



Universität für Bodenkultur Wien

University of Natural Resources and Life Sciences, Vienna

Curriculum

of the Master program

Applied Limnology

Aquatic ecosystem management

program code

Oct 1, 2011



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§ 1 QUALIFICATION PROFILE

The Master program Applied Limnology is a degree program that serves to extend and complement scientific education on the basis of a Bachelor degree program (§ 51.2 Z 5 UG 2002 BGBl. I no. 81/2009). The program fulfils the requirements of Art. 11 lit e of the directive on the recognition of professional qualifications 2005/36/EG.

1a) Knowledge, skills, personal and subject-specific competence

The Master program Applied Limnology conveys basic and applied knowledge of aquatic ecosystems (streams and lakes). Students shall get insight into essential functions and processes of chemical/physical and biotic system components, as well as understand their interactions. They shall further get to know the principles of nutrient dynamics, water quality and habitat characteristics. Students learn to describe aquatic organisms (fish, benthic invertebrates, aquatic plants) and their ecological demands, as well as their relations to the abiotic system components in order to detect systemic links. They learn to identify and critically examine human impacts as well as evaluate their consequences for ecosystems. Based on this, students shall develop measures for the protection and the restoration of aquatic ecosystems in terms of ecologically orientated water management concepts.

1b) Fields of work and activity

The Master program Applied Limnology qualifies students to pursue the following professional activities: dealing with freshwater ecological issues in offices, governmental departments, international authorities, water management and ecological planning offices, NGOs and international organizations, and scientific institutions. The field of activity comprises all relevant freshwater ecological tasks arising from national, European (especially the Water Framework Directive) and international laws, directives and other commitments.

§ 2 ADMISSION REQUIREMENTS

The following learning outcome is required for admission of Bachelor degree program graduates:

Students need to be familiar with scientific basics and skills and

- be able to identify and systematically categorize essential groups of plants and animals, as well as describe their anatomical and physiological characteristics, and to understand similarities and differences;
- comprehend significant interrelations between organisms and their environment on the level of autecology, synecology and population ecology, as well as evaluate their basic roles for the functioning of ecosystems;
- be familiar with the basics of inorganic and organic chemistry, as well as understand essential physiological and biogeochemical processes;
- be familiar with the general principles of physics and comprehend essential environmental processes (e.g. climate, water cycle);
- master mathematics and the basics of statistics, perform explorative and descriptive data analyses, calculate and interpret simple ecological models;
- hold basic knowledge of geology and soil science, recognize and describe types of rocks and soils, as well as understand essential processes of rock and soil formation and its implications for the shaping of the environment, and

- be familiar with the theoretical basics of geographic information systems and apply GIS software to simple scientific questions.

§ 3 PROGRAM STRUCTURE

3a) Duration, scope (ECTS points) and structure of the Master program

The program comprises 120 ECTS points corresponding to a duration of four semesters (a total of 3000 hours à 60 minutes). The program is structured as follows:

Compulsory courses:	36 ECTS points
(including Master seminar: 3 ECTS points)	
Master thesis:	30 ECTS points
Elective courses:	36 ECTS points
Free elective courses:	18 ECTS points

3b) 3-column principle

The 3-column principle is the central characteristic of both Bachelor and Master programs at the University of Natural Resources and Life Sciences Vienna. In the Master program, the sum of learning contents in the compulsory and elective courses is composed of a minimum of

15% engineering,
15% life sciences, as well as
15% economics, social sciences, and law.

The Master thesis, the internship as well as the free elective courses are exempted from the 3-column principle.

§ 4 COMPULSORY COURSES

The Master program comprises the following compulsory courses:

	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Master seminar	SE	3	10	80	10
Module: Basics in Limnology	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Limnology	VU	3	10	80	10
Limnochemistry and nutrient cycling	VU	3	10	80	10
Ecology of aquatic systems	VO	3	10	80	10
Module: Ecology of aquatic organisms	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw

Ecology of benthic invertebrates	VU	3	5	95	0
Ecology of fishes	VO	3	10	90	0
Module: Basics in applied limnology	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Physical environment of riverine landscape	VO	2	15	70	15
Biomonitoring and -assessment	VO	2	10	80	10
Human impacts in riverine landscapes	VO	2	10	80	10
Module: Aquatic ecosystem management	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Water legislation	VO	2	0	0	100
Ecological river landscape management	VO	2	30	50	20
Applications in river landscape management	VX	2	30	50	20
Module: Scientific working	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Scientific methods and writing	SE	3	10	80	10
Multivariate analyses of ecological data	VU	3	10	80	10

Engin. = Engineering; *Sciences* = Life sciences; *EcoSocLaw* = Economics, social sciences, and law

§ 5 ELECTIVE COURSES

In the course of the Master program, elective courses corresponding to a minimum of 36 ECTS points need to be completed. Students need to choose a minimum of 2 out of 3 biologically orientated modules: (1) Fish monitoring and assessment, (2) Benthic invertebrate monitoring and assessment, (3) Aquatic plants.

Module: Ecohydromorphological monitoring	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Habitat and river landscape assessment	VU	4	15	70	15
Ecohydromorphological mapping	VU	2	15	70	15
Module: Fish monitoring and assessment	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Fish sampling and monitoring	VU	3	20	60	20
Fish ecological status assessment	VU	3	10	60	30
Module: Benthic invertebrate monitoring and assessment	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Benthic invertebrate sampling and monitoring	VU	3	20	70	10
Benthic invertebrate status assessment	VU	3	5	80	15
Module: Aquatic plants	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Ecology of aquatic plants	VU	2	10	90	0
Ecology of algae	VU	2	10	80	10
Ecology, restoration and conservation of aquatic and riparian vegetation	VU	2	10	80	10
Module: Environmental impacts	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Environmental impacts on fish	VS	2	10	80	10
Environmental impacts on benthic invertebrates	VS	2	15	70	15
Climate change in aquatic ecosystems	VS	2	15	70	15
Module: Restoration and conservation	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Restoration and conservation of riverine landscapes	VS	2	20	60	20
Restoration of fish and invertebrate communities	VS	2	20	60	20
Floodplain Ecology: Ecology - Ecosystem services -	VS	2	20	60	20

Restoration and Management Perspectives					
Module: Planning and management	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
GIS in riverscape planning	VU	2	70	30	0
Fish passes and continuity	VU	2	60	30	10
Environmental history of aquatic systems	VS	2	10	60	30
Module: Interdisciplinarity and socioeconomics	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Interdisziplinäre Ansätze und Methoden (German)	VO	3	30	10	60
Recreation in riverine landscapes	VS	3	10	30	60
Module: Fisheries management and aquaculture	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Fish parasitology and pathology	VO	2	0	90	10
Fisheries management and conservation	VS	2	10	60	30
Fish farming and aquaculture	VO	2	10	80	10
Module: Ecosystem modeling	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Data mining, study design and statistics in aquatic ecology	VU	2	0	100	0
Multi-scale modeling and system dynamics in aquatic ecosystems	VU	2	30	60	10
Aquatic habitat modeling	VU	2	30	60	10
Module: Hydrology and morphology	Course type	ECTS points	Fraction/column (in %)		
Course name			Engin.	Sciences	EcoSocLaw
Water resources planning and management	VO	2	30	50	20
Sediment regime and river morphology	VO	2	40	60	0

Engin.= Engineering; Sciences = Life sciences; EcoSocLaw = Economics, social sciences, and law

§ 6 FREE ELECTIVE COURSES

In the course of the Master program, free elective courses corresponding to 18 ECTS points need to be completed. These courses can be selected from the complete course program offered by any recognized national or international university. The free elective courses shall convey knowledge and skills from fields related to the student's subject, as well as from fields of general interest.

It is recommended to cover at least part of the free elective course requirements with courses from the elective modules offered within this curriculum.

§ 7 INTERNSHIP

(1) The completion of an internship is recommended, yet not compulsory. In an internship, competences acquired during the Master program shall be extended. Further, the purpose of an internship is the promotion of the task-orientated application of acquired knowledge and skills as well as the establishment of relationships between science and practice.

(2) It is recommended to complete the internship between the second and the third semester.

(3) The minimum duration of an internship is four weeks and is credited with 3 ECTS points within the free elective courses.

(4) As an alternative to an internship, a summer school can be attended.

§ 8 MASTER THESIS

A Master thesis is a paper about a scientific topic that has to be completed in the course of a Master program (*exceptions see Articles of the University of Natural Resources and Life Sciences Vienna, Part III-Education § 30.9*). The thesis is credited with 30 ECTS points. The Master thesis serves to demonstrate students' ability to achieve adequate standards of content and methodology when independently addressing scholarly topics. (§ 51.8 UG 2002 BGBl. I no. 81/2009).

The assignments for the Master thesis shall be so chosen that it is reasonable to expect a student to complete the work within six months. A number of students may jointly address a topic provided that the performance of individual students can be assessed. (§ 81.2 UG 2002 BGBl. I no. 81/2009).

The Master thesis shall be written in English. The thesis defense shall be held in English.

§ 9 COMPLETION

The Master program Applied Limnology is considered completed as soon as all courses, as well as the Master thesis including its defense have been passed.

§ 10 ACADEMIC DEGREE

Graduates of the Master program Applied Limnology are awarded the academic degree "Master of Science", abbreviated as "MSc" or "M.Sc."

The academic degree "MSc" ("M.Sc.") shall follow the holder's name (§ 88.2 UG 2002 BGBl. I no. 81/2009).

§ 11 EXAMINATION REGULATIONS

(1) The Master program Applied Limnology is considered completed as soon as the following requirements (corresponding to partial performances Article 7) are met:

- the successful completion of the compulsory courses corresponding to 36 ECTS points (§ 4);
- the successful completion of the elective courses corresponding to 36 ECTS points (§ 5);
- the successful completion of the free elective courses corresponding to 18 ECTS points (§ 6);
- the positive assessment of the Master thesis and the defense.

(2) The academic success is assessed via course and module examinations. The form of the course examinations can be written and/or oral and has to be predefined by the course instructor considering the required amount of ECTS points. Potential admission requirements to examinations (“examination chains”) need to be indicated at the courses/modules in § 4.

(3) Proof of module performance. The proof of performance of each module is achieved through the proofs of performance of each course of a module. The overall assessment of a module is obtained from the average of all courses completed within one module weighted by ECTS points. If the average should be equal to or smaller than 5 after the decimal point, the grade shall be rounded down to the better grade, otherwise rounded up to the worse grade. If justified, the dean of studies can arrange for a module examination.

(4) The examination method shall be in accordance with the course type: lectures shall be completed by an oral and/or written examination as long as students are not continually assessed throughout the course. Courses of the type SE and PJ can be completed with an independently written seminar paper the scope of which shall be defined by the course instructor. With all remaining course types, the examination method shall be defined by the instructor.

(5) The subject of the Master thesis shall be chosen in accordance with one subject of study.

(6) The completed Master thesis shall be publicly presented and defended within a scientific discussion (defense). The examining board shall be composed of the chairperson, the examiner (thesis supervisor) and a second examiner. The overall performance (Master thesis and defense) is assessed with one overall grade while both parts need to be completed successfully. The written assessment report about the written Master thesis and the written report about the defense shall be integrated separately into the overall grade and shall be documented individually.

Assessment scale:

- Master thesis: 70%
- defensio (including presentation): 30%

(7) For the overall academic success an overall assessment is needed which shall read “bestanden” (“Passed”) if each partial performance was completed successfully; otherwise it shall read “nicht bestanden” (“failed”). The overall assessment shall read “mit Auszeichnung bestanden” (“passed with distinction”) if no partial performance was graded worse than “gut” and at least half of all partial performances were graded “sehr gut”.

§ 12 EQUIVALENCES

For students entering this new Master curriculum previous courses completed can be transferred according to the Master program equivalence list (appendix C).

§ 13 EFFECT

This curriculum is taking effect as of 10/01/2011.

APPENDIX A COURSE TYPES

The following types of courses can be offered:
(Please do not offer any other course types)

Lectures (VO)

Lectures are courses in which parts of an academic discipline and the methods involved are didactically presented.

Practical courses (UE)

Practical courses are courses in which students acquire and apply specific practical skills under the guidance of course instructors and based on theoretical knowledge.

Practical experience (PR)

Practical experience courses are courses in which students independently work on specific issues based on theoretical and practical knowledge and skills.

Compulsory practical seminar (PP)

The compulsory practical seminar is a course in which students independently work on specific issues related to the professional internship and based on theoretical and practical knowledge and skills.

Seminars (SE)

Seminars are courses in which students independently work and elaborate on teaching subjects.

Excursions (EX)

Excursions are courses in which students experience professional aspects of their subject in a real context in order to strengthen previously acquired knowledge. Excursions may lead to national or international destinations.

Master seminars (MA)

Master seminars are seminars that serve to scientifically support students during their Master thesis work.

Combined courses:

Combined courses unite—with the exception of the project—the definitions of the course types involved, yet include additional beneficial didactic elements.

Lecture and seminar (VS)

Lecture and practical course (VU)

Lecture and excursion (VX)

Projects (PJ)

Projects are courses characterized by task-oriented learning. Under guidance and predominantly in small groups, students apply scientific methods to specific case studies.

Seminar and excursion (SX)

Practical course and seminar (US)

Practical course and excursion (UX)

APPENDIX B MODULE DESCRIPTIONS

Module title	Basics in Limnology				
Module type	<i>Mandatory</i>				
Module code	1				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	9	6	90	90	180
Learning outcome	<p>General overview of current knowledge in aquatic ecology, methods and investigation of fundamental processes such as photosynthesis, respiration, investigation of plankton dynamics, food webs in aquatic ecosystems</p> <p>Physical factors and chemical composition defining the environmental conditions in aquatic ecosystems, laboratory work and application in ecosystems</p>				
C o u r s e s					
Course title	Limnology				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	30				
Total hours (à 60 min)	60				
Participation requirements	<i>no</i>				
Frequency					
C o u r s e s					
Course title	Limnochemistry and nutrient cycling				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	30				
Total hours (à 60 min)	60				
Participation requirements	<i>no</i>				
Frequency					

Courses	
Course title	Ecology of aquatic ecosystems
ECTS-points	3
Hours	2
Contact hours	30
Self-study	30
Total hours (à 60 min)	60
Participation requirements	<i>no</i>
Frequency	

Module title	Ecology of aquatic organisms				
Module type	<i>Mandatory</i>				
Module code	2				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	90	150
Learning outcome	<p>Benthic invertebrates:</p> <p>systematic, taxonomy, anatomy and morphology of benthic invertebrates in general;</p> <p>physiological aspects of aquatic invertebrate life, species traits and functional guilds;</p> <p>zoogeography, migration, dispersal;</p> <p>practical work: taxonomic determination of several benthic invertebrate groups (e.g. Ephemeroptera, Plecoptera, Trichoptera) to best level possible</p> <p>Basic fish ecology, physiology and taxonomy, autecology</p>				

Courses	
Course title	Ecology of benthic invertebrates
ECTS-points	3
Hours	2
Contact hours	30
Self-study	45

Total hours (à 60 min)	75
Participation requirements	<i>No</i>
Frequency	
C o u r s e s	
Course title	Ecology of fishes
ECTS-points	3
Hours	2
Contact hours	30
Self-study	45
Total hours (à 60 min)	75
Participation requirements	<i>no</i>
Frequency	

Module title	Basics in Applied Limnology				
Module type	<i>Mandatory</i>				
Module code	3				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	55	85	140
Learning outcome	<p>Conceptual models across temporal and spatial scales, types of riverine landscapes</p> <p>Key habitat features: hydrological and morphological characteristics, substrate and choriotopes, micro- and mesohabitats, floodplains</p> <p>Biomonitoring and assessment: assessment theories, legal frameworks, reference conditions, indicator species, traits, guilds, communities, metrics, multimetric indices, saprobic indices, biomonitoring programs</p> <p>Human impacts: theories, history, flood protection, hydropower, water abstraction, hydropeaking, cooling water, organic pollution, eutrophication, toxics, land use</p>				
C o u r s e s					
Course title	Physical environment of riverine landscapes				
ECTS-points	2				

Hours	1.5
Contact hours	20
Self-study	30
Total hours (à 60 min)	350
Participation requirements	<i>No</i>
Frequency	
C o u r s e s	
Course title	Biomonitoring and –assessment
ECTS-points	2
Hours	1
Contact hours	15
Self-study	25
Total hours (à 60 min)	40
Participation requirements	<i>no</i>
Frequency	
C o u r s e s	
Course title	Human impacts in riverine landscapes
ECTS-points	2
Hours	1.5
Contact hours	20
Self-study	30
Total hours (à 60 min)	50
Participation requirements	<i>no</i>
Frequency	

Module title	Aquatic ecosystem management
Module type	<i>Mandatory</i>
Module code	4

Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	55	85	140
Learning outcome	<p>Legal basis of European Water Management</p> <p>Integrative river management: conceptual and methodological framework, planning and management instruments at different spatial scales, restoration and conservation programs, measures, success and constraints</p> <p>Characterization of case study areas (excursions)</p>				
C o u r s e s					
Course title	Water legislation				
ECTS-points	2				
Hours	1.5				
Contact hours	20				
Self-study	30				
Total hours (à 60 min)	50				
Participation requirements	No				
Frequency					
C o u r s e s					
Course title	Ecological river landscape management				
ECTS-points	2				
Hours	1				
Contact hours	15				
Self-study	25				
Total hours (à 60 min)	40				
Participation requirements	no				
Frequency					
C o u r s e s					
Course title	Applications in river landscape management				
ECTS-points	2				
Hours	1.5				

Contact hours	20
Self-study	30
Total hours (à 60 min)	50
Participation requirements	<i>no</i>
Frequency	

Module title	Scientific working				
Module type	<i>Mandatory</i>				
Module code	5				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	30	155	185
Learning outcome	<p>Scientific writing, paper reading, analyses, presentation and discussion</p> <p>Applied multivariate data analysis: experimental designs, statistical software and methods for complex ecological dataset</p>				
C o u r s e s					
Course title	Scientific methods and writing				
ECTS-points	3				
Hours	2				
Contact hours	15				
Self-study	95				
Total hours (à 60 min)	110				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					
Course title	Multivariate analyses of ecological data				
ECTS-points	3				
Hours	2				
Contact hours	15				
Self-study	60				

Total hours (à 60 min)	75
Participation requirements	<i>no</i>
Frequency	

Module title	Ecohydromorphological monitoring				
Module type	<i>Optional</i>				
Module code	6				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	40	140	180
Learning outcome	<p>Habitat and river landscape assessment: goals, spatial scales, large/small-scale, international/national</p> <p>River-floodplain system: aquatic and terrestrial habitats</p> <p>Habitat assessment: flow velocity, water depth and substrate conditions, different measurement and mapping techniques and instruments, examples of analyses and documentation</p> <p>Field mapping, data input and analyses</p>				
C o u r s e s					
Course title	Habitat and river landscape assessment				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	70				
Total hours (à 60 min)	100				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					
Course title	Ecohydromorphological mapping				
ECTS-points	3				
Hours	2				

Contact hours	10
Self-study	70
Total hours (à 60 min)	80
Participation requirements	<i>no</i>
Frequency	

Module title	Fish monitoring and assessment				
Module type	<i>Optional</i>				
Module code	7				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	80	140
Learning outcome	<p>Sampling methods and monitoring of fish migration in rivers and lakes: electro-fishing, safety considerations, fish marking techniques</p> <p>Status assessment tools and calculation of metrics in different eco-regions, data input, validation and analysis, descriptive statistics and report writing</p>				
C o u r s e s					
Course title	Fish sampling and monitoring				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	40				
Total hours (à 60 min)	70				
Participation requirements					
Frequency					
C o u r s e s					
Course title	Fish ecological status assessment				
ECTS-points	3				
Hours	2				
Contact hours	30				

Self-study	40
Total hours (à 60 min)	70
Participation requirements	
Frequency	

Module title	Benthic invertebrate monitoring and assessment				
Module type	<i>Optional</i>				
Module code	8				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	80	140
Learning outcome	<p>Introduction on benthic invertebrate sampling design and techniques in rivers and lakes, sample treatment and sorting techniques; demonstration of different sampling gears in the field (river), group field work (sampling) and laboratory work (subsampling, sorting)</p> <p>Ecological status assessment: theory on Screening and Multimetric Index for Austria and other European countries; taxonomic determination of previously sampled benthic invertebrates; software application and interpretation of results, report writing</p>				
C o u r s e s					
Course title	Benthic invertebrate sampling and monitoring				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	40				
Total hours (à 60 min)	70				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					
Course title	Benthic invertebrate status assessment				
ECTS-points	3				

Hours	2
Contact hours	30
Self-study	40
Total hours (à 60 min)	70
Participation requirements	<i>no</i>
Frequency	

Module title	Environmental impacts				
Module type	<i>Optional</i>				
Module code	9				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	40	210	250
Learning outcome	<p>Fish and invertebrate-relevant impacts in different fish regions and effects: continuum disruptions, habitat fragmentation, loss of fluvial habitat (impoundment, reservoir flushing, hydro-peaking, water abstraction, channelization, loss of woody debris,...), interaction among pressures</p> <p>Climate change and biodiversity in freshwater ecosystems: influence on aquatic habitats, species and fisheries, protection and adaptation strategies</p>				
C o u r s e s					
Course title	Environmental impacts on fish				
ECTS-points	2				
Hours	1.5				
Contact hours	15				
Self-study	70				
Total hours (à 60 min)	85				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					
Course title	Environmental impacts on benthic invertebrates				
ECTS-points	2				

Hours	1.5
Contact hours	15
Self-study	70
Total hours (à 60 min)	85
Participation requirements	<i>no</i>
Frequency	
Lehrveranstaltungen	
Course title	Climate change in aquatic ecosystems
ECTS-points	2
Hours	1
Contact hours	10
Self-study	70
Total hours (à 60 min)	80
Participation requirements	<i>no</i>
Frequency	

Module title	Restoration and conservation				
Module type	<i>Optional</i>				
Module code	10				
Effort	ECTS points	Hours	Contact hours	Self-study	Total hours
	6	Semester hours	40	210	250
Learning outcome	<p>Conceptual and methodological framework for river restoration and conservation, case studies international/national and prioritization of restoration and conservation measures</p> <p>Effects of restoration on fish and invertebrates, aspects of water quality: biogeochemical cycles and human impacts</p> <p>Restoration approaches of river floodplain systems, approaches to address multiple pressures</p>				
Courses					
Course title	Habitats and riverine landscape				

ECTS-points	2
Hours	1.5
Contact hours	15
Self-study	70
Total hours (à 60 min)	85
Participation requirements	<i>No</i>
Frequency	
C o u r s e s	
Course title	Restoration of fish and invertebrate communities
ECTS-points	2
Hours	1
Contact hours	10
Self-study	70
Total hours (à 60 min)	80
Participation requirements	<i>no</i>
Frequency	
C o u r s e s	
Course title	Floodplain ecology: ecology – ecosystem services
ECTS-points	2
Hours	1.5
Contact hours	15
Self-study	70
Total hours (à 60 min)	85
Participation requirements	<i>no</i>
Frequency	

Module title	Planning and management
Module type	<i>Optional</i>

Module code	11				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	40	210	250
Learning outcome	<p>GIS in riverscape planning: issues in monitoring, planning of management actions, stream protection, river restoration and modeling.</p> <p>Types of continuum disruptions, principles of fish pass design and typical shortcomings in the execution of planning and construction of fish pass, excursion to different fish pass types including abiotic verification of operation</p> <p>Environmental history of aquatic systems: introduction, data and source, concepts and approaches, overview on long-term changes of rivers, case studies for human impacts</p>				
L e h r v e r a n s t a l t u n g e n					
Course title	GIS in riverscape planning				
ECTS-points	2				
Hours	1.5				
Contact hours	15				
Self-study	70				
Total hours (à 60 min)	85				
Participation requirements	No				
Frequency					
C o u r s e s					
Course title	Fish passes and continuity				
ECTS-points	2				
Hours	1.5				
Contact hours	15				
Self-study	70				
Total hours (à 60 min)	85				
Participation requirements	no				
Frequency					
C o u r s e s					

Course title	Environmental history of aquatic systems
ECTS-points	2
Hours	1
Contact hours	10
Self-study	70
Total hours (à 60 min)	80
Participation requirements	<i>no</i>
Frequency	

Module title	Interdisciplinarity and socioeconomics				
Module type	<i>Optional</i>				
Module code	12				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	40	110	150
Learning outcome	<p>History, concepts, challenges in dis-, inter- and transdisciplinarity within education and research, paradigms, philosophies, integrative and participatory methods in sampling, analyses, assessment and management of data</p> <p>Concepts of integrative river management and ecosystem services focusing on social and cultural aspects, the legal background, its social/economic conflicts and the integration of recreational aspects into planning practice</p>				
C o u r s e s					
Course title	Interdisziplinäre Ansätze und Methoden (German)				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	40				
Total hours (à 60 min)	70				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					

Course title	Recreation in riverine landscapes
ECTS-points	3
Hours	2
Contact hours	10
Self-study	70
Total hours (à 60 min)	80
Participation requirements	<i>no</i>
Frequency	

Module title	Aquatic plants				
Module type	<i>Optional</i>				
Module code	13				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	55	105	160
Learning outcome	<p>Biological basics, ecology, bioindication, nature protection, habitat and species assemblage of water and riparian plants</p> <p>The role of algae in ecosystems, environmental factors, taxonomic aspects, monitoring and assessment methods for running waters</p> <p>Riparian ecosystem concept and key aspects of floodplain ecology focusing on floodplain vegetation, national and international case studies: riparian vegetation and ecology, effects of impact and management</p>				
C o u r s e s					
Course title	Ecology of aquatic plants				
ECTS-points	2				
Hours	1.5				
Contact hours	20				
Self-study	40				
Total hours (à 60 min)	60				
Participation requirements	<i>No</i>				
Frequency					

Courses	
Course title	Ecology of algae
ECTS-points	2
Hours	1.5
Contact hours	20
Self-study	40
Total hours (à 60 min)	60
Participation requirements	<i>no</i>
Frequency	
Courses	
Course title	Ecology, restoration and conservation of aquatic and riparian vegetation
ECTS-points	2
Hours	1
Contact hours	15
Self-study	25
Total hours (à 60 min)	40
Participation requirements	<i>no</i>
Frequency	

Module title	Fisheries management and aquaculture				
Module type	<i>Optional</i>				
Module code	14				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	80	140
Learning outcome	<p>Fish parasitology, fish diseases</p> <p>Fisheries management: aims, the legal basis (international comparison), ecology of the main species and ecological implications</p> <p>Management tools: habitat improvement, stocking, fishing regulations, establishment of communities</p>				

	Fish farming and aquaculture, world fisheries, aquaculture in tropical and temperate zones, technologies, developing countries
C o u r s e s	
Course title	Fish parasitology and pathology
ECTS-points	2
Hours	1
Contact hours	15
Self-study	25
Total hours (à 60 min)	40
Participation requirements	<i>No</i>
Frequency	
C o u r s e s	
Course title	Fisheries management and conservation
ECTS-points	2
Hours	2
Contact hours	30
Self-study	30
Total hours (à 60 min)	60
Participation requirements	<i>no</i>
Frequency	
C o u r s e s	
Course title	Fish farming and aquaculture
ECTS-points	2
Hours	1
Contact hours	15
Self-study	25
Total hours (à 60 min)	40
Participation requirements	<i>no</i>
Frequency	

Module title	Aquatic ecosystem modeling				
Module type	<i>Optional</i>				
Module code	15				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	55	105	160
Learning outcome	<p>Environmental studies and monitoring, data management and statistical software, applied multivariate data analyses, use of statistical results in publications</p> <p>Conceptual models, semi-quantitative models, large scale models</p> <p>Biotic micro- ,mesohabitat modeling, hydraulic modeling, rating curves, surveying strategies in the field, interpretation of habitat modeling results and ecological application</p>				
C o u r s e s					
Course title	Data mining, study design and statistics in aquatic ecology				
ECTS-points	2				
Hours	1				
Contact hours	15				
Self-study	25				
Total hours (à 60 min)	40				
Participation requirements	<i>No</i>				
Frequency					
C o u r s e s					
Course title	Multi-scale modeling and system dynamics in aquatic ecosystems				
ECTS-points	2				
Hours	1.5				
Contact hours	40				
Self-study	20				
Total hours (à 60 min)	60				
Participation requirements	<i>no</i>				
Frequency					

Courses	
Course title	Aquatic habitat modeling
ECTS-points	2
Hours	1.5
Contact hours	20
Self-study	40
Total hours (à 60 min)	60
Participation requirements	<i>no</i>
Frequency	

Module title	Hydrology and morphology				
Module type	<i>Optional</i>				
Module code	16				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	80	140
Learning outcome	<p>River engineering, catchment planning, decision support tools, water resources planning and management</p> <p>River morphodynamics, sediment transport, river channelization, catchment management</p>				
Courses					
Course title	Water resources planning and management				
ECTS-points	3				
Hours	2				
Contact hours	30				
Self-study	40				
Total hours (à 60 min)	70				
Participation requirements	<i>No</i>				
Frequency					
Courses					

Course title	Sediment regime and river morphology
ECTS-points	3
Hours	2
Contact hours	30
Self-study	40
Total hours (à 60 min)	70
Participation requirements	<i>no</i>
Frequency	

APPENDIX C EQUIVALENCE LIST

Moduls	ECTS	Contents/lectures	TS-LV	VS	pe	LV-Nr.	Äquivalenzliste (Bestehende LV)	WS-alt	TS-alt
Master seminar	3	Master seminar	3	2		812084	Masterseminar	2	3
Basics in limnology	9	Limnology	3	2	VU		NEW		
		Limnochemistry and nutrient cycling	3	2	VU	812001	Nutrient dynamics in riverine landscapes: ecological functioning	2	3
		Ecology of aquatic systems	3	2	VO	812326	Allgemeine Ökologie aquatischer Lebensräume	2	3
Ecology of aquatic organisms	6	Ecology of benthic invertebrates	3	2	VU	812304; 812305	Ökologie der einheimischen Fließgewässerfauna; Taxonomie de	2	3
		Ecology of fishes	3	2	VO	812373	Ökologie heimischer Fische	2	3
Basics in applied limnology	6	Physical environment of river landsca	2	1,5	VO		NEW		
		Biomonitoring and -assessment	2	1	VO		NEW		
		Human impacts in riverine landscape	2	1,5	VO	812324	Angewandte Gewässerökologie	1	2
Aquatic ecosystem management	6	Water legislation	2	1,5	VO	812311	Europäisches Wasserrecht - WRRL	2	3
		Ecological river landscape managem	2	1	VO	812321	Ökologisches Gewässermanagement	1	2
		Applications in river landscape manag	2	1,5	VX	812328	Flusslandschaftsplanung	2	3
Scientific working	6	Scientific methods and writing	3	2	SE	812370	Gewässerökologisches Seminar	2	3
		Multivariate analyses of ecological da	3	2	VU		NEW		
Ecohydromorphological monitoring	6	Habitat and river landscape assessm	4	3	VU		NEW		
Fish monitoring and assessment	6	Ecohydromorphological mapping	2	1	VU	812301	Übung zum Ökologischen Gewässermanagement	1	2
		Fish sampling and monitoring	3	2	VU	812306	Fischökologisches Spezialpraktikum	3	5
		Fish ecological status assessment	3	2	VU	812307; 812308	Methoden der Fischereibiologie	3	5
Benthic invertebrate monitoring and asse	6	Benthic invertebrate sampling and mc	3	2	VU	812368; 812369	Gütebewertung von Fließgewässern	3	5
		Benthic invertebrate status assessme	3	2	VU	812319	Biologische Gütebeurteilung von Fließgewässern	3	5
Environmental impacts	6	Environmental impacts on fish	2	1,5	VS	812325	Übungen zur Angewandten Gewässerökologie	1	2
		Environmental impacts on benthic inv	2	1,5	VS		NEW		
		Climate change in aquatic ecosystem	2	1	VS		NEW		
Restoration and conservation	6	Restoration and conservation of riveri	2	1,5	VS	812323	Seminar zur Flusslandschaftsplanung	2	3
		Restoration of fish and invertebrate c	2	1	VS		NEW		
		Floodplain Ecology: Ecology - Ecosys	2	1,5	VS	812004	Floodplain Ecology: Ecology - Ecosystem services - Restoration	3	5
Planning and applications	6	GIS in river landscape planning	2	1,5	VU		NEW		
		Fish passes and continuity	2	1,5	VU		NEW		
		Environmental history of aquatic syst	2	1	VS	812309	Historische Daten zur Fließgewässerentwicklung und Biologie	1	2
Interdisciplinarity and socioeconomics	6	Interdisziplinäre Ansätze und Method	3	2	VO	731105	Interdisziplinäre Ansätze und Methoden (deutsch)	2	3
Aquatic plants	6	Recreation and participation in river l	3	2	VU		NEW		
		Ecology of aquatic plants	2	1,5	VU	831301	Biologie der Wasser- und Uferpflanzen	2	3
		Ecology of algae	2	1,5	VU		NEW		
Fisheries management and aquaculture	6	Ecology, restoration and conservator	2	1	VU		NEW		
		Fish parasitology and pathology	2	1	VO	812035	Fischpathologie	1	2
		Fisheries management and conservat	2	2	VS		NEW		
Ecosystem modelling	6	Fish farming and aquaculture	2	1	VO	812313	Einführung in die Aquakultur	1	2
		Data mining, study design and statisti	2	1	VU	812098	Erhebung, Verarbeitung und Analyse von Umweltdaten	2	3
		Multi-scale modelling and system dyn	2	1,5	VU	812312	Multi-scale Modelling of Aquatic Ecosystems	2	3
		Aquatic habitat modelling	2	1,5	VU		NEW		