Universität für Bodenkultur Wien

University of Natural Resources and Life Sciences, Vienna

Curriculum

for the Master´s Programme in

Applied Limnology

and

the International Joint Master´s Programme in

Limnology & Wetland Management

Programme classification no. 066 448

Effective date: 1.10.2014

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§ 1 QUALIFICATION PROFILE

The Master's programme in Applied Limnology and the International Joint Master´s 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's programme in Applied Limnology and the International Joint Master´s 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 Master´s Programme in Limnology & 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's programme in Applied Limnology and the International Joint Master´s Programme in Limnology & Wetland Management qualifies students to pursue the following professional activities: dealing with freshwater ecological issues in public and private bureaus, governmental departments, international authorities, water management and ecological planning offices, NGOs, international organisations 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:

- Identify and systematically categorise 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;
- Discuss fundamentals of the structure (abiotic and biological components) and ecological functioning of freshwater ecosystems;
- Understand basics of inorganic and organic chemistry, as well as understand essential physiological and biogeochemical processes;
- Comprehend fundamental environmental processes such as, climate, water cycle and basic hydrology);
- Apply mathematics and statistical methods to perform explorative and descriptive data analyses, calculate and interpret simple ecological models;
- Recognise 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
- Understand fundamentals of geographic information systems and apply GIS software.

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

§ 3 PROGRAMME STRUCTURE

3a) Duration, total ECTS credits, and structure

The Master's programme in Applied Limnology and the International Joint Master´s Programme in Limnology & Wetland Management consist of courses and other requirements worth a total of 120 ECTS credits. This is equivalent to a duration of four semesters (a total of 3,000 60-minute credit hours).

The Master's programme in Applied Limnology is divided into

Compulsory courses:	39 ECTS credits
Master's thesis:	30 ECTS credits
Elective courses:	36 ECTS credits
Free electives:	15 ECTS credits

The International Joint Master´s Programme in Limnology & Wetland Management is divided into

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

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´s Programme in Limnology & Wetland Management is implemented jointly by BOKU (Austria), Egerton University (Kenya) and UNESCO-IHE (The Netherlands). Graduates receive a Joint Master's Degree in Limnology & 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 programme 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's programmes comprise the following compulsory courses:

4.1. COMPULSORY COURSES AT BOKU: AL & LWM

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
Taxonomy and 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 5 (LWM5): Scientific methods	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			AL	LWM
Statistical analyses of ecological data	VU	3	Yes	Yes
Scientific reading and presentation in aquatic ecology	SE	3	Yes	No
Module 6: Research proposal & master seminar	**Course type**	**ECTS points**	**Comp.**	**Comp.**
Course name			AL	LWM
Research proposal	VS	3	Yes	No
Master seminar	SE	3	Yes	No

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

4.2. COMPULSORY COURSES AT EGERTON UNIVERSITY: LWM

Module LWM6: Lake Ecology	Course type	ECTS points
Course name		
Lake Ecology	VU	5.6
Module LWM7: Ecology of Streams and Rivers	Course type	ECTS points
Course name		
Ecology of Streams and Rivers	VX	5.6
Module LWM8: Wetlands for Water Quality	Course type	ECTS points
Course name		
Wetlands for Water Quality	VX	5.6
Module LWM9: Fisheries & Aquaculture	Course type	ECTS points
Course name		
Fisheries & Aquaculture	VU	5.6

List of compulsory modules for LWM (International Joint Master´s Programme in Limnology & Wetland Management) at Egerton University, Kenya. The modules are also elective modules for AL (Master´s programme in Applied Limnology).

4.3. COMPULSORY COURSES AT UNESCO-IHE: LWM

Module LWM10: Data Analysis and Modelling for Aquatic Ecosystems	Course type	ECTS points
Course name		
Data Analysis and Modelling for Aquatic Ecosystems	VU	5.6
Module LWM11: Aquatic Ecosystems Processes and Applications	Course type	ECTS points
Course name		
Aquatic Ecosystems Processes and Applications	VU	5.6
Module LWM12: Wetlands for Livelihoods and Conservation	Course type	ECTS points
Course name		
Wetlands for Livelihoods and Conservation	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: Research Methods & Summer School	Course type	ECTS points
Course name		
Research Methods & Summer School	VS	3.8

List of compulsory modules for LWM (International Joint Master´s Programme in Limnology & Wetland Management) at UNESCO-IHE, The Netherlands. The modules are also elective modules for AL (Master´s programme in Applied Limnology).

§ 5 ELECTIVE COURSES

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 are required to choose a minimum of 2 biological/limnological orientated modules (e.g. "Fish monitoring and assessment"; "Benthic invertebrate monitoring and assessment"; "Aquatic plants"; "Ecology and taxonomy of freshwater fish and benthic invertebrates"; "Limnochemistry in human impacted aquatic ecosystems"). Students are required to choose one of the seminar-type modules, either "Environmental impacts on riverine ecosystems", or "Restoration & conservation of riverine landscapes". Modules/courses of the International Joint Master Degree Programme in Limnology & Wetland Ecosystems, which are given at Egerton University and UNESCO-IHE, are also eligible as elective courses for Applied Limnology.

Module 7: Ecohydromorphological monitoring	**Course type**	**ECTS points**
Course name		
River habitat and landscape assessment	**VU**	**4**
Ecohydromorphological mapping	**VU**	**2**
Module 8: Fish monitoring and assessment	**Course type**	**ECTS points**
Course name		
Fish sampling and monitoring	**VU**	**3**
Fish ecological status assessment	**VU**	**3**
Module 9: 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 10: 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 11: Environmental impacts on riverine ecosystems	**Course type**	**ECTS points**
Course name		
Environmental impacts on riverine ecosystems I	**SE**	**4**
Environmental impacts on riverine ecosystems II	**SE**	**2**
Module 12: Restoration & conservation of riverine landscapes	**Course type**	**ECTS points**
Course name		
Restoration and conservation of riverine landscapes I	**SE**	**4**
Restoration and conservation of riverine landscapes II	**SE**	**2**

Module 13: 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 14: Interdisciplinarity and socioeconomics	Course type	ECTS points
Course name		
Participatory methods in development research and practice	SE	3
Recreation in riverine landscapes	VS	3
Module 15: 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 16: Ecosystem modelling	Course type	ECTS points
Course name		
Data mining and data management in aquatic ecology	VU	2
Multi-scale modelling and system dynamics in aquatic ecosystems	VU	2
Aquatic habitat modelling	VU	2
Module 17: Hydrology and morphology	Course type	ECTS points
Course name		
Hydrological Processes and modelling	VO	3
Sediment regime and river morphology	VO	3
Module 18: Limnochemistry in human impacted aquatic ecosystems	Course type	ECTS points
Course name		
Limnochemistry II	PR	4
Water quality aspects in river restoration	SE	2
Module 19: Ecology and taxonomy of freshwater fish and benthic invertebrates	Course type	ECTS points
Course name		
Ecology and taxonomy of selected invertebrate groups	UX	3
Taxonomy and evolution of European fish communities	UX	3

Module 20: Fish genetics	Course type	ECTS points
Course name		
Population genetics and evolutionary theory relevant for the management and protection of aquatic organisms (in Eng.)	**VO**	**3**
Laboratory methods in fish genetics (in Eng.)	**SE**	**4**

§ 6 FREE ELECTIVES

6.1 FREE ELECTIVES APPLIED LIMNOLOGY

Free electives worth a total of 15 ECTS credits are required to complete the Master's Programme in Applied Limnology. Free electives may be selected from all courses offered by all recognised 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.

6.2 FREE ELECTIVES LIMNOLOGY & WETLAND MANAGEMENT

Free electives worth a total of 13.4 ECTS credits are required to complete the International Joint Masters Programme in Limnology & Wetland Management. Students are free to choose electives courses at BOKU, Egerton University, UNESCO-IHE, or any other recognised university. For students doing their MSc project at BOKU, the BOKU courses "Scientific reading and presentation in aquatic ecology", "Research proposal" and "Master Seminar" are strongly recommended.

§ 7 MASTER´S 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] UG2002 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 have been met:

- positive completion of the compulsory courses worth a total of 39 ECTS credits (§ 4);
- positive completion of elective courses worth a total of 36 ECTS credits (§ 5);
- positive completion of free electives worth a total of 15 ECTS credits (§ 6); and
- a positive grade on the master's thesis and the defence 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 free electives worth a total of 13.4 ECTS points (§ 6);
- a positive grade on the master's thesis and the defence 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 committee shall consist of a committee chair and two additional university teachers with a venia docendi or equivalent qualification. The student's total performance (thesis and defence examination) will be assigned a comprehensive grade. Both thesis and defence examination must receive a passing 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 fulfil 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) 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 recognised towards the new programme under the provisions of this curriculum based on the list of equivalent courses (Appendix C).

§ 12 EFFECTIVE DATE

This curriculum shall take effect on 1.10.2014.

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)

ANNEX B MODULE DESCRIPTIONS

B1. MODULES AT BOKU

<table>
<tr><td>Module title</td><td colspan="5">Basics in Limnology</td></tr>
<tr><td>Module type</td><td colspan="5">Mandatory</td></tr>
<tr><td>Module code</td><td colspan="5">1 (LWM1)</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>9</td><td>6</td><td>110</td><td>115</td><td>225</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
• Understand the ecological principles of aquatic ecosystems;
• Analyse fundamental properties of lakes and river ecosystems;
• Describe major chemical properties of aquatic ecosystems
• Identify and apply adequate methods to analyse chemical and physical properties of aquatic systems
• Apply knowledge and skills to plan and carry-out simple research investigations for analysing the interactions between organisms and the environment;
• Interpret and present research results in oral and written form (manuscript & technical report);
• Evaluate the role of environmental factors and anthropogenic impacts on nutrient conditions and chemical characteristics of lentic and lotic ecosystems;
Evaluate environmental factors, climate change and anthropogenic impacts on lake and stream ecosystems</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Limnology</td></tr>
<tr><td>ECTS-points</td><td colspan="5">3</td></tr>
<tr><td>Hours</td><td colspan="5">2</td></tr>
<tr><td>Contact hours</td><td colspan="5">40</td></tr>
<tr><td>Self-study</td><td colspan="5">35</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">75</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td colspan="6">Frequency</td></tr>
</table>

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	**After successful completion of this module, participants are able to:** • **Explain the life cycles and ecology of European and selected other important fish species;** • **Understand principles of zoological systematics and taxonomical work;** • **Use morphological features to identify benthic macro-invertebrates and fish with taxonomic keys from taxa-group to species level;** • **Classify functional groups of benthic invertebrates based on morphological features (feeding-type, current preference, etc);** • **Relate benthic invertebrate communities and fish to habitat categories, river types and eco-regions;** • **Apply knowledge of ecology, physiology, and zoogeography of benthic invertebrates and fish to understand aquatic ecosystem functioning.**				
Courses					
Course title	Taxonomy and 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					

<table>
<tr><td>Module title</td><td colspan="5">Basics in Applied Limnology</td></tr>
<tr><td>Module type</td><td colspan="5">Mandatory</td></tr>
<tr><td>Module code</td><td colspan="5">3 (LWM3)</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>60</td><td>90</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
Understand the major controlling factors of river systems across multiple spatio-temporal scales;
Describe the hydrological, morphological and sedimentological characteristics of river - floodplain systems at different spatial scales;
Understand the interdependencies between hydromorphological processes and aquatic habitat conditions;
Apply this knowledge to identify natural and human induced changes of the physical environment of rivers.
Describe fish-ecological conditions in Austrian & European rivers;
Understand principles of bioassessment;
Review monitoring and assessment methods used for water management
and biodiversity conservation;
Understand the application of monitoring and assessment methods;
Interpret monitoring and assessment results;
Discuss methods for assessing and improving ecological integrity;
Evaluate the impacts of human activities on running waters;
Evaluate the role of bioassessment within the legal framework of water management and biodiversity conservation.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Physical environment of riverine landscapes</td></tr>
<tr><td>ECTS-points</td><td colspan="5">2</td></tr>
<tr><td>Hours</td><td colspan="5">1.5</td></tr>
<tr><td>Contact hours</td><td colspan="5">20</td></tr>
<tr><td>Self-study</td><td colspan="5">30</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">50</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td>Frequency</td><td colspan="5"></td></tr>
</table>

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	

<table>
<tr><td>Module title</td><td colspan="5">Aquatic ecosystem management</td></tr>
<tr><td>Module type</td><td colspan="5">Optional</td></tr>
<tr><td>Module code</td><td colspan="5">4 (LWM4)</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>46</td><td>104</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
Consider the most important legislation documents for planning and implementing projects towards the sustainable management of aquatic ecosystems in Austria & Europe.
Describe different types of management concepts and measures;
Characterise major planning tools;
Discuss ecological management measures with regard to goals, spatio-temporal scales, reference conditions and importance for the aquatic environment;
Develop a conceptual framework for the process of ecological river management;
Identify appropriate criteria for setting restoration and conservation priorities in management programs;
Apply knowledge about ecological river management to discuss case studies in the field;
Assess success and constraints of different types of management measures;
Identify appropriate planning tools for specific management tasks and problems;
Cope with practical challenges and framework conditions for implementing management programs;
Write a well argued, logically sound, coherent and well edited report.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Water legislation</td></tr>
<tr><td>ECTS-points</td><td colspan="5">2</td></tr>
<tr><td>Hours</td><td colspan="5">1</td></tr>
<tr><td>Contact hours</td><td colspan="5">13</td></tr>
<tr><td>Self-study</td><td colspan="5">37</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">50</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td>Frequency</td><td colspan="5"></td></tr>
</table>

Courses	
Course title	**Ecological river landscape management**
ECTS-points	**2**
Hours	**1**
Contact hours	**13**
Self-study	**37**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	
Courses	
Course title	**Applications in river landscape management**
ECTS-points	**2**
Hours	**2**
Contact hours	**20**
Self-study	**30**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	

<table>
<tr><td>Module title</td><td colspan="5">Scientific working</td></tr>
<tr><td>Module type</td><td colspan="5">Mandatory for AL, partly mandatory for LWM</td></tr>
<tr><td>Module code</td><td colspan="5">5 (LWM5)</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>45</td><td>105</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
• Understand the role of scientific publications in science;
• Search and identify relevant publications;
• Read and understand scientific publications;
• Analyse, compare and summarise scientific publications;
• Generate a critical personal perception of published research results;
• Present, discuss and defend research results;
• Understand the scientific background and assumptions of statistics in aquatic ecology in theory and practice;
• Demonstrate ability to select appropriate methodologies for data analysis, based on the specific properties of particular data sets;
• Formulate statistical hypotheses;
• Understand differences of parametric and non-parametric analyses;
• Discuss and compare means and to calculate correlation and regression coefficients;
• Use different software for data management and data analyses (MS Excel, SPSS, R);
• Present statistical analyses in tables and graphs.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Scientific reading and presentation in aquatic ecology</td></tr>
<tr><td>ECTS-points</td><td colspan="5">3</td></tr>
<tr><td>Hours</td><td colspan="5">2</td></tr>
<tr><td>Contact hours</td><td colspan="5">15</td></tr>
<tr><td>Self-study</td><td colspan="5">60</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">75</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td colspan="6">Frequency</td></tr>
</table>

Courses	
Course title	Statistical 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	**Research proposal & master seminar**				
Module type	***Mandatory for AL students; elective for LWM students***				
Module code	**6**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**30**	**120**	**150**
Learning outcome	**After successful completion of this module, participants are able to:** • **Engage critically with theory and literature in a chosen field of research;** • **Develop research questions in the context of current knowledge which can be answered by a research project;** • **Set explicit research objectives and hypotheses for a proposed research project;** • **Justify study designs, research methods, sampling designs and methods of analysis which are valid, feasible and efficient;** • **Develop realistic time tables and cost estimations;** • **Compose a detailed written research project proposal;** • **Present and defend a research project proposal;** • **Review and critically reflect on the validity and appropriateness of research proposals;** • **Present concisely the Master project objectives, relevance and justification, research methodology and research results;** • **Relate own research results to contemporary research findings in the specific field of studies;** • **Reflect critically on own research results and eventual limitations of the research project;** • **Demonstrate skills in analytical problem-analysis, synthetic thinking and communication;** • **Integrate knowledge to evaluate the relevance of own research findings to wider contexts.**				

Courses	
Course title	Research proposal
ECTS-points	**3**
Hours	**2**
Contact hours	**15**
Self-study	**60**
Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	
Courses	
Course title	Master seminar
ECTS-points	**3**
Hours	**2**
Contact hours	**15**
Self-study	**60**
Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	

<table>
<tr><td>Module title</td><td colspan="5">Ecohydromorphological monitoring</td></tr>
<tr><td>Module type</td><td colspan="5">Optional</td></tr>
<tr><td>Module code</td><td colspan="5">7</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>54</td><td>96</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
Explain different national and international hydromorphological survey and assessment methods;
Identify key-habitats of river landscapes for hydromorphological surveys and assessments;
Apply hydromorphological survey and assessment methods in the field by using various techniques and instruments;
Plan, prepare and realise an areal field mapping with data input and analyses;
Analyse hydromorphological data sets with GIS;
Evaluate hydromorphological data sets with regard to specific assessment goals;
Propose suitable hydromorphological monitoring methods for specific monitoring goals and spatial scales;
Present the field survey and assessment results.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">River habitat and landscape assessment</td></tr>
<tr><td>ECTS-points</td><td colspan="5">4</td></tr>
<tr><td>Hours</td><td colspan="5">2</td></tr>
<tr><td>Contact hours</td><td colspan="5">30</td></tr>
<tr><td>Self-study</td><td colspan="5">70</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">100</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td colspan="6">Frequency</td></tr>
</table>

Courses	
Course title	Ecohydromorphological mapping
ECTS-points	**2**
Hours	**2**
Contact hours	**24**
Self-study	**26**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	

Module title	**Fish monitoring and assessment**				
Module type	***Optional***				
Module code	**8**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	4	**48**	**102**	**150**
Learning outcome	**After successful completion of this module, participants are able to:** • **Understand why fish stocks need to be monitored;** • **Apply different fish sampling methods in the field;** • **Apply different desk methods for fish stock assessment;** • **Assess the quality of fish stocks and explain possible deficits;** • **Design fish monitoring programmes based on legal requirements;** • **Integrate fish stock assessment into the ecological status assessment frameworks;** • **Compose a technical report for fish-based, river-type-specific assessment of ecological integrity.**				
Courses					
Course title	Fish sampling and monitoring				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**24**				
Self-study	**51**				
Total hours (à 60 min)	**75**				
Participation requirements	*No*				
Frequency					

Courses	
Course title	Fish ecological status assessment
ECTS-points	**3**
Hours	**2**
Contact hours	**24**
Self-study	**51**
Total hours (à 60 min)	**75**
Participation requirements	*No*
Frequency	

Module title	**Benthic invertebrate monitoring and assessment**				
Module type	***Optional***				
Module code	**9**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**60**	**90**	**150**
Learning outcome	**After successful completion of this module, participants are able to:** • **Discuss various methods of sampling macro- invertebrates and their application in applied research and monitoring;** • **Identify ecologically meaningful habitat types (choriotopes) and estimate their proportional occurrence in the field;** • **Apply standardised sampling methods ("Multi-Habitat-Sampling") in wadeable rivers;** • **Examine benthic invertebrate communities according to the European Water Framework Directive (sorting and identification of invertebrates);** • **Compare assessment methods currently used in Europe with regard to their respective advantages and disadvantages;** • **Apply autecological information of selected bio-indicators to identify different stressors of aquatic systems;** • **Analyse reactions of the macro-invertebrate community to environmental variables;** • **Evaluate biological data and discuss potential impacts on benthic communities based on provided species lists from previous projects;** • **Apply ECOPROF - the Austrian assessment software;** • **Interpret and present research results in written form (technical report) and within Powerpoint presentation.**				

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	Aquatic plants				
Module type	*Optional*				
Module code	10				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	55	95	150
Learning outcome	After successful completion of this module, participants are able to: • Describe the biology and habitat preferences of aquatic plants and the ecological role of riparian vegetation in floodplains; • Identify key-species of aquatic plants, riparian vegetation and main algal groups (e.g. green algae, diatoms, cyanobacteria); • Discuss conservation aspects and relevant EU guidelines with regard to alagem aquatic plants and riparian vegetation; • Evaluate selected environmental effects on algae; • Apply knowledge and skills to run short term experiments on ecophysiology of algae; • Apply standard methods for recording and mapping of vegetation and physical habitat parameters in the field and fundamentals in modelling of riparian ecosystems; • Evaluate the effects of human impacts on algae and plants - such as eutrophication, river regulation, hydro-power plants, reservoirs etc.; Evaluate the current assessment approaches using algae in lentic and lotic ecosystems.				
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	

<table>
<tr><td>Module title</td><td colspan="5">Environmental impacts on riverine ecoosystems</td></tr>
<tr><td>Module type</td><td colspan="5">Optional</td></tr>
<tr><td>Module code</td><td colspan="5">11</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>48</td><td>102</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
• Discuss concepts to assess riverine ecosystem degradation;
• Review methodological approaches to assess environmental and human impacts on riverine ecosystems;
• Understand the effects of climate change on aquatic biota in rivers;
• Apply methods for quantitative and qualitative data analyses including GIS analyses;
• Assess the effects of environmental impacts on fish and benthic invertebrates, as well as on ecosystem services;
• Present and defend own investigation results based on case studies;
• Analyse and assess in depth the effects of environmental impacts on riverine biota (fish and benthic invertebrates), as well as on ecosystem services;
• Apply active reading strategies in order to analyse and interpret scientific articles;
• Synthesise knowledge gained through scientific articles;
• Discuss own research questions based on a literature review;
• Write a well argued, logically sound, coherent and well edited scientific text.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Environmental impacts on riverine ecosystems I</td></tr>
<tr><td>ECTS-points</td><td colspan="5">4</td></tr>
<tr><td>Hours</td><td colspan="5">3</td></tr>
<tr><td>Contact hours</td><td colspan="5">36</td></tr>
<tr><td>Self-study</td><td colspan="5">64</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">100</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td>Frequency</td><td colspan="5"></td></tr>
</table>

Courses	
Course title	Environmental impacts on riverine ecosystems II
ECTS-points	**2**
Hours	**1**
Contact hours	**12**
Self-study	**38**
Total hours (à 60 min)	**50**
Participation requirements	*No*
Frequency	

Module title	**Restoration and conservation of riverine landscapes**				
Module type	***Optional***				
Module code	**12**				
Effort	**ECTS points**	**Hours**	**Contact hours**	**Self-study**	**Total hours**
	6	**4**	**48**	**102**	**150**
Learning outcome	**After successful completion of this module, participants are able to:** • **Understand different tasks and methodological approaches for river restoration/conservation concepts and strategies;** • **Describe restoration and conservation concepts for different aquatic ecosystems;** • **Apply methods for quantitative and qualitative data analyses, GIS analyses;** • **Analyse the status quo of the aquatic environment/riverine landscapes (habitat- and ecological trait losses, deviations from reference conditions);** • **Assess the effects of restoration/conservation measures on the aquatic environment as well as on ecosystem services;** • **Develop restoration/conservation concepts;** • **Discuss and evaluate restoration/conservation concepts and management scenarios;** • **Present and defend own investigation results based on case study work;** • **Assess in depth the effects of restoration/conservation measures on riverine ecosystems, as well as on ecosystem services;** • **Analyse and review scientific papers critically in terms of key messages, consistency and relevance;** • **Summarise and organise information from a literature review;** • **Draw relevant conclusions from scientific literature for own research questions;** • **Discuss own research questions based on a literature review;** • **Write a well argued, logically sound, coherent and well edited scientific report/paper.**				

Courses	
Course title	Restoration and conservation of riverine landscapes I
ECTS-points	4
Hours	3
Contact hours	36
Self-study	64
Total hours (à 60 min)	100
Participation requirements	*No*
Frequency	
Courses	
Course title	Restoration and conservation of riverine landscapes II
ECTS-points	2
Hours	1
Contact hours	12
Self-study	38
Total hours (à 60 min)	50
Participation requirements	*no*
Frequency	

<table>
<tr><td>Module title</td><td colspan="5">Planning and management</td></tr>
<tr><td>Module type</td><td colspan="5">Optional</td></tr>
<tr><td>Module code</td><td colspan="5">13</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4</td><td>30</td><td>120</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module, participants are able to:
Describe fundamental concepts, methods and data/sources in environmental history
Discuss most important historical developments of aquatic systems
Apply the knowledge to integrate environmental history aspects into research projects
Identify and structure work flows in GIS;
Examine potential data sources for GIS analyses in aquatic ecology;
Apply GIS tools suitable for monitoring, management, planning, and analyses of riverine ecosystems and create GIS maps;
Interpret GIS results for riverscape analyses;
Understand reasons for fish migration;
Know ranging behaviour and swimming performance of different fish species;
Identify ecological prioritisation for river continuity restoration;
Design different types of fish passes according to specific ecological criteria;
Select appropriate field-survey techniques and sampling strategies for technical evaluation and biological assessment of fish passes.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">GIS in riverscape planning</td></tr>
<tr><td>ECTS-points</td><td colspan="5">2</td></tr>
<tr><td>Hours</td><td colspan="5">1.5</td></tr>
<tr><td>Contact hours</td><td colspan="5">10</td></tr>
<tr><td>Self-study</td><td colspan="5">40</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">50</td></tr>
<tr><td>Participation requirements</td><td colspan="5">No</td></tr>
<tr><td>Frequency</td><td colspan="5"></td></tr>
</table>

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	**Transdisciplinary approaches in natural resource management**				
Module type	***Optional***				
Module code	**14**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	4	**?**	**?**	**150**
Learning outcome	**After successful completion of this module, participants are able to:** • **Describe different participatory methods and approaches and how they evolved;** • **Describe participatory approaches and methods used in developing countries and explain why they are used;** • **Identify different epistemologies of different stakeholder groups and consequences of different approaches of collaborative research and management;** • **Assess strengths of different participative approaches;** • **Master methods in different professional roles (notably as researcher, process facilitator);** • **Integrate participatory methods into research on and management of natural resources;** • **Design participatory methods and applications based on training examples;** • **Evaluate different participatory methods and shortcomings of professional practice;** • **Develop integrative river management concepts, considering socio-cultural aspects, legal background and socio-economics;** • **Integrate recreational aspects into river management planning practice.**				
Courses					
Course title	Participatory methods in development research and practice				
ECTS-points	**3**				
Hours	**2**				
Contact hours	**?**				
Self-study	**?**				
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	**Fisheries management and aquaculture**				
Module type	***Optional***				
Module code	**15**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	6	4	**60**	**90**	**150**
Learning outcome	**After successful completion of this module participants are able to:** • **Relate the life histories of fish parasites to transmission, prevention and control of fish diseases;** • **Describe pathological diagnosis of important fish diseases and approaches to monitor and to manage fish health;** • **Describe the state and potential of the aquaculture in the world;** • **Summarise fish farming methods and technologies in temperate and tropical zones and potential environmental impacts;** • **Apply ecological knowledge to enhance fish production and to reduce environmental impacts;** • **Summarise current topics in fisheries management and conservation of freshwater fish species;** • **Identify relevant problems related to artificial fish production and stocking;** • **Assess possibilities and limitations of sustainable, ecological orientated fisheries management;** • **Evaluate potential sources of conflicts between fisheries and conservation measures;** • **Present scientific studies on fisheries management and conservation issues.**				

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 modelling				
Module type	*Optional*				
Module code	16				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	90	150
Learning outcome	After successful completion of this module, participants are able to: • Understand fundamentals of multidimensional and applied ecosystem modelling at different spatial scales, from micro-habitat to catchment scale; • Analyse and discuss ecological and environmental data-sets by using different modeling methods; • Select appropriate field-survey techniques, sampling strategies and data management schemes for specific research and management goals; • To sample data in a standardised way in the field; • Know how to manage their own data (e.g. MS Access); and • Incorporate information of different kinds (quantitative and qualitative) and from different perspectives (natural and social science) in research and decision-making related to managing aquatic ecosystems; • Understand and identify the main elements and processes features of applied aquatic ecosystems modelling and structure and relate them in a hierarchical manner (the conceptual causal modelling unit follows hereby the concepts of hierarchy theory supported by qualitative reasoning as means for qualitative causal simulations); • Apply statistical intuition and abstract reasoning as well as reasoning from numerical data through ecology-based and other research (sociology, adaptive management); • Apply field surveys techniques, data management schemes and modeling techniques to their own data-sets; • Select and use appropriate field-sampling techniques, sampling strategies and data management schemes for specific research and management goals; • Understand in theory and practice field methods (snorkling, fish observation, habitat assessment) useful on micro- and meso- habitat scale; • Apply data, sampled by their own, to different modelling techniques; • Demonstrate critical thinking in interpreting and deriving conclusions from environmental and ecological data-sets.				

Courses	
Course title	Data mining and data management 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 modelling 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	17				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	60	90	150
Learning outcome	After successful completion of this module, participants are able to: • Process understanding for individual components of the hydrological cycle; • Know measurements techniques and the availability of hydrological data at different spatial scales; • Know different model concepts for hydrological processes; • Choose and apply models for different applications; • Solve problems related with sediment transport and river morphology (the lack and surplus of sediments leads to the very actual problem of river bed degradation and reservoir sedimentation with ecological, technical and economical negative consequences).				
Courses					
Course title	Hydrological processes and modelling				
ECTS-points	3				
Hours	2				
Contact hours	?				
Self-study	?				
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					

<table>
<tr><td>Module title</td><td colspan="5">Limnochemistry in human impacted aquatic ecosystems</td></tr>
<tr><td>Module type</td><td colspan="5">Optional</td></tr>
<tr><td>Module code</td><td colspan="5">18</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>6</td><td>4,5</td><td>54</td><td>96</td><td>150</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module participants are able to:
Discuss the impact of human activities on elemental cycles;
Apply a wide range of methods to analyse major chemical and physical properties of different compartments of aquatic ecosystems;
Analyse various nutrient fluxes and their interaction in aquatic ecosystems;
Evaluate limnochemical parameters reflecting major ecosystem properties and human impacts in selected aquatic ecosystems.</td></tr>
<tr><td colspan="6">Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Limnochemistry II</td></tr>
<tr><td>ECTS-points</td><td colspan="5">4</td></tr>
<tr><td>Hours</td><td colspan="5">3</td></tr>
<tr><td>Contact hours</td><td colspan="5">36</td></tr>
<tr><td>Self-study</td><td colspan="5">64</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">100</td></tr>
<tr><td>Participation requirements</td><td colspan="5">Limnochemistry I, or equivalent course</td></tr>
<tr><td>Frequency</td><td colspan="5">Every 2nd Year (alternating with “Ecology and taxonomy selected invertebrate groups”)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Course title</td><td colspan="5">Water Quality aspects in River restoration</td></tr>
<tr><td>ECTS-points</td><td colspan="5">2</td></tr>
<tr><td>Hours</td><td colspan="5">1,5</td></tr>
<tr><td>Contact hours</td><td colspan="5">18</td></tr>
<tr><td>Self-study</td><td colspan="5">32</td></tr>
<tr><td>Total hours (à 60 min)</td><td colspan="5">50</td></tr>
<tr><td>Participation requirements</td><td colspan="5">none</td></tr>
<tr><td>Frequency</td><td colspan="5">Every 2nd Year (alternating with “Taxonomy and evolution of European fish communities”)</td></tr>
</table>

Module title	Ecology and taxonomy of freshwater fish and benthic invertebrates				
Module type	*Optional*				
Module code	19				
Effort	ECTS points	Semester hours	Contact hours	Self-study	Total hours
	6	4	48	102	150
Learning outcome	After successful completion of this module, participants are able to: • Use taxonomical keys comprehensively; • Identify selected benthic invertebrate groups to species level in larval and/or adult stages; • Understand morphological and behavioural adaptions of benthic invertebrates in an environmental context; • Evaluate the role of species, genera and families of selected benthic invertebrate groups in ecosystem functioning; • Classify benthic invertebrate taxa with regard to habitat preferences, functional feeding type and zoogeographical regions; • Use benthic invertebrate taxa as bioindicators according assessment programs like the WFD; • Detect different benthic invertebrate stages (larvae and adults) in the field; • Contribute to biodiversity issues. • Understand the development of the family tree of fish and the major differences between the different fish families; • Identify and distinguish native and introduced fish species in Middle Europe, both adult and juvenile life stages; • Assess and apply different methods for fish species identification.				
Courses					
Course title	Ecology and taxonomy selected invertebrate groups				
ECTS-points	3				
Hours	2				
Contact hours	24				
Self-study	51				
Total hours (à 60 min)	75				
Participation requirements	??				
Frequency	Every 2nd Year (alternating with “Limnochemistry II”)				

Course title	**Taxonomy and evolution of European fish communities**
ECTS-points	**3**
Hours	**2**
Contact hours	**24**
Self-study	**51**
Total hours (à 60 min)	**75**
Participation requirements	**Ecology of fishes recommended**
Frequency	Every 2nd Year (alternating with "Water Quality aspects in River restoration")

Module title	**Fish genetics**				
Module type	***Optional***				
Module code	**20**				
Effort	**ECTS points**	**Semester hours**	**Contact hours**	**Self-study**	**Total hours**
	7	**5**	**60**	**115**	**175**
Learning outcome	**After successful completion of this module, participants are able to:** • **Understand basic principles in population genetics, with emphasis on applied examples in fishery management and protection;** • **Discuss basic principles in evolutionary science relevant to aquatic habitat restoration, fishery management and conservation;** • **Develop study designs relevant to applied questions and management in aquatic habitats;** • **Understand protocols and theory for DNA extraction, DNA and tissue preservation, PCR, DNA sequencing and microsatellite typing;** • **Apply protocols for DNA extraction, DNA and tissue preservation, PCR, DNA sequencing and microsatellite typing in the laboratory (hands on practice in lab);** • **Apply methods for genetic data analysis including introduction to various software programs and internet tools.**				

Courses	
Course title	Population genetics and evolutionary theory relevant for the management and protection of aquatic organisms (in Eng.)
ECTS-points	**3**
Hours	2
Contact hours	25
Self-study	50
Total hours (à 60 min)	75
Participation requirements	
Frequency	
Course title	Laboratory methods in fish genetics (in Eng.)
ECTS-points	4
Hours	3
Contact hours	35
Self-study	65
Total hours (à 60 min)	100
Participation requirements	
Frequency	Annually

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 are able to:** • **Characterise 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 Ecology				
ECTS-points	5.6				
Hours	4				
Contact hours	69				
Self-study	70				

Total hours (à 60 min)	139
Participation requirements	*No*
Frequency	

Module title	**Ecology of Streams and Rivers**				
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 are able to:** • **Distinguish the main stream ecosystem boundaries at watershed, eco-system and stream segment scales;** • **Characterise the bio-geophysical components of watersheds;** • **Relate and conceptualize the inter-connectedness between riverine and other ecosystems;** • **Analyse, 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	Ecology of Streams and Rivers
ECTS-points	5.6
Hours	4
Contact hours	90
Self-study	51
Total hours (à 60 min)	141
Participation requirements	*No*
Frequency	

Module title	**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 are 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	Wetlands for Water Quality
ECTS-points	5.6
Hours	4
Contact hours	88
Self-study	52
Total hours (à 60 min)	140
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 are 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	Fisheries & Aquaculture
ECTS-points	5.6
Hours	4
Contact hours	62
Self-study	79
Total hours (à 60 min)	141
Participation requirements	*No*
Frequency	

B3. MODULES AT UNESCO-IHE

<table>
<tr><td>Module title</td><td colspan="5">Data Analysis and Modelling for Aquatic Ecosystems</td></tr>
<tr><td>Module type</td><td colspan="5">Mandatory for LWM</td></tr>
<tr><td>Module code</td><td colspan="5">LWM10</td></tr>
<tr><td rowspan="2">Effort</td><td>ECTS points</td><td>Semester hours</td><td>Contact hours</td><td>Self-study</td><td>Total hours</td></tr>
<tr><td>5.6</td><td>4</td><td>48</td><td>92</td><td>140</td></tr>
<tr><td>Learning outcome</td><td colspan="5">After successful completion of this module participants are 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 eco-logical 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</td></tr>
</table>

	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	
Course title	**Data Analysis and Modelling for Aquatic Ecosystems**
ECTS-points	5.6
Hours	4
Contact hours	48
Self-study	92
Total hours (à 60 min)	140
Participation requirements	*No*
Frequency	

Module title	**Aquatic Ecosystems Processes and 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 are 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;** • **Analyse data to answer the research question using statistical or model-ling 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 analyse colleagues' work in the form of a peer review.**
Courses	
Course title	**Aquatic Ecosystems Processes and Applications**
ECTS-points	5.6
Hours	4
Contact hours	81
Self-study	59
Total hours (à 60 min)	140
Participation requirements	*No*
Frequency	

Module title	**Wetlands for Livelihoods and Conservation**
Module type	***Mandatory for LWM***
Module code	**LWM12**

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 are 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;** • **Analyse problems and formulate objectives according to the Objective Oriented Planning (OOP) method;** • **Analyse 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					
Course title	Wetlands for Livelihoods and Conservation				
ECTS-points	5.6				
Hours	4				
Contact hours	52				
Self-study	88				
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 are 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					
Course title	Group-work				
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 are 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;** • **Organise 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					
Course title	Research Methods & Summer School				
ECTS-points	3.8				
Hours	3				
Contact hours	48				
Self-study	48				
Total hours (à 60 min)	96				
Participation requirements	*No*				
Frequency					