Fakultät für Umwelt und natürliche Ressourcen
Faculty of Environment and Natural Ressources

Module handbook / Modulhandbuch

Master of Science (M.Sc.)
Umweltwissenschaften/Environmental Sciences

Summer semester 2025

(Examination regulations version 2023)

universität freiburg

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Prolog

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Prologue

This module handbook contains the modules and associated courses of the 2nd semester of the MSc Environmental Sciences. Before going into the individual modules, you will first find a general description of the degree program in this prologue.

Content Prologue

1. Short Profile

Subject	Environmental Sciences
Degree	Master of Science
Study duration	4 semesters / 2 years
Study format	Full-time
Scope	120 ECTS
Faculty	Faculty for Environment and Natural Resources
University	Albert-Ludwigs-University Freiburg
Website	https://www.msc-umwelt.uni-freiburg.de/en

Language(s)	German and English – or English only
Admission requirements	■ B.Sc. Graduation with a grade average of at least 2.5 (German grade) ■ Background in environmental sciences, forestry or related ■ Language English level B2 or C1 (depending on major) ■ Proof of academic requirements relevant for the major (Information on the website)
Start of study	Winter semester
Version examination regulation	Last version of the examination regulation: PO 2023
Special features	5 majors as main focus areas: ■ Landnutzung und Naturschutz (mostly German) ■ Climate Change Ecology ■ Environmental Modelling and Data Sciences ■ Sustainability Assessment and Transformation ■ Wildlife and Biodiversity

2. Objective of the study programme

The Master of Environmental Sciences provides an in-depth education in the field of environmental sciences. The spectrum of the course content ranges from basic ecosystem interrelationships and current issues of ecological change to technical and socio-economic strategies for the preservation, adaptation and restoration of an intact environment. Central importance is attached to the guiding principle of sustainability in dealing with the environment and natural resources.
The acquired and deepened knowledge can be applied and further developed within the framework of practice-oriented modules to solve environmental problems at regional, national and international level.
The aim is to familiarize students in this way with the theoretical knowledge and practical skills that are indispensable in the broad spectrum of possible fields of work of environmental scientists in science and practice.

3. Five Majors as focus areas

Students choose one of the five majors as their focus and can also individualize their studies with electives and a compulsory internship.

1) Landnutzung und Naturschutz (taught in German, partly English)
Students learn about different natural and social science approaches to understanding and evaluating the use and protection of nature and landscapes in their complexity.

2) Climate Change Ecology
Climate Change Ecology studies the impact of climate change on terrestrial ecosystems at local, regional and global scales. Both the meteorological and climatological causes of anthropogenic climate change and the impact on biogeochemical cycles are critically analysed. Hands-on laboratory and field-based approaches are used to quantify stress-induced changes in plants and ecosystems. The aim is to gain in-depth knowledge on alterations of important ecosystem processes, such as carbon or water cycles. Finally, an introduction to earth system modelling approaches addresses these processes at larger scales.

3) Environmental Modelling and Data Sciences
This major aims at equipping the students with a wide and relevant range of computer-based skills to address research and application challenges in environmental science. Ever-larger data sets from automatised data collections (remote sensing, omics) and large research and public data collections (weather stations, iNaturalist, ebird) require appropriate data science and modelling competences. As these methods are in constant flux, the profile Environmental Modelling and Data Science (EMDS) develops fundamental skills in statistics and programming and combines them with concrete studies and analyses.

4) Sustainability Assessment and Transformation
This major is a new interdisciplinary track for students who want to build a solid scientific basis for addressing topical sustainability questions. You will become an expert in cutting-edge sustainability assessment tools, including material and energy flow analysis, cost benefit analysis, life cycle assessment (LCA), and legal analysis! You will engage in world-class training in systems thinking, critical thinking, and analytical thinking on the above questions. You will learn how to apply models and develop indicators to evaluate innovative business, technical, infrastructural, regulatory, policy, and behavioural solutions for a sustainable future.

5. Wildlife and Biodiversity
Understanding the ecology and conservation biology of Wildlife and biodiversity with a focus on terrestrial ecosystem is the aim of this major. It's targeting on ecological research in a conservation context, but is also aiming at students interested in the interface between science and its application. Therefore, module contents range from theory and research methods to field work, data analysis and scientific writing.

4. Structure

A total of 120 ECTS must be earned in the MSc Environmental Sciences. These are divided into core modules (15 ECTS), major modules (50 ECTS), electives 15 ECTS), an internship (19 ECTS) and a Master's thesis (30 ECTS).

1) Core modules:
Three core modules (15 ECTS) are compulsory for all students. They are offered in the first and third semesters. All modules here are taught in English language.

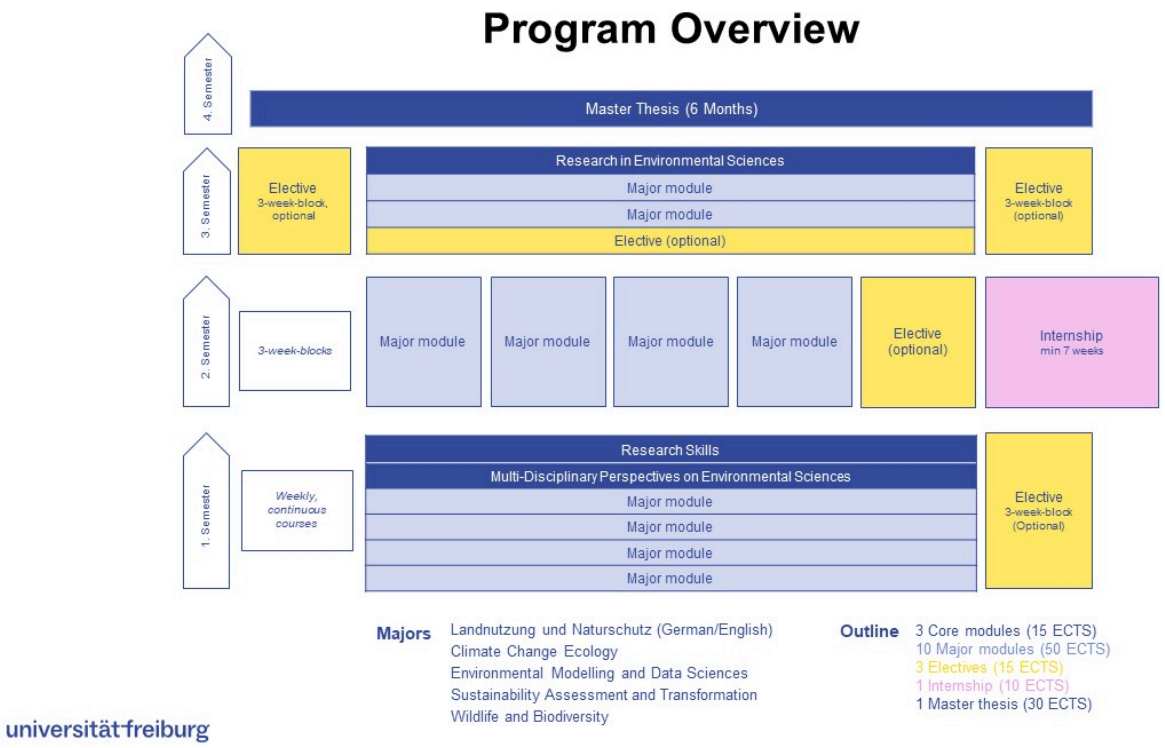
2) Major modules:
Major modules are mandatory for the major chosen. In total, 10 major modules accounting for 50 ECTS need to be taken, usually in the first, second and third semester. They form the focus and thus the specialization of the study programme. The modules may include excursions, trips and/or laboratory work in order to deepen the practical relevance.

3) Electives:
Three electives totalling 15 ECTS must be taken during the program. Students can choose from a variable offer of modules for the two Master's programs MSc Forest Sciences and MSc Environmental Sciences. It is also possible to choose modules from other Master's degree programs of the faculty, the university or outside the university, as long as there is a subject-related connection. The examination board decides on suitability in accordance with the respective major. Language courses are not considered as suitable courses.

4) Internship:
An internship (10 ECTS) of at least 7 weeks (275 working hours, full-time) is required for the successful completion of the M.Sc. in Environmental Sciences. It is usually completed during the lecture-free period between the second and third semester, but can also be completed flexibly at another time if required. The internship enables students to gain practical experience and is also a good opportunity to explore possible professional fields and career opportunities. It can be completed in Germany or abroad, either as a single placement or split into two practical phases of at least three weeks. Internships must be found and organized by the students themselves, but all lecturers are happy to provide tips and contacts from their networks on request. The programme coordinator also has a folder with addresses and evaluations from former students that you can look into.

5) Master thesis:
The Master thesis is worth 30 ECTS credits and is an individual examination paper. This thesis must be completed within 6 months and the topic must be chosen from the area of the chosen major.
The aim for the student is to be able to work on a topic in depth using scientific methods within the specified period and to present the results adequately. The topic and the supervisors are organized and agreed upon by the students themselves. Students with a minimum of 60 ECTS credits on their transcript of records can register for the Master thesis.

Study plan for full-time studies
Here you can see the study plan for a full-time MSc in Environmental Science programme. Please refer to the website for the programme overviews of the respective majors.



5. Examinations and Coursework

Examination
The type of examination is specified in the examination regulations of the degree program (=Prüfungsordnung 2023). These are either written or oral examinations. Written examinations are either written examinations (e.g. written work under supervision or an e-examination) or written assignments (e.g. report, portfolio, semester-long exercises, poster, review, minutes).
Oral examinations are oral examinations (examination discussions) and oral presentations (e.g. lecture, poster presentation).

The assessment of examinations is included in the final grade.
In addition to examinations, modules may also include coursework. The ECTS points for the respective module are awarded when all the required work has been completed.

Coursework
Coursework (=Studienleistung) is individual written, oral or practical work completed by students. They can, for example, consist of exercise sheets, protocols, written papers, posters or presentations. Coursework is ungraded and assessed as “passed” or “failed”. Coursework may also be graded for feedback reasons, but this grade will not be included in the final grade.

Registration for examinations and coursework
- Regardless of the course you are enrolled in, you must always register for examinations via the Campus Management System (HISinOne)!
- Instructions can be found in the WiKi of the Computer Center of the University of Freiburg.

- The valid dates for exam registration and the exam dates are listed there. The examination periods specified in HISinOne always apply.
- For courses in which coursework must be completed in addition to the examination, separate registration of examination and coursework must be made via HISInOne.

Attendance
Attendance is not mandatory in lectures. Specific practical-oriented courses, excursions and lab courses can require regular attendance as part of the coursework (pass/fail assessment) because it is essential for reaching the learning targets of these courses. Exercises may require regular attendance as well, in which case this fact will be stated in the description of the specific module.

6 Scope of this module handbook

This handbook describes all major modules of the MSc Environmental Sciences for the summer semester 2025 (usually the 2nd semester of study if the programme is completed within the standard length of study). If the modules are offered in English, the description is in English and for German-taught modules the description is in German.
In the summer semester, the courses are taught in a 3-week block format and may include excursions. Four consecutive modules are offered (= four blocks). The courses are booked via HisInOne in the respective booking period.
In the 5th block there is the possibility to take an elective module. There is a separate module handbook for the electives on the website.

Overview Major modules for the summer term (2nd semester)

Landnutzung und Naturschutz (German)

Number	Name	Language
12106	Experimentelle Ökologie im Naturschutz	DE
12108	Umweltwahrnehmung und Umweltbildung	DE
12105	Artenkenntnis und Diversität	DE
12107	Landnutzung und Vegetation	DE

Climate Change Ecology

Number	Name	Language
12206	Land-Atmosphere Interactions	ENG
12207	Land Use Adaption	ENG
12205	Experimental Climate Stress Physiology	ENG
12208	Methods in Ecosystem Research	ENG

Environmental Modelling and Data Sciences

Number	Name	Language
12308	Remote Sensing and Geoinformatics	ENG
12305	Applied Land Surface Modelling	ENG
12306	Bioinformatics	ENG
12307	Modelling Environmental Systems	ENG

Sustainability Assessment and Transformation

Number	Name	Language
12405	Supply Chain Modelling	ENG
12407	Systems Thinking, Planning and Transition	ENG
12404	Energy System Transition	ENG
12406	Sustainability Law & Transformation	ENG

Wildlife and Biodiversity

Number	Name	Language
12505	Experimental Ecology	ENG
12507	Research in Wildlife Ecology	ENG
12506	Protected Area Management	ENG
12507	Wildlife Behavioural Ecology	ENG

Terms used

This Module handbook is derived automatically from the online platform, which did not translate all terms into English. Here is a list for the terms to enable full comprehension.

DE	ENG
In jedem Sommersemester	Every summer semester
Lehrveranstaltung	Course
Pflicht (P)	Mandatory
Veranstaltung	Event
Prüfungsleistung	Exam / Examination
Studienleistung	Coursework

--- Deutsche Version ---

Prolog

Dieses Modulhandbuch umfasst die Module und zugehörigen Veranstaltungen des 2. Semesters des MSc Umweltwissenschaften. Bevor auf die einzelnen Module eingegangen wird, finden Sie zuerst eine allgemeine Beschreibung des Studiengangs in diesem Prolog.

Inhaltsverzeichnis Prolog

1. Kurzbeschreibung des Studiengangs

Fach	Umweltwissenschaften / Environmental Sciences
Abschluss	Master of Science
Regelstudienzeit (Studiendauer)	4 Semester / 2 Jahre
Studienform	Vollzeitstudium
Studienumfang in ECTS-Punkten	120 ECTS
Fakultät	Fakultät für Umwelt und Natürliche Ressourcen
Institut	Albert-Ludwigs-Universität Freiburg
Homepage	https://www.msc-umwelt.uni-freiburg.de

Sprache(n)	Deutsch und Englisch - oder nur Englisch
Zugangsvoraussetzungen	■ B.Sc.-Abschluss mit Notendurchschnitt von mindestens 2,5 ■ Forst- oder umweltwissenschaftlicher Hintergrund ■ Sprachzertifikat Englisch B2 oder C1 (Je nach Profillinie) ■ Nachweis zu spezifische akademische Voraussetzungen je nach Profillinie (Informationen auf der Webseite)
Möglicher Studienbeginn	Wintersemester
Version Prüfungsordnung	Letzte Version der Prüfungsordnung: PO 2023
Besonderheiten des Studiengangs	5 Profillinien zur Vertiefung: ■ Landnutzung und Naturschutz ■ Climate Change Ecology ■ Environmental Modelling and Data Sciences ■ Sustainability Assessment and Transformation ■ Wildlife and Biodiversity

2. Struktur des Studiengangs

Der Masterstudiengang MSc Umweltwissenschaften/Environmental Sciences vermittelt eine vertiefte Ausbildung im Bereich der Umweltwissenschaften. Das Spektrum der Lehrinhalte reicht dabei von grundlegenden Ökosystem-Zusammenhängen über aktuelle Fragen ökologischer Veränderungen bis hin zu technischen und sozio-ökonomischen Strategien zur Erhaltung, Adaptation und Wiederherstellung einer intakten Umwelt. Zentrale Bedeutung kommt dabei dem Leitbild der Nachhaltigkeit im Umgang mit der Umwelt und natürlichen Ressourcen zu.
Das erlangte und vertiefte Wissen kann im Rahmen von anwendungsorientierten Modulen zur Lösung von Umweltproblemen auf regionaler, nationaler und internationaler Ebene angewendet und weiterentwickelt werden.
Ziel ist es, die Studierenden auf diese Weise mit den theoretischen Kenntnissen und praktischen Fähigkeiten vertraut zu machen, die im breiten Spektrum möglicher Arbeitsbereiche von Umweltwissenschaftler*innen in Wissenschaft und Praxis unverzichtbar sind.

3. Fünf Profillinien als Vertiefungsschwerpunkte

Studierende wählen eine der fünf Profillinien als ihren Schwerpunkt und können zusätzlich durch Wahlpflichtmodule und ein Pflichtpraktikum ihr Studium individualisieren.

1) Landnutzung und Naturschutz:
In dieser Profillinie werden unterschiedliche natur- und sozialwissenschaftliche Ansätze kennengelernt um die Nutzung und den Schutz von Natur und Landschaft in ihrer Komplexität zu erfassen und zu bewerten.

2) Climate Change Ecology
Diese Profillinie untersucht die Auswirkungen des Klimawandels auf terrestrische Ökosysteme im lokalen, regionalen und globalen Maßstab. Sowohl die meteorologischen und klimatologischen Ursachen des anthropogenen Klimawandels als auch die Auswirkungen auf biogeochemische Kreisläufe werden kritisch analysiert. In praktischen Labor- und Feldversuchen werden stressinduzierte Veränderungen in Pflanzen und Ökosystemen quantifiziert. Ziel ist es, vertiefte Kenntnisse über Veränderungen wichtiger Ökosystemprozesse, wie z.B. des Kohlenstoff- oder Wasserkreislaufs, zu gewinnen. Eine Einführung in die Modellierung von Erdsystemen befasst sich schließlich mit diesen Prozessen in größerem Maßstab.

3) Environmental Modelling and Data Sciences
Diese Profillinie zielt darauf ab, die Studierenden mit einem breiten und relevanten Spektrum an computergestützten Fähigkeiten auszustatten, um Forschungs- und Anwendungsherausforderungen in der Umweltwissenschaft anzugehen. Immer größere Datensätze aus automatisierten Datensammlungen (Fernerkundung, Omics) und große Datensammlungen für die Forschung und die Öffentlichkeit (Wetterstationen, iNaturalist, ebird) erfordern angemessene Kompetenzen in den Bereichen Datenwissenschaft und Modellierung. Da sich diese Methoden ständig weiterentwickeln, werden im Profil Environmental Modelling and Data Science (EMDS) grundlegende Kenntnisse in Statistik und Programmierung vermittelt und mit konkreten Studien und Analysen kombiniert.

4) Sustainability Assessment and Transformation
Diese interdisziplinäre Profillinie richtet sich an Studierende, die eine solide wissenschaftliche Grundlage für die Beantwortung aktueller Nachhaltigkeitsfragen schaffen wollen. Sie erlangen Expertenwissen für modernste Instrumente zur Nachhaltigkeitsbewertung, darunter Material- und Energieflussanalysen, Kosten-Nutzen-Analysen, Lebenszyklusanalysen (LCA) und rechtliche Analysen! Sie werden eine erstklassige Ausbildung in Systemdenken, kritischem Denken und analytischem Denken zu den oben genannten Fragen erhalten. Darüber hinaus werden Modelle angewendet und Indikatoren entwickelt, um innovative geschäftliche, technische, infrastrukturelle, regulatorische, politische und verhaltensbezogene Lösungen für eine nachhaltige Zukunft zu bewerten.

5. Wildlife and Biodiversity
Ziel hier ist es, die Ökologie und Erhaltungsbiologie von Wildtieren und der biologischen Vielfalt zu verstehen, wobei der Schwerpunkt auf terrestrische Ökosysteme liegt. Die Profillinie zielt auf ökologische Forschung im Naturschutzkontext ab, richtet sich aber auch an Studierende, die sich für die Schnittstelle zwischen Wissenschaft und ihrer Anwendung interessieren. Daher reichen die Modulinhalte von Theorie und Forschungsmethoden bis hin zu Feldarbeit, Datenanalyse und wissenschaftlichem Schreiben.

4. Aufbau und Ablauf

Insgesamt sind im MSc Umweltwissenschaften / Environmental Sciences 120 ECTS zu erwerben. Diese sind in Kernmodule (15 ECTS), Profillinienmodule (50 ECTS), Wahlpflichtmodule (15 ECTS), Praktikum (19 ECTS) und Masterarbeit (30 ECTS) aufgeteilt.

1) Kernmodule / Grundlagenbereich:
Drei Kernmodule (15 ECTS) sind für alle Studierenden verpflichtend. Sie werden im ersten und dritten Semester, jeweils also in den Wintersemestern, angeboten und auf Englisch unterrichtet.

2) Profillinien-Module:
Diese Module sind für die gewählte Profillinie obligatorisch. Insgesamt sind 10 Profillinienmodule im Umfang von 50 ECTS zu belegen, in der Regel im ersten, zweiten und dritten Semester. Sie bilden den Schwerpunkt und damit die Vertiefung des Studiums ab. In den Modulen ist es möglich, dass Exkursionen, Ausflüge und / oder Laborarbeiten durchgeführt werden um den Praxisbezug zu vertiefen.

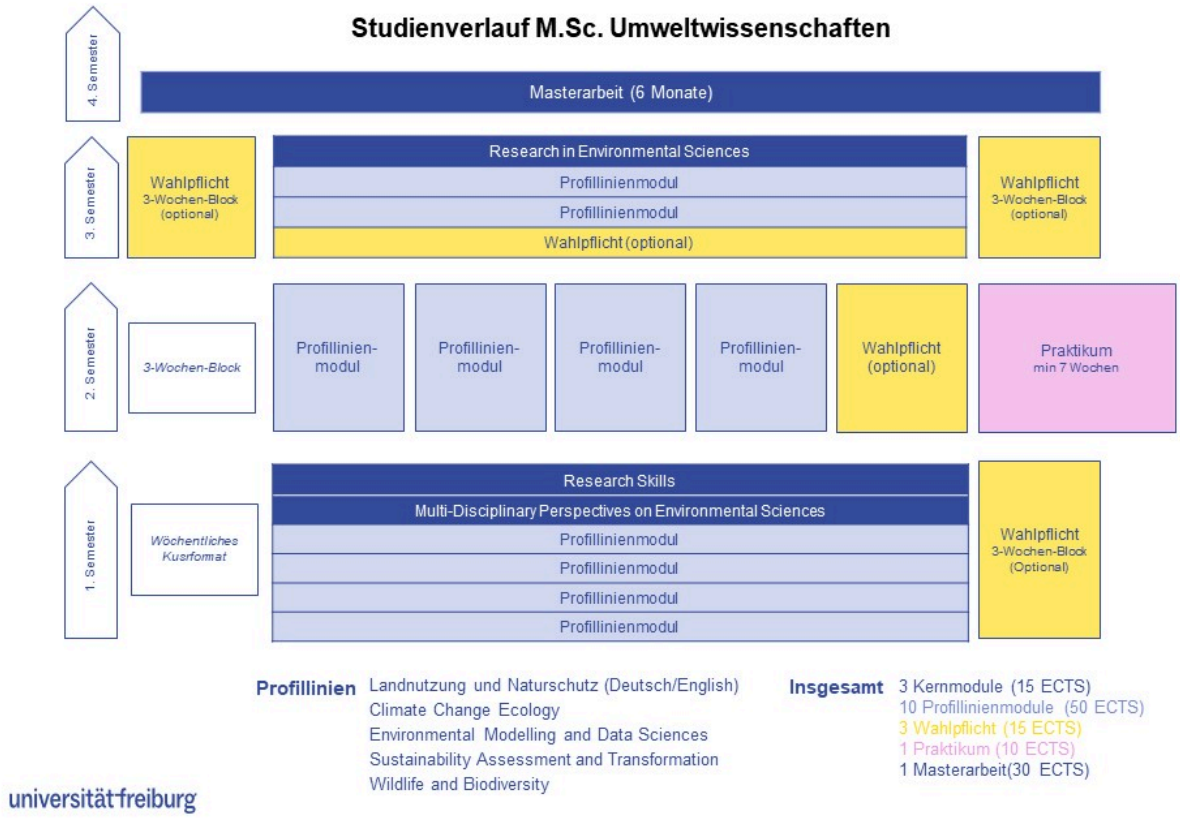
3) Wahlpflichtfächer:
Während des Studiums müssen drei Wahlpflichtfächer im Umfang von 15 ECTS belegt werden. Die Studierenden können aus einem variablen Angebot an Modulen für die beiden Masterstudiengänge MSc Forstwissenschaften / Forest Sciences und MSc Umweltwissenschaften / Environmental Sciences wählen. Es können auch Module aus anderen Masterstudiengängen der Fakultät, der Universität oder außerhalb der Universität gewählt werden, sofern ein fachlicher Bezug besteht. Über die Eignung entscheidet der Prüfungsausschuss nach Maßgabe des jeweiligen Studienschwerpunkts. Sprachkurse werden nicht als geeignete Lehrveranstaltungen anerkannt.

4) Praktikum:
Für den erfolgreichen Abschluss des M.Sc. Umweltwissenschaften ist ein Praktikum (10 ECTS) von mindestens 7 Wochen (275 Arbeitsstunden, Vollzeit) erforderlich. Es wird in der Regel in der vorlesungsfreien Zeit zwischen dem zweiten und dritten Fachsemester absolviert, kann aber bei Bedarf auch flexibel zu einem anderen Zeitpunkt durchgeführt werden. Das Praktikum ermöglicht den Studierenden Praxiserfahrung zu sammeln und ist außerdem eine gute Gelegenheit mögliche Berufsfelder und Karrieremöglichkeiten zu erkunden. Es kann in Deutschland oder im Ausland entweder zusammenhängend oder aufgeteilt, auf zwei mindestens dreiwöchige Praxisphasen, abgeleistet werden. Praktika müssen von den Studierenden selbstständig gesucht und organisiert werden, aber alle Lehrenden sind auf Anfrage gerne bereit, Tipps und Kontakte aus ihren Netzwerken zu geben.

5) Masterarbeit:
Die Masterarbeit hat einen Leistungsumfang von 30 ECTS-Punkten und ist eine individuelle Prüfungsarbeit. Innerhalb von 6 Monaten ist diese Arbeit anzufertigen und das Thema ist aus dem Bereich der gewählten Profillinie zu wählen.
Ziel ist, dass der Student oder die Studentin in der Lage ist, innerhalb der vorgegebenen Frist ein Thema aus seinem/ihrem Studienfach nach wissenschaftlichen Methoden vertiefend zu bearbeiten und die Ergebnisse adäquat darzustellen. Das Thema und die Betreuer werden hierbei durch die Studierenden selbst organisiert und abgesprochen. Ab einer Mindestanzahl von 60 verbuchten ECTS auf der Leistungsübersicht, kann die Masterarbeit angemeldet werden.

Studienplan bei einem Vollzeitstudium

Hier sehen Sie den Studienverlaufsplan bei einem Vollzeitstudium MSc Umweltwissenschaften / Environmental Sciences. Die Studienverläufe für die einzelnen Profillinien entnehmen Sie bitte der Webseite.



5. Prüfungs- und Studienleistungen

Prüfungsleistungen
Die Prüfungsart ist in der Prüfungsordnung des Studiengangs festgelegt. Hierbei handelt es sich entweder um schriftliche oder mündliche Prüfungsleistungen. Schriftliche Prüfungen sind entweder Klausuren (z.B. schriftliche Aufsichtsarbeiten oder E-Klausur) oder schriftliche Ausarbeitungen (wie z.B. Bericht, Portfolio, semesterbegleitende Übungsaufgaben, Poster, Review, Protokoll). Mündliche Prüfungsleistungen sind mündliche Prüfungen (Prüfungsgespräche) und mündliche Präsentationen (z.B. Vortrag, Posterpräsentation).

Die Bewertung von Prüfungsleistungen geht in die Abschlussnote ein.
In den Modulen können neben Prüfungsleistungen auch Studienleistungen zu erbringen sein. Die ECTS-Punkte des jeweiligen Moduls werden dann vergeben, wenn alle geforderten Leistungen erbracht wurden.

Studienleistungen
Studienleistungen (SL) sind individuelle schriftliche, mündliche oder praktische Leistungen, die von Studierenden erbracht werden. Sie können z.B. aus Übungsblättern, Protokollen, schriftlichen Ausarbeitungen, Postern oder Vorträgen bestehen. Studienleistungen werden mit „bestanden“ oder „nicht bestanden“ bewertet. Studienleistungen dürfen aus Feedbackgründen auch benotet werden, allerdings darf diese Note nicht in die Abschlussnote einfließen.

Anmeldung von Prüfungs- und Studienleistungen

- Unabhängig von der Belegung der Veranstaltung ist immer eine Anmeldung zur Prüfung über das Campus Management System (HISinOne) notwendig!
- Eine Anleitung finden Sie im WiKi des Rechenzentrums der Universität Freiburg.
- Die jeweils gültigen Termine zur Prüfungsanmeldung und die Prüfungstermine sind dort hinterlegt. Es gelten immer die in HISinOne angegebenen Prüfungszeiträume.
- Für Veranstaltungen bei denen neben der Prüfungsleistung eine Studienleistung zu erbringen ist, muss eine getrennte Anmeldung von Prüfungs- und Studienleistung über HISInOne erfolgen.

Anwesenheit

In den Vorlesungen besteht keine Anwesenheitspflicht. Bei bestimmten praxisorientierten Kursen, Exkursionen und Laborkursen kann die regelmäßige Anwesenheit als Teil der Studienleistung verlangt werden (Bewertung mit bestanden/nicht bestanden), da sie für das Erreichen der Lernziele dieser Kurse unerlässlich ist. Auch bei Übungen kann eine regelmäßige Anwesenheitspflicht bestehen; in diesem Fall wird dies in der Beschreibung des jeweiligen Moduls oder dem Kursverlauf (auf der Lernplattform Ilias) angegeben.

6. Umfang dieses Modulhandbuchs

Dieses Handbuch beschreibt alle Profillinienmodule des MSc Umweltwissenschaften / Environmental Sciences für das Sommersemester 2025 (in der Regel dem 2. Fachstudiensemester bei einem Absolvieren des Studiums in der Regelstudienzeit). Wenn die Module auf Englisch angeboten werden, steht die Beschreibung in englischer Sprache und bei deutsch-sprachigen Modulen ist die Beschreibung in deutscher Sprache.

Im Sommersemester werden die Veranstaltungen in einem 3-Wochen-Block-Format unterrichtet und können Exkursionen beinhalten. Es werden 4 nacheinander-folgende Module angeboten (= vier Blöcke). Die Belegung der Veranstaltungen findet über HisInOne statt in dem jeweils hinterlegten Belegungszeitraum.

Im 5. Block besteht die Möglichkeit ein Wahlpflichtmodul zu belegen. Für das Wahlpflichtangebot gibt es ein separates Modulhandbuch auf der Studiengangswebseite.

Übersicht Profillinienmodule für das Sommersemester (2. Fachsemester)

Landnutzung und Naturschutz

Nummer	Name	Sprache
12106	Experimentelle Ökologie im Naturschutz	DE
12108	Umweltwahrnehmung und Umweltbildung	DE
12105	Artenkenntnis und Diversität	DE
12107	Landnutzung und Vegetation	DE

Climate Change Ecology

Nummer	Name	Sprache
12206	Land-Atmosphere Interactions	ENG
12207	Land Use Adaption	ENG
12205	Experimental Climate Stress Physiology	ENG
12208	Methods in Ecosystem Research	ENG

Environmental Modelling and Data Sciences

Number	Name	Sprache
12308	Remote Sensing and Geoinformatics	ENG
12305	Applied Land Surface Modelling	ENG
12306	Bioinformatics	ENG
12307	Modelling Environmental Systems	ENG

Sustainability Assessment and Transformation

Nummer	Name	Sprache
12405	Supply Chain Modelling	ENG
12407	Systems Thinking, Planning and Transition	ENG
12404	Energy System Transition	ENG
12406	Sustainability Law & Transformation	ENG

Wildlife and Biodiversity

Nummer	Name	Sprache
12505	Experimental Ecology	ENG
12507	Research in Wildlife Ecology	ENG
12506	Protected Area Management	ENG
12507	Wildlife Behavioural Ecology	ENG

Verwendete Begriffe

Dieses Modulhandbuch wurde automatisch von der Online-Plattform übernommen, die nicht alle Begriffe ins Englische übersetzt hat. Hier ist eine Liste der nicht-übersetzten Begriffe, um ein vollständiges Verständnis zu ermöglichen

DE	ENG
In jedem Sommersemester	Every summer semester
Lehrveranstaltung	Course
Pflicht (P)	Mandatory
Veranstaltung	Event
Prüfungsleistung	Exam / Examination
Studienleistung	Coursework

Name of node	Number of node
Land-Use and Conservation	10LE07KT-PLU-2023-LuN-12100
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

Compulsory/Elective (C/E)	Compulsory

↑

Name of module	**Number of module**
Artenkenntnis und Diversität	10LE07MO-M.12105
Responsible	
Prof. Dr. Alexandra-Maria Klein	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	
Attendance	90 h
Independent study	60 h
Recommended semester	2
Duration	3 Wochen
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Artenkenntnis und Diversität	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
In diesem Modul werden wir anhand von klassischen Bestimmungsschlüsseln und Fachliteratur das Bestimmen von Blütenpflanzen und Wildbienen vertiefen, um zu verdeutlichen wie wichtig Artkenntnisse für die Beurteilung von naturschutzfachlichen Bewertungen und für die Biodiversitätsforschung sind. Dabei wird vertieftes Fachwissen zur Taxonomie und Biologie (vor allem von Merkmalen „traits“) von häufigen und seltenen Familien, Gattungen und Arten vermittelt.
Qualification
Die Studierenden lernen: ■ Artkenntnisse zu Gefäßpflanzen (mit Schwerpunkt auf Blütenpflanzen), Hymenoptera (mit Schwerpunkt auf Wildbienen) in Deutschland/Schweiz ■ den Umgang mit Bestimmungsschlüssel und Apps, Terminologie und Merkmale für systematisch definierte Einheiten ■ die Anwendung von standardisierten Methoden für die Biodiversitätserfassung (nach Absprache) ■ Hypothesenformulierung, Datenaufnahme, Auswertung und Interpretation zu Biodiversitätsbewertung
Examination achievement
Klausur

Course achievement
Präsentation
Teaching method
Vorlesung, Bestimmungsübungen, Exkursion, Gruppenarbeit
Literature
Literatur wird zu Beginn und fortlaufend während des Moduls auf Ilias bereitgestellt. Wenn Sie eigene Bestimmungsliteratur haben, bringen Sie dies bitte mit.
Usability
Pflichtmodul

↑

Name of module	Number of module
Artenkenntnis und Diversität	10LE07MO-M.12105
course	
Artenkenntnis und Diversität	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12105

ECTS-Points	5.0
Workload	150 h
Attendance	90 h
Independent study	60 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents
Vertiefte Kenntnisse in der Taxonomie und Systematik von Pflanzen und Insekten sind für viele Berufe im Naturschutz notwendig und sind unabdingbar für die Biodiversitätsforschung. In diesem Modul werden wir anhand von klassischen Bestimmungsschlüsseln und Fachliteratur das Bestimmen von Blütenpflanzen und Wildbienen vertiefen, um zu verdeutlichen wie wichtig Artkenntnisse für die Beurteilung von naturschutzfachlichen Bewertungen und für die Biodiversitätsforschung sind. Dabei wird vertieftes Fachwissen zur Taxonomie und Biologie (vor allem von Merkmalen „traits“) von häufigen und seltenen Familien, Gattungen und Arten vermittelt. Auf Exkursionen werden wir das Wissen ausbauen und vertiefen und Fragestellungen erarbeiten, die für den praktischen Biodiversitätsschutz von Bedeutung sind. In Gruppenarbeiten werden im Gelände Daten zu Biodiversitätsfragen gesammelt, die Arten bestimmt und anhand von verschiedenen Auswertungsverfahren gemeinsam analysiert. Wir wollen damit erarbeiten, in welchen naturschutzfachlichen und wissenschaftlichen Zusammenhängen, detaillierte Artkenntnisse nötig sind. Das Modul ist in drei Teile unterteilt. 1. Woche: Zunächst werden wir die Grundlagen zur Taxonomie/Systematik und der Bestimmung von Pflanzen und Wildbienen in Form von Vorlesungen und Bestimmungsübungen vermitteln und vertieft üben, um die Fachterminologie einzuprägen und einen sicheren Umgang mit den Bestimmungsschlüsseln zu erlernen. 2. Woche: Wir werden ein Zielgebiet außerhalb Freiburgs heraussuchen, in dem wir die Woche zusammen verbringen. Dort werden wir Exkursionen durchführen um Artkenntnisse zu vertiefen. In Gruppenarbeit werden Fragestellungen aus der Biodiversitätsforschung und angewandtem Naturschutz entwickelt und ein standardisiertes Arteninventar, anhand verschiedener Methoden (Braun-Blanquet, Transekte, Punktaufnahmen) aufgenommen und ausgewertet. 3. Woche: Die Gruppenarbeiten werden in Präsentationen zusammengeführt und abschließend den Teilnehmern und Dozenten des Moduls als Studienleistung vorgestellt. Am letzten Tag werden wir das erlernte Wissen und Fähigkeiten abfragen. Dazu müssen Familien, Gattungen und Arten aus den verschiedenen taxonomischen Gruppen (auch im fixierten Zustand z.B. Herbarmaterial) erkannt und nach Bestimmungsschlüsseln bestimmt werden. Weiter werden Theorien zur Artbestimmung und Ökologie der wichtigsten Taxa abgefragt.
Qualification
Die Studierenden lernen:

- Artkenntnisse zu Gefäßpflanzen (mit Schwerpunkt auf Blütenpflanzen), Hymenoptera (mit Schwerpunkt auf Wildbienen) in Deutschland/Schweiz
- den Umgang mit Bestimmungsschlüssel und Apps, Terminologie und Merkmale für systematisch definierte Einheiten
- die Anwendung von standardisierten Methoden für die Biodiversitätserfassung (nach Absprache)
- Hypothesenformulierung, Datenaufnahme, Auswertung und Interpretation zu Biodiversitätsbewertung

Examination achievement
Klausur
Course achievement
Präsentation
Literature
Literatur wird zu Beginn und fortlaufend während des Moduls auf Ilias bereitgestellt. Wenn Sie eigene Bestimmungsliteratur haben, bringen Sie dies bitte mit.
Compulsory requirement
Keine / None
Teaching method
Vorlesung, Bestimmungsübungen, Exkursion, Gruppenarbeit

↑

Name of module	Number of module
Experimentelle Ökologie im Naturschutz	10LE07MO-M.12106
Responsible	
Prof. Dr. Alexandra-Maria Klein	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	100 h
Independent study	50 h
Recommended semester	2
Duration	3 Wochen
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine / None
Recommended requirement
Grundlagen in Statistik

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Experimentelle Ökologie im Naturschutz	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
Während dieses Kurses erwerben die Studierenden Kenntnisse über beobachtende und experimentelle Ökologie in Theorie und Praxis. Es werden an drei Nachmittags-Exkursionen aktuelle und relevante Projekte von Forschenden der Universität Freiburg besucht. Besonderer Wert wird auf die praktische Erfahrung in der Planung und Durchführung eines eigenständigen Projektes gelegt, welches in kleinen Gruppen in der zweiten und dritten Kurswoche selbstständig unter Betreuung durchgeführt wird.
Qualification
Die Studierenden können: ■ die Bedeutung von wissenschaftlicher Evidenz für den Naturschutz und das Management verstehen ■ die Grundsätze der wissenschaftlichen Datenerhebung rekapitulieren ■ Experimentelle Ansätze und Designs in der experimentellen Ökologie benennen und erläutern ■ Vor- und Nachteile sowie Stärken und Grenzen verschiedener Designs erklären und abwägen ■ Experimenteller Designs in aktuellen Projekten in der Naturschutz- und Biodiversitätsforschung wiedererkennen und bewerten ■ Ein eigenes Forschungsprojekt entwickeln und durchführen, das Folgendes umfasst: a) die Findung einer relevanten Forschungsfrage und der richtige entsprechenden Hypothese, b) die Planung eines

geeigneten Experiments, c) die Umsetzung und Datenerhebung in Teamarbeit, d) die Analyse der Daten und Beschreibung der Ergebnisse in Textform sowie grafisch visualisiert e) Zusammenfassung der Ergebnisse, Interpretation und Diskussion im Kontext der verfügbaren Literatur, f) effektive mündliche und schriftliche Kommunikation des Projektes
- Stärken und Grenzen des eigenen Projekts erkennen und kritisch reflektieren

Examination achievement
schriftliche Ausarbeitung
Course achievement
mündliche Präsentation
Teaching method
Vorlesungen, Projektarbeit
Literature

- Clapham, A. R. (1966) What is experimental ecology? Folia Geobotannica & Phytotaxonomica Vol 1(1): 88-92.
- Karban, Huntziger, Pearse (2023) How to do ecology – A concise handbook. Third edition. Princeton University Press

↑

Name of module	Number of module
Experimentelle Ökologie im Naturschutz	10LE07MO-M.12106
course	
Experimentelle Ökologie im Naturschutz	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12106

ECTS-Points	5.0
Workload	150 h
Attendance	100 h
Independent study	50 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents

Während dieses Kurses erwerben die Studierenden Kenntnisse über beobachtende und experimentelle Ökologie in Theorie und Praxis. Es werden an drei Nachmittags-Exkursionen aktuelle und relevante Projekte von Forschenden der Universität Freiburg besucht. Besonderer Wert wird auf die praktische Erfahrung in der Planung und Durchführung eines eigenständigen Projektes gelegt, welches in kleinen Gruppen in der zweiten und dritten Kurswoche selbstständig unter Betreuung durchgeführt wird.

- Einführung in die beobachtende und experimentelle Ökologie
- Grundlagen der Entwicklung und Planung eines Forschungsprojekts
- Vorstellung von Methoden und Design in der experimentellen Ökologie in der Theorie
- Veranschaulichung durch Besichtigung aktueller Forschungsprojekte in den Bereichen Biodiversität, Naturschutz und Waldökologie
- Entwicklung und Durchführung von studentischen Forschungsprojekten in Gruppen in den Bereichen Pflanzenökologie, Tierökologie oder biotischen Interaktion auf der Ebene der Populations- oder Gemeinschaftsökologie – je nach Interessen der Studierenden
- Präsentation von Projekten in mündlicher und schriftlicher Form

Qualification

Die Studierenden können:

- die Bedeutung von wissenschaftlicher Evidenz für den Naturschutz und das Management verstehen
- die Grundsätze der wissenschaftlichen Datenerhebung rekapitulieren
- Experimentelle Ansätze und Designs in der experimentellen Ökologie benennen und erläutern
- Vor- und Nachteile sowie Stärken und Grenzen verschiedener Designs erklären und abwägen
- Experimenteller Designs in aktuellen Projekten in der Naturschutz- und Biodiversitätsforschung wiedererkennen und bewerten
- Ein eigenes Forschungsprojekt entwickeln und durchführen, das Folgendes umfasst: a) die Findung einer relevanten Forschungsfrage und der richtige entsprechenden Hypothese, b) die Planung eines geeigneten Experiments, c) die Umsetzung und Datenerhebung in Teamarbeit, d) die Analyse der Daten und Beschreibung der Ergebnisse in Textform sowie grafisch visualisiert e) Zusammenfassung der Ergebnisse, Interpretation und Diskussion im Kontext der verfügbaren Literatur, f) effektive mündliche und schriftliche Kommunikation des Projektes
- Stärken und Grenzen des eigenen Projekts erkennen und kritisch reflektieren

Examination achievement
schriftliche Ausarbeitung (100%)
Course achievement
mündliche Präsentation
Literature
■ Clapham, A. R. (1966) What is experimental ecology? Folia Geobotannica & Phytotaxonomica Vol 1(1): 88-92. ■ Karban, Huntziger, Pearse (2023) How to do ecology – A concise handbook. Third edition. Princeton University Press ■ Spezifische Studien aus Fachzeitschriften
Compulsory requirement
Keine
Recommended requirement
Grundlagen in Statistik, Kenntnisse heimischer Arten
Teaching method
Vorlesungen, Projektarbeit

↑

Name of module	Number of module
Landnutzung und Vegetation	10LE07MO-M.12107
Responsible	
Prof. Dr. Markus Hauck	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	60 h
Independent study	90 h
Recommended semester	2
Duration	3 Wochen
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Landnutzung und Vegetation	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150h

Contents
Im Modul sollen Einflüsse der Landnutzung auf die Vegetation der Wälder Mitteleuropas in der Theorie und in der Praxis durch Exkursionen, eigene Vegetationsaufnahmen und die Einführung in die Analyse von Vegetationsdaten betrachtet werden. Die praktischen Teile umfassen die Berechnung von Biodiversitätsindizes und Ordinationen.
Qualification
Die Studierenden ■ erlangen Kenntnisse über den Umfang der Landschaftsveränderungen durch den Menschen in Europa und in ausgewählten außereuropäischen Regionen und ihren zeitlichen Ablauf ■ kennen intensive versus extensive Landnutzungsformen in unterschiedlichen Lebensraumtypen ■ kennen unterschiedliche Bewirtschaftungssysteme im Wald ■ erlangen Kenntnisse über den Vergleich Urwald - Wirtschaftswald ■ üben in Kleingruppen zum Einfluss der Bewirtschaftung auf Biodiversität und Strukturmerkmalen von Wäldern
Examination achievement
schriftliche Ausarbeitung

Course achievement
Anwesenheit an den Geländetagen
Teaching method
Vorlesung, Übungen, Exkursionen, Gruppenarbeit
Literature
https://link.springer.com/book/10.1007/978-3-319-43042-3 Leuschner & Ellenberg: Ecology of Central European Forests. Springer, 2017

↑

Name of module	Number of module
Landnutzung und Vegetation	10LE07MO-M.12107
course	
Landnutzung und Vegetation	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12107

ECTS-Points	5.0
Workload	150h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents

Der Mensch verändert die Vegetation seit Jahrtausenden in vielfacher Hinsicht durch den Bau von Siedlungen, Verkehrswegen sowie durch die Land- und Forstwirtschaft. Dadurch wird die Fläche von Ökosystemen verkleinert und gehen Arten in ihrem Bestand zurück. Andere Arten breiten sich nach Störung neu an Standorten aus, an denen sie von Natur aus nicht vorkamen. Ist der anthropogene Einfluss sehr groß, werden Ökosysteme zu anderen Ökosystemen transformiert. Dabei wurden teilweise neue Kulturlebensräume geschaffen, die ihrerseits heute gefährdete Arten enthalten können.
Die Lehrveranstaltung soll in Form einer Kombination aus Vorlesungen, Exkursionen, Übungen und Seminarvorträgen in die Thematik einführen. Ein Schwerpunkt wird dabei im Wald liegen, da das im Zeitplan davor liegende Modul „Formenkenntnisse, Biodiversität und Funktionen“ seinen Schwerpunkt in Lebensräumen des Offenlandes hat. Die Exkursionen werden als Tagesexkursionen von Freiburg aus durchgeführt.

Qualification

Die Studierenden
- erlangen Kenntnisse über den Umfang der Landschaftsveränderungen durch den Menschen in Europa und in ausgewählten außereuropäischen Regionen und ihren zeitlichen Ablauf
- kennen intensive versus extensive Landnutzungsformen in unterschiedlichen Lebensraumtypen
- kennen unterschiedliche Bewirtschaftungssysteme im Wald
- erlangen Kenntnisse über den Vergleich Urwald - Wirtschaftswald
- üben in Kleingruppen zum Einfluss der Bewirtschaftung auf Biodiversität und Strukturmerkmalen von Wäldern

Examination achievement

schriftliche Ausarbeitung

Course achievement

Anwesenheit an den Geländetagen

Literature

https://link.springer.com/book/10.1007/978-3-319-43042-3

Leuschner & Ellenberg: Ecology of Central European Forests. Springer, 2017
Compulsory requirement
keine
Teaching method
Vorlesung, Übungen, Exkursionen, Gruppenarbeit

↑

Name of module	Number of module
Umweltwahrnehmung und Umweltbildung	10LE07MO-M.12108
Responsible	
Dr. Andrea Heidemarie Seim	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	60 h
Independent study	90 h
Recommended semester	2
Duration	3 Wochen
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Umweltwahrnehmung und Umweltbildung	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
Das Modul „Umweltwahrnehmung und Umweltbildung“ stellt eine Veranstaltung dar, die Umweltwahrnehmung analysiert und entsprechende Konzepte der Umweltbildung vermittelt und praktisch umsetzt.
Qualification
Die Studierenden ■ lernen theoretische Grundlagen der Umweltwahrnehmung in den Bereichen Nachhaltigkeit, Natur- und Umweltschutz, Landschaftsentwicklung und Denkmalschutz im Wald (Feldstudien) ■ erlangen eine theoretische Basis der Umweltbildung und Besonderheiten der Umweltbildung (BNE) ■ können das Erlernte in die Praxis umsetzen
Examination achievement
Presentation
Course achievement
Anwesenheit und aktive Beteiligung
Teaching method
Vorlesung, Seminar, Exkursionen

Literature
Literatur wird zu Beginn des Moduls auf Ilias bereitgestellt.

↑

Name of module	Number of module
Umweltwahrnehmung und Umweltbildung	10LE07MO-M.12108
course	
Umweltwahrnehmung und Umweltbildung	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07S-M.12108/51190

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents
Das Modul „Umweltwahrnehmung und Umweltbildung“ stellt eine Veranstaltung dar, die Umweltwahrnehmung analysiert und entsprechende Konzepte der Umweltbildung vermittelt und praktisch umsetzt. 1. Woche: Zunächst werden die konzeptuellen Hintergründe der Umweltbildung dargestellt, inkl. Umweltethik und Nachhaltigkeitszielen. Die Besonderheiten von Umweltbildung und Bildung für Nachhaltige Entwicklung (BNE) werden erarbeitet und anhand von Praxisbeispielen aus beiden Bereichen veranschaulicht. 2. Woche: Zunächst werden Umweltwahrnehmungen in Gegenwart und Vergangenheit aufgezeigt. Dabei werden u.a. naturbezogene philosophische Ansätze, die geschichtlichen Entwicklungslinien der Nachhaltigkeit sowie des Natur- und Umweltschutzes vorgestellt und kritisch hinterfragt. Landschafts- und umweltprägende Faktoren sowie das Erkennen, Interpretieren und Schützen von Bodendenkmälern werden auf Exkursionen vertieft. 3. Woche: Abschließend werden die theoretisch vermittelten Inhalte in der Praxis geprüft. Eigene Studien zur Umweltwahrnehmung, zur Umweltbildung oder zur Verknüpfung von beiden schließen das Modul ab. Prüfungsformen sind das Verfassen eines Essays und das Erstellen eines Posters.
Qualification
Die Studierenden ■ lernen theoretische Grundlagen der Umweltwahrnehmung in den Bereichen Nachhaltigkeit, Natur- und Umweltschutz, Landschaftsentwicklung und Denkmalschutz im Wald (Feldstudien) ■ erlangen eine theoretische Basis der Umweltbildung und Besonderheiten der Umweltbildung (BNE) ■ können das Erlernte in die Praxis umsetzen
Examination achievement
Präsentation

Course achievement
Anwesenheit (mind. 80% der Veranstaltungen), aktive Beteiligung
Literature
Literatur wird zu Beginn des Moduls auf Ilias bereitgestellt.
Compulsory requirement
Keine
Recommended requirement
keine
Teaching method
Vorlesung, Seminar, Exkursionen

↑

Name of node	Number of node
Climate Change Ecology	10LE07KT-PLU-2023-CCE-12200
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

Compulsory/Elective (C/E)	Compulsory

↑

Name of module	Number of module
Experimental Climate Stress Physiology	10LE07MO-M.12205
Responsible	
Prof. Dr. Christiane Werner Pinto	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	90
Independent study	60
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Experimental Climate Stress Physiology	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
This module teaches experimental approaches for analyzing the effects of climate change on vegetation. The focus is on plant adaptation strategies to climate change and the effects of extreme climate changes (e.g. heat, drought) on vegetation. The module teaches classical and modern methods of ecophysiology, which will be carried out in the students' own experiments in the laboratory, greenhouse and climate chambers.
Qualification
Students will ■ learn important principles of designing experiments (planning and conducting their own experiments, including selection of suitable methods) ■ learn about important steps in the research process, from formulating hypotheses to interpreting data and writing a short research paper ■ can critically evaluate the accuracy of measurements, possible sources of error and reproducibility of ecological measurements, etc. ■ learn the safe application of various methods that are important for ecosystem research
Examination achievement
Oral presentation with discussion

Course achievement
Attendance
Teaching method
Lectures, Seminar, Practical Experiments
Literature
Will be handed out during the course

↑

Name of module	Number of module
Experimental Climate Stress Physiology	10LE07MO-M.12205
course	
Experimental Climate Stress Physiology	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12205

ECTS-Points	5.0
Workload	150 h
Attendance	90
Independent study	60
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents
This module teaches experimental approaches for analyzing the effects of climate change on vegetation. The focus is on plant adaptation strategies to climate change and the effects of extreme climate changes (e.g. heat, drought) on vegetation. Students carry out their own experiments in the laboratory, greenhouse and climate chambers, divided into small groups with different scientific questions. The module teaches classical and modern methods of ecophysiology, which are essential for future scientific work (e.g. the Master's thesis). The experiments are accompanied by a lecture on the theoretical foundations of methodology, adaptation strategies and the effects of climate change on vegetation. The basics of scientific work are taught, such as the derivation of hypotheses, the statistical design of experiments, the evaluation of the significance of the results, as well as their presentation and interpretation, and the publication of the results.
Qualification
Students will ■ learn important principles of designing experiments (planning and conducting their own experiments, including selection of suitable methods) ■ learn about important steps in the research process, from formulating hypotheses to interpreting data and writing a short research paper ■ can critically evaluate the accuracy of measurements, possible sources of error and reproducibility of ecological measurements, etc. ■ learn the safe application of various methods that are important for ecosystem research
Examination achievement
Oral presentation with discusion
Course achievement
Attendance
Literature
Will be handed out during the course

Compulsory requirement
None
Teaching method
Lectures, Seminar, Practical Experiments

↑

Name of module	Number of module
Land-Atmosphere Interactions	10LE07MO-M.12206
Responsible	
Prof. Dr. Andreas Christen	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	56 h
Independent study	94 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Land-Atmosphere Interactions	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
■ Measuring and modelling land-atmosphere exchange processes of energy, water, and trace gases between biosphere and atmosphere. ■ Micrometeorological methods of measuring and modelling land-atmosphere exchanges. ■ Attribution methods for land sources and sinks.
Qualification
■ Understanding of basic land-atmosphere interactions and micrometeorological concepts. ■ Understanding of flux measuring and modeling techniques (e.g., eddy covariance and gradient approaches). ■ Knowledge of the flux data processing criteria and post-processing pipeline. ■ Knowledge of footprints calculation and relevant remote-sensing products (e.g. Google Earth Engine). ■ Familiarization of other trace gases fluxes. ■ Awareness of global flux database (FLUXNET, ICOS, etc) and relevant flux modelling. ■ Application of learned concepts on a selected project and improved skills in presentation.
Examination achievement
Written assignment (30%) and presentation (70%)

Course achievement
Participation in the exercises
Teaching method
Lecture, Excursion, Exercises
Literature
■ Monson, R., & Baldocchi, D. (2014). Terrestrial biosphere-atmosphere fluxes. Cambridge University Press. ■ Monteith, J., & Unsworth, M. (2013). Principles of environmental physics: plants, animals, and the atmosphere. Academic Press. Burba, G. (2022). Eddy Covariance Method for Scientific, Regulatory, and Commercial Applications. LI-COR Biosciences. https://www.licor.com/env/products/eddy_covariance/ec-book/ ■ ICOS FLUXES. https://www.icos-cp.eu/fluxes

↑

Name of module	Number of module
Land-Atmosphere Interactions	10LE07MO-M.12206
course	
Land-Atmosphere Interactions	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12206

ECTS-Points	5.0
Workload	150 h
Attendance	56 h
Independent study	94 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

- Measuring and modelling land-atmosphere exchange processes of energy, water, and trace gases between biosphere and atmosphere.
- Micrometeorological methods of measuring and modelling land-atmosphere exchanges.
- Attribution methods for land sources and sinks.

Schedule and Program:

21.04.25 Public holiday
22.04.25 09:15 - 13:00 – Course introduction and the land-atmosphere interface (Christen)
23.04.25 09:15 - 13:00 – Radiative and soil transfer mechanisms (Christen)
24.04.25 09:15 - 13:00 – Direct flux measurements by eddy covariance, incl. calculations and corrections (Lee)
25.04.25 09:15 - 13:00 – Partitioning and gap filling of fluxes (Lee)

28.04.25 09:15 - 13:00 – Land surface complexity and geospatial data (Christen)
29.04.25 09:15 - 13:00 – Footprint modelling and source attribution (Christen)
30.04.25 09:15 - 13:00 – Modelling land-atmosphere exchange (Christen)
01.05.25 Public holiday
02.05.25 08:00 - 14:00 – Field trip to flux tower (Christen)

05.05.25 09:15 - 13:00 – Global flux network and effects of disturbances (Lee)
06.05.25 09:15 - 13:00 – Trace-gas and isotope fluxes (Lee)
07.05.25 09:15 - 13:00 – Flux data for Monitoring, reporting, and verification (Lee)
08.05.25 09:15 - 13:00 – Mini conference day 1 (Lee)
09.05.25 09:15 - 13:00 – Mini conference day 2 (Lee and Christen)

Qualification

- Understanding of basic land-atmosphere interactions and micrometeorological concepts. Understanding of flux measuring and modeling techniques (e.g., eddy covariance and gradient approaches).
- Knowledge of the flux data processing criteria and post-processing pipeline.
- Knowledge of footprints calculation and relevant remote-sensing products (e.g. Google Earth Engine). Familiarization of other trace gases fluxes.

- Awareness of global flux database (FLUXNET, ICOS, etc) and relevant flux modelling.
- Application of learned concepts on a selected project and improved skills in presentation.

Examination achievement
Written assignment (30%) and presentation (70%)
Course achievement
Participation in the exercises
Literature
■ Monson, R., & Baldocchi, D. (2014). Terrestrial biosphere-atmosphere fluxes. Cambridge University Press. ■ Monteith, J., & Unsworth, M. (2013). Principles of environmental physics: plants, animals, and the atmosphere. Academic Press. Burba, G. (2022). Eddy Covariance Method for Scientific, Regulatory, and Commercial Applications. LI-COR Biosciences. https://www.licor.com/env/products/eddy_covariance/ec-book/ ■ ICOS FLUXES. https://www.icos-cp.eu/fluxes
Compulsory requirement
None
Teaching method
Lecture, Excursion, Exercises

↑

Name of module	Number of module
Land Use Adaption	10LE07MO-M.12207
Responsible	
Dr. Kristin Steger	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	70 h
Independent study	80 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Land Use Adaption	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The course will apply existing knowledge of ecosystem processes and discuss the impact of climate change to the current challenges of land use. The land use forms (1) viticulture (2) forestry (3) agriculture and (4) nature conservation are covered. Day excursions and expert interviews will provide initial insights into the issues. The students will compile and explain existing problems and present possible solutions. All students will learn how to design a clear and generally understandable website in order to present their results.
Qualification
The students will ■ gain knowledge about land use problems caused by climate change. ■ gain insights into application-oriented work at authorities, associations and research institutes. ■ are able to critically analyze current land use strategies. ■ can conduct scientific interviews and design websites. ■ can pass on and communicate environmental knowledge to the interested public. ■ can evaluate and summarize the results of their own research.
Examination achievement
Written assignment (70%), Group presentation of websites (30%)

Course achievement
Attendance
Teaching method
Lectures, Interviews, Seminar, Excursions
Literature
Will be provided during the course

↑

Name of module	Number of module
Land Use Adaption	10LE07MO-M.12207
course	
Land Use Adaption	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12207

ECTS-Points	5.0
Workload	150 h
Attendance	70 h
Independent study	80 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

Climate change on a regional and global level influences land use and presents users and planners with new challenges. Different landscape functions and the resulting competition for resources (food and fuel production, nature conservation, water protection) are causing problems. Well-established utilization concepts no longer offer sufficient security: for example, some plant varieties can no longer be cultivated when temperatures rise or crop yields fall (e.g. viticulture). In forest management, the climate and energy requirements of the day after tomorrow must already be taken into account when rejuvenating today, higher temperatures may lead to increased pest problems, and the range shifts of some species also pose new problems for nature conservation.
The aim of the course is to apply existing knowledge of ecosystem processes and how they are influenced by climate change to the current issues of land use. The land use forms (1) viticulture (2) forestry (3) agriculture and (4) nature conservation are covered. Day excursions and expert interviews will provide initial insights into the issues. The students will work in small groups to compile and explain existing problems and present possible solutions based on literature research and interviews with the authorities and land use representatives. All students will be asked to design a clear and generally understandable website on the land use problems and solutions discussed.

Qualification

The students will
- gain knowledge about land use problems caused by climate change.
- gain insights into application-oriented work at authorities, associations and research institutes.
- are able to critically analyze current land use strategies.
- can conduct scientific interviews and design websites.
- can pass on and communicate environmental knowledge to the interested public.
- can evaluate and summarize the results of their own research.

Examination achievement

Written assignment (70%), presentation (30%)

Course achievement

Attendance

Literature
Will be provided during the course
Compulsory requirement
None
Teaching method
Lectures, Interviews, Seminar, Excursions

↑

Name of module	Number of module
Methods in Ecosystem Research	10LE07MO-M.12208
Responsible	
PD Dr. Jürgen Kreuzwieser	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	90 h
Independent study	60 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Methods in Ecosystem Research	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The module deals with the experimental analysis of climate effects on terrestrial ecosystems and the identification of the underlying processes. The students work together in the field on a current problem, divided into small groups with a focus on the different disciplines. Students will learn experimental and analytical methods of field ecology.
Qualification
Students will ■ learn important principles of designing experiments ■ learn how to "translate" a research question into an experimental approach, including the selection of suitable field methods ■ learn about important steps in the research process, from formulating hypotheses to interpreting data and writing a short research paper ■ can critically evaluate the accuracy of measurements, possible sources of error and reproducibility of ecological measurements, upscaling of data to higher hierarchical levels, etc. ■ learn the safe application of various methods that are important for ecosystem research
Examination achievement
Written assignment

Course achievement
Attendance
Directive
Participation in the module Experimental Climate Stress Physiology
Teaching method
Lectures, Seminar, Practical Experiments
Literature
Will be handed out during the course

↑

Name of module	Number of module
Methods in Ecosystem Research	10LE07MO-M.12208
course	
Methods in Ecosystem Research	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12208

ECTS-Points	5.0
Workload	150 h
Attendance	90 h
Independent study	60 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents
The module deals with the experimental analysis of climate effects on terrestrial ecosystems and the identification of the underlying processes. The students work together in the field on a current problem, divided into small groups with a focus on the different disciplines. Students will learn experimental and analytical methods of field ecology, which are essential for future scientific work (e.g. the Master's thesis). The basics of scientific work are taught, such as the derivation of hypotheses, the statistical design of experiments, the evaluation of the significance of the results, as well as their presentation and interpretation. After a general introduction to the topic of "ecosystem research", small groups (2 to max. 4 people) are formed to work on independent scientific projects at the participating professorships. This includes experimental planning and preparation, implementation and data analysis, as well as publication of the results.
Qualification
Students will ■ learn important principles of designing experiments ■ learn how to "translate" a research question into an experimental approach, including the selection of suitable field methods ■ learn about important steps in the research process, from formulating hypotheses to interpreting data and writing a short research paper ■ can critically evaluate the accuracy of measurements, possible sources of error and reproducibility of ecological measurements, upscaling of data to higher hierarchical levels, etc. ■ learn the safe application of various methods that are important for ecosystem research
Examination achievement
Written assignment
Course achievement
Attendance
Literature
Will be handed out during the course

Compulsory requirement
None
Teaching method
Lectures, Seminar, Practical Experiments

↑

Name of node	Number of node
Environmental Modelling and Data Sciences	10LE07KT-PLU-2023-EMDS-12300
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

Compulsory/Elective (C/E)	Compulsory

↑

Name of module	Number of module
Applied Land Surface Modelling	10LE07MO-M.12305
Responsible	
Prof. Dr. René Orth	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	60 h
Independent study	90 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Applied Land Surface Modelling	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
Lectures will introduce the hydrologic water balance model (same model has been introduced and implemented in the module Earth System Modelling) and examples of previous applications of the model in research analyses.
Qualification
Students will ■ Understad relevant land surface processes and how they can be implemented in a model ■ Understand the functioning and handling of a conceptual hydrological water balance model ■ Conduct a scientific analysis independently (with guidance) using the water balance model ■ Learn to design a poster
Examination achievement
Written Assignment
Course achievement
None
Teaching method
Lectures, Modeling with programming, Student presentations, Group discussions

Literature
■ Bonan, G., Ecological Climatology (Cambridge Univ. Press) ■ Smith, P. & J. Environmental Modelling, An Introduction (Oxford Univ. Press)

↑

Name of module	Number of module
Applied Land Surface Modelling	10LE07MO-M.12305
course	
Applied Land Surface Modelling	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12305

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents

Syllabus:
Week 1: Lectures will introduce the hydrologic water balance model (same model has been introduced and implemented in the module Earth System Modelling) and examples of previous applications of the model in research analyses. Results of implementations of added processes in the model in the module Earth System Modelling will be reviewed to select a suitable and common model version. This version is then applied in order to analyse an individual research question. Analysis topics will be suggested, and will include e.g. analyses of recent droughts and floods, or long-term trends.
Week 2: Individual analyses are continued. Consultation opportunities will be provided where progress and questions can be discussed. Short presentations from students on status and next steps in their analyses, relevant feedback will be provided.
Week 3: Continuation of individual analyses, as well as of consultation opportunities. The results will be summarized and visualized in a poster with joint poster session on final day.

Qualification

Students will
- Understad relevant land surface processes and how they can be implemented in a model
- Understand the functioning and handling of a conceptual hydrological water balance model
- Conduct a scientific analysis independently (with guidance) using the water balance model
- Learn to design a poster

Examination achievement

Written assignment

Course achievement

None

Literature

- Bonan, G., Ecological Climatology (Cambridge Univ. Press)
- Smith, P. & J. Environmental Modelling, An Introduction (Oxford Univ. Press)

More literature will be provided during the course.
Compulsory requirement
None
Recommended requirement
Basic knowledge of climate modeling and experience in programming
Teaching method
Lectures, Modeling with programming, Student presentations, Group discussions

↑

Name of module	Number of module
Bioinformatics	10LE07MO-M.12306
Responsible	
Cristina Zamora	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	60 h
Independent study	90 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Bioinformatics	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The bioinformatics module equips students with knowledge and practical skills for analyzing molecular data in biology and ecology. The course introduces key bioinformatics concepts, tools, and databases, covering methods for genome and transcriptome assembly and annotation. Students will learn to analyse gene expression data following an RNA-Seq pipeline and gain hands-on experience following a DNA metabarcoding pipeline to study biodiversity and community structure.
Qualification
After completing this course, students will (have): ■ Knowledge the different omics techniques and the application of current bioinformatics tools for the analysis of experimental data generated in forest science. ■ Ability to integrate new technologies into their professional and/or research work. ■ Ability to access the necessary information publicly available online in the specific field of the subject (genomic databases, scientific articles, bioinformatics tools, etc.) and have sufficient criteria for its interpretation and use. ■ Ability to handle massive data efficiently. ■ Recognise and understand the different file formats used in the discipline. ■ Write, present and interpret scientific and technical documentation. ■ Develop the requisite learning skills needed to pursue further studies with a high degree of autonomy.

■ Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas.
Examination achievement
Written reports
Course achievement
None
Teaching method
Lectures, practicals (data analysis)
Literature
Scientific literature will be provided during the course

↑

Name of module	Number of module
Bioinformatics	10LE07MO-M.12306
course	
Bioinformatics	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12306

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents

Introduction to bioinformatics
- Sequencing technologies and generation of next generation sequencing data. Sequencing concepts methods. Computing sequencing depth. Applications of bioinformatics in forest science.

Assembly methods
- Sequence quality assessment and data pre-treatment. Types of assemblers, algorithms for de novo assembly and mapping. Visualizing alignments.

Annotation procedures
- Annotation file formats: GFF, GTF. Current annotation strategies.

Gene expression data analysis (RNA-Seq)
- Transcript abundance measurements. Differential expression analysis and gene enrichment. Interpretation of transcriptomic results.

DNA metabarcoding pipeline
- Sequence quality control, trimming primers and adapters, quality filtering, merging reads, clustering, denoising, and taxonomic assignment. Data visualization.

Qualification

After completing this course, students will (have):
- Knowledge the different omics techniques and the application of current bioinformatics tools for the analysis of experimental data generated in forest science.
- Ability to integrate new technologies into their professional and/or research work.
- Ability to access the necessary information publicly available online in the specific field of the subject (genomic databases, scientific articles, bioinformatics tools, etc.) and have sufficient criteria for its interpretation and use.
- Ability to handle massive data efficiently.
- Recognise and understand the different file formats used in the discipline.
- Write, present and interpret scientific and technical documentation.
- Develop the requisite learning skills needed to pursue further studies with a high degree of autonomy.

■ Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas.
Examination achievement
Submission of written reports
Course achievement
None
Literature
Scientific literature will be provided during the course
Compulsory requirement
Major Environmental Modelling & Data Sciences
Recommended requirement
Basic knowledge of molecular biology and advanced computer skills. It is recommended to have used Bash and R programming language previously.
Teaching method
Lectures, practicals (data analysis)

↑

Name of module	Number of module
Modelling Environmental Systems	10LE07MO-M.12307
Responsible	
Prof. Dr. Carsten Dormann	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	60 h
Independent study	90 h
Recommended semester	2
Duration	3 Wochen
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None
Recommended requirement
Basic statistical knowledge (BSc level: distributions, likelihood) Data import and simple statistical analyses in R (www.r-project.org)

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Modelling Environmental Systems	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The module teaches skills required for the simulation of environmental processes and applies them to specific systems.
Qualification
Students will ■ understand the aims, uses and limitations of system models ■ aim generic and transferable technical skills on the use of system models ■ get the ability to judge the importance of experimental and observational data for the development and calibration of system models ■ get the ability to judge the usefulness and importance of environmental models for the management of natural resources, using forests as example

Examination achievement
Week 1-2: Graded own modelling project and homework (2/3 of final grade) Week 3: Written report (1/3 of final grade)
Course achievement
None
Literature

- Haas, E., Klatt, S., Fröhlich, A., Kraft, P., Werner, C., Kiese, R., Grote, R., Breuer, L. and Butterbach-Bahl, K.: LandscapeDNDC: A process model for simulation of biosphere-atmosphere-hydrosphere exchange processes at site and regional scale, Landsc. Ecol., 28(4), 615–636, doi:10.1007/s10980-012-9772-x, 2013.
- Kraus, D., Weller, S., Klatt, S., Haas, E., Wassmann, R., Kiese, R. and Butterbach-Bahl, K.: A new LandscapeDNDC biogeochemical module to predict CH4 and N2O emissions from lowland rice and upland cropping systems, Plant Soil, 386(1–2), 125–149, doi:10.1007/s11104-014-2255-x, 2015.
- Kraus, D., Weller, S., Klatt, S., Santabárbara, I., Haas, E., Wassmann, R., Werner, C., Kiese, R. and Butterbach-Bahl, K.: How well can we assess impacts of agricultural land management changes on the total greenhouse gas balance (CO2, CH4 and N2O) of tropical rice-cropping systems with a biogeochemical model?, Agric. Ecosyst. Environ., 224, 104–115, doi:10.1016/j.agee.2016.03.037, 2016.
- Sierra, C. A., Müller, M. and Trumbore, S. E.: Models of soil organic matter decomposition : the SOILR package, version 1.0, Geosci. Model Dev., 5, 1045–1060, doi:10.5194/gmd-5-1045-2012, 2012.
- LandscapeDNDC Users Guide (https://ldndc.imk-ifu.kit.edu/products/ldndc-usersguide.pdf)
- Bossel (2004) Systemzoo 2 - Klima, Ökosysteme und Ressourcen. Books on Demand
- Landsberg, J.J., Waring, R.H., Coops, N.C., 2003. Performance of the forest productivity model 3-PG applied to a wide range of forest types. Forest Ecology and Management 172: 199-214.
- Nagel, J., 2012: Waldwachstumsmodell BWinPro http://www.nw-fva.de/~nagel/
- Pretzsch, H. 2001. Modellierung des Waldwachstums. Parey, Berlin. 341 S.
- Soetart & Herman (2009) A Practical Guide to Ecological Modelling – Using R as a Simulation Platform. Springer.
- Petzold, T. Konstruktion ökologischer Modelle mit R; http://hhbio.wasser.tu-dresden.de/projects/modlim/doc/modlim.pdf
- R-Dokumentation unter http://cran.r-project.org/other-docs.html
- * indicates an open resource

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Name of module	Number of module
Modelling Environmental Systems	10LE07MO-M.12307
course	
Modelling Environmental Systems	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07Ü-M.12307/57165

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

The module teaches skills required for the simulation of environmental processes and applies them to specific systems:

- Introduction to system models (processes, states, feedbacks)
- Developing an understanding of an existing model based on the publications and manuals (e.g. forest growth, world economy, …)
- Model parameterisation
- Sensitivity analysis
- Uncertainty analysis using Monte Carlo simulations
- Introduction to the modelling of forest growth at the level of the single tree and the stand, using empirical, process-based and hybrid models
- Introduction to the modelling of tree quality
- Simulation of environmental and management scenarios with a forest growth model

All analyses will be taught in R as well as dedicate modelling software.

Qualification

Students will

- understand the aims, uses and limitations of system models
- aim generic and transferable technical skills on the use of system models
- get the ability to judge the importance of experimental and observational data for the development and calibration of system models
- get the ability to judge the usefulness and importance of environmental models for the management of natural resources, using forests as example

Examination achievement

Week 1-2: Graded own modelling project and homework (2/3 of final grade)
Week 3: Written report (1/3 of final grade)

Course achievement
None
Literature
■ Haas, E., Klatt, S., Fröhlich, A., Kraft, P., Werner, C., Kiese, R., Grote, R., Breuer, L. and Butterbach-Bahl, K.: LandscapeDNDC: A process model for simulation of biosphere-atmosphere-hydrosphere exchange processes at site and regional scale, Landsc. Ecol., 28(4), 615–636, doi:10.1007/s10980-012-9772-x, 2013. ■ Kraus, D., Weller, S., Klatt, S., Haas, E., Wassmann, R., Kiese, R. and Butterbach-Bahl, K.: A new LandscapeDNDC biogeochemical module to predict CH4 and N2O emissions from lowland rice and upland cropping systems, Plant Soil, 386(1–2), 125–149, doi:10.1007/s11104-014-2255-x, 2015. ■ Kraus, D., Weller, S., Klatt, S., Santabárbara, I., Haas, E., Wassmann, R., Werner, C., Kiese, R. and Butterbach-Bahl, K.: How well can we assess impacts of agricultural land management changes on the total greenhouse gas balance (CO2, CH4 and N2O) of tropical rice-cropping systems with a biogeochemical model?, Agric. Ecosyst. Environ., 224, 104–115, doi:10.1016/j.agee.2016.03.037, 2016. ■ Sierra, C. A., Müller, M. and Trumbore, S. E.: Models of soil organic matter decomposition : the SOILR package, version 1.0, Geosci. Model Dev., 5, 1045–1060, doi:10.5194/gmd-5-1045-2012, 2012. ■ LandscapeDNDC Users Guide (https://ldndc.imk-ifu.kit.edu/products/ldndc-usersguide.pdf) ■ Bossel (2004) Systemzoo 2 - Klima, Ökosysteme und Ressourcen. Books on Demand ■ Landsberg, J.J., Waring, R.H., Coops, N.C., 2003. Performance of the forest productivity model 3-PG applied to a wide range of forest types. Forest Ecology and Management 172: 199-214. ■ Nagel, J., 2012: Waldwachstumsmodell BWinPro http://www.nw-fva.de/~nagel/ ■ Pretzsch, H. 2001. Modellierung des Waldwachstums. Parey, Berlin. 341 S. ■ Soetart & Herman (2009) A Practical Guide to Ecological Modelling – Using R as a Simulation Platform. Springer. ■ Petzold, T. Konstruktion ökologischer Modelle mit R; http://hhbio.wasser.tu-dresden.de/projects/modlim/doc/modlim.pdf ■ R-Dokumentation unter http://cran.r-project.org/other-docs.html * indicates an open resource
Compulsory requirement
None
Recommended requirement
■ Basic statistical knowledge (BSc level: distributions, likelihood) ■ Data import and simple statistical analyses in R (www.r-project.org)
Teaching method
Lecture with exercises, excursion

↑

Name of module	Number of module
Remote Sensing and Geoinformatics	10LE07MO-M.12308
Responsible	
Prof. Dr. Teja Kattenborn	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	tbc.
Independent study	tbc.
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	each term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Remote Sensing and Geoinformatics	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The module will introduce the spectrum of geospatial data for monitoring the terrestrial biosphere. Thereupon, we dive into the analysis of different data types, including drone data for forest health assessments on local scales, Earth observation satellite data for monitoring ecosystem states at large spatial scales and characterization of functional plant traits on global scales using Big-Data from citizen science projects. These contents will tackle state of the art data analytics, such as pattern recognition, dimension reduction and deep learning.
Qualification
Students will ■ Understand the advantages and disadvantges of different geospatial datasets for monitoring terrestrial biosphere. ■ earn skills to exploit the synergies among different geospatial datasets (e.g. to overcome spatial scales) ■ obtain experience in the life cycle of data, from data acquisition, preprocessing, data analysis, communication of results to research data management.
Examination achievement
written assignment

Course achievement
none
Teaching method
Lectures, Data analytics with programming, Student presentations, Group discussions
Literature
Will be provided during the course.

↑

Name of module	Number of module
Remote Sensing and Geoinformatics	10LE07MO-M.12308
course	
Remote Sensing and Geoinformatics	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12308

ECTS-Points	5.0
Workload	150 h
Attendance	tbc
Independent study	tbc
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents
Lectures will introduce the spectrum of geospatial data for monitoring the terrestrial biosphere. Thereupon, we will dive into the analysis of different data types, including 1. drone data for forest health assessments on local scales, 2. Earth observation satellite data for monitoring ecosystem states at large spatial scales and 3. characterization of functional plant traits on global scales using Big-Data from citizen science projects. The students will perform individual analysis in small groups. The results will be summarized and visualized in a poster with joint poster session on final day. The poster is supplemented with a short (!) report (3-4 pages).
Qualification
Students will ■ Understand the advantages and disadvantges of different geospatial datasets for monitoring terrestrial biosphere. ■ earn skills to exploit the synergies among different geospatial datasets (e.g. to overcome spatial scales) ■ obtain experience in the life cycle of data, from data acquisition, preprocessing, data analysis, communication of results to research data management.
Examination achievement
written assignment
Course achievement
none
Literature
Lecture slides will be provided.
Compulsory requirement
None

Recommended requirement
Basic knowledge of geoinformatics (e.g. data handling of raster and vector data) and experience in programming (R, Python).
Teaching method
Lectures, Data analytics with programming, Student presentations, Group discussions

↑

Name of node	Number of node
Sustainability Assessment and Transformation	10LE07KT-PLU-2023-SAT-12400
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

Compulsory/Elective (C/E)	Compulsory

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Name of module	Number of module
Energy System Transition	10LE07MO-M.12404
Responsible	
Prof. Dr. Dierk Bauknecht	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	100 h
Independent study	50 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Energy System Transition	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
This seminar introduces the field of Sustainability Transitions. We will learn about main concepts and frameworks for systemic change. We will mainly use the example of the energy transition to discuss and apply theoretical insights. In order to better understand the example of the energy transition, main system implications of the transition towards an energy system based on renewable energies will be introduced and discussed.
Qualification
In this module, students will acquire knowledge on the folowing levels: ■ Getting familiar with the field of sustainability transition research: Understanding prominent concepts and frameworks in the field of socio-technical sustainability transitions ■ Applying these concepts to transitions in the making ■ Energy system knowledge: What are key system implications of renewables, options to deal with them and related regulatory approaches? What are the implications of system transformation? This includes technical, economic, social and policy knowledge. ■ How can theoretical insights inform practitioners and policy-makers and how this can be presented.
Examination achievement
Written assignment

Course achievement
Presentation
Teaching method
Socratic lectures, group work, presentations
Literature
■ Köhler, Jonathan; Geels, Frank W.; Kern, Florian; Markard, Jochen; Onsongo, Elsie; Wieczorek, Anna et al. (2019): An agenda for sustainability transitions research: State of the art and future directions. In: Environmental Innovation and Societal Transitions 31, S. 1–32. DOI: 10.1016/j.eist.2019.01.004. ■ Markard, Jochen; Raven, Rob; Truffer, Bernhard (2012): Sustainability transitions: An emerging field of research and its prospects. In: Research Policy 41 (6), S. 955–967. DOI: 10.1016/j.respol.2012.02.013. ■ IEA-RETD (2015) Integration of Variable Renewables (RE-integration), [A. Conway; Mott MacDonald] IEA Implementing Agreement for Renewable Energy Technology Deployment (IEA-RETD), Utrecht, Netherlands http://iea-retd.org/archives/publications/re-integration

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Name of module	Number of module
Energy System Transition	10LE07MO-M.12404
course	
Energy System Transition	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12404

ECTS-Points	5.0
Workload	150 h
Attendance	100 h
Independent study	50 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	german

Contents
Today we face a variety of environmental and societal challenges such as climate change or environmental pollution. These challenges are wicked problems: they are normative both in terms of problem- and solutions-defining, characterised by a high degree of complexity and uncertainty, value-laden and highly-contested, and they are context-dependent (Markard et al. 2012; Köhler et al. 2019). To solve those problems, systemic changes are necessary that alter our ways of producing and consuming, go beyond technological fixes, and include changes on multiple dimensions. This is true for a number of socio-technical systems such as the energy system. In recent years, Sustainability Transition Studies evolved as a new research agenda and multidisciplinary research community to contribute to solving these challenges. It has two main aims: (1) gaining a better understanding of transition dynamics, and (2) generating an impact for today's transitions in process (governance of transitions). This seminar introduces the field of Sustainability Transitions. We will learn about main concepts and frameworks for systemic change. We will mainly use the example of the energy transition to discuss and apply theoretical insights, but other sectors and a comparison between sectors will be discussed as well. In order to better understand the example of the energy transition, main system implications of the transition towards an energy system based on renewable energies will be introduced and discussed. Moreover, we will evaluate in how far theory can inform and help practitioners and decision-makers to guide and govern (energy) transitions in the making.
Qualification
In this module acquire knowledge on the following levels: 1. Getting familiar with the field of sustainability transition research: Understanding prominent concepts and frameworks in the field of socio-technical sustainability transitions 2. Applying these concepts to transitions in the making 3. Energy system knowledge: What are key system implications of renewables, options to deal with them and related regulatory approaches? What are the implications of system transformation? This includes technical, economic, social and policy knowledge. 4. How can theoretical insights inform practitioners and policy-makers and how this can be presented.

Examination achievement
Written assignment
Course achievement
presentation
Literature
■ Köhler, Jonathan; Geels, Frank W.; Kern, Florian; Markard, Jochen; Onsongo, Elsie; Wieczorek, Anna et al. (2019): An agenda for sustainability transitions research: State of the art and future directions. In: Environmental Innovation and Societal Transitions 31, S. 1–32. DOI: 10.1016/j.eist.2019.01.004. ■ Markard, Jochen; Raven, Rob; Truffer, Bernhard (2012): Sustainability transitions: An emerging field of research and its prospects. In: Research Policy 41 (6), S. 955–967. DOI: 10.1016/j.respol.2012.02.013. ■ IEA-RETD (2015) Integration of Variable Renewables (RE-integration), [A. Conway; Mott MacDonald] IEA Implementing Agreement for Renewable Energy Technology Deployment (IEA-RETD), Utrecht, Netherlands http://iea-retd.org/archives/publications/re-integration
Compulsory requirement
None
Teaching method
Socratic lectures, group work, presentations

↑

Name of module	Number of module
Supply Chain Modelling, Indicators, and Responsibility	10LE07MO-M.12405
Responsible	
Johan Andrés Vélez Henao	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	50 h
Independent study	100 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Supply Chain Modelling, Indicators, and Responsibility	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The course enables participants to conduct environmental footprint analysis for different consumption baskets (household consumption, public investments). The following core content will be covered: ■ Introduction to global supply chains ■ Basics of Input-Output (IO) modeling ■ Environmental extensions for IO models ■ Analytical techniques by product and sectors ■ Broad overview of advanced techniques (Structural path analysis and others) ■ Uncertainty and limitations of IO-models
Qualification
The students will ■ be able to Understand the basic principles of modeling supply chains with linear process models. ■ have a broad overview of different supply chain indicators, and will be able to estimate environmental footprints of aggregated consumption baskets with a multiregional input-output database (EXIOBASE). ■ be in the capacity to break down environmental footprints into industries or regions and reflect and discuss questions of responsibility in relation to environmental footprints and other supply chain indicators.

Examination achievement
Written assignment (100%)
Course achievement
None
Teaching method
Integrated lectures, exercises, and seminars
Literature
■ Input-Output Analysis - Foundations and Extensions, by Ronald E. Miller, University of Pennsylvania, Peter D. Blair, National Academy of Sciences, Washington DC. Publisher: Cambridge University Press, Online ISBN: 9780511626982, DOI: https://doi.org/10.1017/CBO9780511626982 ■ Sun et al. (2020): Shared and environmentally just responsibility for global biodiversity loss. ■ The Computational Structure of Life Cycle Assessment by Heijungs and Suh, Publisher: Springer Dordrecht, Online ISBN: 978-94-015-9900-9, DOI: https://doi.org/10.1007/978-94-015-9900-9 ■ Methodology sections 4 and 5 of the industrial ecology open online course (IEooc), https://www.industrial-ecology.uni-freiburg.de/teaching.aspx/

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Name of module	Number of module
Supply Chain Modelling, Indicators, and Responsibility	10LE07MO-M.12405
course	
Supply Chain Modelling, Indicators, and Responsibility	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12405/64135

ECTS-Points	5.0
Workload	150 h
Attendance	50 h
Independent study	100 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

The course enables participants to conduct environmental footprint analysis for different consumption baskets (household consumption, public investments). The following core content will be covered:

- Introduction to global supply chains
- Basics of Input-Output (IO) modeling
- Environmental extensions for IO models
- Analytical techniques by product and sectors
- Broad overview of advanced techniques (Structural path analysis and others)
- Uncertainty and limitations of IO-models

Qualification

The students will

- be able to Understand the basic principles of modeling supply chains with linear process models.
- have a broad overview of different supply chain indicators, and will be able to estimate environmental footprints of aggregated consumption baskets with a multiregional input-output database (EXIOBASE).
- be in the capacity to break down environmental footprints into industries or regions and reflect and discuss questions of responsibility in relation to environmental footprints and other supply chain indicators.

Examination achievement

Written assignment (100%)

Course achievement

None

Literature

- Input-Output Analysis - Foundations and Extensions, by Ronald E. Miller, University of Pennsylvania, Peter D. Blair, National Academy of Sciences, Washington DC. Publisher: Cambridge University Press, Online ISBN: 9780511626982, DOI: https://doi.org/10.1017/CBO9780511626982
- Sun et al. (2020): Shared and environmentally just responsibility for global biodiversity loss.
- The Computational Structure of Life Cycle Assessment by Heijungs and Suh, Publisher: Springer Dordrecht, Online ISBN: 978-94-015-9900-9, DOI: https://doi.org/10.1007/978-94-015-9900-9

- Methodology sections 4 and 5 of the industrial ecology open online course (IEooc), https://www.industrialecology.uni-freiburg.de/teaching.aspx/

Additional literature such as book chapters, journal articles and reports will be shared via ILIAS.

Compulsory requirement
None
Recommended requirement
Familiarity with quantitative analysis, basic matrix algebra and basic programming skills (python) An introduction to these concepts will be given in the course Material and energy flow analysis in the 1st semester.
Teaching method
Integrated lectures, exercises, and seminars
Recommendation
Calculations with Excel, Basic knowledge on vectors, matrices, matrix multiplication, and matrix inversion. Basic programming skills in python (e.g., operation with matrixes, libraries such as pandas and numpy. Important: This course requires each participant to work on her/his own laptop with the with python and EXIOBASE database a free source. Libraries such as: pandas, numpy, pymrio and matplotlib are going to be used intensively in the course

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Name of module	Number of module
Sustainability Law and Transformation	10LE07MO-M.12406
Responsible	
Prof. Dr. Cathrin Zengerling	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5
Workload	150 h
Hours of week	
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None
Recommended requirement
Some prior knowledge in law is helpful but not required

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Sustainability Law and Transformation	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The course introduces into and discusses the role of law in sustainability transformations.
Qualification
Students will ■ be familiarised with the fundamentals of law and in particular the role of law in sustainability transformations. ■ have a basic knowledge of the fundamentals of law in an international context, including law-making, implementation and enforcement. ■ understand how the concept of sustainable development is (or is not) translated into legislation from the international to the local level. ■ gain a basic knowledge of legal frameworks in areas such as energy and land transitions, circular economy and supply chain regulation. ■ be able to integrate perspectives of environmental law, human rights, economic/trade and labour law. ■ be able to identify links between sustainability assessments and law-making, implementation and enforcement. ■ apply theories of transition and transformation to legal processes in the context of sustainability law. ■ be able to identify and analyse opportunities and barriers to sustainability transformations through a lens of critical legal theory.

Examination achievement
Written assignment
Course achievement
Presentation
Literature
Selected book chapters, journal articles and legal texts available via ILIAS

↑

Name of module	Number of module
Sustainability Law and Transformation	10LE07MO-M.12406
course	
Sustainability Law and Transformation	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12406

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

The course introduces into and discusses the role of law in sustainability transformations. The following core content will be covered:

- Introduction to the basics of law, including law-making, implementation and enforcement
- Characteristics of sustainability transformations and frictions with the functions of law
- Law from local to global scales in a context of decolonization
- Reflection of the concept of sustainable development in laws and institutions, including shortcomings
- Introduction of legal frameworks in key areas of sustainability transformations (energy transition, land transition, circular economy, supply chain regulation, etc.)
- Fragmentation and linkages between environmental, human rights, labour, economic and trade law
- The role of sustainability assessments in law-making, implementation and enforcement
- Introduction to theories and concepts of transformation and transition and their application of these theories and concepts to legal processes
- Introduction to critical legal theory and its application to legal processes in the context of sustainability transformations

Students will have the opportunity to focus their term papers on topics of their own choice in the context of the course.

Qualification

Students will

- be familiarised with the fundamentals of law and in particular the role of law in sustainability transformations.
- have a basic knowledge of the fundamentals of law in an international context, including law-making, implementation and enforcement.
- understand how the concept of sustainable development is (or is not) translated into legislation from the international to the local level.
- gain a basic knowledge of legal frameworks in areas such as energy and land transitions, circular economy and supply chain regulation.
- are able to integrate perspectives of environmental law, human rights, economic/trade and labour law.
- are able to identify links between sustainability assessments and law-making, implementation and enforcement.
- can apply theories of transition and transformation to legal processes in the context of sustainability law.
- are able to identify and analyse opportunities and barriers to sustainability transformations through a lens of critical legal theory.

Examination achievement
written assignment
Course achievement
presentation
Literature
Selected book chapters, journal articles and legal texts available via ILIAS
Compulsory requirement
None
Recommended requirement
Some prior knowledge in law is helpful but not required

↑

Name of module	Number of module
Systems Thinking, Planning and Transition	10LE07MO-M.12407
Responsible	
Prof. Dr. Heiner Schanz	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	70 h
Independent study	80 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Systems Thinking, Planning and Transition	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
The module introduces systems thinking and systems analysis/modeling in the context of planning and managing sustainability transitions.
Qualification
Learning goals and qualifications In this module students learn to: ■ understand the basic properties of complex adaptive system and their challenges for governance (1, 2) ■ comprehend the core strands of planning and transition research for sustainability (1,2) ■ identify, explore and understand patterns of complexity through contributrions from integrative systems sciences (3,4) ■ address complex/problems in using methods, tools, frameworks and practice patterns from systems thinking practice (3,4) ■ apply causal loop diagrams as a basis for system dynamics modeling / analysis (4) ■ develop critical thinking, reading, and research skills (3, 6); Classification of cognitive skills following Bloom (1956): 1 = Knowledge: recalling facts, terms, basic concepts and answers; 2 = Comprehension: understanding something; 3 = Application: using a general concept to solve problems in a particular situation; 4 = Analysis:

breaking something down into its parts; 5 = Synthesis: creating something new by putting parts of different ideas together to make a whole; 6 = Evaluation: judging the value of material or methods.
Examination achievement
Written Exam
Course achievement
none
Teaching method
Lecture, group work, workshops
Literature
A list of relevant texts will be made available at the start of the course; obligatory readings will be made available online in electronic form. ■ Bala, B. K., Arshad, F. M., & Noh, K. M. (2017). Systems Thinking: System Dynamics. In System Dynamics: Modelling and Simulation (pp. 15-35). Singapore: Springer Singapore. https://doi.org/10.1007/978-981-10-2045-2_2 ■ Barbrook-Johnson, P., & Penn, A. S. (Eds.). (2022). Systems Mapping: How to build and use causal models of systems. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-01919-7_1 ■ Mandl, C. E. (2023). Managing Complexity in Social Systems - Leverage Points for Policy and Strategy (2nd ed.). Cham: Springer. https://doi.org/10.1007/978-3-031-30222-0 ■ Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955-967. doi:10.1016/j.respol.2012.02.013

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Name of module	Number of module
Systems Thinking, Planning and Transition	10LE07MO-M.12407
course	
Systems Thinking, Planning and Transition	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12407/94185

ECTS-Points	5.0
Workload	150 h
Attendance	70 h
Independent study	80 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents
The module provides an introduction to systems thinking and systems analysis / modelling in the context of planning and managing sustainability transitions. Based on a short introduction to complexity science, the conceptual foundations of complex adaptive systems will be highlighted. Subsequently, different aspects such as analysis, modeling and design of social-ecological systems are discussed from a theoretical and applied perspective (conceptual approaches, methodologies and instruments). The module is divided into preparatory literature study, lectures (mornings), short workshops on modeling approaches and tools (afternoons), and concludes in the third week with a 3-day workshop on causal loop diagramming as a tool for analyzing dynamics in complex systems.
Qualification
Learning goals and qualifications In this module students learn to: ■ understand the basic properties of complex adaptive system and their challenges for governance (1, 2) ■ comprehend the core strands of planning and transition research for sustainability (1,2) ■ identify, explore and understand patterns of complexity through contributrions from integrative systems sciences (3,4) ■ address complex/problems in using methods, tools, frameworks and practice patterns from systems thinking practice (3,4) ■ apply causal loop diagrams as a basis for system dynamics modeling / analysis (4) ■ develop critical thinking, reading, and research skills (3, 6); Classification of cognitive skills following Bloom (1956): 1 = Knowledge: recalling facts, terms, basic concepts and answers; 2 = Comprehension: understanding something; 3 = Application: using a general concept to solve problems in a particular situation; 4 = Analysis: breaking something down into its parts; 5 = Synthesis: creating something new by putting parts of different ideas together to make a whole; 6 = Evaluation: judging the value of material or methods.
Examination achievement
Written Exam

Course achievement
none
Literature
A list of relevant texts will be made available at the start of the course; obligatory readings will be made available online in electronic form. ■ Bala, B. K., Arshad, F. M., & Noh, K. M. (2017). Systems Thinking: System Dynamics. In System Dynamics: Modelling and Simulation (pp. 15-35). Singapore: Springer Singapore. https://doi.org/10.1007/978-981-10-2045-2_2 ■ Barbrook-Johnson, P., & Penn, A. S. (Eds.). (2022). Systems Mapping: How to build and use causal models of systems. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-01919-7_1 ■ Mandl, C. E. (2023). Managing Complexity in Social Systems - Leverage Points for Policy and Strategy (2nd ed.). Cham: Springer. https://doi.org/10.1007/978-3-031-30222-0 ■ Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955-967. doi:10.1016/j.respol.2012.02.013
Compulsory requirement
None
Teaching method
Lecture, group work, workshops

↑

Name of node	Number of node
Wildlife and Biodiversity	10LE07KT-PLU-2023-WaB-12500
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

Compulsory/Elective (C/E)	Compulsory

↑

Name of module	**Number of module**
Experimental Ecology	10LE07MO-M.12505
Responsible	
Prof. Dr. Alexandra-Maria Klein	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	100 h
Independent study	50 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Experimental Ecology	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
During this course students will acquire knowledge of observational and experimental research in theory and practice. Particular emphasis will be set on practical experience in the field.
Qualification
Students will be able to: ■ Understand the importance of evidence in nature conservation and management ■ Recall the principles of scientific data collection ■ Name and describe common designs and approaches in experimental ecology ■ Explain and discuss advantages/disadvantages and strengths/limitations of different approaches ■ Recognize and evaluate experimental designs in current projects in conservation and biodiversity research ■ Propose and conduct an independent research project including to: a) generate a relevant research question and the correct corresponding hypothesis, b) design and plan an appropriate experiment, c) carry out the data collection in teamwork, d) analyse the data and describe results clearly in text and visualize graphically e) synthesize, interpret and discuss the results in the context of available literature, f) communicate the project effectively in oral and written form ■ Recognize and critically reflect on the strengths and limitations of the own project

Examination achievement
written report
Course achievement
oral presentation
Teaching method
Lectures, project work, excursion
Literature
■ Clapham, A. R. (1966) What is experimental ecology? Folia Geobotannica & Phytotaxonomica Vol 1(1): 88-92. ■ Karban, Huntziger, Pearse (2023) How to do ecology – A concise handbook. Third edition. Princeton University Press ■ Spezifische Studien aus Fachzeitschriften

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Name of module	Number of module
Experimental Ecology	10LE07MO-M.12505
course	
Experimental Ecology	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12505/22205

ECTS-Points	5.0
Workload	150 h
Attendance	100 h
Independent study	50 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

During this course students will acquire knowledge of observational and experimental research in theory and practice. For demonstration, ongoing and relevant projects of researchers at Freiburg University will be visited in three afternoon excursions during the first week. Particular emphasis will be set on practical experience in the field. For this, students will plan independent research projects in small groups, that will be carried out during the second and third course week.

- Introduction to observational and experimental ecology
- Principles of developing and planning a research project
- Presentation of methods and design in experimental ecology in theory
- Illustration by visiting current projects in the fields of biodiversity, nature conservation and forest ecology
- Development and conduction of student research projects in groups related to the fields of plant ecology, animal ecology or biotic interaction at the level of population or community ecology - depending on the students' interests
- Presentation of projects in oral and written form

Qualification

Students will be able to:

- Understand the importance of evidence in nature conservation and management
- Recall the principles of scientific data collection
- Name and describe common designs and approaches in experimental ecology
- Explain and discuss advantages/disadvantages and strengths/limitations of different approaches
- Recognize and evaluate experimental designs in current projects in conservation and biodiversity research
- Propose and conduct an independent research project including to: a) generate a relevant research question and the correct corresponding hypothesis, b) design and plan an appropriate experiment, c) carry out the data collection in teamwork, d) analyse the data and describe results clearly in text and visualize graphically e) synthesize, interpret and discuss the results in the context of available literature, f) communicate the project effectively in oral and written form
- Recognize and critically reflect on the strengths and limitations of the own project

Examination achievement
written report
Course achievement
oral presentation
Literature
■ Clapham, A. R. (1966) What is experimental ecology? Folia Geobotannica & Phytotaxonomica Vol 1(1): 88-92. ■ Karban, Huntziger, Pearse (2023) How to do ecology – A concise handbook. Third edition. Princeton University Press ■ spezifische Studien aus Fachzeitschriften
Compulsory requirement
None
Recommended requirement
Basics in statistic, Knowledge of native species
Teaching method
Lecture, Project work

↑

Name of module	Number of module
Protected Area Management	10LE07MO-M.12506
Responsible	
Prof. Dr. Marco Dietmar Heurich	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	90 h
Independent study	60 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Protected Area Management	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
■ Categories of protected areas ■ Planning and designing reserve systems ■ Social and cultural aspects
Qualification
In this module, the students will ■ obtain an overview of the major scientific concepts and actual topics in protected area management. ■ get an insight into the diversity of management approaches in protected areas. ■ examine concrete examples of case studies and literature and gain some practical experience based on excursions. ■ discuss the strengths and weaknesses of different types of protected areas ■ understand the complexity of protected area management. The course will qualify students for advanced education in the management of protected areas (PhD programmes) and provide the scientific background for careers in the management of protected areas.
Examination achievement
Written exam (90 min)

Course achievement
None
Teaching method
Lectures, Excursion, Tutorials
Literature
■ Harmon, D., & Conard, R. (2016,). The Evolution of the National Park Service: A Hundred Years of Changing Ideas. In The George Wright Forum (Vol. 33, No. 2, p. 230). George Wright Society. ■ Parker, E. (2022). Integrated Protected Area Management. States Academic Press. ■ Stolton, S., Shadie, P., & Dudley, N. (2013). Guidelines for applying protected area management categories including IUCN WCPA best practice guidance on recognising protected areas and assigning management categories and governance types. ■ Watson, J. E., Dudley, N., Segan, D. B., & Hockings, M. (2014). The performance and potential of protected areas. Nature, 515(7525), 67-73

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Name of module	Number of module
Protected Area Management	10LE07MO-M.12506
course	
Protected Area Management	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07S-M.12506/52170

ECTS-Points	5.0
Workload	150 h
Attendance	90 h
Independent study	60 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents

- PA´s as the cornerstone of the global strategy for the protection of biodiversity
- Categories of protected areas and legal foundations
- History of protected areas and the evolution of management objectives
- Planning and design of PA systems
- Species conservatin/visitor management/wildlife management/environmental education/ conservation and research in PA´s
- Ranger systems
- Incorporating social and cultural context
- Conflict resolution, participation
- Evaluation of management effectiveness of protected areas

Qualification

In this module, the students will
- obtain an overview of the major scientific concepts and actual topics in protected area management.
- get an insight into the diversity of management approaches in protected areas.
- examine concrete examples of case studies and literature and gain some practical experience based on excursions.
- discuss the strengths and weaknesses of different types of protected areas
- understand the complexity of protected area management.

The course will qualify students for advanced education in the management of protected areas (PhD programmes) and provide the scientific background for careers in the management of protected areas.

Examination achievement

Written exam (90 min)

Course achievement

None

Literature
■ Harmon, D., & Conard, R. (2016,). The Evolution of the National Park Service: A Hundred Years of Changing Ideas. In The George Wright Forum (Vol. 33, No. 2, p. 230). George Wright Society. ■ Parker, E. (2022). Integrated Protected Area Management. States Academic Press. ■ Stolton, S., Shadie, P., & Dudley, N. (2013). Guidelines for applying protected area management categories including IUCN WCPA best practice guidance on recognising protected areas and assigning management categories and governance types. ■ Watson, J. E., Dudley, N., Segan, D. B., & Hockings, M. (2014). The performance and potential of protected areas. Nature, 515(7525), 67-73
Compulsory requirement
None
Recommended requirement
Basic knowledge in ecology
Teaching method
Lectures, Excursion, Tutorials

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Name of module	Number of module
Research in Wildlife Ecology	10LE07MO-M.12507
Responsible	
Prof. Dr. Gernot Gunter Segelbacher	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	70 h
Independent study	80 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	takes place each summer term

Compulsory requirement
None
Recommended requirement
Statistical knowledge

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Research in Wildlife Ecology	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
■ Overview on methods in wildlife research ■ Wildlife monitoring approaches ■ Data analysis and interpretation
Qualification
Students will ■ obtain an overview on different methods and approaches which are applied in wildlife research. ■ get an insight in the diversity of research approaches, their backgrounds and areas of application. ■ work on case studies, read original literature as well as gain practical experience based on field work, excursions and analysis of real data sets. ■ discuss the strengths and weaknesses of different research methods. ■ focus on wildlife monitoring and its recent developments, e.g. genetic approaches. ■ be qualified for advanced education in conservation biological and wildlife biology research (PhD programmes). The module provides the scientific background for careers in wildlife ecology.

Examination achievement
Written assignment
Course achievement
Report and excursions
Teaching method
Lectures, field work, group assignments
Literature
■ Morellet, N., Klein, F., Solberg, E., Andersen, R. (2011) The census and management of populations of ungulates in Europa. In: Putman, R., Apollonio, M., Andersen, R. (Eds.): Ungulate Management in Europe: Problems and Practices. Cambridge University Press.

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Name of module	Number of module
Research in Wildlife Ecology	10LE07MO-M.12507
course	
Research in Wildlife Ecology	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07S-M.12507/52120

ECTS-Points	5.0
Workload	150 h
Attendance	70 h
Independent study	80 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents
Overview on different methods in wildlife ecology and wildlife research 1. Tracking and monitoring of wildlife (telemetry, camera trapping and other monitoring methods) 2. Sampling design, data analysis and interpretation 3. Developing individual research projects
Qualification
Students will ■ obtain an overview on different methods and approaches which are applied in wildlife research. ■ get an insight in the diversity of research approaches, their backgrounds and areas of application. ■ work on case studies, read original literature as well as gain practical experience based on field work, excursions and analysis of real data sets. ■ discuss the strengths and weaknesses of different research methods. ■ focus on wildlife monitoring and its recent developments, e.g. genetic approaches. ■ be qualified for advanced education in conservation biological and wildlife biology research (PhD programmes). The module provides the scientific background for careers in wildlife ecology.
Examination achievement
Written assignment
Course achievement
Report and excursions
Literature
■ Morellet, N., Klein, F., Solberg, E., Andersen, R. (2011) The census and management of populations of ungulates in Europa. In: Putman, R., Apollonio, M., Andersen, R. (Eds.): Ungulate Management in Europe: Problems and Practices. Cambridge University Press.
Compulsory requirement
None

Recommended requirement
Statistical knowledge
Teaching method
Lectures, field work, group assignments

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Name of module	Number of module
Wildlife Behavioural Ecology	10LE07MO-M.12508
Responsible	
Dr. Luca Corlatti	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	
Attendance	90 h
Independent study	60 h
Recommended semester	2
Duration	3 weeks
Compulsory/Elective (C/E)	Compulsory
Frequency	each term

Compulsory requirement
None
Recommended requirement
Basic knowledge in ecology

Assigned Courses					
Name	Type	C/E	ECTS	HoW	Workload
Wildlife Behavioural Ecology	andere (z.B. Kurse, Tutorien)	Compulsory	5.0	4.0	150 h

Contents
■ Introduction to behavioural ecology ■ Choosing where to live and resource competition ■ Predators, preys and the Landscape of Fear ■ Sexual selection, parental care and family conflicts ■ Mating systems and strategies ■ Living in groups and social behaviour
Qualification
Students will ■ be introduced into the main topics in animal behaviour and can combine them with concepts of evolutionary biology, population ecology and conservation biology ■ learn how the theory of evolution through natural and sexual selection and the life history theory can be used to gain an understanding of the adaptive value of different behaviours, from the selfish to the cooperative ones, and how this can serve as a support for conservation actions. ■ read original papers in specific areas of behavioural ecology and will discuss them critically.

■ use the knowledge acquired in the first part of the module to propose original ideas for investigations in behavioural ecology.
Examination achievement
Oral exam, presentation
Course achievement
None
Teaching method
Presentation, group work, group assignements
Literature
Davies, N.B., Krebs, J.R, West, S.A. (2012) An Introduction to Behavioural Ecology, 4th Ed. Wiley-Blackwell.

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Name of module	Number of module
Wildlife Behavioural Ecology	10LE07MO-M.12508
course	
Wildlife Behavioural Ecology	
Event type	Number
andere (z.B. Kurse, Tutorien)	10LE07V-M.12508/64088

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	2
Frequency	takes place each summer term
Compulsory/Elective (C/E)	Compulsory
Language	english

Contents
■ Introduction to behavioural ecology ■ Choosing where to live and resource competition ■ Predators, preys and the Landscape of Fear ■ Sexual selection, parental care and family conflicts ■ Mating systems and strategies ■ Living in groups and social behaviour
Qualification
Students will ■ be introduced into the main topics in animal behaviour and can combine them with concepts of evolutionary biology, population ecology and conservation biology ■ learn how the theory of evolution through natural and sexual selection and the life history theory can be used to gain an understanding of the adaptive value of different behaviours, from the selfish to the cooperative ones, and how this can serve as a support for conservation actions. ■ read original papers in specific areas of behavioural ecology and will discuss them critically. ■ use the knowledge acquired in the first part of the module to propose original ideas for investigations in behavioural ecology.
Examination achievement
Oral exam, presentation
Course achievement
None
Literature
Davies, N.B., Krebs, J.R, West, S.A. (2012) An Introduction to Behavioural Ecology, 4th Ed. Wiley-Blackwell.
Compulsory requirement
none

Recommended requirement
Basic knowledge of ecology
Teaching method
Presentation, group work, group assignements

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