EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Module handbook

Biodiversity, Ecology and Evolution
Master of Science

Valid from Winter Term 2024/25

Faculty of Sciences
Department of Biology
Institute for Evolution and Ecology

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Contents

1 Programme overview

The diversity of the biosphere is shaped by selection and evolution in complex and dynamic environments characterised by a complex mix of biotic and abiotic agents. Since the start of the Anthropogenic Era, it faces accelerating, large-scale anthropogenic changes in land use, pollutants, biological invasions and climate. Students of the Master of Science in "Biodiversity, Ecology and Evolution" develop an in-depth understanding of the processes and service functions associated with biodiversity from molecular to global scales. They can quantify diversity in genes, morphology, behaviour, or community composition and link it with biological function and ecosystem stability. With this integrative view, students learn to predict ecological and anthropogenic effects on biodiversity, and to design, conduct and analyse rigorous empirical investigations under laboratory and field settings. Furthermore, BEE M.Sc. students strengthen their skills to communicate their findings and to contribute actively to ongoing societal debates.

Admission requirements

For admission to the M.Sc. degree in Biodiversity, Ecology and Evolution, a B.Sc. degree in biology with a grade of 2.50 or better (German scale equivalent) is required. This degree is designed to run entirely in English. Students can choose to add German courses to their elective module. Proof of English language proficiency at level B2 and German language proficiency at level A2 of the European Framework of Reference for Languages must be supplied. Further details can be found on the website of the Department of Biology.

Study aims

The *Master in Biodiversity, Ecology and Evolution* programme is designed for a duration of four semesters (120 ECTS credits). Specifically, the program focuses on the study, complexity, function, interactive nature and ecological service of organismal diversity in environments under varying degrees of human impact. The programme trains students in dealing with ecological and biological complexity both from a short-term, local, and a long-term, global perspective. It fuses top-down and bottom-up approaches in the study of plasticity, adaptability, evolvability, functionality, resilience, facilitation, and conservation at levels ranging from ecosystems down to populations and their genetic and molecular diversity.

Successful graduates will:

- be able to formulate and justify scientific questions, derive relevant research hypotheses from existing theory and empirical evidence, test them with well-defined replicable observations, structural, behavioural, physiological, biochemical or molecular analyses under laboratory or field conditions, and connect them with theoretical models where feasible.
- learn the relevance of responsibility, trustworthiness, and constructive criticism for good scientific practice and can reflect and integrate these elements into their own scientific projects. This includes the ability to identify key elements of clarity in scientific communication and their application to their own oral presentation and writing assignments in professional English.
- receive qualification for careers in research- or application-related positions in a variety of international academic and (non-)governmental institutions and organisations, as well as in private enterprises and industry that rely on profound and integrative knowledge in ecology,

ecotoxicology and evolution, taxonomic expertise in botany and zoology, and the mastery of associated field, laboratory, statistical, imaging, and other computing methods.

- improve their fluency in English, offering native German students a bilingual advantage in the rapidly increasing number of international working environments in Germany.

2 Curriculum

The programme is split into different *Modules* that convey the competences required to successfully complete the programme and enable working in modern research. Some of these modules are *compulsory* while others are *elective*. The topic of the Master thesis is, of course, a free choice[1]. Each *Module* has a certain weight given in ECTS that depends on the contact hours and the time spent into individual self-reliant course work. One ECTS credit point equals a workload of about 30 hours (contact hours + self-reliant work + preparations for the exam). Each year of studies usually yields 60 credits. Module details can be found in the electronic course catalogue ALMA.

2.1 Overview by Modules

Module number	Compulsory/ elective	Module name	Recommended semester	CP
BEE-001	c	Biodiversity	1	6
BEE-002	c	Evolution	1	6
BEE-003	c	Ecology	2	6
BEE-004	c	Scientific communication	3-4	6
BEE-005	c	Biostatistics II	3	6
BEE-006	c	Concepts	1-3	12
BEE-007	c	Applications	1- 3	12
BEE-008	c	Field work	1-3	12
	e	Interdisciplinary Study Area	1-4	24
BEE-100	c	Master's thesis	4	30
			total[2]	120

[1] The topic must be biodiversity, ecology or evolution related
[1] at least 60 CP must be achieved before candidates can be admitted to the master thesis
[2] up to 30 additional credits can be listed in the transcript but will not affect the final grade

2.2 Overview by Study Progress

Semester	Total CP	Module number	compulsory elective	Module name	CP
1	30	BEE-001	c	Biodiversity	6
		BEE-002	c	Evolution	6
		BEE-006	c	**and/or** Concepts	
		BEE-008	c	**and/or** Field work	18
			c	**and/or** Interdisciplinary Study Area	
				$\sum$	30
2	30	BEE-003	c	Ecology	6
		BEE-006	c	**and/or** Concepts	
		BEE-007	c	**and/or** Applications	24
		BEE-008	c	**and/or** Field work	
			c	**and/or** Interdisciplinary Study Area	
				$\sum$	60
3	30	BEE-004	c	Scientific communication	6
		BEE-005	c	Biostatistics II	6
		BEE-007	c	**and/or** Applications	18
			c	**and/or** Interdisciplinary Study Area	
				$\sum$	90
4	30	BEE-100	c	Master's thesis[1]	30
				total[2]	120

[1] at least 60 CP must be achieved before candidates can be admitted to the master thesis
[2] up to 30 additional credits can be listed in the transcript but will not affect the final grade

2.3 Compulsory modules

2.3.1 Biodiversity

This course offers a broad overview of key questions and findings but also gaps and challenges in current biodiversity research. The topics covered include methods for studying biodiversity at different levels and scales; taxonomic versus functional diversity; large-scale biodiversity patterns and trends; key initiatives in biodiversity monitoring and politics; importance of biodiversity for ecosystems and human life.

Objectives

Students are able to critically discuss the importance of biodiversity as well as some of the gaps and future directions in biodiversity research by knowing key findings, important data sources and methods for studying biodiversity and being able to identify challenges in quantifying biodiversity. This leads them to an up-to-date overview of current biodiversity research.

Study aims

This module provides knowledge about

- Structural and functional diversity: functional traits in plants and animals, their mechanistic understanding and ecological meaning.
- Global biodiversity and trends across time, scales, and geographic gradients.
- Integrative taxonomy, systematics and phylogenetic diversity.
- Niche divergence, trait-based approaches, adaptive and non-adaptive radiation.
- Functions and services.
- Threats to biodiversity and national and international initiatives in biodiversity monitoring and conservation.

BEE-001	**Biodiversity**		
Category	compulsory		
ECTS Credits	6		
Workload	180 h	attendance: 60 h (4 class hours)	private study: 120 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, seminar, exercises, field course, lab course		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and exercises, field course and lab course **Assessment:** Written exam		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. O. Betz		

2.3.2 Evolution

Micro- and macroevolution, neutral and adaptive processes, evolutionary potential, future change. The module provides in-depth understanding of fundamental mechanisms of evolution. Students learn to identify and interconnect the specific effects of microevolutionary mechanisms. They learn the core principles of population genetics and quantitative genetics. They broaden their knowledge by reading and discussing original literature in English They apply the in-depth knowledge gained for the exemplary analysis of population genetic data in the practical course. Students learn selected phylogenetic methods based on morphological and molecular biological data. They are trained in the use of the necessary software and apply it exemplarily in the practical course.

Study aims

Students will

- understand the mechanisms of microevolution and their actions and interactions. They understand why populations are the central evolving entities and can derive how within and between population differentiation leads to macroevolutionary processes, such as speciation and extinction.
- be able to distinguish between speciation processes, understand the principles of population and quantitative genetics and phylogenetic tree reconstruction. They understand the principles of character reconstruction, character evolution, and character correlation.

BEE-002	**Evolution**		
Category	compulsory		
ECTS Credits	6		
Workload	180 h	attendance: 60 h (4 class hours)	private study: 120 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, seminar, exercises		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and exercises **Assessment:** written exam		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. K. Foerster		

2.3.3 Ecology

This course trains students in a range of (predominantly) field methods for quantifying biodiversity, understanding ecological interactions and species coexistence, and human-induced changes in ecosystem functioning in natural populations. Students work in teams to collect data and test eco-evolutionary hypotheses. The course has a strong fieldwork component, combined with some theory and data analyses.

Study aims

Students will

- be familiar with a range of methds for studying biodiversity and ecological processes in the field.
- know how to develop and formulate hypotheses based on theory and observation, and how to collect data to answer these hypotheses.

BEE-003	**Ecology**		
Category	compulsory		
ECTS Credits	6		
Workload	180 h	attendance: 60 h (4 class hours)	private study: 120 h
Duration	1 term		
Cycle of offer	Each summer term		
Language	English		
Format	Lecture, seminar, exercises, field course, project		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar, exercises and field course **Assessment:** oral or written exam		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. O. Bossdorf		

2.3.4 Scientific communication

The module delivers the key elements of proper scientific conduct (e.g., the importance of peer review, requirements for well-organized and FAIR data management, objective data and results interpretation) as well as best practice for structure and style in oral and written scientific communication. It guides students how to practically apply the acquired knowledge to public presentations about their M.Sc. thesis and a writing assignment in the context of their thesis.

Study aims

Students will

- understand the relevance of responsibility, trustworthiness, and constructive criticism for good scientific practice in order to reflect and integrate these elements into their own scientific projects.
- be able to identify key elements of clarity in scientific communication and apply these to their own presentation and writing assignments.

BEE-004	**Scientific communication**		
Category	compulsory		
ECTS Credits	6		
Workload	180 h	attendance: 60 h (4 class hours)	private study: 120 h
Duration	1 term		
Cycle of offer	Each term		
Language	English		
Format	Lecture, seminar, exercises		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and exercises **Assessment:** Essays		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Dr. N. Anthes		

2.3.5 Biostatistics II

Students learn current methods in the statistical analysis of biological experiments and observations. This includes, among others, a short introduction to the principles of experimental planning and design, power analysis, generalized linear models (GLM) and linear mixed models (LMM), model selection, survival analysis, multivariate statistics and permutation tests. Students apply this knowledge in the practical course in performing exercises with the support of the relevant statistical software and reporting their results in written form.

Study aims

Students will

- have an overview of the advanced statistical methods currently used in evolution and ecology research and are able to apply these methods independently with the support of relevant software.
- be able to make an independent decision as to which statistical method is suitable for analysing a particular data set.
- understand the basic principles of project planning and experimental design.

BEE-005	**Biostatistics II**		
Category	compulsory		
ECTS Credits	6		
Workload	180 h	attendance: 60 h (4 class hours)	private study: 120 h
Duration	1 term		
Cycle of offer	Each winter term		
Language	English		
Format	Lecture, seminar, exercise		
Requirements	Basic knowledge in biostatistics, comparable to the contents of the ”Biostatistics I” module for B.Sc. Biology students at the Institute of Evolution and Ecology.		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and exercises **Assessment:** written exam		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. K. Tielbörger		

2.3.6 Concepts

In-depth training in how to develop concepts and theories, aided by a choice of mathematical and computer-based modelling and analysis techniques where appropriate. Students strengthen the conceptual foundation of their Master Thesis project. Students can choose courses for a total of 12 CP from a selection that is explicitly earmarked for this module in alma.

Study aims

Students will

- know how to derive expectations and hypotheses from first principles and can use this skill to produce novel and testable working hypotheses.

BEE-006	**Concepts**		
Category	compulsory		
ECTS Credits	12		
Workload	360 h	attendance: 120 h (8 class hours)	private study: 240 h
Duration	1-2 terms		
Cycle of offer	Each term		
Language	English		
Format	Lecture, seminar, lab course		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and lab courses **Assessment:** depending on the selected courses		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. N. Michiels		

2.3.7 Applications

In-depth training in advanced methodology in biodiversity, ecology, ecotoxicology, evolution and data analysis. Students can choose courses for a total of 12 CP from a selection that is explicitly earmarked for this module in alma.

Study aims

Students will

- sharpen their profile as a young researcher and gather professional expertise in practical / methodological approaches for their Master Thesis, improving their career perspectives.

BEE-007	**Applications**		
Category	compulsory		
ECTS Credits	12		
Workload	360 h	attendance: 120 h (8 class hours)	private study: 240 h
Duration	1-2 terms		
Cycle of offer	Each term		
Language	English		
Format	Lecture, seminar, lab course		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular attendance of all lectures, active participation in the seminar and lab courses **Assessment:** depending on the selected courses		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Prof. Dr. H.-R. Köhler		

2.3.8 Field work

Field courses deliver state-of-the-art tools for biodiversity surveys and in situ investigations of ecological processes. The focus can be on organismic groups including species identification techniques, on communities and ecological function in defined biomes or habitats, on natural and anthropogenic drivers of environmental change, or on hypothesis-driven experimental work. Typical courses deliver competences in study design, data collection, data analysis and results reporting.

Study aims

Students will

- learn how to handle the complex requirements of collecting quantitative, qualitative or experimental data under spatially and temporally varying field conditions to describe patterns and processes in biodiversity, ecology and evolution.
- be able to develop field study approaches that provide data at high standards.
- train methods to extract core findings from the often complex and extensive field data, carefully differentiating between correlation and causality when interpreting their results.

BEE-008	**Field work**		
Category	compulsory		
ECTS Credits	12		
Workload	360 h	attendance: 120 h (8 class hours)	private study: 240 h
Duration	1-2 terms		
Cycle of offer	Each term		
Language	English		
Format	Field courses, seminar		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** regular and active participation in the seminar and field courses **Assessment:** depending on the selected courses		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Dr. N. Anthes		

2.3.9 Interdisciplinary master module

The students should expand their studies in the direction of other disciplines to round up their chosen fields of work. Here, it should be taken into account that the subject of biology is diverse and has many interrelationships with other disciplines. The students can choose any course offered by the University of Tübingen. In cases where students have no background in key approaches (e.g. statistics), students are allowed to take up to 12 CP of introductory courses offered to 3rd-year B.Sc. degree.

Study aims

Students will

- acquire interdisciplinary skills with a broad qualification profile, which enables them to independently develop their professional interests and to take advantage of offers from the widest possible spectrum of fields of application

BEE-009	**Interdisciplinary master module**		
Category	compulsory		
ECTS Credits	24		
Workload	720 h	attendance: depending on the selected courses	private study: depending on the selected courses
Duration	1-2 terms		
Cycle of offer	Depending on the selected courses		
Language	English		
Format	Lecture, seminar, exercise, excursion, practical		
Requirements	none		
Assessment and grading	**Non-assessed coursework:** depending on the selected courses **Assessment:** depending on the selected courses		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Dean of academic affairs		

2.3.10 Master's thesis

In the thesis, the students work independently on a given research project They acquire new data, exploit and interpret their results, design clear and informative figures and write a clear and concise thesis. The results should contribute to the gain of knowledge of the scientific community.

Study aims

Within the Master's thesis students will show that they

- can acquaint themselves with complex scientific questions in a given time and are able to make suggestions to solve scientific problems.
- they are able to find and apply suitable methods to answer scientific questions
- they are able to work in a team in an international scientific environment and participate in lab meetings/progress report
- they are able to present their results to an international scientific community
- they are able to write clear and concise research texts

BEE-100	**Master's thesis**		
Category	compulsory		
ECTS Credits	30		
Workload	900 h	attendance: 30 h (2 class hours)	private study: 870 h (independent lab work and writing)
Duration	1 term		
Cycle of offer	Each term		
Language	English		
Format	Final thesis, progress report		
Requirements	The following modules must be finished before thesis submission: Biodiversity, Evolution, Ecology, Scientific Communication and Biostatistics II.		
Assessment and grading	**Non-assessed coursework:** oral presentation of their research results **Assessment:** written thesis		
Usability	Master of Science Biodiversity, Ecology and Evolution		
Module coordination	Supervisor of the thesis		

2.4 Required elective modules

With the *required elective modules* the following general rules apply:

1. At maximum 12 ECTS may be ungraded.
2. Only courses from the course catalogue of the University of Tübingen, or foreign universities in the context of an official semester abroad (e.g. via Erasmus) can be credited.
3. External courses such as internships in external laboratories, companies etc. **can not** be credited.
4. Modules already listed in the B.Sc. transcript **can not** be credited.
5. Up to 30 additional ECTS can be listed in the transcript of records. They will **not** affect the final grade, though.

2.5 Interdisciplinary Study Area (24 CP)

In this field of study, students can extend their studies in the direction of other disciplines to round off their chosen fields of work. Students can choose any course offered by University of Tübingen. In cases where students have no background in key approaches (e.g. statistics), students are allowed to take up to 12 CP of introductory courses offered to 3rd-year students of the B.Sc. Biology degree. Details on the contents of the courses and modules can be found in the module handbook of the respective degree programme and on alma.

3 Contact & Information

General Information about the programme

Website of *Master in Biodiversity, Ecology and Evolution* programme

Application

Online via the Alma portal of the Universität. Application deadline: 15th July.

Study coordinator

Prof. Dr. Nico Michiels

Academic adivsory service

Dr. Matthias Stoll, Studiendekanat

Transcript, Certification

Examinations office, Biology

Enrolling/Changing of the subject, granting of a leave

Student administration

Informal information about studying biology, help and hints

Study body of the department of Biology: www.fsbiotuebingen.de