Course directory 2020.2021

school of Biology (FBM-BIO) Master

* your selection

> Biology > Master of Science (MSc) in Behaviour, Evolution and Conservation, Specialisation Geosciences, Ecology and Environment

UNIL | Université de Lausanne

SUMMARY

NOTICE

This course catalogue was produced using data from the *SylviaAcad* information system of the University of Lausanne. Its database contains all information about courses proposed by the different faculties and their times. This data can also be consulted online at the address :
https://applicationspub.unil.ch/interpub/noauth/php/Ud/index.php.

Web site of the faculty : **http://www.unil.ch/ecoledebiologie/**

Generated on : 09.11.2021

LEGEND

NAME OF THE COURSE

Teacher

Type of course	Status	Hours per week	Teaching language	Hours per year
Semester	Credits			

N: Levels

P: Programme requirements

O: Objective

C: Content

B: Bibliography

I: Additional information

ABBREVIATIONS

TYPE OF COURSE

Attest.	Attestation
C	Course
C/S	Course - seminar
Cp	Camp
E	Exercises
Exc	Excursion
Lg	Guided lecture
S	Seminar
T	Fieldwork
TP	Practical work

STATUS

Fac	Facultative
Obl	Compulsory
Opt	Optional
Fac/Comp/Opt	Facultative, compulsory or optional (according to the study programme)

SEMESTER

Sp	Spring
A	Autumn

Unil | Université de Lausanne
Ecole de biologie

Master of Science in Behaviour, Evolution and Conservation
Specialisation Geosciences, Ecology and Environment
2020-2021

The Master program has a normal duration of 3 semesters and comprises 90 ECTS :

- 15 ECTS : Compulsory (5.5 ECTS) and Optional courses (9.5 ECTS) (Module 1)
- 15 ECTS : First Step Project (Module 2)
- 30 ECTS : Compulsory (5 ECTS) and Optional courses (25 ECTS) (Module 3)
- 30 ECTS : Personal Research Project (Master Thesis) (Module 4)

For specialisation Geosciences, Ecology and Environment (GEE) (30 ECTS), the student must obtain :
- 5.5 ECTS with Compulsory courses (marked in green) and at least one Cross-disciplinary course (marked in blue) in Module 1
- 5 ECTS with Inter-disciplinary compulsory courses in Module 3
- 19.5 ECTS with at least 15 ECTS with Disciplinary and Cross-disciplinary Optional courses in the Module 3
- Modules 2 and 4 have to be in geosciences, ecology or environment fields, validated by the head of GEE specialisation

Training objectives are available in its programme regulations.

Specific training objectives: At the end of the course the students will be able to :
- Solve complex ecological problems through quantitative and modelling approaches, using complementary knowledge acquired in geosciences and environmental sciences
- Have an integrated view of natural systems and conduct interdisciplinary research projects in ecology / environment
- Transfer scientific knowledge and skills acquired to applied problems in the field of ecology, environment and conservation

Autumn Semester (semester 1)

Module	Courses / Enseignement	Hours per semester C	E/S	PW	Teaching Staff	ECTS Credits	Limited nb of students
MODULE 1	**Compulsory / *Obligatoires***						
	Data Analysis *Analyses de données*	6	-	6	**Salamin N.**, Bergmann S., Ciriello G., Trejo Banos D.	2	
	Introduction into Scientific Writing *Introduction à la rédaction scientifique*	7	9	-	**Waterhouse R.**	2	
	Spatial Analysis and GIS in Ecology *Analyses spatiales et SIG en écologie*	7	10	-	**Guisan A.**	1,5	
	Master BEC Retreat *Retraite Master BEC*	-	-	-	**Kawecki T.**	-	
	Subtotal	20	19	6		5,5	
	Optional / Optionnel						
	Environmental chemistry and toxicology (GSE) *Chimie environnementale et toxicologie*		56 CPW		**Chèvre N., Asta M.**	5	
	Environmental time-series analysis (GSE) *Traitement du signal et analyse de séries temporelles*		56 CPW		**Irving J.**	5	
	Nature Conservation (in French) (GSE) *Conservation de la nature*		28 CPW		**Chanteloup L.**, Reynard E., Badman T., Walters G.	4	
	Remote sensing of Earth Systems (GSE) *Télédétection des systèmes terrestres*		56 CPW		**Mariethoz G., Lane S., Mettra F.**	5	
	Advanced Data Analysis *Analyses de données : niveau avancé*	6	-	6	**Salamin N.**, Bergmann S., Ciriello G., Trejo Banos D.	2,5	
	Animal Communication and Parasitism *Communication animale et parasitisme*	14	-	-	**Christe P.**, Roulin A.	1,5	
	Major Transitions in Evolution *Les grandes étapes de l'évolution*	14	-	-	**Keller L.**	1,5	12
	Molecular Methods in Ecology and Evolution *Méthodes moléculaires en écologie et évolution*	18	-	42	**Sanders I.**, Fumagalli L., Salamin N.	5	
	Phylogeography *Phylogéographie*	7	10	-	**Fumagalli L.**	1,5	
	Population Genetics and Dynamics *Génétique et dynamique des populations*	7	10	-	**Goudet J.**	1,5	
	Animal Experimentation and Wild Animals * *Expérimentation animale et animaux sauvages*	20	-	20	**Rubin J.-F.**	-	
	Introduction to R (optional support) *Introduction à R (mise à niveau optionnelle)*				**Schütz F.**	-	
	Total					**15**	
MODULE 2	**Practical Project / *Travail pratique***						
	First Step Project *Travail d'initiation à la recherche*	-	-	224	**Kawecki T., Guisan A.**	**15**	

* Only students who choose a master project with animal experimentation are allowed to select this course

Disciplinary courses marked in green
Cross-disciplinary optional courses marked in blue

Abbreviations
C = Course
E/S = Exercise/Seminar
PW = Practical Work
CPW or CE = Course/Practical Work or Course/Exercise

BIOLOGICAL SECURITY

Patrick Michaux

C	Obl	English	2
A			

N: Master

P: A basic knowledge of microbiology and vegetal science

O: To familiarise future researchers with legislation concerning genetic engineering. In addition, possible biological risks associated to different applications of this technology will be discussed with the help of examples.
This teaching is a mandatory prerequisite for First-Step.

C: * Legislation: article 24 of the Federal Constitution; law concerning environmental protection; law concerning epidemics; ordnance on protection against major accidents; Swiss commissions on biological security: notification and registration of projects.
* Biological security in the laboratory: containment; security equipment; technical measures: laboratory construction; standard laboratory (microbiological) practice; classification of biological material: plasmids, microorganisms, cell lines, primary cells; security levels 1-4.
* Release of genetically modified bacteria in the environment: monitoring, survival and dissemination, ecological impact, transfer of genes, containment systems.
* Potential biological risks associated with the use of transgenic plants: dissemination, cross-pollination, gene transfer.
* The problem of recombinant vaccines: vectors, DNA vaccines.
* Somatic genetic therapy I: Illnesses accessible to treatment by somatic genetic therapy, gene transfer methods.
* Somatic genetic therapy II: Evaluation of the biological risk for the patient and his environment.

DATA ANALYSIS

Nicolas Salamin

C	Obl/Opt	English	6
A	2.00		

TP	Obl/Opt	English	6
A			

N: Master

P: We assume nothing more than the mathematics you would have obtained in your studies when you were 18.

O: In this course the goal is to be able to formulate hypotheses properly, design experiments, whether in the laboratory, in a clinic, or in the filed, that have sufficient power to test these hypotheses, conduct appropriate statistical tests of the data generated, generate clear figures, and interpret the results obtained.

C: We will cover:
1. Distributions and random variables
2. Variance, covariance and measures of association
3. Constructing statistical tests using distributions
4. Regression
5. Non-linear regression

INTRODUCTION INTO SCIENTIFIC WRITING

Robert Waterhouse

C	Obl	English	7
A	2.00		

E	Obl	English	9
A			

N: Master

P: Lecturing and paper writing are in English.

O: This short but intensive block course introduces students to the practice of scientific writing (and aspects related to publishing in peer-reviewed scientific journals).
We will discuss questions/topics such as:
- Why is it important to publish?
- What is good/clear versus bad/unclear (scientific) writing?
- How to learn how to write well?
- How to structure and write a good scientific manuscript?
- The submission, editorial and reviewing process.
- How to review someone else's paper?
- Plagiarism and publication ethics

Publishing is of key importance in scientific research: your job as a scientist is not finished until you have published your results - science is to a very large extent about effectively communicating your results and insights, i.e. what you have learned about how nature works.
The ultimate aim of this intensive course is thus to equip students with a solid understanding of how to effectively communicate their research in writing.

C: Course Content

The course includes both lectures and practical exercises in class, distributed over four half-days. The lectures will give a broad and brief overview of different aspects of scientific writing and publishing as well as on plagiarism and publication ethics; however, the major emphasis of the course is on practical work on the part of the students. During the practical parts the students will learn, from scratch, the fundamental structure and essential components of scientific writing, how to write effective outlines/drafts and - most importantly - how to write complete, clear, well-structured papers. These practical exercises will thus require students to do reading and writing assignments, often under a bit of time pressure.
At the beginning the exercises will be worked on by teams of 2-4; towards the end, each student will work individually. Finally, to get a grade for this class, students will have to complete a written report (homework assignment). For each exercise as well as for the written report we will give detailed and individualized feedback. Note that all lecturing and assignment writing are in English.

Detailed Programme
Module 1: Lecture 1: Writing papers: overview of why and how.
We will discuss the following: Overview of class and organizational things (incl. homework assignments). Why is it important to publish? What is good/clear versus bad/unclear (scientific) writing? How to learn how to write well? [We will also briefly touch upon issues of good scientific practice and conduct, and various ethical issues connected to publishing.] Approx. 2 hours.
Module 1: Practical 1. Summarise a paper: title, keywords, abstract.
In groups of 2-3. Read the assigned (stripped down and short) manuscript and come up with a title and with keywords. Then write a short abstract (< 200 words). Approx. 1.5 hours. We will then discuss the solutions you have come up with, and their potential pros and cons, together in class. Approx. 30 mins.
Module 2: Lecture 2: Writing papers: details on structure, drafting, revising.
We will discuss the basics and essentials of writing a scientific paper (and also what not to do!). Specifically, I will explain how a paper should be structured and sub-structured, how to draft a paper (i.e., how to get started), how to build and complete a full manuscript, and then how to improve it by continuous and aggressive revising and re-revising. I will also give you hints and tips for effective writing. Approx. 1.5 hours.
Module 2: Practical 2. Write a paper: your own nano-paper from results.
I will give you some data/results (e.g., data figures/tables/legends/statistical outcomes) to choose from. Form teams of 3-4 people. Ask yourself: What do the results/tables/figures/analyses show and mean? Then prepare a very short nano-paper (2 pages max), including: Title, Abstract, Introduction, Materials and Methods, Results, Discussion and Conclusion (there are some other components in a paper that we will skip for the sake of this exercise). Each component should be between 1 and 3-4 sentences maximum. Approx. 2 hours. We will then discuss your solutions and their potential pros and cons together in class; Approx. 30 mins. We will then give you detailed feedback on your papers by e-mail after the course.
Module 3: Lecture 3: Publishing papers: understanding the whole process.
We will briefly recapitulate what we have discussed and learned so far, and then focus on the 'final' stages of writing a paper and submitting it to a journal. Approx. 1 hour
Module 3: Practical 3: Review a paper: critically assess a manuscript.
What distinguishes a good from a bad manuscript? Now you are the reviewer! Being a critical reviewer will help you to learn to distinguish between good and bad writing and thus help you to improve your own scientific writing. You will be given a short, stripped-down manuscript. Team up in groups of 2-3. Read both manuscripts critically, then make pro and contra lists for both manuscripts. Briefly explain why you would accept/reject (or reach some other decision) the manuscript for publication (

SPATIAL ANALYSIS AND GIS IN ECOLOGY

Antoine Guisan

E	Obl/Opt	English	10
A			

C	Obl/Opt	English	7
A	1.50		

N: Master

P: Basics in statistics and ecology

O: Teaching students the basics of GIS and remote sensing, as well as the main spatial methods available in spatial ecology.

C: 1. Introduction to GIS
2. Introduction to remote sensing
3. Raster analyses
4. Neighbourhood analyses
5. Spatial interpolation
6. Detection of spatial structures and patterns

B: Wadsworth, R. & Treweek, J. 1999. Geographical Information Systems for Ecology
Caloz, R. & Collet, C. 2002. Précis de télédetection, vol. 3. Presses Univ. du Québec
Turner, Gardner, O'Neill 2001. Landscape Ecology in Theory and Practice: Patterns and Process. Springer
Dale, Birks, Wiens 2000. Spatial Pattern Analysis in Plant Ecology. Cambridge University Press.
Klopatek, J.M. & Gardner, R.H. 1999. Landscape Ecological Analysis: isuues and applications. Springer.
Hunsaker, C.T., Goodchild, M.F., Friedl, M.A. and Case, T.J. (Eds). 2001. Spatial uncertainty in ecology. Springer.
Hansson, L., Fahrig, L. and Merriam, G. 1995. Mosaic Landscapes and Ecological Processes. Chapman & Hall.

I: http://www.unil.ch/ecospat

ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY

Maria Pilar Asta Andres, Nathalie Chèvre

C/TP	Opt	4	English	56
A	5.00			

N: Master

P: - Hydrochimie et pollution des eaux
- Ecotoxicologie

O: This 5 credit course (56 hrs C&TP) is required for students completing the Masters in Environmental Geosciences. This course is divided into two modules focused on (i) application of empirical, thermodynamics and kinetic models that describe the distributions and concentrations of chemical species in environmental systems (ii) learning the methods and limits of environmental risk assessment, with a focus on chemicals, alone or in mixture
A personal assessement of one case study linked with the course topics is also required.

C: - Partitioning of organic and inorganic contaminants
- Structure-activity relationships
- Aqueous and surface speciation
- Rates of contaminant degradation
- Dose-response curves
- Environmental risk assessment

B: All the books are available in the Geosciences library:
Principles and Applications of Aquatic Chemistry (1993) Morel and Hering
Geochemistry, Groundwater and Pollution (2009) Appelo and Postman
Environmental Modeling (1996) Schooner
Encyclopedia of aquatic ecotoxicology 2 volumes A-G et H-Z. (2013). Frérard JF., Blaise C., 2013 :
Fundamentals of ecotoxicology. 3rd ed (2010) Newman M. C.
Risk assessment of chemicals: an introduction (2007). Van Leeuwen C. J., Vermeire T. G., 2007 (ed).

ENVIRONMENTAL TIME-SERIES ANALYSIS

James Irving

C/TP	Opt	3	English	56
A	5.00			

N: Master

O: This course provides an introduction to time series analysis and signal processing for the environmental sciences. Topics to be covered, in the context of relevant environmental examples, include linear system and signal analysis, convolution, the Fourier transform, auto- and cross-correlation, data filtering, filter design, sampling and signal reconstruction theory, spectral estimation, and time-frequency analysis. Concepts learned in lectures will be reinforced through weekly computer exercises.

NATURE CONSERVATION

Tim Badman, Laine Chanteloup, Emmanuel Reynard, Gretchen Walters

C/TP	Opt	2	French
A	4.00		

N: Master

O: In November 2019, the University of Lausanne and the IUCN signed a partnership agreement aimed at intensifying their exchanges around research work and its applications on the planet's environmental concerns. This course is a concrete application of this partnership involving both various researchers from Unil and IUCN professionals.
A convention is also being set up between the University of Lausanne and the Lavaux World Heritage Association to strengthen the scientific knowledge carried out in this protected area. This course aims to get better acquainted with this site and the conservation challenges it faces.
The objective of this course is to bring elements of reflection and analysis to students concerning contemporary debates around the conservation and protection of nature. This course reviews the definitions as well as the historical and cultural aspects of nature conservation and the implementation of different protected areas around the world. It also addresses through various examples and case studies the current management issues in nature conservation. This course-seminar includes two field trips with meetings of IUCN professionals.

C:
- Introduction to Nature Conservation
- Protected areas and landscape governance
- Conservation and management issues
- Management effectiveness, World Heritage, geoparks, biosphere reserves and Ramsar.
- Fieldtrip to Lavaux Unesco site
- Hunting, protected areas and conservation
- Fieldtrip to IUCN center
- Conservation by indigenous peoples and local communities
- Conservation and Education

B:
- Adams WM (2004) Against extinction: the story of conservation. Earthscan, London#; Sterling, VA
- Bory Stéphanie et Gábor Baranyai (dir), 2016, Les espaces naturels protégés sont-ils nécessaires?, Pessac Gironde, Presses univ de Bordeaux, Dynamiques environnementales 35, 235 p.
- Depraz Samuel, 2008, Géographie des espaces naturels protégés genèse, principes et enjeux territoriaux, Paris, A. Colin, Collection U. Géographie, 1 p.
- Héritier, Stéphane et Lionel Laslaz (dir), 2008, Les parcs nationaux dans le monde: protection, gestion et développement durable, Paris, Ellipses, Carrefours. Les dossiers, 312 p.
- Larrère, Raphaël. « Le conflit entre les chasseurs et les protecteurs de la nature ». La Ricerca Folklorica, no 48 (2003): 45 51.https://doi.org/10.2307/1480073.
- Laslaz, Lionel (dir.), 2012, Atlas mondial des espaces protégés: les sociétés face à la nature, Paris, EdAutrement, Autrement. Collection Atlas/Monde, 96 p.
- Laslaz Lionel, C. Gauchon, M. Duval, S. Héritier (dir.),, 2014, Les espaces protégés: entre conflits et acceptation, Paris, Belin, Mappemonde, 431 p.
- Mollett, Sharlene, and Thembela Kepe, eds. 2018. Land Rights, Biodiversity Conservation and Justice: Rethinking Parks and People. Routledge Studies in Sustainable Development. Abingdon, Oxon#; New York, NY: Routledge, Taylor & Francis Group.

REMOTE SENSING OF EARTH SYSTEMS

Pascal Egli, Stuart Lane, Grégoire Mariéthoz, Fabio Oriani

C/TP	Opt	4	English	56
A	5.00			

N: Master

P: Bases in remote sensing, use of Matlab and/or other scripting languages

O: The aim of this course is to provide advanced knowledge of some specific methods used in remote sensing. This will include retrieval and processing of satellite data, data acquisition techniques such as photogrammetry, Structure-From-Motion and methods used as well as computer-aided processing and visualization of remote sensing data.

C: At the end of this course, students will: - Be able to locate and download satellite imagery, and apply treatment to such images in order to extract information; - Be familiar with platforms such as USGS GLOVIS and Google Earth Engine; - Be able to use advanced software tools such as the Matlab Image Processing Toolbox for the processing of remote sensing data; - Be able to apply standard methodologies such as classification, pansharpening, interpolation, edge detection or filters, among others; - Have the ability to apply and understand the principles of photogrammetry.

B: - T. Lillesand, R. Kiefer, J. Chipman, 2015, Remote Sensing and Image Interpretation, Wiley. - J. Campbell & R. Whyne, 2011, Introduction to Remote Sensing, Guilford Press.- M-C Girard et C-M Girard, 2010, Traitement des données de télédétection, Dunod.- G. Vosselman and H.-G. Maas, 2010, Airborne and Terrestrial Laser Scanning, CRC Press.

ADVANCED DATA ANALYSIS

Nicolas Salamin

C	Obl/Opt	English	6
A	2.50		

TP	Obl/Opt	English	6
A			

N: Master

P: You must have attended the first data analysis course, or convince me that you are competent at basic statistical analyses.

O: The aim of this course is to build upon the data analysis course, to prepare you to handle a range of different data and more complex analysis problems.

C: In this course we will cover:
1. Repeated measures models and mixed effects models.
2. Survival analyses
3. Bayesian statistical inference

ANIMAL COMMUNICATION AND PARASITISM

Philippe Christe

C	Opt	English	14
A	1.50		

N: Master

P: None

O: Across the animal kingdom, individuals of the same species differ in their propensity to take risks, and explore new environments, and to be active, aggressive or sociable. Individual differences in behaviour that are consistent through time and across contexts are coined 'personalities', 'behavioural syndromes' or 'temperaments'. The terminology of personality is not a mere fashionable label of something usually studied by behavioural ecologists, but useful to conceptualize the common phenomenon that individuals differ markedly and consistently in their behavioural phenotypes across ecological and social contexts. The notion of personality implies that suites of behaviours are correlated within individuals and hence individuals are less flexible than would be expected under optimality models. In this course, I propose to study personality from an evolutionary point of view and also the evolution of language.

C: This lecture is interactive and illustrated by recent research articles.
7h will be given by A. Roulin and 7h by P. Christe

B: Réale, D., Reader, S.M., Sol, D., McDougall, P.T. & Dingemanse, N.J. (2007). Integrating animal temperament within ecology and evolution. Biol. Rev., 82, 291-318.
Sih, A., Bell, A.M., Johnson, J.C. & Ziemba, R.E. (2004). Behavioral syndromes: an integrative overview. Q. Rev. Biol., 79, 241-277.
Journaux scientifiques figurant à la bibliothèque du Biophore ou sur internet (http://perunil.unil.ch/perunil/periodiques/).

I: Aucune

MAJOR TRANSITIONS IN EVOLUTION

Laurent Keller

C	Opt	English	14
A	1.50		

N: Master

P: none

O: The aim of this course is to discuss some of the major transitions that occurred over the course of evolution. The general idea is that students will be able to work on a topic they selected themselves

C: Students (in groups of 2 or 3) will have to identify a specific topic of interest and make a short presentation. There will then be a discussion between all participants of the course. The discussion will be lead by the students presenting and myself. Examples of topics that have previously been chosen by students include: Evolutionary explanation to the evolution of cooperation, speciation, the resolution of genomic conflict, evolution of sex chromosomes, the moulding of senescence, and the evolution of sexes.

B: La bibliographie sera déterminée lors du cours

MOLECULAR METHODS IN ECOLOGY AND EVOLUTION

Luca Fumagalli, Ian Sanders

C	Obl/Opt	English	18
A	3.50/5.00		

TP	Obl/Opt	English	42
A			

N: Master

O: The objective of this course is to learn the relevant molecular tools that are currently used in ecology, evolutionary and conservation biology research and understand why and when to apply them.

C: This course covers the reasons why molecular genetics is a necessary tool in many ecology, evolution and conservation biology projects. We study its uses and then look at at selection of techniques, particularly for looking at polymorphism, that are not traditionally taught in molecular cell biology courses. Man of the techniques can only be learnt in the classroom as there is not enough time in a week to practically learn all useful techniques. Therefore, the associated laboratory class cover some of the fast techniques that are useful for studying polymorphisms in populations.

B: The course is mostly based on publications in international journals rather than one specific book. The publications are made available in pdf format at the beginning of the course.

PHYLOGEOGRAPHY

Luca Fumagalli

C	Opt	English	7
A	1.50		

E	Opt	English	10
A			

N: Master

O: 1) Course
Study of the historical processes (population expansions, bottlenecks, vicariance and migration) responsible for the current geographic distribution of genealogical lineages.
2) TPs
Analysis and interpretation of phylogeographic data with the help of several softwares.

C: 1) Phylogeography: definition and historical backgrounds
2) Animal and plant molecular markers
3) Distribution area
4) Gene tree/species tree
5) Molecular clocks
6) Coalescence
7) Mismatch distribution
8) Phylogenetic trees and networks
9) Phylogeographic patterns
10) Comparative phylogeography
11) Phylogeography and conservation
12) Phylogeography and genomics.

B: Avise JC. 2000. Phylogeography. Harvard University Press.

POPULATION GENETICS AND DYNAMICS

Jérôme Goudet

C	Obl/Opt	English	7
A	1.50		

E	Obl/Opt	English	10
A			

N: Master

P: A good grasp of the principles of population genetics and population dynamics (i.e. at least an introductory course in both)

O: Gain an understanding of how genetics and genomics interact with demographic and selective processes.
website:
http://www2.unil.ch/popgen/teaching/PGD20

C: In the first part of the course, selected papers from the
recent literature are presented by students and discussed in a
journal club format.
In the second part, in groups of 2-3 students you will use
computer simulations and the quantiNemo program to investigate questions such as:
-efficacy of selection in the face of gene flow?
-effect of the number of loci encoding a trait on the speed of
adaptation
-is neutral diversity a good proxy for adaptive diversity?

I: http://www2.unil.ch/popgen/teaching/PGD20/

ANIMAL EXPERIMENTATION AND WILD ANIMALS

Jean-François Rubin

C	Opt	English	20
A			

TP	Opt	English	20
A			

N: Master

FIRST STEP PROJECT

Richard Benton, Marie-Christine Broillet, Antoine Guisan, Tadeusz Kawecki, Laurent Lehmann, Marc Robinson-Rechavi

TP	Obl	English	224
A	15.00		

TP	Obl	English	282
A	15.00		

TP	Obl	English	250
A	14.00		

TP	Obl	English	224
A	15.00		

TP	Obl	English	224
A	15.00		

TP	Obl	English	224
A	15.00		

N: Master

P: Practicals performed during the bachelor (molecular biology, genetics, biochemistry, bioinformatics)

O: - An initiation to the work of a scientist
- Conduct experimental work in research lab (wet bench or in silico)
- Interpretation of research results
- Implement basic principles in experimental design (e.g. include the appropriate controls, statistical significance of the results etc...)
- Present your experimental work in a written report which will be organized like a typical research article (intruduction, results, discussion, materials and methods)
- present your work orally (seminar style)

C: Perform laboratory work for about 12 weeks during the time when the student does not follow theoretical classes. This research project will typically be performed under the guidance of a PhD student or a post-doc from the host laboratory.

Unil | Université de Lausanne
Ecole de biologie

Master of Science in Behaviour, Evolution and Conservation
Specialisation Geosciences, Ecology and Environment
2020-2021

Spring Semester (semester 2)

MODULE 3

Courses / Enseignement	Hours per semester C	E/S	PW	Teaching Staff	ECTS Credits	Limited nb of students
Interdisciplinary Compulsory Courses ***Enseignements interdisciplinaires obligatoires***						
Integrated course Mountain Ecosystems - Ecology & Evolution *Cours intégré écosystèmes de montagne - écologie et évolution*	14	-	-	**Guisan A.**	1,5	
Integrated course Mountain Ecosystems - Geo-Environmental Sciences *Cours intégré écosystèmes de montagne - sciences géo-environnementales*	14	-	-	**Guisan A.**	1,5	
Integrated Practical Work Mountain Ecosystems in the Alps *Travaux pratiques intégrés écosystèmes de montagne dans les Alpes*	-	-	44	**Guisan A.**	2	
Subtotal	28	0	44		**5**	
Optional Courses / Enseignements optionnels *						
Environmental data mining (GSE) *Fouille de données environnementales*	56 CPW			**Kanevski M.**	5	
Geostatistics and GIS (GSE) *Géostatistique et SIG (Syst. d'Inform. Geogra.)*	56 CPW			**Kanevski M.**	5	
Aquatic Ecosystems : Glaciers, Rivers and Lakes (GSE) *Ecosystèmes aquatiques : glaciers, rivières et lacs*	56 CPW			**Perga M.-E., Mettra F.**	5	
Environmental biogeochemistry (GSE) *Biochimie environnementale*	30 CE			**Peña J., Asta M.**	5	
Field and laboratory methods (I) : The UNIL campus as a microcosm (GSE) *Méthodes de terrain et de laboratoire : le campus UNIL comme microcosme*	56 PW			**Peña J.**, Chèvre N., Vennemann T.	5	
Field and laboratory methods (II) : Alpine catchments (GSE) *Méthodes de terrain et de laboratoire (II) : bassin versant alpin*	40 PW			**Perga M.-E.**	5	
Applied Ecology *Ecologie appliquée*	14	-	28	**Pellet J.**	3	
Biological Invasions *Invasions biologiques*	14	-	-	**Bertelsmeier C.**	1,5	
Co-evolution, Mutualism, Parasitism *Co-évolution, mutualisme, parasitisme*	14	-	-	**Sanders I.**	1,5	
Current Problems in Conservation Biology *Problèmes actuels en biologie de la conservation*	14	14	-	**Wedekind C.**	3	10
Ecology of the Fishes of Switzerland *Ecologie des poissons de Suisse*	7	-	10	**Rubin J.-F.**	1,5	
Honeybee Ecology, Evolution and Conservation *Ecologie des abeilles, évolution et conservation*	14	-	-	**Dietemann V.**	1,5	
Phylogeny and Comparative Methods *Phylogénie et méthodes comparatives*	7	14	-	**Salamin N.**	1,5	
Plant Population Genetics and Conservation *Génétique des populations végétales et biologie de la conservation*	7	-	10	**Felber F.**	1,5	
Spatial Modelling of Species and Biodiversity *Modélisation spatiale des espèces et de la biodiversité*	14	14	-	**Guisan A.**	3	
Comparative Genomics : from Thousands of Genomes to Single Cells *Génomique comparative : des milliers de génomes aux cellules individuelles*	7	7	-	**Arguello R.**	1,5	
Evolutionary Consequences of Hybridization and whole Genome Duplication *Conséquences évolutives de l'hybridation et de la duplication de génome*	14	-	-	**Arrigo N.**	1,5	
Introduction to Primate Behaviour, Cognition and Culture *Introduction au comportement, à la cognition et à la culture des primates*	10	8	-	**Van de Waal E.**	1,5	
Scientific Communication - Scientific Hands-on Workshop Module (in French only) *Médiation scientifique - module atelier scientifique*	14	14	-	**Kaufmann A., Reymond P.,** Ducoulombier D.,Trouilloud S.	3	8
Scientific Mediation and Communication - Museum Module *Communication et médiation scientifique - module musée*	6	-	22	**Sartori M.,** Glaizot O.	3	6
The Environment, addressed in an interdisciplinary way (most in French) (GSE) *Séminaire interfacultaire en environnement*	-	10	-	**Guisan A.**	2	
The Evolution of Cooperation : from Genes to Learning and Culture *L'évolution de la coopération : des gènes à l'apprentissage et la culture*	28	-	-	**Lehmann L.**	3	
Social Genetics *Génétique sociale*	2	12	-	**Keller L.,** Kay T.	1,5	
Optional Field Courses **(Financial participation required by the student)** ***Etudes de terrain optionnelles***						
Drivers of Invertebrate Biodiversity along Ecological Gradients *Facteurs déterminant la biodiversité des invertébrés le long de gradients écologiques*	7	-	49	**Schwander T.**	3	20
Ecology and Faunistics of the Sea Shore, Roscoff *Ecologie et faunistique du bord de mer, Roscoff*	7	-	49	**Schwander T.**	3	20
Evolution and Biogeography of Semi-arid and Island Floras *Evolution et biogéographie des flores insulaires en zone semi-aride*	-	-	40	**Pannell J.**	2	14
Total					**30**	

* Possibility of taking Cross-disciplinary optional courses from the module 1 during semester 3 according to their availability
Disciplinary courses marked in green
Cross-disciplinary optional courses marked in blue

Spring semester (semester 2) and Autumn Semester (semester 3)

MODULE 4

Course / Enseignement		ECTS Credits
Master Thesis GEE *Travail de Master GEE*	Thesis Director *Directeur du travail de Master*	30

Due to the sanitary evolution related to COVID-19, the study plans may be adapted during the semester as follows:

- possibility to switch from one mode of teaching to another (face-to-face <-> distance, synchronous <-> asynchronous, switch to co-modal teaching where it was not initially planned).
- adaptation of evaluation modalities, without inducing derogations from the Study Regulations (oral <-> written, exam <-> validation, individual work <-> group work, practical work <-> theoretical work, face-to-face evaluation <-> online evaluation, etc.).
- alternative or time-shifted modalities for teachings, internships, practical work, fieldworks and camps that could not take place or teachings that could no longer take place in the form initially planned.

Students are invited to consult this document regularly (Study Plan & Evaluation Procedure)

INTEGRATED COURSE MOUNTAIN ECOSYSTEMS - ECOLOGY & EVOLUTION

Antoine Guisan

C	Obl/Opt		English	14
S	1.50			

N: Master

INTEGRATED COURSE MOUNTAIN ECOSYSTEMS - GEO-ENVIRONMENTAL SCIENCES

Antoine Guisan

C	Obl/Opt	English	14
S	1.50		

N: Master

INTEGRATED PRACTICAL WORK MOUNTAIN ECOSYSTEMS IN THE ALPS

Antoine Guisan

T	Obl/Opt		English	44
S	2.00			

N: Master

P: Bachelor in environmental and/or biological sciences.

O: To offer an interdisciplinary vision of mountain environments and elevation gradients through the lens of different questions in ecology and evolution.

C: Two fields retreats of 2-days and 3-days, with courses and practical works and exercises, with 14C of lectures by different teachers in-between. Content of the lectures:
1. Adaptations to marginal environments
2. Reproductive systems along elevation
3. Patterns of micro-organisms along elevation
4. Biological invasions in mountains
5. Impact of climate change on mountain species and communities - field observations and experiments
6. Impact of climate change on mountain species and communities - spatial modelling
7. Human-wild fauna conflicts in mountain regions

B: See English pages of the course

I: See English pages of the course

ENVIRONMENTAL DATA MINING

Mikhail Kanevski

C/TP	Opt	English	56
S	5.00		

N: Master

P: Course in basic statistics, Geostatistics and GIS

O: - To present basics of data driven modelling and methodology of environmental data mining
- To understand and to use artificial neural networks of different architectures for environmental data analysis and modelling.
- To present fundamental ideas of statistical learning theory and application of kernel-based methods for the analysis and modelling of environmental data

C: Introduction to data driven modelling and data mining.
- Basic notions and concepts
- Learning from data: methodology
- Presentation of data and case studies
Machine learning and data analysis
- Basics of machine learning
- Models selection and models evaluation
- Benchmark model: k-Nearest Neighbours
- Artificial neural networks:
Multilayer perceptron (MLP).
General Regression Neural Networks (GRNN) and Probabilistic Neural Networks (PNN)
Self-Organizing Kohonen (SOM) maps
Statistical Learning Theory
- Concepts and hypotheses
- Support Vector Machines (SVM)
- Support Vector Regression (SVR)
- Classification and mapping of environmental data.
Seminars, case studies, practices

B: - Kanevski M., Pozdnoukhov A., Timonin V. Machine Learning for Spatial Environmental Data. EPFL Press, 2009.
- Kanevski M. (Editor). Advanced Mapping of Environmental Data. Geostatistics, Machine Learning, and Bayesian Maximum Entropy. iSTE/Wiley, 2008.
- Bishop C. Pattern recognition and machine learning. Springer, 2006.
- Hastie T., Tibshirani R., Friedman J. The Elements of Statistical Learning. 2d edition. Springer, 2009.

GEOSTATISTICS AND GIS

Mikhail Kanevski

C/TP	Opt	English	56
S	5.00		

N: Master

P: Course in basic statistics

O: The main objectives of the course are the following: to present fundamental hypotheses and theoretical ideas and applications of the analysis and modelling of spatial data; to use both deterministic and geostatistical models for spatial data treatment; to perform real data case studies based on topo-climatic and pollution data; to understand geostatistical models and interpretation of their results; to present and manipulate geospatial data using Geographical Information Systems (GIS).

C:
- Exploratory analysis of spatial data.
- Analysis of monitoring networks and de-clustering
- Global and local estimations
- Moving window statistics
- Deterministic interpolations and cross-validation
- Variography: exploratory variography and variogram modelling
- Geostatistics: family of kriging models
- Geostatistics and GIS.
- Geostatistical simulations. Modelling of spatial uncertainty and variability
- Sequential Gaussian simulations
- Post-processing of the simulations.
- Advanced simulation algorithms.
- Risk mapping.

B:
1. Kanevski M. and M. Maignan. Analysis and Modelling of Spatial Environmental Data. EPFL Press, 2004.
2. Kanevski M. (Editor). Advanced Mapping of Environmental Data. Geostatistics, Machine Learning, and Bayesian Maximum Entropy. iSTE/Wiley, 2008.
3. Wackernagel H. Multivariate Geostatistics. 3d edition. Springer, 2003.
4. Chiles J-P., Delfiner P. Geostatistics. Modelling Spatial Uncertainty. John Wiley and Sons, 2012.

AQUATIC ECOSYSTEMS: GLACIERS, RIVERS, AND LAKES

Stuart Lane, Marie-Elodie Perga

C/TP	Opt	English	56
S	5.00		

N: Master

P: Basic fluvial hydraulics (or equivalent) General ecology Statistical analysis of environmental Data

O: The objective of this course is to provide to the students a watershed-wide perspective on aquatic ecosystems and associated environmental issues, accounting for the ecological continuity of glaciers, rivers and lakes in the Alpine landscape. This course builds on preliminary knowledge in river hydrology and geomorphology to develop the ecological dimensions of river management. It also includes a full course in limnology blending the physical, biogeochemical and ecological aspects of lakes, emphasizing the necessity for such an integrative perspective to deal with current environmental challenges on Swiss lakes. The course is designed to favor hands-on in situ or in silico approaches of rivers and lakes. The course concludes with an introduction in how these principles are reflected in the Swiss Water Law as well as international comparisons.

C: The courses is divided into 2:
(1) Lakes and limnology, including lake ecology
(2) Rivers and ecology
The course finishes with a consideration of the relationship between this scientific understanding and policy, looking at the Swiss Water Law and also international comparisons.
The course comprises lectures and practical classes, as well as a small amount of fieldwork to support understanding. Specific training is also provided in certain key methods used by industry and regulators for biological water quality assessment.

B: Limnology, 3rd Edition
Lakes and River Ecosystems, R. Wetzel, 2001, Elsevier
Lakes: a very short introduction, W Vincent, 2018, Oxford University Press

ENVIRONMENTAL BIOGEOCHEMISTRY

Xavier Dupla

C/E	Opt	French	30
S	5.00		

N: Master

P: General Geochemistry, Aquatic Chemistry, Introductory Chemistry & Physics

O: Reactions occurring at mineral and microbial surfaces govern the attenuation, release and cycling of the elements in aquatic and soil environments. This course draws on the fields of surface chemistry, mineralogy and environmental microbiology to develop an understanding of key (bio)geochemical reactions in natural environments, particularly those impacted by anthropogenic activities.
LEARNING OBJECTIVES
- To understand interfacial processes and the application of empirical and thermodynamic-based models to describe sorption processes
- To gain a molecular-scale perspective of chemical reactions occurring at water-mineral, water-microbe, and microbe-mineral interfaces
- To become familiar with microscopic and spectroscopic techniques used to characterize natural particles and detect surface species
- To gain experience with the critical reading of the scientific literature

C: Part 1: Structure drives reactivity
-Soil components from a chemical perspective
-Arrangement of atoms in minerals and organic matter
-Properties of soil components and implications for interactions with ions/molecules in the soil solution
Part 2: Critical chemical processes in soils
-Dissolution and precipitation
-Ion sorption
-Electron transfer (reduction-oxidation reactions)

FIELD AND LABORATORY METHODS (I): THE UNIL CAMPUS AS A MICROCOSM

Jasmine Berg, Nathalie Chèvre, Torsten Vennemann

TP	Opt		English	60
S	5.00			

N: Master

FIELD AND LABORATORY METHODS (II): ALPINE CATCHMENTS

Marie-Elodie Perga

CP	Opt	English	50
S	5.00		

N: Master

P: Aquatic ecosystems: glaciers, rivers, and lakes

O: This field camp aims at training students to the application of classical and up-to-date technologies to the study of the hydrological, geomorphological, physical and ecological aspects of an alpine catchment.

C: During a 5-day field camp , students will be trained to the use of typical hydrological tools, to the completion of ecological samplings and analyses for bioindications, to the good use and practices of automated sensors and probes for the study of alpine waters. Building a sampling plan and collecting their own data, students will have to conduct their own research question along these 5 days, in relative autonomy.

APPLIED ECOLOGY

Jérôme Pellet

C	Opt	English	14
S	3.00		

TP	Opt	English	28
S			

N: Master

P: BSc level in biology, including ecology

O: Applied ecology is a young crisis discipline undergoing a major effectiveness revolution. In most situations, urgent action is necessary, even in the absence of reliable information. How do we gather sound ecological information? How do we use it to plan natural communities conservation? In the process of answering these questions, wildlife ecologists often realize that research and practice are just two sides of the same coin.

C: The goal of the course is to teach students some of the skills they will need as evidence-based conservationists. Practical examples will be drawn from various ecosystems, communities and species. The course will revolve around the stages of adaptive management:
monitoring ecological resources, monitoring occupancy and abundance
research syntheses (systematic reviews and meta-analyses)
ecological triage (systematic conservation planning and red lists)
natural communities conservation planning and legislative context.
Field-based case studies will provide students an opportunity to apply and discuss some of the principles illustrated in the course. Practical work will include meeting with practitioners, discussing and analyzing their approach and methods through the prism of adaptive management.
« There is no such thing as a special category of science called applied science; there is science and its applications, which are related to one another as the fruit is related to the tree that has borne it. » Louis Pasteur

BIOLOGICAL INVASIONS

Cleo Bertelsmeier

C	Opt	English	14
S	1.50		

N: Master

O: 1. Explain core theory and concepts underlying the spread and impacts of invasive species
2. Critically assess the current debate about invasive organisms (semantic, social, economic, biological..)
3. Understand how globalization leads to the accelerating dynamics of species ranging from viruses to mammals
4. Understand the characteristics of invasive species and vulnerable ecosystems
5. Discuss the interactions between biological invasions and other drivers of global change such as climate change

C: Biological invasions are considered one of the most important global threats to biodiversity. Understanding the processes shaping the success of species outside of their native ranges is therefore a major goal of conservation research. In this course, we elucidate the main hypotheses explaining the success and spread of invasive species, while insisting on current controversies and future research questions. Specifically, we will address:
- The different stages of the invasion process (transport, establishment, spread, impacts)
- Impacts and case studies of some of the worst invasive species
- Mechanisms of invasions
- Socio-economic aspects
- The role of rapid adaptation in the invasion process
- Species interactions, enemy release, community structure
- Large scale patterns and dynamics
- Interactions with other drivers of global change

B: See English pages of the course

CO-EVOLUTION, MUTUALISM AND PARASITISM

Ian Sanders

C	Opt	English	14
S	1.50		

N: Master

P: Must understand english and be prepared to give presentations

O: To understand the evolutionary consequences of organisms living together in mutualism or parasitism and how to investigate it experimentally

C: The course comprises some introductory talks given by me about concepts in co-evolution and theoretical frameworks for studying co-evolution. Afterwards, students give presentations on chosen key publications in this field and the group discusses these subjects after the presentations.

B: : All bibliography is made availble in pdf format before the course begins. For an example of the publications discussed you can find last years publications in my docunil public folder.

CURRENT PROBLEMS IN CONSERVATION BIOLOGY

Claus Wedekind

C	Opt	English	14
S	3.00		

E	Opt	English	14
S			

N: Master

P: Lectures, discussions, and proposal writing in English.

O: Introduction into
- some important problems of conservation biology
- funding opportunities for conservation projects
- the planning, writing, and reviewing of grant proposals in the context of the course

Own ideas shall be developed, presented and discussed in class.

C: Some current research topics within the field of conservation biology will be further introduced in lectures, potentially also guest lectures, and discussions in class. Each student then develops an own idea of a research project within these topics. After an introduction into funding agencies and the planning and writing of grant proposals, each student (or groups of two) write(s) up an own proposal and present(s) it to the class. The proposals of colleagues will then be peer-reviewed after an introduction into peer-reviewing of grant proposals.
Class size restricted to 10 students.

ECOLOGY OF THE FISHES OF SWITZERLAND

Jean-François Rubin

C	Opt	English	7
S	1.50		

TP	Opt	English	10
S			

N: Master

P: none

O: Recognize the different habitats and species
Know the biology of the principal species
Identify the problems linked to the management of these habitats and species

C: Generalities on water
Lakes
Watercourses
Plankton and plants
Systematic of fish
Anatomy of fish
The fish of Switzerland

HONEYBEE ECOLOGY, EVOLUTION AND CONSERVATION

Vincent Dietemann

C	Opt	English	14
S	1.50		

N: Master

O: This series of lectures will show the complexity of insect societies, taking the honey bee as an example. It will give the opportunity to see how concepts learned elsewhere by the students can be placed within the context of a single species.

C: Since honeybees are economically important insects, they have been studied early in history and the knowledge we possess about them is greater than for any other social insect species. Our understanding of the honeybee reveals the complex organisation reached by insects when they form societies. This series of lectures will present some aspects of this complexity that will be replaced within its evolutionary context. Various aspects of honeybee ecology and evolution, including geophylogeny, biology, reproduction at individual and colony level, division of labour, communication, economical value, pathogens will be presented.
After a general introduction of this model species describing the diversity and biogeography of the taxon, we will dissect the communication abilities of European honeybees and compare it with related Asian species. We will see how this communication is used to organise foraging tasks sustaining colony growth. Honeybee health is a current concern and we will review the pathogens affecting them and comment the role of humans in their spread and control in an evolutionary context. Since honeybees are globally threatened, we will see what economical losses their decline could have and some conservation projects to invert the trend will be put in context.

B: Seeley T, 1985. Honeybee Ecology. Princeton University Press.
Seeley T, 1995. The wisdom of the hive. Harvard University Press.
Moritz RFA, Southwick EE, 1992. Bees are superorganisms. Spiringer Verlag
Oldroyd B, Wongsiri S, 2006. Asian Honey Bees. Harvard University Press.
Koeniger N, Koeniger G, Tingek S, 2010.Honey Bees of Borneo. Natural History Publications
Winston ML, 1987. The Biology of the honey bee. Harvard University press.

PHYLOGENY AND COMPARATIVE METHODS

Nicolas Salamin

C	Opt	English	7
S	1.50		

E	Opt	English	14
S			

N: Master

P: none

O: Phylogenetic reconstruction methods and their application in evolutionary biology. To know and understand phylogenetic reconstruction methods in order to test the processes leading to genes and organisms evolution.

C: The subjects will be presented during lectures as well as practicals.
I. Reconstruction methods
- What is a phylogenetic tree and how to interpret it?
- Tree reconstruction:
a) optimisation criteria and models of evolution
b) search for the optimum tree
c) Bayesian methods
- Can we trust the inferred tree?
II. Uses for phylogenetic trees
- Detecting positive selection in a coding gene
- Testing coevolution and cospeciation
- Macroevolution:
a) dating evolutionary events
b) tempo and mode of evolution
c) testing for key innovations
- Phylogeny and conservation

B: Felsenstein, J. 2003. Inferring phylogenies. Sinauer Associates.
Page, R. 2003. Tangled trees: Phylogeny, cospeciation, and coevolution. University of Chicago Press.
Purvis, A., Gittleman, J.L. and Brooks, T. 2005. Phylogeny and conservation. Cambridge University Press.
Swofford, D.L., Olsen, G.K., Waddell, P.J. and Hillis, D.M. 1996. Phylogeny reconstruction. Pages 407-514 In Molecular Systematics (D.M. Hillis, C. Moritz, B.K. Mable, eds.). Sinauer Associates.
Yang, Z.H. 2006. Computational Molecular Evolution. Oxford University Press.

I: http://www.unil.ch/phylo/teaching/pmc.html

PLANT POPULATION GENETICS AND CONSERVATION

François Felber

C	Opt	English	7
S	1.50		

TP	Opt	English	10
S			

N: Master

SPATIAL MODELLING OF SPECIES AND BIODIVERSITY

Antoine Guisan

C	Opt	English	14
S	3.00		

E	Opt	English	14
S			

N: Master

P: If possible, course 'Spatial Analyses & GIS' (ANSPAT) in 1st semester of the Master (not strictly required).

O: Species distribution models (SDMs) are increasingly important in ecology and conservation biology. This course proposes an introduction to these models and related concepts and methods. Overview of the main steps of model building. Advantages and limitations. Applications to various domains (climate change, invasions, rare species, ...).

C: Chap. 1. Introduction to species' niche & distributions, and related models. Theory and principles behind these models. Competition and disperal limitations. Types of response variables, main predictive modelling approaches, field sampling design, from predicting species distributions to predicting communities.
Chap. 2. Model calibration. Presence-only versus presence-absence data, statistical theory and methods for presence-only data, regressions and classifications for presence-absence, ensemble modelling and forecasting.
Chap. 3. Model evaluation. Internal versus external evaluation. Data and metrics for evaluation. Crossvalidation, jackknife, bootstrap, uncertainties.
Chap. 4. Assumptions behind these models. Pseudo-equilibrium, niche conservatism, niche completeness, realized niche, and other postulates.

B: Guisan, A. & Zimmermann, N.E. (2000). Predictive habitat distribution models in ecology. Ecological Modelling 135(2-3): 147-186.
Guisan A, Thuiller W (2005) Predicting species distribution: offering more than simple habitat models. Ecology Letters, 8, 993-1009.
Guisan et al. (2013) Predicting species distributions for conservation decisions. Ecology Letters 16: 1424-1435.

I: http://www.unil.ch/ecospat

COMPARATIVE GENOMICS: FROM THOUSANDS OF GENOMES TO SINGLE CELLS

Roman Arguello

C	Opt	English	7
S	1.50		

E	Opt	English	7
S			

N: Master

EVOLUTIONARY CONSEQUENCES OF HYBRIDIZATION AND WHOLE GENOME DUPLICATION

Nils Arrigo

C	Opt	English	14
S	1.50		

N: Master

INTRODUCTION TO PRIMATE BEHAVIOUR, COGNITION AND CULTURE

Erica Van de Waal

C	Opt	English	10
S	1.50		

S	Opt	English	8
S			

N: Master

O: The first goal of this course is to give a general introduction into primate behaviour, with a special focus on primate cognition and culture. The topic will be developed in a comparative framework, with references to behaviours found in other animals as well as well highlighting behaviours shared between human and non-human primates and the ones unique to humans. This first part will give the general background to understand the articles that will be discussed in the seminar sessions. During the seminar, students will select articles to read and discuss together. This part aims at developing the critical thinking of students and the exchange between the students using concrete examples of research with conflicting findings. The course will train students to summarize, explain and discuss a paper during the final presentation in front of the class, as well as to develop ideas about potential future directions of the research on a specific topic.

C: This course will be composed of three main parts followed by seminar sessions.
1) Primate Behaviour. Here we will study briefly the bases of animal behaviour followed by a presentation of the diversity in the taxa Primates. Then we will study the specificities of Primate behaviour. We will investigates the topics of social structure, reproduction and life history. Later we will focus more on social relationships with lectures on competition and conflict management, communication and cooperation. All these topics will be discussed with a comparative approach to other animals and humans.
2) Primate Cognition. Here we will study the cognitive abilities of primates. We will investigate briefly the specificities of primate physical cognition and we will develop more on their social cognition. On this topic, we will study the abilities of primates to understand others' minds (theory of mind) and to exhibit strategic social behaviours like deception.
3) Primate Culture: Here we will study social learning mechanisms and strategies. We will investigate cases of conformity, traditions and culture in primates. This subject will highlight the specificities of human cultural behaviour as well as the shared roots with primates and other animals.
Additionally, a guest lecture will introduce students to principles of self-organised collective behaviour across taxa, from insects to fish and Humans.
During the seminar, students will choose a scientific article to read (alone or in groups depending on the number of students following the course). The papers will be discuss in the class. At the end of the seminar, all the students will present the main finding of their paper and potential future directions of research on the topic.

B: van Schaik, C. P. (2016). The primate origins of human nature (Vol. 2). John Wiley & Sons.
Clutton-Brock, T. (2016). Mammal societies. John Wiley & Sons.
Boyd, R., & Silk, J. B. (2014). How humans evolved. WW Norton & Company.

SCIENTIFIC COMMUNICATION - SCIENTIFIC HANDS-ON WORKSHOP MODULE

Alain Kaufmann, Philippe Reymond

C	Opt	French	14
S	3.00		

E	Opt	French	14
S			

N: Master

SCIENTIFIC MEDIATION AND COMMUNICATION - MUSEUM MODULE

Michel Sartori

C	Opt	English	6
S	3.00		

TP	Opt	English	22
S			

N: Master

P: None

O: This is a theoretical and practical course which will teach you how to write a text for an exhibition (scientific popularization). From original articles and textbooks to the exhibition content, several steps are required to make the exhibition attractive and accessible to a large audience. During this course, you will learn the basics of exhibition building, from content development to the elaboration of a mediation concept and a communication strategy.

C: After a 6 period's theoretical introduction, you will develop a personal project. This year, an due to the pandemia, we will propose general subjects linked to biology. We will propose individual subjects to be developed during the first lecture hours. We are also expecting from you to create a press release on your subject, as well as a mediation project.

THE ENVIRONMENT, ADDRESSED IN AN INTERDISCIPLINARY WAY.

Antoine Guisan, Pierre-Louis Rey

S	Opt	French	18
S	2.00		

N: Master

P: None

O: To give students a deep understanding of an environmental issue, animated for the most part through contributions from external visitors to UNIL.

C: Conferences are in french.
See french section for the 2019 programme.

B: Précisé par les intervenants de semaine en semaine

THE EVOLUTION OF COOPERATION : FROM GENES TO LEARNING AND CULTURE

Laurent Lehmann

C	Obl/Opt	English	28
S	3.00		

N: Master

O: What makes us such a unique species, able to cooperate in large-scale societies, organize social interactions, and dominate ecologically the Earth? The main goal of this course is to provide the foundations of social evolution, which consists of two main ingredients in humans: cooperation and cumulative cultural evolution. On one side, the course will thus focus on studying the main forces favoring and maintaining cooperation (mutually beneficial interactions, altruism) and conflict (cheating, malevolence, warfare) in group-structured populations. On the other side, we will study the forces behind cultural evolution, where behavior in interactions depends on genetic determinants, social learning, and individual learning ("gene-culture coevolution"). This will allow discussing the major steps in human social organization evolution, from primate autarky to division of labor in large-scale societies.

C: The course will be composed of five main parts and more focused on human behavior than the "Ecology and Evolution" class on which it builds:
(1) Cooperation and conflict in well-mixed populations. Here, we will study the evolution of cooperation (and cheating) in well-mixed population (no division into groups). We will study the standard one-shot social dilemmas illustrating the tension between self-interest and group-interest, like the prisoner's dilemma and the stag-hunt game. We will then investigate various settings of repeated interactions, where reputation dynamics between individuals are crucial to sustain long-term relationships.
(2) Cooperation and conflict in group-structured population. Here, we will study the forces shaping cooperation when interactions occur in group-structured populations (the rule in humans), and where the localization of the social interactions generates in the same time novel incentives to cooperate and novel incentives for spiteful behavior. We will also consider conflicts between groups and study warfare in small-scale hunter-gather societies.
(3) Social learning and gene-culture coevolutionary theory. Here, we will study the main modes of social learning ("cultural transmission"), which underlies cumulative cultural evolution that is the main determinant of the human lineage ecological success. We will also study gene-culture coevolution and how social learning impacts the dynamics of cooperation within groups.
(4) Individual learning and preferences. Here, we will discuss the main modes of individual learning that allow individuals to learn information about the relevant behavior to express on their own (e.g., trial-and error learning and related decision heuristics, maximizing behavior). We will investigate the conditions under which evolution may and may not lead individuals to become equipped with goal functions ("utility maximization behavior").
(5) Major transition from small to large-scale societies. Here, we will discuss the main evolutionary steps that took the human lineage in a 6 million year long co-evolutionary gene-culture ride from self reliant primate social organizations ("autarky") to large scale societies with extreme division of labor ("catallaxy"). This transition involved a zizag path from dominance, to egalitarianism, to inequality again.

SOCIAL GENETICS

Laurent Keller

C	Opt	English	2
S	1.50		

E	Opt	English	12
S			

N: Master

P: none

O: This course provides the opportunity to read about, synthesise and then discuss the state-of-the-art in two social genetics topics: How did eusociality evolve? And what determines caste-fate in social insects?

C: Students will be set a question and given recent scientific papers to read and write about and they will then participate in discussions on the topic with the other students. They will additionally have the opportunity to discuss with researchers working directly on the topics.

DRIVERS OF INVERTEBRATE BIODIVERSITY ALONG ECOLOGICAL GRADIENTS

Tanja Schwander

C	Opt	English	7
S	3.00		

T	Opt	English	49
S			

N: Master

P: Program requirement: Financial participation required by the student (approximately 700.-)

O: During this field course, we study different invertebrate taxa (mainly insects and gastropods) to understand the factors driving biodiversity and community composition, as well as the evolution of different life cycles under diverse ecological conditions in the Swiss Alps/Prealps.

C: Course content:
- Introductory lectures
- Excursions and group field work: analysis of community composition and biodiversity in various habitats
- Personal experiments (experimental design, data collection & analysis, presentation of results)
- Discussion of scientific papers

ECOLOGY AND FAUNISTICS OF THE SEA SHORE, ROSCOFF

Tanja Schwander

T	Opt	English, French	49
S	3.00		

C	Opt	English, French	7
S	3.00		

N: Master

P: Financial participation required by the student.
!!! Please, contact the person in charge before your inscription !!!

O: To allow a first, integrated approach of the itertidal biotope, and to understand the role played by the tides, the substrate and other conditions on the faunistic composition of littoral communities and on the physical and behavioural adaptations of the species.

C: Lecture (6 h): Introduction to intertidal ecology.
Excursions and group field work: analysis of zonation and biodiversity in various habitats (sand beach, rock, estuaries and so on). Additionnally, each student shall be responsible for the study of one taxonomic group.
Lab experimentations: experimental design and realisation of an experiment in etho-ecology illustrating adaptative behaviour of an intertidal species.

EVOLUTION AND BIOGEOGRAPHY OF SEMI-ARID AND ISLAND FLORAS

John Pannell

T	Opt	French	40
S	2.00		

N: Master

P: Financial participation required by the student.