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

Module description handbook (Modulhandbuch)

Master of Science (M.Sc.) Umweltwissenschaften / Environmental Sciences
(Prüfungsordnung 2023 / Examination regulations version 2023 = PO 2023)

universität freiburg

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Prolog

---------- english version ----------

Content/Aim

In Freiburg, environmental sciences are characterized by the interdisciplinary interaction of forest sciences, geosciences, geography and hydrology. The spectrum of teaching content ranges from fundamental ecosystem interrelationships to current issues of ecological change and technical and socio-economic strategies for the preservation, adaptation and restoration of an intact environment. The guiding principle of sustainability in dealing with the environment and natural resources is of central importance.
The basic knowledge acquired can be applied and further developed in application-orientated 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 for environmental scientists in science and practice.

Language

The core modules are offered in English for all students.
Depending on the chosen major, the teaching language in the major modules is predominantly English or German.
For a German major, the English language level B2 of the Common European Framework of Reference for Languages is required.
For the English majors, proof of English language level C1 of the Common European Framework of Reference for Languages must be submitted with the application.
Native speakers are exempt from this requirement.
Individual electives are offered in either German or English.

Structure of the program

The modules in the winter semester are always semester-long. In the summer semester, the modules are organized in consecutive 3-week block courses. All modules have a scope of 5 ECTS, which corresponds to a workload of 150 hours/module (contact time plus self-study and examination time).

1. semester (winter semester): 2 core modules, 4 major modules (semester-wise structure)
2. semester (summer semester): 4 major modules, optionally 1 individual elective (block-structure)
3. semester (winter semester): 1 core module, 2 major modules, a total of 3 individual electives (semester-wise structure)
4. semester (summer semester): master thesis (6 months)

mandatory internship (min. 7 weeks, recommended between 2nd & 3rd semester)

Explanation of the module types and examinations mentioned:

1. Basic/Core modules: The three core modules (15 ECTS) are compulsory for all students of the MSc Environmental Sciences. They are offered in the first and third semesters.
2. Major modules: When you apply, you choose one of the five majors. Ten modules totaling 50 ECTS are then taken in the first three semesters.
3. Individual electives: Three individual electives totaling 15 ECTS must be taken during the course of the program. Students can choose from a variable offer of modules for the two Master's program in Forest Sciences and Environmental Sciences or 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.

- Internship:

An internship (10 ECTS) of at least 7 weeks (full-time) is required for the successful completion of the MSc Environmental Sciences. It is usually completed during the lecture-free period between the second and third semesters, 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 one internship 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.

- Master's thesis:

The Master's thesis is worth 30 ECTS credits and is an examination paper in which the candidate should demonstrate that he/she is able to work on a topic from his/her field of study within the specified period (6 months) using scientific methods and present the results adequately. The topic and the supervisors are organized and agreed by the students themselves. Students with a minimum of 60 ECTS credits on their transcript of records can register for the Master's thesis.

Remark:
This module handbook only lists the mandatory Major and Core modules that are offered in the corresponding semester. Compulsory elective modules are listed in a separate document.

---------- Deutscher Prolog ----------

Inhalt/Ziel
In Freiburg sind die Umweltwissenschaften geprägt durch das interdisziplinäre Miteinander der Forstwissenschaften, Geowissenschaften, Geographie und Hydrologie. Das Spektrum der Lehrinhalte reicht dabei von grundlegenden ökosystemaren Zusammenhängen über aktuelle Fragen ökologischer Veränderungen bis hin zu technischen und sozioökonomischen 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 Grundlagenwissen 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.

Sprache
Die Grundlagenmodule werden für alle Studierenden gemeinsam auf Englisch angeboten.
Je nach gewählter Profillinie ist die Lehrsprache in den Profillinienmodulen überwiegend Englisch oder Deutsch.
Für eine deutsche Profillinie wird das englische Sprachniveau B2 des Gemeinsamen Europäischen Referenzrahmens gefordert.
Für die englischen Profillinien muss ein Nachweis über das englische Sprachniveau C1 des Gemeinsamen Europäischen Referenzrahmens bei der Bewerbung vorliegen.
Muttersprachler sind von der Nachweispflicht ausgenommen.
Wahlpflichtmodule werden entweder auf Deutsch oder Englisch angeboten.

Aufbau des Studiums
Die Module im Wintersemester sind immer semesterbegleitend. Im Sommersemester sind die Module in aufeinanderfolgende 3-wöchigen-Blockveranstaltungen organisiert. Alle Module haben

einen Umfang von 5 ECTS, was einem Workload von 150h/Modul (Kontaktzeit plus Selbststudium und Prüfungszeit) entspricht.

1. Fachsemester (Wintersemester): 2 Grundlagenmodule, 4 Profillinienmodule (semesterbegleitend)
2. Fachsemester (Sommersemester): 4 Profillinienmodule, optional 1 Wahlpflichtmodul aus dem Angebot (geblockt)
3. Fachsemester (Wintersemester): 1 Grundlagenmodul, 2 Profillinienmodule, insgesamt 3 Wahlpflichtmodule (semesterbegleitend)
4. Fachsemester (Sommersemester): Masterarbeit (6 Monate)

- Pflichtpraktikum (min. 7 Wochen, empfohlen in der veranstaltungsfreien Zeit zwischen 2. und 3. Semester)

Erläuterung zu den genannten Modultypen und Prüfungsleistungen:

1. Grundlagenmodule/Kernmodule: Die drei Grundlagenmodule (15 ECTS) sind für alle Studierenden des M.Sc. Umweltwissenschaften verpflichtend. Sie werden im ersten und dritten Semester angeboten.
2. Profillinienmodule: Mit der Bewerbung legt man sich auf eine der fünf Profillinien fest. In dieser werden dann in den ersten drei Semestern zehn Module im Umfang von 50 ECTS belegt.
3. Wahlpflichtmodule:Im Laufe des Studiums müssen drei Wahlpflichtmodule im Umfang von 15 ECTS belegt werden. Die Studierenden können hier aus einem variablem Modulangebot für die beiden Masterstudiengänge Forstwissenschaften und Umweltwissenschaften oder Module anderer Masterstudiengänge der Fakultät, der Universität oder außerhalb der Universität wählen, solange ein fachlicher Zusammenhang besteht.

- Praktikum:

Für den erfolgreichen Abschluss des M.Sc. Umweltwissenschaften ist ein Praktikum (10 ECTS) von mindestens 7 Wochen (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, Ihnen Tipps und Kontakte aus ihren Netzwerken zu geben.

- Masterarbeit:

Die Masterarbeit hat einen Leistungsumfang von 30 ECTS-Punkten und ist eine Prüfungsarbeit, in der der Kandidat/die Kandidatin zeigen soll, dass er/sie in der Lage ist, innerhalb der vorgegebenen Frist (6 Monate) ein Thema aus seinem/ihrem Studienfach nach wissenschaftlichen Methoden 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.

Anmerkung:

Dieses Modulhandbuch listet nur die verpflichtenden Profillinien- und Grundlagenmodule auf, die im entsprechenden Semester angeboten werden. Wahlpflichtmodule werden in einem weiteren Dokument aufgeführt.

Name of node	Number of node
Core Modules	10LE07KT-GLBU-2023-11100
Fakultät / Faculty	
Fakultät für Umwelt und natürliche Ressourcen / Faculty of Environment and Natural Ressources	

Mandatory or Elective	Mandatory

↑

Name of module	Number of module
Multi-Disciplinary Perspectives on Environmental Sciences	10LE07MO-M.11101
Responsible	
Prof. Ph.D. Stefan Pauliuk	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	75 h
Independent study	75 h
Recommended semester	1
Duration	1
Mandatory or Elective (M/E)	Mandatory
Frequency	in every Wintersemester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Multi-Disciplinary Perspectives on Environmental Sciences	Course	Mandatory	5.0	4.0	150 h

Contents
Leading experts from the Faculty of Environment and Natural Resources in Freiburg will present their research field and focus within the environmental sciences. They will present core concepts, methods, and selected applications as well as introduce a topical exercise or other form of assignment from that discipline. On top of that, core concepts of the philosophy and ethics of science will be introduced, as well as concepts to describe the relation between science and society. Different concepts of generating and verifying scientific knowledge based on scientific evidence will be presented, and a number of case studies will be discussed to apply the concepts across multiple disciplines. Students will get an overview of which modes of science are followed by the different fields present in the MSc program, what constitute valid research questions and methods in the different fields, and what type of evidence and knowledge are generated. The first, topical part accounts for about 2/3, the latter, science-philosophical part, accounts for about 1/3 of the course.
Qualification
This course provides students with a broad overview of the different scientific fields, methods, and modes of conducting sciences at the Faculty of Environment and Natural Resources in Freiburg. Each field will be

introduced by a leading expert from the faculty, who will present core concepts and selected applications as well as introduce a topical exercise or other form of assignment from that discipline. On top of that, students will work with core concepts of the philosophy and ethics of science, as well as concepts to describe the relation between science and society. They will be able to apply those concepts to the different disciplines presented by the experts, to identify which modes of science are followed, what constitute valid research questions and methods in the different fields, and what type of evidence and knowledge are generated. The first, topical part accounts for about 2/3, the latter, science-philosophical part, accounts for about 1/3 of the course.
Examination achievement
Written assignment
Course achievement
none
Teaching method
Lectures and seminars
Literature
Reading material will be provided on ILIAS.

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Name of module	Number of module
Multi-Disciplinary Perspectives on Environmental Sciences	10LE07MO-M.11101
Event	
Multi-Disciplinary Perspectives on Environmental Sciences	
Event type	Number
Course	10LE07V-M.11101

ECTS-Points	5.0
Workload	150 h
Attendance	75 h
Independent study	75 h
Hours of week (HoW)	4.0
Recommended semester	1
Frequency	every Winter semester
Mandatory or Elective (M/E)	Mandatory

Contents
Leading experts from the Faculty of Environment and Natural Resources in Freiburg will present their research field and focus within the environmental sciences. They will present core concepts, methods, and selected applications as well as introduce a topical exercise or other form of assignment from that discipline. On top of that, core concepts of the philosophy and ethics of science will be introduced, as well as concepts to describe the relation between science and society. Different concepts of generating and verifying scientific knowledge based on scientific evidence will be presented, and a number of case studies will be discussed to apply the concepts across multiple disciplines. Students will get an overview of which modes of science are followed by the different fields present in the MSc program, what constitute valid research questions and methods in the different fields, and what type of evidence and knowledge are generated. The first, topical part accounts for about 2/3, the latter, science-philosophical part, accounts for about 1/3 of the course.
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Examination achievement
Written assignment

Course achievement
none
Literature
Reading material will be provided on ILIAS.
Compulsory requirement
None
Recommended requirement
None
Teaching method
Lectures and seminars

↑

Name of module	**Number of module**
Research Skills	10LE07MO-M.11102
Responsible	
Dr. Gian Marco Palamara	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week (HoW)	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory or Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Research Skills	Course	Mandatory	5.0	4.0	150 h

Contents
The aim of this module is acquiring the basic skills and concepts that are needed to conduct and communicate scientific research.
Qualification
Students will be able - to plan and perform a simple research project, applying the scientific method. - to interpret, critically reflect on and communicate scientific results. Students will have - a basic understanding of all important aspects of science, being able to describe concepts of good scientific practice, experimental design and structure of a research paper. Students will know - some tools for literature search and management, data analysis and scientific writing and they will be able to use them in a simple setting.

Examination achievement
Project paper (developed in series of assignments) (5-15 pages, 50%) Oral presentation (25%) Mid-term Report (25%)
Course achievement
none

↑

Name of module	Number of module
Research Skills	10LE07MO-M.11102
Event	
Research Skills	
Event type	Number
Course	10LE07S-M.11102

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week (HoW)	4.0
Recommended semester	1
Frequency	every winter semester
Mandatory or Elective (M/E)	Mandatory
Group size	91

Contents

Research skills refer to a mixture of abilities that researchers need to acquire at some point in their career. Most of them are also useful beyond research and the scope of this module is thus a very wide one. The content falls broadly into the following categories:

- Generating ideas and hypotheses: sketching ideas, flowcharts, logical thinking, brainstorming, finding parallels/metaphors
- Planning and executing: experimental design, identifying a good hypothesis, simulation experiments, statistics basics
- Good scientific practice: reproducibility, validity, lab notebook, versioning, backups, plagiarism/fraud
- Knowing the state of the art: literature reviews, online searches, when to look (and when not to), judging quality of findings, track records and ratings, quick reading; social media and science, citing literature
- Scientific communication, writing and graphics: publication formats and their structure, free software for data analysis and writing (LibreOffice, LaTeX, JabRef, R); telling a story with scientific results and data, tables vs. figures; what to keep in/out; writing style, typical language issues; graphic quality
- Presentations and Posters (harmonizing audience, aim and own personality; the role of surprise; new/known-balance)

Qualification

Students

- will get a broader horizon of research practice and a better understanding of the scientific method
- understand how to formulate a research question and hypotheses
- understand the importance of communication of research results
- know some important tools and software for scientific activities

Examination achievement

none

Course achievement

Project paper (developed in series of assignments) (5-15 pages, 50%)
Oral presentation (25%)
Mid-term Report (25%)

Literature
■ W.C. Booth, G.G. Colomb and J.M. Williams (2003) The craft of research. University of Chicago Press 2nd / 3rd edition. ■ Florian Hartig. Lecture Notes “Research Skills” (http://florianhartig.github.io/ResearchSkills/, https://www.dropbox.com/s/1otretqxn2o34e3/ResearchSkills.pdf)
Compulsory requirement
none
Recommended requirement
Basic Knowledge of R
Teaching method
Lectures, tutored exercises, group work

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Name of module	**Number of module**
Research in Environmental Science	10LE07MO-M.11103
Responsible	
Prof. Dr. Andreas Christen	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	3
Duration	1
Mandatory or Elective (M/E)	Mandatory
Frequency	every winter semester

Compulsory requirement

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Research in Environmental Science	Course	Mandatory	5.0	4.0	150 h

Contents
To be found in Ilias - The internal Teaching platform
Qualification
To be found in Ilias - The internal Teaching platform
Examination achievement
none
Course achievement
Research proposal

↑

Name of module	Number of module
Research in Environmental Science	10LE07MO-M.11103
Event	
Research in Environmental Science	
Event type	Number
Course	10LE07V-M.11103

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	3
Frequency	Winter semester
Mandatory or Elective (M/E)	Mandatory
Group size	91

Contents
To be found on Ilias - Internal teaching plattform
Examination achievement
none
Course achievement
Research proposal
Compulsory requirement
none

↑

Name of node	Number of node
Profillinie / Major: Landnutzung und Naturschutz	10LE07KT-PLU-2023-LuN-12100
Faculty	
Fakultät für Umwelt und natürliche Ressourcen / Faculty of Environment and Natural Ressources	

Mandatory or Elective	Pflicht / Mandatory

↑

Name of module	Number of module
Landwende- und Forstrecht (in German)	10LE07MO-M.12101
Responsible	
Prof. Dr. Cathrin Zengerling	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory or Elective (M/E)	Wahlpflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Landwende- und Forstrecht	Course	Mandatory	5.0	4.0	150 h

Contents

- Einführung in multiple Umweltkrisen mit Wurzeln in der Landnutzung, Notwendigkeit einer „Landwende“ (auch auf Waldflächen), Bezüge zum Rechtsrahmen
- Landnutzungsformen und deren spezifische Herausforderungen
- Einführung in verschiedene Zugänge (rechtsphilosophisch, rechtstheoretisch, rechtssoziologisch) und Methoden rechtswissenschaftlicher Analyse und Fallbearbeitung
- Wiederholung und Vertiefung: Grundlagen des Umweltrechts und deren Bedeutung für die Regulierung verschiedener Landnutzungsformen
- Einführung in die Rechtsbereiche, die die genannten Landnutzungsformen primär regulieren
- Möglichkeit der Vertiefung in den einzelnen Teilbereichen je nach Interessenschwerpunkt in der Abschlussarbeit;

Qualification

Die Studierenden

- kennen zentrale rechtliche Grundlagen und Herausforderungen verschiedener Landnutzungsformen mit Relevanz für Klimawandel, Verlust an Biodiversität und Umweltverschmutzung.
- sind mit wichtigen Zugängen und Methoden rechtswissenschaftlicher Analyse und Fallbearbeitung vertraut.
- kennen beispielhaft konkrete Rechtstexte aus der Legislative, Exekutive und Judikative, die Landnutzungskonflikte adressieren.

■ können rechtliche Fragestellungen in diesen Kontexten rechtlich einordnen und in Ansätzen selbständig bearbeiten. ■ haben sich vertieft und kritisch mit denkenn rechtlichen Rahmenbedingungen eines konkreten Konfliktfalls oder eines Themengebiets im Bereich des Landwende- oder Forstrechts auseinandergesetzt.
Examination achievement
Schriftliche Ausarbeitung
Course achievement
Präsentation
Teaching method
Socratic teaching, aktives Lernen, Einzel- und Gruppenarbeiten
Literature
■ Koch, H.-J., Hoffmann, E., Reese M. (2023). Handbuch Umweltrecht, 6. Auflage, Beck. ■ Schlacke, S. (2023). Umweltrecht, 9. Auflage, Nomos. ■ Ausgewählte Textexzerpte via ILIAS

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Name of module	Number of module
Landwende- und Forstrecht (in German)	10LE07MO-M.12101
Veranstaltung / Event	
Landwende- und Forstrecht	
Event type	Number
Lehrveranstaltung / Course	10LE07V-M.12101

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	in jedem Wintersemester / every winter semester
Mandatory or Elective	Pflicht / Mandatory
Group size	30

Contents

- Einführung in multiple Umweltkrisen mit Wurzeln in der Landnutzung (insbesondere: Klimawandel, Verlust an Biodiversität, Umweltverschmutzung), Notwendigkeit einer „Landwende“ (auch auf Waldflächen), Bezüge zum Rechtsrahmen
- Landnutzungsformen und deren spezifische Herausforderungen in Bezug auf die drei genannten Krisen: Agrarflächen, Waldflächen, Siedlungs- und Verkehrsflächen, Wasserflächen; lokale und globale Bezüge, inkl. „environmental footprints“, also extraterritorialer Wirkungen lokaler Nutzung/telecoupling und Herausforderungen des Rechtsrahmens, diese zu adressieren
- Einführung in verschiedene Zugänge (rechtsphilosophisch, rechtstheoretisch, rechtssoziologisch) und Methoden rechtswissenschaftlicher Analyse und Fallbearbeitung
- Wiederholung und Vertiefung: Grundlagen des Umweltrechts (u.a. Verfassungsrecht, Einbettung in das Mehrebenensystem, Gewaltenteilung, Verwaltungsrecht, Prinzipien des Umweltrechts) und deren Bedeutung für die Regulierung verschiedener Landnutzungsformen
- Einführung in die Rechtsbereiche, die die genannten Landnutzungsformen primär regulieren (also insbesondere das Agrar(umwelt)-, Forst-, Naturschutz-, Klima-, Immissionsschutz-, Bau- und Planungs- sowie das Wasserrecht); grundsätzlich mit Blick auf das Mehrebenensystem und transnationale Bezüge, Arbeit mit konkreten Gesetzestexten und Beispielen aus Gesetzgebung, Verwaltung und Rechtsprechung
- Möglichkeit der Vertiefung in den einzelnen Teilbereichen je nach Interessenschwerpunkt in der Abschlussarbeit; Studierende wählen dazu einen konkreten Konfliktfall oder ein Themengebiet sowie die eingeführten Zugänge und Methoden rechtswissenschaftlicher Analyse und Fallbearbeitung; Vorstellung von Fragestellung, Analysezugang und ersten Ergebnissen der Abschlussarbeiten sowie deren Diskussion im letzten Drittel des Semesters.

Qualification

Die Studierenden

- kennen zentrale rechtliche Grundlagen und Herausforderungen verschiedener Landnutzungsformen mit Relevanz für Klimawandel, Verlust an Biodiversität und Umweltverschmutzung.
- sind mit wichtigen Zugängen und Methoden rechtswissenschaftlicher Analyse und Fallbearbeitung vertraut.
- kennen beispielhaft konkrete Rechtstexte aus der Legislative, Exekutive und Judikative, die Landnutzungskonflikte adressieren.

- können rechtliche Fragestellungen in diesen Kontexten rechtlich einordnen und in Ansätzen selbständig bearbeiten.
- haben sich vertieft und kritisch mit denkenn rechtlichen Rahmenbedingungen eines konkreten Konfliktfalls oder eines Themengebiets im Bereich des Landwende- oder Forstrechts auseinandergesetzt.

Examination achievement
Schriftliche Ausarbeitung
Course achievement
Präsentation
Literature

- Koch, H.-J., Hoffmann, E., Reese M. (2023). Handbuch Umweltrecht, 6. Auflage, Beck.
- Schlacke, S. (2023). Umweltrecht, 9. Auflage, Nomos.
- Ausgewählte Textexzerpte via ILIAS

Compulsory requirement
None (Keine)
Recommended requirement
Idealerweise verfügen die Studierenden bereits über Grundkenntnisse in den Bereichen des Umwelt- und Planungsrechts, der Umweltplanung und/oder der Umweltpolitik, erforderlich ist dies jedoch nicht.
Teaching method
Socratic teaching, aktives Lernen, Einzel- und Gruppenarbeiten

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Name of module	**Number of module**
Politische Prozesse in Landnutzung und Naturschutz (in German)	10LE07MO-M.12102
Responsible	
Dr. Sylvia Isabelle Kruse	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	50 h
Independent study	100 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Politische Prozesse in Landnutzung und Naturschutz	Course	Mandatory	5.0	4.0	150 h

Contents
In diesem Modul lernen die Studierenden politische Prozesse in Landnutzung und Naturschutz kennen. Sie lernen anhand konkreter, aktueller Fälle, wie sie diese Prozesse analysieren und erklären können. Dafür lernen Sie zunächst Landnutzung und Naturschutz als Politikfelder kennen. Anschließend erarbeiten sie sich zentrale Ansätze der Politikanalyse und setzen diese schließlich selbst in Fallstudien aus den Bereichen Landnutzung und Naturschutz um. Dabei werden insbesondere folgende Dimensionen berücksichtigt: ■ der Prozess von der Problemformulierung, der Entwicklung von politischen Lösungen sowie deren Implementation, ■ Staatliche und nicht-staatliche Akteure und deren Interaktion in politischen Prozessen von der lokalen bis zur internationalen Ebene, ■ politische Instrumente und Mechanismen von politischer Steuerung und Governance. Für die Analyse politischer Prozesse in Landnutzung und Naturschutz werden verschiedene Theorien, Ansätze und Methoden berücksichtigt (z.B. Rational Choice, Institutionenanalyse, Diskursanalyse, Cultural Theory). Um die politischen Prozesse besser zu verstehen, werden Expert*innen aus Landnutzung und Naturschutz bzw. aus der Forschung eingebunden.

Qualification
Die Studierenden können politische Prozesse in Landnutzung und Naturschutz strukturiert analysieren, ihre Ergebnisse interpretieren und kritisch reflektieren und in Textform darlegen. Die Studierenden sind in der Lage, kritisch wissenschaftliche Literatur zu den oben genannten Themen zu lesen und zu diskutieren.
Examination achievement
Schriftliche Ausarbeitung
Course achievement
Präsentation
Teaching method
Inputs, Gruppenarbeit, praktische Übungen
Literature
Eine Liste mit relevanten Texten wird zu Beginn des Kurses verteilt.

↑

Name of module	Number of module
Politische Prozesse in Landnutzung und Naturschutz (in German)	10LE07MO-M.12102
Event	
Politische Prozesse in Landnutzung und Naturschutz	
Event type	Number
Course	10LE07V-M.12102

ECTS-Points	5.0
Workload	150 h
Attendance	50 h
Independent study	100 h
Hours of week	4.0
Recommended semester	1
Frequency	in jedem Wintersemester / every winter semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Group size	30

Contents

In diesem Modul lernen die Studierenden politische Prozesse in Landnutzung und Naturschutz kennen. Sie lernen anhand konkreter, aktueller Fälle, wie sie diese Prozesse analysieren und erklären können.
Dafür lernen Sie zunächst Landnutzung und Naturschutz als Politikfelder kennen. Anschließend erarbeiten sie sich zentrale Ansätze der Politikanalyse und setzen diese schließlich selbst in Fallstudien aus den Bereichen Landnutzung und Naturschutz um. Dabei werden insbesondere folgende Dimensionen berücksichtigt:

- der Prozess von der Problemformulierung, der Entwicklung von politischen Lösungen sowie deren Implementation,
- Staatliche und nicht-staatliche Akteure und deren Interaktion in politischen Prozessen von der lokalen bis zur internationalen Ebene,
- politische Instrumente und Mechanismen von politischer Steuerung und Governance.

Für die Analyse politischer Prozesse in Landnutzung und Naturschutz werden verschiedene Theorien, Ansätze und Methoden berücksichtigt (z.B. Rational Choice, Institutionenanalyse, Diskursanalyse, Cultural Theory).
Um die politischen Prozesse besser zu verstehen, werden Expert*innen aus Landnutzung und Naturschutz bzw. aus der Forschung eingebunden.

Qualification

Die Studierenden können politische Prozesse in Landnutzung und Naturschutz strukturiert analysieren, ihre Ergebnisse interpretieren und kritisch reflektieren und in Textform darlegen. Die Studierenden sind in der Lage, kritisch wissenschaftliche Literatur zu den oben genannten Themen zu lesen und zu diskutieren.

Examination achievement

Schriftliche Ausarbeitung

Course achievement

Präsentation

Literature

Eine Liste mit relevanten Texten wird zu Beginn des Kurses verteilt.

Compulsory requirement
Grundkenntnisse der Umweltpolitik; Research Skills and Ethics
Teaching method
Inputs, Gruppenarbeit, praktische Übungen

↑

Name of module	Number of module
Regionalentwicklung (in German)	10LE07MO-M.12103
Responsible	
Prof. Dr. Heiner Schanz	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Regionalentwicklung	Course	Mandatory	5.0	4.0	150 h

Contents

- Einführendes Seminar zu normativen Grundlagen der Zielbildung: Landschaft – Heimat – Wildnis – Nachhaltigkeit
- Einführung in die institutionellen und rechtlichen Grundlagen der Raumordnung und des Systems der Raum- und Landschaftsplanung in Deutschland
- Einführung in die Regionalplanung
- Einführung in die nachhaltige Regionalentwicklung (Konzepte, Instrumente) mit Schwerpunkt auf ländliche Räume
- Raumnutzungskonflikte und der Ausgleich von sozialen und wirtschaftlichen Ansprüchen an ländliche Räume in Einklang mit deren ökologischen Funktionen
- Praxis der Regionalentwicklung:
  - Bedeutung von Gebiets- (z.B. Nationalparke, Naturparke und Biosphärenreservate) und Förderkulissen (z.B. LEADER, PLENUM) für die integrierte Entwicklung ländlicher Räume
  - Regionalplanerische Rohstoffsicherung
  - Planung von (Groß)Infrastrukturprojekten im Rahmen der strategischen Planung auf Landesebene

Qualification

Die Studierenden können:

- die Grundlagen des Systems der Planung in Deutschland, mit Schwerpunkt nachhaltiger Regionalentwicklung ländlicher Räume erklären.

- die Herausforderung der politischen Steuerung und der Governance nachhaltiger Regionalentwicklung in Theorie und Praxis verdeutlichen.
- verschiedene Praktiken der nachhaltigen Regionalentwicklung auf unterschiedlichen Planungsebenen systematisch identifizieren.

Examination achievement

Klausur

Course achievement

Teilnahme an mindestens einer der drei Exkursionen

Teaching method

Vorlesung, Seminar, Exkursionen

Literature

- Piechocki, R. (2010). Landschaft-Heimat-Wildnis: Schutz der Natur - aber welche und warum? : CH. Beck.
- Weiland, U., & Wohlleber-Feller, S. (2007). Einführung in die Raum- und Umweltplanung: UTB Schöningh. Elektronisch verfügbar über die UB unter: http://www.redi-bw.de/start/unifr/eBooks-utb/9783838583631
- Chilla, T., Kühne, O., & Neufeld, M. (2016). Regionalentwicklung (Vol. 4566): UTB. Elektronisch verfügbar über die UB unter: http://www.redi-bw.de/start/unifr/eBooks-utb/9783838545660

Weiteres Arbeitsmaterial wird auf ILIAS bereitgestellt

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Name of module	Number of module
Regionalentwicklung	10LE07MO-M.12103
Event name	
Regionalentwicklung	
Event type	Number
Course	10LE07V-M.12103

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	in jedem Wintersemester / every winter semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Group size	30

Contents

- Einführendes Seminar zu normativen Grundlagen der Zielbildung: Landschaft – Heimat – Wildnis – Nachhaltigkeit
- Einführung in die institutionellen und rechtlichen Grundlagen der Raumordnung und des Systems der Raum- und Landschaftsplanung in Deutschland
- Einführung in die Regionalplanung
- Einführung in die nachhaltige Regionalentwicklung (Konzepte, Instrumente) mit Schwerpunkt auf ländliche Räume
- Raumnutzungskonflikte und der Ausgleich von sozialen und wirtschaftlichen Ansprüchen an ländliche Räume in Einklang mit deren ökologischen Funktionen
- Praxis der Regionalentwicklung:
  - Bedeutung von Gebiets- (z.B. Nationalparke, Naturparke und Biosphärenreservate) und Förderkulissen (z.B. LEADER, PLENUM) für die integrierte Entwicklung ländlicher Räume
  - Regionalplanerische Rohstoffsicherung
  - Planung von (Groß)Infrastrukturprojekten im Rahmen der strategischen Planung auf Landesebene

Qualification

Die Studierenden können:

- die Grundlagen des Systems der Planung in Deutschland, mit Schwerpunkt nachhaltiger Regionalentwicklung ländlicher Räume erklären.
- die Herausforderung der politischen Steuerung und der Governance nachhaltiger Regionalentwicklung in Theorie und Praxis verdeutlichen.
- verschiedene Praktiken der nachhaltigen Regionalentwicklung auf unterschiedlichen Planungsebenen systematisch identifizieren.

Examination achievement

Klausur

Course achievement

Teilnahme an mindestens einer der drei Exkursionen

Literature
■ Piechocki, R. (2010). Landschaft-Heimat-Wildnis: Schutz der Natur - aber welche und warum? : CH. Beck. ■ Weiland, U., & Wohlleber-Feller, S. (2007). Einführung in die Raum- und Umweltplanung: UTB Schöningh. Elektronisch verfügbar über die UB unter: http://www.redi-bw.de/start/unifr/eBooks-utb/9783838583631 ■ Chilla, T., Kühne, O., & Neufeld, M. (2016). Regionalentwicklung (Vol. 4566): UTB. Elektronisch verfügbar über die UB unter: http://www.redi-bw.de/start/unifr/eBooks-utb/9783838545660 Weiteres Arbeitsmaterial wird auf ILIAS bereitgestellt
Compulsory requirement
none
Recommended requirement
Basic Knowledge of R
Teaching method
Vorlesung, Seminar, Exkursionen

↑

Name of module	Number of module
Umwelt- und Landschaftsplanung (in German)	10LE07MO-M.12104
Responsible	
Prof. Dr. Tanja Mölders	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week (HoW)	4.0
Attendance	50 h
Independent study	100 h
Recommended semester	1
Duration	1
Mandatory / Elective (M/E)	Pflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Umwelt- und Landschaftsplanung	Course	Mandatory	5.0	4.0	150 h

Contents

- Planung als technischer und politischer Prozess
- System der räumlichen Planung in Deutschland
- Instrumente und Methoden der Umwelt- und Landschaftsplanung
- Ausgewählte Handlungsfelder sozial-ökologischer Transformation

Qualification

Die Studierenden
- kennen das System der räumlichen Planung und das System der Umweltplanung in Deutschland,
- sind in der Lage, Instrumente und Methoden der Umwelt- und Landschaftsplanung hinsichtlich ihrer Ziele, Einsatzbereiche, Verfahrensabläufe sowie Rechtwirksamkeit zu benennen,
- können Entwicklungslinien im planungstheoretischen Denken unterscheiden und hinsichtlich der darin eingeschriebenen Rationalitäten reflektieren,
- sind in der Lage, aktuelle Handlungsfelder sozial-ökologischer Transformation aus einer planungspraktischen und -theoretischen Perspektive einzuordnen,
- erweitern ihr Reflexionsvermögen und ihre Kritikfähigkeit,
- erweitern ihre Präsentationskompetenz,
- erlernen Methoden des wissenschaftlichen Arbeitens und Schreibens.

Examination achievement

Schriftliche Ausarbeitung (100%)

Course achievement
Referat
Teaching method
Input der Lehrenden (Vorlesung), Inputs der Studierenden (Referate), Gruppenarbeit, Diskussionen, Gastvorträge
Literature
■ Foliensätze der Veranstaltung ■ Akademie für Raumforschung und Landesplanung (Hrsg.) (2018): Handwörterbuch der Stadt- und Raumentwicklung. Verlag der ARL: Hannover. ■ Fürst, Dietrich/Scholles, Frank (Hrsg.) (2008): Handbuch Theorien und Methoden der Raum- und Umweltplanung. 3., vollständig überarbeitete Auflage. Verlag Dorothea Rohn: Dortmund. ■ Haaren, von Christina (Hrsg.) (2004): Landschaftsplanung. Ulmer: Stuttgart. ■ Jessel, Beate/Tobias, Kai (2002): Ökologisch orientierte Planung. Eine Einführung in Theorien, Daten und Methoden. Verlag Eugen Ulmer: Stuttgart. ■ Wiechmann, Thorsten (Hrsg.) (2019): ARL Reader Planungstheorie. Band 1: Kommunikative Planung – Neoinstitutionalismus und Governance. Springer: Heidelberg. ■ Wiechmann, Thorsten (Hrsg.) (2019): ARL Reader Planungstheorie. Band 2: Strategische Planung – Planungskultur. Springer: Heidelberg. ■ Eine Auswahl weiterer weiterführender Literatur wird im Rahmen der Veranstaltung bekannt gegeben.

↑

Name of module	Number of module
Umwelt- und Landschaftsplanung	10LE07MO-M.12104
Event name	
Umwelt- und Landschaftsplanung	
Event type	Number
Course	10LE07V-M.12104

ECTS-Points	5.0
Workload	150 h
Attendance	50 h
Independent study	100 h
Hours of week	4.0
Recommended semester	1
Frequency	in jedem Wintersemester / every winter semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Group size	30

Contents

Im ersten Teil des Moduls wird, ausgehend von einer Auseinandersetzung mit der räumlichen Planung in Deutschland, das System der Umweltplanung als integrativer und Sektor übergreifender Ansatz betrachtet. Gegenstand sind dabei sowohl raum- und umweltbezogene Fachplanungen als auch die Landschaftsplanung, die im System der Umweltplanung eine zentrale Rolle einnimmt: Sie ist Fachplanung des Naturschutzes und der Landschaftspflege (sektoral) und bündelt außerdem die Belange des raumbezogenen Umweltschutzes (querschnittsorientiert). Vor dem Hintergrund dieser Einordnungen werden Instrumente (z.B. Eingriffsregelung, Umweltverträglichkeitsprüfung, Strategische Umweltprüfung) und Methoden (insbesondere Methoden der Zielformulierung, Bewertung und Entscheidung) der Umwelt- und Landschaftsplanung eingeführt und exemplarisch vertieft.
Den zweiten Teil des Moduls bildet eine planungstheoretische Reflexion der substantiellen, d.h. gegenstandbezogenen sowie prozeduralen Ebene der Umwelt- und Landschaftsplanung. Im Kontext der Profillinie ist dabei insbesondere die Frage nach dem Verhältnis von Naturschutz und Landnutzung relevant.
In einem dritten Teil werden ausgewählte Handlungsfelder sozial-ökologischer Transformation (z.B. die Energie-, die Mobilitäts- und die Agrarwende) vorgestellt und hinsichtlich ihrer praktischen und theoretischen umweltplanerischen Implikationen diskutiert.
Die umwelt- und landschaftsplanerischen Perspektiven werden durch Gastvorträge von Expert:innen aus Wissenschaft und Praxis erweitert.

Qualification

Die Studierenden
- kennen das System der räumlichen Planung und das System der Umweltplanung in Deutschland,
- sind in der Lage, Instrumente und Methoden der Umwelt- und Landschaftsplanung hinsichtlich ihrer Ziele, Einsatzbereiche, Verfahrensabläufe sowie Rechtwirksamkeit zu benennen,
- können Entwicklungslinien im planungstheoretischen Denken unterscheiden und hinsichtlich der darin eingeschriebenen Rationalitäten reflektieren,
- sind in der Lage, aktuelle Handlungsfelder sozial-ökologischer Transformation aus einer planungspraktischen und -theoretischen Perspektive einzuordnen,
- erweitern ihr Reflexionsvermögen und ihre Kritikfähigkeit,
- erweitern ihre Präsentationskompetenz,

- erlernen Methoden des wissenschaftlichen Arbeitens und Schreibens.

Examination achievement

Schriftliche Ausarbeitung (100%)

Course achievement

Referat

Literature

Foliensätze der Veranstaltung

- Akademie für Raumforschung und Landesplanung (Hrsg.) (2018): Handwörterbuch der Stadt- und Raumentwicklung. Verlag der ARL: Hannover.
- Fürst, Dietrich/Scholles, Frank (Hrsg.) (2008): Handbuch Theorien und Methoden der Raum- und Umweltplanung. 3., vollständig überarbeitete Auflage. Verlag Dorothea Rohn: Dortmund.
- Haaren, von Christina (Hrsg.) (2004): Landschaftsplanung. Ulmer: Stuttgart.
- Jessel, Beate/Tobias, Kai (2002): Ökologisch orientierte Planung. Eine Einführung in Theorien, Daten und Methoden. Verlag Eugen Ulmer: Stuttgart.

Eine Auswahl weiterer weiterführender Literatur wird im Rahmen der Veranstaltung bekannt gegeben.

Compulsory requirement

none

Recommended requirement

none

Teaching method

Inputs der Lehrenden (Vorlesung), Inputs der Studierenden (Referate), Gruppenarbeit, Diskussionen, Gastvorträge

↑

Name of module	Number of module
Genetische Methoden in Naturschutz und Forstwirtschaft (in German)	10LE07MO-M.12109
Responsible	
Prof. Dr. Katrin Heer	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Genetische Methoden in Naturschutz und Forstwirtschaft	Course	Mandatory	5.0	4.0	150 h

Contents
Die Anwendung genetischer und genomischer Methoden hat unser Verständnis über die genetischen Vielfalt innerhalb der Arten und ihrer räumlichen Verteilung, zur lokalen Anpassung und der genetischen Grundlage phänotypischer Merkmale erheblich verbessert. Außerdem ermöglichen genetische Methoden die Bewertung von Populationseigenschaften, die für das Management und die Erhaltung von Arten relevant sind, wie z. B. effektive Populationsgrößen, Muster des Genflusses und der Hybridisierung. In diesem Modul werden wir aktuelle Methoden und Anwendungen vorstellen, einschlägige Literatur lesen und diskutieren und die Vorteile und Grenzen genetischer Methoden kritisch erörtern. Die Studierenden werden sich intensiv mit der wissenschaftlichen Literatur zur relevanten Themen in Forst- und Naturschutzgenetik auseinandersetzen und in Kleingruppen einen Review verfassen.
Qualification
Die Studierenden verstehen, wie man auf der Grundlage genetischer Daten Parameter und Prozesse wie effektive Populationsgröße, genetische Vielfalt, Hybridisierung und lokale Anpassung bestimmen kann. Die Studierenden können wissenschaftliche Literatur zu den oben genannten Themen kritisch lesen und diskutieren.

Die Studierenden sind in der Lage, Ergebnisse von wissenschaftlichen Studien zusammenzufassen, kritisch zu evaluieren und in wissenschaftlicher Sprache und mit adäquaten Abbildungen zu präsentieren.
Examination achievement
Schriftliche Ausarbeitung
Course achievement
Seminarvortrag
Literature
Wissenschaftliche Literatur wird während des Kurses bereitgestellt

↑

Name of module	Number of module
Genetische Methoden in Naturschutz und Forstwirtschaft	10LE07MO-M.12109
Name of event	
Genetische Methoden in Naturschutz und Forstwirtschaft	
Event type	Number
Course	10LE07V-M.12109/22110

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	3
Frequency	in jedem Wintersemester / every winter semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Group size	35

Contents
Die Anwendung genetischer und genomischer Methoden hat unser Verständnis über die genetischen Vielfalt innerhalb der Arten und ihrer räumlichen Verteilung, zur lokalen Anpassung und der genetischen Grundlage phänotypischer Merkmale erheblich verbessert. Außerdem ermöglichen genetische Methoden die Bewertung von Populationseigenschaften, die für das Management und die Erhaltung von Arten relevant sind, wie z. B. effektive Populationsgrößen, Muster des Genflusses und der Hybridisierung. In diesem Modul werden wir aktuelle Methoden und Anwendungen vorstellen, einschlägige Literatur lesen und diskutieren und die Vorteile und Grenzen genetischer Methoden kritisch erörtern. Die Studierenden werden sich intensiv mit der wissenschaftlichen Literatur zur relevanten Themen in Forst- und Naturschutzgenetik auseinandersetzen und in Kleingruppen einen Review verfassen.
Qualification
Die Studierenden verstehen, wie man auf der Grundlage genetischer Daten Parameter und Prozesse wie effektive Populationsgröße, genetische Vielfalt, Hybridisierung und lokale Anpassung bestimmen kann. Die Studierenden können wissenschaftliche Literatur zu den oben genannten Themen kritisch lesen und diskutieren. Die Studierenden sind in der Lage, Ergebnisse von wissenschaftlichen Studien zusammenzufassen, kritisch zu evaluieren und in wissenschaftlicher Sprache und mit adäquaten Abbildungen zu präsentieren.
Examination achievement
Schriftliche Ausarbeitung
Course achievement
Seminarvortrag
Literature
Wissenschaftliche Literatur wird während des Kurses bereitgestellt

Compulsory requirement
None / Keine
Teaching method
Vorlesungen, Seminarvorträge, Diskussion wissenschaftlicher Literatur

↑

Name of module	Number of module
Naturschutzkonzepte (in German)	10LE07MO-M.12110
Responsible	
Dr. Anna Saave	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	50 h
Independent study	100 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Frequency	in jedem Wintersemester / every winter semester

Compulsory requirement
Keine / None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Naturschutzkonzepte	Course	Mandatory	5.0	4.0	150 h

Contents
■ Naturschutzkonzepte verstehen und einordnen ■ Abwägen von Schutzstrategien angesichts gesellschaftlicher Ordnungen, Konfliktfelder sowie gesellschaftlicher Naturverhältnisse ■ Ausgewählte Themen und Handlungsfelder im Naturschutz
Qualification
Die Studierenden ■ erlangen ein fundiertes Verständnis der wesentlichen Naturschutzkonzepte, die in Deutschland angewendet werden. ■ sind befähigt, diese Konzepte im Kontext gesellschaftlicher Zielkonflikte kritisch zu reflektieren und abzuwägen. ■ sind durch die Anwendung von analytischen Fähigkeiten in der Lage, in konkreten Situationen verschiedene Naturschutzkonzepte gegeneinander abzuwägen und diesen Prozess sowohl in beruflichen als auch akademischen Kontexten transparent zu kommunizieren. ■ demonstrieren die Fähigkeit, komplexe gesellschaftliche Konflikte auf praxisnahe Anwendungsfälle herunterzubrechen und Lösungsansätze zu entwickeln. ■ erweitern ihr Reflexionsvermögen und ihre Kritikfähigkeit. ■ erweitern ihre Präsentationskompetenz und rhetorische Kompetenz. ■ erweitern ihr Verständnis von und ihre Erfahrung in Führungskompetenzen angesichts komplexer Entscheidungssituationen.

- erlernen Methoden des wissenschaftlichen Arbeitens, Schreibens und Argumentierens.

Examination achievement

Mündliches Prüfungsgespräch 100%

Course achievement

Referat/Präsentation

Literature

Foliensätze der Veranstaltung

Literatur

- Eser, Uta (2016). Naturschutz. In: Handbuch Umweltethik, herausgegeben von Ott, Konrad; Dierks, Jan; Voget-Kleschin, Lieske. Stuttgart: J.B. Metzler, S. 44–48.
- Trepl, Ludwig (2012). Die Idee der Landschaft. Eine Kulturgeschichte von der Aufklärung bis zur Ökologiebewegung. Bielefeld: transcript.
- Fischer, Ludwig (Hg.) (2004). Projektionsfläche Natur. Zum Zusammenhang von Naturbildern und gesellschaftlichen Verhältnissen. Hamburg: Hamburg University Press. (Veröffentlichungen des Forschungsprojekts "Natur im Konflikt. Naturschutz, Naturbegriff und Küstenbilder")
- Hofmeister, Sabine und Mölders, Tanja (2013). Caring for natures? Naturschutz aus der Perspektive Vorsorgenden Wirtschaftens. In: Wege Vorsorgenden Wirtschaftens, herausgegeben von Netzwerk Vorsorgendes Wirtschaften. Marburg: Metropolis-Verlag, S. 85–114.
- Büscher, Bram und Fletcher, Robert (2020). The Conservation Revolution. Radical Ideas for Saving Nature Beyond the Anthropocene. New York: Verso.
- Ott, Konrad (2018). Naturschutztheorie, bpb.de.
- Jax, Kurt (2024). Conservation Concepts. Rethinking Human–Nature Relationships. New York: Routledge.
- Maris, Emma (2013). Rambunctious Gardens. Saving Nature in a Post-Wild World: Rambunctious Garden: Saving Nature in a Post-Wild World. New York: Bloomsbury.

- Die Auswahl weiterführender Literatur wird im Rahmen der Veranstaltung bekannt gegeben.

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Name of module	Number of module
Naturschutzkonzepte (in German)	10LE07MO-M.12110
Name of event	
Naturschutzkonzepte	
Event type	Number
Course	10LE07V-M.12110

ECTS-Points	5.0
Workload	150 h
Attendance	50 h
Independent study	100 h
Hours of week	4.0
Recommended semester	3
Frequency	in jedem Wintersemester / every winter semester
Mandatory / Elective (M/E)	Pflicht / Mandatory
Group size	30

Contents

Das Modul „Naturschutzkonzepte“ bietet einen umfassenden Überblick über unterschiedliche Konzepte zum Schutz von Natur und stellt diese in den Kontext gesellschaftlicher Ordnungen, Konfliktfelder sowie gesellschaftlicher Naturverhältnisse. Das Modul erarbeitet somit sozialwissenschaftliche Grundlagen für die Analyse der Rolle des Naturschutzes in der heutigen Gesellschaft. Es berücksichtigt besonders das Zusammenspiel von planerischen Instrumenten und gesellschaftlichen Zielkonflikten. Die Studierenden werden schrittweise in die wichtigsten Konzepte des Naturschutzes und deren Anschlussstellen zu gesellschaftlichen Debatten eingeführt und durch Diskussionen, Präsentationen und Exkursionen zu einem vertieften Verständnis geführt. Um kritische Reflexionen des Verhältnisses von Schutz und Nutzen zu ermöglichen, wird ein Schwerpunkt auf feministische sozial-ökologische Forschungszugänge und Lösungsansätze zu gesellschaftlichen Naturverhältnissen gelegt.
Im ersten Teil des Moduls werden die Konzepte des konservierenden, des integrativen Naturschutzes und des Prozessschutzes eingeführt und vor dem Hintergrund gesellschaftlicher Naturverhältnisse verglichen und eingeordnet. Im zweiten Teil werden gesellschaftliche Konfliktfelder mit Bezug zu Naturschutz und Naturnutzung aufgearbeitet und mit Naturschutzkonzepten und darauf basierenden möglichen Lösungen in Verbindung gebracht. Im dritten Teil haben die Studierenden Gelegenheit, innerhalb einer Exkursion die gewonnenen Erkenntnisse zur Abwägung verschiedener Naturschutzkonzepte auf ein Fallbeispiel anzuwenden. Das Modul schließt mit einem Ausblick auf aktuelle Diskussionen und Konzepte zum Verständnis von Natur sowie den entsprechenden Schutzkonzepten ab. Die Modulinhalte werden ergänzt durch eine fortlaufende Reflexion über Führungskompetenzen in Bezug auf komplexe Entscheidungssituationen.

Qualification

Die Studierenden
- erlangen ein fundiertes Verständnis der wesentlichen Naturschutzkonzepte, die in Deutschland angewendet werden.
- sind befähigt, diese Konzepte im Kontext gesellschaftlicher Zielkonflikte kritisch zu reflektieren und abzuwägen.
- sind durch die Anwendung von analytischen Fähigkeiten in der Lage, in konkreten Situationen verschiedene Naturschutzkonzepte gegeneinander abzuwägen und diesen Prozess sowohl in beruflichen als auch akademischen Kontexten transparent zu kommunizieren.

- demonstrieren die Fähigkeit, komplexe gesellschaftliche Konflikte auf praxisnahe Anwendungsfälle herunterzubrechen und Lösungsansätze zu entwickeln.
- erweitern ihr Reflexionsvermögen und ihre Kritikfähigkeit.
- erweitern ihre Präsentationskompetenz und rhetorische Kompetenz.
- erweitern ihr Verständnis von und ihre Erfahrung in Führungskompetenzen angesichts komplexer Entscheidungssituationen.
- erlernen Methoden des wissenschaftlichen Arbeitens, Schreibens und Argumentierens.

Examination achievement

Mündliches Prüfungsgespräch 100%

Course achievement

Referat/Präsentation

Literature

- Foliensätze der Veranstaltung

Literatur

- Eser, Uta (2016). Naturschutz. In: Handbuch Umweltethik, herausgegeben von Ott, Konrad; Dierks, Jan; Voget-Kleschin, Lieske. Stuttgart: J.B. Metzler, S. 44–48.
- Trepl, Ludwig (2012). Die Idee der Landschaft. Eine Kulturgeschichte von der Aufklärung bis zur Ökologiebewegung. Bielefeld: transcript.
- Fischer, Ludwig (Hg.) (2004). Projektionsfläche Natur. Zum Zusammenhang von Naturbildern und gesellschaftlichen Verhältnissen. Hamburg: Hamburg University Press. (Veröffentlichungen des Forschungsprojekts "Natur im Konflikt. Naturschutz, Naturbegriff und Küstenbilder")
- Hofmeister, Sabine und Mölders, Tanja (2013). Caring for natures? Naturschutz aus der Perspektive Vorsorgenden Wirtschaftens. In: Wege Vorsorgenden Wirtschaftens, herausgegeben von Netzwerk Vorsorgendes Wirtschaften. Marburg: Metropolis-Verlag, S. 85–114.
- Büscher, Bram und Fletcher, Robert (2020). The Conservation Revolution. Radical Ideas for Saving Nature Beyond the Anthropocene. New York: Verso.
- Ott, Konrad (2018). Naturschutztheorie, bpb.de.
- Jax, Kurt (2024). Conservation Concepts. Rethinking Human–Nature Relationships. New York: Routledge.
- Maris, Emma (2013). Rambunctious Gardens. Saving Nature in a Post-Wild World: Rambunctious Garden: Saving Nature in a Post-Wild World. New York: Bloomsbury.

- Die Auswahl weiterführender Literatur wird im Rahmen der Veranstaltung bekannt gegeben.

Compulsory requirement

none

Recommended requirement

none

Teaching method

Inputs der Lehrenden (Vorlesung), Inputs der Studierenden (Referate), Reflexion zu Führungskompetenz (Übung), Gruppenarbeit, Diskussionen, Exkursion

↑

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

Mandatory / Elective (M/E)	Mandatory

↑

Name of module	Number of module
Climate Impact Research	10LE07MO-M.12201
Responsible	
Prof. Dr. Christiane Werner Pinto	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Climate Impact Research	Course	Mandatory	5.0	4.0	150 h

Contents
■ Overview on current approaches in climate change research ■ One-week excursion to Garmisch-Partenkirchen ■ Group work: Development and defense of a short research proposal on climate impact research on a selected topic
Qualification
Students will ■ gain an in-depth and overarching understanding of climate change on biogeochemical cycles, forest growth, and ecosystem physiology ■ gain insights into current research approaches and topics ■ be able to work with and critically analyze original English-language literature ■ be able to summarize and present original research.
Examination achievement
Written assignment and presentation
Course achievement
Attendance, Participiation in the excursion, Project proposal

Teaching method
Lectures, seminar, excursion
Literature
Will be handed out during the course

↑

Name of module	Number of module
Climate Impact Research	10LE07MO-M.12201
Name of event	
Climate Impact Research	
Event type	Number
Course	10LE07S-M.12201

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	18

Contents

The module provides an insight into current climate impact research analysing the effects of climate change on ecosystem processes. In particular, current experimental and methodological research approaches and concepts for analysing the consequences of climate change on various ecosystem processes will be taught. These include climate change manipulation experiments on the effects of elevated CO2 (FACE) or other climatic factors (drought, heat, etc.) carried out in a global network, as well as cross-scale research approaches to detect changes in biogeochemical processes (especially biomass production in forests). Additional emphasis is placed on analysing the effects of environmental change on past tree and forest growth (including dendroecology and dendroclimatology) and developing predictive models (including forest growth models and simulators). The three-week module includes a 5-day field trip to the KIT experimental plots in Garmisch-Partenkirchen in the second week. Students will work in small groups to develop their own ideas for a project proposal and defend their project ideas in a joint proposal evaluation at the end of the course.

Qualification

Students will
- gain an in-depth and overarching understanding of climate change on biogeochemical cycles, forest growth, and ecosystem physiology
- gain insights into current research approaches and topics
- be able to work with and critically analyze original English-language literature

be able to develop a research idea, design a research study and defend the proposalmmarize and present original research.

Examination achievement

Written assignment and presentation

Course achievement

Attendance, Participiation in the excursion, Project proposal

Literature

Will be handed out during the course

Compulsory requirement
none
Recommended requirement
none
Teaching method
Lecture, lab visits, colloquium, group work, excursion

↑

Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12202
Responsible	
Prof. Dr. Christiane Werner Pinto	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Ecosystem Functioning (ECOFUN)	Course	Mandatory	5.0	4.0	150 h

Contents
This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning. It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.
Qualification
Students will ■ get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view. ■ be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy. ■ achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.

■ study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.
Examination achievement
Written Exam (90 min)
Course achievement
none
Teaching method
Lecture, tutoria, group work
Literature
Will be provided during the course

↑

Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12202
Name of event	
Ecosystem Functioning (ECOFUN)	
Event type	Number
Course	10LE07S-M.12202/12302/12401/22202

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning.

It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.

Qualification

Students will
- get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view.
- be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy.
- achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.
- study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.

Examination achievement

Written Exam (90 min)

Course achievement

none

Literature

Will be provided during the course

Compulsory requirement
none
Recommended requirement
none
Teaching method
Lecture, tutoria, group work

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12203
Responsible	
Prof. Dr. Carsten Dormann	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental Statistics	Course	Mandatory	5.0	4.0	150 h

Contents
This module builds on and extends statistical knowledge and its application: ■ Generalised Additive Models ■ Classification & Regression Trees (incl. randomForest and BRT) ■ non-parametric statistic (resampling approaches) ■ model selection incl. cross-validation ■ spatial statistics (correlogram, variogram) ■ extreme value statistics ■ time-series analysis (autocorrelation, decomposition) All topics will be taught in the free software R.
Qualification
Students will ■ extend their statistical knowledge ■ solve complex statistical tasks ■ advance the use of R
Examination achievement
Exam
Course achievement
10 out of 12 weekly homework assignments passed with over 60% of the points

Teaching method
Lectures, practical exercises, group work
Literature
■ Crawley (2007) The R Book. Wiley. ■ *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf) ■ Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger ■ *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf * indicates an open resource

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12203
Name of event	
Environmental Statistics	
Event type	Number
Course	10LE07S-M.12203/12304/12503/57140

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module builds on and extends statistical knowledge and its application:
- Generalised Additive Models
- Classification & Regression Trees (incl. randomForest and BRT)
- non-parametric statistic (resampling approaches)
- model selection incl. cross-validation
- spatial statistics (correlogram, variogram)
- extreme value statistics
- time-series analysis (autocorrelation, decomposition)

All topics will be taught in the free software R.

Qualification

Students will
- extend their statistical knowledge
- solve complex statistical tasks
- advance the use of R

Examination achievement

Exam

Course achievement

10 out of 12 weekly homework assignments passed with over 60% of the points

Literature

- Crawley (2007) The R Book. Wiley.
- *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf)
- Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger
- *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf

* indicates an open resource
Compulsory requirement
none
Recommended requirement
■ Basic statistical knowledge: distributions, maximum likelihood, regressions; ANOVA, GLM, PCA ■ Data import und simple statistical analyses in R (www.r-project.org) ■ Knowledge of all content of “R for Beginners” (https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)
Teaching method
Lectures, practical exercises, group work

↑

Name of module	Number of module
Lab-Analysis of Climate Change Impact	10LE07MO-M.12204
Responsible	
Prof. Dr. Friederike Lang	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Lab-Analysis of Climate Change Impact	Course	Mandatory	5.0	4.0	150 h

Contents
Learning about and testing experimental approaches and analytical laboratory methods to quantify climate-dependent processes and determine climate-related changes in ecosystems, including plant physiological and dendroecological analyses or the analysis of the components of the carbon balance of soils.
Qualification
Students: ■ are familiar with currently used laboratory analyses to quantify the effects of climate change on carbon/nutrient/water-associated mechanisms and processes in plants, soils and microorganisms ■ are able to statistically evaluate analytical data, to interpret results obtained, and to discuss them in the context of international literature ■ can develop concepts for quality control and for quantifying the uncertainties of the methods used
Examination achievement
Report (55%) and presentation (45%)
Course achievement
Participation in experimental lectures
Teaching method
Lectures, analytical-experimental exercises, instructions for data analyses, interpretation and presentation of results

Literature
A summary of method descriptions and data analyses are provided as well as annually changing primary literature
Recommendation
Students will need a basic understanding of scientific methods and interest in analytical work

↑

Name of module	Number of module
Lab-Analysis of Climate Change Impact	10LE07MO-M.12204
Name of event	
Lab-Analysis of Climate Change Impact	
Event type	Number
Course	10LE07V-M.12204

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	18

Contents
The predicted and, in some cases, already occurring changes of the climate on a regional and global level influence the properties and functioning of ecosystems. It is to be expected that changing environmental conditions (e.g. higher temperatures, changes in the amount and frequency of precipitation, increased CO2 concentration) will affect the carbon and nutrient cycle, the water balance and the productivity of ecosystems, among other things. Identifying and quantifying these effects is essential for predicting climate impacts and developing adaptation strategies. A variety of experimental approaches and analytical methods are available in the various disciplines to quantify weather- and climate-dependent processes and to determine climate-induced changes in the state of ecosystems. In our module, selected laboratory methods from the various disciplines involved (soil ecology, ecosystem physiology, forest growth science/dendroecology) are presented and applied in supervised small groups in the respective laboratories. In addition to the methodological basics of of data analyses and interpretation, the limitations and sources of error of the methods are addressed. In addition, an introduction to laboratory work, experimental planning, quality assurance and laboratory safety is given.
Qualification
Students: ■ are familiar with currently used laboratory analyses to quantify the effects of climate change on carbon/nutrient/water-associated mechanisms and processes in plants, soils and microorganisms ■ are able to statistically evaluate analytical data, to interpret results obtained, and to discuss them in the context of international literature ■ can develop concepts for quality control and for quantifying the uncertainties of the methods used
Examination achievement
Report (55%) and presentation (45%)
Course achievement
Participation in experimental lectures

Literature
A summary of method descriptions and data analyses are provided as well as annually changing primary literature
Compulsory requirement
None
Recommended requirement
Foundation in natural sciences
Teaching method
Lectures, analytical-experimental exercises, instructions for evaluation, interpretation and presentation of results

↑

Name of module	Number of module
Earth System Modelling	10LE07MO-M.12209
Responsible	
Prof. Dr. René Orth	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Earth System Modelling	Course	Mandatory	5.0	4.0	150 h

Contents
Lecture: The lectures in this module provide an overview of computational models and their origins and applications in Earth system science. Models of varying complexity are presented, from conceptual models to weather prediction models and Earth system models, including their areas of application. Specifically, it also addresses the incorporation of existing observational data into modeling (data assimilation), the handling of processes that cannot be spatially or temporally resolved (parameterizations), and the computation of climate projections. A conceptual hydrologic water balance model is presented in depth as a basis for practical modeling using programming. Modeling via Programming: Students implement a simple water balance model under guidance and test it with prepared data at selected sites. Seminar: In small groups, students select a research question to be investigated by modeling with the water balance model. Relevant scientific literature will be studied, and reference will be made to the knowledge gained in the lectures. The results will be summarized and visualized in a poster.
Qualification
Students will

■ Understand models of different complexity and their components ■ know the strengths, weaknesses, and areas of application of various models ■ understand the functioning and handling of a conceptual hydrological water balance model ■ develop a scientific problem and addressing it independently using the water balance model ■ learn to work efficiently in a team
Examination achievement
written assignment
Course achievement
none
Literature
Lecture slides will be provided.

↑

Name of module	Number of module
Earth System Modelling	10LE07MO-M.12209
Name of event	
Earth System Modelling	
Event type	Number
Course	10LE07V-M.12209/12301

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	56

Contents

Lecture:
The lectures in this module provide an overview of computational models and their origins and applications in Earth system science. Models of varying complexity are presented, from conceptual models to weather prediction models and Earth system models, including their areas of application. Specifically, it also addresses the incorporation of existing observational data into modeling (data assimilation), the handling of processes that cannot be spatially or temporally resolved (parameterizations), and the computation of climate projections. A conceptual hydrologic water balance model is presented in depth as a basis for practical modeling using programming.

Modeling via Programming:
Students implement a simple water balance model under guidance and test it with prepared data at selected sites.

Seminar:
In small groups, students select a research question to be investigated by modeling with the water balance model. Relevant scientific literature will be studied, and reference will be made to the knowledge gained in the lectures. The results will be summarized and visualized in a poster.

Qualification

Students will
- Understand models of different complexity and their components
- know the strengths, weaknesses, and areas of application of various models
- understand the functioning and handling of a conceptual hydrological water balance model
- develop a scientific problem and addressing it independently using the water balance model
- learn to work efficiently in a team

Examination achievement

written assignment

Course achievement
none
Literature
Lecture slides will be provided.
Compulsory requirement
none
Recommended requirement
Basic knowledge of climate modeling and first experience in programming
Teaching method
Lectures, modeling with programming, seminar (group work, development of poster)

↑

Name of module	Number of module
Environmental Monitoring, Data Analysis and Visualization	10LE07MO-M.12210
Responsible	
Prof. Dr. Markus Weiler	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental Monitoring, Data Analysis and Visualization	Course	Mandatory	5.0	4.0	150 h

Contents

Inhalt:
In diesem Modul werden Grundlagen für die Erfassung, Bearbeitung und Verarbeitung von Zeitreihen (mit räumlichen Aspekten) vermittelt, damit sie in einer geeigneten Form für eine spätere Modellierung vorliegen. Das Rahmenthema ist die experimentelle Beschreibung der „urbanen Wärmeinsel“ in der Stadt Freiburg. Der Kurs verwendete eine GitHub-Umgebung, um an zwei verschiedenen Themen zu arbeiten und mit eigenen Daten Übungen zu absolvieren.
Datenerfassung und Analyse: Es werden analoge und digitale Methoden zur Datenerfassung im Feld vorgestellt und diskutiert. Dies reicht von den Grundelementen analoger Feldprotokolle (Feldbuch) bis hin zur komplexen Datenerfassung. Die Studierenden programmieren eigenhändig Temperaturdatenlogger, installieren sie an ihrem Wohnort, lesen die aufgezeichneten Daten aus und überprüfen diese kritisch auf ihre Richtigkeit. Zum Vergleich werden Zeitreihendaten aus dem Internet heruntergeladen (verschiedene Arten und Skalen). Alle Zeitreihen werden in R einem umfassenden Qualitätskontrollverfahren unterzogen. Fehler in den Zeitreihen werden gelöscht und die daraus resultierenden Datenlücken mit verschiedenen Methoden gefüllt. Dadurch können charakteristische Parameter für das Temperaturverhalten ermittelt werden.
Datenvisualisierung: Eine wichtige Komponente des Kurses ist die Datenvisualisierung. Studierende erlernen verschiedene Datentypen, die Theorie der Datenvisualisierung und effektive Möglichkeiten der Visualisierung in R und GIS (Best Practice Guide). Sie arbeiten auch mit Klimadaten und Klimaindizes in größerem Maßstab (Baden-Württemberg), um zeitliche und räumliche Datenanalysen zu kombinieren.
Datenbanken: Mit R werden die ermittelten Parameter räumlich interpoliert und mit vorhandenen Metadaten der Stadt (z. B. Gebäudedichte) verglichen. Darauf folgt eine Einführung in SQL und gän-

gige Datenbanksysteme. Eine einfache Speicherlösung wird vorgestellt und verwendet, um Daten zu speichern, eine Analysen der gesammelten Daten durchzuführen und mit den Daten der Vorjahre zu vergleichen.
· Zeitreihenanalysen (Trends, Jumps, Autokorrelation, Dekomposition)
- Räumliche Visulisierung (Karten, räumliche Interpolation)
- Temperatur und Dürreindizes

Qualification
Studierende können ■ Daten im Gelände mit analogen und modernen digitalen Methoden erfassen. ■ Datenquellen, Datentypen und grundlegende Datenformate unterscheiden. ■ Internet-Datenquellen identifizieren und kritisch nutzen. ■ für gesammelte Daten die Datenqualität kontrollieren und kennen Datenbanken. ■ Zeitreihendaten räumlich interpolieren und deren Dyanmik bewerten.
Examination achievement
Schriftliche Ausarbeitung: zwei korrigierte Übungen (gleiche Gewichtung)
Course achievement
none
Literature
Zahumenský, I (2004): Guidelines on Quality Control Procedures for Data from Automatic Weather Stations, WMO, Geneva.

↑

Name of module	Number of module
Environmental Monitoring, Data Analysis and Visualization	10LE07MO-M.12210
Name of event	
Environmental Monitoring, Data Analysis and Visualization	
Event type	Number
Course	10LE07V-M.12210/12303

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

Inhalt:
In diesem Modul werden Grundlagen für die Erfassung, Bearbeitung und Verarbeitung von Zeitreihen (mit räumlichen Aspekten) vermittelt, damit sie in einer geeigneten Form für eine spätere Modellierung vorliegen. Das Rahmenthema ist die experimentelle Beschreibung der „urbanen Wärmeinsel“ in der Stadt Freiburg. Der Kurs verwendete eine GitHub-Umgebung, um an zwei verschiedenen Themen zu arbeiten und mit eigenen Daten Übungen zu absolvieren.
Datenerfassung und Analyse: Es werden analoge und digitale Methoden zur Datenerfassung im Feld vorgestellt und diskutiert. Dies reicht von den Grundelementen analoger Feldprotokolle (Feldbuch) bis hin zur komplexen Datenerfassung. Die Studierenden programmieren eigenhändig Temperaturdatenlogger, installieren sie an ihrem Wohnort, lesen die aufgezeichneten Daten aus und überprüfen diese kritisch auf ihre Richtigkeit. Zum Vergleich werden Zeitreihendaten aus dem Internet heruntergeladen (verschiedene Arten und Skalen). Alle Zeitreihen werden in R einem umfassenden Qualitätskontrollverfahren unterzogen. Fehler in den Zeitreihen werden gelöscht und die daraus resultierenden Datenlücken mit verschiedenen Methoden gefüllt. Dadurch können charakteristische Parameter für das Temperaturverhalten ermittelt werden.
Datenvisualisierung: Eine wichtige Komponente des Kurses ist die Datenvisualisierung. Studierende erlernen verschiedene Datentypen, die Theorie der Datenvisualisierung und effektive Möglichkeiten der Visualisierung in R und GIS (Best Practice Guide). Sie arbeiten auch mit Klimadaten und Klimaindizes in größerem Maßstab (Baden-Württemberg), um zeitliche und räumliche Datenanalysen zu kombinieren.
Datenbanken: Mit R werden die ermittelten Parameter räumlich interpoliert und mit vorhandenen Metadaten der Stadt (z. B. Gebäudedichte) verglichen. Darauf folgt eine Einführung in SQL und gängige Datenbanksysteme. Eine einfache Speicherlösung wird vorgestellt und verwendet, um Daten zu speichern, eine Analysen der gesammelten Daten durchzuführen und mit den Daten der Vorjahre zu vergleichen.
· Zeitreihenanalysen (Trends, Jumps, Autokorrelation, Dekomposition)
- Räumliche Visulisierung (Karten, räumliche Interpolation)
- Temperatur und Dürreindizes

Qualification

Studierende können
- Daten im Gelände mit analogen und modernen digitalen Methoden erfassen.
- Datenquellen, Datentypen und grundlegende Datenformate unterscheiden.
- Internet-Datenquellen identifizieren und kritisch nutzen.

■ für gesammelte Daten die Datenqualität kontrollieren und kennen Datenbanken. ■ Zeitreihendaten räumlich interpolieren und deren Dyanmik bewerten.
Examination achievement
Schriftliche Ausarbeitung: zwei korrigierte Übungen (gleiche Gewichtung)
Course achievement
none
Literature
Zahumenský, I (2004): Guidelines on Quality Control Procedures for Data from Automatic Weather Stations, WMO, Geneva.
Compulsory requirement
None

↑

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

Mandatory / Elective (M/E)	Mandatory

↑

Name of module	Number of module
Earth System Modelling	10LE07MO-M.12301
Responsible	
Prof. Dr. René Orth	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Earth System Modelling	Course	Mandatory	5.0	4.0	150 h

Contents
Lecture: The lectures in this module provide an overview of computational models and their origins and applications in Earth system science. Models of varying complexity are presented, from conceptual models to weather prediction models and Earth system models, including their areas of application. Specifically, it also addresses the incorporation of existing observational data into modeling (data assimilation), the handling of processes that cannot be spatially or temporally resolved (parameterizations), and the computation of climate projections. A conceptual hydrologic water balance model is presented in depth as a basis for practical modeling using programming. Modeling via Programming: Students implement a simple water balance model under guidance and test it with prepared data at selected sites. Seminar: In small groups, students select a research question to be investigated by modeling with the water balance model. Relevant scientific literature will be studied, and reference will be made to the knowledge gained in the lectures. The results will be summarized and visualized in a poster.
Qualification
Students will

- Understand models of different complexity and their components
- know the strengths, weaknesses, and areas of application of various models
- understand the functioning and handling of a conceptual hydrological water balance model
- develop a scientific problem and addressing it independently using the water balance model
- learn to work efficiently in a team

Examination achievement
written assignment
Course achievement
none
Teaching method
Lectures, modeling with programming, seminar (group work, development of poster)
Literature
Lecture slides will be provided.

↑

Name of module	Number of module
Earth System Modelling	10LE07MO-M.12301
Name of event	
Earth System Modelling	
Event type	Number
Course	10LE07V-M.12209/12301

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	56

Contents

Lecture:
The lectures in this module provide an overview of computational models and their origins and applications in Earth system science. Models of varying complexity are presented, from conceptual models to weather prediction models and Earth system models, including their areas of application. Specifically, it also addresses the incorporation of existing observational data into modeling (data assimilation), the handling of processes that cannot be spatially or temporally resolved (parameterizations), and the computation of climate projections. A conceptual hydrologic water balance model is presented in depth as a basis for practical modeling using programming.

Modeling via Programming:
Students implement a simple water balance model under guidance and test it with prepared data at selected sites.

Seminar:
In small groups, students select a research question to be investigated by modeling with the water balance model. Relevant scientific literature will be studied, and reference will be made to the knowledge gained in the lectures. The results will be summarized and visualized in a poster.

Qualification

Students will
- Understand models of different complexity and their components
- know the strengths, weaknesses, and areas of application of various models
- understand the functioning and handling of a conceptual hydrological water balance model
- develop a scientific problem and addressing it independently using the water balance model
- learn to work efficiently in a team

Examination achievement

written assignment

Course achievement
none
Literature
Lecture slides will be provided.
Compulsory requirement
none
Recommended requirement
Basic knowledge of climate modeling and first experience in programming
Teaching method
Lectures, modeling with programming, seminar (group work, development of poster)

↑

Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12302
Responsible	
Prof. Dr. Christiane Werner Pinto	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Ecosystem Functioning (ECOFUN)	Course	Mandatory	5.0	4.0	150 h

Contents
This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning. It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.
Qualification
Students will ■ get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view. ■ be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy. ■ achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.

■ study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.
Examination achievement
Written Exam (90 min)
Course achievement
none
Teaching method
Lecture, tutoria, group work
Literature
Will be provided during the course

↑

Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12302
Name of event	
Ecosystem Functioning (ECOFUN)	
Event type	Number
Course	10LE07S-M.12202/12302/12401/22202

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning.

It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.

Qualification

Students will
- get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view.
- be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy.
- achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.
- study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.

Examination achievement

Written Exam (90 min)

Course achievement

none

Literature

Will be provided during the course

Compulsory requirement
none
Recommended requirement
none
Teaching method
Lecture, tutoria, group work

↑

Name of module	Number of module
Environmental Monitoring, Data Analysis and Visualization	10LE07MO-M.12303
Responsible	
Prof. Dr. Markus Weiler	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental Monitoring, Data Analysis and Visualization	Course	Mandatory	5.0	4.0	150 h

Contents
In diesem Modul werden Grundlagen für die Erfassung, Bearbeitung und Verarbeitung von Zeitreihen (mit räumlichen Aspekten) vermittelt, damit sie in einer geeigneten Form für eine spätere Modellierung vorliegen. Das Rahmenthema ist die experimentelle Beschreibung der „urbanen Wärmeinsel“ in der Stadt Freiburg. Der Kurs verwendete eine GitHub-Umgebung, um an zwei verschiedenen Themen zu arbeiten und mit eigenen Daten Übungen zu absolvieren.
Qualification
Studierende können ■ Daten im Gelände mit analogen und modernen digitalen Methoden erfassen. ■ Datenquellen, Datentypen und grundlegende Datenformate unterscheiden. ■ Internet-Datenquellen identifizieren und kritisch nutzen. ■ für gesammelte Daten die Datenqualität kontrollieren und kennen Datenbanken. ■ Zeitreihendaten räumlich interpolieren und deren Dyanmik bewerten.
Examination achievement
Schriftliche Ausarbeitung: zwei korrigierte Übungen (gleiche Gewichtung)
Course achievement
none

Literature
Zahumenský, I (2004): Guidelines on Quality Control Procedures for Data from Automatic Weather Stations, WMO, Geneva.

↑

Name of module	Number of module
Environmental Monitoring, Data Analysis and Visualization	10LE07MO-M.12303
Name of event	
Environmental Monitoring, Data Analysis and Visualization	
Event type	Number
Course	10LE07V-M.12210/12303

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

Inhalt:
In diesem Modul werden Grundlagen für die Erfassung, Bearbeitung und Verarbeitung von Zeitreihen (mit räumlichen Aspekten) vermittelt, damit sie in einer geeigneten Form für eine spätere Modellierung vorliegen. Das Rahmenthema ist die experimentelle Beschreibung der „urbanen Wärmeinsel“ in der Stadt Freiburg. Der Kurs verwendete eine GitHub-Umgebung, um an zwei verschiedenen Themen zu arbeiten und mit eigenen Daten Übungen zu absolvieren.
Datenerfassung und Analyse: Es werden analoge und digitale Methoden zur Datenerfassung im Feld vorgestellt und diskutiert. Dies reicht von den Grundelementen analoger Feldprotokolle (Feldbuch) bis hin zur komplexen Datenerfassung. Die Studierenden programmieren eigenhändig Temperaturdatenlogger, installieren sie an ihrem Wohnort, lesen die aufgezeichneten Daten aus und überprüfen diese kritisch auf ihre Richtigkeit. Zum Vergleich werden Zeitreihendaten aus dem Internet heruntergeladen (verschiedene Arten und Skalen). Alle Zeitreihen werden in R einem umfassenden Qualitätskontrollverfahren unterzogen. Fehler in den Zeitreihen werden gelöscht und die daraus resultierenden Datenlücken mit verschiedenen Methoden gefüllt. Dadurch können charakteristische Parameter für das Temperaturverhalten ermittelt werden.
Datenvisualisierung: Eine wichtige Komponente des Kurses ist die Datenvisualisierung. Studierende erlernen verschiedene Datentypen, die Theorie der Datenvisualisierung und effektive Möglichkeiten der Visualisierung in R und GIS (Best Practice Guide). Sie arbeiten auch mit Klimadaten und Klimaindizes in größerem Maßstab (Baden-Württemberg), um zeitliche und räumliche Datenanalysen zu kombinieren.
Datenbanken: Mit R werden die ermittelten Parameter räumlich interpoliert und mit vorhandenen Metadaten der Stadt (z. B. Gebäudedichte) verglichen. Darauf folgt eine Einführung in SQL und gängige Datenbanksysteme. Eine einfache Speicherlösung wird vorgestellt und verwendet, um Daten zu speichern, eine Analysen der gesammelten Daten durchzuführen und mit den Daten der Vorjahre zu vergleichen.
· Zeitreihenanalysen (Trends, Jumps, Autokorrelation, Dekomposition)
- Räumliche Visulisierung (Karten, räumliche Interpolation)
- Temperatur und Dürreindizes

Qualification

Studierende können
- Daten im Gelände mit analogen und modernen digitalen Methoden erfassen.
- Datenquellen, Datentypen und grundlegende Datenformate unterscheiden.
- Internet-Datenquellen identifizieren und kritisch nutzen.

■ für gesammelte Daten die Datenqualität kontrollieren und kennen Datenbanken. ■ Zeitreihendaten räumlich interpolieren und deren Dyanmik bewerten.
Examination achievement
Schriftliche Ausarbeitung: zwei korrigierte Übungen (gleiche Gewichtung)
Course achievement
none
Literature
Zahumenský, I (2004): Guidelines on Quality Control Procedures for Data from Automatic Weather Stations, WMO, Geneva.
Compulsory requirement
None

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12304
Responsible	
Prof. Dr. Carsten Dormann	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Recommended semester	1
Duration	1
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental Statistics	Course	Mandatory	5.0	4.0	150 h

Contents
This module builds on and extends statistical knowledge and its application: ■ Generalised Additive Models ■ Classification & Regression Trees (incl. randomForest and BRT) ■ non-parametric statistic (resampling approaches) ■ model selection incl. cross-validation ■ spatial statistics (correlogram, variogram) ■ extreme value statistics ■ time-series analysis (autocorrelation, decomposition) All topics will be taught in the free software R.
Qualification
Students will ■ extend their statistical knowledge ■ solve complex statistical tasks ■ advance the use of R
Examination achievement
Exam
Course achievement
10 out of 12 weekly homework assignments passed with over 60% of the points

Teaching method
Lectures, practical exercises, group work
Literature
■ Crawley (2007) The R Book. Wiley. ■ *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf) ■ Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger ■ *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf * indicates an open resource

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12304
Name of event	
Environmental Statistics	
Event type	Number
Course	10LE07S-M.12203/12304/12503/57140

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module builds on and extends statistical knowledge and its application:
- Generalised Additive Models
- Classification & Regression Trees (incl. randomForest and BRT)
- non-parametric statistic (resampling approaches)
- model selection incl. cross-validation
- spatial statistics (correlogram, variogram)
- extreme value statistics
- time-series analysis (autocorrelation, decomposition)

All topics will be taught in the free software R.

Qualification

Students will
- extend their statistical knowledge
- solve complex statistical tasks
- advance the use of R

Examination achievement

Exam

Course achievement

10 out of 12 weekly homework assignments passed with over 60% of the points

Literature

- Crawley (2007) The R Book. Wiley.
- *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf)
- Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger
- *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf

* indicates an open resource
Compulsory requirement
none
Recommended requirement
■ Basic statistical knowledge: distributions, maximum likelihood, regressions; ANOVA, GLM, PCA ■ Data import und simple statistical analyses in R (www.r-project.org) ■ Knowledge of all content of “R for Beginners” (https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)
Teaching method
Lectures, practical exercises, group work

↑

Name of module	Number of module
Advanced Statistics	10LE07MO-M.12309
Responsible	
Marieke Wesselkamp	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	52 h
Independent study	98 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None
Recommended requirement
Basic statistical knowledge in statistics (ANOVA, ANCOVA, GLMs, GAMs) and R

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Advanced Statistics	Course	Mandatory	5.0	4.0	150 h

Contents
■ Analysis of temporally/spatially correlated data ■ Bayesian mixed-effect models ■ (generalized) mixed-effect models
Qualification
Students will ■ be able to apply and interprete mixed effects models ■ be able to solve complex statistical tasks independently using the software R and its relevant resources ■ get competences for the development (research) and application (practice) of advanced but important statistical models in the environmental sciences.
Examination achievement
Written assignment

Teaching method
Lecture, demonstration, tutored exercises
Literature
Scripts and reading material will be made available during the course on Github and on ILIAS. Some suggested literature is given here: ■ Paradis, E. R for Beginners (https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf) ■ Crawley M (2007) The R Book. Wiley ■ Zuur A et al. (2007) Mixed Effect Models and their Extensions in Ecology with R. Springer. ■ Bolker B et al. (2009) Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology and Evolution 24:127 – 135. ■ Documentation for the lme4 package: https://cran.r-project.org/web/packages/lme4/index.html

↑

Name of module	Number of module
Advanced Statistics	10LE07MO-M.12309
Name of event	
Advanced Statistics	
Event type	Number
Course	10LE07V-M.12309

ECTS-Points	5.0
Workload	150 h
Attendance	52 h
Independent study	98 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	25

Contents

The module teaches competences for the development (research) and application (practice) of advanced but important statistical models in the environmental sciences.

The module focuses on mixed effects models and their application in R. Mixed effects models are powerful tools to deal with structure and heterogeneity in environmental data arising from such common practices as multiple sampling of units, grouping units at various hierarchical levels, or spatial sampling. A rough estimation shows that 80-90 % of environmental studies require mixed effects models to analyse their data. However, mixed effects models are also complex and sometimes difficult to apply and interpret. More, they are developing fast and their possibilities expand continuously. The module´s goal is to teach students the basics of mixed effects models on which to build on when analysing their own data. The course thus extends statistical knowledge and its application as conveyed by other courses at the faculty. Topics covered will be repeated measurement ANOVA, generalised least squares (GLS), linear mixed models (LMMs), Generalised linear mixed models (GLMM), Bayesian mixed models, optimization methods and possibly Generalised additive mixed models (GAMM).

All topics will be taught in the free software R, mainly using the R-packages nlme, lme4, brms, gls, aov and their add-ons.

Qualification

Students will
- be able to apply and interprete mixed effects models
- be able to solve complex statistical tasks independently using the software R and its relevant resources
- get competences for the development (research) and application (practice) of advanced but important statistical models in the environmental sciences.

Examination achievement

Written assignment

Course achievement
Literature
Scripts and reading material will be made available during the course on Github and on ILIAS. Some suggested literature is given here: ■ Paradis, E. R for Beginners (https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf) ■ Crawley M (2007) The R Book. Wiley ■ Zuur A et al. (2007) Mixed Effect Models and their Extensions in Ecology with R. Springer. ■ Bolker B et al. (2009) Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology and Evolution 24:127 – 135. ■ Documentation for the lme4 package: https://cran.r-project.org/web/packages/lme4/index.html
Compulsory requirement
None
Recommended requirement
Basic statistical knowledge in statistics (ANOVA, ANCOVA, GLMs, GAMs) and R
Teaching method
Lecture, demonstration, tutored exercises

↑

Name of module	Number of module
Capstone Project	10LE07MO-M.12310
Responsible	
Prof. Dr. Carsten Dormann	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
Participants should have taken the majority of courses in the Major „Environmental Modelling and Data Science“, as this course builds on the skills acquired there.

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Capstone Project	Course	Mandatory	5.0	4.0	150 h

Contents
Lectures will cover scientific reproducibility (open data, open source, versioning, open science platforms); critical reading of papers including evaluation of claimed novelty; identifying sensitive assumptions or routines; and writing terse technical comments. This knowledge is then used, in group projects of 2-3 people, to (i) reproduce a published study; (ii) change the data or methods a bit to explore the consequences for the findings; and (iii) write a maximally 2-page comment accompanied by a full length documentation of steps (i) and (ii) in fully reproducible format.
Qualification
Students will be empowered to critically read, reproduce and re-analyse scientific studies. They will practice the use of versioning and literal programming software. Finally, they will learn to write with a focus on the key criticisms (or confirmation) of the study, by writing a terse, short and to-the-point comment on the original publication, reflecting their findings.
Examination achievement
Half-way through and at the end of the module, each group will briefly present their paper, the main target of re-analysis and findings with respect to consistency or discrepancy of the reproduction. Students will write a final written report, of maximally 2 pages of scientific writing plus many pages of documented and reproducible code as supplement.

Teaching method
Lectures, supervised group projects, student presentations
Literature
Dormann, C.F., Schneider, H., and Gorges, J. (2019) Neither global nor consistent: a technical comment on the tree diversity-productivity analysis of Liang et al. (2016). bioRxiv, https://doi.org/10.1101/524363
Recommendation
none

↑

Name of module	Number of module
Capstone Project	10LE07MO-M.12310
Name of event	
Capstone Project	
Event type	Number
Course	10LE07V-M.12310

ECTS-Points	5.0
Workload	150 h
Attendance	50 h
Independent study	100 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	25

Contents
Lectures will cover scientific reproducibility (open data, open source, versioning, open science platforms); critical reading of papers including evaluation of claimed novelty; identifying sensitive assumptions or routines; and writing terse technical comments. This knowledge is then used, in group projects of 2-3 people, to (i) reproduce a published study; (ii) change the data or methods a bit to explore the consequences for the findings; and (iii) write a maximally 2-page comment accompanied by a full length documentation of steps (i) and (ii) in fully reproducible format.
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Examination achievement
Half-way through and at the end of the module, each group will briefly present their paper, the main target of re-analysis and findings with respect to consistency or discrepancy of the reproduction. Students will write a final written report, of maximally 2 pages of scientific writing plus many pages of documented and reproducible code as supplement.
Course achievement

Literature
Dormann, C.F., Schneider, H., and Gorges, J. (2019) Neither global nor consistent: a technical comment on the tree diversity-productivity analysis of Liang et al. (2016). bioRxiv, https://doi.org/10.1101/524363
Compulsory requirement
Participants should have taken the majority of courses in the Major „Environmental Modelling and Data Science“, as this course builds on the skills acquired there.
Recommended requirement
R, Python, remote sensing techniques
Teaching method
Lectures, supervised group projects, student presentations

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

Mandatory / Elective (M/E)	Mandatory

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Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12401
Responsible	
Prof. Dr. Christiane Werner Pinto	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Ecosystem Functioning (ECOFUN)	Course	Mandatory	5.0	4.0	150 h

Contents
This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning. It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.
Qualification
Students will ■ get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view. ■ be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy. ■ achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.

■ study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.
Examination achievement
Written Exam (90 min)
Course achievement
none
Teaching method
Lecture, tutoria, group work
Literature
Will be provided during the course

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Name of module	Number of module
Ecosystem Functioning	10LE07MO-M.12401
Name of event	
Ecosystem Functioning (ECOFUN)	
Event type	Number
Course	10LE07S-M.12202/12302/12401/22202

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module will cover different aspects of ecosystem processes across scales, providing insights into advanced knowledge of ecosystem functioning.

It will cover the fundamental ecological processes of ecosystems, such as the carbon and water cycle, biogeochemical cycles, soil processes, and community dynamics. Lectures will showcase how ecosystem functioning is driven by changes in environmental factors, while in turn ecosystem processes feed-back to the environment. Lectures will cover how ecosystem functions relate to structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within and across ecosystems. Further lecture material to deepen the knowledge will be provided. The lectures are accompanied by discussion groups on specific aspects and link the different thematic fields.

Qualification

Students will
- get an overview on ecosystem processes and functioning at an advanced level from a scientific point of view.
- be qualified to critically follow the scientific and public debates on the subject and give them background knowledge for careers in research, education and consultancy.
- achieve an in depth understanding of the complexity and interactions of processes within ecosystems and their feedback on the environment.
- study examples of case studies and additional literature, which will be provided to deepen their understanding of such processes.

Examination achievement

Written Exam (90 min)

Course achievement

none

Literature

Will be provided during the course

Compulsory requirement
none
Recommended requirement
none
Teaching method
Lecture, tutoria, group work

↑

Name of module	Number of module
Environmental and Resource Economics	10LE07MO-M.12402
Responsible	
Prof. Dr. Stefan Baumgärtner	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental and Resource Economics	Course	Mandatory	5.0	4.0	150 h

Contents
Part I Introduction 1. Environment and economy 2. Mathematics for environmental economics Part II Microeconomic foundations of environmental economics 1. Utility of the natural environment for humans 2. Scarcity and opportunity costs of natural resources 3. Optimization and optimality conditions Part III Welfare economics: markets, nature, and government 1. Market equilibrium 2. Markets and welfare 3. Public goods 4. Open access to natural resources 5. Externalities 6. Regulation of a heterogeneous polluting industry 7. Government failure

Qualification
In this module, students will learn how to analyze the (un)sustainable use of natural environment and natural resources from an economic perspective. To this end, students will learn intermediate and advanced concepts and methods from ecological, environmental and resource economics, and apply them to analyze (un)sustainable economy-environment systems.
Examination achievement
Written Exam (90 minutes)
Course achievement
none
Teaching method
Lecture, homework
Literature
There is no single textbook for this module. References for several chapters of the course include: ■ M. Common and S. Stagl: Ecological Economics. An Introduction, Cambridge University Press, 2005 ■ H.E. Daly and J. Farley: Ecological Economics. Principles and Applications, Washington DC: Island Press, 2004 ■ Endres and V. Radke: Economics for Environmental Studies. A Strategic Guide to Micro- and Macroeconomics, Springer, 2012 ■ N. Hanley, J.F. Shogren and B. White: Environmental Economics in Theory and Practice, 2nd edition, Palgrave Macmillan, 2007 ■ R. Perman, Y. Ma, J. McGilvray and M. Common: Natural Resource and Environmental Economics, 3rd edition, Pearson Education, 2003

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Name of module	Number of module
Environmental and Resource Economics	10LE07MO-M.12402
Name of event	
Environmental and Resource Economics	
Event type	Number
Course	10LE07V-M.12402

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

Part I Introduction
1. Environment and economy
2. Mathematics for environmental economics

Part II Microeconomic foundations of environmental economics
1. Utility of the natural environment for humans
2. Scarcity and opportunity costs of natural resources
3. Optimization and optimality conditions

Part III Welfare economics: markets, nature, and government
1. Market equilibrium
2. Markets and welfare
3. Public goods
4. Open access to natural resources
5. Externalities
6. Regulation of a heterogeneous polluting industry
7. Government failure

Qualification

In this module, students will learn how to analyze the (un)sustainable use of natural environment and natural resources from an economic perspective. To this end, students will learn intermediate and advanced concepts and methods from ecological, environmental and resource economics, and apply them to analyze (un)sustainable economy-environment systems.

Examination achievement

Written Exam (90 minutes)

Course achievement

none

Literature
There is no single textbook for this module. References for several chapters of the course include: ■ M. Common and S. Stagl: Ecological Economics. An Introduction, Cambridge University Press, 2005 ■ H.E. Daly and J. Farley: Ecological Economics. Principles and Applications, Washington DC: Island Press, 2004 ■ Endres and V. Radke: Economics for Environmental Studies. A Strategic Guide to Micro- and Macroeconomics, Springer, 2012 ■ N. Hanley, J.F. Shogren and B. White: Environmental Economics in Theory and Practice, 2nd edition, Palgrave Macmillan, 2007 ■ R. Perman, Y. Ma, J. McGilvray and M. Common: Natural Resource and Environmental Economics, 3rd edition, Pearson Education, 2003
Compulsory requirement
None
Recommended requirement
Basic (environmental and resource) economics from a Bachelor program
Teaching method
Lecture, homework

↑

Name of module	Number of module
Material and Energy Flow Analysis	10LE07MO-M.12403
Responsible	
Prof. Ph.D. Stefan Pauliuk	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	10.0
Workload	300h
Hours of week	6.0
Recommended semester	1
Duration	1
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Material and Energy Flow Analysis	Course	Mandatory	10.0	6.0	300h

Contents
During the course ‘material and energy flow analysis’, students learn about the fundamentals and application of quantitative systems analysis to socioecological systems. The module combines the theory of socioecological systems (1) with the basics of quantitative analysis of systems (2). It also provides extensive factual knowledge of the material and energetic basis of our society (3) and methodological skills for its analysis (4). The four areas are closely interlinked in the lectures and exercises. The following mathematical methods will be applied during the course, partly in Python (an introduction is provided) + Basics of linear algebra: matrix multiplication and inversion, multiplication of matrices by vectors, rearrangement of matrix equations, systems of linear equations. + Performing simple and matrix calculations using MS Excel (e.g. row sum, multiplication, inverse) and Python. + Basic knowledge of differential calculus: partial derivative of simple functions. It is assumed that this mathematical knowledge is available and will be consolidated independently before and during the course. The mathematical methods themselves will not be re-introduced during the course.
Qualification
Students taking this module will: - acquire comprehensive factual knowledge on the material and energetic basis of human activities - learn to understand societal metabolism as a complex adaptive system - become familiar with the theory of socio-ecological systems and with contemporary concepts of sustainable development, such as the doughnut economy or the safe operating space for humanity and learn to discuss these concepts critically.

- acquire basic competencies in quantitative systems analysis to address environmental and sustainability issues
- become familiar with strategies to transform the biophysical basis of our society

Core technical skills acquired include:
- understand and apply the basics of energy and material flow analysis
- understand and learn to apply the basics of input-output analysis
- learn to deal with quantitative data, and in particular to use mass balance and error propagation
- be able to use common software (Excel and Python) to model concrete case studies of sustainable energy and material scenarios
- model concrete case studies of sustainable energy and material flow management
- develop an understanding of the possibilities and limitations of existing tools and methods, and gain experience in the selection and application of quantitative analytical methods

Examination achievement

Written exam *(2h, individual)*

Course achievement

none

Teaching method

Integratetd lectures, exercises, and seminars

Literature

- Practical Handbook of Material Flow Analysis. By Paul H Brunner, and Helmut Rechberger. CRC/Lewis, 2004. ISBN: 0203507207. Provided on ILIAS.
- Metabolism of the Anthroposphere, second edition. By Peter Baccini and Paul H. Brunner. MIT press, 2012, ISBN: 978-0262016650
- Input-Output Analysis Foundations and Extensions. By R.E. Miller and P.D. Blair. Cambridge University Press, 2009. ISBN: 978-0521739023
- The Economics of the Coming Spaceship Earth. Kenneth E Boulding. Buchkapitel in “Environmental Quality in a Growing Economy”, 1966. Johns Hopkins University Press. http://www.ub.edu/prometheus21/articulos/obsprometheus/BOULDING.pdf
- The role of in-use stocks in the social metabolism and in climate change mitigation. Stefan Pauliuk. Global Environmental Change 24, 2014, pp 132-142. DOI: 10.1016/j.gloenvcha.2013.11.006

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

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Name of module	Number of module
Material and Energy Flow Analysis	10LE07MO-M.12403
Name of event	
Material and Energy Flow Analysis	
Event type	Number
Course	10LE07V-M.12403

ECTS-Points	10.0
Hours of week	6.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

During the course ‘material and energy flow analysis’, students learn about the fundamentals and application of quantitative systems analysis to socioecological systems. The module combines the theory of socioecological systems (1) with the basics of quantitative analysis of systems (2). It also provides extensive factual knowledge of the material and energetic basis of our society (3) and methodological skills for its analysis (4). The four areas are closely interlinked in the lectures and exercises.
1) Theory of socioecological systems: Starting from the 'two sphere model', an interdisciplinary theory of socio-ecological systems (SES, from socioecological systems) is presented, which serves as the theoretical foundation of the entire course. It is shown how bridging concepts and paradigms describe different aspects of SES from the perspective of social and natural sciences. Central concepts of the description and practical implementation of sustainability are introduced and classified with the help of the general theory. These concepts are e.g. 'Safe operating space for humanity', sociometabolic regimes, sociometabolic transitions, 'Sustainable Development Goals', as well as the economic forms 'circular economy', 'performance economy', bioeconomy', and 'spaceman economy'.

2) Fundamentals of quantitative system analysis: system definition, system variables and parameters, balance equations, system equations and their analytical and numerical solution, error consideration and error propagation, data quality and measurement deviations, static, stationary and dynamic systems, material cycles and product systems.

3) Methods of system analysis:
Energy and material flow analysis of industrial systems is the basic method for quantifying the energy and material levels of human society (Baccini and Brunner 2012). It is used to capture the material and energy flows and stocks in technical processes in a system context, providing the basis for assessment and decision making. Input-output analysis is an important tool for studying industrial systems and calculating so-called footprints for CO2, water, land use, and other resources. Both methods will be explained in detail and taught through several exercises.

4) The biophysical basis of human society and its sustainable transformation: In addition to the theory and methods of material flow management, extensive factual knowledge about the material and energetic basis of central human activities such as living, working, transport, communication, nutrition or cleaning is imparted in special background lectures, which then also forms the basis for the respective exercises. In addition to the facts, there is knowledge about the interrelationships in the system 'societal metabolism' and about the restructuring of the societal metabolism with regard to its sustainable development.

The following mathematical methods will be applied during the course, partly in Python (an introduction is provided)

+ Basics of linear algebra: matrix multiplication and inversion, multiplication of matrices by vectors, rearrangement of matrix equations, systems of linear equations.
+ Performing simple and matrix calculations using MS Excel (e.g. row sum, multiplication, inverse) and Python.
+ Basic knowledge of differential calculus: partial derivative of simple functions.

It is assumed that this mathematical knowledge is available and will be consolidated independently before and during the course. The mathematical methods themselves will not be re-introduced during the course.

Qualification

Students taking this module will:
- acquire comprehensive factual knowledge on the material and energetic basis of human activities
- learn to understand societal metabolism as a complex adaptive system
- become familiar with the theory of socio-ecological systems and with contemporary concepts of sustainable development, such as the doughnut economy or the safe operating space for humanity and learn to discuss these concepts critically.
- acquire basic competencies in quantitative systems analysis to address environmental and sustainability issues
- become familiar with strategies to transform the biophysical basis of our society

Core technical skills acquired include:
- understand and apply the basics of energy and material flow analysis
- understand and learn to apply the basics of input-output analysis
- learn to deal with quantitative data, and in particular to use mass balance and error propagation
- be able to use common software (Excel and Python) to model concrete case studies of sustainable energy and material scenarios
- model concrete case studies of sustainable energy and material flow management
- develop an understanding of the possibilities and limitations of existing tools and methods, and gain experience in the selection and application of quantitative analytical methods

Examination achievement

Written exam *(2h, individual)*

Course achievement

none

Literature

- Practical Handbook of Material Flow Analysis. By Paul H Brunner, and Helmut Rechberger. CRC/ Lewis, 2004. ISBN: 0203507207. Provided on ILIAS.
- Metabolism of the Anthroposphere, second edition. By Peter Baccini and Paul H. Brunner. MIT press, 2012, ISBN: 978-0262016650
- Input-Output Analysis Foundations and Extensions. By R.E. Miller and P.D. Blair. Cambridge University Press, 2009. ISBN: 978-0521739023
- The Economics of the Coming Spaceship Earth. Kenneth E Boulding. Buchkapitel in “Environmental Quality in a Growing Economy”, 1966. Johns Hopkins University Press. http://www.ub.edu/prometheus21/articulos/obsprometheus/BOULDING.pdf
- The role of in-use stocks in the social metabolism and in climate change mitigation. Stefan Pauliuk. Global Environmental Change 24, 2014, pp 132-142. DOI: 10.1016/j.gloenvcha.2013.11.006

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

Compulsory requirement

Recommended requirement
Familiarity with quantitative analysis
Teaching method
Integratetd lectures, exercises, and seminars

↑

Name of module	Number of module
Research Project	10LE07MO-M.12408
Responsible	
Prof. Ph.D. Stefan Pauliuk	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	10.0
Workload	300 h
Hours of week	6.0
Attendance	80 h
Independent study	220 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Research Project	Course	Mandatory	10.0	6.0	300 h

Contents
The scope of the work in the Project module is flexible, but a qualified scientific advisor from the SAT teachers team must be found. The work can be carried out individually or in groups. The following list shows potential projects that we could support, provided that the below-mentioned stakeholders are interested and have capacity: Circular Economy plan for city and region, targeting major material groups (link to the city) Climate protection plan for the Uni (link to the Uni) Scenarios for sustainable nutrition (link to the Innovation Campus / research group on sustainable nutrition systems) Scenarios for sustainable nitrogen and phosphorous management in the region Energy transition studies, covering solar PV in different constellations, hydrogen-based solution, consumer-driven solutions, etc. Plus topics in economics/market design, legal analysis, transformation science, etc. Also: Modelling activities (different sectors and scopes), life cycle analyses, footprint studies, … From the technical and scientific side, we will set some minimum standards (reg. scientific report/presentation/poster) with core features (literature overview, research gap + questions, discussion and classification of the results according to tbd. criteria, bibliography).

Qualification
This course qualifies students for interdisciplinary research in the SAT major. This includes the application of the central research skills, the formulation of research questions that require an interdisciplinary approach, the development of a research program to tackle these questions. Organisation of the research, either individually or as a team. Compilation of a report and a presentation, including a critical discussion of the results generated.
Examination achievement
none
Course achievement
Project report, can be individual or a group work AND a presentation in a final seminar.
Literature
■ Industrial Ecology Open Online Course: https://www.industrialecology.uni-freiburg.de/teaching ■ Good Scientific Practice in Industrial Ecology - A Factsheet. This document provides researchers and students with a condensed overview of three main aspects of good scientific practice in industrial ecology: research ethics, best practice for conducting and documenting research, and research tools. The following topics are covered: (1) Research ethics overview. Core scientific principles and good scientific conduct. (2) Best practice for carrying out, documenting, and publishing research: including recommendations for report structure and scientific writing as well as reproducible research. (3) Some state-of-the art tools and infrastructure for IE research: https://www.industrialecology.uni-freiburg.de/Content/IEooc_Methods_Good_Scientific_Practice.pdf Additional literature such as book chapters, journal articles and reports will be shared via ILIAS.

↑

Name of module	Number of module
Research Project	10LE07MO-M.12408
Name of event	
Research Project	
Event type	Number
Course	10LE07V-M.12408

ECTS-Points	10.0
Workload	300 h
Attendance	80 h
Independent study	220 h
Hours of week	6.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	25

Contents

The scope of the work in the Project module is flexible, but a qualified scientific advisor from the SAT teachers team must be found. The work can be carried out individually or in groups.
The following list shows potential projects that we could support, provided that the below-mentioned stakeholders are interested and have capacity:
Circular Economy plan for city and region, targeting major material groups (link to the city)
Climate protection plan for the Uni (link to the Uni)
Scenarios for sustainable nutrition (link to the Innovation Campus / research group on sustainable nutrition systems)
Scenarios for sustainable nitrogen and phosphorous management in the region
Energy transition studies, covering solar PV in different constellations, hydrogen-based solution, consumer-driven solutions, etc.
Plus topics in economics/market design, legal analysis, transformation science, etc.
Also: Modelling activities (different sectors and scopes), life cycle analyses, footprint studies, …

From the technical and scientific side, we will set some minimum standards (reg. scientific report/presentation/poster) with core features (literature overview, research gap + questions, discussion and classification of the results according to tbd. criteria, bibliography).

Qualification

This course qualifies students for interdisciplinary research in the SAT major. This includes the application of the central research skills, the formulation of research questions that require an interdisciplinary approach, the development of a research program to tackle these questions. Organisation of the research, either individually or as a team. Compilation of a report and a presentation, including a critical discussion of the results generated.

Examination achievement

none

Course achievement
Project report, can be individual or a group work AND a presentation in a final seminar.
Literature
■ Industrial Ecology Open Online Course: https://www.industrialecology.uni-freiburg.de/teaching ■ Good Scientific Practice in Industrial Ecology - A Factsheet. This document provides researchers and students with a condensed overview of three main aspects of good scientific practice in industrial ecology: research ethics, best practice for conducting and documenting research, and research tools. The following topics are covered: (1) Research ethics overview. Core scientific principles and good scientific conduct. (2) Best practice for carrying out, documenting, and publishing research: including recommendations for report structure and scientific writing as well as reproducible research. (3) Some state-of-the art tools and infrastructure for IE research: https://www.industrialecology.uni-freiburg.de/Content/IEooc_Methods_Good_Scientific_Practice.pdf Additional literature such as book chapters, journal articles and reports will be shared via ILIAS.
Compulsory requirement
none
Recommended requirement
none
Teaching method
Integrated lectures and seminars, project work

↑

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

Mandatory / Elective (M/E)	Mandatory

↑

Name of module	**Number of module**
Analysis of Biodiversity Data	10LE07MO-M.12501
Responsible	
Prof. Dr. Markus Hauck	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Analysis of Biodiversity Data	Course	Mandatory	5.0	4.0	150 h

Contents
Main focus of this module:- Measuring and comparing biological diversity (α-, β- and γ-Diversity) by using rarefaction/extrapolation and modelling approaches- Analysing community data with multivariate statistics (ordinations)
Qualification
Students will - receive a deeper understanding about how to measure biological diversity - learn widely applied methods, especially in plant ecology- increase R-knowledge
Examination achievement
Written report
Course achievement
Attendance
Teaching method
Lectures, practical exercises

↑

Name of module	Number of module
Analysis of Biodiversity Data	10LE07MO-M.12501
Name of event	
Analysis of Biodiversity Data	
Event type	Number
Course	10LE07V-M.12501/22201

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents
Main focus of this module:- Measuring and comparing biological diversity (α-, β- and γ-Diversity) by using rarefaction/extrapolation and modelling approaches- Analysing community data with multivariate statistics (ordinations)
Qualification
Students will - receive a deeper understanding about how to measure biological diversity - learn widely applied methods, especially in plant ecology - increase R-knowledge
Examination achievement
Written report
Course achievement
Attendance
Compulsory requirement
None
Recommended requirement
Basic statistical knowledge and familiar with R
Teaching method
Lectures, practical exercises

↑

Name of module	Number of module
Biodiversity and Conservation Biology	10LE07MO-M.12502
Responsible	
Prof. Dr. Ilse Storch	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Biodiversity and Conservation Biology	Course	Mandatory	5.0	4.0	150 h

Contents
■ Biodiversity concept, measures and indicators ■ The biodiversity crisis and its causes ■ Biodiversity policy and instruments ■ Approaches to priority setting in conservation ■ Conservation approaches from species to landscapes ■ Animal population restauration ■ The scientific basis for conservation ■ International Conservation Case Examples
Qualification
Students understand the concept of "biodiversity" and its different aspects, and are able to understand, critically discuss and interpret conservation biology studies for application in conservation.
Examination achievement
written assignment
Course achievement
SL

Teaching method
Lectures, presentations, discussions

↑

Name of module	Number of module
Biodiversity and Conservation Biology	10LE07MO-M.12502
Name of event	
Biodiversity and Conservation Biology	
Event type	Number
Course	10LE07V-M.12502

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	16

Contents
■ Biodiversity concept, measures and indicators ■ The biodiversity crisis and its causes ■ Biodiversity policy and instruments ■ Approaches to priority setting in conservation ■ Conservation approaches from species to landscapes ■ Animal population restauration ■ The scientific basis for conservation ■ International Conservation Case Examples
Qualification
Students understand the concept of "biodiversity" and its different aspects, and are able to understand, critically discuss and interpret conservation biology studies for application in conservation.
Examination achievement
written assignment
Course achievement
SL
Compulsory requirement
none
Recommended requirement
none
Teaching method
Vorlesung, Präsentationen, Diskussion

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12503
Responsible	
Prof. Dr. Carsten Dormann	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
none

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Environmental Statistics	Course	Mandatory	5.0	4.0	150 h

Contents
This module builds on and extends statistical knowledge and its application: ■ Generalised Additive Models ■ Classification & Regression Trees (incl. randomForest and BRT) ■ non-parametric statistic (resampling approaches) ■ model selection incl. cross-validation ■ spatial statistics (correlogram, variogram) ■ extreme value statistics ■ time-series analysis (autocorrelation, decomposition) All topics will be taught in the free software R.
Qualification
Students will ■ extend their statistical knowledge ■ solve complex statistical tasks ■ advance the use of R
Examination achievement
Exam
Course achievement
10 out of 12 weekly homework assignments passed with over 60% of the points

Teaching method
Lectures, practical exercises, group work
Literature
■ Crawley (2007) The R Book. Wiley. ■ *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf) ■ Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger ■ *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf * indicates an open resource

↑

Name of module	Number of module
Environmental Statistics	10LE07MO-M.12503
Name of event	
Environmental Statistics	
Event type	Number
Course	10LE07S-M.12203/12304/12503/57140

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

This module builds on and extends statistical knowledge and its application:
- Generalised Additive Models
- Classification & Regression Trees (incl. randomForest and BRT)
- non-parametric statistic (resampling approaches)
- model selection incl. cross-validation
- spatial statistics (correlogram, variogram)
- extreme value statistics
- time-series analysis (autocorrelation, decomposition)

All topics will be taught in the free software R.

Qualification

Students will
- extend their statistical knowledge
- solve complex statistical tasks
- advance the use of R

Examination achievement

Exam

Course achievement

10 out of 12 weekly homework assignments passed with over 60% of the points

Literature

- Crawley (2007) The R Book. Wiley.
- *Helsel & Hirsch (1992) Statistical Methods in Water Resources. (www.epa.gov/region9/qa/pdfs/statguide.pdf)
- Schönwiese (2006) Praktische Statistik für Meteorologen und Geowissenschaftler, 4. Aufl., Bornträger
- *R-documentation under http://cran.r-project.org/other-docs.html, like http://cran.r-project.org/doc/contrib/Dormann+Kuehn_AngewandteStatistik.pdf

* indicates an open resource
Compulsory requirement
none
Recommended requirement
■ Basic statistical knowledge: distributions, maximum likelihood, regressions; ANOVA, GLM, PCA ■ Data import und simple statistical analyses in R (www.r-project.org) ■ Knowledge of all content of “R for Beginners” (https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)
Teaching method
Lectures, practical exercises, group work

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Name of module	Number of module
Genetic and Genomic Methods in Wildlife Management and Conservation	10LE07MO-M.12504
Responsible	
Prof. Dr. Katrin Heer	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	1
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Genetic and Genomic Methods in Wildlife Management and Conservation	Course	Mandatory	5.0	4.0	150 h

Contents
The application of genetic and genomic methods has greatly enhanced our understanding of the extent and spatial distribution of genetic diversity within species, of patterns of local adaptation and the genetic basis underlying phenotypic traits. Also, genetic methods allow assessing population properties that are relevant for species management and conservation such as effective population sizes, patterns of gene flow and hybridization. In this module, we will present current methods and applications, read and discuss relevant literature and critically discuss the advantages and limitations of genetic methods. Students will learn how to design molecular studies in the lab, and acquire basic knowledge in analyzing genetic data and evaluate case studies.
Qualification
Student understand how to determine parameters and processes like effective population size, genetic diversity, hybridization and local adaptation based on genetic data. Students can critically read and discuss scientific literature on the above mention topics.
Examination achievement
Written assignment
Course achievement
Seminar presentation

Literature
Allendorf et al. 2022 Conservation and the Genomics of Populations.

↑

Name of module	Number of module
Genetic and Genomic Methods in Wildlife Management and Conservation	10LE07MO-M.12504
Name of event	
Genetic and Genomic Methods in Wildlife Management and Conservation	
Event type	Number
Course	10LE07S-M.12504

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	1
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents
The application of genetic and genomic methods has greatly enhanced our understanding of the extent and spatial distribution of genetic diversity within species, of patterns of local adaptation and the genetic basis underlying phenotypic traits. Also, genetic methods allow assessing population properties that are relevant for species management and conservation such as effective population sizes, patterns of gene flow and hybridization. In this module, we will present current methods and applications, read and discuss relevant literature and critically discuss the advantages and limitations of genetic methods. Students will learn how to design molecular studies in the lab, and acquire basic knowledge in analyzing genetic data and evaluate case studies.
Qualification
Student understand how to determine parameters and processes like effective population size, genetic diversity, hybridization and local adaptation based on genetic data. Students can critically read and discuss scientific literature on the above mention topics.
Examination achievement
Written assignment
Course achievement
Seminar presentation
Literature
Allendorf et al. 2022 Conservation and the Genomics of Populations.
Compulsory requirement
None
Recommended requirement
Grundlagen der Populationsgenetik

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Name of module	Number of module
Conservation of Forest Biodiversity	10LE07MO-M.12509
Responsible	
Prof. Dr. Ilse Storch	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Conservation of Forest Biodiversity	Course	Mandatory	5.0	4.0	150 h

Contents
The DFG-funded Research Training Group ConFoBi Conservation of Forest Biodiversity in Multiple-use Landscapes of Central Europe is a major research and qualification programme of Freiburg University. ConFoBi combines multi-scale ecological studies on forest biodiversity with social and economic studies of biodiversity conservation, and focuses on the effectiveness of structural retention measures, namely habitat trees and dead wood, for the conservation of biodiversity in managed forests. See also: http://confobi.uni-freiburg.de/ The module will offer students insights into the approaches, study design, field methods and data anlysis of ConFoBi. ConFoBi researchers will present their projects, students will visit study plots and – as far as possible - participate in data collection and/or analysis. After a general introduction to forest biodiversity conservation issues, and the ConFoBi project, students will work on various aspects of ConFoBi (field work, lab, data analysis, written assignments). Details will be specified each summer shortly before the module according to ConFoBi's research schedule. The module may also prepare students for MSc thesis work, and possibly later PhD research, within the ConFoBi project.
Qualification
Students will ■ gain knowledge of major approaches and challenges in conservation of biodiversity in managed forests ■ will gnowledge of retention forestry approaches ■ understand the interdisciplinary study design and the translational approach of ConFoBi

■ be qualified for advanced education in conservation biological research (PhD programmes) and the scientific background for careers in forest conservation policy and management will be provided.
Examination achievement
Research paper (max 2.500 words)
Course achievement
none
Literature
Lectures, group assignments, field excursions

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Name of module	Number of module
Conservation of Forest Biodiversity	10LE07MO-M.12509
Name of event	
Conservation of Forest Biodiversity	
Event type	Number
Course	10LE07S-M.12509/52180

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory

Contents

The DFG-funded Research Training Group ConFoBi Conservation of Forest Biodiversity in Multiple-use Landscapes of Central Europe is a major research and qualification programme of Freiburg University. ConFoBi combines multi-scale ecological studies on forest biodiversity with social and economic studies of biodiversity conservation, and focuses on the effectiveness of structural retention measures, namely habitat trees and dead wood, for the conservation of biodiversity in managed forests.
See also: http://confobi.uni-freiburg.de/
The module will offer students insights into the approaches, study design, field methods and data anlysis of ConFoBi. ConFoBi researchers will present their projects, students will visit study plots and – as far as possible - participate in data collection and/or analysis. After a general introduction to forest biodiversity conservation issues, and the ConFoBi project, students will work on various aspects of ConFoBi (field work, lab, data analysis, written assignments). Details will be specified each summer shortly before the module according to ConFoBi's research schedule. The module may also prepare students for MSc thesis work, and possibly later PhD research, within the ConFoBi project.

Qualification

Students will
- gain knowledge of major approaches and challenges in conservation of biodiversity in managed forests
- will gnowledge of retention forestry approaches
- understand the interdisciplinary study design and the translational approach of ConFoBi
- be qualified for advanced education in conservation biological research (PhD programmes) and the scientific background for careers in forest conservation policy and management will be provided.

Examination achievement

Research paper (max 2.500 words)

Course achievement

none

Literature

To be specified towards start of the module

Compulsory requirement
none
Recommended requirement
Basic knowledge of forest ecology and management
Teaching method
Lectures, group assignments, field excursions

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Name of module	Number of module
Frontiers in Wildlife Ecology and Conservation Biology	10LE07MO-M.12510
Responsible	
Dr. Catalina Munteanu	
Faculty	
Fakultät für Umwelt und natürliche Ressourcen	

ECTS-Points	5.0
Workload	150 h
Hours of week	4.0
Attendance	60 h
Independent study	90 h
Recommended semester	3
Duration	1 Semester
Mandatory / Elective (M/E)	Mandatory
Frequency	Every winter semester

Compulsory requirement
None

Assigned Courses					
Name	Type	M/E	ECTS	HoW	Workload
Frontiers in Wildlife Ecology and Conservation Biology	Course	Mandatory	5.0	4.0	150 h

Contents
■ Overview of timely topics and recent advancements in the fields of ecology and conservation ■ Interpretation and discussion of research output and methodological advancements ■ Implications of research for conservation action
Qualification
■ Students can name and describe concepts and recent scientific advancements in the field wildlife ecology and conservation and are in the position to synthesize and critically analyze research output of selected research papers ■ Students can explain and communicate main research outputs to a peer audience, jointly weight costs and benefits of different conservation options and position themselves in relation to the discussed points ■ Students can participate in polarized discussion, accept and analyze opposing arguments, and consequently develop and clarify their own standpoint
Examination achievement
Oral presentation (100%)

Course achievement
■ Synthesize and present main research advancements on one selected research topic. ■ Develop critical arguments for/against implementation of a certain conservation strategy ■ Participate in weekly discussions and quizzes
Literature
2-3 readings will be assigned weekly. PDF documents will be posted online a week in advance.

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Name of module	Number of module
Frontiers in Wildlife Ecology and Conservation Biology	10LE07MO-M.12510
Name of event	
Frontiers in Wildlife Ecology and Conservation Biology	
Event type	Number
Course	10LE07V-M.12510

ECTS-Points	5.0
Workload	150 h
Attendance	60 h
Independent study	90 h
Hours of week	4.0
Recommended semester	3
Frequency	Every winter semester
Mandatory / Elective (M/E)	Mandatory
Group size	18

Contents

The seminar discusses recent scientific concepts and advancements in the fields of wildlife ecology and conservation practice with special emphasis on providing the scientific background for critically assessing conservation management implications. Each week, we will read and critically discuss research papers that cover following topics such as:

- Extinction drivers and their interactions
- Species responses to global climate change
- Frontiers in habitat assessments and passive wildlife monitoring
- Connectivity, fragmentation and wildlife movement
- Conservation approaches: Land Sharing vs. Land sparing, Half Earth, SDGs
- Novel Ecosystems and invasive species
- Extinction debt and time-delayed biodiversity change
- Human interaction with nature: biophilia, biophobia, perception

Qualification

- Students can name and describe concepts and recent scientific advancements in the field wildlife ecology and conservation and are in the position to synthesize and critically analyze research output of selected research papers
- Students can explain and communicate main research outputs to a peer audience, jointly weight costs and benefits of different conservation options and position themselves in relation to the discussed points
- Students can participate in polarized discussion, accept and analyze opposing arguments, and consequently develop and clarify their own standpoint

Examination achievement

oral presentation (100%)

Course achievement
■ Synthesize and present main research advancements on one selected research topic. ■ Develop critical arguments for/against implementation of a certain conservation strategy ■ Participate in weekly discussions and quizzes
Literature
2-3 readings will be assigned weekly. PDF documents will be posted online a week in advance.
Compulsory requirement
none
Recommended requirement
Basic knowledge/ course in Wildlife Ecology and/or Conservation Biology
Teaching method
Frontal teaching, Group work, Student presentations, Polarized discussion

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