students will be able to consider complex issues of vegetation ecology in the context of landscape history and the physical properties of landscapes. They will be able to assess Central European vegetation types from a nature conservation perspective. Through teamwork in the practical field course they are able to develop and present scientific facts.
Module examination (number, form, scope):	*Written exam (90min) OR oral exam (20min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture Vegetation of Central Europe	1			Written or oral exam	
Lecture Vegetation history of Central Europe	1			Written or oral exam	
Tutorial and practical field course Flora and Vegetation, preferably in Central Germany	4 (block)			Protocol (ca. 10 pages)	

Note: These courses are taught in German!

Offered:	*Every year: winter semester (lectures), summer semester (field course)*
Prerequisite for taking the module	*Recommended is basic botanical knowledge, especially in plant species characteristics and determination*
Teaching units:	IBB, PD Dr. Heinken
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM 4: Applied ecology BIO-O-WM 7: Biodiversity research BIO-O-WM 8: Ecology of specific habitats 1 BIO-O-WM 9: Ecology of specific habitats 2 BIO-O-WM 12: Applications in nature conservation BIO-O-WM 13: Biology of plants and fungi

Ecology of the mediterranean vegetation	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content and qualification goals:** - Extension of knowledge of botanic-taxonomical, phytogeographical and ecological correlations and the problems of nature conservation in an example of the Mediterranean region - Extension of knowledge of botanical structures and taxa - Planning, realization and analysis of an ecological field experiment - Realization of team work - Realization of literature search - Presentation of scientific results
Module examination (number, form, scope):	*Project report (ca. 15 pages)*
Independent study time (in hours (h)):	70

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Seminar (2 days)	1 (block)			Talk (20min)	
Practical tutorial with excursion part	7 (block)			Protocol (ca. 10p)	

These courses are taught in German.

Offered:	*End of winter semester: The two-day seminar is preparatory for the practical tutorial with the excursion part. The seminar takes place about 2-4 weeks prior to the practical part.*
Prerequisite for taking the module	*Recommended is knowledge of basics of botanical structures and taxa*
Teaching units:	IBB, Dr. Kummer
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM4: Applied ecology BIO-O-WM7: Biodiversity research BIO-O-WM8: Ecology of specific habitats 1 BIO-O-WM9: Ecology of specific habitats 2 BIO-O-WM13: Biology of plants and fungi

Taxonomy and biodiversity of fungi and lower plants	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content and qualification goals:** - Main features of phylogeny, taxonomy, biodiversity and ecology of cryptogams (algae, fungi, lichen, mosses, ferns) - Extension of knowledge of botanical and mycological structures and taxa - Extension of knowledge of evolution and ecology of lower plants and fungi - Extension of ability for sample preparation and microscope them - Extension of mode of thought and operation in taxonomy and ecology - Realization of literature search - Presentation of scientific results
Module examination (number, form, scope):	*Written exam (90min)*
Independent study time (in hours (h)):	90
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Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture to biology of fungi and lower plants	2			Written exam	
Seminar / Practical tutorial to morphology, taxonomy and ecology of cryptogams with excursion part*	4			Talk (20min)	

These courses are taught in German.

****To complete the module, the participation on one excursion (4 h) during the winter semester ("Botanisch-ökologische Samstagsexkursionen") is necessary!***

Offered:	*winter semester*
Prerequisite for taking the module	*Recommended is knowledge of basics of botanical structures and taxa*
Teaching units:	IBB, Dr. Kummer
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM2: Basics of ecology BIO-O-WM7: Biodiversity research BIO-O-WM13: Biology of plants and fungi BIO-O-WM17: interactions ecology, evolution, and genetics

Biogeography	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** • Basics and methods in biogeography and phylogeography • Overview on the biomes and realms of the world (Question: How is biodiversity distributed on earth?) • The macrogenetic structure of the world (Question: What are the geological triggers for the distribution of biodiversity on our planet?) • Island biogeography (Questions: How are location and structure of islands and islands groups influencing their biodiversity? Which general conclusions can be drawn on mainland areas and for nature conservation?) • Influence of environmental gradients on habitats (biotic, abiotic, anthropogenic) (Questions: What has triggered the regional and local patterns of biodiversity? Which influences do human activities have on biodiversity?) **Qualification goals:** • The students get a comprehensive overview on biodiversity on earth and of their origin and distribution. • The students learn to evaluate and analyse data in a biogeographical context. • The students learn the advanced handling and analysis of biogeographic and ecologic data sets. • The students get a comprehensive overview on the biomes of the earth and learn the analysis of habitats also outside Central Europe. • The students acquire in-depth knowledge for the deduction of nature conservation concepts and a profound overview on several animal groups. • The students analyse and understand the importance of characteristic physio-geographic and socio-economic factors as well as their importance for the regional animal and plant associations (climate, geomorphology, geology, soil science, land use, landscape history, etc.). • The students acquire in-depth knowledge on the fauna and flora of a particular region outside of the northern German plains. They understand the interactions between animals and plants in a biogeographic-ecological context.
Module examination	*Written exam (90min)*
Independent study time (in hours (h)):	70 if selecting option 2 55 if selecting option 3

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture „Biogeography“	2	-	-		
Field course	6	Oral-presentation (10 min)	-		
Excursion with field course	8	Written report (5-10 pages)	-		
For completing “Biogeography”, the lecture has to be taken; Depending on the student’s interests, she or he may choose either the (2) field course or the (3) excursion with field course					
Offered:		*Lecture: winter semester, Excursion and field course at the end of the summer semester (September), alternating every year*			

Prerequisite for taking the module	*None*
Teaching units:	IBB / SGN, Prof. Dr. Schmitt
Assignable to PULS-module	BIO-O-WM1: Organismic ecology, BIO-O-WM4: Applied ecology, BIO-O-WM17: Interactions ecology, evolution, and genetics

Plant ecology						Number of credit points (CP): 6
Module type (mandatory or elective):	Elective					
Content and objective of module:	**Content:** Current concepts and specific methods in plant ecology **Qualification goals:** Overview of basic and current research in plant ecology Ability to independently carry out a population biological study In-depth knowledge of scientific planning and design of experiments and their evaluation					
Module examination (number, form, scope):	*Written exam (120 min)*					
Independent study time (in hours (h)):	90					
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)	
		For completing the module	For admission to the module exam			
Lecture Plant Ecology	2	-	-			
Lecture/ Excercise Population biology of plants	4	Seminar paper (12 pages)	-			
Note: Plant Ecology: weekly lecture in winter; Populations biology of plants: block course in summer.						
Offered:	*Winter and summer semester (two semesters)*					
Prerequisite for taking the module	*None*					
Teaching units:	IBB, Prof. Dr. Jeltsch					
Assignable to PULS-module	BIO-O-WM 1: Organismic Ecology BIO-O-WM 2: Basics of Ecology BIO-O-WM 3: Concepts of Ecology BIO-O-WM 5: Data acquisition and analysis BIO-O-WM 6: Experimental Ecology					

	BIO-O-WM 7: Biodiversity Research BIO-O-WM 13: Biology of Plants and Fungi

Dryland ecology						Number of credit points (CP): 6
Module type (mandatory or elective):	Elective					
Content and objective of module:	**Content:** Current challenges, advanced methods and concepts in Arid zone Research **Qualification goals:** Advanced Knowledge of current topics and research approaches Arid zone Research					
Module examination (number, form, scope):	*Written exam (120min)*					
Independent study time (in hours (h)):	90					
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)	
		For completing the module	For admission to the module exam			
Lecture on Dryland Ecology	2	-	-			
Exercise on advanced methods in Dryland Ecology	4	*Exercise Protocol (10 pages*	-			
Offered:	*Lecture in winter semester, exercise in summer semester*					
Prerequisite for taking the module	*None*					
Teaching units:	IBB, PD Dr. Blaum					
Assignable to PULS-module	BIO-O-WM1: Organismic ecology, BIO-O-WM4 Applied ecology, BIO-O-WM5 Data acquisition and analysis, BIO-O-WM6 Experimental ecology, BIO-O-WM7: Biodiversity research, BIO-O-WM8 Ecology of specific habitats I, BIO-O-WM9 Ecology of specific habitats II, BIO-O-WM11 Conservation biology					

Crop plants and domestic animals	**Number of credit points (CP): 6**
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** In this module on the one hand biodiversity, history, techniques of plant breeding and plant production, and on the other hand biology of domestic animals and animal husbandry are taught. Practical parts (e.g. excursion) are included. **Qualification goals:** The students will get an understanding of the relationship between biodiversity, cultural history and breeding progress as well as the dependence of plant production on regional climate and soil conditions. They will also have basic knowledge of the biology of important domestic animals and there husbandry. Courses with practical parts include e.g. search, presentation and discussion of scientific facts.
Module examination (number, form, scope):	*Written exam (90min)* *OR oral exam (30min)* *OR oral presentation with questioning (30min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture	3				
Seminar / practical tutorial	3				
OR lecture and seminar	6				
OR lecture and seminar and practical course	8				

For all PULS-Modules, you need to gather 6 CP. You may select lecture and seminar / practical tutorial, OR lecture and seminar, OR lecture and seminar and practional course.

Offered:	*Every year (winter semester and/or summer semester (see actual university calendar)*
Prerequisite for taking the module	*none*
Teaching units:	IBB, PD Dr. Heinken
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM 4: Applied ecology BIO-O-WM 13: Biology of plants and fungi BIO-O-WM 14: Ecology of mammals

Scientific nature conservation	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Concepts, scientific challenges and current methods of conservation biology. **Qualification goals:** In-depth knowledge of current topics, methods and research approaches of scientific nature conservation. Independent processing and presentation of a conservation-relevant scientific topic.
Module examination (number, form, scope):	*Oral exam with questionnaire (30 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture 'Scientific basis of nature conservation' ('Wissenschaftliche Grundlagen des Naturschutzes') OR	2	Passing a written or oral exam	-		
Lecture 'Implementing nature conservation' ('Angewandter Naturschutz') OR	2	Passing a written or oral exam			
Lecture and exercise ‚Biotope mapping' ('Biotopkartierung') OR	2	Passing a written or oral exam			
Lecture 'Introduction to environmental planning' ('Einführung in die Umweltplanung')	2	Passing a written or oral exam			
Current questions and methods in conservation biology / Aktuelle Themen im wissenschaftlichen Naturschutz (seminar with exercise)	4	-	-		

Note: all lectures are taught in German! *This module requires (i) the exercise with seminar ('Current questions…') and (ii) one of the lectures (or the lecture with exercise). The exercise with seminar ('Current questions…') includes a weekly seminar and a one week block exercise course.*	
Offered:	*Seminar+Exercise: summer semester; Lectures: winter semester (the entire course takes two semesters!).*
Prerequisite for taking the module	A parallel assignment of the course 'Regional and Applied Nature Conservation' is recommended.
Teaching units:	IBB, Prof. Dr. Jeltsch
Assignable to PULS-module	BIO-O-WM3, BIO-O-WM4, BIO-O-WM7, BIO-O-WM11

Regional and applied nature conservation					Number of credit points (CP): 6
Module type (mandatory or elective):	Elective				
Content and objective of module:	**Content:** Challenges and implementations of regional conservation in public authorities and non-governmental organizations. **Qualification goals:** In-depth knowledge of problems and approaches to concrete nature conservation at the regional level. In-depth knowledge for the conception, implementation and evaluation of data surveys for nature conservation purposes.				
Module examination (number, form, scope):	*Seminar paper (15 pages)*				
Independent study time (in hours (h)):	90				
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Regional aspects of nature conservation (lecture and exercise)	6	-	-		6
This course includes introductory lectures, a 3 week (minimum) internship in public conservation authorities or non-governmental conservation organization, and a final presentation workshop. ***Note: German language is required in most internships.***					
Offered:	*Every year (course takes two semesters!)*				
Prerequisite for taking the module	A concurrent assignment of the course 'Scientific Nature Conservation' is recommended.				
Teaching units:	IBB, Prof. Dr. Jeltsch, Dr. Niels Blaum				

Assignable to PULS-module	BIO-O-WM 4: Applied Ecology BIO-O-WM 7: Biodiversity Research BIO-O-WM 8: Ecology of specific habitats 1 BIO-O-WM 9: Ecology of specific habitats 2 BIO-O-WM 12: Applications of Nature Conservation

Conservation Genetics					Number of credit points (CP): 6
Module type (mandatory or elective):	Elective				
Content and objective of module:	**Lecture and practical course in conservation genetics.** **Content**: The lecture will give an introduction into Conservation Genetics. Modern methods (e.g. NGS) are likewise covered as will be concepts and problem tackling approaches in Conservation genetics. The lecture also provide information on Wildlife Forensics and modern Biobanking. The practical lab course is divided into two parts, one is the generation of data (small projects), the second one is dedicated to the analysis of data and the interpretation of results. **Qualification goals**: Students will develop a general understanding of Conservation genetics and the related problems and will learn to conceptualize and to carry out own projects.				
Module examination (number, form, scope):	*Written exam (90min)*				
Independent study time (in hours (h)):	180				
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture „Conservation genetics“	2	-	-		2
Practical course in conservation genetics	4	-	-		4
Note: this course is taught in German!					
Offered:	*Winter semester*				
Prerequisite for taking the module	*None*				
Teaching units:	IBB / IZW, Prof. Dr. Fickel				
Assignable to PULS-module	- BIO-O-WM2: Basics of ecology - BIO-O-WM3: Concepts of ecology				

	- BIO-O-WM5: Data acquisition and analysis - BIO-O-WM17: Interactions ecology, evolution, and genetics

Behavioural ecology						Number of credit points (CP): 6
Module type (mandatory or elective):	Elective					
Content and objective of module:	**Content: (1)** Basic concepts of animal ecology and behavioural ecology: heterotrophy, foraging theory, optimisation, landscape of fear, life history and ecology, applied animal ecology, effects of urbanisation, (2) a small behavioural project parallel to the lecture, (3) information on recent research in the seminar (local research and guests), (4) consolidation of selected aspects in literature seminar / conference **Qualification goals:** Concepts and Theory, experimental planning and analysis, soft skills: presentation in literature seminar, organisation of a conference					
Module examination (number, form, scope):	*Oral Exam (30min)*					
Independent study time (in hours (h)):	e.g. 90h					
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)	
		For completing the module	For admission to the module exam			
Lecture Animal Ecology with Behavioural Ecology Project in small groups	2	-	-			
Seminar Aktuelle Themen in Tierökologie und Humanbiologe	2	-	-			
Literature seminar Behavioural Ecology (Conference style: presentation of talk or poster, Blockseminar)	2	-	-			
Offered:	*Every Winter-semester*					
Prerequisite for taking the module	*none*					
Teaching units:	IBB, Prof. Dr. Eccard					
Assignable to PULS-module	e.g. BIO-O-WM1, 2, 3, 4 and 14					

Experimental animal ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Planning, conducting and analysing an ecological field project in animal ecology. Concepts and theory and literature, pilot tests, data collection, analysis with R, reports and presentations **Qualification goals:** Concepts and Theory, experimental planning and statistical analysis, presentation of results as seminar talk and report, soft skills: group projects, group organisation, time scheduling.
Module examination (number, form, scope):	*1 Report (Protocol)*
Independent study time (in hours (h)):	e.g. 30h

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
12 day Block course (2 weeks) at the Biological Station Gülpe	8	-	-		
Lectures field methods in animal ecology (during Block course)	1	-	-		
Lectures statistics in Animal Ecology (during block course)	1	-	-		

Offered:	*Every Summer semester*
Prerequisite for taking the module	*None, knowledge in statistics e.g. from Compulsory Module BIO-O-KM2 are recommended.*
Teaching units:	IBB, Prof. Dr. Eccard
Assignable to PULS-module	e.g. BIO-O-WM1, 4, 5, 6 and 14

Anthropology basics	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Anthropologische/humanbiologische Grundkonzepte in Ontogenese und Phylogenese des Menschen , Anthropologische Übung **Qualification goals:** Planung und Durchführung anthropologischer Untersuchungen Experimentelles Design, Aufarbeitung wissenschaftlicher Ergebnisse, Vortragsübung
Module examination (number, form, scope):	*Schriftlich (60 Minuten), Vortrag (15 Minuten)*
Independent study time (in hours (h)):	110

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Vorlesung Grundlagen der Humanbiologie	2			1 Klausur 60 min	3
Humanethologische Vorlesung mit Übung oder Literaturseminar	1 1			1 Vortrag 15 min 2 Vorträge 15 min	2
Anthropologische Übung aus dem Angebot der Humanbiologie	1		Praktikums-bericht		1

Note: Courses are taught in German

Offered:	*Every summer and winter semester: Grundlagen der Humanbiologie* *Every winter semester: literature seminar* *Every 2 years in winter semester: Humanethologie* *Completion of the entire course may need >1 year!*
Prerequisite for taking the module	*keine*
Teaching units:	IBB, PD Dr. Scheffler
Assignable to PULS-module	BIO-O-WM 1: Organismic ecology BIO-O-WM4: Applied ecology BIO-O-WM 14: Ecology of mammals

Anthropology advanced	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Mensch-Umwelt-Interaktion, Globale Probleme der Menschheit, Anthropologische Übung **Qualification goals:** Planung und Durchführung anthropologischer Untersuchungen Experimentelles Design, Aufarbeitung wissenschaftlicher Ergebnisse, Vortragsübung
Module examination (number, form, scope):	*Schriftlich (60 Minuten) Vortrag (15 Minuten)*
Independent study time (in hours (h)):	110

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Vorlesung Anthropografie und Humanökologie	2			1 Klausur 60 min	3
Vorlesung Humanethologie mit Übung ODER Literaturseminar	1 1			1 Vortrag 15 min 2 Vorträge 15 min	2
Anthropologische Übung aus dem Angebot der Humanbiologie	1		Praktikums-bericht		1
Note: Courses are taught in German					

Offered:	*Every winter semester: literature seminar* *Every 2 years in winter semester (alternating): Lecture „Anthropografie und Humanökologie“, and VL „Humanethologie“, respectively* *Completion of the entire course needs >1 year!*
Prerequisite for taking the module	*Grundlagen der Humanbiologie bzw. Vergleichbare Vorlesung*
Teaching units:	IBB, PD Dr. Scheffler
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM4: Applied ecology BIO-O-WM14: Ecology of mammals

Macroecology and global change	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This module provides an introduction into the field of macroecology. The participants will get introduced to concepts and methods in modern macroecological and quantitative biodiversity research. Based on a broad range of contemporary international literature, they will learn about observed and expected biodiversity response to global change, and international efforts to conserving biodiversity. In a mix of lectures and exercises, the participants will learn different macroecological analyses (e.g. for quantifying alpha and beta diversity, functional and phylogenetic diversity) and species distribution modelling. All analyses will be carried out within the R software environment. The participants will apply the gained theoretical and methodological knowledge to case studies and solve practical problems related to macroecology and global change. **Qualification goals:** • Basic understanding of macroecological concepts, spatial ecology, and quantitative biodiversity research. • Overview of concurrent international literature on global change impacts on biodiversity. • Advanced statistical skills (different statistical methods like GLM, GAM, CART), GIS functionality in R, functional and phylogenetic analyses in R • Presentation of scientific results
Module examination (number, form, scope):	*Seminar paper (15 pages) OR Oral exam (30 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Macroecology and global change (lecture and seminar)	2	-	-		2
Macroecological analyses (seminar and exercise)	2	-	-		2
Species distribution modelling (lecture and exercise)	2	-	-		2

Offered:	*Every winter semester*
Prerequisite for taking the module	*None, knowledge in statistics e.g. from Compulsory Module BIO-O-KM2 are recommended.*
Teaching units:	IBB, Prof. Dr. Zurell
Assignable to PULS-module	BIO-O-WM4 Applied Ecology BIO-O-WM11: Conservation biology BIO-O-WM12: Applications in nature conservation

Quantitative conservation biogeography	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This module provides an introduction into the field of quantitative conservation biogeography. The participants will get introduced to concepts and methods in conservation biogeography and biodiversity monitoring. In a mix of lectures and seminars on contemporary international literature, we will learn about different concepts of basic biogeography, applied island biogeography, systematic conservation planning incl. prioritization, and different monitoring approaches (e.g., standardized monitoring programmes, citizen science). The module will also teach practical applications. Specifically, the participants learn to apply occupancy modelling to account for imperfect detection in biodiversity data, and to apply spatially explicit population models for adaptive monitoring and adaptive management. All analyses will be carried out within the R software environment. The participants will apply the gained theoretical and methodological knowledge to case studies and solve practical problems related to quantitative conservation biogeography. **Qualification goals:** • Basic understanding of conservation biogeography, monitoring, and prioritization. • Overview of concurrent international literature on quantitative conservation biogeography. • Advanced statistical skills (applied hierarchical models in R), applications of metapopulation modelling for adaptive monitoring and adaptive management • Presentation of scientific results
Module examination (number, form, scope):	*Seminar paper (15 pages) OR Oral exam (30 min)*
Independent study time	90 (in hours (h))

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Conservation biogeography (lecture and seminar)	2	-	-		2
Monitoring and occupancy modelling (lecture and exercise)	2	-	-		2
Applied population modelling (lecture and exercise)	2	-	-		2

Offered:	*Every summer semester*
Prerequisite for taking the module	*None, knowledge in statistics e.g. from Compulsory Module BIO-O-KM2 are recommended. A parallel enrollment in the course 'Scientific Nature Conservation' is advantageous.*
Teaching units:	IBB, Prof. Dr. Zurell
Assignable to PULS-module	BIO-O-WM4 Applied Ecology BIO-O-WM11: Conservation biology BIO-O-WM12: Applications in nature conservation

Basic theoretical ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This course offers students an introduction to the field of theoretical ecology. The course combines lectures, to provide the foundational concepts of ecological modelling, with computer exercises that provide hands-on experience. The course will use both pen-and-paper approaches and modern simulation techniques, introducing students to a selection of programming languages (MatLab, R, Python) that are widely used in theoretical ecology and beyond. In addition to exploring the classic models in theoretical ecology, students will develop their own small research project to gain own experience in conducting modelling studies, and put everything learned in the lectures and exercises into practice. **Qualification goals:** The students are introduced to the classic models of theoretical ecology, and learn various modelling techniques for developing, analyzing and interpreting ecological models.
Module examination (number, form, scope):	*Written exam (120 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work required (CP)
		For completing the module	For admission to the module exam		
Lecture + exercises on the subject of theoretical ecology	3				
Computer lab numerical modelling: practical exercises combined with lectures and/or seminars (block course or in parallel with lectures)	3	Report (ca. 15 pages)			

Offered:	Winter semester
Prerequisite for taking the module	None
Teaching units:	IBB, Dr. Klauschies
Assignable to PULS-module	BIO-O-WM2: Basics of ecology BIO-O-WM3: Concepts of ecology BIO-O-WM15: Theoretical ecology and ecological modelling I BIO-O-WM16: Theoretical ecology and ecological modelling II

Advanced theoretical ecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This course is ideal for students interested in ecological theory. Students are introduced to advanced models and concepts in theoretical ecology, as well as state-of- the art approaches in modelling, that are highly relevant for current research. A combination of lectures and hands-on exercises are used to give students a strong grasp of the theoretical background. Advanced simulation techniques using modern programming languages (R, Python, C/C++) will be introduced and used to explore more complex and ecologically relevant models. Additionally, this course will introduce various sophisticated data analysis techniques (e.g. spectral analysis using Fourier or Wavelet analysis). Students will develop their own research project to gain own experience in conducting modelling studies, and put everything learned in the lectures and exercises into practice. **Qualification goals:** The students learn - state-of-the-art techniques for the analysis of advanced ecological models - modern methods of data analysis - methods for confronting simulated model dynamics with ecological data
Module examination (number, form, scope):	*Written exam (120 min) OR oral exam (30 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture + exercises on the subject of theoretical ecology	2-4				
Computer lab numerical modelling: practical exercises combined with lectures and/or seminars (block course or in parallel with lectures)	2-4	Report (ca. 15 pages)			

Offered:	Summer semester
Prerequisite for taking the module	It is recommended that students take the Basic Theoretical Ecology module first
Teaching units:	IBB, Dr. Guill
Assignable to PULS-module	BIO-O-WM3: Concepts of ecology BIO-O-WM15: Theoretical ecology and ecological modelling I BIO-O-WM16: Theoretical ecology and ecological modelling II

Ecological modeling with computer simulations	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Conception, implementation and evaluation of ecological computer simulation models **Qualification goals:** • Strategies and techniques of modern computer-based modeling approaches in ecology and nature conservation • Development and evaluation methods of simple ecological computer simulation models • Programming basics of modeling
Module examination (number, form, scope):	*Seminar paper (15 pages)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Programming for ecologists & Introduction to Ecological Modeling (lecture & exercise)	4	-	-		4
Advanced Ecological Modeling (lecture & exercise)	2	-	-		2

Offered:	*Winter and summer semester (course takes 2 semesters!)*
Prerequisite for taking the module	*None*
Teaching units:	IBB, Prof. Dr. Jeltsch
Assignable to PULS-module	BIO-O-WM 4: Applied Ecology BIO-O-WM 12: Applications of Nature Conservation BIO-O-WM15: Theoretical ecology and ecological modelling I

System Ecology and Evolution	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** In the lecture System Ecology (Ecology II) knowledge on the functionalities and properties of natural and anthropogenically influenced ecosystems will be intensified. The focus is on descriptions and properties of communities, factors and mechanisms influencing biodiversity, the mechanisms how biodiversity influences ecosystem functions, mechanisms determining the material and energy flows in ecosystems, the regulation of food webs, comparisons between the structure and functioning of terrestrial and pelagic ecosystems, and human ecology. The lecture „Evolutionary Biology“ covers the historical process leading to the synthetic theory of evolutionary biology as well as the general evolutionary mechanisms and micro- and macroevolutionary processes, illustrated by examples. The interactions between genotype and phenotype as well as molecular evolutionary processes are specifically addressed. Furthermore, molecular techniques applicable to evolutionary research will be introduced. **Qualification goals:** The students gain a better understanding of today's concepts in systems ecology and how and why distinct types of ecosystems function in a particular way. This theoretical foundation is used to understand causes, consequences and potential solutions of major environmental problems. They will acquire basic knowledge in evolutionary biology and will be able to understand biological phenomena in an evolutionary context. They will know the central evolutionary mechanisms and processes. They can design experiments to answer questions in molecular evolution. They will be able to use basic terms of evolutionary biology and can seek for additional knowledge in recent text books.
Module examination	*Exam on the lectures System Ecology and Evolutionary Biology (120 min)*
Independent study time (in hours (h)):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture System ecology	2	-	-		
Facultative tutorial for lecture system ecology	2				
Lecture evolutionary biology	2	-	-		
Note: the courses in this module are taught in German. The tutorial is facultative (no extra credit points!)					

Offered:	*System ecology: winter semester (Prof. Ursula Gaedke)* *Evolutionary Biology: summer semester (Prof. Ralph Tiedemann)*
Prerequisite for taking the module	None.
Teaching units:	IBB, Prof. Dr. Tiedemann / Prof. Dr. Gaedke
Assignable to PULS-module	BIO-O-WM1: Organismic ecology BIO-O-WM2: Basics of ecology BIO-O-WM3: Concepts of ecology BIO-O-WM17: Interaction ecology, evolution, and genetics

The central role of evolutionary biology in biosciences	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** "Nothing makes sense in biology except in the light of evolution.": This module aims at evaluating Dobzhansky's famous phrase by (1) a joint lecture series where different biological disciplines are discussed in the light of evolution, (2) a lecture series dealing with the major disputes/syntheses in evolutionary biology (Lamarckism vs. Darwinism, epigenetics, the modern synthesis, genotypic vs. phenotypic evolution) and a complementary seminar. **Qualification goals:** • Deepening of basic evolutionary knowledge and concepts using current examples • Familiarization with current topics through reading publications in scientific journals • Introduction to and presentation of current topics and self-developed questions and results The students work in a team and can present their results in writing and orally in accordance with scientific standards.
Module examination	*Oral exam (20min)*
Independent study time	90 (in hours (h))

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For compl-eting the module	For admission to the module exam		
Lecture or seminar on evolutionary ecology	4	-	Written exam OR during at least 90% of the appointments, the tasks / exercises specified are processed / executed and a closure report is kept, 10 Pages (exercise)		
Seminar “Integrative function of Evolutionary Biology”	1	-	Presentation (15-30 min.) and active participation in at least 90% of the appointments. Writing a standardized short protocol (max. 1 page)		
Seminar „Colloquium in evolutionary biology / genetics“	1	-	During at least 90% of the appointments, a standardized short protocol (max. 1 page) has to be written		

Offered:	*Every semester*
Prerequisite for taking the module	*None*
Teaching units:	IBB, Prof. Dr. Tiedemann
Assignable to PULS-module	BIO-O-WM18

Microevolution / Conserving the evolutionary process	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Basic principles of conservation biology and genetics will be taught in an evolutionary framework, including genetic aspects such as inbreeding and drift vs. selection and adaptation. The concept of preserving "the evolutionary process" acting in taxa and ecosystems will be covered and discussed. **Qualification goals:** • Deepening of knowledge in microevolution and species protection, including the use of molecular markers and population genetic data processing • Students can apply molecular techniques (DNA / RNA isolation, PCR, gel electrophoresis, and molecular cloning) and evaluate the data with various software programs. Familiarization with current topics through reading publications in scientific journals • Introduction to and presentation of current topics and self-developed questions and results The students work in a team and can present their results in writing and orally in accordance with scientific standards.
Module examination (number, form, scope):	*Oral exam (20min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture „Conservation Genetics“	2	-	Written exam		
Course/Exercises „Molecular population genetics/ Conservation genetics”	4	-	Presentation (20 min.) and during at least 90% of the appointments the tasks / exercises are processed / carried out, final protocol (10 pages) is written		

Offered:	*Every winter semester*
Prerequisite for taking the module	*None*
Teaching units:	IBB / IZW, Prof. Dr. Tiedemann / Prof. Dr. Fickel
Assignable to PULS-module	BIO-O-WM19

Terrestrial palaeoecology	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Students will gain an understanding of changes in ecosystems in space and time, with a special focus on the late Pleistocene and Holocene. Students learn basic methods in paleoecology and paleogenetics / environmental genetics and apply these methods in the laboratory. For this purpose, students carry out a paleoecological analysis of a lake sediment core as a case study during a two-week block course. Two methodological approaches are pursued: 1) Microscopic analyzes of pollen and diatoms, as well as of plant macro-residues, are used to analyze vegetation and diatom composition. 2) Sediments are investigated using DNA analysis (for example DNA isolation from sediments, polymerase chain reaction and gel electrophoresis), DNA sequence data are collected (or pre-existing data used) and used to identify vegetation and diatoms. Students use the results of both methods to reconstruct the history of the environment. Based on preparatory phases and small group discussions, students deepen basic skills in the production of posters and lectures. **Qualification goals:** Understanding changes in ecosystems in space and time. Knowledge of basic concepts and methods of paleoecology and paleo / environmental genetics. Introduction to methodical work with sediment cores. Deepening of the soft skills for poster creation and presentation, as well as development, preparation and presentation of a case study.
Module examination:	Creation and presentation of a scientific poster with oral presentation (15min) of course results using a case study
Independent study time (in hours (h)):	100h

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture on paleoecology	2	-	-		
Seminar	2	-	-		
Practical tutorial	2	-	-		

Offered:	*End of each winter semester (14 days / block course!).* ***Update: the block course will be from* 24.2.-6.3.2020.**
Prerequisite for taking the module	*None. Literature recommendations:* Smol et al. (ed.): Tracking Environmental Change using Lake Sediments. Vol. 1-5, Springer Trevor J. C. Beebee; Graham Rowe, An introduction to molecular ecology, Oxford University Press 2008
Teaching units:	IBB / AWI, Prof. Dr. Herzschuh
Assignable to PULS-module	BIO-O-WM1: Organismic ecology, BIO-O-WM2: Basics of ecology, BIO-O-WM3: Concepts of ecology, BIO-O-WM17: Interactions ecology, evolution, and genetics

Analysis of high-throughput sequencing data	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This module will provide students with theoretical and most importantly practical knowledge about how to handle and analyze high throughput sequencing data. Current techniques and use-cases will be introduced and discussed. The whole module will be in one two-week block course after the end of the semester in the lecture free time. Each day will start with a lecture to introduce concepts and to give the necessary theoretical foundations. The rest of the day the students will be guided through exercises to gain hands-on competences and to deepen their understanding. Work will be done on a remote Linux server using a bash terminal. Computation intensive calculations may be running over night or several days. Students are expected to have basic practical knowledge of Linux and how to use a terminal. The first day will be taken to review and deepen this knowledge. **Qualification goals:** - Professional competence How to use high-throughput sequencing approaches for research and diagnostics. - Methodological competence Basic features and use-cases of current high-throughput sequencing techniques. Nature of the produced data. How to handle and analyze big amounts of data. Current processing methods. - Hands-on competence Working on a Linux server using the terminal. Sequencing data handling. Quality control. Genome and transcriptome assembly. Mapping. Variant calling and effect prediction. Gene expression analysis. Interaction site identification. Genetic mapping. Other current processing methods.
Module examination :	*Written exam (180 min)*
Independent study time (in hours (h)):	90

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lectures	2	-	-		
Exercises	4	-	-		

Offered:	*Winter semester*
Prerequisite for taking the module	Students are expected to have basic practical knowledge of Linux and how to use a terminal.
Teaching units:	IBB, Dr. Kappel (AG Prof. Dr. Lenhard)
Assignable to PULS-module	BIO-O-WM5: Data acquisition and analysis; BIO-O-WM17: Interactions ecology, evolution, and genetics

Bioimage analysis and extended phenotyping	Number of credit points (CP): 6
Module type	Elective
Content and objective of module:	The module will provide students with a basic understanding of bioimage analysis and extended phenotyping. The students will be familiarized with basic image processing techniques and their applications in biological studies: experimental design, digitizing, segmentation, quantification and statistical analysis. Application-oriented work in regard to biological questions are central part of this module In this module, students will learn: - to apply basic bioimage analyses by using existing tools and basic programming (Python or Matlab) - to read and critically evaluate original scientific literature in English and how to extract essential points - how to resolve biological questions in a team of people with different backgrounds and competences As a result, students will be able to: - present their work to a scientific audience using appropriate media and deal with questions and/or comments in a scientific and technical discussion about their topic. - ask concise, to-the-point questions about possible future research directions to follow up a given problem. The lecture and exercise series will focus on bioimage analysis and extended phenotyping to answer current research questions. We will introduce the scientific context and the growing importance of bioimage analysis for faster, more precise and objective phenotyping. Students will learn how to apply basic bioimage techniques using existing tools and programming languages. A special emphasise will be given to current research in plant science. Researchers from the University of Potsdam and the Max Planck Institute for Molecular Plant Physiology will present their work and illustrate technical and biological challenges addressed by bioimage analysis. More current research will be discussed based on original scientific articles about current topics in either bioimage processing or applications in biological sciences. The block practical will be done by working in small groups (teams). Each group will have to answer a biological question following a complete bioimage analysis workflow (image acquisition to statistical analysis and biological discussion). Students with different backgrounds are encouraged to work together. The block practical is only open to students who followed the lecture and exercise series.
Module examination	*Written exam (180 min)*
Independent study time	90 (in hours (h)

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Lecture series	2	-	-		
Exercises	1	-	-		
Block practical	3	-	-		

Offered:	Winter semester
Prerequisite for taking the module	None
Teaching units:	IBB, Dr. Kappel (AG Prof. Dr. Lenhard)
Assignable to PULS-module	BIO-O-WM5: Data acquisition and analysis; BIO-O-WM17: Interactions ecology, evolution, and genetics

Genetic and genomic basis of evolutionary change	Number of credit points (CP): 6
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** This course examines the processes and patterns occurring at the genomic level that underpin adaptive phenotypic evolution and diversification. Lectures will cover theo-retical concepts and methods of analysis, and then show how these can be applied to genome data across a variety of recent case studies. We also carry out discussion groups among student to develop problem solving skills and provide training for the final exam. During seminars, students will discuss recent scientific papers relevant to the lecuture material. This provides opportunity for informal scientific discussion which the students can direct towards their own interests and needs. **Qualification goals:** Upon completion, students will be expected to have developed: • a solid understanding of the basic analytical methods applied by genomic stu-dies on adaptive evolution: gene trees, F-statistics, admixture tests, dN/dS ra-tios • be able to descibe and provide examples of the effects of selection on the ge-nome, including Fst outliers, incongruent gene trees, an excess of non-synonymous substitutions and selective sweeps • exposure to the primary scientific literature, and an ability to understand, in-terpret and comment on genomics research articles • Have an appreciation of how to design experiments to test evolutionary hypo-theses using genomic approaches, considering things like sample size and da-ta requirements
Module examination (number, form, scope):	Eine Prüfung der folgenden Formen: Klausur (90 Min.)
Independent study time (in hours (h)):	120 Stunden

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Vorlesung	30h/2SWS	-	50% tests & Hausaufgaben		Vorlesung
Seminar	30h/2SWS	-	-		Seminar

Häufigkeit des Angebots:	Summersemester
Voraussetzung für die Teilnahme am Modul:	-
Anbietende Lehreinheit(en):	IBB, Dr. Barlow / AG Adaptive genomics (Prof. Dr. Hofreiter)
Assignable to PULS-module	BIO-O-WM17: Interactions ecology, evolution, and genetics

4.3 Electives (6LP) from Area B

The course content of electives from area B is administrated by other institutes and departments at the Faculty of Science (e.g. physics, mathematics, geoecology).

Please search the PULS system using the respective module abbreviation to find detailed information about the actual course content.

4.4 Electives (specialization modules, 12 LP)

BIO-O-VM1: Plankton ecology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** The students will be introduced to their tentative Master project by running preliminary experiments and by learning biological, chemical and mathematical analyses. The writing of a scientific protocol will be taught as well.
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial Plankton Ecology	180	-	-	-	12

Offered:	Every semester
Prerequisite for taking the module	Recommended is knowledge of 12 LP on aquatic ecology
Teaching units:	IBB, PD Dr. Weithoff

BiO-O-VM2: Animal ecology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Gaining experience in animal ecology research, data collection, literature research, reports and analysis **Qualification goals:** Reporting, communication, time scheduling
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial „Scientific Work in Animal Ecology and Human Biology"	2	-	-	-	12

Offered:	Every semester
Prerequisite for taking the module	Knowledge in statistics e.g., from compulsory module 2 is recommended.
Teaching units:	IBB, Prof. Dr Eccard

BIO-O-VM3: Human biology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Introduction and theoretical orientation phase to scientific work of a concrete project, which is based on ongoing human biological research work **Qualification goals:** literature research, different methods of data collection and statistical evaluation of the results, Presentation of scientific results
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial Humanbiological research	360h, supervised: 75h	-	-		12

Optional: Research on human beings requires compliance with data protection and ethical rules , participate on the working group seminar (e.g. Scientific work in Animal ecology and Human biology)

Offered:	*Every semester*
Prerequisite for taking the module	Modul: Anthropology basic or advanced
Teaching units:	IBB, PD Dr. Scheffler

BIO-O-VM4: Ecological microbiology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** The module provides in-depth knowledge of ecological microbiology. The students work on current research topics of the working group. Topics in the field of toxic freshwater cyanobacteria, terrestrial symbiotic cyanobacteria or methanogenic archaea can be selected. In particular, the role and diversity of cyanobacterial secondary metabolites is being explored. The student learns and deepens molecular biology techniques for the analysis of complex environmental samples (DNA and RNA analysis), metagenome analyzes, fluorescence microscopy techniques and chemical analysis (HPLC and mass spectroscopy). The student participates in seminars of the working group and learns to interpret research data in the field of ecological microbiology, to critically question them and to develop their own research approaches. **Qualification goals:** 4) Scientific competences Students - Have a basic understanding of molecular microbial techniques - Have basic skills in microscopic techniques - Have a basic understanding of chemical analytics using HPLC and mass spectrometry - Have a specific knowledge about the physiology of cyanobacteria or methanogenic archaea - Have bioinformatic skills in microbial genome and metagenome analysis 5) Method competences Students - Know to develop strategies for the analysis of microorganisms in their habitats aimed to understand their metabolic roles - Know principal techniques for the analysis of microorganisms in situ and of microbial communities - Can develop and compare alternative strategies for the analysis of microorganisms and microbial communities and can estimate advantages and disadvantages of techniques - Can put experimental data obtained during a practical course into a broader scientific context and critically discuss their scientific insights - Can relate experimental data to roles of microorganisms in a habitat-specific or metabolic context 6) Action competences Students - Can present scientific contents related to microbial ecology in an oral or written form - Can design experiments related to microbial ecological questions - Can develop strategies to work on complex problems in collaboration with partners - Utilize feedback provided in scientific discussions or after presentations to improve their work and its interpretation - Can perform experiments according to safety rules in microbial laboratories
Module examination	*Protocol, 15 pages, not graded*

(number, form, scope):	
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial Ecological Microbiology	360h, supervised: 75h	-	-	-	12

Offered:	*Every semester*
Prerequisite for taking the module	*Recommended is knowledge on basic Molecular Biology and Microbiology*
Teaching units:	IBB, Prof. Dr. Dittmann

BIO-O-VM5: Microbial ecology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** Realization of a small research project, including data analysis, interpretation and documentation. Introduction into the principles of scientific research by carrying out a specific project which is closely related to current research topics in the field of microbial ecology. While the participants are encouraged to contribute to the selection of their project topics, the focus of this module is a practical and experimental approach on subjects related to microbial ecology. **Qualification goals:** The participants - are aware of the strategies and methods to tackle scientific questions in the field of microbial ecology. - are provided with the skill set to connect different stages of scientific work (from the early planning of the project to final documentation of the results), which has been conducted independently by the students. - know how to acquire knowledge through literature study and self-responsible data analysis as well as, how to document and present their results and the ones of others in a scientific way. - get an idea about the work in a scientific research group
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial	360h, under supervision: 75h	-	Oral presentation (20min)	-	12

Offered:	Every semester
Prerequisite for taking the module	None
Teaching units:	IBB / GFZ; Prof. Liebner

BIO-O-VM6: Biodiversity of land plants and fungi	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content and qualification goals:** - Scientific work on a special project - Theoretical orientation and project planning - Independent data collection and analysis - Realization of literature search Documentation and presentation of scientific results
Module examination (number, form, scope):	*Protocol, c. 15 pages, not graded*
Independent study time (in hours (h)):	240

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Practical tutorial: realization of a specific scientific project	8	-	-	-	12

Offered:	Every semester
Prerequisite for taking the module	Knowledge of basics of botanical structures and taxa
Teaching units:	IBB, Dr. Kummer

BIO-O-VM7: Geobotany	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** In this module a concrete research project in geobotany is conducted. **Qualification goals** Strategies and methods to work on scientific questions in the field of geobotany. Students learn to deal with the different phases of a concrete research project (from planning over data collection and data analysis to documentation of the results) both self-contained in in exchange with a scientific working group.
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project		-	-	-	12

Offered:	Every semester
Prerequisite for taking the module	Recommended is knowledge on vegetation ecology and/or geobotany, from module Vegetation Ecology of Central Europe, Geobotany, Plant Ecology, Ecology of the Mediterranean vegetation, or Taxonomy and biodiversity of fungi and lower plants
Teaching units:	IBB, PD Dr. Heinken

BIO-O-VM8: Methods in conservation biology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** Advanced methods and knowledge of current research in the field of modern conservation biology. **Qualification goals:** Independent practical and science-based processing of a biological nature conservation problem.
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project	8	-	-	-	12

*Optional: comments (pls keep short!)**

Offered:	Every semester
Prerequisite for taking the module	Successful completion of at least one of the following modules BIO-O-WM11: Conservation biology or BIO-O_WM12: Applications of nature conservation
Teaching units:	IBB, Prof. Dr. Jeltsch

BIO-O-VM9: Modelling in plant ecology and nature conservation	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** Advanced methods and knowledge of current research in the field of ecological modeling. **Qualification goals:** Independent practical and science-based processing of a plant-ecological or nature conservation problem by means of computer modeling.
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project	8	-	-	-	12

Offered:	Every semester
Prerequisite for taking the module	Successful participation in the module BIO-O-WM15 Theoretical Ecology and Ecological Modeling I or BIO-O-WM16 Theoretical Ecology and Ecological Modeling II
Teaching units:	IBB, Prof. Dr. Jeltsch

BIO-O-VM10: Arid-zone research	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content** Advanced methods and knowledge of current research in arid zone research. **Qualification goals:** Independent practical and science-based processing of a challenge or problem in arid zone research.
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project	8	-	-	-	12
…					

Offered:	Every semester
Prerequisite for taking the module	Recommended is knowledge on arid zone research / dryland ecology or conservation biology (e.g. lecture, seminar and practical work offered at IBB)
Teaching units:	IBB, PD Dr. Blaum

BIO-O-VM11: Data analysis, modelling, and theory in community ecology	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Content:** The module focusses on practical training (6 weeks as a block or after agreement/ content requirements). It will be based on a small research project, includes a written protocol and contains: • Theoretical familiarization phase, literature research • Introduction to scientific work based on a concrete project, which is based on current research issues. • Methods of data analysis, including the development of statistical models and /or simulation models based on ordinary differential equations • Preparation of a final scientific report **Objectives:** 1. Subject-specific competencies: The students: • show a deeper understanding of theoretical ecological concepts and their implementation in mathematical and / or statistical models, • have a good understanding of the integration of more comprehensive ecological data into models, calibration and validation of models, • can develop model projections and critically reflect their ecological meaningfulness and reliability, • have learned a conceptual and hypothesis-driven way of thinking in research. 2. Methodological competencies The students: • are able to understand ecological relationships, to develop new insights and to interpret them adequately, • master the theoretical basics in order to develop new, own questions and to • implement them in (simulation) experiments, • can apply their acquired knowledge to solve given problem tasks, • can deal with ecological models, translate scientific facts into mathematical equations and analyse the resulting systems with mathematical, statistical and/or graphical methods, • are able to abstract general concepts and mechanisms from complex issues and relationships, • gain initial experience in programming with leading statistical and analytical software(e.g. using R, Matlab), • can statistically evaluate results and document them in a scientific protocol. 3. Personal competencies The students: • are able to independently work on scientific issues by identifying the essential information of tasks, structuring them, and derive appropriate conclusions. • are able to present ecological facts in a concise form verbally and written. • make use of the availability of up-to-date original literature to classify their own • hypotheses and answers. Are able to use up-to-date statistical and analytical software
Module examination	*Protocol, not graded*
Independent study time	285 (in hours (h))

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For com-pleting the module	For admission to the module exam		
Practical training	360h, of which 75h are supervised	-	Protocol	-	12

Offered:	Every semester
Prerequisite for taking the module	Both core modules
Teaching units:	Module responsible: Prof. Dr. Gaedke Execution: Prof. Dr. Gaedke, Dr. Christian Guill, Dr. Toni Klauschies, Dr. Ellen van Velzen

BIO-O-VM12: Evolutionary biology (alternative A)	Number of credit points (CP): 12
Module type (mandatory or elective):	Elective
Content and objective of module:	**Note: BIO-O-VM12 can be completed in two alternative ways, A and B. See below for the contents of alternative B.** **Content** Introduction to scientific work based on a defined project. Either modeling or empirical / experimental methods can be used. **Qualification goals:** Mediated subject-specific qualifications: Based on a defined project, the module conveys strategies and methods for dealing with scientific questions in evolutionary biology research. The students learn to combine the different phases of a specific scientific work (from planning to documentation) and to work independently. Mediated key qualifications: research, independent editing, documenting, presenting, discussing and scientific writing of specially processed and foreign scientific facts
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project	360h, 75h are supervised	-	-	-	12

Offered:	*Every semester*
Prerequisite for taking the module	"The knowledge required for the proper and safe conduct of laboratory equipment must be available for admission to the experimental part. Hence, the elective module BIO-O-WM19: *Microevolution/Conserving the evolutionary process* is a prerequisite, if the specialization module contains experimental work. Otherwise: No prerequisite
Teaching units:	IBB, Prof. Dr. Tiedemann

Evolutionary Biology (alternative B)	**Number of credit points (CP): 12**
Module type (mandatory or elective):	Elective
Content and objective of module:	**Note: BIO-O-VM12 can be completed in two alternative ways, A and B. See above for the contents of alternative A.** **Components of the module**: • Carrying out of a small research project including • Data acquisition, evaluation and analysis and • written final report Either 6 weeks en bloc or two days per week per semester **Content and objective** The students will be introduced to organise project work (planning, ordering, executing) based on a real (currently running) research project. This may include both modelling approaches and/or experimental/ empirical methods. **Professional knowledge acquired** Using real (currently running) scientific projects the module teaches strategies and methods applied in evolutionary ecological research. The students will learn how to link the different phases of a project (from planning/data acquisition/analysis to documentation and presentation) and to work on them by themselves. **Key knowledge acquired** Working independently on different phases of a research project, following good scientific practise, interpretation and presentation of one's own results and discussion of results of others (published articles).
Module examination (number, form, scope):	*Protocol, 15 pages, not graded*
Independent study time (in hours (h)):	285
Note: this course is taught in German!	

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related (partial) module examinations (number, form, scope)	Total work require (CP)
		For completing the module	For admission to the module exam		
Implementation of a research project	360h, supervised: 75h	-	-	-	12

*Optional: comments (pls keep short!)**	
Offered:	*Winter semester*
Prerequisite for taking the module	*None*
Teaching units:	IBB / IZW, Prof. Dr. Fickel

a. Facultative courses

Actual topics in Aquatic Ecology: Continuous seminar (winter and summer semester) on the ecology and ecological modelling of (mostly aquatic) food webs. Teaching unit: IBB/Prof. Dr Gaedke.

Seminar on Theoretical Ecology (Seminar zur Theoretischen Ökologie): Seminar on ecological theory and modelling. Strong interest in mathematical models is recommended. Teaching unit: IBB/Prof. Dr. Gaedke.

Seminar on Current Topics in Biodiversity research (Oberseminar Aktuelle Themen der Biodiversitätsforschung). Teaching unit: IBB/PD Dr. Weber.

Field course in “Feldornithologie” (Freilandkurs in der Biologischen Station Gülpe). Teaching unit: IBB/Prof. Dr. Eccard.