Universität für Bodenkultur Wien

University of Natural Resources and Life Sciences, Vienna

Curriculum

for the Master Programme in

Applied Limnology

and

the international Joint Master Programme in

Limnology & Wetland Management

Programme classification no.: 066 448

Effective date: 1.10.2012

TABLE OF CONTENTS

§ 1 Qualification profile 3

§ 2 Admission requirements 4

§ 3 Programme structure 5

§ 4 Compulsory courses 6

4.1 Compulsory courses at BOKU: **AL & LWM** 6

4.2. Compulsory courses at Egerton University: **LWM** 7

4.3. Compulsory courses at UNESCO-IHE: **LWM** 8

§ 5 Elective courses 9

§ 5.1 Elective courses Applied Limnology 9

§ 5.2 Elective courses Limnology and Wetland Management 10

§ 6 Free elective courses 11

§ 7 Master thesis 11

§ 8 Completion 11

§ 9 Academic Degree 11

§ 10 Examination regulations 12

§ 11 Transitional provisions 13

§ 12 Effect 13

Annex A Types of courses 14

Appendix B Module Descriptions 15

B1. Modules at BOKU 15

B2. Modules at Egerton University 35

B3. Modules at UNESCO-IHE 43

Appendix C Equivalence list 50

§ 1 QUALIFICATION PROFILE

The Master programme in Applied Limnology and the international Joint Master programme in Limnology & Wetland Management are a degree programmes which serve to deepen and extend students' pre-vocational academic education, building on the basis provided by a bachelor degree programme (§ 51 [2] item 5 of the Universities Act UG 2002, Federal Law Gazette BGBl I no. 81/2009). The programmes fulfil the requirements of Directive 2005/36/EC on the recognition of professional qualifications, article 11, letter e.

1a) Knowledge and personal and professional skills

The Master programme in Applied Limnology and the international Joint Master programme in Limnology & Wetland Management convey fundamental and applied knowledge of aquatic ecosystems (streams/rivers, lakes and wetlands). Students shall get insight into the essential functions and processes of chemical/physical and biotic system components, as well as 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, planktic and benthic invertebrates, aquatic plants and algae) 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 to 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.

Graduates will be equipped with the competencies to:

- describe how hydrology, morphology and aquatic organisms relate to biochemical processes and ecological functions of inland aquatic ecosystems;
- summarise provisioning and regulating ecosystem services provided by inland surface waters and wetlands;
- evaluate how catchment land use, climate variability, invasive species and fisheries exploitation might impact on the ecology of lakes, rivers and wetlands;
- evaluate anthropogenic impacts on rivers, lakes and rivers;
- think critically in evaluation of results, information derived from the literature and other sources, and for problem-solving of complex issues related to aquatic ecosystems;
- design sampling strategies for the cost-effective monitoring of aquatic ecosystems, that can support and inform policy objectives;
- meet deadlines through independent and efficient time management;
- effectively plan, organise and conduct a research project that has clear aims and objectives;
- write a thesis and reports, and present seminars to a professional standard;
- collate stakeholder views and integrate potentially conflicting objectives for the efficient and sustainable use of lakes, rivers and wetlands using concepts of an environmental management system, including management objectives for realistic action plans;
- work effectively in an interdisciplinary team; and
- provide effective, rational and evidence-based arguments, and be able to present these to a variety of audiences.

Graduates of the international Joint MSc programme in Limnology and Wetland Management will be equipped with additional skills to:

- evaluate the usefulness of wetlands as treatment systems of waste water;
- produce a wetland management plan;

- evaluate anthropogenic impacts on rivers, lakes and rivers in both temperate and tropical settings;
- apply their knowledge and scientific skills in international and multicultural teams and different socio-cultural environments;
- evaluate the interaction of environmental and socio-economic challenges in both developed and developing countries; and
- contribute to global development efforts (MDG's - Millennium Development Goals; policies & programmes of national and international development cooperation agencies).

1b) Professional qualifications

The Master programme in Limnology & Wetland Management 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, 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

For graduates of bachelor's programs, mastery of the following learning outcomes is required for admission:

- 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.

Sufficient skills in English are required and have to be verified.

§ 3 PROGRAMME STRUCTURE

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

The Master programme in Applied Limnology and the international Joint Master programme in Limnology & Wetland Management consist of courses and other requirements worth a total of 120 ECTS credits. This is equivalent to a total of 3,000 60-minute credit hours.

Structure of the Master programme in Applied Limnology:

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

Structure of the international Joint Master programme in Limnology & Wetland Management:

Compulsory courses at BOKU:	28.0 ECTS points
Compulsory courses at Egerton University:	22.4 ECTS points
Compulsory courses at UNESCO-IHE:	26.2 ECTS points
Master's thesis:	30.0 ECTS points
Elective courses:	13.4 ECTS points

3b) Three-pillar principle

The three-pillar principle is the central identifying characteristics of both the bachelor's and master's programmes offered at the University of Natural Resources and Life Sciences, Vienna. In the master's programmes, the sum of the compulsory and elective courses must be made up of at least

15% technology and engineering
15% natural sciences
15% economic and social sciences, law

The master's thesis, compulsory internship and free electives are excluded from the three-pillar rule.

3c) Joint degree programmes

The international Joint Master programme in Limnology & Wetland Management is implemented jointly by BOKU (Austria), Egerton University (Kenya) and UNESCO-IHE (The Netherlands). Graduates receive a Joint Master Degree in Limnology and Wetland Management from the three partner institutions.

3d) Courses with a restricted number of participants

For courses with a restricted number of participants, the instructor of a master's level course is entitled to give first priority to students enrolled in a master's programme (i.e. students enrolled in a bachelor's programme will only be admitted to the course if places are still available after all master's level students have been accommodated). When accepting master's program students into a course, the following priority criteria with regard to the students' course requirements shall be applied: compulsory course, elective course, free elective.

§ 4 COMPULSORY COURSES

The Master programmes comprise the following compulsory courses:

*4.1 COMPULSORY COURSES AT BOKU: **AL & LWM***

	Course type	ECTS points	Comp.	Comp.
Course name			**AL**	**LWM**
Master seminar	**SE**	**3**	**Yes**	**No**
Module 1 (LWM1): Basics in Limnology	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			**AL**	**LWM**
Limnology	**VU**	**3**	**Yes**	**Yes**
Limnochemistry and nutrient cycling	**VU**	**3**	**Yes**	**Yes**
Ecology of aquatic systems	**VO**	**3**	**Yes**	**Yes**
Module 2 (LWM2): Ecology of aquatic organisms	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			**AL**	**LWM**
Ecology of benthic invertebrates	**VU**	**3**	**Yes**	**Yes**
Ecology of fishes	**VO**	**3**	**Yes**	**Yes**
Module 3 (LWM3): Basics in applied limnology	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			**AL**	**LWM**
Physical environment of riverine landscape	**VO**	**2**	**Yes**	**Yes**
Aquatic biomonitoring and -assessment	**VO**	**2**	**Yes**	**Yes**
Human impacts in riverine landscapes	**VO**	**2**	**Yes**	**Yes**
Module 4 (LWM4): Aquatic ecosystem management	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			**AL**	**LWM**
Water legislation	**VO**	**2**	**Yes**	**Yes**
Ecological river landscape management	**VO**	**2**	**Yes**	**Yes**
Applications in river landscape management	**VX**	**2**	**Yes**	**No**
Module LWM5: Scientific methods	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			**AL**	**LWM**
Multivariate analyses of ecological data	**VU**	**3**	**Yes**	**Yes**
Scientific methods and writing in aquatic ecology	**SE**	**3**	**Yes**	**No**

Comp. = compulsory; AL= Master programme in Applied Limnology; LWM = international Joint Master programme in Limnology & Wetland Management.

4.2. COMPULSORY COURSES AT EGERTON UNIVERSITY: ***LWM***

Module LWM6: Lake Ecology	**Course type**	**ECTS points**
Course name		
Lake typology, physico-chemical characteristics and pelagic food-web of tropical lakes	**VU**	**1.8**
Phyto- and zooplankton composition, biomass and primary/secondary production in tropical lakes	**VU**	**1.9**
Trophic status of tropical lakes: anthropogenic impacts, climate change and management strategies	**VU**	**1.9**
Module LWM7: Stream & River Ecology	**Course type**	**ECTS points**
Course name		
Geomorphology, hydrology, watershed-ecology and ecological characterization of tropical streams & rivers	**VX**	**1.2**
Biological components, energy/matter flux and ecological integrity of tropical streams & rivers	**VX**	**2.2**
Ecological assessment of tropical streams & rivers	**VU**	**2.2**
Module LWM8: Tropical Wetlands for Water Quality	**Course type**	**ECTS points**
Course name		
Functioning & management of natural wetlands to improve ecosystem services	**VU**	**2.2**
Constructed wetlands for wastewater treatment	**VX**	**3.4**
Module LWM9: Fisheries & Aquaculture	**Course type**	**ECTS points**
Course name		
Fish ecology and fisheries management	**VX**	**2.2**
Aquacultural techniques and production ecology of fishponds	**VU**	**3.4**

Comp. = compulsory; AL= Master programme in Applied Limnology; LWM = international Joint Master programme in Limnology & Wetland Management.

4.3. COMPULSORY COURSES AT UNESCO-IHE: ***LWM***

Module LWM10: Wetlands for Livelihoods & Conservation	**Course type**	**ECTS points**
Course name		
Wetlands for Livelihoods & Conservation	**VU**	**5.6**
Module LWM11: Aquatic Ecosystems – Processes & Applications	**Course type**	**ECTS points**
Course name		
Aquatic Ecosystems – Processes & Applications	**VU**	**5.6**
Module LWM12: Data Analysis & modeling for Aquatic Ecosystems	**Course type**	**ECTS points**
Course name		
Data Analysis & Modeling for Aquatic Ecosystems	**VU**	**5.6**
Module LWM13: Group-work	**Course type**	**ECTS points**
Course name		
Group-work (Integrative approach to solve environmental problems)	**PJ**	**5.6**
Module LWM14: MSc Preparatory Course	**Course type**	**ECTS points**
Course name		
MSc Preparatory Course	**VS**	**1.9**
Module LWM15: Summer School	**Course type**	**ECTS points**
Course name		
Summer School	**VS**	**1.9**

Comp. = compulsory; AL= Master programme in Applied Limnology; LWM = international Joint Master programme in Limnology & Wetland Management.

§ 5 ELECTIVE COURSES

§ 5.1 ELECTIVE COURSES APPLIED LIMNOLOGY

Elective courses worth a total of 36 ECTS credits are required to complete the Master's programme in Applied Limnology. 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. Students can choose also modules of the International Joint Programme in Limnology & Wetland Ecosystems, which are given at Egerton University and UNESCO-IHE.

Module: Ecohydromorphological monitoring	**Course type**	**ECTS points**
Course name		
Habitat and river landscape assessment	**VU**	**4**
Ecohydromorphological mapping	**VU**	**2**
Module: Fish monitoring and assessment	**Course type**	**ECTS points**
Course name		
Fish sampling and monitoring	**VU**	**3**
Fish ecological status assessment	**VU**	**3**
Module: Benthic invertebrate monitoring and assessment	**Course type**	**ECTS points**
Course name		
Benthic invertebrate sampling and monitoring	**VU**	**3**
Benthic invertebrate status assessment	**VU**	**3**
Module: Aquatic plants	**Course type**	**ECTS points**
Course name		
Ecology of aquatic plants	**VU**	**2**
Ecology of algae	**VU**	**2**
Ecology, restoration and conservation of aquatic and riparian vegetation	**VU**	**2**
Module: Environmental impacts	**Course type**	**ECTS points**
Course name		
Environmental impacts on fish	**VS**	**2**
Environmental impacts on benthic invertebrates	**VS**	**2**
Climate change in aquatic ecosystems	**VS**	**2**
Module: Restoration and conservation	**Course type**	**ECTS points**
Course name		
Restoration and conservation of riverine landscapes	**VS**	**2**
Restoration of fish and invertebrate communities	**VS**	**2**
Floodplain Ecology: Ecology - Ecosystem services - Restoration and Management Perspectives	**VS**	**2**
Module: Planning and management	**Course type**	**ECTS points**
Course name		
GIS in riverscape planning	**VU**	**2**
Fish passes and continuity	**VU**	**2**

Environmental history of aquatic systems	**VS**	**2**
Module: Interdisciplinarity and socioeconomics	**Course type**	**ECTS points**
Course name		
Interdisziplinäre Ansätze und Methoden (German)	**VO**	**3**
Recreation in riverine landscapes	**VS**	**3**
Module: Fisheries management and aquaculture	**Course type**	**ECTS points**
Course name		
Fish parasitology and pathology	**VO**	**2**
Fisheries management and conservation	**VS**	**2**
Fish farming and aquaculture	**VO**	**2**
Module: Ecosystem modeling	**Course type**	**ECTS points**
Course name		
Data mining, study design and statistics in aquatic ecology	**VU**	**2**
Multi-scale modeling and system dynamics in aquatic ecosystems	**VU**	**2**
Aquatic habitat modeling	**VU**	**2**
Module: Hydrology and morphology	**Course type**	**ECTS points**
Course name		
Water resources planning and management	**VO**	**2**
Sediment regime and river morphology	**VO**	**2**

§ 5.2 ELECTIVE COURSES LIMNOLOGY AND WETLAND MANAGEMENT

Elective courses worth a total of 13.4 ECTS credits are required to complete the international Joint Master's programme in Limnology & Wetland Management. Students are free to choose electives courses at BOKU, Egerton University, or UNESCO-IHE. For students doing their MSc project at Boku, the Boku courses "Scientific Methods & Writing and Master Seminar" are strongly recommended.

§ 6 FREE ELECTIVE COURSES

Free electives worth a total of 18 ECTS credits are required to complete the Master's Programme in Applied Limnology. Free electives may be selected from all courses offered by all recognized universities in Austria and abroad. Free electives are intended to impart knowledge and skills in the student's own academic subject as well as in 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 MASTER THESIS

A master's thesis is a paper on a scientific topic, to be written as part of a master's degree programme (for exceptions please see the By Laws (Satzung) of the University of Natural Resources and Life Sciences, Vienna, part III- Teaching, § 30[9]). The thesis is worth a total of 30 ECTS credits. With their master's theses, students demonstrate their ability to independently address a scientific topic, both thematically and methodologically (§ 51 [8] UG 2002 BGBl. I no. 81/2009).

The topic of a master's thesis shall be chosen in such a way that it is reasonable to expect a student to be able to complete it within six months. Multiple 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's thesis shall be written in English. Languages other than English are permissible only if approved and confirmed by the thesis supervisor. The thesis defence must be held in English regardless of the language of the thesis.

§ 8 COMPLETION

The Master's Programmes in Applied Limnology and in Limnology & Wetland Management have been completed when the student has passed all required courses and received a positive grade on the master's thesis and defence examination.

§ 9 ACADEMIC DEGREE

Graduates of the Master's Programme in Applied Limnology are awarded the academic title Master of Science, abbreviated as MSc or M.Sc. by BOKU University. Graduates of the international Joint Master's Programme in Limnology & Wetland Management are awarded the academic degree "Master of Science", abbreviated as "MSc" or "M.Sc." by the three partner institutions BOKU, Egerton University and UNESCO-IHE.

The academic degree MSc (M.Sc.) shall follow the holder's name (§ 88 [2] UG 2002 BGBl. I no. 81/2009).

§ 10 EXAMINATION REGULATIONS

(1a) The Master's Programme in Applied Limnology has been completed successfully when the following requirements (corresponding to components in [7] below) are met:

- positive completion of the compulsory courses worth a total of 36 ECTS points (§ 4);
- positive completion of elective courses worth a total of 36 ECTS points (§ 5);
- positive completion of free elective courses worth a total of 18 ECTS points (§ 6); and
- a positive grade on the Master's thesis and the defense examination.

(1b) The international Joint Master's Programme in Limnology & Wetland Management has been completed successfully when the following requirements (corresponding to components in [7] below) are met:

- positive completion of the compulsory courses worth a total of 76.6 ECTS points (§ 4);
- positive completion of elective courses worth a total of 13.4 ECTS points (§ 5);
- a positive grade on the Master's thesis and the defense examination.

(2) Student evaluation takes the form of course and module examinations. Course examinations can be either written or oral, as determined by the course instructor, taking the ECTS credit value of the course into account. Any prerequisites for admission to examinations shall be listed in § 4 under the respective course/module.

(3) Student evaluation in modules: Module evaluation is based on the grades given the students in the individual courses that make up the module. The total evaluation for the module is calculated as the average of the grades of all module courses, weighted by ECTS credits. Average values of .5 or lower are rounded to the better (numerically lower) grade; values of over .5 are rounded to the worse (numerically higher) grade. If deemed necessary, the Dean of Students may require a module examination at his/her discretion.

(4) The choice of examination method shall be based on the type of course: Lectures shall conclude with a written or oral examination, if continuous assessment of student performance is not applied. Seminars (SE) and project-based courses (PJ) can be evaluated based on independently written papers, length and contents of which are determined by the course instructor. For all other course types, the examination type is at the instructor's discretion.

(5) The topic of the master's thesis shall be selected from one of the subjects of the master's programme.

(6) After the successful completion of all the courses and examinations required in the Master's Programme, the completed master's thesis, after it has been given a positive evaluation by the thesis supervisor, shall be publically presented by the student and defended in the form of an academic discussion (defence examination). The examination committee shall consist of a committee chair, a first examiner (the student's thesis supervisor) and a second examiner. The student's total performance (thesis and defence examination) will be assigned a comprehensive grade. Both thesis and defence examination must receive a pass-ing grade for the student to complete the programme. The written evaluations stating the rationale for

the thesis grade and the defence examination grade are included in calculating the comprehensive grade and are documented separately.

The comprehensive grade is calculated as follows:
– Master's thesis: 70%
– Defence examination (incl. presentation): 30%

(7) A comprehensive evaluation of the student's performance on the entire programme shall be assigned. A comprehensive evaluation of "passed" means that each individual component of the programme was completed successfully. If individual components of the programme have not been successfully completed, the comprehensive evaluation is "failed". A comprehensive evaluation of "passed with honours" is granted if the student has received no grade worse than a "good" (2) on all individual components, and if at least 50% of the individual components were graded with 1 (excellent/sehr gut). Students of the international Joint Master's Programme in Limnology & Wetland Management need to fulfill the distinction criteria of Egerton University and UNESCO-IHE additionally.

§ 11 TRANSITIONAL PROVISIONS

For students continuing their studies under the provisions of the previously valid curriculum, the list of equivalent courses (Äquivalenzliste, Appendix C) pursuant to a resolution of the Academic Programme Committee (Studienkommission) applies. This list includes all courses that correspond to courses offered in the previously valid curriculum.

For students who switch to the new master's programme curriculum, examinations for courses taken under the provisions of the previously valid curriculum shall be recognized towards the new programme under the provisions of this curriculum based on the list of equivalent courses (Appendix C).

§ 12 EFFECT

This curriculum is taking effect as of 1.10.2012.

ANNEX A TYPES OF COURSES

The following types of courses are available:

Lecture (VO)
Lectures are courses in which certain areas of a subject and the methods used in this area are imparted through didactic presentation.

Exercise course (UE)
Exercise courses are courses in which students are instructed in specific practical skills, based on theoretical knowledge.

Practical course (PR)
Practical courses are classes in which students deal with specific topics independently, based on previously acquired theoretical and practical knowledge.

Compulsory internship seminar (PP)
The compulsory internship seminar is a class in which students deal independently with topics related to their internship placements, based on previously acquired theoretical and practical knowledge.

Seminar (SE)
Seminars are courses in which students are required to work independently on the respective subject, deepen their knowledge of the topic and discuss relevant issues.

Field trips (EX)
Field trips are courses in which students have the opportunity to experience relevant fields of study in real-life practical application, to deepen their knowledge of the respective subject. Field trips can be taken to destinations both in Austria and abroad.

Master thesis seminar (MA)
Master thesis seminars are seminars intended to provide students with academic support during the thesis writing process.

Mixed-type courses:
Mixed-type courses combine the characteristics of the courses named above (with the exception of project-type courses). Integration of different course-type elements improved the didactic value of these courses.

Lecture and seminar (VS)
Lecture and exercise (VU)
Lecture and field trip (VX)
Project course (PJ)
Project courses are characterized by problem-based learning. Under instruction, students work - preferably in small groups - on case studies, applying appropriate scientific methods.

Seminar and field trip (SX)
Exercise and seminar (US)
Exercise and field trip (UX)

APPENDIX B MODULE DESCRIPTIONS

B1. MODULES AT BOKU

Module title	**Basics in Limnology**				
Module type	***Mandatory***				
Module code	**1 (LWM1)**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	9	**6**	**110**	**115**	**225**
Learning outcome	**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** **Physical factors and chemical composition defining the environmental conditions in aquatic ecosystems, laboratory work and application in ecosystems**				
Courses					
Course title	Limnology				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**40**				
Self-study	**35**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				
Frequency					
Courses					
Course title	Limnochemistry and nutrient cycling				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**40**				
Self-study	**35**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				

Frequency	
Courses	
Course title	Ecology of aquatic ecosystems
ECTS-points	**3**
Hours	**2**
Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	*no*
Frequency	

Module title	**Ecology of aquatic organisms**				
Module type	***Mandatory***				
Module code	**2 (LWM2)**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Benthic invertebrates:** **systematics, taxonomy, anatomy and morphology of benthic invertebrates in general;** **physiological aspects of aquatic invertebrate life, species traits and functional guilds;** **zoogeography, migration, dispersal;** **practical work: taxonomic determination of several benthic invertebrate groups (e.g. Ephemeroptera, Plecoptera, Trichoptera) to best level possible** **Basic fish ecology, physiology and taxonomy, autecology**				
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	*No*
Frequency	
Courses	
Course title	Ecology of fishes
ECTS-points	**3**
Hours	**2**
Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	

Module title	**Basics in Applied Limnology**				
Module type	***Mandatory***				
Module code	**3 (LWM3)**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Conceptual models across temporal and spatial scales, types of riverine landscapes** **Key habitat features: hydrological and morphological characteristics, substrate and choriotopes, micro- and mesohabitats, floodplains** **Biomonitoring and assessment: assessment theories, legal frameworks, reference conditions, indicator species, traits, guilds, communities, metrics, multimetric indices, saprobic indices, biomonitoring programs** **Human impacts: theories, history, flood protection, hydropower, water abstraction, hydropeaking, cooling water, organic pollution, eutrophication, toxics, land use**				
Courses					

Course title	Physical environment of riverine landscapes
ECTS-points	**2**
Hours	**1.5**
Contact hours	**20**
Self-study	**30**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	
Courses	
Course title	Aquatic biomonitoring and –assessment
ECTS-points	**2**
Hours	**1**
Contact hours	**20**
Self-study	**30**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	
Courses	
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	*No*
Frequency	

Module title	**Aquatic ecosystem management**				
Module type	***Mandatory for AL, partly mandatory for LWM***				
Module code	**4 (LWM4)**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Legal basis of European Water Management** **Integrative river management: conceptual and methodological framework, planning and management instruments at different spatial scales, restoration and conservation programs, measures, success and constraints**				
Courses					
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					
Courses					
Course title	Ecological river landscape management				
ECTS-points	**2**				
Hours	**1.5**				
Contact hours	**20**				
Self-study	**30**				
Total hours (à 60 min)	**50**				
Participation requirements	*No*				
Frequency					
Courses					
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	*No*
Frequency	

Module title	**Scientific working**				
Module type	***Mandatory for AL, partly mandatory for LWM***				
Module code	**5 (LWM5)**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**45**	**105**	**150**
Learning outcome	**Applied multivariate data analysis: experimental designs, statistical software and methods for complex ecological dataset**				
Courses					
Course title	Scientific methods and writing in aquatic ecology				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**15**				
Self-study	**60**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				
Frequency					
Courses					
Course title	Multivariate analyses of ecological data				
ECTS-points	**3**				
Hours	**2**				

Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	

Module title	**Ecohydromorphological monitoring**				
Module type	***Optional***				
Module code	**6**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**50**	**100**	**150**
Learning outcome	**Habitat and river landscape assessment: goals, spatial scales, large/small-scale, international/national** **River-floodplain system: aquatic and terrestrial habitats** **Habitat assessment: flow velocity, water depth and substrate conditions, different measurement and mapping techniques and instruments, examples of analyses and documentation** **Field mapping, data input and analyses**				
Courses					
Course title	Habitat and river landscape assessment				
ECTS-points	**4**				
Hours	**3**				
Contact hours	**40**				
Self-study	**60**				
Total hours (à 60 min)	**100**				
Participation requirements	*No*				
Frequency					
Courses					
Course title	Ecohydromorphological mapping				

ECTS-points	**2**
Hours	**1**
Contact hours	**40**
Self-study	**50**
Total hours (à 60 min)	**80**
Participation requirements	*no*
Frequency	

Module title	**Fish monitoring and assessment**				
Module type	***Optional***				
Module code	**7**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Sampling methods and monitoring of fish migration in rivers and lakes: electro-fishing, safety considerations, fish marking techniques** **Status assessment tools and calculation of metrics in different eco-regions, data input, validation and analysis, descriptive statistics and report writing**				
Courses					
Course title	Fish sampling and monitoring				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**30**				
Self-study	**45**				
Total hours (à 60 min)	**75**				
Participation requirements					
Frequency					
Courses					
Course title	Fish ecological status assessment				
ECTS-points	**3**				

Hours	**2**
Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	
Frequency	

Module title	**Benthic invertebrate monitoring and assessment**				
Module type	***Optional***				
Module code	**8**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**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)** **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**				
Courses					
Course title	Benthic invertebrate sampling and monitoring				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**30**				
Self-study	**45**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				
Frequency					
Courses					

Course title	Benthic invertebrate status assessment
ECTS-points	**3**
Hours	**2**
Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	*no*
Frequency	

Module title	**Environmental impacts**				
Module type	***Optional***				
Module code	**9**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**30**	**120**	**150**
Learning outcome	**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** **Climate change and biodiversity in freshwater ecosystems: influence on aquatic habitats, species and fisheries, protection and adaptation strategies**				
Courses					
Course title	Environmental impacts on fish				
ECTS-points	**2**				
Hours	**1.5**				
Contact hours	**10**				
Self-study	**40**				
Total hours (à 60 min)	**50**				
Participation requirements	*No*				
Frequency					
Courses					

Course title	Environmental impacts on benthic invertebrates
ECTS-points	**2**
Hours	**1.5**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	
Courses	
Course title	Climate change in aquatic ecosystems
ECTS-points	**2**
Hours	**1**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	**Restoration and conservation**				
Module type	***Optional***				
Module code	**10**				
Effort	**ECTS points**	**Hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**Semester hours**	**30**	**120**	**150**
Learning outcome	**Conceptual and methodological framework for river restoration and conservation, case studies international/national and prioritization of restoration and conservation measures** **Effects of restoration on fish and invertebrates, aspects of water quality: biogeochemical cycles and human impacts** **Restoration approaches of river floodplain systems, approaches to address multiple pressures**				

Courses	
Course title	Restoration and conservation of habitats and riverine landscape
ECTS-points	**2**
Hours	**1.5**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	
Courses	
Course title	Restoration of fish and invertebrate communities
ECTS-points	**2**
Hours	**1**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	
Courses	
Course title	Floodplain ecology: ecology – ecosystem services
ECTS-points	**2**
Hours	**1.5**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	Planning and management				
Module type	*Optional*				
Module code	11				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	30	120	150
Learning outcome	GIS in riverscape planning: issues in monitoring, planning of management actions, stream protection, river restoration and modeling. 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 Environmental history of aquatic systems: introduction, data and source, concepts and approaches, overview on long-term changes of rivers, case studies for human impacts				
Courses					
Course title	GIS in riverscape planning				
ECTS-points	2				
Hours	1.5				
Contact hours	10				
Self-study	40				
Total hours (à 60 min)	50				
Participation requirements	*No*				
Frequency					
Courses					
Course title	Fish passes and continuity				
ECTS-points	2				
Hours	1.5				
Contact hours	10				
Self-study	40				
Total hours (à 60 min)	50				
Participation requirements	*no*				

Frequency	
Courses	
Course title	Environmental history of aquatic systems
ECTS-points	**2**
Hours	**1**
Contact hours	**10**
Self-study	**40**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	**Interdisciplinarity and socioeconomics**				
Module type	***Optional***				
Module code	**12**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**45**	**105**	**150**
Learning outcome	**History, concepts, challenges in dis-, inter- and transciplinarity within education and research, paradigms, philosophies, integrative und participatory methods in sampling, analyses, assessment and management of data** **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**				
Courses					
Course title	Interdisziplinäre Ansätze und Methoden (German)				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**30**				
Self-study	**45**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				

Frequency	
Courses	
Course title	Recreation in riverine landscapes
ECTS-points	**3**
Hours	**2**
Contact hours	**15**
Self-study	**60**
Total hours (à 60 min)	**75**
Participation requirements	*no*
Frequency	

Module title	**Aquatic plants**				
Module type	***Optional***				
Module code	**13**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**55**	**95**	**150**
Learning outcome	**Biological basics, ecology, bioindication, nature protection, habitat and species assemblage of water and riparian plants** **The role of algae in ecosystems, environmental factors, taxonomic aspects, monitoring and assessment methods for running waters** **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**				
Courses					
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	*No*
Frequency	
Courses	
Course title	Ecology of algae
ECTS-points	**2**
Hours	**1.5**
Contact hours	**20**
Self-study	**30**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	
Courses	
Course title	Ecology, restoration and conservation of aquatic and riparian vegetation
ECTS-points	**2**
Hours	**1**
Contact hours	**15**
Self-study	**35**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	**Fisheries management and aquaculture**				
Module type	***Optional***				
Module code	**14**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Fish parasitology, fish diseases** **Fisheries management: aims, the legal basis (international comparison), ecology**				

	of the main species and ecological implications **Management tools: habitat improvement, stocking, fishing regulations, establishment of communities** **Fish farming and aquaculture, world fisheries, aquaculture in tropical and temperate zones, technologies, developing countries**
Courses	
Course title	Fish parasitology and pathology
ECTS-points	**2**
Hours	**1**
Contact hours	**15**
Self-study	**35**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	
Courses	
Course title	Fisheries management and conservation
ECTS-points	**2**
Hours	**2**
Contact hours	**30**
Self-study	**20**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	
Courses	
Course title	Fish farming and aquaculture
ECTS-points	**2**
Hours	**1**
Contact hours	**15**
Self-study	**35**

Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	**Aquatic ecosystem modeling**				
Module type	***Optional***				
Module code	**15**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**Environmental studies and monitoring, data management and statistical software, applied multivariate data analyses, use of statistical results in publications** **Conceptual models, semi-quantitative models, large scale models** **Biotic micro- ,mesohabitat modeling, hydraulic modeling, rating curves, surveying strategies in the field, interpretation of habitat modeling results and ecological application**				
Courses					
Course title	Data mining, study design and statistics in aquatic ecology				
ECTS-points	**2**				
Hours	**1**				
Contact hours	**15**				
Self-study	**35**				
Total hours (à 60 min)	**50**				
Participation requirements	*No*				
Frequency					
Courses					
Course title	Multi-scale modeling and system dynamics in aquatic ecosystems				
ECTS-points	**2**				
Hours	**1.5**				
Contact hours	**15**				

Self-study	**35**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	
Courses	
Course title	Aquatic habitat modelling
ECTS-points	**2**
Hours	**1.5**
Contact hours	**15**
Self-study	**35**
Total hours (à 60 min)	**50**
Participation requirements	*no*
Frequency	

Module title	**Hydrology and morphology**				
Module type	***Optional***				
Module code	**16**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	River technical sciences, catchment planning, decision support tools, water resources planning and management River morphodynamics, sediment transport, river channelization, catchment management				
Courses					
Course title	Water resources planning and management				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**30**				
Self-study	**45**				

Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	
Courses	
Course title	Sediment regime and river morphology
ECTS-points	**3**
Hours	**2**
Contact hours	**30**
Self-study	**45**
Total hours (à 60 min)	**75**
Participation requirements	*no*
Frequency	

B2. MODULES AT EGERTON UNIVERSITY

Module title	**Lake Ecology**				
Module type	***Mandatory for LWM***				
Module code	**LWM6**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**69**	**70**	**139**
Learning outcome	**After successful completion of this module, participants will be able to:** • **Characterize lakes based on formation, morphometry, mixing types and chemical composition of water;** • **Describe the composition and production of planktic communities;** • **Evaluate factors influencing trophic interactions in tropical lakes;** • **Evaluate climate change and anthropogenic impacts on tropical lake eco-systems; and** • **Generate suitable methods for the protection and management of Lake ecosystems.**				
Courses					
Course title	Lake typology, physico-chemical characteristics and pelagic food-web of tropical lakes				
ECTS-points	**1.8**				
Hours	**1.3**				
Contact hours	**21**				
Self-study	**24**				

Total hours (à 60 min)	**45**
Participation requirements	*No*
Frequency	
Courses	
Course title	Phyto- and zooplankton composition, biomass and primary/secondary production in tropical lakes
ECTS-points	**1.9**
Hours	**1.3**
Contact hours	**19**
Self-study	**28**
Total hours (à 60 min)	**47**
Participation requirements	*No*
Frequency	
Courses	
Course title	Trophic status of tropical lakes: anthropogenic impacts, climate change and management strategies
ECTS-points	**1.9**
Hours	**1.3**
Contact hours	**29**

Self-study	**18**
Total hours (à 60 min)	**47**
Participation requirements	*No*
Frequency	

Module title	**Stream & River Ecology**				
Module type	***Mandatory for LWM***				
Module code	**LWM7**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**90**	**51**	**141**
Learning outcome	**After successful completion of this module, participants will be able to:** • **Distinguish the main stream ecosystem boundaries at watershed, ecosystem and stream segment scales;** • **Characterize the bio-geophysical components of watersheds;** • **Relate and conceptualize the inter-connectedness between riverine and other ecosystems;** • **Analyze, identify and discriminate riparian vegetation in terms of their importance as sources of energy to streams;** • **Assess water quality using physical and biological characteristics of the stream;** • **Evaluate the importance of socio-economics in sustainable management of watersheds (riverine ecosystems);** • **Design suitable sampling strategies for stream benthos (i.e. organic matter, biofilms, and nutrients).**				
Courses					

Course title	Geomorphology, hydrology, watershed-ecology and ecological characterisation of tropical streams & rivers
ECTS-points	**1.2**
Hours	**1**
Contact hours	**17**
Self-study	**13**
Total hours (à 60 min)	**30**
Participation requirements	*No*
Frequency	
Courses	
Course title	Biological components, energy/matter flux and ecological integrity of tropical streams & rivers
ECTS-points	**2.2**
Hours	**1.5**
Contact hours	**27**
Self-study	**28**
Total hours (à 60 min)	**55**
Participation requirements	*No*
Frequency	

Courses	
Course title	Ecological assessment of tropical streams & rivers
ECTS-points	**2.2**
Hours	**1.5**
Contact hours	**46**
Self-study	**10**
Total hours (à 60 min)	**56**
Participation requirements	*No*
Frequency	

Module title	**Tropical Wetlands for Water Quality**				
Module type	***Mandatory for LWM***				
Module code	**LWM8**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**88**	**52**	**140**

Learning outcome	**After successful completion of this module, participants will be able to:** • **Identify types of wetlands, explain processes in wetlands and assess their functions and values;** • **Identify wastewater sources, characteristics and treatment options;** • **Classify ecological sanitation systems and their principles of operation;** • **Evaluate the water quality function and explain the process of wastewater purification by natural and constructed wetlands;** • **Design, construct, operate and maintain constructed wetland for wastewater treatment ;** • **Apply ecological models for management of constructed wetlands.**
Courses	
Course title	Functioning & management of natural wetlands to improve ecosystem services
ECTS-points	**2.2**
Hours	**1.6**
Contact hours	**33**
Self-study	**23**
Total hours (à 60 min)	**56**
Participation requirements	*No*
Frequency	
Courses	
Course title	Constructed wetlands for wastewater treatment
ECTS-points	**3.4**
Hours	**2.4**

Contact hours	**55**
Self-study	**29**
Total hours (à 60 min)	**84**
Participation requirements	*No*
Frequency	

Module title	**Fisheries & Aquaculture**				
Module type	***Mandatory for LWM***				
Module code	**LWM8**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**62**	**79**	**141**
Learning outcome	**After successful completion of this module, participants will be able to:** • **Evaluate global/national production trends and emerging issues in fisheries;** • **Appraise and apply the ecology of fish to fisheries management and aquaculture exploitation;** • **Evaluate the interaction of fish and the environment (water quality, environmental impacts, etc.);** • **Appraise of aquaculture systems and their productivity potential;** • **Assess interactions and emerging issues on fish and people;** • **Evaluate techniques for fish post-harvest handling (preservation, processing, packaging & marketing); and** • **Appraise measures to reduce fish diseases and fish parasites in aquaculture.**				
Courses					

Course title	Fish ecology and fisheries management
ECTS-points	**2.2**
Hours	**1.5**
Contact hours	**26**
Self-study	**29**
Total hours (à 60 min)	**55**
Participation requirements	*No*
Frequency	
Courses	
Course title	Aquacultural techniques and production ecology of fishponds
ECTS-points	**3.4**
Hours	**2.5**
Contact hours	**36**
Self-study	**50**
Total hours (à 60 min)	**86**
Participation requirements	*No*
Frequency	

B3. MODULES AT UNESCO-IHE

Module title	**Wetlands for Livelihoods & Conservation**				
Module type	***Mandatory for LWM***				
Module code	**LWM10**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**52**	**88**	**140**
Learning outcome	**After successful completion of this module participants will be able to:** • **Understand the concept of ecosystem functions and services, and means of assessing it;** • **Develop adaptive management for wetlands in response to climate change;** • **Analyze problems and formulate objectives according to the Objective Oriented Planning (OOP) method;** • **Analyze systematically the role that stakeholders have in wetland planning and management;** • **Develop and carry out stakeholder interviews and surveys; and** • **Construct a wetland management plan based on the guidelines of the Ramsar convention.**				
Courses					
ECTS-points	**5.6**				
Hours	**4**				
Contact hours	**52**				
Self-study	**88**				

Total hours (à 60 min)	**140**
Participation requirements	*No*
Frequency	

Module title	**Aquatic Ecosystems: Processes & Applications**				
Module type	***Mandatory for LWM***				
Module code	**LWM11**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**81**	**59**	**140**
Learning outcome	**After successful completion of this module participants will be able to:** • **Describe the main ecological pathways in aquatic systems and apply standard methods for assessing them;** • **Relate physical-chemical dynamics to biotic properties in aquatic ecosystems in the context of light, nutrients, primary production, ecosystem metabolism, and food web structure;** • **Develop and pursue a research question with an appropriate experimental design;** • **Analyze data to answer the research question using statistical or modelling techniques;** • **Produce a report in the format of a scientific article that presents research questions, the data supporting it, and a discussion of results, including a review of relevant literature; and** • **Critically analyze colleagues' work in the form of a peer review.**				
Courses					
ECTS-points	**5.6**				

Hours	**4**
Contact hours	**81**
Self-study	**59**
Total hours (à 60 min)	**140**
Participation requirements	*No*
Frequency	

Module title	**Data Analysis and Modelling for Aquatic Ecosystems**				
Module type	***Mandatory for LWM***				
Module code	**LWM12**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**48**	**92**	**140**
Learning outcome	**After successful completion of this module participants will be able to:** • **Store and manipulate experimental data efficiently in a simple database;** • **Perform exploratory data analysis using time series plots, scatter plots and descriptive statistics in MS Excel and R;** • **Perform basic statistical procedures and analyses using R (distribution tests and transformations, t-tests, ANOVAs, non-parametric tests, simple and multiple regression, etc.)** • **Understand the principles of Bayesian statistics and apply them to ecological data;** • **Do multivariate statistical analyses such as factor analysis, cluster analysis and multi-dimensional scaling using R;** • **Construct a simple dynamic simulation model of an aquatic ecosystem**				

	using Stella; • **Discuss critically the strengths, weaknesses, missing information, advantages and disadvantages of the analyses; and** • **Communicate effectively the methods, results and conclusions of a case study (presentation and written report).**
Courses	
ECTS-points	**5.6**
Hours	**4**
Contact hours	**48**
Self-study	**92**
Total hours (à 60 min)	**140**
Participation requirements	*No*
Frequency	

Module title	**Group-work**				
Module type	***Mandatory for LWM***				
Module code	**LWM13**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	5.6	**4**	**30**	**110**	**140**
Learning outcome	**After successful completion of this module participants will be able to:** • **Solve complex environmental problems by integrating the content of the**				

	preceding modules; • **Make decisions on the basis of a limited amount of information; and** • **Work in a team to solve complex environmental problems.**
Courses	
ECTS-points	**5.6**
Hours	**4**
Contact hours	**30**
Self-study	**110**
Total hours (à 60 min)	**140**
Participation requirements	*No*
Frequency	

Module title	Research Methods & Summer School				
Module type	*Mandatory for LWM*				
Module code	LWM14				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	3.8	3	48	48	96
Learning outcome	After successful completion of this module participants will be able to: • Clearly formulate, specify, define and justify an issue to be studied, related to the content of the programme and achievable within the available time frame; • Organize and conduct research work on an individual basis; • Carry out a comparative literature review on selected topics; • Apply basic scientific analysis procedures, (engineering) tools and technologies; • Integrate knowledge to achieve solutions for complex environmental problems in a multi-stakeholder scenario.				
Courses					
ECTS-points	1.9				
Hours	1.5				
Contact hours	24				
Self-study	24				
Total hours (à 60 min)	48				
Participation requirements	*No*				
Frequency					

Courses	
ECTS-points	**1.9**
Hours	**1.5**
Contact hours	**24**
Self-study	**24**
Total hours (à 60 min)	**48**
Participation requirements	*No*
Frequency	

APPENDIX C EQUIVALENCE LIST

Moduls	ECTS	Contents/lectures	CTS-LV	VS	pe	LV-Nr.	Äquivalenzliste (Bestehende LV)	WS_alt	CTS_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 a	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 landscapes	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 manageme	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		
		Ecohydromorphological mapping	2	1	VU	812301	Übung zum Ökologischen Gewässermanagement	1	2
Fish monitoring and assessment	6	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 mo	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 co	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 syste	2	1	VS	812309	Historische Daten zur Fließgewässerentwicklung und Biologie	1	2
Interdisciplinarity and socioeconomics	6	Interdisziplinäre Ansätze und Methode	3	2	VO	731105	Interdisziplinäre Ansätze und Methoden (deutsch)	2	3
		Recreation and participation in river la	3	2	VU		NEW		
Aquatic plants	6	Ecology of aquatic plants	2	1,5	VU	831301	Biologie der Wasser- und Uferpflanzen	2	3
		Ecology of algae	2	1,5	VU		NEW		
		Ecology, restoration and conservation	2	1	VU		NEW	3	5
Fisheries management and aquaculture	6	Fish parasitology and pathology	2	1	VO	812035	Fischpathologie	1	2
		Fisheries management and conservat	2	2	VS		NEW		
		Fish farming and aquaculture	2	1	VO	812313	Einführung in die Aquakultur	1	2
Ecosystem modelling	6	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		