UNIVERSITY OF L'AQUILA

Department of Health, Life and Environmental Sciences

Profile of

2nd Cycle Degree in ENVIRONMENTAL BIOLOGY AND MANAGEMENT OF ECOSYSTEMS

Laurea Magistrale in BIOLOGIA AMBIENTALE E GESTIONE DEGLI ECOSISTEMI

Tuning Oversight Council for ENVIRONMENTAL BIOLOGY AND MANAGEMENT OF ECOSYSTEMS

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DEGREE PROFILE OF

Laurea Magistrale in BIOLOGIA AMBIENTALE E GESTIONE DEGLI ECOSISTEMI

Second Cycle Degree in:

ENVIRONMENTAL BIOLOGY AND MANAGEMENT OF ECOSYSTEMS

TYPE OF DEGREE & LENGTH	Single Degree designed with two Tracks: *Environment Biology* (international) and *Environment Management and Protection*, 120 ECTS-credits, 2 years. The track *Environment Biology* is international and provides the students with the opportunity to be awarded of a French-Italian double degree
INSTITUTION(S)	Università degli Studi dell'Aquila - *University of L'Aquila,* ITALY For the international track: -Università degli Studi dell'Aquila - *University of L'Aquila, ITALY, and* -Université Claude Bernard Lyon 1 - *University of Lyon*, FRANCE
ACCREDITATION ORGANISATION(S)	Italian Ministry of Education, AVA, Ordine Nazionale dei Biologi – Italian Register of Biologists (ONB- http://www.onb.it)
PERIOD OF REFERENCE	Programme validated for 3 years for cohorts starting on 2016
CYCLE /LEVEL	EQF-LLL: 2nd cycle: EQF Level: 7; NQF: Laurea Magistrale

A	PURPOSE
	The Master degree in *"Environmental Biology and Management of Ecosystems"* aims to provide the students with advanced theoretical and technical knowledge in environmental assessment and capacity to manage and evaluate the relationship between human activities and environmental context. The program is designed to enable the students: 1) to carry out the analysis and the monitoring of environmental systems/processes from the perspective of sustainability and prevention of environmental quality; 2) to acquire skills and expertise in assessing biodiversity on the field by identifying the main biological components of freshwater and terrestrial environments; 3) to apply statistical methodologies for performing univariate and multivariate analyses in order to assess relationships between environmental (physico-chemical features) and biological (fauna and flora) data sets; 3) to translate data in a geographic mapping by GIS; 4) to use biological and environmental data in EIAs procedures (Environmental Impact Assessment) coupling the environmental background knowledge with the EU and national policies. The course is designed to provide to the students an adequate mastery of general scientific methods and the acquisition of specific professional knowledge to operate on the different fields of the environmental context.

B	CHARACTERISTICS	
1	DISCIPLINE(S) / SUBJECT AREA(S)	The degree course is strongly interdisciplinary. Components (30:30:40) are: a) Basic science and math; b) Environmental sciences; c) Specialization area. Precisely: Biology: biodiversity assessment (applied zoology and applied botany, freshwater ecology, conservation biogeography, the role of bacteria in ecosystem functioning, along with practical experiences in the field and in the laboratory; Chemistry & Physics: environmental description, status and trends (environmental physics, environmental chemistry, global change modelling, geographical mapping);

		Basic Mathematics: coupling biodiversity assessment and environmental status by means of statistical ecology (*R* and *Matlab* softwares) (50: 20: 30).
2	GENERAL / SPECIALIST FOCUS	Specialized, with focus on the biodiversity assessment and biodiversity threats and losses (from species identification, and related concepts (e.g., the role of the present-day environmental status and trends in defining the biodiversity trends - the ecological scale- and the role of historical events – the evolutionary scale)
3	ORIENTATION	The degree is primarily practically and professionally oriented to form a clearly defined professional profile. The two tracks provide slightly different orientations. The track *Environment Management and Protection* has a strong technical orientation providing skills for a specialized and scientific approach to the environmental market place - in industry, government and public agencies, non-profit and non-governmental organizations and the consulting sector. The track *Environment Biology* is articulated in such a way that students are able to enter in research activities in both public and private companies in Italy and abroad. The degree offers a high-level background preparation for being competitive in obtaining under competition a PhD position.
4	DISTINCTIVE FEATURES	The degree has a special focus and strong emphasis on skills development through fieldwork in different environments and work with leading researchers from a range of fields. This programme is developed with the aim to involve student to do research in a multidisciplinary context. Students selected for the international track must spend a semester/year in the partner University of Lyon to obtain the Italian-French double degree.

C	EMPLOYABILITY & FURTHER EDUCATION	
1	EMPLOYABILITY	Graduates in *Environmental Biology and Management of Ecosystems*, after the successful national test, can be enrolled in the Register of Professional Biologists (Section A) and carry out professional activities as professionals in Biology and related fields. They can perform highly specialized professional activity, as employees or freelance, in: 1) National/Regional Agencies for Environmental Protection; 2) Governmental public institutions; 3) public/private institutions for land and environmental management; 5) Universities and public/private research centre; 6) Industries . Furthermore the *Environmental Biologist* is allowed to use her/his title for private professional rules (e.g. as consultants in EIA, in Evaluation Incidence as stated by the Habitat Directive) in the national and international water agencies as environmental experts. Educational and outreach activities related to environmental and teaching are also possible. The environmental biology is considered among the most emergent disciplines in the wide field of the BIOLOGY Science.
2	FURTHER STUDIES	The Master Degree in *Environmental Biology and Management of Ecosystems* allows the graduate to compete for entry into a Third Cycle program /doctoral school. Graduates can continue the studies in PHD programmes close to their field of competence. Research activity in PhD schools and professional master schools, both inside the specific areas mentioned in the section B.1 (advanced statistical ecology; molecular ecology, molecular biology applied to species distinction and conservation biogeography); and in environmental physics, environmental chemistry (remediation, management of impacted sites, e.g. Sites of National Interest (coded SIN). Subscription to national schools (in the national universities) addressed to give teaching experience for the biologists interested to teach in primary and secondary schools.

D	EDUCATION STYLE	
1	LEARNING & TEACHING APPROACHES	Lectures, laboratory classes, seminars, small group work, individual study based on text books and lecture notes, field work, individual consultations with academic staff. Stages in national/international research centre, seminars, placement, research activity aimed to the preparation of the thesis.

2	ASSESSMENT METHODS	Formative assessment is a fundamental part of the teaching and learning activities. In-class activities, Computer simulations & exercises, Laboratory work, Problems to solve, Papers, group work projects, and presentations are the main tools for allowing the students to become independent and self-motivated learners, thriving on challenge and opportunities to think for themselves. At the start of the degree each student is assigned a Tutor who, throughout the studies, provides help in three important areas: supporting academic progress, developing transferable skills and dealing with any welfare issues. Summative assessment is performed in several ways, according to the characteristics of each Module. Written exams, oral exams, laboratory and project reports, oral presentations, continuing assessments, course work evaluation, final comprehensive exam. Particular emphasis is given to team work, with a variety of assessment methods of results obtained in either a group or individually (by splitting tasks and assignments), by written reports or a presentation. The aim is to develop a research-orientated approach to a problem and to acquire essential skills that are highly valued by the employers. Students are informed of the assessment procedure before the courses start and are also provided with previous examples. The final exam consists in writing a thesis, which must possess the characters of originality, exhaustive documentation and scientific investigation and which will be defended in front of a committee of university professors and experts. Students enrolled in the International Tracks will defend the thesis in both universities and receive a joint evaluation of their work. Re-assessment procedures follow the principles decided at institutional level.
E	PROGRAMME COMPETENCES	
1	GENERIC	
	Analysis and synthesis: capacity for analysis and synthesis using logical arguments and proven facts. Effectively using research skills and knowledge: capacity to design and evaluate an improvement project based on appropriate evidence. Flexible mind: acquisition of a flexible mind, open to apply basic knowledge and competences in a wide range of job opportunities and in everyday life. Critical self –reflection: ability to identify and address personal and academic development needs. Abstract reasoning, problem modeling: ability to identify relevant problems and delineate their solution. Project management skills: capacity to demonstrate a timely and well planned research study. Team-work: capability to perform guided teamwork in a lab setting and related special skills demonstrating capacity for handling the rigor of the discipline and for time management (including meeting deadlines). Communication skills: ability to communicate effectively and to present complex information in a concise manner orally and in writing and using ICT and appropriate technical language; ability to correctly write scientific and technical reports in second EU language. Popularization skills: ability to hold an oral presentation and to write a lucid article on the research conducted for a general, non-specialist public. Ability to communicate with non-experts, including some teaching skills. Learning abilities: Capacity to read and understand scientific texts on other topics directly or indirectly inherent the ones learned during the master course. Work ethical: capacity to identify, respect and manage ethical, cultural and diversity issues	
2	SUBJECT SPECIFIC	
	On the completion of the two years the students will acquire specific competences as established and agreed in collaboration with the field stakeholders, clustered within the key overarching competences summarized below, according to the tracks. Track " *Environment Management and Protection":* Knowledge and understanding ability: Students should - have mastery of the scientific method; - have knowledge on the most important methods for the investigation of environmental quality and pollution; - have knowledge and understanding of the scientific basis of environmental problems, of the interaction between different environmental compartments and the complex relations among them, of the functioning of eco-systems and the critical importance of the relationship between mankind and the environment; - have advanced knowledge and broadly interdisciplinary management of terrestrial, marine and inland waters; - are able to take broadly interdisciplinary decisions. Ability to apply knowledge and to understand: Students should acquire the ability	

	- to apply scientific method and the skills acquired to collecting information on the environment and to the solving of environmental problems; - to understand and manage the relations between the different parts of the environment: abiotics and biotics; will know the biogeochemical cycles of substances and will be able to evaluate material and energy flows; - to perform chemical, physical, ecological, biological and geological instrumental analysis and process the environmental data obtained. Judgment skills: Students should demonstrate - to have judgment skills related to environmental problems; - to be able to evaluate the quality of environmental data; - to be able to use the basic instruments for economic analysis; - to be familiar with the fundamentals of evaluation of anthropic impact on the environment. Learning skills: Students should - have ability to use scientific method as a working tool; - have know how to search information; - achieve a method study, be able to pursue specific goals, and be able to work both alone and in a group. Communication skills: Students should be able - to communicate in at least one European language apart from Italian; - to communicate, without ambiguity, scientific data and information to both specialist and non-specialist; - use the right tools to debate a scientific presentation; - to have familiarity with the main computing tools and with the Internet; - to process and present experimental data with the multi-media tools. - to use a range of interpersonal skills to lead and influence others, including the management of conflict situations. Problem solving: Students should - demonstrate ability to formulate, analyze and synthesize solutions to scientific problems at an abstract level by dividing them into testable sub-problems, differentiating between major and minor aspects. Modeling: Students should -have acquired ability to set up appropriate models of natural phenomena, deriving consequences and deepening understanding of the natural world. Computing skills: Students should -have acquired ability to design and implement computer programs and to use current application programs. Track *"Environment Biology"* Students should acquire *Knowledge of:* -multiple categories of evidence for biodiversity monitoring and analyses and how this evidence is used to infer environmental relationships between biodiversity patterns and environmental variables. -the experimental design for in-field biodiversity monitoring. -the fundamental issues related to environmental physico-chemical pollution and the way to measure and predict them. -the main drivers of the global change in climate at the local, national and European scales. -statistical analyses for assessing trends in biodiversity status (good, under threat, bad – i.e. biodiversity loss, biodiversity homogenization). *Comprehension/understanding*: -ability to classify (taxonomic identification) biodiversity components. -ability to explain the results obtained by analyzing environmental and biological data under a critical view, by also offering/presenting alternative points of view or alternative procedures. -ability "to read" the environment in a wider sense: from the small microhabitat scale to the large landscape scale under both environmental and biological points of view. -ability le to understand written reports or scientific papers in a critical view. -ability to write self-explanatory and correct reports on monitoring, analysis, and sampling of environmental parameters and species. *Application*: -ability to apply general statements to specific study cases. -ability to infer conclusion on the basis of the available data, either environmental either biological. -ability to enter environmental policies, apply them in environmental impact assessment, and incidence evaluations. *Analysis*: -Capacity of selection among different monitoring approaches of both environmental and biological variables. -ability to design alternative hypothesis working on the basis of a self-critical approach. -Capacity to plan an experimental project, by selecting the most adequate solutions. *Synthesis*: -ability to arrange the results in a clear and conceptually organized way. -ability to plan scientific activity by developing or setting adequate operational protocols and to produce reports or scientific outputs following a synthetic conceptual scheme.

	-ability in analyzing biodiversity data sets (animals, plants and microrganism) *Creativity:* -capacity to adapt an experimental result on a robust set of case studies in order to generate a general trend in biodioversity patterns and processes. -capacity to consider alternative hypothesis under new light for generating new explantory concepts on biodiversity patterns and/or on relationships among biodiversity distributioin and environmental attributes. *Evaluation* - skills in assessing rigorous scientific methodology. -capacity to identified flaws in published papers and report trhough scientific method - skills for a self critical analysis of proposed methods of monitoring, stastistical procedures, etc. -capacity to identify and adopt alternative options when the selected one results to be uncorfortable or unsuccessful *Problem Managing* -Capacity to solve a problem during a procedure (sampling, species identification, statistical procedure adequacy) -capacity to manage critical situations involving environmental justice issues, supporting stakeholders in reconciling divergent interests when addressing complex and interrelated environmental, public health, economic, and social problems in local communities *Communication* -ability to defend ideas, project contents, scientific results obtained in both written and oral communication. -ability to question or debate in the scientific arena or with end-users or stakeholders the oucomes of a concertation procedure or the research outputs. -ability to justify the position assumed under a given environmental situation.

F	COMPLETE LIST OF PROGRAMME LEARNING OUTCOMES
	A newly graduated Master in *Environmental Biology and Management of Ecosystems* will demonstrate: -in-depth knowledge of key concepts of physics, chemistry, earth science, and environmental sciences; - deep knowledge and understanding of key concepts of biodiversity status and trends, and related environmental issues and understand the cause-effect relation; -ability to analyze phenomena (both natural and technological) in terms of fundamental principles and knowledge. -ability to make order-of-magnitude estimates and find approximate solutions with explicit statements of assumptions and the use of special and limiting cases; -ability in the use of advanced research equipment and proper techniques utilized within the environmental biology research areas; -ability to apply the general concepts of biodiversity drivers and environmental describers and their relationships and to interpret the results; -capacity to use and summarize concepts of environmental physics and environmental chemistry related to their field of study and to apply scientific reasoning as a primary form of problem solving; - ability to perform experiments independently, as well as to describe, analyze and critically evaluate experimental data; -ability to conceive a working hypothesis, distinguish between independent and dependent variables, and analyze basic biological concepts within problems; -ability to collect data following proper laboratory protocols and analyze results; -ability to design lab experiments and field activities using appropriate methodology, analyze data to test working hypotheses and infer possible outcomes of a single case study to a general theory; -ability to develop and justify predictive models for analysing biodiversity and environmental patterns; - ability to design, appraise and/or defend solutions to complex environmental problems identifying protocols in order to achieve research goals; - ability to debate proposed solutions to problems for each concept; -capacity to create and deliver effective oral presentations showing basic understanding of commonly used scientific terms; -be able to use scientific rigorous methodology in performing the activities required and to express scientific concepts in another language.

Comprehensive Scheme of the 2nd Cycle Degree in ENVIRONMENTAL BIOLOGY AND MANAGEMENT OF ECOSYSTEMS

Track ENVIRONMENTAL BIOLOGY

YEAR	CODE	COURSE	Credits (ECTS)	Semester
I	F0259	Environmental Chemistry	6	1
	DM225	Environmental Physics and Global Change and Modeling	12	1
	F0324	Geographic Information Systems	6	1
	DM0228	Ecology and Biomonitoring of Inland Waters	9	2
	DM0224	Environmental Law and Economics	6	2
	F0258	Aerobiology	6	2
	DM0149	Experimental analysis of biodiversity	10	2
	F0181	English training course	3	1-2
II	DM0146	Conservation Biogeography	6	1
	F1073	Data Analysis in Experimental Biology	6	1
	DM0226	Evolutionary Genetics	6	1
	F1072	Microorganisms and Ecosystem Functioning	6	1
	F1150	Free choice courses/activities	8	1-2
	F0103	*Experimental Thesis*	30	1-2

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Track ENVIRONMENT MANAGEMENT AND PROTECTION

I	F0259	Environmental Chemistry	6	1
	F1058	Environmental Physics	6	1
	DM0146	Conservation Biogeography	6	1
	DM0223	Geographic Information Systems and Techniques for Environmental Assessment	12	1
	DM0156	Environmental Botany	9	2
	DM0228	Ecology and Biomonitoring of Inland Waters	9	2
	DM0224	Environmental Law and Economics	6	2
	F0181	English training course	3	1-2
II	DM0227	Soil Bioengineering and Eco-Hydraulics	9	1
	DM0226	Evolutionary Genetics	6	1
	F1046	Hydrogeology and Environmental Risk	6	1
	DM0153	Mycology and Microbial Ecology	10	2
	F1150	*Free choice courses/activities*	9	1-2
	F0103	*Experimental thesis*	23	1-2