C3A Manifesto of Studies 2019-2020

Please note:
Each student must earn a minimum of 15 course credits.
Attendance of 75% is expected for ALL courses.
It may also be possible to follow additional courses offered by DICAM and CIBIO

Course title	Lecturer(s)	N hrs	ECTS	Synopsis and Skills Learned	Evaluation procedure	Notes and Pre-requisites	Month/year
Laboratory health and safety (LHS)	C3A and FEM health and safety officers and consultants (org. by UNITN)	12		**Summary:** Lectures and practicals in general laboratory safety procedures, equipment use, and basic first aid. **Description:** Legally required basic (4 hours) and specific (8 hours) training in health and safety and risks connected to work activities. **Skills acquired:** knowledge of basic chemical manipulation, laboratory skills, biological hazards, fire and radiation safety and basic first aid.	Multiple choice quiz	Obligatory for all PhD students (unless certificate of previous courses available)	01/2020
BASIC AND ADVANCED COURSES							
Experimental Economics	Matteo Ploner	25	3	The course provides students with knowledge and understanding of principles of experimental economics https://www.unitn.it/drss/em/221/curriculum	Final examination to be defined	1st year	01-03/2020
Invasive Species and forest health (SFH1)	**Nicola La Porta**	16	2	**Summary:** the aim of the course is to provide basic knowledge on the role of the introduction and spread of invasive alien species on forest health and sustainablity of natural environmental management. Specific case studies concerning representative Alpine forest ecosytems will provide examples of the possible methodological approaches. The course will consist of lectures and group works on real cases. **Module 1 (8 hours):** main alien invasive pathogens in forest ecosystems. Their introduction and spread by global trade and human movements. Effects of climate changes and further opportunities for aliens on their establishment and impact. **Module 2 (8 hours):** main alien invasive forest trees and their effect in	Final written test	1st year	3-6/02/2020

				terms of biodiversity and landscape losses. Associated risks and possible challenges.			
Integrated river morphodynamics (IRM1)	**Guido Zolezzi,** Walter Bertoldi, Marco Tubino	32	4	**Summary:** The general aim of the course is to show how the integration of different approaches can lead to a comprehensive insight into river morphodynamics. The course strategy is to focus on one specific morphodynamic pattern, i.e. alternate bars in channelized streams, a subset of river bars that can be taken as an example of other patterns evolving at different time and spatial scales. Basic knowledge of fluid mechanics and sediment transport are recommended **Module 1 (20 hours):** Analytical theories of river bars. This module provides an overview of assumptions and outcomes of analytical morphodynamic theories and a step-by-step development of a linear stability analysis for free bars in straight channels. **Skills acquired:** learn the "machinery" that lays behind the linear stability analysis of free bars, and, more in general, behind linear stability analyses in morphodynamic problems and develop and use simple computational tools to predict the main properties of free bars in straight channels. **Module 2 (8 hours):** Bars in rivers: processes, forms and implications for river behaviour. This module describes river bars in different fluvial systems, their relationship with river planform style, the effect of flow unsteadiness, the role of vegetation, and the relationship with hyporheic flow. **Skills acquired:** develop an understanding of how to integrate multiple approaches to investigate morphodynamics of river bars **Module 3 (4 hours):** Numerical simulation of river bars. This module illustrates the potential of 2D numerical models resolving the shallow water equations to investigate alternate bars dynamics and quantify their properties. **Skills acquired:** ability to use a 2D numerical model to reproduce alternate bars dynamics.	Presentation	1st year	10-14 February 2020
Exploring Biodiversity using DNA-barcoding and	**Omar Rota-Stabelli**	12	1.5	**Summary**: A combination of lectures and practicals using phylogenetic methods to explore the diversity within ecosystems and understand how species (or varieties/strains) of bacteria, viruses, insects, plants	Presentation	1st year	17;18;20 February 2020

molecular clocks (EBB1)				and fungi have evolved through time. The course is organised in 3 lessons: 1. Introduction to molecular phylogenetics with a particular emphasis on species phylogenies and DNA barcoding (4 hours); 2. A focus on estimating divergence times of organisms using molecular clocks and on how to use this technique for paleobiological and paleoecological reconstructions (4 hours); 3. A journal club where students present and discuss a paper chosen form the literature on either barcoding or molecular clocks (4 hours). **Skills acquired**: practical tools for studying the evolution and diversification of species (molecular phylogenetics, DNA barcoding, estimates of divergence times using molecular clocks); skills in presenting and discussing scientific articles on biodiversity.			
Introduction to Nonparametric Analysis (INA1)	Valerio Mazzoni	16	2	**Summary:** Introduction to the basic concepts of descriptive statistics and probability theory **Description:** the following techniques will be studied: contingency tables and goodness-of-fit tests; hypothesis testing about the probability of an event, on a single sample, on two paired samples and on two independent samples; the case of more than two (dependent/independent) samples; tests for the trend detection and correlation; measures of association and related hypothesis testing methods; non parametric inference (Jackknife and Bootstrap). **Skills acquired:** use of nonparametric techniques to solve hypotheses testing problems where the conditions for parametric tests are not fulfilled	Written exam	1st year: no prerequisites required	18;20;25;27 February 2020
The transmitters: the fascinating life of insect vectors of plant pathogens	Daniele Cornara	20	2.5	**Arguments and general structure:** 1) Lecture: “Basic knowledge on vector transmission of plant pathogens” 2) Lecture/Case study: “Vectors of Xylella fastidiosa” 3) Lecture/Case study: “Aphids, thrips, whiteflies and mealybugs transmission of viruses” 4) Lecture/Case study: “Psyllids transmission of Ca. Liberibacter spp.”	Final oral exam; attendance to at least 75% of the course is mandatory for admittance to the final exam	1st year	24-28 February 2020

				5) Practice: "How to set-up a transmission study" 6) Practice: "Electrical Penetration Graph: introduction and how to use it in transmission studies" **Objectives/main goals** Overall, the students will acquire basic knowledge about the role of the insects in the epidemiology of plant pathogens, together with the fundamental skills needed to approach the research on the complex interaction insect-pathogen-host plant. Furthermore, they will be introduced to the concept of multidisciplinary and how integration of knowledge from different fields/topics is essential for the study of vector-borne diseases. Finally, lectures will be integrated with practical lessons focusing on: i) how to plan and conduct a transmission experiment from field surveys to pathogen detection in lab; ii) the Electrical Penetration Graph (EPG), and how real-time monitoring of the probing/feeding behavior of a vector can furnish fundamental breakthroughs for the understanding of a vector-borne plant pathogen epidemiology			
Food chemistry and physics (FCP1)	**Eugenio Aprea,** Flavia Gasperi, Isabella Endrizzi	24	3	**Summary**: the aim of the course is to provide the notions of general chemistry, organic chemistry and the physical states of the main food systems. In particular, it focuses on the world of molecules and their reactions to understand what food is and what happens during cooking and food preparation. **Module 1** (10 hours): Fundamentals: The basic concepts of the matter and its forms will be revised as well as the importance of the atomic and molecular forces, focusing on food systems. An overview of the main properties of aqueous solution will be given, recalling the concept of colligative properties and the definitions of pH and water activity. Description of the basic molecules of food (carbohydrates, lipids, proteins and water) and their nutritional, chemical and technological properties will be provided. **Skills acquired:** Knowledge of food constituents and their physical and chemical properties. **Module 2** (6 hours): Heat transfer and effects on foods: Methods of heat transfer will be discussed also in relation to the different cooking methods. The modification of the main constituents of food during	Written exam and Presentation	1st year	02-03/2020

				preparation and cooking will be revised with a focus on the Maillard Reaction and its implication for the final quality of food systems. **Skills acquired:** The student will be able to predict the effect of cooking on final product as a function of its composition and modality of energy transfer. **Module 3** (8 hours): How to measure the impact of cooking processes on food quality. The module is based on practical activities. The effects of preparation and cooking on real foods will be evaluated through instrumental measurements and/or sensory evaluations of the characteristics of the products (eg. texture, color, taste, ...). The data will be processed by the students who will also prepare a report to describe and explain the observed phenomena. **Skills acquired:** Knowledge and "hands-on" on the principal methods and instruments to measure physical, chemical and sensory modifications of food.			
Sustainable production and consumption from a social perspective (SPC1)	Emanuela Bozzini, Francesca Forno, Giolo Fele	24	3	**Summary:** The objective of this course is to critically discuss the transformations in patterns and practices of production and consumption, giving particular attention to sustainability ideas and practices. The class will be articulated in three main modules (8 hours each). **Module 1 (8 hours):** Overview of long-term trends in agricultural production and its sustainability **Skills acquired:** Knowledge on historical trends in agricultural production, resource use, chemical input across world regions; knowledge on issues of sustainability of current agricultural systems in relation to demography, urbanization and resource depletion. **Module 2 (8 hours):** Consumer Culture and Society. This module offers the opportunity to engage with sociological theories of consumption and contemporary consumer society. **Skills acquired:** Familiarity with sociological concepts to investigate changes in consumption practices and lifestyles, with a special attention on food consumption trends. The focus will be on the practice of consumption with regard to lifestyle, consumer subjectivity, meaning making, sustainability and 'food diversity'.	Final written report or presentation	1st year	2-3/2020

				Module 3 (8 hours): The social determinants of taste. The module will explore scientific, professional and profane knowledge in tasting, and the history and criticism of the sheets, scores, and evaluations of the sensorial characteristics of the food products. **Skills acquired:** familiarity with sociological concepts in relation to taste; field work activities			
Molecular Plant Breeding (MPB1)	**Silvia Vezzulli,** Laura Costantini, Fabrizio Costa, Francesco Emanuelli, Claudio Varotto	40	5	**Summary:** This course will present the most advanced frontiers in Plant Breeding, the science of creation, the fixation and selection of superior plant phenotypes. This course is organized in four modules for a total of 40 hours distributed in 20 lectures. The students will acquire knowledge about the principles undertaking the control of important agricultural traits and will be introduced to the several strategies to date available for a DNA-guided precise selection in different species, distinguished also by a different ploidy level. **Module 1:** Molecular markers and Marker-Assisted Selection (12 hours): it will introduce the basic concept of plant breeding and the genetic control of simple mendelian traits. **Skills acquired:** knowledge of the types of molecular markers and their employment in Marker-Assisted Selection (MAS). **Module 2:** Mapping of quantitative trait loci in experimental populations (8 hours): it will introduce the analysis of quantitative traits. **Skills acquired:** use of molecular markers in constructing genetic linkage maps and in detecting quantitative trait loci (QTL) in progenies. **Module 3:** Molecular dissection of complex traits in germplasm collection (12 hours): in the end, alternative methods of QTL mapping employing complex and more structured genetic background will be presented. **Skills acquired:** Linkage Disequilibrium (LD) analysis and the detection of QTL through Association Study (AS) approaches, introducing to the principle of Genomic Selection (GS). **Module 4:** PolyploidyPolyploidy in plant breeding:	Presentation	1st year	2 March – 4 May 2020

				This module (8 hrs) aims to introduce the use of polyploidy in plant breeding by highlighting advantages and disadvantages. **Skills acquired:** an updated overview on plant polyploidy-specific genetic and genomic issues that needs to be considered in the molecular dissection of complex traits through QTL mapping.			
Environmental data management and analysis with GIS (EDM1)	**Marco Ciolli**, Alfonso Vitti, Paolo Zatelli	40	5	**Summary:** 13 lectures and 7 practicals in Numerical cartography and GIS **Module 1 (26 hours):** Numerical cartography and GIS. Introduction to GIS theory, tools and data, Cartographic projections, reference systems and their transformations, GRASS GIS: features, structure and usage, data I/O, Thematic maps, Geoprocessing, network analysis, WebGIS, Geostatistics, Digital data sources, Spatial databases. **Skills acquired:** selection of suitable Geographic Information Systems, digital spatial data acquisition and processing. Selection and management of the correct datum and execution of map reprojections. Understanding of the information content of different digital map formats and knowledge of digital spatial information data sources. Knowledge of the Free and Open Source Software GRASS and QGIS. Creation of thematic maps and application of geoprocessing, network analysis and geostatistics. Introductory knowledge of spatial data base management and image analysis. **Module 2 (14 hours):** hand-on experience in the use of GRASS and QGIS for environmental applications. **Skills acquired:** datum selection and map data input and output, maps reclassification, rasterization and interpolation. Creation of reports. Accomplishment of simple map processing for typical GIS tasks. Creation of a complete environmental model in a GIS.	Written exam	1st year	9-13 March 2020
Aquatic ecosystems in natural and human impacted environments (AES1)	**Monica Tolotti,** Maria Cristina Bruno, Walter Bertoldi, Guido Zolezzi	24	3	**Summary:** The course provides an insight on the physical, chemical, ecological and biological properties and dynamics of freshwater ecosystem, considering natural conditions (Module 1) and the effects of human stressors (Module 2). Specific case studies of different freshwater ecosystems will provide examples of the possible methodological approaches. **Module 1 (12 hours):** Aquatic ecosystem in natural conditions. This	Presentation	1st year	23-26 March 2020

				module addresses the main variables and processes driving the habitat dynamics in natural freshwater ecosystems. **Skills acquired:** ability to describe and interpret aquatic habitats in running waters and lakes, across time and space, including physical, chemical, morphological variables, such as flow, temperature, nutrients, and foodweb descriptors and the effects of vegetation on the above. **Module 2 (12 hours):** Aquatic ecosystem under direct and indirect human stressors. This module provides insight on direct (e.g., pollution, water withdrawals, engineering) and indirect (land use and climate change) **Skills acquired:** methods to recognize and quantify stressors such as source and point pollution, hydro-morphological alterations, thermal alterations, extinction and creation of habitats; methods for mitigation /restoration strategies (e-flows, morphological restoration, sediment augmentation)			
Exploring gene evolution using phylogenetics and phylogenomics (EPP1)	**Omar Rota-Stabelli**			**Summary**: Evolution can deepen our understanding of biological processes by revealing how things come to be the way we currently observe them. Useful evolutionary tool are those based on phylogenetic trees: they aim at understanding how genes evolved in different species and can provide important clues for understanding the molecular bases of organism biology. **Description**: This introductory course will provide the theoretical and practical bases of some tree-based methods using human and Drosophila as main model organisms. The course is divided in three lessons: 1. Introduction to molecular phylogenetics from sequence alignment to Bayesian inference with a particular emphasis on gene phylogenies (4 hours); 2. A focus on phylogenomics, the study of how genes evolve in different genomes, with particular emphasis in detecting gene family expansion/contraction and selection in the species of interest (4 hours);	Presentation	1st year	03/2020

				3. A journal club where students present and discuss with the others a paper chosen form the literature (4 hours). **Skills acquired**: practical tools for studying gene evolution using phylogenetics and phylogenomics; skills in presenting and discussing scientific articles on evolutionary biology. **See also: https://www.unitn.it/drbs/38/teaching-program** **CIBIO Manifesto of Studies 2017-2018 (which will be repeated in 2019-2020)** **This course is offered by CIBIO UNITN.**			
Innovative methods in crop protection (ICD1)	**Gianfranco Anfora,** Ilaria Pertot, Michele Perazzolli, Gerardo Puopolo, Valerio Mazzoni, Emanuela Bozzini	16	2	**Summary:** The course will give an overview about regulation aspects and innovative procedures for the control of plant pathogens and insects on major crops. **Module 1 (4 hours):** Regulatory provisions on pesticides and biopesticides. This module will provide details on novel regulatory provisions on plant protection products and sustainable use of pesticides with a focus on the European Union. Skills acquired: knowledge of policy principles and provisions informing EU regulation on plant protection products. **Module 2 (6 hours)**: Innovative approaches for pathogen control. This module will provide details on innovative approaches to control plant pathogens. Skills acquired: knowledge of new generation tools for biological control of pathogens. **Module 3 (6 hours)**: Innovative approaches for insect control. The aim of this module is to provide expertise on the principles of plant protection strategies and alternative methods to the use of synthetic chemicals, including biological control and integrated pest management. **Skills acquired:** knowledge of the pioneering low impact techniques for the integrated management of insect pests (i.e. semiochemicals,	Final written test	1st year	6-7 April 2020

				natural enemies, sterile insect technique); to learn the main types of existing bioagrochemicals, their mode of action, their application strategies, the advantages and disadvantages deriving from their application.			
Direct and ambient mass spectrometry for food, health and environment: principles and applications (DMS1)	**Franco Biasioli,** Iuliia Khomenko, Eugenio Aprea, Brian Farneti	32	4	**Summary:** Direct and ambient mass spectrometry: principles and applications in food, health and environment. (8 hours lectures, 24 hours practicals). **Module 1 (8 hours):** Direct methods in mass spectrometry and their implementation. Basic introduction to mass spectrometry. Rationale behind direct methods in mass spectrometry also in relation with alternative approaches (e.g. gas chromatography, solid state sensors, spectroscopy) and with a focus on volatile compounds and process analytical technologies. Principles and implementation of direct and ambient mass spectrometry. Data analysis strategies for fingerprinting mass spectrometry. Examples of applications of direct mass spectrometric methods in food, health and environment with a focus on the class interests. **Skills acquired:** Basic knowledge of mass spectrometry. Critical understanding of pros and cons of direct mass spectrometric methods. Improving students' vision and scientific activity with a sound understanding of the possibilities of rapid, non-invasive and advanced analytical methods. **Module 2 (24 hours):** Application of direct injection mass spectrometry to a case study agreed with the class. After a short hands-on course on a Proton Transfer Reaction Mass Spectrometry (PTR-MS) set up, the class will propose and detail an experiment based on PTR-MS fingerprinting of samples of relevance for c3a and of interest for the involved students (scientific/technical question, literature search, experimental plan) and perform the necessary laboratory work (sample preparation, measurement, data analysis). Finally, the class will be required to report on the results in the form of a conference talk and/or a paper manuscript. **Skills acquired:** Application of advanced instrumentation for volatile organic compounds monitoring in food, health and environment: sampling, measuring and data analysis. Planning and execution of a	Final written report or presentation	1st year	21;23;30 April 5;7 May 2020

				detailed experimental work. Reporting on experimental work. Basics mass spectrometry and multivariate statistics.			
Plant Physiology and Genetics of Fruit Ripening (PFR1)	Fabrizio Costa, Nicola Busatto, Brian Farneti, Michele Perazzolli	24	3	**Summary:** The course will provide the basics of plant physiology, focusing on phenology and fruit ripening. A special attention will be also given to the genetic mechanisms undertaking important physiological pathways and innovative plant physiology for precision agriculture. **Module 1 (4 hours)** Smart plant physiology. This module will provide specific knowledge of plant physiology with particular attention to new tools for precision agriculture. **Skills acquired:** knowledge of plant physiology and precision agriculture aspects. **Module 2 (7 hours)** Fruit ripening physiology. This module will provide a general description of the type of fruits and their mode of ripening. The interplay between different hormones in regulating the fruit ripening will be discussed, introducing, moreover, the genetic analysis addressed to the detection of the main loci controlling fruit ripening related pathways. **Skills acquired:** knowledge of ripening physiology and the interplay among several hormones **Module 3 (7 hours):** Genetic regulation of fruit ripening. This module will present the road map of the functional analysis carried out to date to disclose the main regulating mechanisms of fruit ripening. The state of the art of the molecular and biotech techniques used to date to investigate the fruit ripening processes will be also discussed, from recombinant DNA to OMIC approaches. **Skills acquired:** investigation of the molecular mechanisms regulating fruit ripening using the most advanced biotechnology approaches **Module 4 (6 hours):** Fruit quality and postharvest physiology. This module will be dedicated to underlying the relationship between fruit ripening and fruit quality, and how fruit quality can be investigated. To this end, classic and novel methodologies will be illustrated. The last part of the course will be devoted to postharvest, discussing how fruit	Presentation	1st year	6/05-12/06 (Wednesday and Friday) May 2020

				change during storage and which are the most modern postharvest technologies oriented to preserve fruit quality. **Skills acquired:** understanding of the regulatory processes underlying fruit quality and their impact in the postharvest physiology			
Evaluation of agri-food products and policies (EPP1)	**Simone Cerroni**	24	3	**Summary/Description** The course provides students with an in-depth description of state-of the-art methods and tools that are used to evaluate the demand for innovative food products (e.g., lab meat, antibiotic-free products) and welfare benefits generated by environmental and agri-food policies of recent relevance (e.g., climate change, sustainable consumption). Among the methodologies covered in the course: stated preferences (i.e., discrete choice experiments), experimental methods (i.e., experimental auctions) and randomized control trials. The course also provides principles of statistics and econometrics to be used in data analysis. Classes will consist of 7 standard frontal lectures, 1 tutorial on statistics and econometrics, 1 tutorial on research ethics in policy evaluation, and 3 interactive practical lectures. **Skills acquired** The course will improve knowledge and understanding of new trends and policies in the agri-food sector. Students will familiarize with methods and tools for demand and policy evaluation that can be useful in the job market. Strengths and limitations of these methods will be covered to stimulate critical thinking and the elaboration of new research ideas. The course also aims to improve students' knowledge and understanding of principles of statistics and econometrics applied to evaluation problems.	- Oral presentation of an academic paper (20%) - Oral presentation and short report on the development of an experimental protocol (40%) - Oral presentation and short report on conducted data analysis (40%)	1st year	12;14; 19;21; 26;28 May 2020
Animal Conservation in Theory and Practice (ACP1)	**Francesca Cagnacci,** Federico Ossi, Heidi C. Hauffe	24	3	**Summary** Conservation biology strives to describe, understand, and forecast biodiversity dynamics by applying ecological and evolutionary theory within the contexts of resource management, economics, sociology and political science. This course will explore the motivation for preserving biodiversity at all levels (genetic, species, ecosystem), available decision-making tools, and the consequences of various	Group project (written with scientific presentation (oral assignment) - Data analysis	1st year	12-15 May 2020

				interventions, covering mainly terrestrial and freshwater ecosystems and including wild animal and plant species. **Module 1 (8 hours)** Principles of conservation biology. We have entered the Anthropocene, the Era of humans, where human impact is widespread in all biomes. The module will cover the essentials of conservation biology science, its area of application, and the analysis of major threats of humans on ecosystems. **Skills acquired:** theory of conservation biology and fields of application. **Module 2 (8 hours)** Conservation of terrestrial mammals in the Alps. The module will use the principle acquired in Module 1 to analyse conservation cases of terrestrial mammals in the Alpine range. **Skills acquired:** application of conservation biology theory to terrestrial mammals **Module 3 (8 hours)** Conservation genetics. The interactive module will focus on the application of genetics, genomics and metagenomics to conservation science, including wildlife forensics, and the importance of preserving genetic variation. **Skills acquired:** principles of conservation genetics/genomics with practical examples of current research, and active discussion of case studies.	and/or Outreach (practical assignments)		
Soil quality assessment in a climate change perspective (SQA1)	**Mirco Rodeghiero**, Michele Perazzolli, Ilaria Pertot	16	2	**Summary:** The course will give an overview about soil quality and its determination in order to optimize sustainable crop production. **Module 1 (4 hours)**: Applied metagenomic for the assessment of soil microbiological quality. The module will illustrate novel approaches for the assessment of fungal, bacterial and oomycete taxa hosted in soils based on amplicon sequencing studies and methods for the functional recognition of potential microbiological properties and their contribution to the soil microbiological quality. **Skills acquired:** knowledge on soil microbiological quality and practical applications. **Module 2 (4 hours)**: The module will describe soil chemical fertility in relation to the needs and optimal growing conditions of different crops and orchards. Chemical indicators (organic C, soil N,	- Research paper (major written assignment and short written assignment) - Scientific dissemination (major oral assignment) - Data analysis and/or Outreach (practical assignments)	1st year	13 and 20 May 2020

				macro/micronutrients, pH, cation exchange capacity, base saturation percentage, calcium carbonate content, electric conductivity, toxic elements) and their diagnostic significance will be described. The main and more useful soil quality indexes will be illustrated with some practical examples on their application, with particular reference to meso- and macro-faunal communities. A special focus will be deserved to QBS-ar and QBS-e Indexes with reference to arthropod and earthworms communities respectively. **Skills acquired:** knowledge on indexes of soil biological quality. **Module 3 (8 hours)**: Soil fertility and the carbon cycle. The module will illustrate the soil carbon cycle in agricultural and forest systems and the soil carbon storage capacity. The links between the nitrogen cycle and the carbon cycle will be analyzed. The main methods to calculate the soil carbon balance, including soil respiration measuring systems, will be described. A discussion about soil carbon and global warming will complete the module. **Skills acquired:** knowledge on soil carbon balance and soil respiration assessment.			
Field sampling and Spatial Ecological Modelling (SEM1)	**Marco Ciolli,** Clara Tattoni	40	5	**Summary:** 18 hours lectures, Basis of Field sampling techniques and Spatial Ecological modelling using GIS and GPS; 10 hours field sampling work with measuring instruments and GPS; 12 hours practical Exercises with basis of GIS Ecological modelling with QGIS and R. **Module 1 (28 hours):** Theoretical and practical basis of field sampling techniques and data collection and spatial ecological modelling. Exploration of field data and how they can be used/misused, How to perform sampling in the forest and GPS data collection in the field, basis of spatial ecological modelling, overview of various modelling techniques with special reference to landscape ecology, land use change modelling and scenarios development, Vegetation Analysis and cartography, basis of remote sensing for vegetation. Forest landscape change detection, Markov Chain scenarios and Landscape Ecology indexes and parameters. **Skills acquired:** How to select sampling areas in the field and the reliability and limits of field data. Importance of data understanding	Written exam	1st year	06/2020

				and of sampling procedures. Data acquisition and critical interpretation of data sources. Improving GPS data sampling in the field. **Module 2 (12 hours):** Practical exercises with a Special focus on Land use change, Vegetation Analysis and cartography, basis of remote sensing for vegetation, Past Forest landscape change detection, Production of Markov Chain scenarios future/past and Landscape Ecology indexes and parameters and modelling of different pollution sources. Overview of various modelling techniques. Comparison of different techniques, pros and cons. Alien species modelling and study cases. Interpretation of Model results and validation. GIS and R Practice on sample data. **Skills acquired: It will give a thorough introduction to the** How to use and combine the data in a GIS to perform geospatial analysis and ecological modelling. How to use QGIS plugins and basic use of R as a GIS.			
Forest biodiversity and productivity: from genes to remote-sensing (FDP1)	Cristiano Vernesi, Mirco Rodeghiero, Damiano Gianelle, Loris Vescovo, Roberto Zampedri, Michele Dalponte, Luca Belelli Marchesini	24	3	**Summary:** Four modules of lectures and practicals will provide fundamental knowledge of genetic, ecosystem and global forest biodiversity and the impact on productivity. **Module 1 (8 hours):** Genetic biodiversity: the foundation of adaptation. This module will provide a general overview of the importance and estimating of the first component of biological diversity to adaptation to ongoing and future global change, using specific examples from forest ecosystems. **Skills acquired:** Knowledge of most updated techniques used in forest genomics along with basic theoretical introduction to population genetics. **Module 2 (8 hours):** New tools for investigating leaf and ecosystem processes. This module will give practical insights into photosynthesis and respiration measurements within forests at the leaf and ecosystem level using of modern instruments, as well as climate change effects on ecosystems productivity and biodiversity. **Skills acquired:** Laboratory and field measurements; introduction to the main approaches to data analysis.	Presentation and/or report	1st year	22-24/09/2020

				Module 3 (4 hours): Upscaling to regional and global scales. This module will describe the issues and possibilities of upscaling measurements to regional and global scales using remote sensing and modelling approaches. **Skills acquired:** practical methods for data upscaling. **Module 4 (4 hours):** Forest Carbon Inventories. The module will offer an overview of the data and information obtainable from a Forest Inventory with particular focus on carbon stocks in a climate change perspective. **Skills acquired:** real data from forest inventories will be elaborated for the calculation of carbon stocks and fluxes.			
Food quality and consumer choice: from theory and practice (FOC1)	**Flavia Gasperi,** Eugenio Aprea, Isabella Endrizzi	24	3	**Summary**: This course, organized in three modules, will provide fundamental knowledge in sensory analysis and consumer science to investigate the perceived quality of food and its relation to consumer responses. **Module 1 (8 hours):** Sensory analysis principles and good practices. Introduction on basic principles, potentials and problems of sensory techniques applied in food industry. General rules to conduct sensory tests. Overview on sensory methods: traditional discriminant and descriptive methodologies and new ones. **Module 2 (8 hours):** Sensory properties of food. Explore the association between food properties and sensory perception. Describe and measure which are the physical and chemical characteristics of food matrices that mainly influence our sensory perception. How to correlate instrumental determinations and sensory data: data treatment and predictive modelling. **Module 3 (8 hours):** Preference and acceptability of food. Learn consumer-testing methods and associated data analysis procedures. Understand the basic tools of quantitative consumer research. Learn how to segment consumer populations and the ways to relate consumer data to sensory evaluation data in order to optimize product sensory quality and marketing opportunities.	Final written report or presentation	1st year	2-17 November (Mondays and Tuesdays) 2020

				Skills acquired: The course will improve knowledge and understanding of potentialities, strengths and limitations of the most common sensory methods. Students will be able to critically choice the most effective methodologies in function of specific "sensory questions" and to manage and interpret sensory data.			
Protecting innovation	Matteo Ferrari, Arturo Pironti	24	3	The main goal of the course is to introduce students to the protection of innovation through Intellectual Property rights. The first part of the course will focus on patents, breeders' rights and trade secrets as different tools to protect innovation, looking to their pros and cons. A brief introduction to copyright and trademarks will be also provided. The second part will deal with the role that technology transfer contracts can play in protecting scientific discoveries and technological advancements, as well in fostering cooperation among different scientists and research centres. In the final part, students will engage in the analysis and drafting of documents (patent and breeders' rights applications, material transfer agreements, non-disclosure agreements, license agreements).	Drafting of a document analysed during the course	Law	4-6 November; 12-13/19-20 November 2020
Econometrics	Carlo Fezzi	38	4.5	The course provides students with knowledge and understanding of a diverse range of econometric approaches https://www.unitn.it/drss/em/221/curriculum	Final examination to be defined	1st year	Oct-Dec 2020
Behavioural Economics	Luigi Mittone	48	6	The course provides students with knowledge and understanding of principles of behavioural economics https://www.unitn.it/drss/em/221/curriculum	Final examination to be defined	1st year	Oct-Dec 2020
Data exploration (DEX1)	Pietro Franceschi	12	1.5	**Summary**: data exploration and visualization, introduction to some of the bioinformatical and biostatistical tools/concepts used to explore a multidimensional dataset (PCA, Clustering, Linear Modeling, ...). **Description:** The aim is to highlight the advantages and limitations of each approach. **Skills acquired:** During the course the different aspects will be illustrated by live R/Python sessions on publicly available datasets. The students will be also encouraged to bring their own data to discuss and (possibly) analyse them.	Individual/ Group reports and discussion on assigned topics	1st year	To be defined

				See also: https://www.unitn.it/drbs/38/teaching-program CIBIO Manifesto of Studies 2017-2018 (which will be repeated in 2019-2020) **This course is offered by CIBIO UNITN, but may be repeated on the FEM campus if demand is high.**			
Introduction to metagenomics (ITM1)	**Nicola Segata**	12	1.5	**Summary**: The course will present the state-of-the-art metagenomic approaches for studying the microbial communities (microbiomes) populating the human body and the environment, and will describe the main recent microbial ecology findings, with a focus on those related to human diseases. **Description and skills acquired**: Metagenomic tools based on microarray chips, 16S rRNA sequencing surveys, and shotgun high-throughput sequencing from both the experimental and technological viewpoints will be presented. An overview of the challenges and solutions for analyzing metagenomic data computationally will also be presented including methods for taxonomic characterization, functional profiling, genome assembly, and phylogenetic inference of microbiomes. Advanced sequencing based approaches for pathogen detection and characterization will also be discussed. Recent findings about the relation between human-associated microbial communities and complex diseases will be illustrated as well as the mechanisms of vertical microbiome transmission (e.g. from mother to neonate) and gut microbial colonization. **See also: https://www.unitn.it/drbs/38/teaching-program CIBIO Manifesto of Studies 2017-2018 (which will be repeated in 2019-2020)** **This course is offered by CIBIO UNITN.**	Presentation and critical discussion of a paper (during the last 2-hour lecture)	1st year	To be defined
Production and characterization of fermented foods (PFC1)	**Roberto Larcher,** Tiziana Nardin, Raffaele Guzzon, Tomas	16	2	**Summary:** The course aims to provide, through a series of monographic seminars, notions about current issues or innovative trends in the transformation of raw food, with particular reference to traditional fermented foods. Ample space will also be given to analytical techniques for the characterization of food.	Written exam	2nd year	To be defined

	Roman, Moser Sergio, Loris Tondiandel, Mario Malacarne						
Spatio-temporal data analysis in Movement and Population Ecology (MPE1)	**Francesca Cagnacci,** Luca Delucchi, and additional colleagues, including external experts	40	5	**Summary:** The advancement of a movement and population ecology theoretical framework has been paralleled by the increasing spatial and temporal resolution and size of datasets available from tagging or genomics techniques. Movement and population data come with complex associated information related to the environmental context, such as population density, weather, habitat types and vegetation indexes based on remote sensing. This course has two main objectives: to learn how to store, handle and process in a robust and efficient way the spatio-temporal information linked with movement and population data; and to learn how to integrate and analyse movement and population data with their environmental context. These objectives will be pursued through a hands-on, step by step approach. Some introductory general lectures and exercises will be followed by two typical examples of ecological problem-solving, based on PostgreSQL/PostGIS, R and QGIS software environments. Teaching approach: An intense one-week course with a mix of technical lectures and hands-on exercises to handle and manipulate spatial data typically used in Movement and Population Ecology.	Project and final practical test	2nd year **Summer School**	A.Y. 2020/21
Statistical methods and data analysis (SMD2)	Stefano Siboni	32	4	**Summary:** illustration of the basic mathematical tools for the analysis and modeling of experimental data and to introduce and analyse the statistical models implemented by computational procedures, underlining their limitations and the interpretation of the results **Description:** topics encompass short recalls about errors in experimental measurements, random variables, functions of random variables. Then sample theory is introduced, for small and large samples. The main content of the course concerns hypothesis testing, related to kind or parameters of statistical populations, comparison of statistical populations, Pearson's linear correlation coefficient, 1 and 2 way ANOVA, linear regression model	Written exam	2nd year: Prerequisite: SMD1 recommended??	11-12/2020

				Skills acquired: general understanding of how statistical tests work, that she/he can appropriately use the basic statistical tests and also easily understand and apply further, more specific tests not presented in the course The aim of the course is to illustrate the basic mathematical tools for the analysis and modelling of experimental data, particularly concerning the main statistical methods. The idea is not simply to describe and discuss the "cooking recipes" for the statistical treatment of data, but also to introduce and analyse in a critical way the statistical models implemented by the computation procedures, stressing their limitations and the actual interpretation of the results.			
Food authenticity and origin (FAO1)	**Federica Camin,** Luana Bontempo, Roberto Larcher, Matteo Perini	16	2	**Summary:** The course will be focused on the topics of food authenticity and origin traceability. Issues such as legislative requirements, commercial impact and consumer protection, as well as the applicable analytical tools will be addressed. The course will consist of lectures and group works on real cases. **Module 1 (4 hours):** concepts and meaning of food authenticity, origin traceability, legislative requirements, tools to tackle these problems and to protect consumers and dishonest producers **Module 2 (4 hours):** stable isotope ratios techniques **Module 3 (4 hours):** mineral profile techniques **Module 4 (4 hours):** other analytical approaches	Written exam and Presentation	2nd year	11/2020-01/2021
Ecological and epidemiological modelling (EEM2)	**Roberto Rosà**, Andrea Pugliese,	16	2	**Summary:** 8 hours of lectures on the basis of eco-epidemiological models with application both in agriculture and public health. 8 hours of practical exercises with software R using experimental data from agriculture and public health case studies. **Description:** this course will provide an insight on the development and analysis of ecological and epidemiological models with applications in agriculture and public health.	Presentation or report	2nd year Students are expected to know the basic concepts of mathematics and statistics. Prior knowledge of open source software R use is also required	01-02/2021

				Skills acquired: conceptual ideas and mathematical tools needed for implementing ecological and epidemiological models, especially population dynamic models as well as epidemiological models.			
Domestication and diversification of crop species (DDC2)	**Stella Grando,** Claudio Moser	24	3	**Summary:** Most recent efforts to promote sustainable agricultural systems adapted to demanding environments aim to include more species with desirable traits in the list of domesticated plants. This course will cover the study of the genetic architecture of crop domestication and the nature of selection in domesticated species. Based on this knowledge, the course will address the approaches to mimic domestication events that have occurred throughout history and strategies to accelerating domestication of new crops. The course will also provide students the opportunity to develop and improve their practical skills on population genomics data analysis, aiming to identify causative changes to the plant genomes that are associated with domestication events and may be targets for the domestication of new plants. The course will be focused on plants but may also offer a seminar on animal domestication. **Module 1. Genetics of the evolution of domesticated plant species (8 h).** This module will cover the evolutionary stages of plant domestication and diversification, domestication and diversification traits, relevant genes and types of mutations that are associated with the origin of crop species, plants with desirable traits that are currently being domesticated as new crops. **Module 2. Identification of the signature of selection and domestication (8 h)**. This module will introduce statistics and estimators used to identify domestication and diversification genes with a particular emphasis on selective sweeps and association mapping. **Module 3. New strategies for crop domestication (8 h).** This module will provide some basic knowledge on the New Breeding Techniques (NBTs) and will discuss some recent applications of NBTs to study and identify domestication genes and use them for the domestication of new crops.	Attendance (75%) + Presentation or report		2nd year
SOFT SKILLS							

Scientific writing in English (SWE2)	**Heidi C. Hauffe**	16	2	**Summary:** Clear, concise scientific writing in English is an essential skill for researchers at all levels, for producing scientific publications and grant proposals. **Module 1 (6 hours):** 1-hour weekly interactive workshops will take a very practical approach, first analysing scientific papers to understand the language style and the organization of ideas, paragraphs, major sections (introduction, materials and methods, etc) in scientific written work. **Module 2 (10 hours):** Four 1-hour tutorials with 6 additional hours as an observer; 2 observers per tutorial will guide each student to understanding their strengths and weaknesses using material that they are actually working on (e.g. conference abstract, draft of a scientific article, grant proposal). **Skills acquired:** an understanding of the organization and style of English scientific papers; improved scientific writing	Individual-based assignments	Recommended for 2nd year students (max 10-12 students per session)	Individual timetables will be discussed
Scientific presentations in English (SPE2)	**Heidi C. Hauffe**	16	2	**Summary:** Effective scientific presentations are essential for today's researcher for illustrating results at international conferences, making a good impression at job interviews, and interacting with stakeholders (outreach). **Module 1 (8 hours):** scientific presentations **Module 2 (8 hours):** presentations to non-experts **Skills acquired:** A practical, interactive approach will be taken in which students will discuss what makes a good presentation, and prepare and present their PhD project and/or results to their peers, in readiness for an international conference, job interview, committee review or defense, receiving input from the lecturer and their peers. The outreach section will focus on the language and graphics necessary for speaking to non-scientific audiences, and again include the preparation of captivating TED-like or flash talks.	Research presentation and Outreach presentation	1st year students (max 10-12 students per session)	Individual timetables will be discussed
How to write a research project (HWR1)	**Ilaria Pertot**	16	2	**Summary:** Basic knowledge on how to prepare a research project proposal. The EU funding scheme and the evaluation process. Opportunities for project proposal application (4 hours lesson and 16 hours project preparation)	Project proposal	2nd or 3rd year	To be defined

				Funding opportunities in the H2020 and FP9			
Research, Intellectual Property and Start up Creation (RIP1)	**UNITN Research Support and Knowledge Transfer Division**	8	2	**Summary:** The main goal of the course is to introduce students to the protection of innovation through Intellectual Property rights. **Module 1:** Intellectual Property Protection and Valorization **Module 2:** Get started for research (a toolkit for young researchers, including MSCA Fellows):	Project proposal	2nd year	To be defined