Course list and detailed course descriptions

N.B. The course list may be subject to changes. The course list you will eventually see under your personal course list (TROPIMUNDO AIM-tool, menu 'Courses') will be the correct list. Any new courses in black do not have a course description yet and will be completed soon.

Following feedback of earlier generations of students, the optional course list has been expanded significantly. This resulted in the impossibility to schedule all optional courses without overlap and the responsibilisation of students to verify the course schedules and deal with overlaps. In general rule optional courses are never scheduled in overlap with compulsory courses, but some optional courses may overlap one another.

As long as the national security councils impose Covid-19 social distancing regulations, the number of students that can follow course on-campus may be limited or courses may take place online. Some courses are likely to adopt such blended learning permanently. You are free to contact the respective teacher to know which course parts are online or on-campus.

Course list per semester and per Partner Return to TOC

Courses separated by '**OR**' indicate that students need to choose between these specialised courses. Course and schedule changes may occur from year to year. The detailed course lists per semester can be reached by clicking on the respective partner in the first table below. Likewise, the detailed course descriptions can be reached by clicking on the course title links. However, please note the general comments at the start of the detailed course descriptions. Please refer to the Trajectories to understand the possible choices in the different TROPIMUNDO Trajectories. Finally, note that for certain optional courses student quota may exist or be imposed in a later stage.

Semester 1 (S1)	Semester 2 (S2)	Semester 3 (S3)	Semester 4 (S4)
ULB-VUB	UDEA UdA UCAD UDsch UNIVANTA UNIRé TUM RUH UMT UP UNC	SU-MNHN UNIFI UdG	All European Partners

S1 course list at the Université Libre de Bruxelles (ULB) and the Vrije Universiteit Brussel (VUB)

COMPULSORY:

	ECTS
MODULE: ULB	
Scientific presentation skills and career planning	3
Social-ecological systems	6

	ECTS
MODULE: VUB	
Analysis of biological data	6
Social-ecological systems	6

OPTIONAL (at least 15 ECTS to be chosen) :

	ECTS
MODULE: ULB	
The Earth system and its interactions[1]	5
Tropical parasitology and entomology	5
Marine ecology	5
Plant-soil interactions (not available in 2023-2024)	5
Biology of animal societies	5
Behavioural ecology in natural and man-made environment (not available in 2023-2024)	5
Plant responses to environmental stress	5
Pédologie et écosystèmes	5
Genomics, proteomics, evolution (Bioinformatics)	5
Biological invasions and management	3
Analyse et gestion des impacts environnementaux	5
Bioéthique et droit de la conservation	5
Cours ou stage hors ULB	5
Professionnal internship / Stage professionnel	15

[1] This course is compulsory if your S3 is at SU, MNHN or UdG (France), and optional if your S3 is at UNIFI. Note that in the latter case you will have the UNIFI S3 compulsory course 'Tropical climatology'.

N.B. Provided agreement by the inter-university jury the student can choose optional courses outside the proposed module, but accepting the risk of overlapping schedules.

	ECTS
MODULE: VUB	
Freshwater ecology	5
Marine ecology	5
Global change biology	6
Governance and policy in development and cooperation	3
Toxins in amphibians and reptiles	3
Terrestrial Ecology	6
Agroecology	3
Professionnal internship	12
Professionnal internship	6

N.B. Provided agreement by the inter-university jury the student can choose optional courses outside the proposed module, but accepting the risk of overlapping schedules.

Professional Internship courses can only be selected once throughout all semesters. Since it goes at the expense of theoretical and practical courses, it is subject to authorisation from the COFF. If it is in excess of the minimum number of ECTS credits required in a semester, and provided that the student has obtained good course marks in the past, it will always be authorised.

Please also consult the most recent versions of the course sheets directly on the ULB and VUB websites:
ULB: https://www.ulb.be/fr/programme/ma-bior
VUB: https://www.vub.be/en/study/biology/#programme

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Generic S2 course list (all Partners)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school (see detailed info below per study pole)	15
Geomatics (see detailed info below per study pole)	3
Skills and qualifications in tropical biodiversity (see detailed info below per study pole)	9
Thesis proposal	3

S2 FIELD SCHOOL (one to be chosen):

	ECTS
Universidad de Antioquia (Colombia) Tropical biodiversity and ecosystems field school: from montane to coastal ecosystems and landscapes	15
Université des Antilles (Guadeloupe) Tropical biodiversity and ecosystems field school: Caribbean insular ecosystems	15
Université Cheikh Anta Diop de Dakar (Senegal) Tropical biodiversity and ecosystems field school: West-African semi-arid Sahel ecosystems	15
Université de Dschang (Cameroon) Tropical biodiversity and ecosystems field school: Central African terrestrial ecosystems	15
Technical University of Mombasa (Kenya) Tropical biodiversity and ecosystems field school: East-African ecosystems	15
Université d'Antananarivo (Madagascar) not in academic year 2023-2024 Tropical biodiversity and ecosystems field school: Malagasy forest ecosystems	15
Université de La Réunion (Reunion Island)	15

	ECTS
Tropical biodiversity and ecosystems field school: Tropical forest ecosystems of Reunion Island and the South West Indian Ocean Region	
University of Ruhuna (Sri Lanka) Tropical biodiversity and ecosystems field school: Sri Lankan terrestrial and aquatic ecosystems	15
Universiti Malaysia Terengganu (Malaysia) Tropical biodiversity and ecosystems field school: Malaysian mangrove ecosystems	15
Unibersidad ng Pilipinas (Philippines) Tropical biodiversity and ecosystems field school: terrene, palustrine and marine habitats of the Western Pacific	
Université de la Nouvelle Calédonie (New Caledonia) Tropical biodiversity and ecosystems field school: biodiversity and habitats of the South-Pacific archipelago of New-Caledonia	15

Detailed S2 course list at Universidad de Antioquia (UDEA) UNDER CONSTRUCTION

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: from montane to coastal ecosystems and landscapes	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Course 1	
Course 2	
Course 3	
…	

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Detailed S2 course list at Université des Antilles (UdA)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Caribbean insular ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Introduction à l'écotoxicologie	3
Ecologie comportementale	3

	ECTS
Interactions durables	3
Ecophysiologie en milieu contraint	3

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Detailed S2 course list at Université Cheikh Anta Diop de Dakar (UCAD)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: West-African forest, savanna, wetland and other Sahel ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Biodiversité ichtyologique	3
Biodiversity conservation : issues, challenges and assessment methods	3
Biologie et Écologie des poissons d'eaux douces Africains	3
Biostatistique	3
In vitro culture and cryopreservation at the service of biodiversity	3
Initiation à l'ethnobotanique quantitative	3
Biodiversité et fonctions des Insectes dans les écosystèmes tropicaux	3

Detailed S2 course list at Université de Dschang (UDsch)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Central African terrestrial ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Phylogénie et systématique	5
Ecosystèmes aquatiques (incl. Ecologie des milieux humides tropicaux)	5
Biodiversity conservation*	3
Natural resource evaluation methods*	3
Ecosystèmes terrestres (incl. Ecologie Forestière, Sylviculture tropicale)	5
Socio-economic analysis and elaboration of a management plan for forests and community forests*	3
Forest management and certification*	3
Ethnobotanique (incl. Plantes mellifères, pollens et production des miels, Plantes Médicinales et ethnopharmacologie, Méthodes et techniques ethnobotaniques)	5
Ethnobotanique et valorisation des ressources naturelles*	3

* decided on a yearly basis whether or not these courses will be taught.

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Detailed S2 course list at Technical University of Mombasa (TUM)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: East-African ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Behavioural ecology of tropical wildlife	3
Wildlife habitat management	3
Tropical savanna ecosystem and biodiversity	3
Wetland ecology and management	3
Tropical coastal biodiversity and resource conservation	3
Tropical coastal resource assessment and monitoring tools	3
Tropical coastal and marine fisheries resources	3
Restoration of tropical coastal and marine ecosystems	3
Coastal settlement and infrastructure development	3

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Detailed S2 course list at Université d'Antananarivo (UNIVANTA) **not in academic year 2023-2024**

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Malagasy forest ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Floristic biodiversity of Madagascar	3
Terrestrial fauna biodiversity	3
Biogeography	3
Primatology: evolution of extant malagasy prosimians - parasites and primates behavior	3
Biodiversity offset	3
Fundamental bases ethnobotany and indigenous and local knowledge	3
Applied Palynology	3
Wood anatomy in the tropics	3
Plant reproductive ecology and pollination in the tropics	3

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Detailed S2 course list at Université de La Réunion (UNIRé)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Tropical forest ecosystems of Reunion Island and the South West Indian Ocean Region	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of the following modules:

	ECTS
Ecological data analysis	3
Tropical plant health ecology and management	3
Molecular evolution	3

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Detailed S2 course list at University of Ruhuna (RUH)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Sri Lankan terrestrial and aquatic ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Biodiversity of wetlands in Sri Lanka, conservation and policies	3
Wood science and technology	3
Plant physiology, biochemistry and plant breeding techniques	3
Ecotoxicology and Environmental science	3
Coastal zone management	3
Indigenous knowledge on plant science	3
Forest ecology and management	3
Microbial ecology	3
Ecology of tropical marine systems	3

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Detailed S2 course list at Universiti Malaysia Terengganu (UMT)

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: Malaysian mangrove ecosystems	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Estuarine and mangrove ecology	3
Conservation of marine endangered species	3
Tropical oceanography	3
Lake and Terrestrial ecology	3

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Detailed S2 course list at Unibersidad ng Pilipinas (UP) UNDER CONSTRUCTION

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: terrene, palustrine and marine habitats of the Western Pacific	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Biodiversity and Conservation Biology	3
Restoration Ecology	3
Advanced Ecology	3

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Detailed S2 course list at Université de la Nouvelle Calédonie (UNC) UNDER CONSTRUCTION

COMPULSORY:

	ECTS
Tropical biodiversity and ecosystems field school: biodiversity and habitats of the South-Pacific archipelago of New-Caledonia	15
Geomatics	3
Thesis proposal	3
Skills and qualifications in tropical biodiversity	9

Skills and qualifications in tropical biodiversity is composed of a combination of the following modules:

	ECTS
Integrated management of water and the land-sea continuum	4
Pacific studies and gender perspectives	4
Echantillonnage et analyse de données environementales multivariées	4

	ECTS
…	

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S3 course list at the Sorbonne Université (SU) and the Muséum National d'Histoire Naturelle (MNHN)

RECOMMENDED :

	ECTS
Initiation aux techniques avancées de collecte et d'inventaire systématique	3
Diversité et histoire des lignées chlorophyliennes (DIVEG)	6
Xylologie-paléoxylologie: systématique et paléoécologie	3
Floristique tropicale (FLORATROP)	3
Ecologie Tropicale (ECOT)	6

OPTIONAL (at least 6 ECTS to be chosen):

	ECTS
Exploration et description de la biodiversité	3
Taxinomie et nomenclature	3
Formalisation des connaissances en systématique et paléobiodiversité	3
Morphologie cladistique informatisée	3
Phylogénie moléculaire	6
Biodiversity informatics	6
Modélisation des formes et analyse des données morphométriques	3
Enjeux patrimoniaux, économiques et scientifiques de la connaissance des espèces	3
Partenaires institutionnels et associatifs de la gestion et de la conservation de la biodiversité	3
Ecologie moléculaire et génétique évolutive des organismes marins	6
Origines de la vie	3
Biogéographie Paléobiogéographie	3
Enjeux professionels en ingénierie écologique et biologie de la conservation	3
Gestion des populations et écosystèmes	6
Structure et histoire paléontologique des clades de Métazoaires	3
Phylogénie des Métazoaires: evolution des plans d'organisation	3
Les crises biologiques: comprendre le passé et l'actuel	3
Ecologie de la restauration	3
Fonctionnement et dynamique des socio-écosystèmes	6
Etnoécologie	3
Evolution des cycles de vie	6
Ecologie et évolution des intéractions hôte-parasite	3
Morphométrie et analyses des formes	3
Morphologie fonctionnelle: évolution et adaptation	3
Conservation ex-situ	3
Gestion et conservation des ressources marines exploitées	3
Ecologie et fonctionnement des écosystèmes côtiers	6

Climat et biotope (c/o Grandes Questions Environnementales)	3

Sciences de la nature et de l'homme : histoire des idées	6
Droit du patrimoine naturel in situ et ex situ	3
Anatomie comparée	3
Diversité des génomes	3

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S3 course list at the Università degli Studi di Firenze (UNIFI)

COMPULSORY:

	ECTS
Applied Conservation Biology	6
Ecosystem Services and Climate Change	6
Advances in tropical botany	6
Tropical climatology	6

OPTIONAL (at least 12 ECTS to be chosen):

	ECTS
Landscape analysis (incl. Methods in Landscape Analysis and Pedology)	6
Methods in animal ecology and evolution (incl. Analysis of ecological communities and Animal phylogeography)	6
Tropical plants in action	6

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S3 course list at the Université de Guyane (UdG)

COMPULSORY:

	ECTS
	ECTS
Introduction à l'environnement tropical	8
Origine et maintien de la biodiversité	4
Modelisation des systèmes éologiques	4
Botanique évolutive et écologie fonctionnelle	7
Gestion des forêts tropicales	5
Professionalisation	2

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S4 course list at ULB-VUB, SU, MNHN, UNIFI, UdG, UdA, UNIRé and UNC

	ECTS
Thesis	30

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Detailed course descriptions

In addition to the course lists per partner and per semester in the section above, for each course a separate course sheet is displayed on each page below. The courses follow approximately the same order as the above course lists per partner, but aggregate S1 and S3 (*i.e.* all S1 and S3 courses given by one and the same partner are displayed in a single list).

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Specific comments

Specific comment with respect to the course breakdown and hours

The following abbreviations are used:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS

Specific comment with respect to the learning outcomes

In a majority of the cases the learning outcomes below are purely the educational learning outcomes of the specific course.

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Specific comment with respect to the prerequisites

Each of the courses below require a **Bachelor's degree** (*i.e.* the equivalent of 180 higher education credits) with a **major in Biology**, **Natural Sciences**, **Environmental Sciences**, **or equivalent** from an **accredited university**, as well as **proficiency in English and/or French** (depending on the Trajectory) equivalent to Common European Framework of Reference for Languages (CEFR) level B2. However, these two prerequisite are not repeated for each course due to their self-evidence. Therefore the prerequisites for the courses below only link to TROPIMUNDO-taught courses. 'None' as a prerequisite implies that students do not need to have followed any TROPIMUNDO courses, but as a matter of fact they will still need to hold a Bachelor's degree.

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Specific comment with respect to the assessment breakdown

For courses assessed by two different means (*e.g.* written report and oral presentation), the general rule is that the student is required to pass both parts with success in order to pass the course. Our consortium works by the principle of an achievement of competences, not by balancing personal forces against personal weaknesses.

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Course descriptions at Université Libre de Bruxelles (ULB) and Vrije Universiteit Brussel (VUB)

Course title: Analysis of Biological data
Course ID: WE-DBIO-10131
University: Vrije Universiteit Brussel
Faculty: Faculteit Wetenschappen en Bio-ingenieurswetenschappen / Sciences and Bio-engineering Sciences
Department: Biologie
Name and e-mail address of the instructor(s): Bram Vanschoenwinkel (Bram.Jasper.Vanschoenwinkel@vub.be)
Course website:
http://www.vub.be/en/study/biology/programme/r/master-of-science-in-biology/27767/emmc-tropical-biodiversity-and-ecosystems
Semester: S1
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 13 hrs
- Exercises: 39 hrs

Course objectives:
The aim of the course is to acquire insight in a number of non-parametric tests as an alternative to the parametric approaches for data analysis.
In the second part we will focus on a number of multivariate techniques. The focus is on when and how these techniques can be applied, what kind of conditions that should be verified, and how the results can be interpreted.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods and tools

Students should be able to manage numerical information using the main basic elements of data management as well as to identify the properties of the sample space with the aim to apply more structured methods (multivariate analysis, geostatistical analysis, time series analysis). They should be able to use specific statistical software such as Statistica, Statview, and/or SPSS.

Course material, text books and further reading:
Multivariate Data Analysis with Readings, J .F. Hair, R.L. Tatham, R.E. Anderson, W.C. Black, Macmillan Publishing Company, New York, 1998
Applied Multivariate Techniques, S. Sharma, John Wiley & Sons, Inc., New York, 1996.
The analysis and interpretation of multivariate data for social scientists, D.J. Bartholomew, F. Steele, I. Moustaki, J.I. Galbraith, Chapman & Hall, Lonon, 2002, http://www.assess.com/Books/b-82956.htm

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Many biological data do not meet the basic conditions for applying parametric tests (normality of the distribution, homogeneity of the variances, etc...) Non-parametric approaches may offer a solution in those cases. The following non-parametric tests, based on the rank order or the empirical distributions, will be explained: Mann-Whitney, Kolmogorov-Smirnov one-sample and two-sample test, Wilcoxon signed ranks test, Spearman rank order and Kendall rank order correlations.

Many observations and experiments in Biology result in a large number data that require simultaneous analysis. It is here that multivariate analysis provides essential tools for optimal exploration and exploitation of the research results.

This course is an application-oriented introduction to some multivariate techniques that are often used in the field of Biology. The focus lies on the concepts of these techniques without much emphasis on the mathematical background of the methods. For each of the multivariate techniques considered in the course we explain:
- What does the technique do and what is the basic principle of the method?
- For what kind of data is the technique appropriate?
- What are the conditions for applying the technique?
- How can and should we interpret the results?

The course is illustrated with examples from the scientific literature where multivariate analysis was the basic methodology. The following techniques are discussed: multiple regression analysis, principal component analysis, discriminant analysis, logistic regression, cluster analysis. Wherever possible, the course will be illustrated with worked-out examples and output from specific statistical software such as Statistica, Statview, and SPSS.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 100%

Course title: The Earth system and its interactions
Course ID: GEOG-F-400-B
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Géographie
Name and e-mail address of the instructor(s): François Fripiat (François.Fripiat@ulb.be)
Course website:
http://banssbfr.ulb.ac.be/PROD_frFR/bzscrse.p_disp_course_detail?cat_term_in=201112&subj_code_in=GEOG&crse_numb_in=F400&PPAGE=ESC_PROGCAT_AREREQ&PPROGCODE=MA-BIOR&PAREA=BIOR4T&PARETERM=201112&PTERM=201112
Semester: S1
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 24 hrs

Course objectives:
Give a global view of the main characteristics of the fluid envelopes (incl. climate) of the Earth and of the complex interactions that govern their behavior and interactions.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Environment Biological level: Global

Be able to describe Earths water budget and climate and link it to processes on a regional scale described in the table of contents below.

Course material, text books and further reading:
Powerpoint presentation, available for the students on the intranet

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
This course outlines the "modus operandi" of the various fluid envelopes of the Earth (atmosphere, ocean, ice) and discusses their interactions. After a review of the various phenomena involved in the radiative energy balance of the Earth and their consequences on the vertical structure of the atmosphere and the latitudinal distribution of energy fluxes, we describe adiabatic processes in the atmosphere and their implications for clouds formation. The main features of the atmospheric circulation are discussed (Coriolis, winds and pressure, Hadley cells, Walker circulation, subpolar jet stream and associated fronts, local winds). The second section of the course focuses on the Oceans. It introduces the principles of ocean thermodynamics and dynamics, illustrating their application with some simple and concrete examples of ocean circulation: thermohaline circulation, zonal circulation, regional circulations. The third part of the course deals with the study of the Cryosphere. We successively review the processes of natural ice formation, the basic principles of ice dynamics, the thermal regimes of glaciers and ice sheets, and the interactions between the cryosphere and the ocean (ice shelves, sea ice and marine ice). A separate chapter is devoted to the cryospheric archives of the environment, and how they are used to reconstruct many of the past environmental variables (temperature, relative humidity, precipitation, volcanic activity, wind, vegetation cover, atmospheric composition ...). It also briefly discusses the different assumptions for the growth of large ice sheets during the transition from warm interglacials to cold glacials. A final chapter addresses the permafrost regions. It presents their spatial distribution, the temperature profiles with depth and the concept of fossil permafrost, the influence of local configuration (lakes, peat, vegetation, substrate type ...). We also discuss the various process of ice formation in the soil, and how they evolve in favor of either aggradation or degradation of permafrost, with their associated socio-economic consequences. The practical work involved in this course are exercises on concepts introduced in the

theory: radiation balance and cloud types, interpretation of aerologic diagrams, interpretation of ocean T ° / Salinity / Density profiles in terms of hydrodynamic conditions, mass balance and zonation in glaciers, basal conditions in glaciers and melting point, interpretations of isotopic diagrams of deep ice cores, analyses of sedimentary structures

Assessment breakdown:	please note the general comment on assessment breakdown
Oral assessment: 100%	

Course title: Social-Ecological Systems
Course ID: ULB BIOL-F4005 / VUB 4018749FNR
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Farid Dahdouh-Guebas (Farid.Dahdouh-Guebas@ulb.be)
Course website:
Semester: S1
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:

THE	TP	EX	EXC	STG	PRJ	SEM	PRS
30 hrs		6 hrs	12 hrs		12 hrs		

In the course schedule the exercises will be scheduled on the same time slot as the theoretical lectures. A conference excursion will be organised but the exact date changes every year.

Course objectives:
Aims and objectives:
1. To provide an overview of the constituents and theory (conceptual, analytical) underlying large-scale social-ecological systems (SES);
2. To understand diversity, redundance, stability, hysteresis and resilience in a functional ecological context and in a sustainability context;
3. To understand the ecological and social-ecological functioning of selected SES;
4. To zoom in on the mangrove forest as a SES and:
4A. To understand the ecological and social-ecological relationships within mangroves and between mangroves and adjacent ecosystems;
4B. To understand the consequences of anthropogenic threats to this SES;
4C. To understand the scientific approaches and tools to monitor, manage and restore this SES.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to understand the constituents of a SES and to track down the ecological consequences on different sublevels (environment, fauna and flora) of anthropogenically induced changes on tropical coastal biodiversity and ecosystems, and must be able to situate the environmental problems in a holistic context (relationship with socio-economical factors).

Course material, text books and further reading:
- **Berkes**, F., J. Colding & C. Folke, **2003**. *Navigating Social-Ecological Systems. Building resilience for complexity and change*. Cambridge University Press, Cambridge, UK. 393 pp.
- **Carson**, W. & S. **Schnitzer**, **2008**. *Tropical Forest Community Ecology*. Wiley Blackwell, Oxford, U.K. 517 pp.
- **Chapin III**, S.F., G.P. Kofinas, C. Folke & M.C. Chapin, **2009**. *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World*. Springer Science, Dordrecht, The Netherlands. 402 pp.
- **Gunderson**, L.H. & L. **Pritchard** Jr., **2002**. *Resilience and the Behavior of Large-Scale Systems*. Island Press, Washington D.C., US. 287 pp.
- **Gunderson**, L.H., C.R. Allen & C.S. Holling, **2009**. *Foundations of Ecological Resilience*. Island Press, Washington D.C., US. 496 pp.
- **Hogarth**, P., **2007**. *The Biology of Mangroves and Seagrasses.* Oxford University Press Inc., Oxford, UK. 273 pp.
- **Waycott**, M., K. McMahon, J. Mellors, A. Calladine & D. Kleine, **2004**. *A guide to Tropical Seagrasses of the Indo-West Pacific.* James Cook University, Townsville, Australia. 72 pp.
and current international research publications

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
The course structure follows a zoom from theoretical introduction (concepts, analytical tools) towards a global overview of SES and finally towards the mangrove forest as a model SES.

Understanding change and ecosystem management:
- definitions linked to SES, systems ecology and adaptive cycles;
- ecosystem services.

Social-ecological change, governance and stewardship:
- Ecological resilience and social-ecological resilience;
- Social-ecological governance and transformations in ecosystem stewardship;
- Adaptive management.

Ecological and socio-ecological individual-based models

Complexity at several levels in biology and ecology:
- Feedbacks and feedback networks from cells to ecology
- Dynamics and stationarity
- Hysteresis and multistationarity
- Thresholds
- Spatial patterns
- Rhythms
- Waves
- Chaos

Mathematical basis for understanding complexity and change:
- Equations
- Simulations
- Models

Complexity and resilience in social insects

Complexity and social-ecological resilience in forest systems

Complexity and social-ecological resilience in dryland systems

Complexity and social-ecological resilience in freshwater systems

Complexity and social-ecological resilience in oceans and estuarine systems

The mangrove forest as a SES, describing constituents and relationships), the links with man and integrated research.
Part I ▫ Mangrove forests and their biocomplexity ▫ Distribution of mangrove forests,; ▫ Faunal and floral biodiversity, incl. morphological, physiological and ethological adaptations to tropical environments and to intertidal and marine life; ▫ Ecological mutual benefits between between mangrove forests, and their adjacent tropical rainforests, seagrass beds and coral reefs; ▫ Food webs and trophic relationships;
Part II ▫ Ethnobiology and anthropogenical impacts on mangroves and adjacent ecosystems ▫ Social, economical and cultural values and services of mangrove forests – mangroves as a model SES; ▫ Anthropogenically induced threats on one or more ecosystems and the consequences for the other ecosystems; ▫ Local vs. global patterns of change.

Part III ▫ Scientific research tools ▫ Monitoring, modelling and experiments (incl. management, restoration and conservation); ▫ The use of remote sensing and GIS; ▫ Combinatory and multivariate analyses; ▫ Essentials of tropical habitat management ▫ Case-studies and management guidelines with respect to mangroves as a SES.

Assessment breakdown: please note the general comment on assessment breakdown
Role-Play Simulation: 40%
Oral assessment: 60% (theory, paper discussion, individual-based model discussion)

Course title: Freshwater ecology
Course ID: WE-DBIO-14575 / BIOL-F-458
University: Vrije Universiteit Brussel / Université Libre de Bruxelles
Faculty: Faculteit Wetenschappen en Bio-ingenieurswetenschappen / Sciences and Bio-engineering Sciences / Sciences
Department: Biologie / Biologie des Organismes
Name and e-mail address of the instructor(s): Iris Stiers (Iris.Stiers@vub.be)
Course website:
http://www.vub.be/en/study/biology/programme/r/master-of-science-in-biology/27767/emmc-tropical-biodiversity-and-ecosystems
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
24		12					

Course objectives:
Review the interactions of abiotic and biotic aspects of rivers and lakes.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

After having successfully completed this course, the student should be able to:
- form an idea of the diversity of the geomorphological aspects and chemical composition of aquatic ecosystems
- know the role of functional groups (bacteria, phytoplankton, macrophytes, periphyton, zooplankton, zoobenthos, fish, birds)
- explain the main processes of a lake ecosystem as a function of seasonal variations and vertical gradients
- understand the way in which running waters function as an ecosystem to organisms
- interpret foodweb interactions and interpret field research results and experimental evidence

Course material, text books and further reading:
All illustrations used and a relevant text will be made available and should be complemented with individual notes. Recommended textbooks are **Kalff** Jacob (**2001**) *Limnology*. Prentice Hall; **Lampert** Winfried, **Sommer** Ulrich (**1997**) *Limnoecology: the ecology of lakes and streams*; Review articles and recent papers from scientific journals

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Selected contents on the introduction in freshwater ecology are about the distribution of water in the biosphere, the origin and age of lakes, the lake morphometry and catchment properties. The abiotic frame of standing or slow flowing aquatic systems is given by the characteristics of water, the salinity and ion composition, dissolved inorganic carbon, light under water, lake stratification and related oxygen conditions, redox reactions and nutrient cycling. The abiotic frame in rivers is given by the structural properties, catchment properties, physical characteristics, the chemical characteristics, daily and seasonal changes in physical and chemical characteristics. The ecology of temperate rivers and lakes are compared to tropical ecosystems.

The considered biotics are the phytoplankton, bacteria and viruses, benthic primary producers, zooplankton, zoobenthos (macroinvertebates in running waters), fish, water birds and amphibia. Their relationship with abiotics, the osmotic pressure problems for animals, functional groups and biotic interactions are discussed in

the context of various food web interactions. Emphasis is on shallow lakes and the concepts of cascading trophic interactions, alternative stable lakes, microbial loop, niche shifts, succession patterns, short term autogenic succession, long term succession, ageing and trophic concept of lakes. The anthropogenic influences on biodiversity and on natural processes are worked out for effects of eutrophication and of highly invasive exotic species. Important applied aspects of limnology are given on the principles of biomonitoring ecological water quality of rivers, the biomanipulation of shallow lakes, the properties of tropical lakes and the aquatic weed management.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 100%

Course title: Marine ecology
Course ID: BIOL-F-417 / WE-DBIO-5542
University: Vrije Universiteit Brussel / Université Libre de Bruxelles
Faculty: Faculteit Wetenschappen en Bio-ingenieurswetenschappen / Sciences and Bio-engineering Sciences / Sciences
Department: Biologie / Biologie des Organismes
Name and e-mail address of the instructor(s): Anton Van De Putte (anton.van.de.putte@ulb.be) and Marc Kochzius (Marc.Kochzius@vub.be)
Course website:
http://www.vub.be/en/study/biology/programme/r/master-of-science-in-biology/27767/emmc-tropical-biodiversity-and-ecosystems
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 9 hrs
- Excursions: 9hrs

Course objectives:
To provide a sound introduction to biotic and abiotic proceses controlling marine ecosystems

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

After this course the student will have a general overview on oceanography and the most important marine ecosystems and know how to search for data sources to supplement the learning material, make an analysis and synthesis of the course material and present and transfer the acquired knowledge

Course material, text books and further reading:
• Lecture slides
• Castro P, Huber ME (2010) Marine biology. MacGraw-Hill, New York, 8. Edition
• Thurman HV, Trujillo AP (2004) Introductory oceanography. Pearson Prentice Hall, New Jersey, 10. Edition
• Nybakken JW, Bertness MD (2004) Marine biology – an ecological approach. Pearson Benjamin Cummings, San Francisco, 6. Edition
• Kaiser et al. (2005) Marine ecology – processes, systems, and impacts. Oxford University Press, Oxford

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Physical and chemical properties of sea water. Introduction to oceanic circulation and climate impact. Processes controlling pelagic ecosystems. Processes controlling benthic ecosystems. Examples of pelagic and benthic ecosystems: the Antarctic ocean, seagrass beds, coral reefs.

Selected topics in marine biology: adaptations of algae to hydrodynamism; recruitment of marine larvae: a case study with sea urchins; adhesion and adhesive substances in the marine environment, introduction to marine microbiology

This course also provides an overview on the history of marine research and technology, oceanography (incl. intertidal zones, estuaries, the continental shelf, the open ocean and the deep sea) and dicusses human impact on them.

Assessment breakdown: breakdown Oral assessment: 100%	please note the general comment on assessment

Course title: Tropical parasitology and entomology
Course ID: BIOL-F-428
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Yves ROISIN (Yves.Roisin@ulb.be)
Course website: http://www.ulb.ac.be/catalogue-ancien/sciences/cours/BIOL-F-428-en.html
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 18
- Projects: 18

Course objectives:
Integrated pest management (IPM) and methods of control avoiding chemical insecticides in tropical regions. To collect and summarize up-to-date information about a particular tropical insect pest problem, with the perspective of eventual management.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Community

To pinpoint and illustrate by examples the special difficulties encountered in tropical regions regarding management of insect pests.

Course material, text books and further reading:
Web site: FAO, Plant production & protection: http://www.fao.org/waicent/st/level_1.asp?main_id=13 Crop Protection Compendium (CD-set). CABI, Wallingford, UK. Handbook of Pest Management in Agriculture (3 volume-set). D. Pimentel (editor). CRC Press, 1981. Pests of Crops in Warmer Climates and Their Control. D.S. Hill. Springer Verlag, 2008.

Prerequisites: please note the general comment on prerequisites
Good notions of general entomology

Table of contents:
Generalities.
Tropical climates.
Particularities of tropical conditions for agriculture.
Pesticide use in the tropics
Generalist pests: mites, sap-sucking insects, generalist moths, migratory locusts, social insects.
Biology, damage, economical impact, control methods
Pests of cereals.
Pests of fruits and fruit trees.
Forestry pests
Examples of recent pest outbreaks
Conclusions.
Precautions and management methods.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Biology of animal societies
Course ID: BIOL-F-455 / WE-DBIO-12585
University: Université Libre de Bruxelles and Vrije universiteit Brussel
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Yves ROISIN (Yves.Roisin@ulb.be)
Course website:
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 36 hrs
- Exercises: 12 hrs

Course objectives:
The question behind this course is 'How did animal societies evolve, from loose aggregations or basic mother-offspring groups to highly complex army ant colonies or baboon troops ?'

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Community

Students are expected to acquire (1) an overall view of the diversity of social organization pattrens in animals, (2) a basic theoretical knowledge of how natural selection acts upon animal societies, and (3) the ability to identify such selective pressures through the formulation and testing of hypotheses and predictions.

Illustrated lectures. Personal essay: each student will read in detail a scientific paper related to the social behaviour of a selected animal species, and summarize theoretical background, aim of the study, results and conclusion (take-home message), course taught in English.

Course material, text books and further reading:
Sociobiology: The New Synthesis. E.O. Wilson. Harvard University Press, 1975. Les Sociétés Animales. S. Aron, L. Passera. De Boeck Université, 2000.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Levels of sociality ▫ Theoretical introduction natural selection in animal societies: altruism and selfishness, reciprocity, kinship, inclusive fitness, etc ▫ Levels of sociality ▫ Sociality in Arthropods. From simple parental behaviour to complex termite colonies ▫ Social Hymenoptera: theoretical implications of haplodiploidy ▫ Evolution of highly social bees, wasps and ants ▫ Skew models ▫ Cooperatively breeding vertebrates. Kin selection, parental manipulation, reproductive skew, and importance of ecological conditions: examples from cichlid fishes and birds ▫ Mammals. Examples from social carnivores and primates. Insect-like sociality in rodents (mole-rats). Conclusions: common features of all animal societies. Methods of investigation in sociobiology.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Governance and policy in development and cooperation
Course ID: WE-DBIO-14386
University: Vrije Universiteit Brussel
Faculty: Faculteit Wetenschappen en Bio-ingenieurswetenschappen / Sciences and Bio-engineering Sciences
Department: Biologie
Name and e-mail address of the instructor(s): Nico Koedam (nikoedam@vub.be)
Course website:
http://www.vub.be/en/study/biology/programme/r/master-of-science-in-biology/27767/emmc-tropical-biodiversity-and-ecosystems
Semester: S1 or S3
Tuition language: English
Student quota: annually variable (contact instructor at the onset of the academic year)
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 12
- Exercises: 12

Course objectives:
General
- Evaluate the societal relevance (I)
- Evaluate the scientific relevance (II)
- Report in various ways (III)

Field specific
- Problem solving as a thinking process (IV)
- Extrapolation between different scientific fields (VI)
- Recognize and work out bio-ethical implications (VII)

The course objectives are not targeted to one particular scientific discipline, but intend to set the framework of successful translation of scientific data and scientific theory to governance and policy, with an emphasis on aquatic and semi-terrestrial systems in developing countries.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Course material, text books and further reading:
No specific textbook is used. Besides recent material from the literature and media, the following books can be useful:
Rist G 2008 The history of development. From Western origin to global faith. ZED Books, London
Sachs W (ed.) 2010 The development dictionary. ZED Books, London.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Within the wide field covered by the course title, specifically attention is paid to frameworks that facilitate or impede the translation of science to policy and governance. Target systems and areas for this course are the aquatic and semi-terrestrial systems in tropical and subtropical developing countries. The course is given in the perspective of a scientist and addresses an audience of scientists.

The course covers two different aspects : a conceptual part and a practical part.

For the conceptual part, specific problems that may be dealt with are: scientific uncertainty vs. governance and policy, commons and the public/private debate in environmental management, the scientist's responsibility and the value of science or scientific data, the value of biological resources in view of governance and policy.

For the practical part surveys are made of relevant international bodies, agreements, treaties and other tools, donor agencies.

The work forms comprise: lectures, seminars by or interviews with societal sectors or actors. For the external seminars a wide coverage of political levels and geographical regions is offered (NGO, regional government, national government, EU,…). Since many students already have a professional background, this expertise can be introduced in debate and dialogue.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 100%

Course title: Plant-soil interactions
Course ID: BIOL-F-444 / WE-DBIO-12596
University: Université Libre de Bruxelles and Vrije Universiteit Brussel
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Pierre MEERTS (Pierre.Meerts@ulb.be)
Course website:
http://banssbfr.ulb.ac.be/PROD_frFR/bzscrse.p_disp_course_detail?cat_term_in=201112&subj_code_in=BIOL&crse_numb_in=F444&PPAGE=ESC_PROGCAT_AREREQ&PPROGCODE=MA-BIOR&PAREA=BIOR5T&PARETERM=201112&PTERM=201112
Semester: S1 or S3
Tuition language: English
Student quota: max. 10 students
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 24 hrs
- Exercises: 12 hrs

Course objectives:
To analyse the role of plant-soil interactions on plant community structure and ecosystem functioning. To examine the influence of soil limiting factors, especially toxic mineral elements, on plants.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Organism

To be able to critically discuss the role of plant-soil interactions on plant community structure and ecosystem functioning. To be able to propose specific working hypotheses, to design simple experimental protocols to test them, and to propose appropriate statistical tests.

Course material, text books and further reading:
Course notes.
W. H. **Schlesinger**, **1997**. *BIOGEOCHEMISTRY: An Analysis of Global Change*, Academic Press, 1997.
Chapin, Matson, and Mooney, **2002**. *Principles of Terrestrial Ecosystem Ecology*. Blackwell.
Lambers, H., F. S. Chapin III, and T. L. Pons **1998**. *Plant physiological ecology*. Springer-Verlag, Berlin.

Prerequisites: please note the general comment on prerequisites
Elements of ecology
None

Table of contents:
Variation of plant mineral element concentrations: genetic and environmental factors. Influence of plants on biogeochemical cycles in terrestrial environments Adaptation of plants to low nutrient soil. Adaptation and evolution on geochemical anomalies. Biotic interactions in the soil and their role in biological invasions. Influence of soil on species richness of plant communities.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100% (including discussion of scientific paper)

Course title: Behavioural ecology in natural and man-made environment
Course ID: BIOL-F-436 / WE-DBIO-14359
University: Université Libre de Bruxelles and Vrije Universiteit Brussel
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Claire DETRAIN (Claire.Detrain@ulb.be)
Course website:
http://banssbfr.ulb.ac.be/PROD_frFR/bzscrse.p_disp_course_detail?cat_term_in=201112&subj_code_in=BIOL&crse_numb_in=F436&PPAGE=ESC_PROGCAT_AREREQ&PPROGCODE=MA-BIOR&PAREA=BIOR4A&PARETERM=201011&PTERM=201112
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 36 hrs

Course objectives:
To get an overwiew of current trends in behavioural ecology with an emphasis on animal communication and its evolution. To understand the ultimate and proximate causes driving the behaviour of animal species in their natural environement To provide a comparative analysis of the main vectors of information and to discuss about their biological function mainly in insects and vertebrates.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Population

The student should be able:
- to discuss the mechanisms and constraints that impact the behavioral strategies of animals in natural populations
- to form an idea of the diversity of communication at different biological levels (individual, populations, communities)
- to understand how animals process information and make adaptive decisions
- to critically analyze data in the field of behavioural ecology and ethology.

Course material, text books and further reading:
Kreb, J.R. & N.B. Davies, 2000. *An Introduction to Behavioural Ecology*. Wiley Blackwell. 200 pp.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Historical background and main trends in Behavioural Ecology. Analysis of foraging and habitat selection within a behavioural ecology perspective. Definition of communication and language. Comparative study of communication vectors (acoustical, visual, chemical). Sensory channels and perception. Structures and function of signals and cues. Cognition and linguistic abilities in animals. Introduction ot information theory. Information transfer and collective decision in animal societies.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Global change biology
Course ID: 4020582FNR
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Thomas Merckx (Thomas.Merckx@vub.be)
Course website: https://www.vub.be/en/study/fiches/55764/global-change-biology
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 13 hrs
- Seminars, exercises, practicals, field training: 6 hrs
- Independent or external form of study: 7 hrs

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Global

Upon successful completion of the course the student must have:
- acquired a broad understanding of the connection between human activities and the structure and function of biological systems
- enhanced the ability to engage primary research and synthesize data within research articles
- achieved a higher level of critical thinking that enables proper evaluation and educated decision-making regarding issues in global change

Course material, text books and further reading:
No specific textbook is used.
Course slides and research articles

Prerequisites: please note the general comment on prerequisites
None

Content:
We live in a world where humans are having profound impacts on the global environment. The challenges are formidable and reflected in the view that a geological era, the Anthropocene should be delimited. Climate is warming, the populations of many species are in decline, eutrophication is affecting ecosystems and human health, and human societies now face new risks in terms of food security and natural disturbances. Using case studies, this course will illustrate the concepts of key drivers of global change and the impact on human society and ecological systems. Guest speakers from various professional sectors which are experts in their respective domains illustrate their specific view and approach of the problem.

LECTURES

Drivers of global change:
- human population and consumption
- loss and fragmentation of natural habitats, biodiversity loss
- eutrophication
- biological invasions
- toxic chemical pollution and exposure

Impact on human society and ecological systems:
- community responses (population declines and extinction, adaptation/evolution)
- ecosystem responses

- human society responses (heath, food security, natural disturbances)

Exercises:
Group discussion around case studies based on reading assignments

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment with written preparation: 80%
Participation in group discussions: 20%

Course title: Plant responses to environmental stress
Course ID: BIOL-F443
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Organism Biology
Name and e-mail address of the instructor(s): Nathalie Verbruggen (Nathalie.Verbruggen@ulb.be)
Course website:
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 24 hrs

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Upon susseccful completion of the course the student must have:
the necessary tools to understand mechanisms of plant responses to different environmental stresses.

Course material, text books and further reading:
No specific textbook is used.
Course slides and research articles

Prerequisites: please note the general comment on prerequisites
None

Content:
The course will be a review of plant responses to different types of environmental stress, in particular physiological and molecular analysis. Molecular biology tools have allowed tremendous progress in our understanding of plant responses. Responses of plants to drought salt stress, temperature stress, toxic concentrations of trace metals, biotic stress, ... will be presented. The course will also include advances in the improvement of plant resistance to stress by genetic engineering. General research strategies will be discussed through analysis of case studies.

Assessment breakdown: please note the general comment on assessment breakdown
Written examination (50%) + oral presentation of a personal work (50%)

Course title: Pédologie et écosystèmes
Course ID: BIOL-F4002
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Organism Biology
Name and e-mail address of the instructor(s): Thomas Drouet de la Thibauderie (Thomas.Drouet@ulb.be)
Course website:
Semester: S1 or S3
Tuition language: French
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 36 hrs

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Au terme de l'enseignement l'étudiant sera en mesure :
- De comprendre les principaux processus de formation des sols en relation avec les facteurs du milieu.
- D'élaborer une gestion raisonnée des grands types de sols mondiaux en fonction de leurs propriétés et de leurs aptitudes.
- De reconnaître les contraintes physiques, chimiques et environnementales liées à un grand nombre de types de sol.
- D'intégrer la composante sol dans l'étude des cycles d'éléments, de la diversité biologique et des changements globaux.

Course material, text books and further reading:
No specific textbook is used.
Course slides and research articles

Prerequisites: please note the general comment on prerequisites
None

Content:
Considérations fondamentales sur les interactions entre facteurs du milieu et processus pédogénétiques. Notion de matériaux parents (typologie et méthodes d'étude). Grands types de sols mondiaux (distribution géographique, mode de formation, propriétés et aptitudes, problèmes environnementaux spécifiques : andosols, vertisols, sols isohumiques et érosion, sols calcimagnésiques et processus d'altération physique, sols hydromorphes, sols brunifiés, processus d'altération chimique et bilans d'altération, sols podzolisés et processus de chéluviation, sols ferrallitiques et contraintes agronomiques des sols tropicaux.

Assessment breakdown: please note the general comment on assessment breakdown
Examen oral (60 %) et travail personnel (40 %).

Course title: Genomics, proteomics, evolution (Bioinformatics)
Course ID: BIOL-F402
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Organism Biology
Name and e-mail address of the instructor(s): Jean-François Flot (jean-francois.flot@ulb.be) and Matthieu Defrance (matthieu.dc.defrance@ulb.be)
Course website:
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:

- Lectures: 24 hrs
- Exercises, practicals: 24 hr

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant/Animal Biological level: Organism

Upon susseccful completion of the course the student must have:
- explain the different methods used to sequence DNA and RNA as well as to process bioinformatically the resulting data (processing different file formats using the command line, converting data from one format into another, checking the quality of the sequences);
- explain the different methods used to assemble de novo, map and annotate genomic data, as well as to perform genome assemblies and estimate the quality of the result obtained;
- explain the different methods used for phylogenetic network analyses, as well as to apply them to real datasets and to interpret the results in terms of the evolution of organisms and species delimitation;
- perform synteny analyses in order to detect whole-genome duplication events and genomic rearrangements, as well as to detect genome regions evolving under positive or negative selection;
- explain the different approaches used in epigenomic and proteomic studies as well as to analyse the resulting datasets.

Other skills:
- Acquiring the basic concepts and knowledge of informatics and biology required for devising projects in bioinformatics and modelling.
- Mastering the mathematical, statistical and informatic knowledge on which bioinformatic and modelling studies are resting.
- Analyzing critically original research articles in bioinformatics and modelling.
- Understanding the evolution of knowledge on a given subject as well as collecting and managing scientific articles pertaining to it.
- Being able to use existing bioinformatic resources and to develop new programs (algorithms, databases, analytic tools, etc.).
- Write a research report with clarity and rigor.
- Presenting orally in a clear and concise way the results of a work and facing the questions and criticisms of the public.

Course material, text books and further reading:

Course slides and research articles

Felsenstein, 2002. Inferring Phylogenies. Sinauer Associates. 580 pp. ISBN 9780878931774.
Graur, 2016. Molecular and Genome Evolution. Sinauer Associates. 612 pp. ISBN 9781605354699.
Haddock & Dunn, 2010. Practical Computing for Biologists. Sinauer Associates. 538 pp. ISBN 9780878933914.
Wang, 2016. Next-Generation Sequencing Data Analysis. CRC Press. 246 pp. ISBN 9781482217889.

Prerequisites: please note the general comment on prerequisites

The practicals require students to be comfortable with the command line. Here are a few useful tutorials for students who need to brush up their command-line skills:
http://linuxcommand.org/lc3_learning_the_shell.php
http://webext.pasteur.fr/tekaia/BCGA2012/TALKS/FT_Unix.pdf
http://webext.pasteur.fr/tekaia/BCGA2012/TALKS/FT_perl.pdf
http://www.cs.usfca.edu/~parrt/course/601/lectures/unix.util.html
http://cs.nyu.edu/courses/fall06/G22.2245-001/syll/syll.html

Content:
11 sessions:

01. Crash course on command line processing
02. Crash course on omics processing using R
03. Quiz; reference genome and read mapping
04. Genomics and variant calling
05. Transcriptomics and RNA-seq
06. Epigenomics and ChIP-seq
07. 1st oral presentation
08. Sequencing technologies comparison
09. De novo assembly, theory
10. De novo assembly, practical
11. 2nd oral presentation

The sessions combine theoretical lectures, exercices and practicals. Students will also give oral presentations pertaining to the topic of the course

Assessment breakdown: please note the general comment on assessment breakdown
One quiz and two oral presentations
20% for each written assignment, 40% for each oral presentation

Course title: Toxins in amphibians and reptiles
Course ID: 4016550FNR
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Kim Roelants (Kim.Roelants@vub.be)
Course website:
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures Seminars, exercises, practicals, field training: 24 hrs

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

By covering an important and widespread ecological adaptation, this course broadens a herpetologist's general knowledge of amphibian and reptile natural history. Furthermore, the course represents an excellent preparation for any biologist interested in pursuing a research carrier in toxinology, either from a fundamental scientific perspective or from an applied clinical one. After following the 15-hours course, students are expected to:
- have a broad knowledge of the taxonomic diversity of amphibians and reptiles that use toxins for predation, defense or competition;
- know the major molecular classes of toxins in amphibian poisons and reptile venoms, their synthesis, functioning, and similarities to other animal toxins;
- be aware of important genetic and ecological aspects of toxicity and be capable to discuss these in an evolutionary context that extends beyond the field of herpetology.
- be aware of the medical problems of snake envenomation and treatment worldwide, and understand the potential of amphibian and reptile toxins in various clinical application fields.
- be capable to understand and critically analyse any literature published on the various aspects of toxinology, including discovery, pharmacology, and evolutionary genetic and ecological implications.

Course material, text books and further reading:
No specific textbook is used.
Course slides and research articles

Prerequisites: please note the general comment on prerequisites
None

Content:
Toxins represent an important ecological adaptation in a large number of amphibian and reptile species. While in amphibians, toxins are secreted through skin glands as a passive defense weapon (a poison) against predators or pathogenic microorganisms, reptile toxins are actively administered through a bite (a venom) to serve either predation or antipredator defense. Despite these fundamental differences, amphibian poisons and reptile venoms share many functional, structural, and genetic characteristics that allow new insights in the fields of molecular biology, evolutionary biology, ecology and pharmacology. This course introduces students into the fascinating field of amphibian and reptile toxinology and illustrate its multidisciplinary nature, with affinities to research fields as diverse as herpetolology, ecology, evolutionary biology, genetics, biochemistry and pharmacology. By means of numerous recent case studies, it presents a comprehensive and up-to-date overview of:
(1) the taxonomic range of the poisonous amphibians and venomous reptiles (e.g. poison arrow frogs, monitor lizards and pit vipers);
(2) the structural and functional diversity of toxins found in both groups (e.g., alkaloids, steroids, peptides and proteins);

(3) their targets in a prey's or predator's physiological processes (e.g. in neural signal transduction, inflammation and hemostasis);
(4) genetic, ecological and evolutionary phenomena, patterns and hypotheses related to toxicity (e.g., evolutionary convergence, aposematism, toxin resistance, and evolutionary arms races between prey and predator);
(5), snake bite treatment and the application of toxins in disease modeling, diagnostics and drug design.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment with written preparation (100%)

Course title: Biological invasions and management
Course ID: BIOL-F1715
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Iris Stiers (Iris.Stiers@vub.be)
Course website: https://www.ulb.be/en/programme/2022-biol-f1715
Semester: S1
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours: please note the general comment on abbreviations

THE	TP	EX	EXC	STG	PRJ	SEM	PRS
16 hrs	6 hrs				6 hrs		

Course objectives:
This course will examine the theoretical and applied aspects of invasive species ecology and management, including terrestrial and aquatic flora and fauna. Major themes of the course will include: 1) ecological processes and the spread of invasive species; 2) impacts of invasive species; 3) invasive species management; and 4) policies and regulations involving invasive species.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to:
-Explain the history of invasion ecology.
-Outline the stages of the invasion process.
-Describe and critically evaluate the hypotheses to explain biological invasions.
-Summarize the effects of invasions on communities and ecosystems.
-List the possible management strategies for invasions and their pros and cons.
-Frame biological invasions within the science-policy interface
-Understand the added value of education and public awareness for successful prevention and management of invasive species.
-Synthesize and critique about primary literature.
-Discuss literature with fellow scientists and orally present.

Course material, text books and further reading:
No specific textbook is used. Powerpoint slides and relevant scientific and opinion papers will be made available.
The following books can be useful:
-Lockwood et al. Invasion Ecology (2013) Wiley-Blackwell
-Davis M Invasion Biology (2009) Oxford University Press

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
In this human-shaped epoch that is the Anthropocene, the spread and establishment of Invasive Alien Species (IAS) is regarded as one of the main threats to biodiversity worldwide. Highly adaptable and competitive, these invaders spread and establish quickly upon introduction into a novel environment, especially when this is disturbed by anthropogenic activities. This course will cover following subjects:

-An introduction to invasion ecology
-Transport vectors and pathways
-Ecological processes and the spread of invasive species
-Impacts of invasive species
-Management of invasive species
-Policy and legislation involving invasive species
-Education and outreach with regard to invasive species

Guest speakers from various academic and/or professional sectors which are experts in certain invasive taxonomic groups will be invited to illustrate their specific view and approach of the problem.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 80 %
Projects/Presentations/Reporting: 20 %

Course title: Terrestrial ecology
Course ID: BIOL-Y060 / 4023907ENR
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Harry olde Venterink (harry.olde.venterink@vub.be)
Course website: https://www.ulb.be/en/programme/2022-biol-y060 and https://caliweb.cumulus.vub.ac.be/caliweb/?page=course-offer&id=011849&anchor=1&target=pr&year=2223&language=en&output=html
Semester: S1
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours: please note the general comment on abbreviations

THE	TP	EX	EXC	STG	PRJ	SEM	PRS
12 hrs	12 hrs						

Course objectives:
The course focuses on ecology of terrestrial ecosystems and contains a theoretical and a practical part. The content of the course builds on the ecological knowledge obtained in the Bachelor courses 'Plants & Fungi' and 'Ecology', but these courses are not compulsory since the course is also open for students who did their bachelor study elsewhere.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions Biological level: ecosystem

Upon completion of the course a student must be able to
- Obtain knowledge about a wide variety of theories and hypotheses in the field of terrestrial ecosystems ecology and learning to apply this knowledge to newly collected data.
- Learn how to measure and quantify various variables about ecological processes in terrestrial plant communities and ecosystems, and understanding the difference between data collected by monitoring in natural ecosystems and data obtained from experimentally manipulated sites.
- Analyse, process and present ecological data, and practice with working and collaborating in groups.

Course material, text books and further reading:

Digital course material (Required) : Powerpointpresentaties

Handbook (Recommended) : Principles of Terrestrial Ecosystem Ecology, Chapin F.S. III, Matson P.A. & Vitousek P.M., Springer, New York, 2011

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
How do carbon (C), nitrogen (N), phosphorus (P) and energy cycle through terrestrial ecosystems and their food webs, and how are these cycles affected by landscape factors and human activities? How does the balance (stoichiometry) between C, N and P influence plant growth, primary production, decomposition, as well as the competition between plant species and the occurrence of endangered and exotic invasive species? How is plant growth affected by soil microbes, herbivores and carnivores? And how can we apply the landscape of fear principle from African savanna to the recent re-introduction of wolves in Western Europe? Are exotic invasions a major cause for the loss of biodiversity in terrestrial ecosystems, and how does biodiversity itself influence exotic invasions and

ecosystem functionality? How does climate change influence terrestrial ecosystems? And how do novel species interactions from range shifts compare to those resulting from exotic invasions? How does nature management impact terrestrial ecosystems and the conservation of biodiversity, and which factors need to be considered for the restoration of degraded ecosystems? This kind of questions are treated in the course 'Terrestrial Ecology', and various hypotheses, mechanisms and theoretical predictions, mainly from the field of Ecosystems Ecology, are presented to answer these questions. The theory, excursions and practical's, provide insight in the functioning of terrestrial ecosystems, how they are threatened by human activities and global change, and how management can be applied for conservation and restoration.

The theoretical part deals with important topics of ecosystems ecology. The ecological theory, processes and mechanisms will be illustrated with examples from terrestrial ecosystems in Europe, Africa and South- and North America, and Australia. Many examples will be given from own long-term research in Europe, African savanna and the Brazilian Cerrado. The following topics will be covered:

1. Introduction to ecosystems ecology, ecosystem components and stability
2. Cycles of carbon, nitrogen and phosphorus
3. Ecological stoichiometry
4. Primary production and growth limitation
5. Decomposition
6. Plant-soil microbe interactions
7. Plant-herbivore-carnivore interactions
8. Food web ecology
9. Competition and facilitation among species
10. Biodiversity - ecosystem functionality relationships
11. Loss of biodiversity
12. Exotic invasions and novel species interactions
13. Impact of climate change on terrestrial ecosystems
14. Nature conservation, restoration and management

The practical part consists of field excursions to two nature reserves where the results of successful nature restoration projects will be observed, as well as to experimental field sites. During these field visits some of the ecological processes discussed in the oral lectures will be studied by performing measurements and collecting data (4 days). The obtained ecological data will be processed and processed in small groups (1 day) and presented and discussed in the entire group (2 hours).

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 100 %, conditional of participation in the course's practical sessions

The theory presented and explained in the lectures and WPO will be examined in an oral exam. This exam is based on questions which can prepared just before the exam. The oral exam is only open for students that have actively participated in the practical part. Students who missed a part of the WPO must carry out a replacement task.

Course title: Agroecology
Course ID: BIOL-Y061 / 4023854ENR
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Franky Bossuyt (franky.bossuyt@vub.be)
Course website: https://www.ulb.be/en/programme/2022-biol-y061 and https://caliweb.cumulus.vub.ac.be/caliweb/?page=course-offer&id=011815&anchor=1&target=pr&year=2223&language=en&output=html
Semester: S1
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours: please note the general comment on abbreviations

THE	TP	EX	EXC	STG	PRJ	SEM	PRS
12 hrs							

Course objectives:
Farming and food systems are intimately related to environmental, social and ethical issues. In this course, students are introduced to agroecology as a science, a practice and a social movement. Students will learn the basics of applying a systems approach in designing and studying agricultural systems and food production chains.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions Biological level: ecosystem

Upon completion of the course a student must be able to
- understand the fundamental aspects of sustainable agriculture, agroecosystem management and sustainable food systems
- understand structure and function of complex agroecosystems
- understand some of the most important methods in agroecology, such as agroforestry, food forests, permaculture, alley cropping, sylvopasture…
- explain why agroecological methods are beneficial for the climate, biodiversity and nutrient crisis
- identify the main perennial plants that are used in agroforestry

Course material, text books and further reading:
Powerpoint slides of the lectures (available on CANVAS)
Relevant scientific and opinion papers (available via CANVAS).

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
The course deals with the food system as a whole, from taking care for the soil, over design of agricultural systems, to the organization of societies. It explains how agroecosystems that imitate nature in form and function can provide food and many other needs, and at the same time remediate the climate, biodiversity and nutrient crisis.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100 %

Course title: Analyse et gestion des impacts environnementaux
Course ID: ENVI-F452
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Environmental Sciences
Name and e-mail address of the instructor(s): Wouter Achten (wouter.achten@ulb.be)
Course website: https://www.ulb.be/fr/programme/2022-envi-f452
Semester: S1
Tuition language: French
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 36 hrs

Course objectives:
La durabilité environnementale est de plus en plus importante pour les décideurs politiques, des entrepreneurs, des consommateurs, et la recherche. Toutes ces parties prenantes sont confrontées aux questions de durabilité sur les développements qu'ils créent ou supportent. Les consommateurs veulent être informés sur les performances environnementales des produits. Les entrepreneurs et les politiciens sont souvent confrontés à leurs responsabilités par rapport d'environnement. À toutes les étapes l'aide à la décision concernant la durabilité environnemental est nécessaire.

Ce cours vise à familiariser les étudiants avec des concepts et outils couramment utilisés pour évaluer et gérer les impacts environnementaux des produits, des projets, des organisations, des stratégies, des politiques, etc.

Les objectifs d'apprentissage

Management environnemental :

Obtenir un aperçu synthétique des pratiques de Gestion Environnementale dans le milieu des entreprises privées, et autorités publiques

Évaluation des impact environnementaux

- Obtenir un aperçu de la pluralité des analyses pour évaluer les impacts environnementaux et les méthodes de gestion

- Obtenir un aperçu des procédures des différentes techniques. Quelles questions peuvent-elles être traitées, quelles données sosont -elles nécessaires, choix méthodologiques qui doivent être pris, ...

- Obtenir un aperçu des points forts, des faiblesses et des pièges, ... des techniques

Aide à la décision multicritère: - Se familiariser avec la structuration d'un problème de décision multicritère (définition des alternatives, des critères, modélisation des préférences, problématiques, etc.) - Expérimenter la résolution d'un problème original à l'aide de la plateforme D-SIGHT WEB (utilisant d'outils visuels interactifs, analyse de sensibilité et robustesse, aspects multi-décideurs, etc.)
Compétences visées

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Methods & tools Biological level: Ecosystem

Après avoir suivi ce cours, les étudiants doivent être en mesure de

1) identifier les concepts, outils et techniques appropriés pour une problème ou question par rapport à la gestion et l'évaluation environnementale,
2) faire une conception/mise en page d'une démarche de gestion ou de recherche pour une question de gestion ou évaluation d'impact ou une question d'aide à la décision ,
3) évaluer de manière critique la valeur d'un rapport d'évaluation ou gestion d'impact donné.

Course material, text books and further reading:
This will be informed during the first lecture.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

General overview of environmental impact management and evaluation concepts, tools, techniques (thought in English)

Environmental management: ISO 14001 & EMAS, Eco-innovation: cleaner production, life cycle thinking, industrial ecology, cradle to cradle; circular economy (thought in English)

Environmental impact evaluation: Principles, criteria and indicators, material flow analysis, life cycle assessment, footprinting, input-output analysis, environmental extended input-output assessment (Thought in English), Evaluations Environnementales et Analyse multi-critères (enseigné en Français).

Assessment breakdown: please note the general comment on assessment breakdown

Examen écrit: 13/20
- Questions sur connaisances: 4/20
- Question d'application de connaisances: 4/20
- Question lié à la capacité d'analyse: 5/20
- (exemples vont être donnés pendant le cours et pendant la dernière séance du cours).

Rapport aide à la décision: 7/20

Course title: Bioéthique et droit de la conservation
Course ID: BIOL-F448
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Bruno Danis (Bruno.Danis@ulb.be)
Course website: https://www.ulb.be/en/programme/biol-f448
Semester: S1
Tuition language: French
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 20 hrs
- Exercices: 36 hrs
- Seminars : 4 hrs

Course objectives:
Société et le rôle du scientifique et du biologiste en particulier

Learning outcomes : please note the general comment on learning outcomes
Education level: General Ecosystem focus: Methods & tools Biological level: Global

Constituer, entretenir et développer des connaissances dans le domaine des sciences biologiques
Acquérir des savoirs par une recherche personnelle et critique de la littérature scientifique.
Reconnaitre les explications inconsistantes et les généralisations abusives.
Identifier les besoins et trouver les expertises requises.
Faire preuve de polyvalence et intégrer la multidisciplinarité dans la gestion d'un projet.
Communiquer dans un langage rigoureux adapté au contexte et à son public
Développer une argumentation scientifique.
Défendre un projet et un travail de recherche personnel.
Discuter des implications pratiques et théoriques d'une recherche ainsi que de ses perspectives.

Course material, text books and further reading:
Lecture notes

Prerequisites: please note the general comment on prerequisites
Excellentes notions fondamentales en biologie des organismes, évolution et écologie

Table of contents:
Bioéthique: Interaction "Sciences-Société" et rôle de la bioéthique. Réflexions critiques sur l'impact des avancées (et conséquences) des techniques scientifiques dans la société ; comparaisons entre législations.

Droit de la conservation: généralités sur le cadre institutionnel lié à la conservation, aux niveaux national, européen, et international. Éléments de stratégies de conservation.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 50 %
Written assessment: 50 %

Course title: Cours ou stage hors ULB
Course ID: BIOL-F535
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Yves Roisin (Yves.Roisin@ulb.be)
Course website: https://www.ulb.be/fr/programme/biol-f535
Semester: S1 or S3
Tuition language: French, English, Dutch or Italian
Number of credits (ECTS): 5

Course breakdown and hours:
- Practical training: 60 hrs

Course objectives:
Enabling the student to valorise summer schools, winter schools, monsoon schools, or equivalent

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: variable Biological level: variable

Course material, text books and further reading:
This will be provided by the course organiser

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
This will be provided by the course organiser

Assessment breakdown: please note the general comment on assessment breakdown

This will be provided by the course organiser

Course title: Professionnal internship / Stage professionnel
Course ID: STAG-F034
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Denis Fournier (Denis.Fournier@ulb.be)
Course website: https://www.ulb.be/fr/programme/2022-stag-f034
Semester: S1 or S3
Tuition language: French, English, Dutch or Italian
Number of credits (ECTS): 15

Course breakdown and hours:
- Practical training: 380 hrs

Course objectives:
• stage dans une structure d'accueil ou il est possible d'etre engagé en tant que biologiste (ONG, ASBL, entreprise/industrie, secteur public ou privé, médias ...)
• en Belgique ou a l'étranger
• mais pas en laboratoire ni dans un centre de recherches
• pas en lien avec le memoire de fin d'etudes: l'expérience doit etre différente de celle vecue lors du MFE.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: variable Biological level: variable

After completion of the internship, the students will have experience in a professional environment. They will have competences in evaluating the scientific and societal relevance, reporting and social communication, problem-solving and insight in real working situation.

Course material, text books and further reading:
None

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Variable

Assessment breakdown: please note the general comment on assessment breakdown

L'evaluation est basee sur quatre elements :
• L'evaluation du travail par le maitre de stage (via la grille d'evaluation)
• Le portfolio (evalue par le superviseur academique)
• Le texte integrateur (5-8 pages max, tourni aux membres du jury)
• L'entretien (face au jury, 10 min de presentation et 10 minutes de questionsreponses)

Course title: Professionnal internship
Course ID: coming soon
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-Engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Luc Leyns (Luc.Leyns@vub.be)
Course website: coming soon
Semester: S1 or S3
Tuition language: English, Dutch, French or Italian
Number of credits (ECTS): 12

Course breakdown and hours:
- Practical training : 30 days (240 hrs)

Course objectives:
During your internship you will be guided and evaluated by a local supervisor who will be in contact with a representative of the Biology Department (typically the coordinator of your master program or the chairman of the Biology Master educational board; now Prof. Kim Roelants). After completing your internship, you write and submit a report on the work you have completed, which will be evaluated and graded by your internship supervisor in dialog with the coordinator of your graduation option, or the chairman of the Biology Master educational board.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: variable Biological level: variable

After completion of the internship, the students will have experience in a professional environment. They will have competences in evaluating the scientific and societal relevance, reporting and social communication, problem-solving and insight in real working situation.

Course material, text books and further reading:
Digital course material (Recommended) : Professional Internship Guidelines.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Detailed info and guidelines regarding this course can be found in the document 'Professional Internship Guidelines 2019 2020.pdf' on the course pages 'Professional Internship' of the Canvas platform (https://canvas.vub.be/).

The following points explain how to apply for an internship:

1) As a student choosing the course 'Professional internship', you are responsible for finding an internship position. This is an important and valuable part of the course, as it helps you gain experience in job application.

Note: The expenses for daily transport are on the account of the student.

2) Once you have found a possible internship place, download the form 'internship agreement request form' (IARF.doc) from the course page 'Professional Internship' on the Canvas platform (https://canvas.vub.be/). Complete this form and send it by e-mail to:

- the coordinator of the graduation option you are enrolled in;
- the chairman of the educational Board of the Biology Master program, Kim Roelants; (Kim.Roelants@vub.be);
- the secretariat of the Biology department (Bert Vervloessem; biologie@vub.ac.be).

Your request should be approved by the coordinator of the graduation option you are enrolled in, or by the chairman of the Biology Master educational board.

3) After approval, download the relevant internship agreement template (Internship Agreement 6ECTS.doc or Internship Agreement 9ECTS.doc) from relevant course page on the Canvas platform (https://canvas.vub.be/) and fill it in. Print out three hard copies and make sure that both you and your supervisor at the host company/institution sign all copies of the agreement.

4) Send the completed and signed internship agreement to the chairman of the Biology Master educational board (Kim Roelants; Kim.Roelants@vub.be). The chairman will make sure that the agreement is signed by the Faculty Dean and will send you two copies back (one for you, one for the internship supervisor).

Important: The internship agreement should be signed by all parties (you, your internship supervisor and the Dean) BEFORE the start of your internship.

Assessment breakdown: please note the general comment on assessment breakdown

The final grade is composed based on the following categories:
SELF Internship determines 100% of the final mark.

Within the SELF Internship category, the following assignments need to be completed:

Internship report with a relative weight of 1 which comprises 50% of the final mark.

Note: Your internship supervisor will be contacted by the Biology Department during the exam session in which you submitted your report. He/she will be asked to give feedback on your internship and give a score based on your daily work and the final version of your internship report. Your daily work will be valuated based on your motivation, initiative, resourcefulness, punctuality and attitude during your internship. The final version of your internship report will be evaluated by your internship supervisor in dialog with the Department's internship coordinator (the coordinator of your graduation option or the Chairman of the Master educational board) based on its scientific quality, completeness, level of insight, writing style and overall format.
Daily work and performance with a relative weight of 1 which comprises 50% of the final mark.

Your internship supervisor will be contacted by the Biology Department during the exam session in which you submitted your report. He/she will be asked to give feedback on your internship and give a score based on your daily work and the final version of your internship report. Your daily work will be valuated based on your motivation, initiative, resourcefulness, punctuality and attitude during your internship. The final version of your internship report will be evaluated by your internship supervisor in dialog with the Department's internship coordinator (the coordinator of your graduation option or the Chairman of the Master educational board) based on its scientific quality, completeness, level of insight, writing style and overall format.

Course title: Professionnal internship
Course ID: 4016928FNR
University: Vrije Universiteit Brussel
Faculty: Sciences and Bio-Engineering Sciences
Department: Biology
Name and e-mail address of the instructor(s): Luc Leyns (Luc.Leyns@vub.be)
Course website: https://caliweb.cumulus.vub.ac.be/caliweb/?page=course-offer&id=007352&anchor=1&target=pr&year=2122&language=en&output=html
Semester: S1 or S3
Tuition language: English, Dutch, French or Italian
Number of credits (ECTS): 6

Course breakdown and hours:
- Practical training : 15 days (120 hrs)

Course objectives:
During your internship you will be guided and evaluated by a local supervisor who will be in contact with a representative of the Biology Department (typically the coordinator of your master program or the chairman of the Biology Master educational board; now Prof. Kim Roelants). After completing your internship, you write and submit a report on the work you have completed, which will be evaluated and graded by your internship supervisor in dialog with the coordinator of your graduation option, or the chairman of the Biology Master educational board.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: variable Biological level: variable

After completion of the internship, the students will have experience in a professional environment. They will have competences in evaluating the scientific and societal relevance, reporting and social communication, problem-solving and insight in real working situation.

Course material, text books and further reading:
Digital course material (Recommended) : Professional Internship Guidelines.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Detailed info and guidelines regarding this course can be found in the document 'Professional Internship Guidelines 2019 2020.pdf' on the course pages 'Professional Internship' of the Canvas platform (https://canvas.vub.be/).

The following points explain how to apply for an internship:

1) As a student choosing the course 'Professional internship', you are responsible for finding an internship position. This is an important and valuable part of the course, as it helps you gain experience in job application.

Note: The expenses for daily transport are on the account of the student.

2) Once you have found a possible internship place, download the form 'internship agreement request form' (IARF.doc) from the course page 'Professional Internship' on the Canvas platform (https://canvas.vub.be/). Complete this form and send it by e-mail to:

- the coordinator of the graduation option you are enrolled in;
- the chairman of the educational Board of the Biology Master program, Kim Roelants; (Kim.Roelants@vub.be);
- the secretariat of the Biology department (Bert Vervloessem; biologie@vub.ac.be).

Your request should be approved by the coordinator of the graduation option you are enrolled in, or by the chairman of the Biology Master educational board.

3) After approval, download the relevant internship agreement template (Internship Agreement 6ECTS.doc or Internship Agreement 9ECTS.doc) from relevant course page on the Canvas platform (https://canvas.vub.be/) and fill it in. Print out three hard copies and make sure that both you and your supervisor at the host company/institution sign all copies of the agreement.

4) Send the completed and signed internship agreement to the chairman of the Biology Master educational board (Kim Roelants; Kim.Roelants@vub.be). The chairman will make sure that the agreement is signed by the Faculty Dean and will send you two copies back (one for you, one for the internship supervisor).

Important: The internship agreement should be signed by all parties (you, your internship supervisor and the Dean) BEFORE the start of your internship.

Assessment breakdown: please note the general comment on assessment breakdown

The final grade is composed based on the following categories:
SELF Internship determines 100% of the final mark.

Within the SELF Internship category, the following assignments need to be completed:

Internship report with a relative weight of 1 which comprises 50% of the final mark.

Note: Your internship supervisor will be contacted by the Biology Department during the exam session in which you submitted your report. He/she will be asked to give feedback on your internship and give a score based on your daily work and the final version of your internship report. Your daily work will be valuated based on your motivation, initiative, resourcefulness, punctuality and attitude during your internship. The final version of your internship report will be evaluated by your internship supervisor in dialog with the Department's internship coordinator (the coordinator of your graduation option or the Chairman of the Master educational board) based on its scientific quality, completeness, level of insight, writing style and overall format.
Daily work and performance with a relative weight of 1 which comprises 50% of the final mark.

Your internship supervisor will be contacted by the Biology Department during the exam session in which you submitted your report. He/she will be asked to give feedback on your internship and give a score based on your daily work and the final version of your internship report. Your daily work will be valuated based on your motivation, initiative, resourcefulness, punctuality and attitude during your internship. The final version of your internship report will be evaluated by your internship supervisor in dialog with the Department's internship coordinator (the coordinator of your graduation option or the Chairman of the Master educational board) based on its scientific quality, completeness, level of insight, writing style and overall format.

**Course descriptions at Sorbonne Université (SU)
and Muséum National d'Histoire Naturelle (MNHN)**

Course title: Climate et biotope (c/o Grandes Questions Environnementales)
Course ID: GQE
University: Sorbonne Université
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): H. Chepfer (chepfer@lmd.polytechnique.fr), L. Abbadie (abbadie@biologie.ens.fr) and P. Huchon (philippe.huchon@SU.fr)
Course website: http://admweb.lmd.polytechnique.fr/M1SDUEE/index.php/Accueil
Semester: S1
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 24 hrs
- Projects: 6 hrs

Course objectives:
L'UE MU002 vise à donner à l'ensemble des étudiants inscrits en 1ère année du Master une vision pluridisciplinaire et transversale des questions sur l'environnement terrestre et planétaire. il s'agit de démontrer que l'approche de l'étude de l'environnement, de sa biodiversité, est liée à des concepts et théories écologiques qu'il est nécessaire de confronter avec les autres sciences afin de proposer des modèles et scénarios de gestion de l'écosystème.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Interactions Biological level: Global

A la fin du cours les étudiants doivent être capable de détailler les modes de variabilité naturelle du climat et les mécanismes mis en jeu: les cycles de Milankovitch (théorie astronomique du climat), l'oscillation Nord-Atlantique, les phénomènes El-Niño / La Niña, les grandes éruptions volcaniques. L'effet de serre atmosphérique et naturel et la température de la Terre. Les activités humaines et les perturbations du climat. Ecrire un modèle simple du bilan radiatif de la Terre, et introduire la notion de « sensibilité climatique ».

Course material, text books and further reading:
Climat d'hier et d'aujourd'hui. (1999) S. Joussaume. CNRS Edition
Is the temperature rising ? (1998) S. G. Philander. Princeton Univ Press
Comprendre le changement climatique. (2007) Editeurs : J.L. Fellous et C. Gautier. O. Jacob
Panorama de la Physique (2007) Ed Belin
Sur les origines de l'effet de serre et du changement climatique, S. Arrhenius, T. C. Chamberlin, J. Croll, J. Fourier, C. Pouillet, J. Tyn

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
- Phénomènes Climatiques et Mécanismes Biologiques
- Dynamique du Globe : du noyau à la lithosphère
- Océan et Environnement
- Le cycle de l'Eau : Enjeux globaux
- Le Climat et ses Variations
- Les Atmosphères Planétaires

Assessment breakdown: breakdown Written assessment: 50% Oral assessment: 50%	please note the general comment on assessment

Course title: Sciences de la nature et de l'homme: histoire des idées
Course ID: TC01b
University: Muséum National d'Histoire Naturelle
Faculty: Muséum
Department: Régulations, Dévelopement et Diversité Moléculaire
Name and e-mail address of the instructor(s): Pascale Debey (debey@mnhn.fr)
Course website: to be posted
Semester: S1
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
A travers l'histoire de grands courants de la pensée scientifique et leur évolution au cours des siècles, ce module vise à montrer aux étudiants qui feront leur cursus au Muséum quelles ont été les grandes étapes des recherches en Sciences de la Nature et de l'Homme dans lesquelles le Muséum a été impliqué. Il montrera comment se sont entrecroisés et respectivement nourris des domaines de recherche tels que la géologie, la paléontologie, la systématique, la biologie animale et végétale, l'anatomie comparée, la génétique, la génomique, l'anthropologie, l'écologie, l'histoire des sciences, la muséologie.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Acquérir une ouverture intellectuelle et scientifique sur un domaine qui ne concerne pas directement la biodiversité et les environnements tropicaux.

Course material, text books and further reading:
Notes de cours. Livres disponibles au Muséum.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Des conférences de haut niveau dispensées le matin s'accompagnent de visites de collections fossiles et vivantes du Muséum, et de présentations du travail sur ces collections (zoothèque, anatomie comparée, cryptogamie/phanérogamie, Jardin Botanique, Conservatoire Botanique, galerie de Paléontologie, galerie de Minéralogie, collections de préhistoire, etc.).

Thématiques :
Séminaire: Génétique - Gènes - Génomes: introduction pour les non biologists
Séminaire: Evolution des génomes de vertébrés
Excursion: Galerie de Paléontologie
Séminaire: A la découverte de l'origine des mâchoires
Excursion: Galerie d'Anatomie Comparée
Table ronde: Des gènes aux formes
Séminaire: L'origine des éléments chimiques : de la physique nucléaire à la collection de météorites du Muséum
Séminaire: La Crise Crétacé-Tertiaire et la non-extinction des dinosaures
Excursion: Serres du Muséum
Séminaire: Grands singes et hommes : une histoire partagée
Séminaire: Les plus anciens peuplements humains d'Eurasie
Séminaire: Lecture moléculaire de l'histoire de l'Homme

Excursion: Collections de l'Institut de Paléontologie Humaine
Séminaire: Animaux consommés/animaux figurés au Paléolithique supérieur en Europe
Séminaire: Evolution de la biodiversité et anthropisation durant les 10 000 dernières années : les données de l'archéologie
SéminaireLes menaces qui pèsent sur la biodiversité
Séminaire: Les espèces, pierres angulaires de la connaissance de la biodiversité et de la compréhension des origins
Table ronde: Discussion avec les étudiants et présentation des modalités d'évaluation.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Droit du patrimoine naturel in situ et ex situ
Course ID: TC04
University: Muséum National d'Histoire Naturelle
Faculty: Enseignement supérieur / Recherche
Department: Hommes, Natures, Sociétés
Name and e-mail address of the instructor(s): Jean-Dominique Wahiche (wahiche@mnhn.fr)
Course website: to be posted
Semester: S1
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 22 hrs
- Exercises: 8 hrs

Course objectives:
Cet enseignement a pour but de donner aux étudiants les bases et les principes juridiques de la préservation et de la gestion du patrimoine naturel.
L'introduction permettra aux étudiants de disposer des outils indispensables à la compréhension tant du reste du cours qu'au fonctionnement des institutions.
Le patrimoine *in situ*, faune, flore et minéraux, sont dans la nature aujourd'hui protégés en tant que tels.
Pourquoi et comment en est-on arrivé là ? Jusqu'où va la protection de l'environnement, de quels moyens dispose-t-on ? Quelle est l'efficacité des dispositifs actuels et quelle évolution peut-on attendre ? Quelles sont les questions actuelles relatives à la biodiversité et aux populations autochtones qui affectent notamment la recherche scientifique, la propriété intellectuelle et les équilibres Nord-Sud ?
Dans le musée, le patrimoine naturel devient patrimoine culturel *ex situ* et change radicalement de statut. S'applique alors largement le droit des collections publiques. Toutefois, les spécimens d'histoire naturelle, une fois dans le musée, gardent certains traits juridiques de leur existence précédente dans la nature.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Comprendre les bases et les principes juridiques de la préservation et de la gestion du patrimoine naturel.

Course material, text books and further reading:
Notes de cours.
Guillot, P.Ch.A., 2006. Droit du patrimoine culturel et naturel. Ellipses. 160 pp.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Qu'est-ce que le Droit ? · La hiérarchie des normes · Histoire et évolution du Droit de l'environnement · Le patrimoine naturel, objet ou sujet de droit ? · Les acteurs du Droit de l'environnement - La responsabilité des Etats · Les grandes conventions internationales relatives à la biodiversité · La convention de Rio sur la diversité biologique : organisation, gouvernance et fonctionnement - La convention de Rio sur la diversité biologique : questions de fond - La recherche scientifique relative à l'environnement : droits et devoirs, accès à la biodiversité, partage des avantages et propriété intellectuelle · Le développement durable et l'agenda 21. La valeur économique de la nature · L'Union Européenne et l'environnement. Les Directives Habitat et Oiseaux · Le droit de la mer et les biotechnologies marines -Le droit des populations autochtones et les connaissances traditionnelles.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment: 50%
Oral assessment: 50%

Course title: Anatomie comparée
Course ID: SEP14/MU517
University: Muséum National d'Histoire Naturelle
Faculty: Enseignement supérieur / Recherche
Department:
Name and e-mail address of the instructor(s): Géraldine Véron (veron@mnhn.fr) & Jean-Denis Vigne (vigne@mnhn.fr)
Course website: to be posted
Semester: S1
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Projet: 4 hrs
- Excursion: 4 d

Course objectives:
Donner aux étudiants une formation élémentaire en ostéologie comparée, dans une perspective évolutive. L'architecture du squelette, du crâne et des dents, suivie sur la longue durée des ères géologiques et inscrite dans son contexte fonctionnel (musculature, notamment), sera détaillée pour les différents groupes de vertébrés. Les enseignements, essentiellement pratiques, s'appuieront sur les collections de paléontologie et d'anatomie comparée du Muséum ainsi que sur des séances de dissection..

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Animal Biological level: Organism

Comprendre les bases et les principes juridiques de la préservation et de la gestion du patrimoine naturel.

Course material, text books and further reading:
Notes de cours et matériel en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
- Orientation et architecture générale du squelette
- Architecture du crâne des mammifères
- Squelette appendiculaire et membre chiridien
- Adaptations du squelette
- Vertébrés non tétrapodes (« poissons » s.l.)
- Tétrapodes
- Amniotes actuels et fossiles
- Oiseaux
- Structure et évolution dentaire des mammifères.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Fondamentaux en Biodiversité et Evolution (FOBEE) / Diversité des génomes
Course ID: SEP46 / MU505
University: Sorbonne Université et Muséum National d'Histoire Naturelle
Faculty:
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Donato Bergandi (bergandi@mnhn.fr) & René Zaragüeta (Rene.Zaragueta_Bagils@SU.fr)
Course website: to be posted
Semester: S1
Tuition language: French
Number of credits (ECTS): 9 (à l'SU) / 3 (à l'MNHN)

Course breakdown and hours:
Lectures, exercises, practicals and group work: *ca.* 90 hrs / 30 hrs

Course objectives:
La finalité première de ce cours est de permettre d'analyser et d'approfondir un large éventail de problématiques propres à l'histoire et à la philosophie des sciences de manière à éclairer les étudiants en systématique, évolution et paléontologie sur les enjeux des débats épistémologiques propres à leurs disciplines.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Interactions Biological level: global

Permettre d'analyser et d'approfondir un large éventail de problématiques propres à l'histoire et à la philosophie des sciences.

Course material, text books and further reading:
None

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Introduction à quelques concepts clé de l'histoire et de la philosophie des sciences (les positivismes, Bachelard, Popper, Kuhn et perspectives nouvelles). Épisodes marquant de l'histoire des classifications (approche ethnobiologique des classifications ; système et méthode : Linné, Adanson, Jussieu ; les débuts de la cladistique). Éthique, ontologie et philosophie des sciences (Antécédents et implications philosophiques de l'approche scientifique du vivant : les pre-socratiques, Goethe, la biodiversité et les éthiques environnementales).

Assessment breakdown: please ote the general comment on assessment breakdown
Written and /or oral assessment: 100%

Course title: Initiation aux techniques avancées de collecte et d'inventaire systématique
Course ID: SEP18 / NU826
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Jean-Yves Dubuisson (jean-yves.dubuisson@SU.fr) and Christine Rollard (christine.rollard@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Projects: 4 hrs
- Excursions: 4 days

Course objectives:
Approffondir les différentes techniques de collectes et d'inventaires dans des milieux variés ainsi qu'à l'identification à partir de matériel collecté.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Methods and tools

Aquérir des savoirs-faires avancés dans les techniques interdisciplinaires de collectes et de l'inventaire.

Course material, text books and further reading:
Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Caractérisation des milieux. Approche géologique des zones prospectées. Aspects écologique, biologique et systématique sur divers groupes zoologiques et botaniques avec apport paléontologique.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Diversité et histoire des lignées chlorophyliennes (DIVEG)
Course ID: SEP04 / NU944
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Jean-Yves Dubuisson (jean-yves.dubuisson@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 40 hrs
- Exercises: 20 hrs

Course objectives:
Cette unité de recherche se propose de préciser dans un cadre historique et évolutif détaillé l'organisation desprincipaux phylums d'« algues » et de plantes terrestres (Embryophytes) et les événements clés qui ont caractérisé cette évolution. Par exemple, les hypothèses sur l'origine multiple des plastes (et donc des diverses lignées chlorophylliennes), sur l'origine des plantes terrestres ou de la fleur seront détaillées. Les étudiants auront également l'occasion d'observer des organismes fossiles qui seront comparés avec les actuels, afin d'illustrer l'histoire qui a produit la diversité végétale actuelle. Dans un cadre épistémologique, les différentes classifications (systèmes artificiels, classifications naturelles traditionnelles, gradistes ou cladistiques) seront exposées et comparées. La formation pratique intégrera les différentes méthodes d'identification des organismes végétaux.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Montrer des connaissances approfondi de l'organisation et de l'évolution des principaux lignées chlorophyliennes. Pouvoir lier cette évolution aux événements clés géologiques.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.
Raven, P.H., R.F. Evert & S.E. Eichhorn, 2007. Biologie Végétale. 2ème Edition. De Boeck Université, Louvain-la-Neuve, Belgique. 870 pp.
Raven, P.H., G.B. Johnson, JB. Losos & S.S. Singer, 2007. *Biologie*. De Boeck Université, Louvain-la-Neuve, Belgique. 1250 pp.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Les premières cellules autotrophes et les cyanobactéries - Origine des plastes et endosymbioses - Les principaux phylums d'algues - Diversité et évolution des Embryophytes : des premières plantes terrestres aux Spermatophytes et aux Angiospermes - Notions et méthodologies en identification et floristique (analyse florale). Le niveau de ce cours est avancé.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Xylologie-paléoxylologie: systématique et paléoécologie
Course ID: SEP28 / NU830
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Dario De Franceschi (dario.de-franceschi@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Exercises: 15 hrs
- Lab work: 15 hrs

Course objectives:
Le cours vise une reconnaissance des indications fournies par les caractères microscopiques du bois en systématique, phylogénie et écologie. Application aux bois fossiles pour la reconstruction des paléoflores et des paléoenvironnements.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Reconnaitre les caractères microscopiques du bois (coupe récentes comme fossiles) en systématique, phylogénie et écologie et pouvoir reconstruer des paléoflores et des paléoenvironnements à l'aide de ces cacatères.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.
Baas, P., 2010. *New Perspectives in Wood Anatomy*. Springer, Germany. 264 pp.
Wilson, K. & D.J.B. White, 2006. *Anatomy of Wood: Its Diversity and Variability*. Stobart Davies Limited, 316 pp.
Carlquist, S., 2001. *Comparative Wood Anatomy: Systematic, Ecological, and Evolutionary Aspects of Dicotyledon Wood.* Springer, Germany. 458 pp.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Définition, origine du bois et fonctions assurées par ce tissu. Principes et applications de l'expertise en xylologie. Caractères anatomiques, variabilité individuelle (racine, tronc, branche) et variabilité intra-spécifique. Xylologie, phylogénie et environnement ; importance du bois dans la reconstitution des paléoenvironnements, et applications à quelques gisements fossiles (observations au microscope, interprétations, dessins).

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 50%
Exercise assessment: 50%

Course title: Floristique Tropicale (FLORATROP)
Course ID: SEP / NU832
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Jean-Yves Dubuisson (jean-yves.dubuisson@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises: 6 hrs
- Projects: 4 hrs

Course objectives:
Présenter sous forme d'une série de conférences les grandes problématiques actuelles en biodiversité végétale et botanique tropicale, en incluant les principales méthodes d'investigation, de collection et d'analyse de cette biodiversité.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Pouvoir détailler les principales méthodes d'investigation, de collection et d'analyse de la biodiversité végétale et botanique tropicale. Connaitre et comprendre les enjeux et les problématiques actuelles de cette biodiversité. Etre capable de trouver les sources scientifiques et médiatiques sur cette thématique.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.
- Primack, R. & R. Corlett, 2005. Tropical Rain Forests : An Ecological and Biogeographical Comparison. Blackwell Science Ltd., Oxford, U.K. 319 pp.
- Puig, H., 2001. La Forêt Tropicale Humide. Editions-Belin, Paris, France. 448 pp.
- Carson, W. & S. Schnitzer, 2008. Tropical Forest Community Ecology. Wiley Blackwell, Oxford, U.K. 517 pp.
- Hogarth, P., 2007. The Biology of Mangroves and Seagrasses. Oxford University Press Inc., Oxford, UK. 273 pp.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Des spécialistes de divers groupes taxonomiques tropicaux représentatifs (« Cryptogames » et Spermatophytes) présenteront l'historique, les projets en cours et les perspectives de la recherche sur ces taxons afin d'illustrer les diverses approches qui sont développées actuellement en floristique tropicale. Des rappels sur les bases de la floristique seront également dispensés en début de l'unité d'enseignement.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 60%
Oral assessment: 40%

Course title: Ecologie Tropicale (ECOT)
Course ID: M2S1
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor: Jacques GIGNOUX, CR, gignoux@biologie.ens.fr
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 48 hrs
- Exercises: 12 hrs
- Projects: 10 hrs

Course objectives: Le but de ce module est d'apprendre aux étudiants à raisonner sur des écosystèmes (1) où s'expriment des mécanismes écologiques différents de ceux qu'ils connaissent en milieu tempéré et (2) où des mécanismes déjà connus s'expriment de façon extrême en raison de l'environnement physico-chimique différent, éventuellement de façon contre intuitive. L'enseignement s'ancre d'une part vers l'écologie de terrain, par une coordination de ce module avec les écoles thématiques d'écologie tropicale (ETET), et d'autre part vers l'écologie théorique, à travers l'analyse des apports de l'écologie tropicale à la théorie écologique. L'objectif ultime est de donner une compétence " système " aux étudiants à travers l'analyse détaillée des écosystèmes tropicaux, valorisable aussi bien pour la recherche (analyse multifactorielle d'un système écologique) que pour l'ingénierie écologique (analyse des moyens d'action possibles sur un écosystème).

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant and Animal Biological level: Organism-Ecosystem

Course material, text books and further reading:
Notes de cours. Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Le module comporte trois parties :
- une présentation des milieux et des contraintes climatiques de la zone tropicale (CM : 9 h)
- une analyse approfondie des principaux processus écologiques importants dans le cadre tropical : - processus écophysiologiques (rayonnement, eau, nutriments) et exploitation du milieu physique (CM 12 h) - processus démographiques et structuration spatiale (CM 12 h) - contributions de l'écologie tropicale à l'écologie théorique (CM 6 h)
- une synthèse resituant les écosystèmes tropicaux dans le fonctionnement de la biosphère (CM 9 h).

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 50%
Oral assessment: 50%

Course title: Exploration et description de la biodiversité
Course ID: SEP33 / NU965
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Philippe Bouchet (philippe.bouchet@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 22 hrs
- Projects: 8 hrs

Course objectives:
Présenter l'actualité de la découverte et de la description de nouvelles espèces d'animaux, plantes et champignons.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Community

Comprendre les enjeux scientifiques de la découverte et de la description de nouvelles espèces, y compris les droits de propriété intélectuelle, les droits de propriété indingène et les principes de publication.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Nombre mesuré d'espèces connues et projections sur le nombre réel d'espèces de la biosphère. Régions, taxons et écosystèmes sources des espèces nouvelles. Présentation de quelques programmes et initiatives européennes et internationales de catalogues d'espèces. Alpha-taxonomie et exhaustivité documentaire. Relations entre systématique descriptive et facteur d'impact.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Taxinomie et nomenclature
Course ID: SEP20 / NU961
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Alain Dubois (adubois@mnhn.fr) and Frédéric Tronchet (tronchet@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Exposer les fondements théoriques et les grandes lignes du fonctionnement de la taxinomie et de la nomenclature des organismes en zoologie et en botanique.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Organism

Approfondir les connaissances en taxinomie et en nomenclature botanique et zoologique.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Taxinomie : principaux paradigmes, bases théoriques, méthodes, espèce et spéciation, relations avec la phylogénie ; bases théoriques des systèmes nomenclaturaux ; nomenclatures zoologique et botanique ; systèmes alternatifs de nomenclature (Phylocode, etc.). Le niveau de ce cours est avancé.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Formalisation des connaissances en systématique et paléobiodiversité
Course ID: SEP38 / NU829
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): René Zaragueta-Bagils (Rene.Zaragueta_Bagils@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Exercises: 15 hrs
- Projects: 5 hrs

Course objectives:
La formalisation des connaissances est au cours de toute démarche méthodologique. Cet enseignement a pour objectif de présenter les objets mathématiques et informatiques au travers desquels sont ensuite présentés et discutés les concepts de la systématique, et des méthodes d'analyse phylogénétique.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Organism

Comprendre et pouvoir appliquer des methods mathématiques et informatiques sur des jeux de données en systématique et phylogénie.

Course material, text books and further reading:
Notes de cours. Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Formalisation, modèle, codage Langage et représentation informatique, niveaux d'abstraction, Les objets mathématiques de la classification : distances, arbres, ensembles, graphes Groupes monothétiques et polythétiques La méthode à trois éléments, formalisation et comparaison 3ia/ parcimonie, Hiérarchie et temps, Caractère, homologie, individus/taxa.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 50%
Oral assessment: 50%

Course title: Morphologie cladistique informatisée
Course ID: SEP21 / NU843
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Véronique Barriel (veronique.barriel@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 16 hrs
- Exercises: 8 hrs
- Projects: 4 hrs

Course objectives:
L'objectif de ce module est d'assurer aux étudiants une initiation, la plus complète possible, aux méthodes d'analyses phylogénétiques informatisées. Les différents principes de la reconstruction phylogénétique assistée par ordinateur dans le cadre de la méthode cladistique (systématique phylogénétique) sont présentés avec une initiation au logiciel PAUP. Une présentation théorique succincte des différents éléments de la méthode cladistique est suivie d'exercices pratiques empruntés à la littérature scientifique tant morphologique que moléculaire.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Connaitre et savoir utiliser les méthodes et logiciels appropriés pour analyser des jeux de données phylogénétiques.

Course material, text books and further reading:
Notes de cours. Manuels de logiciels.
Aricles scientifiques

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Les concepts de la systématique phylogénétique, l'utilisation d'un logiciel de reconstruction phylogénétique (PAUP) et la phylogénie des amniotes. Un des exercices les plus conséquents consiste à confronter les étudiants à l'observation de caractères morphologiques de quelques amniotes (mammifères, tortues, lépidosauriens, crocodiliens et oiseaux). Les caractères sont ensuite codés afin d'établir une matrice morphologique analysée en parcimonie pour discuter des relations de parenté au sein des amniotes.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Phylogénie moléculaire
Course ID: SEP 22
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: Enseignement supérieur / Recherche
Department: Centre Thématique Européen pour la Diversité Biologique
Name and e-mail address of the instructor(s): Nicolas Vidal, MC, MNHN, nvidal@mnhn.fr ; Cyrille D'Haese, CR2, CNRS, cyrille.dhaese@mnhn.fr.
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 60 hrs

Course objectives: Objectifs
Présentation des bases théoriques de la reconstruction phylogénétique à l'aide de l'outil moléculaire et apprentissage de la pratique depuis l'extraction d'ADN jusqu'à l'interprétation des arbres phylogénétiques à l'aide d'un jeu de données obtenu pendant l'UE.

Organisation pédagogique
Cours théoriques sur les différentes approches (distances, parcimonie, approches probabilistes, robustesse, fiabilité)
TP/TD (extraction d'ADN, PCR, nettoyage des séquences, alignement, analyses phylogénétiques)

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
aucun

Table of contents:

Assessment breakdown: please note the general comment on assessment breakdown
Évaluation par un rapport écrit. Written assessment: 100%

Course title: Biodiversity informatics
Course ID: SEP41 / NU823
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Régine Vignes-Lebbe (regine.vignes_lebbe@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French or English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 15 hrs
- Exercises: 15 hrs
- Projects: 30 hrs

Course objectives:
Apprentissage et application des langages autour du web pour la représentation et la diffusion des données scientifiques (XHTML, CSS, SQL, XML, PHP …) : manipulation de données, échanges de format, communication entre applications scientifiques, diffusion en ligne d'information. Connaissance des grands programmes d'information sur la biodiversité, leurs enjeux et les problèmes informatiques actuels dans ce domaine. Acquisition des compétences techniques permettant de comprendre l'architecture des projets et d'y contribuer.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Acquérir une maîtrise de l'outil informatique pour la recherche scientifique : manipulation de données, échanges de format, communication entre applications scientifiques, diffusion en ligne d'information …
Connaître les grands programmes d'information sur la biodiversité, les enjeux et problèmes informatiques actuels dans ce domaine.
Acquérir les compétences techniques permettant de comprendre l'architecture des projets et d'y contribuer.

Course material, text books and further reading:
Notes de cours. Manuels de logiciels.
Articles scientifiques.

Prerequisites: please note the general comment on prerequisites

Aucun

Table of contents:
Recherche, information et société. Projets et programmes en Informatique pour la biodiversité - Systèmes d'information, rappels sur les SGBD et SQL. - Diffusion et exploitation des connaissances. Technologie web, web dynamique (HTML, CSS, PHP) - Organisation et gestion de projets. Outils de travail collaboratif - Langage XML et échange de données. Standards internationaux pour la biodiversité - Nouvelles technologies (imagerie) - Automatisation de traitement (batch) - Bases de programmation de scripts - Outil de modélisation (UML).

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 30%
Projet assessment : 40%
Oral assessment: 30%

Course title: Modélisation des formes et analyse des données morphométriques
Course ID: SEP19 / NU955
University: Sorbonne Université and Muséum National d'Histoire Naturelle
Faculty: UFR TEB (Terre, Environnement, Biodiversité)
Department: Master de sciences de l'Univers, environnement, écologie
Name and e-mail address of the instructor(s): Michel Baylac (baylac@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Exercises: 10 hrs
- Projects: 10 hrs

Course objectives:
Fournir les concepts nécessaires à la compréhension de la littérature morphométrique classique et géométrique et à la mise en oeuvre d'une analyse simple par les méthodes de la morphométrie géométrique. Seront introduits les concepts et méthodes propres aux morphométries classiques et géométriques, avec des exemples d'applications en systématique et biologie évolutive.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Methods and tools

Connaitres les bases théoriques et applications de morphométrique classique et géométrique .

Course material, text books and further reading:
Notes de cours. Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Biométrie et morphométrie. Données morphométriques, distances, points-repères, contours et approches morphométriques appropriées, homologie. Acquisition des données. Tailles, formes et conformations, méthodes de partition de la taille, tailles allométriques et tailles isométriques : approches bivariées et multivariées. Les travaux dirigés comprennent toutes les phases d'un traitement morphométrique d'un jeu de données depuis la numérisation jusqu'à l'interprétation en passant par la mise en oeuvre d'analyses morphométriques et statistiques.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Enjeux patrimoniaux, économiques et scientifiques de la connaissance des espèces
Course ID: E2F2 / NU956
University: Muséum National d'Histoire Naturelle
Faculty: Enseignement supérieur / Recherche
Department: Département de Systématique et Evolution
Name and e-mail address of the instructor(s): Jacques Bardat (jacques.bardat@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30

Course objectives:
L'objectif de ce cours est de sensibiliser les étudiants à l'émergence, il y a une dizaine d'années, du mot biodiversité qui a donné une nouvelle dimension à la connaissance des faunes et des flores. En quittant le champ naturaliste pour investir le domaine politique et juridique, la biodiversité est désormais l'objet d'enjeux patrimoniaux (conservation des espèces et des espaces, esthétique des paysages) et économiques (molécules biologiquement actives, ressources génétiques, écotourisme) qui prolongent et amplifient les enjeux scientifiques (inventaire des espèces, relations phylogénétiques, biogéographie).

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Connaitre le cadre international scientifique, economique et patrimonial du concept de biodiversityé et pourvoir l'expliquer et l'illustrer.

Course material, text books and further reading:
Notes de cours.
Articles scientifiques.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:

Introduction au cours

Enjeux patrimoniaux
Les enjeux d'une politique européenne et internationale de connaissance des espèces
Qu'est ce que le patrimoine naturel, du social au juridique
Qu'est-ce qu'une espèce patrimoniale, une espèce déterminante, l'inventaire ZNIEFF
Les enjeux de l'inventaire faune-flore et habitats du futur réseau Natura 2000 dans le processus de mise en oeuvre de la directive habitats en France.
Le concept de livres et listes rouges
Valeurs sociale et culturelle de la biodiversité : application à la gestion durable de la pêche artisanale dans 3 régions forestières.
Conservation de la biodiversité et savoirs naturalistes locaux : les enjeux actuels
Le rôle des organisations de conservation de la nature : le cas de l'IUCN

Enjeux scientifiques
Espèces invasives et conservation de la biodiversité animale

Connaître pour gérer : quels enjeux dans les hydrosystèmes ?
Bryologie et évaluation biocénotique à différentes échelles
Les fondements éthiques de la conservation des espèces et des milieux
Lutte biologique
Utilisation de la biologie des espèces pour l'évaluation de la qualité d'un milieu

Enjeux économiques
La connaissance de la diversité génétique
Les mammifères invasifs et incidences économiques
Plantes invasives, impact économique
conservation et valorisation des espèces, quelques exemples
La recherche des molécules actives
Insectes invasifs & Incidences économiques
Conclusion

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Partenaires institutionnels et associatifs de la gestion et de la conservation de la biodiversité
Course ID: E2F4 / NU957
University: Muséum National d'Histoire Naturelle
Faculty: Enseignement supérieur / Recherche
Department: Centre Thématique Européen pour la Diversité Biologique
Name and e-mail address of the instructor(s): Dominique Richard (drichard@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
L'objectif de cette unité d'enseignement est de situer le besoin d'expertise taxinomique par rapport à différents employeurs potentiels ou générateurs indirects d'emplois, institutionnels ou associatifs. De nombreux partenaires institutionnels sont ainsi demandeurs d'une expertise sur la connaissance des espèces et de leurs milieux. Ceci s'exprime de la part des délégués représentant la France dans les négociations et discussions internationales dans le cadre de la Convention sur la Diversité Biologique ; au niveau européen, en soutien à la mise en oeuvre des Directives communautaires mais également pour un suivi de la biodiversité à l'échelle de l'Europe; dans un cadre national (MEEDAT) ou déconcentré (DREAL) pour la mise en oeuvre de politiques et de stratégies de gestion et de conservation du patrimoine naturel ou encore dans des organismes spécialisés publics ou associatifs concernés au quotidien par la gestion d'espèces et de leurs milieux.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Comprendre le besoin d'expertise taxinomique par rapport à différents générateurs directs ou indirects d'emplois, institutionnels ou associatifs. Etre capable de trouver les besoins de ces employeurs potentiels.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Implications de la mise en oeuvre de la Convention sur la Diversité Biologique quant au besoin en expertise taxinomique. Présentation du cadre européen relatif à la conservation de la Biodiversité. Rôle et activités de l'Agence Européenne de l'Environnement. Besoins du MEEDAT et des DREAL pour la mise oeuvre du réseau NATURA 2000 et pour la prise en compte de la biodiversité dans l'aménagement du territoire en général. Gestion d'espaces et d'espèces : Parc naturel régional, forêts, faune sauvage, conservatoire de sites collectivité locale ayant à intégrer la conservation du patrimoine naturel dans la gestion du territoire.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Ecologie moléculaire et génétique évolutive des organismes marins
Course ID: EMGE
University: Sorbonne Université
Faculty:
Department: UMR 7144 SU-CNRS
Name and e-mail address of the instructor(s): Christophe Lejeusne (clejeusne@sb-roscoff.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures : 30 hrs
- Practical exercises and group work: 18 + 22 hrs

Course objectives:
L'objectif de cette unité d'enseignement est de former des étudiants en génétique des populations, génétique évolutive et écologie moléculaire dans le domaine marin. L'étude des modalités de la dispersion, des barrières entre espèces, des effets de la fragmentation de l'habitat sur la connectivité entre populations ou encore des variations des systèmes de reproduction sont au cœur de nombreuses questions abordées dans les recherches fondamentales d'écologie et d'évolution ainsi que dans des domaines plus appliqués comme la gestion des espaces naturels côtiers. Les avancées techniques de marquage moléculaire et les récents développements théoriques de la génétique des populations offrent de puissants outils pour aborder ces questions relatives à l'écologie et à la micro-évolution chez les organismes marins. Ce module présente la double originalité de développer les questions spécifiques au milieu marin et de s'intéresser à la fois aux modèles animaux et végétaux (invertébrés marins et macroalgues).

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Comprendre les concepts d'espèces et études de phylogéographie en milieu marin, diversité et structure génétique dans des réseaux de populations (flux de gènes et connectivité), modes de reproduction en milieu marin, adaptation et effets des perturbations d'origine anthropiques (exemple : pollutions, fragmentation d'habitats, invasions biologiques).

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Rappel de génétique des populations : les statistiques F de Wright
Les marqueurs moléculaires
Limites des concepts d'espèces en milieu marin : illustration par l'étude des zones hybrides
Apport des approches de phylogéographie à la compréhension des profils biogéographiques
Les espèces invasives en milieu marin : apport de la génétique des populations et de l'écologie moléculaire dans la compréhension des processus d'invasion biologique
Influence des systèmes de reproduction et des cycles de vie sur la diversité et la structure génétique des populations d'organismes marins
Adaptation et test de sélection : le cas des espèces hydrothermales et des milieux dits « extrêmes »
Analyses de paternité et de descendances
Séminaires de recherche (5 heures) (intervenants extérieurs).

Assessment breakdown: breakdown Written assessment: 40% Oral assessment: 30% Practical work: 30%	please note the general comment on assessment

Course title: Origines de la vie (L'origine des espèces)
Course ID: ORIG
University: Muséum National d'Histoire Naturelle
Faculty:
Department: Systématique et Evolution
Name and e-mail address of the instructor(s): Pierre-Henry Gouyon (gouyon@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Ce cours a plusieurs objets.
- D'une part, aider ceux qui le suivent à lire et comprendre le livre fondateur de Darwin sur un plan à la fois historique et contemporain.
- D'autre part, développer une série de concepts fondamentaux en biologie en explicitant la démarche qui a conduit à l'état actuel des idées
- Enfin, promouvoir la discussion dans le groupe concernant les développements actuels des questions abordées.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

L'idée est qu'à la suite de ce module, les étudiants qui l'ont suivi acquièrent une vision dynamique de la pensée en biologie et général et de l'évolution en particulier; et qu'ils sachent situer les concepts qui leur ont été enseignés dans le contexte d'une pensée en mouvement.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Les participants devront avoir lu L'Origine des Espèces au moins dans la traduction française (disponible en livre de poche).
La version anglaise de la première édition se trouve sur le site http://www.esp.org/books/darwin/origin/facsimile/title3.html cliquer sur Table of Contents, on a accès aux différents chapitres. Pour télécharger un chapitre, faire un clic droit sur le titre et choisir "enregistrer la cible sous". Il faut ainsi charger chaque chapitre individuellement. Il s'agit du fac simile de l'édition originale, nous travaillerons dessus (il est utile, voire indispensable,que nous ayons tous les mêmes numéros de pages). Nous pourrons en fournir une version imprimée.
Chaque demi-journée est dévolue à la discussion d'un chapitre du livre, concernant un concept majoritaire et souvent plusieurs. Pour chacun, on commence par discuter de ce qui était connu, cru, ou supposé, avant Darwin. L'apport de ce texte dans ce domaine est alors discuté. Enfin, la suite de ce qui a pu être découvert sur les concepts concernés, ce qui a pu être réfuté, transformé, conservé est discuté ainsi que les questions encore non résolues.

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Biogéographie Paléo-biogéographie
Course ID: SEP37/NU513
University: Sorbonne Université & Muséum National d'Histoire Naturelle
Faculty:
Department:
Name and e-mail address of the instructor(s): Fabrizio Cecca (fabrizio.cecca@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Étude des principes et des méthodes de la biogéographie et de la paléobiogéographie marine et continentale dans un contexte historique. Biogéographie systématique.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Comprendre les principes et des méthodes de la biogéographie et de la paléobiogéographie marine et continentale dans un contexte historique. Biogéographie systématique.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Relation entre biodiversité et biogéographie (rôle de l'endémisme et de l'effet surface/biodiversité, etc.); utilisation des méthodes "phénétiques", historiques issues de méthodes cladistiques dont l'analyse à trois éléments.

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Enjeux professionels en ingénierie écologique et biologie de la conservation
Course ID: EPIC
University: Muséum National d'Histoire Naturelle
Faculty:
Department:
Name and e-mail address of the instructor(s): Nathalie Frascaria-Lacoste (nathalie.frascaria@u-psud.fr), François Sarrazin (sarrazin@mnhn.fr) & Christian Kerbiriou (kerbiriou@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Au cours de ce module, les étudiants trouveront des aides à la réflexion pour leur projet professionnel en Ingénierie écologique ou Conservation et gestion de la biodiversité. Un projet, c'est une projection dans le futur. Elaborer un projet professionnel dans ces domaines doit se faire sur plusieurs étapes depuis la connaissance de soi et de ses compétences vers la connaissance des métiers et des institutions ou entreprises, la recherche de l'emploi, la construction du CV et de la lettre de motivation jusqu'à l'entretien de recrutement. Dans ce module, nous vous aiderons à débuter cette construction par le biais de rencontres avec des professionnels mais aussi par l'élaboration personnelle de documents tels qu'un CV et une lettre de motivation.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Etre capable de faire un projet professionnel, incl. Un CV et une lettre de motivation.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Les domaines d'activité de l'ingénierie écologique et de la conservation de la biodiversité sont en pleine évolution. L'offre d'emploi est encore peu structurée. Il Ce module présente donc les différents secteurs de l'emploi (Bureaux d'Etudes, concours fonction publique, Parcs, ONG, ONCFS…) par une série d'exposés réalisés par des professionnels. Ces intervenants fournissent des clés pour mieux comprendre les missions de ces organismes, les types d'emplois proposés et les compétences et qualités requises pour y accéder. Par ailleurs, le module comprend aussi les soutenances des étudiants pro de l'année précédente avec l'opportunité d'échanges avec leurs encadrants professionnels..

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Gestion des populations et écosystèmes
Course ID: GEPE
University: AgroParisTech
Faculty:
Department:
Name and e-mail address of the instructor(s): C. Bessa Gomes & T. Spataro
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 60 hrs

Course objectives:
Ce module traite essentiellement de diverses formes d'intervention humaine sur le fonctionnement de populations (et, à un moindre degré, de communautés et d'écosystèmes) :
- populations exploitées (pêche, chasse)
- populations cultivées (cultures de plein champ et sous serres, forêts, bioréacteurs)
- populations invasives
- habitats préservés (parcs naturels, etc.)

La démarche générale consiste à s'appuyer sur les connaissances fondamentales en écologie des populations pour les appliquer à des cas concrets. Certains aspects relatifs à la préservation des espèces menacées pourront être ponctuellement abordés mais cette problématique ne constituera pas le thème principal de cette UE car d'autres UE proposées au cours du semestre lui sont exclusivement consacrées.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Population

Etre capable de s'appuyer sur les connaissances fondamentales en écologie des populations pour les appliquer à des cas concrets.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Quelques exemples de thèmes qui pourront être abordés :

- Gestion de la " grande pêche " en mer
- Gestion " fine " de la pêche lacustre
- Optimisation multicritère (durabilité+profitabilité) d'une pêcherie
- Optimisation de la lutte chimique contre les ravageurs des cultures
- Gestion des populations de petit et gros gibier
- Sylviculture des forêts mélangées
- Biologie des mycorhizes et utilisation en foresterie
- Plantes transgéniques et gestion de la résistance des ravageurs
- Systèmes écologiques contrôlés : chemostats, bioréacteurs
- Dynamique du plancton lacustre et lutte contre l'eutrophisation
- Gestion des espaces naturels

- Bienfaits et dangers de la lutte biologique
- Ecologie du paysage et protection des cultures.

Assessment breakdown: please note the general comment on assessment breakdown

Written or oral assessment: 100%

Course title: Structure et histoire paléontologique des grands clades de Métazoaires
Course ID: SEP5/NU949
University: Muséum National d'Histoire Naturelle
Faculty:
Department:
Name and e-mail address of the instructor(s): Gaël Clément (gclement@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Ce module aborde, par des études de cas choisis dans les divers grands clades des organismes métazoaires, les principaux problèmes rencontrés et les méthodes utilisées en biologie comparative, phylogénie et systématique.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Le cours vise une bonne compréhension des divers clades des organismes métazoaires.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Des clades majeurs (mollusques, arthropodes, échinodermes et les grands clades de vertébrés) ont été choisis notamment pour illustrer l'impact des fossiles sur les phylogénies ; ceci en raison de l'information que portent les caractères morphologiques de leurs représentants fossiles.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Phylogénie des Métazoaires: evolution des plans d'organisation
Course ID: SEP45/NU943
University: Sorbonne Université
Faculty:
Department:
Name and e-mail address of the instructor(s): Michaël Manuel (michael.manuel@SU.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Exercises: 12 hrs
- Projects: 9 hrs

Course objectives:
Cette UE envisage la diversité des plans d'organisation des animaux pluricellulaires (métazoaires) dans un cadre phylogénétique, à haut niveau taxonomique (au-dessus du niveau de l'embranchement, à la différence de l'UE SEP5 « Paleomet »). Les travaux sur la phylogénie des métazoaires (basés sur des données moléculaires, mais aussi morphologiques) ont connu un essor considérable depuis une vingtaine d'années, et ont abouti à des hypothèses nouvelles remettant en partie en cause les conceptions « traditionnelles ». À travers une synthèse critique de la littérature récente, on discutera l'impact de ces travaux sur la manière dont on conçoit l'évolution des métazoaires : abandon des préconceptions gradistes, réévaluation de la valeur phylogénétique des caractères morpho-anatomiques et embryologiques. La contribution des données concernant les gènes de développement (« Evo-Devo ») sera également prise en compte. Le concept de plan d'organisation, clé de voûte de la zoologie « traditionnelle », fera l'objet d'une discussion critique. On insistera sur l'intérêt des embranchements dits « mineurs », rarement abordés dans les enseignements universitaires.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Comprendre la diversité des plans d'organisation des animaux pluricellulaires (métazoaires) dans un cadre phylogénétique.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
L'histoire du concept de plan d'organisation – L'élaboration de la phylogénie « traditionnelle » de Haeckel à Hyman – La base de l'arbre des métazoaires – La phylogénie des Bilateria – Origine et radiations anciennes des métazoaires : l'apport de la paléontologie – Métamérie et cavités liquidiennes : signification évolutive d'après la phylogénie et l'Evo-Devo – Morpho anatomie et intérêt évolutif de quelques embranchements « mineurs » (travaux pratiques : observations, dissections).

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Les crises biologiques : comprendre le passé et l'actuel
Course ID: SEP51/NUXXX
University: Sorbonne Université et Muséum National d'Histoire Naturelle
Faculty:
Department: Laboratoire de Micropaléontologie
Name and e-mail address of the instructor(s): Silvia Gardin (silvia.gardin@SU.fr) & Annachiara Bartolini (bartolini@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Ce module a pour but de faire le point sur nos connaissances autour des crises biologiques du passé mais aussi celle du présent. Au cours de ce module, on abordera les différentes méthodes d'analyses (systématique, paléontologique, écologique…) et leurs limites, pour une lecture critique des modèles proposés, à une comparaison entre les différentes crises biologiques ainsi qu' une discussion sur les prospectives de recherche..

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Global

Comprendre les crises biologiques dans leur contexte.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
- Les crises biologiques : définitions, évolution des concepts, approches méthodologiques.
- L'enregistrement fossile (marin versus continental) des crises biologiques majeures et mineures.
- Approche systématique, paléontologique, écologique et environnementale des crises actuelles et passées.
- Comparaison entre les crises : sévérité taxonomique versus sévérité écologique, l'importance des contraintes temporelles.
- « Modélisation » des crises : débats sur les causes et les mécanismes.

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Ecologie de la restauration
Course ID: ECOR
University: Sorbonne Université et Muséum National d'Histoire Naturelle
Faculty:
Department:
Name and e-mail address of the instructor(s): François Sarrazin (sarrazin@mnhn.fr) & Nathalie Frascaria-Lacoste (nathalie.frascaria@u-psud.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs

Course objectives:
Si de nombreux travaux en conservation de la biodiversité s'intéressent aux processus de déclin et aux moyens de les enrayer, on voit émerger depuis deux décennies des travaux développés spécifiquement dans un contexte d'écologie de la restauration. Ils concernent différents niveaux d'intégration : population, métapopulation, communautés, écosystèmes. Ces travaux souvent empiriques par le passé s'appuient de plus en plus sur les connaissances les plus récentes en biologie des populations ou dans le fonctionnement des écosystèmes. Cette UE est ainsi destiné aussi bien aux étudiants motivés par des parcours 'recherche' que des parcours 'professionnel' qu'ils soient intéressés directement par les thèmes de la conservation, ou de l'ingénierie écologique, ou souhaitant acquérir une culture générale dans ce domaine.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecoystem

Comprendre les bases et les applications de l'écologie de la restauration.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Restauration en écologie, buts, critères de succès.
- Réintroduction et renforcements de populations (préparation et suivi)
- Fondation des petites populations (aspects démographiques et génétiques)
- Restauration des sols - Restauration des écosystèmes (structure et fonctionnement)
- Exemples d'application.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Fonctionnement et dynamique des socio-écosystèmes
Course ID: FOSE
University: Muséum National d'Histoire Naturelle
Faculty:
Department:
Name and e-mail address of the instructor(s): Lus Semal, Denis Couvet & Anne-Caroline Prevot
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 48 hrs
- Exercises: 12 hrs
- Projects: 10 hrs

Course objectives:
Outre la préservation des espèces menacées et la restauration des espaces, les enjeux globaux de conservation réclament aujourd'hui que nous apprenions à mieux concilier activités humaines et biodiversité. La notion de socio-écosystème nous aide à aller en ce sens, en mettant l'accent sur l'intérêt de penser conjointement les enjeux écologiques et sociaux.
L'UE propose des outils d'analyse du fonctionnement des socio-écosystèmes, à partir d'approches interdisciplinaires issues de la biologie de la conservation, de la psychologie de la conservation, des sciences politiques et de l'économie écologique. Ces approches complémentaires nous aideront à questionner l'ampleur des changements sociaux nécessaires pour conserver la biodiversité, en accordant une attention particulière au problème des limites à la croissance.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Global

Le cours vise une ouverture à l'interdisciplinarité pour analyser les systèmes socio-écologiques, et à une capacité à construire une grille d'analyse de situations réelles, en intégrant différents angles.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Notion de socio-écosystème (cadre d'analyse d'E. Ostrom).
Idées, acteurs et courants de l'écologie politique
Économie écologique
Psychologie de la conservation et écologie de la réconciliation
Enjeux associés à la biodiversité dans les espaces anthropisés (ville et agriculture)
Représentations multiples de la nature et de la biodiversité, motivations à agir.

Assessment breakdown: please note the general comment on assessment breakdown
Written or oral assessment: 100%

Course title: Etnoécologie
Course ID: ETNO
University: Muséum National d'Histoire Naturelle
Faculty:
Department: UMR 7206 Éco-anthropologie et ethnobiologie
Name and e-mail address of the instructor(s): Serge Bahuchet (bahuchet@mnhn.fr)
Course website: to be posted
Semester: S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Practicals : 6 hrs

Course objectives:
Approfondir les connaissances en ethnoécologie (interrelations culturelles sociétés-environnement) au travers d'un séminaire de recherche et l'étude de textes spécialisés. Le séminaire s'appuie sur des études de cas (travaux en cours au sein des équipes de recherche associées à EDTS ou de chercheurs extérieurs invités afin élargir certains thèmes dans un souci d'approche interdisciplinaire). Il sera construit autour d'un ou plusieurs thèmes : les produits forestiers non-ligneux, les pêcheurs et les ressources piscicoles marines et dulçaquicoles, l'ethnoécologie du feu, etc. Seront abordés l'ethnoécologie de différentes sociétés dans un contexte contemporain.
Complémentaire de l'UE EDTS 35 Anthropologie de la conservation.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Ecoystem

Être capable d'appréhender la complexité des relations sociétés-environnement du point de vue des sciences sociales et de proposer les méthodes adaptées de recherche, de recueil et d'analyse de données pertinentes et nécessaires à la conduite d'une étude ethnoécologique.

Course material, text books and further reading:
Notes de cours. Ressources en ligne.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:
Ethnoécologie
Relation sociétés-nature
Ressources naturelles
Dynamiques contemporaines des sociétés.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course descriptions at Università degli Studi di Firenze (UNIFI)

Course title: Applied Conservation Biology
Course ID: B031838
University: Università degli Studi di Firenze – University of Florence (Italy)
School: Scuola di Scienze Matematiche Fisiche e Naturali – School of Science
Department: Dipartimento di Biologia – Department of Biology
Name and e-mail address of the instructor(s): Prof. Francesco Rovero (francesco.rovero@unifi.it)
Course website: to be posted
Semester: S3
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 32 hours
- Exercises: 16 hours

Course objectives: provide an understanding of the fundamentals of conservation biology and the strategies and methods for biodiversity conservation both at global level and with a focus on tropical rainforests.

Learning outcomes: please note the general comment on learning outcomes
Competence acquired: approaches to quantify biodiversity, methods in quantitative ecology to assess the vulnerability of populations and communities; understanding of the multitude of management approaches at global level.
Skills acquired: capacity to critically assess and evaluate strategies and plans for biodiversity conservation; capacity to engage into inferential studies to assess spatio-temporal variation of populations and communities.

Course material, text books and further reading: material used during the course will consist in slides, scientific papers reviewed during the lectures, web-sites and grey literature and files used for exercises of data analyses (in Excel and R). In addition, the following books will be the main reference ones:
Primack 2014. Essentials of Conservation Biology. Sinauer Associates.
Groom, Meffe e Carroll 2005. Principles of conservation biology. Sinauer Associates.

Prerequisites: please note the general comment on prerequisites
notions of ecology and animal ecology
please note the general comment on prerequisites

Table of contents:
Conservation biology: introduction to the discipline. Biodiversity (focus at species-level): definitions, measures (richness and indices), global distribution of terrestrial biodiversity (hotsposts and other rankings). Value of biodiversity (ecosystem, economic, social, intrinsic and ethical issues). Biodiversity crisis and the sixth extinction: historic, current and future situation, causes and threats (habitat degradation and loss, overexploitation, climate changes, etc.). Overview of the Anthropocene.
Focus on tropical rainforests: key characteristics, threats and conservation issues. Conservation strategies at global level: (1) species protection – focus in-situ, (2) habitat protection, (3) ecosystem management outside protected areas. (1) Fundamentals of quantitative ecology to assess distribution, abundance and vulnerability of populations and communities: sampling (principles of statistical inference) e prime methods with focus on terrestrial mammals (transects, camera trapping, capture-recapture). Relative abundance and indices. Hierarchical approaches to estimate occurrence and abundance of populations. Conservation by proxy (umbrella, charismatic, threatened, indicator species, etc.) and design of monitoring plans to determine temporal trends and vulnerability. The course will include examples of data analyses in R. (2) Protected areas (terrestrial realm): global situation, criteria to design protected areas. (3) Overview on ecosystem management, connectivity, sustainable development, global scenarios.

Assessment breakdown: please note the general comment on assessment
100% oral exam

Course title: Ecosystem services and climate change
Course ID: B031837
University: Università degli Studi di Firenze
School: Scienze Matematiche Fisiche e Naturali – School of Sciences
Department: Dipartimento di Biologia – Department of Biology
Name and e-mail address of the instructor(s): Stefano Cannicci (Stefano.Cannicci@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 6 hrs

Course objectives:
Understanding of climate change causes and of its effects on natural ecosystems. Understanding the link between physiological and biological characteristics at organismal level and global changes at ecosystem level.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Global

General information on the effect of climate changes on natural systems. Predictive models about the impacts of global warming, ocean acidification and purported enhanced frequency of hypoxic events on ecosystems. Information on the relationship between the eco-physiological chaacteristics of the species and the effect of climate change.

Course material, text books and further reading:
IPPC, Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. Avaiable at www.ipcc.ch
Ecoystems and human well-being. Vol 1: Current States and Trends. The Millenium Ecosystem Assessment. Island Press, 2005

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
The course will first provide an introduction to climate change science, with a focus on the effects of global change on Tropical ecosystem functions and services, and then it will address the observed and anticipated impacts of global climate change on wetlands, forests and coastal ecosystems. During the course, the students will also acquire an in-depth knowledge of conservation and management issues related to vulnerable tropical ecosystems and of mitigation protocols and scenarios.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Landscape analysis (*partim* Methods in Landscape Analysis)
Course ID: B031843
University: Università degli Studi di Firenze
School: Scienze Matematiche Fisiche e Naturali – School of Sciences
Department: Dipartimento di Scienze della Terra – Department of Earth Sciences
Name and e-mail address of the instructor(s): Filippo Catani (filippo.catani@unifi.it); Federico Raspini (Federico.raspini@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 3 (this subcourse contributes 50% of the course **Landscape analysis** of 6 ECTS).

Course breakdown and hours:
- Lectures: 32h
- Excercises: 16h

Course objectives:
The target of this course is to present an overview of the basics and methods for modeling and understanding the physical landscape as a dynamic system starting from multi-source data, with special reference to the tropics and wetland ecosystems.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global
At the end of the course, the students should be able to measure and model the main geo-physical processes and related landscapes in humid tropics by direct field observation, analysis of available map or remote sensing data and the literature. They should be able to relate landscape shaping factors to needed data for a successful modeling and understanding of landsurface dynamics.

Course material, text books and further reading:
Basic theory explanation will be provided during the course by using a computer-animated presentation which will be available for students. Textbooks on Physical Geography and will be suggested.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
The course is subdivided in two moules: 1) Physical geography and GIS and 2) Physical landscape modelling. The main landsurface processes. Spatial distribution of prevalent sediment erosion, mass wasting, transport and deposition processes in a tropical catchment. Basics of landscape process analysis. Hillslope and floodplain hydrology as related to tropical ecosystems and wetlands. Data acquisition from different available sources for strategic, large-scale studies. Modeling of physical interactions in the tropical environment. Production of modeling scenarios for physical landscape evolution with special reference to the Influence of human impacts on tropical landscapes

Assessment breakdown: please note the general comment on assessment breakdown
written assessment 100%

Course title: Landscape analysis (*partim* Pedology)
Course ID: B031843
University: University of Florence
Faculty: School of Mathematical, Physical and Natural Sciences
Department: Department of Earth Sciences
Name and e-mail address of the instructor(s): Anna Andreetta (anna.andreetta@unifi.it)
Course website:
Semester: S3
Number of credits (ECTS): 3 (this subcourse contributes 50% of the course **Landscape analysis** of 6 ECTS).

Course breakdown and hours:
- Lectures: 14
- Exercises:
- Projects: 6
- Lab work:
- Excursions: 4

Course objectives:
This teaching aims to provide the basis for a) knowing the soil and its functional relationships with various environmental compartments; b) understanding the evolution of the soil, the processes of genesis of the different types of soil in relation to time, climate, vegetation, geomorphology and geological substrate; c) knowing the main types of soil present in Tropical and Subtropical countries, their geographical distribution, characteristics, and their primary physical and chemical limits for sustainable management; d) knowing the main threats to the soil due to human impact.

Learning outcomes: please note the general comment on learning outcomes
At the end of the course, students will understand basic soil properties and soil-forming processes, knowing in detail soil types that developed in Tropical and Subtropical countries.
Students will be able to relate soil types to their landscape and environment, recognise soil chemical and physical properties from soil type (USDA and WRB) and individuate principal limits for sustainable management. Students will improve their communication ability by appropriately using technical and pedological terms and critically integrating knowledge.

Course material, text books and further reading:
Lecture notes, slides and scientific articles provided or recommended during the course.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Soil functional relationships with other environmental compartments; the ecological role of the soil.
Soil physical properties. Soil-water relationships. Soil forming factors. Soil profile description and recognition of diagnostic horizons. Principal soil types, following WRB and USDA classification systems, in Tropical and Subtropical countries focus on soils of the littoral environment (mangrove soils), Organic soils (tropical peats) and soils of the rainforests: geographical distribution, characteristics, chemical and physical limits, and sustainable use. Significant threats to the soil. Soil, carbon sequestration and climate change. Presentation of international soil databases such as FAO and ISRIC. Pedo-landscape reading tools: cartography, geographic information systems and Land evaluation. Evaluation of case studies using R and QGIS for data analysis.

Assessment breakdown: please note the general comment on assessment
Written: 70%
Project: 30%

Course title: Tropical climatology
Course ID: B031839
University: Università degli Studi di Firenze
School: Agriculture
Department: Scienze delle Produzioni Agroalimentari e dell'Ambiente (DISPAA)
Name and e-mail address of the instructor(s): Simone Orlandini (simone.orlandini@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 6 hrs

Course objectives:
The aim of the course is to give concepts that form the basis for understanding the climate of tropical environment, monitoring and analysis techniques. At the end of the course the students are expected to be able to evaluate the effects of tropical climate on bio-physical systems.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Environment Biological level: Global

Analysis of meteo-climatic characteristics of tropical environments in relation with different spatial and temporal scales. Methods for climate monitoring and the application of modeling for environmental management and planning. Climatic variables and basic element for data analysis to assess mean and extreme conditions. Climate change impacts, vulnerability, adaptation and mitigation strategies. Exercises dealing with climatic data analysis and bio-physical modeling application.

Course material, text books and further reading:
Guide to Agricultural Meteorological Practices (GAMP) 2010 Edition (WMO-No.134), Geneva (CH)
Applied Agrometeorology, 2010, Kees Stigter (Ed.), Springer (Berlin) (D)
Lecture notes edited by the Instructor

Prerequisites: please note the general comment on prerequisites
none

Table of contents:
Lectures:
Basic knowledge of climatology and meteorology: variables, measurements, bio-physical effects
Reference scales for space and time
Climatology of tropical environment
Climate change: impacts, adaptation and mitigation
Simulation and forecasting models
Exercises:
Sensors, instruments, acquisition systems, data transmission
Software for climate data analysis
Modeling application

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment 50%
Project and exercise assessment 50%

Course title: Advances in Tropical botany
Course ID: B031836
University: Università degli Studi di Firenze
School: Scienze Matematiche Fisiche e Naturali – School of Sciences
Department: Dipartimento di Biologia – Department of Biology **Name and e-mail address of the instructor(s):**
Alessio Papini (alessio.papini@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 6 hrs

Course objectives:
Learn the most important tropical plant families, their morphological features, ecology, adaptations in different tropical areas of the world, interactions between plants and animals.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Plant Biological level: Organism

Use of identification keys of Flora. Knowledge of the general tropical plant diversity and principles of the collecting data and herbarium management.

Course material, text books and further reading:
Textbooks on Tropical Botany (Paleo- and Neo-tropical areas of the world) are available at the Tropical Herbarium Library and at the Botanical Library of the Department of Evolutionary Biology. Consultation of international journals are recommended by free access on internet under the teacher's suggestions. Students will be asked to prepare a topic of their choice and present it to the other students within a "journal club" seminar.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
1) General plant morphology ; 2) Ecological adaptations in a Tropical environments ; 3) Tropical biogeography ; 3-6) Paleotropical plant families ; 7-10) Neotropical plant families ; 11) Specific cases of study in tropical plant systematics ; 12) Nomenclature.

Assessment breakdown: please note the general comment on assessment breakdown
Oral presentation and assessment : 100%

Course title: Methods in animal ecology and evolution (*partim* Analysis of ecological communities)
Course ID: B031840
University: Università degli Studi di Firenze – University of Florence (Italy)
School: Scuola di Scienze Matematiche Fisiche e Naturali – School of Science
Department: Dipartimento di Biologia – Department of Biology
Name and e-mail address of the instructor(s): Giacomo Santini, giacomo.santini@unifi.it
Course website: to be posted
Semester: S3
Number of credits (ECTS): 3 (This subcourse contributes 50% of the course **Methods in animal ecology and evolution of 6 ECTS**).

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 6 hours

Course objectives:
To provide an understanding of the fundamentals of ecological community analysis using multivariate methods , and of the methods for the analysis of functional traits.

Learning outcomes: please note the general comment on learning outcomes
Knowledge of the main methods for ecological community analysis. To be able to of understand research papers on community structure and functioning. Autonomy in participating to an ecolocical research.

Course material, text books and further reading:
De Bello et al. 2021. Handbook of Trait-Based Ecology: From Theory to R Tools. Cambrdige University Press.
Zuur et al. 2007. Analyzing Ecological Data. Springer
Borchard et al. 2011 Numerical Ecology with R. Springer
Relevant book chapters, reprints of recent scientific papers and lectures handouts will be available to students.

Prerequisites: please note the general comment on prerequisites
none

Table of contents:
Lectures:
Basics of community ecology. Univariate methods for the estimation of species richness and diversity. Indicator Value (IndVal). Introduction to multivariate methods in ecology. Ordination: unconstrained (PCA, nMDS), and constrained (RDA) methods. Permutation based multivariate analysis of variance. Funtional and trait-based analysis: trait selection and standardization. Community metrics: community weighted means, Functional diversity indices, partitioning of functional diversity.
Exercises:
Multivariate analysis using R

Assessment breakdown: please note the general comment on assessment
100% Oral assessment/presentation

Course title: Methods in animal ecology and evolution (*partim* Animal phylogeography)
Course ID: B031840
University: Università degli Studi di Firenze
School: Scienze Matematiche Fisiche e Naturali – School of Sciences
Department: Dipartimento di Biologia – Department of Biology
Name and e-mail address of the instructor(s): Sara Fratini (sarafratini@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 3 (This subcourse contributes 50% of the course **Methods in animal ecology and evolution of 6 ECTS**).

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises: 4 h

Course objectives:
Learn about history and background of Phylogeography. Understand philosophies and methods of molecular data analysis. Learn about species phylogenies and population genetic structure, in terms of theories and statistical methods. Know the principal molecular markers. Discuss study cases and applications to zoological problems.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Knowledge of the mechanisms of micro and macro-evolution processes. Capacity of analyzing and discussing research papers on phylogeography and population genetic structure. Autonomy in participating to a phylogeography research.

Course material, text books and further reading:
John C. Avise, 2000. Phylogeography: the history and formation of species. Harvard University Press.
John C. Avise, 2004. Molecular markers, natural history, and evolution. Sinauer Associates, Inc. Pub.
Scientific papers.
Duplicated lecture notes.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Lectures:
History and background of Phylogeography. Microevolution, macroevolution and speciation. Coalescence theory. The mitochondrial DNA. Principal molecular techniques. Sequence data analysis: sequence alignment, methods for calculation of genetic distance. Genetic trees. Monophlyletic, paraphyletic and polyphyletic groups. Phylogenetic Inference methods (distance method – NJ, UPGMA - e discrete method - maximum parsimony, maximum likelihood, Bayesian Inference). The bootstrap method. The concept of molecular clock. Neutral theory of molecular evolution. Population genetic structure and gene flow: the F- statistics. Historical demographic events: the neutrality test and the mismatch distribution analysis. Phylogeography categories. Phylogeography and conservation genetics: evolutionary significant units and management units. Nested clade analysis.
Exercises:
Principal software for the analysis of sequence data. Case studies.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 100%

Course title: Tropical Plants in Action
Course ID: B032898
University: Università degli Studi di Firenze
Faculty: School of Mathematical, Physical and Natural Sciences
Department: Biology
Name and e-mail address of the instructor(s): nadia.bazihizina@unifi.it
Course website:
Semester: S3
Number of credits (ECTS): 6

Course breakdown and hours:
- Lectures: 40
- Exercises: 0
- Projects: 0
- Lab work : 12
- Excursions :0

Course objectives:
Plants have shaped the Earth and its environment, and their capacity to adapt and acclimate to wide conditions that make studying them so interesting. Starting from a description of the tropical environments (climate, soils, seasonality) and differences from temperate regions, this course takes students through the parts (organs, tissues and cells) that make up plants, and considers how specific traits enable plants to function and interact with the environment in tropical areas.

Learning outcomes: please note the general comment on learning outcomes
Students will be able to: describe the structure of plants and how each part functions and contributes to the whole; demostrate an understanding of whole plant physiology, including developping skills in measuring net photosynthesis, chlorophyll content, water relations, water transport, ion transport, and plant growth and development. As a result students will gain skills in evaluating plant function, including the dynamic processes of growth, development and the response to the environmental stresses; demonstrate an understanding of the knowledge needed for the conservation and restoration of the tropical landscape

Course material, text books and further reading:
All material is provided during the course.
Textbooks for further reading :
Lüttge, U. Physiological ecology of tropical plants. Springer, 2008
Lambers H, Oliveira RS. Plant physiological ecology. Springer, 2019.
Taiz et al. Plant Physiology and Development. Oxford University Press Inc , 2022

Prerequisites: please note the general comment on prerequisites
None

Table of contents: (i) Tropical environment and differences from temperate regions ; (ii) Ecophysiological responses to drought. Plant hydraulics ; (iii) Responses of tropical forest plants to contrasting light environments ; (iv) Mangroves: Physiological and morphological adaptations ; (v) Ecosystems of coastal sand plains: adaptations to water extremes and salinity ; (vi) Savannas: the role of fire and soil on vegetation ; (vii) Stress-tolerant adaptations in tropical inselbergs.

Assessment breakdown: please note the general comment on assessment
Oral evaluation on the range of topics covered during the course. As a facultative additional evaluation, students can also deliver their own presentations on a chosen topic.

Course descriptions at the Université de Guyane (UdG)

Course title: Introduction à l'environnement tropical
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Stéphane Traissac (Stephane.Traissac@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 8

Course breakdown and hours:
- Lectures: 35 hrs
- Exercices: 12 hrs
- Excursions : 12 hrs

Course objectives:

- Acquérir des bases scientifiques permettant de comprendre le fonctionnement des forêts tropicales et milieux anthropisés.
- Rendre les étudiants conscients des problèmes que pose la conservation de la biodiversité et la gestion des forêts dans les tropiques humides, à partir d'exemples concrets et de témoignages d'acteurs guyanais.

Learning outcomes: please note the general comment on learning outcomes

Education level: Basic Ecosystem focus: Environment Biological level: Ecosystem

Upon completion of the course a student must be able to:
- Comprendre les principes de fonctionnement et de gestion d'une forêt tropicale humide.
- Acquérir une expérience des tropiques en général, de la forêt tropicale humide et de la Guyane en particulier.

Course material, text books and further reading:
Notes de cours.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:

Cours
- Fonctionnement des forêts tropicales : biogéographie, géomorphologie, pédogenèse, caractérisation des sols et des relations sol-plante, botanique, définition, mesure, et maintien de la biodiversité, dynamique forestière
- Enjeux de la gestion de la forêt en Guyane : présentations des spécificités de la Guyane française, systèmes de production paysans, gestion forestière, filière bois, l'industrie forestière, produits forestiers non ligneux.

Assessment breakdown: please note the general comment on breakdown
Oral assessment: 0 %
Written assessment: 0 %

Projects/Presentations/Reporting: 100 %

Course title: Origine et maintien de la biodiversité
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Stéphane Traissac (Stephane.Traissac@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 4

Course breakdown and hours:
- Lectures: 37 hrs
- Exercices: 1.5 hrs
- Excursions: 3 hrs
- Projects: 0 hrs

Course objectives:
- Aborder la biodiversité sous l'angle de sa dynamique dans le temps et l'espace, des interactions entre espèces, des mécanismes de spéciation et l'évolution.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Community

Upon completion of the course a student must be able to:
- Comprendre et appliquer les principales mesures de biodiversité, leur intérêt et leurs limites.
- Comprendre la diversité et les rôles des interactions interspécifiques au sein des écosystèmes.
- Comprendre les modèles de dynamique forestière.
- Comprendre les mécanismes de spéciation.

Course material, text books and further reading:
Notes de cours.

Prerequisites: please note the general comment on prerequisites
- Connaissances générales en écologie
- Connaissances générales en génétique

Table of contents:

Diversité et Evolution :
Entropie des systèmes complexes et mesures de diversité.
Diversité fonctionnelle et phylogénétique.
Écologie évolutive et phylogéographie comparée.

Dynamique Forestière :
Descripteurs collectifs et individuels.
Structuration spatiale des individus et des populations.
Processus dynamiques en forêt tropicale.

Interactions biotiques :
Diversités des interactions biotiques et implication dans le fonctionnement des écosystèmes.
Co-évolution et maintien des interactions.

Assessment breakdown: please note the general comment on assessment breakdown Oral assessment: 0 % Written assessment: 100 % Projects/Presentations/Reporting: 0 %

Course title: Théories de l'Ecologie
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Bruno Hérault (bruno.herault@cirad.fr)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 24 hrs
- Exercices: 0 hrs
- Excursions: 0 hrs
- Projects: 0 hrs

Course objectives:

L'objectif de ce cours est de comprendre comment les différentes théories utilisées pour expliquer les patterns de biodiversité observés sont nées, d'en comprendre la philosophie et les fondements mathématiques, de voir les limites de chacune d'elles et de comprendre dans quel contexte scientifique elles ont émergé.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Forest Biological level: Community

Upon completion of the course a student must be able to:
- Comprendre et appliquer les modèles suivants :
Modèles de compétition
Modèles proies-prédateurs
Modèles de distribution
Théorie neutre
Théorie métabolique

Course material, text books and further reading:
Notes de cours.

Prerequisites: please note the general comment on prerequisites
Ecologie fondamentale
Statistiques descriptives et probabilités
Notions d'utilisation de R

Table of contents:

Epistémologie des théories sur la diversité des espèces.
Construction mathématique et lien entre les modèles.
Modèles de niche et neutralité.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 0 %

Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Course title: Modélisation des systèmes écologiques
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Eric Marcon (eric.marcon@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 4

Course breakdown and hours:
- Lectures: 50 hrs
- Exercices: 0 hrs
- Excursions : 0 hrs
- Projects: 0 hrs

Course objectives:

L'objectif de ce module est de comprendre deux types de modélisation statistique classique en écologie et plus généralement en biologie.
- La partie modèle linéaire propose l'étude des modèles usuels comme l'analyse de la variance, la régression, l'objectif étant d'illustrer la puissance de ces modèles mais aussi leurs limites.
- La partie modèle hiérarchique propose la découverte de la statistique bayésienne qui connaît un grand essor en écologie. L'accent est mis sur la pratique des modèles hiérarchiques, la mise en œuvre des modèles est conduite à l'aide des logiciels WinBugs et R.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Method and tools

Upon completion of the course a student must be able to:
- Savoir appliquer le modèle adapté à une question scientifique en fonction des données disponibles et de la compréhension du modèle sous-jacent.
- Utiliser concrètement les logiciels nécessaires.

-

Course material, text books and further reading:
Notes de cours
Korner-Nievergelt, F. et al. (2015) *Bayesian Data Analysis in Ecology Using Linear Models with R, BUGS, and Stan.* Academic Press

Prerequisites: please note the general comment on prerequisites
Statistiques descriptives et probabilités
Notions d'utilisation de R

Table of contents:

- Modèles linéaires : analyse de variance, régression multiple, analyse de covariance, modèle linéaire généralisé, modèle mixte.

- Modèles hiérarchiques Bayésiens : statistique Bayésienne, modèles graphiques, modèles usuels et notion de conjugaison, variables latentes.

- Outils mathématiques : fonctions usuelles en biologie, plans d'expérience, techniques de ré-échantillonnages, Statistiques Exploratoires.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 0 %
Written assessment: 70 %
Projects/Presentations/Reporting: 30 %

Course title: Botanique évolutive et écologie fonctionnelle
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Patrick Heuret (Patrick.heuret@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 7

Course breakdown and hours:
- Lectures: 6 hrs
- Exercices: 3 hrs
- Excursions : 12.5 hrs
- Projects: 0 hrs

Course objectives:

Cette Unité d'Enseignement met à disposition les connaissances nécessaires à l'interprétation des structures et des comportements des plantes dans les contextes forestiers tropicaux. On cherchera à faire apparaître les liens entre l'adaptation, la morphologie, le comportement et l'évolution.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Plant Biological level: Organism

Upon completion of the course a student must be able to:

- Interpréter la structure végétale, la variabilité des formes et leur significativité fonctionnelle ;
- Comprendre le développement d'un végétal dans l'espace et dans le temps et les relations entre structure et fonctions.
- Connaitre les principales familles d'arbres néotropicaux

Course material, text books and further reading:
Notes de cours

Prerequisites: please note the general comment on prerequisites
Connaissances basiques en morphologie végétale

Table of contents:

- Architecture des plantes.
- Systématique évolutive : ce cours ne reprend pas les catalogues mais donne une idée de la famille, et éventuellement du genre en les replaçant dans leur phylum. Les groupes abondamment représentés localement, seront évoqués préférentiellement, à travers la dimension évolutive et adaptative de leurs caractères.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 0 %
Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Module: Écologie fonctionnelle
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Sabrina Coste (sabrina.coste@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): *partim* 3

Course breakdown and hours:
- Lectures: 25.5 hrs
- Exercices: 4.5 hrs
- Excursions: 0 hrs
- Projects: 0 hrs

Course objectives:

L'objectif de ce cours est de dispenser un enseignement en écologie fonctionnelle des arbres et des peuplements forestiers tropicaux fonctionnant en interaction avec le sol et l'atmosphère.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism to Ecosystem

Upon completion of the course a student must be able to:

- Analyser le fonctionnement du sol en interaction avec les plantes.
- Identifier les stratégies fonctionnelles et les mécanismes de régulation liés aux flux d'eau et de carbone à l'échelle de l'individu.

Course material, text books and further reading:
Notes de cours

Prerequisites: please note the general comment on prerequisites
Connaissances basiques en écologie génerale et biologie végétale

Table of contents:

- Interface sol-plante :
Cycle de l'azote, du phosphore et du carbone et microorganismes du sol impliqués dans ces processus. Fonctionnement des symbioses mycorhiziennes et fixatrices d'azote dans les écosystèmes forestiers. Outils de diagnostic de la fertilité des sols forestiers et agricoles. Outils liés à la restauration des systèmes dégradés (ingénierie écologique)

- Interface plante-atmosphère :
Fonctionnement hydrique des plantes. Mécanismes de régulation en situation de contrainte hydrique. Descriptions des potentiels hydriques foliaires, potentiels de perte de turgescence cellulaire foliaire, synthèse de phytohormone (ABA), régulation stomatique et vulnérabilité des plantes à la cavitation.

Assimilation photosynthétique des arbres. Capacités photosynthétiques foliaires. Durée de vie des feuilles et bilan de carbone.
Diversité fonctionnelle

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 0 %
Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Course title: Gestion des forêts tropicales
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Bruno Hérault (bruno.herault@cirad.fr)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 23 hrs
- Exercices: 0 hrs
- Excursions : 0 hrs
- Projects: 15 hrs

Course objectives:

- Acquérir les concepts de base de la biologie de la conservation et se confronter à un cas réel de gestion des milieux
- Comprendre des enjeux scientifiques, politiques et sociétaux de l'impact des changements climatiques globaux sur les forêts tropicales.
- Envisager la gestion forestière tropicale dans l'objectif de la production de bois.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Ecosystem

Upon completion of the course a student must be able to:
- Comprendre les enjeux de la gestion et de la conservation des forêts tropicales.
- Maîtriser les théories principales de la biologie de la conservation.

Course material, text books and further reading:
Notes de cours

Prerequisites: please note the general comment on prerequisites
Connaissances basiques en écologie.

Table of contents:

- Ecologie Appliquée à la Gestion Conservatoire :
Différentes thématiques de la biologie de la conservation seront abordées : dégradation des espèces et des milieux, conservation des espèces, approche écosystémique de la conservation, étapes de la mise en place d'une aire protégée, conservation et gestion des milieux forestiers.
Le module se clôture par une tournée de deux jours pour rencontrer, sur le terrain, les acteurs de la gestion et de la conservation en Guyane.

- Changements globaux : Ce module abordera en introduction, l'institutionnalisation des problématiques liées aux changements globaux et les bases du débat scientifique et politique. La logique des changements d'échelle sera abordée avec l'exemple de l'Amazonie, en mettant l'accent sur les scénarii et les incertitudes à cette échelle. Puis les effets des changements globaux sur les forêts tropicales seront décrits pour chacune de leurs ressources (carbone, eau, énergie et température, autres facteurs limitants…), illustrés avec quelques modèles.

Assessment breakdown: breakdown Oral assessment: 0 % Written assessment: 50 % Projects/Presentations/Reporting: 50 %	please note the general comment on assessment

Course title: Professionalisation
Course ID:
University: Université de Guyane française (UDG)
Faculty:
Department: DFR Sciences et Technologies
Name and e-mail address of the instructor(s): Eric Marcon (eric.marcon@ecofog.gf)
Course website: to be posted
Semester: S1+S3
Tuition language: French
Number of credits (ECTS): 2

Course breakdown and hours:
- Lectures: 19 hrs
- Exercices: 0 hrs
- Excursions: 0 hrs
- Projects: 0 hrs

Course objectives:

Apprendre les méthodes nécessaires à la pratique de la recherche en écologie:
- analyse des données avec R;
- bibliographie avec un logiciel adapté;
- rédaction d'articles.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Method and tools

Upon completion of the course a student must be able to:
- Effectuer des recherches bibliographiques de façon efficace.
- Gérer sa base de donnée bibliographique.
- Utiliser R pour les analyses de données courantes.
- Rédiger un article scientifique dans les règles de l'art.

Course material, text books and further reading:
Notes de cours
Paradis, E (2005) *R for beginners*. ftp://cran.r-project.org/pub/R/doc/contrib/Paradis-rdebuts_fr.pdf
Kallestinova ED. How to Write Your First Research Paper. *The Yale Journal of Biology and Medicine*. 2011;84(3):181-190.

Prerequisites: please note the general comment on prerequisites
Aucun

Table of contents:

- Initiation Bibliographique
- Rédaction d'article
- Initiation R

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 0 %
Written assessment: 0 %
Projects/Presentations/Reporting: 100 %

Course descriptions at the Universidad de Antioquia (UDEA)

UNDER CONSTRUCTION

Course title: Tropical biodiversity and ecosystems field school: from montane to coastal ecosystems and landscapes
Course ID:
University: Universidad de Antioquia
Faculty:
Department:
Name and e-mail address of the instructor(s): F. Blanco Libreros (juan.blanco@udea.edu.co)
Course website:
Semester: S2
Tuition language: Spanish
Number of credits (ECTS): 15

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS

Course objectives:

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to :

Course material, text books and further reading:

Prerequisites: please note the general comment on prerequisites
Basic knowledge in biology and ecology

Table of contents:

Assessment breakdown: please note the general comment on assessment breakdown

Course descriptions at the Université des Antilles (UdA)

Course title: Tropical biodiversity and ecosystems field school: Caribbean insular ecosystems
Course ID:
University: Université des Antilles
Faculty: UFR Sciences Exactes et Naturelles
Department: Biology
Name and e-mail address of the instructor(s): D. Imbert (daniel.imbert@univ-ag.fr)
Course website:
Semester: S2
Tuition language: English and French
Number of credits (ECTS): 15

Course breakdown and hours:

- Lectures: 20 hrs
- Exercices: 18 hrs
- Excursions : 128 hrs
- Projects: 32 hrs

Course objectives:
This course offers an overview of the main aquatic and terrestrial topical ecosystems, and highlights the specific environmental and biological features of the insular Caribbean Region. It comprises lectures dedicated to the biogeographic, evolutionary and anthropogenic and specificities of these Caribean ecosystems, and a one-month field training highlighting environmental settings, biocenotic structure, ecological functioning, and ecosystem resilience in response to natural or anthropogenic disturbances in the islands.
Overall, this course is intended to give an integrated, teambuilding education based on both theoretical and practical approaches, and adapted to a variety of tropical ecosystems located in one of the major biodiversity hotspots of the world.

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to :
- Master ecological knowledge on Caribbean island ecosystems
- Design and implement field protocols for biodiversity assessment and management

Course material, text books and further reading:
Woods C.A. and Sergile F.E., 2001. Biogeography of the West Indies
Schnell R., 1987. La lore et la vegetation de l'Amérique Tropicale
Snedaker SC & Snedaker JG, 1984. The mangrove ecosystem: research methods
Monti D., Keith P. & Vigneux É. 2010. Atlas des poissons et des crustacés d'eau douce de la Guadeloupe.

Prerequisites: please note the general comment on prerequisites
Basic knowledge in biology and ecology

Table of contents:

Theory (lectures):

- Caractérisation des principaux écosystèmes des îles de la Caraïbe: approches biogéographiques et évolutives
- Concepts et méthodes d'analyse des systèmes artificialisés (théories de la panarchie et de la viabilité, l'analyse de cycle de vie, bilan carbone analyse émergétique).

Practicals:

One-month teambuilding training sessions (field and lab) on various Caribbean ecosystems:

- coral reefs and seagrass beds,
- mangroves,
- upland forests,
- mountain streams

Project:

Each student will implement a project mainly fed by his own experience along the field training sessions.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 0 %

Written assessment: 50 %

Projects/Presentations/Reporting: 50 %

Course title: Geomatics (Systèmes d'Information géographiques et bases de données)
Course ID:
University: Université des Antilles
Faculty: Sciences Exactes et Naturelles
Department: Mathématiques et Informatique
Name and e-mail address of the instructor(s): E. Grandchamp (enguerran.grandchamp @ univ-ag.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Exercices: 22 hrs

Course objectives:
Ce cours présente les concepts et outils de base des Systèmes d'Information Géographique ainsi que l'extraction de données en utilisant des critères sémantiques (tables attributaires, création de formules complexes de sélection utilisant un ou plusieurs champs) et des critères spatiaux (formules de sélection mais aussi outils d'analyse spatiale). Le cours aborde également les principes de base de l'extraction de données dans des rasters.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Upon completion of the course a student must be able to :
Maîtriser les concepts et outils permettant de manipuler des données géographiques, d'en extraire l'information utile et de la représenter selon les conventions usuelles.

Course material, text books and further reading:

Prerequisites: please note the general comment on

None

Table of contents:

Theory (lectures):
- SIG, données spatiales, notion de référentiel et de système de projection, données vectorielles et données raster, analyse sémantique et analyse spatiale
- Analyse sémantique (modèle relationnel, formalisme SQL, requêtes)
- Analyse spatiale (notion de géométrie ensembliste, fonctions spatiales, requêtes)
- Introduction à l'analyse de données raster (histogramme, statistiques, calculs d'indices, masques et profils, 3D)

Practicals:
- Prise en main de QGis
- Analyse sémantique de données avec SQL (filtrage, sélection)

- Analyse spatiale avec SQL (buffers)
- Réalisation de cartes thématiques
- Analyse de données raster

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 0 %
Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Course title: Introduction à l'écotoxicologie
Course ID: EC 82.3
University: Université des Antilles
Faculty: Sciences Exactes et Naturelles
Department: Biologie
Name and e-mail address of the instructor(s): S. Lemoine (soazig.lemoine@univ-ag.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 12 hrs
- Exercices: 8 hrs

Course objectives:
Description des principaux bio-essais (tests daphnies, microtox, test comet, embryotoxicitéetc…). Avantages et inconvénients de ces tests. Utilisation des EC50, LC 50 pour le calcul de l'indice de risque pour l'environnement. La mise en place et bilan de la DCE. Description de la réglementation. Mise en place d'un test en travaux pratiques (embryotoxicité sur des larves d'huîtres).

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Interactions Biological level: Global

Upon completion of the course a student must be able to :
Maîtriser l'utilisation des bio-essais standardisés en écotoxicologie.

Course material, text books and further reading:

Prerequisites: please note the general comment on prerequisites
Notions fondamentales de chimie (chimie organique, chime minérale, chiemie des solutions)

Table of contents:

Theory (lectures):
- Description des principaux bio-essais (tests daphnies, microtox, test comet, embryotoxicitéetc…). Avantages et inconvénients de ces tests.
- Utilisation des EC50, LC 50 pour le calcul de l'indice de risque pour l'environnement.
- La réglementation européenne : mise en place et bilan de la DCE. La réglementation.

Practicals:
Mise en place d'un test d'embryotoxicité sur des larves d'huîtres.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 0 %
Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Course title: Ecologie comportementale
Course ID: EC 82.3
University: Université des Antilles
Faculty: Sciences Exactes et Naturelles
Department: Biologie
Name and e-mail address of the instructor(s): G. Loranger (glorange@univ-ag.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 16 hrs
- Exercices: 8 hrs

Course objectives:
Ce cours a pour but de présenter les principaux concepts théoriques et modes de raisonnement en écologie comportementale et d'illustrer leur application à différents grands domaines. Les enseignements associent une approche évolutive (valeur adaptative, pressions de sélection et contraintes, héritabilité,...) et une présentation des mécanismes en comportement animal (bases physiologique, génétique du comportement, …). Les principaux thèmes abordés sont : les grands concepts de l'écologie comportementale ; l'exploitation des ressources dans l'espace et dans le temps ; la sélection sexuelle; le comportement social.
Les travaux pratiques porteront sur la sélection sexuelle (choix des femelles), la sélection d'habitat et la vigilance et taille de groupe.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Animal Biological level: Population

Upon completion of the course a student must be able to
- comprendre les Grands concepts de l'écologie comportementale
- comprendre l'exploitation des ressources dans l'espace et le temps
- comprendre la sélection sexuelle
- le comportement social

Course material, text books and further reading:

Prerequisites: please note the general comment on prerequisites
Connaissances de base en biologie évolutive (sélection naturelle, dérive génétique)

Table of contents:
Grands concepts de l'écologie comportementale
- Optimisation simple et théorie des jeux
- La Méthode comparative
- Variabilité comportementale et concept de personnalité animale

Exploitation des ressources dans l'espace et le temps
- Stratégies optimales d'exploitation des ressources
- Sélection de l'habitat et dispersion

Sélection sexuelle
- Définition formelle du processus de sélection sexuelle

- Sélection intrasexuelle
- Sélection intersexuelle (modèle de Fisher-Lande, principe du handicap, exploitation sensorielle)
- Sélection sexuelle et spéciation

Comportement social

- Coûts et bénéfices de la vie en groupe
- Organisation sociale de la reproduction et régimes d'appariement
- Evolution de la coopération et de la socialité.
- Polyéthisme et régulations sociales

Travaux Pratiques :

- Sélection sexuelle: analyse du choix des femelles chez le guppy
- Sélection d'habitat chez le bernard l'hermite, *Coenobitaclypeatus*
- Analyse d'articles scientifiques

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 0
Written assessment: 2/3
Projects/Presentations/Reporting: 1/3

Course title: Interactions durables
Course ID: *EC 82.2*
University: Université des Antilles
Faculty: Sciences Exactes et Naturelles
Department: Biologie
Name and e-mail address of the instructor(s): O. Gros (olivier.gros@univ-ag.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Exercices: 4 hrs

Course objectives:
A l'aide de d'exemples pris dans divers milieux, nous montrerons que les interactions durables de type symbiose et parasitisme chez les animaux représentent des moteurs forts de l'évolution (notions de co-spéciation, co-évolution). Il s'agira également de montrer la force de ces interactions dans l'adaptation des organismes aux contraintes physiologiques et environnementales auxquelles sont soumis les organismes évoluant au sein d'écosystèmes variés. Nous aborderons également les interactions plantes-animaux.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Community

Upon completion of the course a student must be able to :
Evaluer la place des interactions durables de type symbiose et parasitisme dans les phénomènes d'adaptation et leur importance au niveau évolutif.

Course material, text books and further reading:

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
1 Le parasitisme
- Avantages et Inconvénients de la vie parasitaire
- Le cycle de vie des parasites
- Les modes de transmission des parasites
- La rencontre parasite-hôte
- La favorisation
- Virulence et maladaptation
- Les insectes parasitoïdes
- Parasitisme et Evolution

2 La symbiose
- Définition et exemples
- Stabilité et spécificité de la reconnaissance.
- Exemples d'interactions eucaryotes-eucaryotes et eucaryotes-procaryotes
- La symbiose est-elle synonyme d'une interaction physiologique à double sens ? Que gagne réellement le

symbiote à s'associer ?
Régulation de la population symbiotique
Symbiose et Evolution

3 Les interactions plantes-insectes
Des stratégies d'exploitation de la plante aux stratégies mutualistes
Défense des plantes contre les insectes.
Des réseaux trophiques plus ou moins complexes autour des plantes *(ex : figuiers, interactions plantes-champignons-phytophages)*
Évolution des interactions insectes-plantes

4 Les interactions biotiques dans le sol
Comment classer les interactions entre organismes dans les sols
La Prédation
La Compétition
Symbiose et Mutualisme (Insectes/Parabasaliens ; Insectes/Champignons)

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 1/3
Written assessment: 2/3

Course title: Ecophysiologie en milieu contraint
Course ID: *EC82.1*
University: Université des Antilles
Faculty: Sciences Exactes et Naturelles
Department: Biologie
Name and e-mail address of the instructor(s): M. Dulormne (maguy.dulormne@univ-ag.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 18 hrs
- Exercices: 6 hrs

Course objectives:
Un premier objectif est d'exposer la fixation du carbone à des échelles intégrées (de la cellule aux couverts végétaux), ainsi que les principaux traits physiologiques concernés et les outils d'évaluation de la diversité fonctionnelle des plantes tropicales. Il s'agit aussi de présenter les adaptations morphologiques, physiologiques, et moléculaires des plantes à des stress tels que la salinité et l'hydromorphie.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Ecosystem

Upon completion of the course a student must be able to :
Analyser la réponse physiologique des espèces (résistance, sensibilité, résilience) à différentes échelles (cellule, feuille, plante, couvert) à l'aide d'outils variés (mesures de fixation de carbone, d'isotopie 13C, de fluorescence). Analyser la résistance et l'adaptation des espèces aux contraintes abiotiques (disponibilité en eau, salinité, taux d'oxygène, température).

Course material, text books and further reading:
Farineau J, Morot-Gaudry J-F, 2011. Photosynthèse : processus physiques, moléculaires et physiologiques, ed Quae
Farquhar G D, Ehleringer J R, and Hubick K T, 1989. Carbon Isotope Discrimination and Photosynthesis. Annual Review of Plant Physiology and Plant Molecular Biology. Vol. 40: 503-537. DOI: 10.1146/annurev.pp.40.060189.002443
Jenks MA, Hasegawa PM, 2014. Plant Abiotic Stress, 2nd Edition
Maxwell k and Johnson GN, 2000. Chlorophyll fluorescence—a practical guide. J. Exp. Bot. 51 (345): 659-668.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

I- Réponses photosynthétiques des plantes aux facteurs environnementaux
I.1. La discrimination isotopique naturelle du carbone au cours de la photosynthèse
I.1.1 Rappel des mécanismes métaboliques chez les espèces de type C3, C4, CAM
I.1.2 La discrimination isotopique naturelle du carbone chez les plantes C3 et C4
I.1.3 Contrainte hydrique et discrimination
I.2. Echanges gazeux à l'échelle de la feuille lors de contraintes abiotiques en zone tropicale
I.3. Assimilation nette du dioxyde de carbone à l'échelle du couvert
I.3.1 Mesure de flux de CO2 à l'échelle du couvert
enceinte, techniques micrométéorologiques, fluctuation turbulente
I.3.2 Réponse de la photosynthèse du couvert à la lumière
I.3.3 Modélisation de la production à l'échelle du couvert
I.3.4 Changement climatique et fixation de carbone

II – Phénomène de fluorescence
II.1. Pourquoi étudier le phénomène de fluorescence ?
II.2. Relation entre photosynthèse et fluorescence
Libération de ROS / Dégagement de chaleur / « Non photochemical quenching » / Fluorescence
II.3. Fonctionnement des antennes et centres réactionnels durant la fluorescence
II.4. Mesure de la fluorescence
Effet Kautsky / Mesures / Paramètres importants : Fo, Fp, Fm /

III - Adaptation des plantes à la salinité et à l'hydromorphie : aspects écophysiologiques et moléculaires
III.1. Généralités
III.1.1. Définition du stress
III.1.2. Types et exemples de stress
III.1.3. Stratégies de réponse au stress
III.2. Les plantes en milieu salé
III.2.1. Notion de salinité
III.2.2. Salinité et sodicité des sols
III.2.3. Effets sur la croissance et réponses physiologiques
III.2.4. Mécanismes de signalisation moléculaire (Homéostasie/Détoxication/Transcriptome et protéome…)
III.2.5. Conclusions/perspectives
III.3. Les plantes en milieu hydromorphe
III.3.1. Sols hydromorphes
III.3.2. Changements dans la rhizosphère
III.3.3. Réponses physiologiques et effets sur la croissance
III.3.4. Réponses métaboliques et adaptations
III.3.5. Adaptations morphologiques
III.3.6. Mécanismes de signalisation moléculaire (ANPs, ABA, éthylène, Ca2+)
III.3.7. Conclusions/perspectives
III.4. Adaptation des plantes à la salinité et à l'inondation: étude de cas

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment:0 %
Written assessment: 100 %
Projects/Presentations/Reporting: 0 %

Course descriptions at Université Cheikh Anta Diop de Dakar (UCAD)

Course title: Tropical biodiversity and ecosystems field school : West-African forest, savanna, Wetland and other Sahel ecosystem
Course ID:
University : Université Cheikh Anta Diop de Dakar
Faculty: Faculté des Sciences et Techniques et Institut Fondamental d'Afrique noire Cheikh Anta Diop
Departments : Biologie Végétale, Biologie Animale et Institut des Sciences de l'Environnement
Name and e-mail address of the instructor(s): Fatimata Niang Diop (mailto:fatimata7.niang@ucad.edu.sn), Aliou Ndiaye (aliou.ndiaye@ucad.edu.sn aliou.ndiaye@ucad.edu.sn), Alla Manga (alla.manga@ucad.edu.sn), Pape Ibnou Ndiaye (ibnou.ndiaye@ucad.edu.sn>, Abdoulaye Baïla NDIAYE (abdoulayeb.ndiaye@ucad.edu.sn), Oumar Sadio (oumar.sadio@ird.fr), Khady Diouf Goudiaby (khady1.diouf@ucad.edu.sn)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS) : 15
Remarque importante : Les coûts du cours seront en partie pris en charge par l'université. Cependant, une participation financière d'un montant maximum de 500 euros pourrait être demandé à chaque étudiant pour les coûts supplémentaires liés au transport, à l'hébergement, à la nourriture, à la logistique sur le terrain etc..

Course breakdown in hours:

Theory	Practical/ Excursion	Exercise		Reporting	Project	Seminar	Personal assignment
	180 heures			180 heures			

Course objectives:
L'école de terrain a pour objectifs de/d' :
- illustrer les enseignements reçus en salle sur les écosystèmes et la biodiversité ;
- mettre en pratique des outils présentés ;
- pratiquer l'approche interdisciplinaire dans des groupes de travail ;
- identifier les principaux facteurs de dégradation des écosystèmes ciblés.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus : West-African forest, savanna, Wetland
Biological level:

Upon completion of the course a student must be able to :
- identifier des composantes des écosystèmes et comprendre leur fonctionnement ;
- utiliser des outils de collecte de données sur les écosystèmes et la biodiversité ;
- travailler en équipe en appliquant l'approche interdisciplinaire ;
- identifier des facteurs de dégradation d'écosystèmes

Course material, text books and further reading:
Notes, supports de cours, manuel

Prerequisites: please note the general comment on prerequisites
Connaissances de base en écologie, biologie et environnement

Table of contents:
Présentation des écosystèmes
Description des écosystèmes ciblés
Méthodes de conservation de la biodiversité des écosystèmes ciblés
Méthodes d'évaluation des écosystèmes et de la biodiversité
Analyse de la biodiversité des écosystèmes concernés

Utilisation du SIG et de la télédétection dans l'étude des écosystèmes et de la biodiversité
Entretiens semi-structurés avec des acteurs locaux
Biens et services des écosystèmes
Conclusion

Assessment breakdown: please note the general comment on assessment breakdown
Examen écrit : 70 %
Évaluation de Project et rapport : 30 %

Course title: Geomatics (GIS et webmapping)
University: Université Cheick Anta Diop
Faculty: Institut fondamental d'Afrique noire Cheikh Anta Diop
Department: Geographie
Name and e-mail address of the instructor(s): Alla Manga (alla.manga@ucad.edu.sn)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
10h	35h	10h	10h		5h		

Course objectives:
Les SIG occupent de plus de en plus une grande place dans tous les domaines (sciences ou activités) notamment la recherche et dans les sciences de la vie et de la terres. Ce cours permettra de familiariser les étudiants au SIG et leur application (utilisation) dans la gestion et le suivi des écosystèmes. Ils pourront apprendre à :
- modéliser (concevoir) une solution SIG par rapport à une thématique ;
- collecter les données nécessaires ;
- structurer, stocker et analyser les données pour proposer une solution ou des solutions pour une meilleure prise de décision ;
- publier les données et les résultats sous forme de carte interactive.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Upon completion of the course a student must be able to :
Les étudiants seront en mesure d'utiliser les outils SIG dans leur projet ou leur travaux afin de bénificier des plus-values offertes par les SIG.

Course material, text books and further reading:
- Bougouss M., Gagnon S. : Formation en Géomatique. Formation donnée au Sénégal par le Cégep Limoilou du 18 au 29 février 2008.
- Brunet R. : La carte, mode d'emploi, Fayard - Reclus, 270 p. 1987.
- Charre J. : Miellet P. Waniez P. : Pratique des systèmes d'information géographique raster, collection Reclus Modes d'emploi N° 18, 50 p.
- Collet C. : Systèmes d'information géographique en mode image, in collection gérer l'environnement N° 7, Presses Polytechniques et Universitaires Romandes, 186 p, 1992.
- Denegre J. Et Salge F. : Les Systèmes d'Information Géographique, PUF n° 3122 Paris, 1996.
- Boris Mericskay : Les Sig et la cartographie à l'ère du géoweb Vers une nouvelle génération de Sig participatifs dans L'espace géographique 2011/2 (Tome 40), pages 142 à 153

Prerequisites: please note the general comment on prerequisites
Les étudiants qui souhaitent accéder à ce cours doivent avoir une bonne connaissance en informatique de base et en géographie en général.

Table of contents:

Théorie:
- Connaissances sur les concepts de base des S.I.G.,
- Données,

- Logiciels et matériels.

Pratique:

- Installation et paramètrage du logiciel
- Modélisation
- Acquisition de données et manipulation des données
- Analyse spatiale et géotraitement
- Publication (cartographie statistique et dynamique).

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment:

Written assessment: 50%

Projects/Presentations/Reporting: 50%

Course title: Biodiversité ichtyologique
Course ID:
University: Cheikh Anta Diop de Dakar
Faculty: Institut fondamental d'Afrique noire Cheikh Anta Diop
Department: Biologie animale
Name and e-mail address of the instructor(s): Oumar SADIO (oumar.sadio@ird.fr) et Khady DIOUF GOUDIABY (khady1.diouf@ucad.edu.sn)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
10h	35h	10h	10h		5h		

Course breakdown in hours:
- Cours théorique : 10 hrs
- Exercices pratiques : 25 hrs

Course objectives:
Apprendre aux étudiants comment étudier la biodiversité ichtyologique :
définition, calcul et interprétation des indices de biodiversité
Apprendre à structurer les peuplements de poissons
Apprendre à utiliser les logiciels de biodiversité

Learning outcomes : please note the general comment on
A la fin du cours, le étudiants seront capables de/d':
- récolter des données liées à l'étude de la biodiversité ;
- calculer les indicateurs de biodiversité ;
- interpréter les résultats des calculs d'indicateurs de biodiversité ;
- étudier la structure d'un peuplement de poisson ;
- Classer les espèces dans des catégories écologiques.

Course material, text books and further reading:
- Vidéoprojecteur
- Support de cours
- Ecran de projection fixe
- Ecran de projection mobile
- Support de tableau de conférence Skin
- Papier pour Flipover
- Marqueur effaçable

Prerequisites : please note the general comment on Bonne
none

Table of contents:

- Introduction à la biodiversité
- Prise en main des logiciels de calcul des indices de biodiversité
- Définition, calcul et interprétation des indices de biodiversité

Assessment breakdown: breakdown Travail individual : 5% Travail en groupe : 5% Contrôle continu : 30% Examen final : 60%	please note the general comment on assessment

Course title: Biodiversity conservation : issues, challenges and assessment methods
Course ID:
University: Université Cheikh Anta Diop de Dakar (UCAD)
Faculty: Faculté des Sciences et Techniques (FST)
Department: Institut des Sciences de l´Environnement (ISE)
Name and e-mail address of the instructor(s): fatimata7.niang @ ucad.edu.sn
Course website: NA
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
30		20			7	8	

Course objectives:
The aim of this course is to introduce students into the issues and challenges related to biodiversity conservation, the status and trends of biodiversity as well as the tools and methods for assessing and conserving biodiversity.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialized Ecosystem focus: Species and interactions Biological level: Plant communities

Upon completion of the course a student must be able to better understand the different levels and aspects of biodiversity, its value, issues and challenges related to human and natural disturbances. In addition, they will learn how species respond to disturbances and some methods of assessing and conserving biodiversity. Ultimately, this course will allow students to understand the role and capital importance of biodiversity in sustainable development and especially in the survival of planet Earth. They will gain tools for measuring biodiversity.

Course material, text books and further reading:
Books, scientific papers and reports.

Prerequisites: please note the general comment on prerequisites
Basics of Biology and ecology

Table of contents:
INTRODUCTION
1. Concepts definitions : ecosystems, species and genetic diversity
2. Notion of biodiversity
3. Role and importance of biodiversity
4. Drivers of biodiversity loss
5. Consequences of biodiversity loss
6. State and general trend of biodiversity
7. Species resistance to disturbances: introduction to functional diversity
7. Methods for measuring and assessing biodiversity
8. Conservation methods
9. Biodiversity management strategies
CONCLUSION: SCREENING OF FILMS ON BIODIVERSITY FOLLOWED BY DEBATE

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 15 %
Written assessment: 60 %
Projects/Presentations/Reporting: 15%

Course title: Biologie et Écologie des poissons d'eau douce Africains
Course ID:
University: Université Cheikh Anta Diop de Dakar
Faculty: Institut Fondamental d'Afrique noire Cheikh Anta Diop
Department: Biologie animale
Name and e-mail address of the instructor(s): Khady DIOUF GOUDIABY (khady1.diouf@ucad.edu.sn)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
20h	30h	10h	12h				

Course objectives:
Donner aux étudiants un aperçu de la faune et des habitas ichtyologiques des milieux continentaux africains et entre, autres, comment étudier les traits de vie des poissons : détermination de l'âge annuel et journalier), des périodes de reproduction et le régime alimentaire.

Learning outcomes : please note the general comment on learning outcomes

A la fin du cours, le étudiants seront capables de/d':
- d'identifier les espèces de poissons ;
- récolter des données liées à la biologie des espèces de poissons ;
- calculer les indicateurs de biologie de reproduction et de la croissance des espèces de poissons ;
- interpréter les résultats des calculs d'indicateurs de biologie de reproduction ;
- étudier la composition et la variation du bol alimentaire d'une espèce de poisson ;
- proposer des mesures de gestion des ressources halieutiques.

Course material, text books and further reading:

- Panfili,]., Pomuai H. (de)., Troadec H., Wright p.]. (éd.), 2002. Manuel de sclérochronologie des poissons. Coédition Ifremer-IRD, 464 p.
- Vidéoprojecteur
- Support de cours
- Ecran de projection fixe
- Ecran de projection mobile
- Marqueur effaçable
- Ichtyomètre, balance, trousse de dissection, alcool, formol, liquid de Gilson, tubes
- Loupe binoculaire
- Microscope
- Mini-bus pour les excursion pédagogiques
- Filets de pêche pour échantillonnages scientifiques

Prerequisites:
None please note the general comment on Bonne

Table of contents:

- La diversité des milieux aquatiques
- Caractéristiques générales de la faune ichtyologique
- Distribution géographique et affinités des poissons d'eau douce africains

- Biogéographie et mise en place des faunes ichtyologiques actuelles
- La diversité des poissons africains
- Taxinomie et systématique
- Les stratégies démographiques
- La reproduction
- Croissance et ontogénie
- Régimes alimentaires et réseaux trophiques
- Réponses aux conditions extrêmes
- L'éthologie
- L'échantillonnage des peuplements de poissons
- Richesse en espèces des peuplements de poissons
- L'habitat des poissons
- Le rôle fonctionnel des poissons

- **Assessment breakdown:** please note the general comment on assessment breakdown
- Written assessment: 60 %
- Practical work: 20%
- Continuous control: 20%

Course title: Biostatistique
Course ID:
University: Cheikh Anta Diop de Dakar
Faculty: Institut fondamental d'Afrique noire Cheikh Anta Diop
Department: Biologie animale
Name and e-mail address of the instructor(s): SADIO Oumar (oumar.sadio@ird.fr)
Course website:
Semester: S2
Tuition language: Français
Number of credits (ECTS): 3

Course breakdown in hours:
- Cours théorique : 15 hrs
- Exercices pratiques : 20 hrs

Course objectives:
Apprendre aux étudiants comment faire des analyses statistiques de données quantitatives et qualitatives à l'aide du logiciel R/RStudio

Learning outcomes : please note the general comment on learning outcomes

A la fin du cours, le étudiants seront capables de/d':

- utiliser les logiciels R et RStudio pour faire des analyses statistiques
- traiter des bases de données
- décrire une variables quelle que soit sa nature
- trouver une liaison entre deux variables
- caractériser des zones, des stations, des sites en fonction des saisons, des paramètres physico-chimiques
- faire des analyses de groupage

Course material, text books and further reading:
- Vidéoprojecteur
- Support de cours
- Manuels de statistique
- Ecran de projection fixe
- Ecran de projection mobile
- Support de tableau de conférence Skin
- Papier pour Flipover
- Marqueur effaçable

Prerequisites: please note the general comment on Bonne Bonne
connaissance en word et Excel
Avoir le niveau de Licence

Table of contents:

OS1: Définition des concepts (termes clé) de la Biostatistique
OS2: Prise en main des logiciels R et RStudio
OS3: Analyse univariée
Analyse descriptive d'une variable qualitative
Analyse descriptive d'une variable quantitative discrète
Analyse descriptive d'une variable quantitative continue

OS3: Analyse bivariée

Liaison entre deux variables qualitatives (Tests de Chi-deux)
Liaison entre deux variables quantitatives (Tests de correlation)
Liaison entre deux variables mixtes (Tests de comparaison)

OS4: Analyse multivariée

Analyse en Composantes Principales (ACP)
Analyse Factorielle des Correspondances Simples (AFCS)
Analyse Factorielle des Correspondances Multiples (AFCM)
Classification Ascendante Hiérarchique (CAH)

Assessment breakdown: please note the general comment on assessment breakdown

Travail individual : 5%
Travail en groupe : 5%
Contrôle continu : 30%
Examen final : 60%

Course title: *In vitro* culture and cryopreservation at the service of biodiversity
Course ID:
University: Cheikh Anta DIOP University
Faculty: Faculty of Sciences and Techniques
Department: Plant Biology
Name and e-mail address of the instructor(s): Pr Aliou NDIAYE (aliou.ndiaye@ucad.edu.sn)
Course website:
Semester: S2
Tuition language: French/English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
30 h	20h	10h					

Course objectives:
- Define the in vitro plant culture conditions
- Study the various stages of plant in vitro culture
- Identify the different in vitro culture methods
- Describe the applications and benefits of in vitro cultures for the biodiversity
- Study the conservation methods (In vitro conservation and plant cryopreservation methods)

Learning outcomes: please note the general comment on
Education level: Knowledge acquired for the *in vitro* culture and plant cryoconservation
Specialization
Biological level: Plant *in vitro* culture and plant cryopreservation

Students will learn the fundamentals of plant biotechnologies and the differents methods of plant biotechnologies. They will learn to choose the appropriate method to solve the problems (plant breeding, Plant propagation, plant sanitation, varital creation, plant cryopreservation…)

Course material, text books and further reading:
Course material**,** Specific papers, websites, and master books
Exemples: - Biotechnologies végétales, Techniques de laboratoire, Robert Haïcour, Editions TEC et DOC; ISBN: 2-7430-0560-2; ISSN: 0993 -3948 (AUF)
- Biotechnologies végétales au service de la régénération du bamboo; Méthodes de multiplication (culture *in vitro* et propagation horticoles de différentes espèces de bambou Verlag/Editeur: Editions universitaires Européennes (Aliou NDIAYE, 2016)

Prerequisites: bachelor's degree in plant biology please note the general comment on prerequisites:
- plant cell biology
- plant growth and development physiology
- chemistry
- Ecology

Table of contents:
- Introduction: Basic knowledges of plant biology
- History of plant *in vitro* culture
- Culture media
- *In vitro* culture conditions
- *In vitro* culture techniques
- Plant cryopreservation techniques

Assessment breakdown: breakdown Written assessment: 60 % Practical work: 20% Continuous control: 20%	please note the general comment on assessment

Course title: Initiation à l'ethnobotanique quantitative
Course ID:
University: Université Cheikh Anta Diop de Dakar (UCAD)
INSTITUT: Institut Fondamental d'Afrique Noire (IFAN)
Department: Botanique et Géologie
Name and e-mail address of the instructor(s): Doudou Diop (doudou.diop@ ucad.edu.sn)
Course website:
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
20 h	25 h	20 h					

Course objectives:
1. Présenter **les enjeux** et **les intérêts** de la science ethnobotanique
2. Fournir les **outils scientifiques de base** pour la réalisation d'une étude ethnobotanique
3. Fournir les outils scientifiques de base pour une **analyse quantitative des données d'enquête**

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Global

A la fin du cours, l'Etudiant doit être capable de mener une enquête ethnobotanique rigoureuse et d'en tirer des résultats pertinents

Course material, text books and further reading:
- Houehanou, Thierry & Assogbadjo, Achille & Chadare, F.J. & Zanvo, Stanislas & Sinsin, Brice. (2016). Approches méthodologiques synthétisées des études d'ethnobotanique quantitative en milieu tropical. Annales des Sciences Agronomiques. 20 : 187-205.
- Claudine Friedberg 1968. Les Méthodes d'Enquête en Ethnobotanique. Comment mettre en évidence les taxonomies indigènes ? Journal d'agriculture traditionnelle et de botanique appliquée 15-7-8 pp. 297-324
- Portères Roland, 1961. L'ethnobotanique : Place - Objet - Méthode - Philosophie . In: Journal d'agriculture tropicale et de botanique appliquée, vol. 8, n°4-5, pp. 102-109;
- Sébastien Larrue, « L'homme et l'arbre chez les malinké du Sénégal oriental », Géographie et cultures [En ligne], 56 | 2006. URL : http:// journals.openedition.org/gc/8499 ; DOI : https://doi.org/10.4000/gc.8499
- Pratiques culturelles, Ia sauvegarde et la conservation de Ia biodiversité en Afrique de l'Ouest et du Centre. Actes du Séminaire-Atelier de Ouagadougou (Burkina Faso), du 18 au 21 juin. Sous Ia direction de Innocent BUTARE.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Introduction
I. Plantes vasculaires-domaines d'usages- Menaces sur la biodiversité
II. La science ethnobotanique
    II.1. Définitions
    II.2. Intérêts
III. Quelques domaines d'investigation
IV. Ethnobotanique classique
V. Ethnobotanique quantitative
    V.1. Techniques d'échantillonnage

V.2. Méthodes d'inventaire ou de collecte d'informations
V.3. Evaluation des connaissances : les indices ethnobotaniques

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 40 %
Projects/Presentations/Reporting: 60%

Course title: Biodiversité et fonctions des Insectes dans les écosystèmes tropicaux
Course ID:
University: Université Cheikh Anta Diop de Dakar (UCAD)
Faculty: Institut fondamental d'Afrique noire (IFAN)
Department: Biologie animale
Name and e-mail address of the instructor(s): Abdoulaye Baila NDIAYE, abdoulayeb.ndiaye@ucad.edu.sn
Course website: NA
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
10	24	20					

Course objectives:
L'objectif du cours est de donner aux étudiants les outils permettant de :
- Situer les insectes du point de vue évolutif (classification du monde vivant) ;
- D'apprécier le niveau de diversité des insectes ;
- D'échantillonner les insectes ;
- S'initier à l'identification des insectes;
- Reconnaitre les groups fonctionnels chez les insectes.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environnement Biological level: Global

L'étudiant qui aura suivi le cours aura les connaissances basiques concernant la classification et la biodiversité des insectes. Il devrait pouvoir reconnaitre les groups taxonomiques et fonctionnels ainsi que leur importance dans les écosystèmes tropicaux.

Course material, text books and further reading:
Support de cours, ouvrages (Delvard G., Aberlenc H. P. (1989). Les insectes d'afrique et d'amérique tropicale : Clés pour la reconnaissance des familles.
PRIFAS, CIRAD, GERDAT, 302p; Aberlenc Henri-Pierre. 2021. Les insectes du monde: Biodiversité, classification, clés de détermination des familles. Editions Quae et Muséo. 1876p.
NAGELEISEN L.-M., BOUGET Ch. et BONNEIL Ph. (2009). L'étude des insectes en forêt: méthodes et techniques; éléments essentiels pour une satndardisation. Office national des forêts, Paris, 144p. Collection entomologique de l'IFAN.
NAGELEISEN L.-M., BOUGET Ch. et BONNEIL Ph. (2009). L'étude des insectes en forêt: méthodes et techniques; éléments essentiels pour une satndardisation. Office national des forêts, Paris, 144p.

Prerequisites: please note the general comment on prerequisites
Good notions of general entomology

Table of contents:
1. Grandes lignes de la classification des Insectes
2. Méthodes d'échantillonnage des insectes
3. Collectes d'insectes :
- xylophages
- insectes du sol
- insectes pollinisateurs
- insectes ravageurs

- insectes des denrées stockés
- insectes aquatiques
4. Identification des insectes au laboratoire
5. Exposées des étudiants suivis de débats sur les différents groupes
6. Rapport sur les travaux réalisé sur un groupe de choix de l'étudiant

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 25 %
Written assessment: 50 %
Projects/Presentations/Reporting: 25%

Course descriptions at Université de Dschang (UDsch)

Course title: Tropical biodiversity and ecosystems field school: Central African terrestrial ecosystems
Course ID: BIO-Y-020
University: Université de Dschang
Faculty: Agronomy and Agricultural Sciences / Sciences
Department: Forestry and Plant Biology
Name and e-mail address of the instructor(s): Marie-Louise Avana Tientcheu (avanatie@yahoo.fr) and François Nguetsop (vfnguetsop@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 15
IMPORTANT: Additional cost (*ca.* 20 000 XAF for transport, 200 000 XAF for accommodation and 133 333 XAF for food, amounting to *ca.* 530 EUR) will be payable by the students.

Course breakdown and hours:
- Exercises: 1 week
- Projects: 3 weeks
- Excursions/Practicals : 4 weeks

Course objectives:
The field course is an interdisciplinary rainforest-oriented workshops with as main goal to put educational theory into educational practice *in situ by giving to student field experience within a rainforest context*.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Ecosystem

Upon successful completion of this course the students will be able to apply:
- Tools and principles of systematics in the rainforest environment;
- tools and principles of participatory research;
- tools of species, habitat and ecosystem assessment
- floristic inventory in forest ecosystems
- assessment of agroforestry initiatives

Course material, text books and further reading:
Course notes. Field course manual.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
- data collection in the rainforest,
- analysis of rainforest biodiversity
- biomass and natural resources
- protocols for describing new species
- use of remote sensing and geographic information systems in analysing forest dynamics, anthropogenic impacts on the rainforest
- forests products and services uses and management

Assessment breakdown: please note the general comment on assessment breakdown

Written exam: 70%
Project assessment: 30 %

Course title: Geomatics (GIS, remote sensing and landscape management)
Course ID: IAGR41A3
University: Université de Dschang
Faculty: Agronomy and Agricultural Sciences
Department: Forestry
Name and e-mail address of the instructor(s): Roger Ndjila Ntankouo (roger.njila@gmail.com)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 15
- Exercises: 5
- Practicals: 25

Course objectives:
The goal of the course is to give to students concepts of geo-referencing, remote sensing and geographical information systems (GIS) and their application to natural resource management.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods and tools

Upon completion of the course the students understand:
- Concepts of information acquisition, projection and geo-referencing systems, scale, layers and entity
- Tools and skills in remote sensing and geo-referencing
- Treatment, analysis and stocking of GIS data.

Course material, text books and further reading:
Alexandria Digital Library on the web of University of Santa Barbara, California
Burrough P.A. 1986. Principle of Geographic Information Systems for Land resources assessment. Clarendon Press.
Collet, C. 1992. Système d'Information Géographique en mode image. Lausanne, Presses Polytechniques et Universitaires. Coll. « Gérer l'environnement ».

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Introduction to remote sensing and GIS and their applications in landscape management
Definition, functions, uses of remote sensing and GIS
Information acquisition
Required skills and notions in GIS and remote-sensing
Representing GIS data
Setting up a GIS: modelling and conceptual representation
Treating, analysing and stocking GIS data: MAPINFO and ARCVIEW (ARCGIS)
Cases studies

Assessment breakdown: please note the general comment on assessment breakdown
Written exam: 70%
Project assessment: 30 %

Course title: Phylogeny systematics (African rainforest)
Course ID: BIV38 / BIOL-Y-022
University: Université de Dschang
Faculty: Faculty of Science
Department: Plant Biology
Name and e-mail address of the instructor(s): Louis Zapfack (lzpafack@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 30 hrs
- Exercises & student individual work: 10 hrs
- Lab work: 5 hrs

Course objectives:
The course aims at familiarizing the students with the systematics and classification of plants of the African Congo Basin rainforest and to review their history. This course refreshes the student with those parts of plant systematics needed for the Mbalmayo field course. In addition, it is a basis for each of the modules chosen.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

The student at the end of the course should be able to know the systematics of the African Congo Basin rainforest, use diagnostic characters of African Congo Basin rainforest plants and classify them, and use modern methods of vegetation studies and floristics.

Course material, text books and further reading:
Course notes.
Determination keys for African Congo Basin rainforest plants.
Herbarium and live plant specimens.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
History of plants classification
Nomenclature and principles of African Congo Basin rainforest plant taxonomy
Herbarium management, herbariums and botanical gardens
Identifications of vascular plants, floristic studies
Literature on botanical systematic

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 80 %
Practical and exercise assessment: 20 %

Course title: Ecosystèmes aquatiques
Course ID: BIV824
University: Université de Dschang
Faculty: Faculty of Science
Department: Plant Biology
Name and e-mail address of the instructor(s):
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 20 hrs
- Projects: 10 hrs

Course objectives:
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Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Community

Comprendre l'écologie des milieu humides dans les forêts tropicales africaines.

Course material, text books and further reading:
Course notes.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
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Assessment breakdown: please note the general comment on assessment breakdown
Written and/or oral assessment: 100 %

Course title: Biodiversity conservation
Course ID: MSRN51I3/BIOL-Y-026
University: Université de Dschang
Faculty: Agronomy and Agricultural Sciences
Department: Forestry
Name and e-mail address of the instructor(s): Martin Tchamba (mtchamba@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20h
- Projects: 10h

Course objectives:
The aim of this course is to introduce students into biodiversity evaluation methods, biodiversity threats and conservation strategies using a fundamental and applied approach.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Community

Upon completion of the course students will understand:
Different levels and aspects of biodiversity
Human impacts on biodiversity uses and eradication
Approaches of valuing biodiversity

Course material, text books and further reading:
Relevant book chapters, reprints of recent scientific papers and lectures handouts will be available to students.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
concepts definitions: genetic and specific; ecosystems biodiversity;
biodiversity evaluation at different scale of biosphere
geographic variation of biodiversity
concepts of endemism, species scarcity and threatened
scale and strategy of biodiversity conservation

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 70%
Project evaluation and attendance: 30%

Course title: SIG et phytogeographie
Course ID: BIV36, BIOL-Y-021
University: Université de Dschang
Faculty: Faculty of Science
Department: Plant Biology
Name and e-mail address of the instructor(s): Jonas Yves Pinta (jonasypinta@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 30 hrs
- Exercises and projects: 10 hrs
- Lab work: 5 hrs

Course objectives:
Define and show to students how different plant formations are distributed over the world. Explain and discuss the causes and consequences of this distribution.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Global

The student at the end of the course should be able to know
- The main vegetation types that are found in the world and their localisation
- The main biological forms that are fond in each vegetation type
- The factors that can explain the distribution of plant formations
- The consequences of the present days distribution of plants formations

Course material, text books and further reading:
Text books related to Biogeography
Maps showing the distribution of plants on the world, in different continents
Particular point is given the Phytogeography of Cameroon. See Letouzey, Phytogeographie du Cameroun (1968)
Video or films related to the topic

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Definition of current terms in phytogeography
Plant biological forms
Main plant formation and their distribution in the world
Phytogeography of Africa and Cameroon

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 80 %
Lab work and excursion: 20 %

Course title: Natural resource evaluation methods
Course ID: MSEV2E4/ENVI-Y-020
University: Université de Dschang
Faculty: Agronomy and Agricultural Sciences
Department: Forestry
Name and e-mail address of the instructor(s): Tsi Evaristus Angwafo (tsievaristus@yahoo.co.nz)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs
- Excursions/Practicals: 15 hrs

Course objectives:
The main goal of this course is to give to students' tools, methods and parameters used in biophysical evaluation of natural resources and mainly biodiversity. The course also covered sampling techniques, data collection and analysis.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Methods and tools

Upon successful completion of this course the students understand:
- Tools and methods of floristic and fauna inventory;
- Theories, concepts and practices of natural resources assessment and valuation;
- Concepts of sustainability in natural resources evaluation;
- Species, habitat and ecosystem level of assessment.

Course material, text books and further reading:
Course notes. Scientific articles of case-studies.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
- Difference in collecting data on fauna and flora;
- Methodological approaches in filed inventory of Biota;
- Deductive and inductive methods in natural resources
- Measurability of biodiversity;
- The sustainability triangle;
- Species and habitat assessment of biodiversity;
- Case study of faunistic evaluation
- Foundation of value theory

Assessment breakdown: please note the general comment on assessment breakdown
Written exam: 70%
Project assement and attendance: 30 %

Course title: Ecosystèmes terrestres
Course ID: BIV44, BIOL-Y-027
University: Université de Dschang
Faculty: Faculty of Science
Department: Plant Biology
Name and e-mail address of the instructor(s): Grace Mendi (ngracemendi@yahoo.com) and Marie-Louise Avana Tientcheu (avanatie@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises & student individual work: 20 hrs
- Lab work: 10 hrs

Course objectives:
- To learn deeply notions on sylviculture and forest ecology.
- To learn more about the sustainable management of forest biodiversity.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Community

The student at the end of the course should be able to know
- About regeneration of forest taxa in situ or ex situ. Main techniques used in Sylviculture.
- About forest resources,
- Linkages between forest compartments (biotic and abiotic factors).
- Sustainable Forest management

Course material, text books and further reading:
Text books related to Sylviculture, Forest Ecology and Forest management

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Ecological particularities of the main forest in the world,
Plant communities in forest ecosystems
Matter and energy transfers
Principles of forest regeneration
Forest exploitation in Cameroon

Assessment breakdown: please note the general comment on assessment breakdown
Wittren assessment: 80 %
Labwork and fieldwork assessment: 20 %

Course title: Socioeconomic analysis and elaboration of a management plan for forests and community forests
Course ID: IFFO42D2/ENVI-Y-024
University: Université de Dschang
Faculty: Faculty of Agronomy and Agricultural Sciences
Department: Forestry
Name and e-mail address of the instructor(s): Serges Bobo Kadiri (bobokadiris@yahoo.com) and Therese Fouda Moulende (agesfo@camnet.cm / agesfosiege@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises: 10 hrs
- Projects: 10 hrs
- Excursions: 5 hrs

Course objectives:
The objectives of this course are to:
- learn how to conceive a participatory management plan for conservationist and rural developers taking in account needs and constraints of all stakeholders;
- plan an integrated management of biodiversity
- learn how to use and apply national and international policies and regulations to natural resources management

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Community

Upon completion of this course students will be able to:
- elaborate a management plan for forestry and community forestry project;
- proposed an integrated management strategy for natural resources;
- understand and apply forest policies and regulations for sustainable natural resources management

Course material, text books and further reading:
Textbooks on basics of forest management
National and international policy instruments on forests resources management

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
- Socioeconomic study of protected areas and borders environment;
- Evaluation of faunistic and Floristic biodiversity of forest land
- Guidelines for integrated management of natural resources in forest area
- Elaboration of a management plan for protected area and buffer zones

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 70%
Projects and attendance: 30%

Course title: Forest management and certification
Course ID: MSRN51G1/ENVI-Y-022
University: Dschang
Faculty: Agronomy and Agricultural Sciences
Department: Forestry
Name and e-mail address of the instructor(s): Serge Bogo Kadiri (bobokadiris@yahoo.fr)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Projects: 10 hrs
- Excursions: 15 hrs

Course objectives: the gaol of the course is to highlight concepts and principles of sustainable forest management. Discuss challenges and opportunities of forest governance and certification of forest products.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Global

Upon completion of the course the students understand:
- Concept of sustainability in forest products uses;
-tools and parameters in forests management
- tools, challenges and opportunities of existing Certification systems.

Course material, text books and further reading:
Textbooks on basics of forest management.
National and international policy instruments on forests resources management.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
History of management: principles of sustainable management forest resources
Forests Dynamic and management methods and parameters
Definition, genesis and evolution of the concept of forest certification;
Analysis of existing certification systems
Certification audits and guidelines
Certification and the value and chain of wood products
Market trends of certified forest products

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 70%
Project assessment and attendance: 30%

Course title: Ethnobotanique
Course ID: BIV828
University: Université de Dschang
Faculty: Faculty of Science
Department: Plant Biology
Name and e-mail address of the instructor(s): Jonas Yves Pinta (jonasypinta@yahoo.fr) and Nicole Guedje (Nicole.Guedje@ulb.be)
Course website: to be posted
Semester: S2
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 30 hrs
- Exercises, Practicals & individual work: 20 hrs

Course objectives:
- To permit to students to know the different melliferous plants and acquire aptitude in bee keeping. They will ultimately learn how to extract different products such as honey, propolis and miellat from the hive.
- To introduce students to traditional medicine and the use of local plants to cure diseases. The student will also learn about the methodology and research on phytotherapy

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Ecosystem

Comprendre les methods et techniques appliquées dans l'étudent ethnobotanique en Afrique.
At the end of the course the student should be able to know about:
- Identifying melliferous plants
- Biology and ecology of *Apis mellifera*
- Functioning of the hive
- Product of the hive and their uses
- Notions on traditional medicine
- Notions on medicinal plants
- Selection of plants for extractions of active principles
- Ethnobotany

Course material, text books and further reading:
Course notes.
Gould, J.L. & C.G. Gould, 1995. *The Honey Bee*. Scientific American Library, New York, U.S.A. 239 pp
and other text books related to Apiculture, bee keeping
Videos on the topic of bee hives, apiary, honey extractors
Text books related to medicinal plants such as
Adjanohoun, E., M.R.A. Ahyi, L. Ake Assi, J. Baniakina, P. Chibon, G. Cusset, V. Doulou, A. Enzanza, J. Eymé, E. Goudoté, A. Keita, C. Mbemba, J. Mollet, J.- M. Moutsamboté, J. Mpati, P. Sita, 1988. Contribution aux études ethnobotaniques et floristiques en République populaire du Congo. Agence de coopération culturelle et technique, (A.C.C.T.), Paris, 605 p. and many other works by Adjanohoun et al.
Videos on the topic
Visits to the medicinal plants garden

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Plantes mellifères, pollens et production des miels
Definitions
Importance of apiculture in the word
Bees' anatomy and Ecology,
Melliferous plants
Practical on bees keeping and honey production
Uses of honey

Plantes médicinales et ethnopharmacologie
Historical review
Methods and techniques for medicinal plants
Scientific evidences on the efficiency of some medicinal plants, advantages and inconvenients
Plant selection for extraction of active principles
Common medicinal plants

Assessment breakdown: please note the general comment on assessment breakdown
Written and/or oral assessment: 100 %

Course title: Ethnobotanique et valorisation des ressources naturelles
Course ID: MSRN51H4/BIOL-Y-034
University: Université de Dschang
Faculty: Faculty of Agronomy and Agricultural sciences
Department: Forestry
Name and e-mail address of the instructor(s): Jonas Yves Pinta (jonasypinta@yahoo.fr) and Marie-Louise Avana-Tientcheu (avanatie@yahoo.fr)
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 15 hrs
- Exercises & student individual work: 10 hrs
- Lab work /project: 5 hrs
- Excursions: 5 hrs

Course objectives:
To introduce students to ethnoscience apply to plants. The student will also learn about the research methodology on ethnobotanical survey , quantitative and qualitative data analysis

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Ecosystem

The student at the end of the course should be able to know about:
- Notions of traditional or local classification systems of plants
- services and products from plants
- quantitative vs qualitative ethnobotany/biological vs anthropological ethnobotany
- principle and practices of ethnobotanical survey

Course material, text books and further reading:
Martin, G.J., **2004**. *Ethnobotany : a methods manual.* Earthscan Publications Ltd., London, U.K. 268 pp.
Cunningham, A.B., **2001**. *Applied Ethnobotany : people, wild plant use and conservation*. Earthscan Publications Ltd., London, U.K. 300 pp.
Videos on the topic
Visits to the medicinal plants garden

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Definition and history of ethnosciences, ethnobotany and related field
Services and products from plants
principles and practices of ethnobotanical surveys
quantifying ethnobotanical data
ethnobotanical surveys for plant resources valorization (domestication and bioprospection)

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 70 %
Lab work and field work: 30 %

Course descriptions at Technical University of Mombasa (TUM)

Course title: Tropical Biodiversity & Ecosystems Field School: East African Ecosystems
Course ID: AFA 5113
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Cosmas Munga (ckamunga2014@tum.ac.ke)
Course website:
Semester: S1
Tuition language: English
Number of credits (ECTS): 15

IMPORTANT: The costs for the Course are in part met by the University, but students will be asked to contribute a maximum of XXX KES for road transport, boat/vehicle rental and other logistic arrangements**.** Also, students will be asked to share the costs of their food and accommodation.

Course breakdown and hours: Total 300 hrs = 25 days
- Excursions : 240 hrs
- Reporting & oral presentation: 60 hrs

Course objectives/purpose:
This course offers an overview of the main aquatic and terrestrial tropical ecosystems and highlights environmental and ecological features of selected ecosystems from marine, coastal and terrestrial environments. This field training offers students the opportunity to gain real experience in the conservation and management of wildlife populations and the integration of state agencies, local communities and other stakeholders in the process. Overall, this course gives an integrated, teambuilding experience based on theoretical and practical field approaches, and adapted to a variety of tropical ecosystems located along the Kenya coast. The trainees gain in-depth knowledge about nature, ecology and wildlife management issues.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Ecosystem
Upon completion of the course, the student should be able to:
- Describe the general operations of stakeholders involved in wildlife management
- Identify and describe emerging/contemporary issues in wildlife conservation and management
- Master knowledge and skills for conservation and management of wildlife and biodiversity in terrestrial ecosystems of the tropics
- Design and implement field protocol for biodiversity assessment and management

Course material, text books and further reading:
Core Tex books for the Course
-Paula, J., Bandeira, S., Msangameno, D., Queiroga, H. (2021). Exercises in marine biodiversity and ecology: a training manual using the intertidal habitats of the WIO region. WIOMSA, Zanzibar Town, 360pp
-Telly, E.M., Fiadjoe, A. (1996). Environmental education and training for savannah ecosystem management: a training of trainers manual. ISBN: 9964-72-041-6. 57pp
-Herrick, J.E., Zee, J.W.V., Havstad, K.M., Burkett, L.M., Whitford, W.G. (2009). Monitoring manual for grassland, shrubland and savanna ecosystems. ISBN: 0-9755552-0-0. 36pp

Prerequisites: please note the general comment
Basic knowledge in biology and ecology

Table of contents:
Population descriptive statistics; Correlation and regression of population traits; Group comparisons: abundance spatial structure; Biological diversity measures

Assessment breakdown: please note the general comment on assessment breakdown
Written scientific report: 60%
Oral presentation: 40%

Course title: Geomatics
Course ID: AFA 5122
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Mr. Stephen O. Odhiambo (stevemtalii@gmail.com)
Course website: TBC
Semester: S1
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 30 hrs
- Exercices: 30 hrs

Course objectives/purpose:
- To introduce the theory, concepts and techniques of Geospatial Information systems and Remote Sensing
- To develop the understanding and technical skills required to analyze geospatial data.

Learning outcomes:
The student is expected to have the following capacities at the end of this course:
- Capacity to carry out mapping and integrate field data to geospatial information systems
- Ability to utilize geospatial techniques in addressing real-world problems in the diverse areas of coastal and marine resource management.
- Capacity to spatially communicate trends and studies in the respective fields.

Course material, text books and further reading:
Core Text books for the Course

- Awange, J.L., Kyalo Kiema, J.B. (2013). Fundamentals of Remote Sensing. In: Environmental Geoinformatics. Environmental Science and Engineering (). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-34085-7_7
- Tolpekin, V., & Stein, A. (2012). The core of GIScience: a process-based approach. (ITC Educational Textbook Series). University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC).
- Fundamentals of Remote Sensing. Canada Centre for Remote Sensing
- Aggarwal, S., & Dun, D. (2005). Principles of Remote Sensing.

Recommended Reference Text Books

- Watt, A. and N. Eng. (2014). Database Design – 2nd Edition. Victoria, B.C.: BCcampus. Retrieved from https://opentextbc.ca/dbdesign01/.
- Mahmoud Hassani and James Carswell. (1992). Transition From Analogue to Digital Photogrammetry, Advances in Remote Sensing vol i. No. 3 – vii.
- T. Schenk, Autumn Quarter 2005, Introduction to Photogrammetry.
- Patra, P. (2010). Remote Sensing And Geographical Information System (GIS). The Association for Geographical studies.
- Https://www.state.nj.us/transportation/eng/documents/survey/chapter7.shtm

Prerequisites: None
Softwares:
- R studio (Data Analysis)
- QGIS (Opensource GIS and Remote Sensing)
- Erdas Imagine(Commercial Remote Sensing)
- ArcGIS(Commercial GIS)

Device specifications:

- Operating system (Any)
- Random Access Memory (4GB and above)
- HDD/SSD (150GB and above
- Access to power

Table of contents:

Basic GIS Concepts and Terminologies; Data capture and encoding; Spatial Analysis Tools and Methods; Data Merging and Integration; Map projections; GIS and Database Management Systems; Remote Sensing (processes); Electromagnetic Radiation Interaction with the Atmosphere; Platforms, Scanners and Sensors; Image Errors/Noises; Remote Sensing (RS) Images
Image Resolution; Image Analysis and Interpretation; Digital Image Processing; Image Classification; Application of GIS on natural resources monitoring and impact assessment.

Assessment breakdown:

Written assessment:
Final exam 60 %
Continous Assessment Tests 20 %
Practicals 20%

Course title: Behavioural ecology of tropical wildlife
Course ID: AFA 5115
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Mohamed Dhidha (mdhidha71@yahoo.com)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Course objectives/purpose: To introduce students on behavioural ecology of tropical wildlife.

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Explain and interpret animal behaviour
- Describe effects of environment on wildlife behaviour
- Understand evolution of behaviour in wildlife animals

Course material, text books and further reading:
Core Tex books for the Course
Macedo, R. (2010). Behavioral Ecology of Tropical Animals. Academic Press. ASIN: B004TSBSE6
Berger, O. (2016). Conservation Behavior: Applying Behavioral Ecology to Wildlife Conservation and Management. Cambridge University Press. ISBN 10: 1107690412
Elliot, N. L. (2019). Observing Wildlife in Tropical Forests: A Geosemeiotic Approach. Delome Publications. ASIN: B081D4TX7P

Recommended Reference Text Books
Stutchbury, B. Morton, E. (2022). Behavioral Ecology of Tropical Birds: Academic Press. ISBN 10: 0128238143
Robinson, J. Bennet, E. (2017). Hunting for Sustainability in Tropical Forests: Columbia University Press. ISBN 10: 0231109768

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Study of behaviour in animals: Physiological approach, experiential approach. Interpretation of animal behavior. Effects of environment on wildlife behavior. Evolution of behaviour in wild animals. Categorization of behaviour in wild animals. Mechanisms of communication in wildlife. Predator-prey interactions. Social organisation of selected tropical wildlife species and groups. Reproduction and mating patterns. Wildlife migration

Assessment breakdown: please note the general comment on assessment breakdown Written assessment: Final exam 60 % Continous Assessment Tests 40 %

Course title: Wildlife habitat management
Course ID: AFA 5120
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Mohamed Dhidha (mdhidha71@yahoo.com)
Course website: TBC
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To impart students with knowledge on wildlife habitats and their management techniques

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Describe different types of wildlife habitats
- Integrate wildlife habitat problem solving skills into management
- Apply management skills on the different types of habitats

Course material, text books and further reading:
Core Tex books for the Course
McComb, B. C. (2021). Wildlife Habitat Management. CRC Press. ISBN - 10: 1032098384
Morrison, M. L., Mathewson, H. A. (2015) Wildlife Habitat Conservation: Concepts, Challenges, and Solutions. Johns Hopkins University Press. ISBN 10: 1421416107
Krausman P.R., Cain III J.W. (Eds) (2013). Wildlife Management and Conservation: Contemporary Principles and Practices. Johns Hopkins University Press. ISBN 10: 9781421409863

Recommended Reference Text Books
Patton, D. R., Fox, B. E., Bailey, J. D. (2019). Conserving Forest Diversity through Ecosystem Management: Trees, Forests, Environment, Habitat, and Wildlife: Oxford University Press. ASIN: B07WGQL69W
Degraaf, R., Yamasaki, M., Leak, W. B. (2007). Technical Guide to Forest Wildlife Habitat Management in New England: University Press of New England. ISBN 10: 1584655879

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Types and classification of wildlife habitats. Wildlife Rangelands: Types and classification of rangeland, Vegetation types within rangelands, Ecosystem services of rangeland, Threats to rangeland and mitigation strategies, Rangeland

management practice. Tropical Wetlands: Types of wetlands in Kenya, Vegetation types within wetlands, Ecosystem services of wetlands, Values of wetlands, Threats facing tropical wetlands, Wetland management practices. Forests: Ecosystem services of forests, Vegetation types within forests, Forest classification, Functions of forests, Threats facing forests in Kenya, Forest ecosystem monitoring**.**

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Tropical savanna ecosystem and biodiversity
Course ID: AFA 5119
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Mumini Dzoga (mdzoga2014@tum.ac.ke)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To equip students with knowledge of tropical savanna ecosystem.

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Describe characteristics of savannah ecosystems
- Describe threats to savannah ecosystems
- Understand socio-economic importance of savannah ecosystems

Course material, text books and further reading:
Core Tex books for the Course

Hill, M. J., Hanan, M. P. (2010). Ecosystem Function in Savannas: Measurement and Modeling at Landscape to Global Scales. CRC Press. ISBN -10: 1439804702

Valayil, J. M., Writing, D. S., (2022). Baako's Wild Journey: A STEM introduction to the African Savanna ecosystem. Alacarte Publishers. ASIN: B09SD18Z8B

Mashapa, C. (2019). Human Livelihoods and Sustainable Conservation in a Savanna Ecosystem: Herbivory and Anthropogenic Impacts on Woody Vegetation in Save Valley, Southern Zimbabwe. LAP LAMBERT Academic Publishing. ISBN: 6200318867

Recommended Reference Text Books

Abbadie, l., Gignoux, J., Roux, X., Lepage, M. (Eds) (2006). Lamto: Structure, Functioning, and Dynamics of a Savanna Ecosystem: Springer. ISBN 10: 0387948449

Solbrig, O. T., Medina, E., Silva, J. F. (1996). Biodiversity and Savanna Ecosystem Processes: A Global Perspective: Yale University Press. ISBN 10: 3540579494

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Definition and characteristics of savannah ecosystem: floral and faunal composition, climate, soils and nutrients. The savannah biome. Threats of savannah ecosystem: Anthropogenic threats, natural threats. Socio-economic importance of savannah ecosystem. Case study: The Masaai Mara ecosystem – a trans-boundary savannah ecosystem between Kenya and Tanzania.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Wetland ecology and management
Course ID: AFA 5121
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Prof. Ezekiel Okemwa (eokemwa@tum.ac.ke)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To equip students with skills on wetland characterization and functional assessment.

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Determine wetland demarcation
- Describe wetland characteristics
- Conduct functional analysis of wetlands
- Apply wetland regulations in management

Course material, text books and further reading:
Core Tex books for the Course
Messina, M. G., Conner, W. H. (Eds.) (2019). Southern Forested Wetlands: Ecology and Management. Routledge. ISBN -10:1119154049; 13 : 978-0367359225
Hook, D. D., McKee Jr, W. H., Smith, H. K., Gregory, J., Burrell Jr, V. G., DeVoe, M. R., and others (Eds) (2014). The Ecology and Management of Wetlands. Springer. ISBN 10: 1468473948; 13: 978-1468473940
Trettin C. C., (2018). Northern Forested Wetland Ecology and Management. Routledge. ISBN-13: 978-1566701778; 10: 1566701775

Recommended Reference Text Books
Hennawy, M. E. (2016). Ecology and Management of Wetland Ecosystem: LAP LAMBERT Academic Publishing. ISBN-10: 9783659858512; 13: 978-3659858512
Whigham, D. F., Good, R. E., Kvet, J. (Eds) (1990). Wetland Ecology and Management: Case Studies. Springer. ISBN-10: 079230893X

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Wetland delineation. Wetland characterization: water, substrate and biota. Especially controversial wetlands. Regulation of wetlands. Lakes origin and classification. Functional classification of wetlands (lakes, deltas and estuaries). East African great lakes (Lake Tanganyika, Lake Victoria and Lake Turkana). Socio-economic importance. Threats facing East African great lakes

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Tropical coastal biodiversity and resources conservation
Course ID: AFA 5117
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Gladys Okemwa (gladyokemwa@gmail.com)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To equip the student with the knowledge of coastal and marine biodiversity and resources conservation

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Explain connectivity of the different types of coastal habitats and related biodiversity
- Understand different levels of coastal resource conservation
- Demonstrate practical aspects of coastal resource conservation
- Demonstrate change in coastal habitats due to anthropogenic & natural impacts

Course material, text books and further reading:
Core Tex books for the Course
Linneweber, V. (2013). Mangrove ecosystems: Function and management (Environmental science & engineering). Springer, 2002nd edition. ISBN-10:3540422080. 477pp
Sivaperuman, C., Velmurugan, A., Singh, A.K., Jaisankar, I. (eds). (2018). Biodiversity and climate change adaptation in tropical islands. Academic Press, 1st edition. ISBN: 0128130644. 777pp
Nagelkerken, I. (ed) (2009). Ecological connectivity among tropical coastal ecosystems (Advances in spatial science). Springer, 2005th edition. ISBN-10:9048124050. 1142 pp.

Recommended Reference Text Books
Michael, E. (2013). Marine conservation biology: The science of maintaining the sea's biodiversity. In: Norse, E.A., Crowder, L.B., Soule, M.E. (eds). Island Press. ISBN-10:1559636629. 496pp
Hiscock, K. (2014). Marine biodiversity conservation: A practical approach (Earthscan Ocean). Routledge, 1st edition. ISBN-10:0415723566. 520pp
Claudet, J. (ed) (2011). Marine Protected Areas: A multidisciplinary approach (Ecology, Biodiversity and Conservation). Cambridge University Press, Illustrated edition. ISBN-10:0521766052. 392 pp

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Mangrove ecosystem and associated biodiversity, threats and conservation; Sea grass ecosystem and associated biodiversity, threats and conservation; Coral ecosystem and associated biodiversity, threats and conservation; Sea turtles conservation in Kenya; Marine mammals conservation and surveillance (dugongs, dolphins, whales); Sharks conservation and fisheries management; Impacts of climate change and adaptation strategies; Realizing AICHI Targets; The development of a sustainable blue economy (conventional MPAs, Community Conserved Areas); Progress in trans-boundary conservation of resources between Kenya and Tanzania. Other coastal and marine resources of ecological importance: estuaries and deltas, sand dunes, beaches, pelagic habitats among others. Drivers of coastal and marine resources degradation: high rates of population growth, urbanization, expansion of industrial developments, overexploitation of natural resources and climate change

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Tropical coastal resources and monitoring tools
Course ID: AFA 5118
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Mohamed Omar (msaid26474@gmail.com)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose:

- To introduce students on the dynamics of coastal and marine resources due to natural and anthropogenic impacts and how these can be monitored for intervention using standard tools
- To conserve coastal and marine resources by promoting, influencing and catalysing sustainable uses
- To achieve significant improvement in sustaining coastal and marine resources for posterity

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Identify resources dynamics due to natural or anthropogenic impacts
- Identify and be able to explain the standard tools and methods used for coastal and marine resources assessment and monitoring for intervention
- Apply the assessment and monitoring methods in resource management

Course material, text books and further reading:

Core Text books for the Course

Kennish, M.J. (2017). Practical handbook of estuarine and marine pollution (Marine Science Series). CRC Press, 1st edition. ISBN-10: 0849384249. 508 pp

Taberlet, P. (2018). Environmental DNA: For biodiversity research and monitoring. Oxford University Press, USA, Illustrated edition. ISBN-10: 0198767285. 253pp

Devin, J., Jensen, K.H., Hestetun, J.T., Sjotun, K., Salvanes, A.G.V., Glenner, H. (eds) (2018). Marine ecological field methods: A guide for marine biologists and fisheries scientists. Wiley-Blackwell, 1st edition. ISBN-10: 9781119184300. 240pp

Recommended Reference Text Books

Beatley, T. (2002). An introduction to coastal zone management. Island Press, 2nd edition. ISBN-10: 1559639156. 352 pp

Nguele, G. (2020). Exploitation of marine resources and protection of the environment: From over-exploitation to an integrated approach to the exploitation of marine resources. Our Knowledge Publishing. ISBN-10: 6202720921. 132 pp.
Jennings, S., Kaiser, M.J., Reynolds, J.D. (2001). Marine fisheries ecology. Blackwell Science, 1st edition. ISBN-10: 9780632050987. 432 pp

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Definition of assessment and monitoring for coastal and marine resources. Importance of resource assessment and monitoring. Assessment and monitoring tools for coastal forests and mangroves, sea grass beds, and corals: Different types of resource monitoring including scientific and non-scientific monitoring. Requirements for the different types of resource monitoring in terms of level of scientific expertise, finances and human resource. Survey types such as use of line and belt transects for underwater fish census, use of quadrats, use of permanent monitoring plots, benthic survey tools. Tools such as GIS and remote sensing. Use of local knowledge and citizen science in resource assessment and monitoring. Community livelihoods in coastal areas. Governance of coastal and marine resources use. Indicators of changing ecosystem state: productivity, fish and fisheries, pollution, socio-economics and governance.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Tropical coastal and marine fisheries resources
Course ID: AFA 5101
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. Cosmas Munga (ckamunga2014@tum.ac.ke)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To introduce the student to tropical coastal and marine fisheries resources.

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Describe different types of tropical coastal & marine ecosystems
- Describe the fisheries resources of tropical coastal & marine ecosystems
- Demonstrate practical management practices in fisheries
- Demonstrate trends in fisheries resources with climate change & physical drivers of production such as currents
- Explain anthropogenic impacts on coastal & marine fisheries resources

Course material, text books and further reading:
Core Tex books for the Course

Phillips, B., Ramirez, M. (2017). Climate change impacts on fisheries and aquaculture: A global analysis. Wiley-Blackwell. ISBN -10:1119154049
Diop S., Scheren, P., Machiwa, J. (Eds.) (2016). Estuaries: A lifeline of ecosystem services in the Western Indian Ocean. ISBN 978-3-319-25368-8
Groeneveld J.C., Koranteng K.A (Eds) (2017). The RV Dr. Fridtjof Nansen in the Western Indian Ocean: Voyages of marine research and capacity development. FAO. Rome, Italy

Recommended Reference Text Books

FAO (2015). Handbook of marine fisheries conservation and management: Oxford University Press. ISBN: 9780195370287
Fagan, B. (2017). Fishing: How the sea fed civilization: Yale University Press. ISBN: 9780195370287

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Definition and characteristics of tropical coastal artisanal fisheries; socio-economic importance of coastal artisanal fisheries. Composition of tropical coastal artisanal fisheries: Coral reef fisheries, Mangrove fisheries, Sea grass fisheries. Status and management of artisanal fisheries in Kenya. Towards ecosystem approach to fisheries (EAF) management. Challenges of tropical coastal fisheries in Kenya and the Western Indian Ocean region, a case study of the bottom trawl prawn fishery. Climate change: threats to ecosystems, adaptations and mitigation; Drivers of fisheries production (coastal currents, monsoon winds, waves and tides); Classification of fisheries: small-scale artisanal and industrial fisheries: Fisheries resources: demersal fishes, pelagic fishes, Crustaceans, Mollusks, Ornamental fisheries. Species Diversity: occurrence and distribution. Trends in Exploitation, Sustainable Management, State of world fisheries resources; Environmental and anthropogenic impacts: Eutrophication, sedimentation, acidification.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Restoration of tropical coastal and marine ecosystems
Course ID: AFA 5116
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Dr. James Kairo (gkairo@kmfri.co.ke)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To equip the student with knowledge and practical skills in restoration of degraded coastal and marine ecosystems

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

- Understand characteristics of degraded coastal and marine ecosystems
- Explain the relationship between degraded coastal and marine ecosystems with community livelihoods
- Demonstrate practical aspects of coastal resource conservation
- Demonstrate change in coastal habitats due to anthropogenic & natural impacts

Course material, text books and further reading:
Core Tex books for the Course
Yamashita, H. (2021). Coatal wetlands restoration: Public perception and community development. Routledge, 1st edition. ISBN-10: 0367863081. 176 pp
Allison, S.K. (2012). Ecological restoration and environmental change: Renewing damaged ecosystems. Routledge, 1st edition. ISBN-10: 1138804568. 265pp
Ayyam, V. Palanivel, S., Chandrakasan, S. (2019). Coastal ecosystems of the tropics – Adaptive management. Springer, 1st edition. ISBN-10: 981138925X. 617 pp

Recommended Reference Text Books
Wolansk, E., Day, J.W., Elliott, M., Ramesh, R. (eds) (2019). Coasts and estuaries: The future. Elsevier, 1st edition. ISBN-10: 0128140038. 676 pp
Milon, J.W., Alvarez, S. (eds) (2019). Coastal resources economics and ecosystem valuation. Mdpi AG. ISBN-10: 3039280163. 104pp
Panagopoulos, T. (2020). Nature-based solutions for restoration ecosystem. Mdpi AG. ISBN-10: 303936249. 218pp

Prerequisites: please note the general comment on prerequisites

None

Table of contents:
Overview and global status of coastal and marine ecosystems: mangroves, sea grass beds, corals and coastal forests. Challenges facing coastal and marine ecosystems management. Ecological restoration principles. Ecosystem recovery. Importance of restoration. Case studies of restored coastal and marine ecosystems.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course title: Advanced coastal settlement and infrastructure development
Course ID: AFA 5114
University: Technical University of Mombasa
Faculty: Applied & Health Sciences
Department: Environment & Health Sciences
Name and e-mail address of the instructor(s): Prof. Saeed Mwaguni (smwaguni@tum.ac.ke)
Course website: FILL
Semester: S2
Tuition language: English
Number of credits (ECTS): FILL

Course breakdown and hours:

- Lectures: 60 hrs
- Exercices: FILL hrs
- Excursions : FILL hrs
- Projects: FILL hrs

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives/purpose: To introduce the student to nature, policies and plans and scope of settlement and examine rural and urban settlement, patterns and trends in the coastal environment

Learning outcomes : please note the general comment on learning outcomes
Education level: FILL Ecosystem focus: FILL Biological level: FILL

Upon completion of the course a student must be able to:

Understand the initiatives and national requirements for sustainable development and management of coastal resources
Apply knowledge of urban population and marine resource use
Discuss the scope of coastal settlement; relationship between resources, human settlement and development programmes affecting settlements and influence of infra-structural facilities on settlement

Course material, text books and further reading:
Core Tex books for the Course

Recommended Reference Text Books

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Scope of coastal settlement; relationship between human settlement and development; development programmes influencing settlements; influence of infrastructure facilities on settlement schemes; planning; building materials and constructional technologies; issues of settlement in the Kenya coast (Coastal communities: culture and history; colonial history, ethnic diversity and religion, the spread of Islam, cultural practices and marine environment conservation,

indigenous knowledge, traditions and beliefs). Appropriate land use planning and associated planning tools. Assessment of the vulnerability of assets and infrastructure. An audit of current land use commitments in coastal areas. Guidelines for future settlement growth. Socio-cultural activities; fishing, mining, forest resources harvesting, harbor and port activities. Community empowerment and awareness creation.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment:
Final exam 60 %
Continous Assessment Tests 40 %

Course descriptions at Université d'Antananarivo (UNIVANTA)

Course title: Tropical biodiversity and ecosystems field school: Malagasy forest ecosystems
Course ID: UTNR
University: University of Antananarivo
Faculty: Sciences
Department: of Plant Biology and Ecology
Name and e-mail address of the instructor(s): Mijoro Rakotoarinivo (rakotoarinivo@outlook.com), Patrick Ranirison (patrick.ranirison@gmail.com)
Course website: -
Semester: S2
Tuition language: English
Number of credits (ECTS): 15
IMPORTANT: Additional costs (for transport, guides, entry fees, research permits), amounting to *ca.* 500 EUR will be payable by the student.

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
14		30	90		40		

Course summary

The field course is about making the student familiar with a rich environment diversity in tropical area through different modules related to the technique used for botany and zoology. Study methods will focus on answering fundamental questions about the diversity of plant and fungal life on the planet, how it evolved and how we can best conserve it.

Course objectives
At the end of the course, the student is expected to acquire knowledge on:
- Plant herbarium management (collecting, identification and curation of specimens).
- Plant systematics: ability to recognize and identify the most frequent plant families of the tropics.
- Ecological survey: vegetation study and management issue.
- Ethnobotany: useful plants and their importance for the subsistence of the local community.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to understand the importance of making voucher specimens for the basis of any scientific study.

Course material, text books and further reading:

- Bridson, D. & Forman, L., 1998. The Herbarium Handbook. 3rd edit. Royal Botanic Garden. Kew.
- Schatz, G. E. 2001. Generic Tree Flora of Madagascar. Cromwell Press, Trowbridge, England.
- Gautier L. & S.M. Goodman (2003). Introduction to the flora of Madagascar. In The natural history of Madagascar, eds. S.M. Goodman & J.P. Benstead. University of Chicago Press. Chicago. Pp: 229-250.

Prerequisites: please note the general comment on prerequisites
Students who wish to attend the course should be familiar with basic botanical terms and have knowledge on the plant systematics.

Table of contents:

Theory:
1- Herbarium essentials: techniques for making of voucher specimens and species identification process
2- Tropical botany: reminder of the diagnostic characters for identifying the major plants groups in tropical area
3- « Etat de santé des habitats et des écosystèmes »
4- "Approche communautaire"

Practicals:
1- Collecting, pressing and drying herbarium specimens
2- Field identification: use of Flora or specialized identification books. Online key if internet is available
3- Ecosystem monitoring assesment
4- Rapid Rural Appraisal (RRA~MARP)

Projects:
1- Study of the local taxonomic diversity
2- Morphological diversity of plants in the study site
3- Habitats and ecosystems survey
4- Values of ecosystem uses

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 10%
Written assessment: 40%
Projects/Presentations/Reporting: 50%

Course title : Geomatics (Remote Sensing and GIS)
Course ID : TELESIG
University: University of Antananarivo
Faculty: Sciences
Department: Institut & Observatoire de Géophysique d'Antananarivo (IOGA)
Laboratory of Environmental Geophysics and Remote Sensing
Name and e-mail address of the instructor(s): RAKOTONDRAOMPIANA Solofo
(srakotondraompiana@gmail.com; solofo.rakotondraompiana@univ-antananarivo.mg)
Course website: -
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
25		20	90		5		

Course summary
Remote sensing and GIS are among new technologies for earth observations. Nowadays, many domains in science use them as tools for research. This course is subdivided in two modules of the same importance: Remote Sensing and GIS.
Remote sensing: students will learn about Earth Observations, methods of satellite digital images processing and image classification.
GIS: students will learn about structure of geospatial database, mapping and information extraction from a geographical database.
Free software packages will be used for both modules: ILWIS for Remote Sensing and QGIS for GIS.
Minimum number of students to allow the opening of the module: 5

Course objectives:
Upon completion, students know and master
* Different spatial images available;
* Main digital image processing and classification methods;
* The two main kind of geographical objects representation;
* Mapping technics;
* One method of information extraction.

Learning outcomes: please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Students will learn how to process image data and how to characterize different types of vegetal formations from images. They will also learn how to make an efficient mapping in order to transmit the right message to users; how to extract the information contained in the geographical data.
Upon completion of the course a student must be able to process a spatial image, to make a map and to extract information.

Course material, text books and further reading:
Required material and equipment needed for this study are:
* scientific paper/literature;
* Spatial images;
* Geographical data;

Prerequisites: Bachelor in Biology. please note the general comment on prerequisites

Table of contents:

Remote sensing:
The remote sensing process;
Electromagnetic spectrum;
Electromagnetic radiation and interactions
Platforms;
Orbits;
Sensors;
Resolutions (spatial, spectral, radiometric and temporal)

Digital image processing:
Image characteristics and representation
Visualization
Image enhancement
Multispectral transformation
Classification

SIG:
Geographical data;
How to represent geographical data;
Proprieties of geographical data;
Mapping
Data vs. Information;
Spatial Decision Support System.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 25 %
Written assessment: 50 %
Projects/Presentations/Reporting: 25 %

Course title: Floristic biodiversity of Madagascar
Course ID: BIOFLOMA
University: University of Antananarivo
Faculty: Science
Department: Plant Biology and Ecology
Name and e-mail address of the instructor(s): FARAMALALA MIADANA Harisoa (faramia2003@gmail.com), Rabakonandrianina Elisabeth (rabakonandrianina@gmail.com), Pr Andrianarimisa Aristide, aristide@wcs.org
Course website: -
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures : 50 hrs
- Exercices : 5 hrs
- Excursions : 10 hrs
- Projects : 10 hrs

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
50		5	10		10		

Course summary
Madagascar is well known for its flora that is both diverse and largely endemic. This course aim to describe and ecologically characterized the forms of vegetal formation existed in Madagascar. This includes primary, secondary formations in different accepted phytogeographic territories. Statistics through their surface and physiognomy demonstrate their present state and their pressure and threats.

Course objectives:
Upon completion, students know and master
*different vegetal formations of Madagascar and their ecological characteristics
* pressures and threats
* dynamics and secondary vegetal formation

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Students are aware of the unique and rich flora biodiversity. They are informed of the various factors underpinning the speciation process in the island. They will learn how to characterize different types of vegetal formation and to describe their threats in order to ensure sustainable management and will learn different technics that can be important for decision making for sustainable management of natural resources.
Education level: S8 and S9 Ecosystem focus: Terrestrial Ecosystems Biological level : Systematics of Botany.
Upon completion of the course a student must be able to characterize and to describe types of vegetation of Madagascar and to analyze the floristic composition and richness.

Course material, text books and further reading:
Required material and equipment needed for this study are:
*scientific paper/literature
*Herbarium specimens, secateurs
*GPS, compass, fontal lamp, maps

Prerequisites: Bachelor in Biology. please note the general comment on prerequisites

Table of contents :

Abiotic and biotic factors
Pressure and threats
Endemic, native and modified vegetation
Flora of Madagascar (Richness, composition, biogeographic affinities and endemism)

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 25 %
Written assessment: 50 %
Projects/Presentations/Reporting: 25 %

Course title: Madagascar terrestrial fauna diversity
Course ID:
University: University of Antananarivo, Madagascar
Institute/School: Domaine of sciences and Technologies, Mention: Zoologie and Biodiversity of Animals
Name and e-mail address of the instructors:
Dr. RAKOTOMALALA Zafimahery, e-mail : zafimahery@yahoo.fr Tel: +261 33 14 837 25. :
Dr. RATSOAVINA Fanomezana Mihaja
Pr. RAKOTOMANANA Haja
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
24		3	3				

Course summary
The island of Madagascar is known for its particular geographic history and for the high level of endemism of its biota, which rank the country as one of the most diverse places on Earth. Home to over than 300 species of Mammals, 284 species of Birds, 380 species of Reptiles and more than 350 species of Amphibians ; Madagascar is amongst the top five countries with a high level of endemism. From south to north and west to east, the wildlife diversity is particularly unique and is worth to understand.

Course objectives:
- Understanding Madagascar terrestrial fauna, origins, diversity and particularity
- Acquiring knowledge on Madagascar emblematic species and their conservation
- Research trends on Madagascar terrestrial fauna

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Organism

Upon completion, student will be able to:
- Understand the characteristic of Madagascar terrestrial fauna
- know the archaism in some taxa
- recognize the endemism per taxa referring to the species ecology and distribution
- be updated about the latest researches and discoveries on Malagasy terrestrial fauna
- Conservation status of endangered populations

Course materials, text books and further reading:
- Glaw, F. &Vences, M. 2007. *A field guide to the amphibians and reptiles of Madagascar*, 3rd Edition. Vences&Glaw. Verlag, Cologne.
- Goodman, S. M. 2012.*Les Carnivora de Madagascar.* Association Vahatra, Antananarivo.
- Langrand, O. 1995.*Guide des oiseaux de Madagascar*. Delachaux et Niestlé, Lausanne.
- Mittermeier, R. A., Louis Jr., E. E., Richardson, M., Schwitzer, C., Langrand, O., Rylands, A. B., Hawkins, F., Rajaobelina, S., Ratsimbazafy, J., Rasoloarison, R., Roos, C., Kappeler, P. & Mackinnon, J. 2010. *Lemurs of Madagascar*. Conservation International, Washington.
- Pedrono, M. 2008. *The tortoises and turtles of Madagascar*. Natural History Publication, Kota Kinabalu.
- Raherilalao, M. J. & Goodman, S. M. 2011.*Histoire naturelle des familles et sous-familles endémiques d'oiseaux de Madagascar*. Association Vahatra, Antananarivo.
- Soarimalala, V. & Goodman, S. M. 2011. *Les petits mammifères de Madagascar*. Association Vahatra, Antananarivo.

Prerequisites:

To attend the proposed course, the student must have knowledge on life diversity and vertebrate biology and morphological functions. Minimum understanding on Madagascar geography is required.

Table of contents:
The exact course content may slightly change but will focus on one or more of the following topics.

Theory:
I-Mammals of Madagascar
1. Generality
2. Systematics and origins of Mammals diversity
3. Particularity of Madagascan mammals
4. Dispersion
5. Populations threat and status

II-Herpetofauna of Madagascar
1. Generality on Amphibians and Reptiles of Madagascar and their origins
2. Systematics of Malagasy herpetofauna
3. Amphibians diiversity
4. Reptiles diversity
5. Conservation status

III-Madagascar Avifauna
1. Generality
2. Systematics of Malagasy Avifauna
3. Malagasy Avifauna and migrations
4. Birding and conservation

Practicals:
Debates and discussions

Projects:
Species identification

Assessment breakdown:
please note the general comment on assessment breakdown
Student participation and attitude + Projects/Presentations/Reporting: 100 %

Course title: Biodiversity offset
Course ID:
University: University of Antananarivo
Institute/School: Mention ZBA
Name and e-mail address of the instructor(s): Pr Andrianarimisa Aristide, aristide@wcs.org
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course summary
Most threats on Madagascar Biodiversity habitat take source from local people poverty exacerbated with an unstable political and economic situation. One in four species as either Endangered or Critically Endangered, this is the case of the endemic Lemurs. Madagascar is a broad country and several areas are in need of conservation.

Course breakdown in hours: 120

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment

Course objectives:
- To familiarize with international standards on the assessments (and technics to reduce biodiversity loss, social consideration from the residual impact during a development project as mining
- To implement high-level profile biodiversity offset programs responding to international standards
- To familiarize with biodiversity management under development companies such as international mining companies

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialized Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to -
- Understand Environmental and Social Impact Assessment (ESIA) requirements for large development and international mining investments.
- Learn and able to implement biodiversity offset programs responding to international standards and requirements for a development project like international mining.
- Understand biodiversity No Net Loss (NNL) and Net Gain (NG) approaches and use high "ecological equivalence metrics" to quantify biodiversity values

Course material, text books and further reading:

- Aima, D., Edwards, S., Bos, G., Ekstrom, J., Krueger, L., Quétier, F., … Bennun, L. (2015). No Net Loss and Net Positive Impact Approaches for Biodiversity. Retrieved from https://portals.iucn.org/library/sites/library/files/documents/2015-003.pdf
- Bull, J. W., Suttle, K. B., Gordon, A., Singh, N. J., & Milner-Gulland, E. J. (2013). Biodiversity offsets in theory and practice. Oryx, 47(03), 369–380. http://doi.org/10.1017/S003060531200172X
- Business and Biodiversity Offsets Program. 2012. Standard on biodiversity offsets. BBOP, Washington, D.C.
- Business and Biodiversity Offsets Programme (BBOP). (2009). Biodiversity Offset Design Handbook. Available at http://www.forest-trends.org/documents/files/doc_3101.pdf
- Business and Biodiversity Offsets Programme (BBOP). (2012). *Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets.*
- International Finance Corporation (IFC) (2012). Performance Standards on Environmental and Social Sustainability. http://www.ifc.org.
- Parkes, D., G. Newell & D. Cheal. (2003). Assessing the quality of native vegetation: the 'habitat hectares' approach. *Ecological Management and Restoration*, 4: 529-538.

- von Hase Amrei, Andrew Cooke, Aristide Andrianarimisa, Rivolala Andriamparany, Vanessa Mass, Robin Mitchell & Kerry ten Kate. (2014). Working towards NNL of Biodiversity and Beyond: Ambatovy, Madagascar – A Case Study. 2014. Available from http://www.forest-trends.org/documents/ambatovy_2014. doi: 10.13140/2.1.1245.7288

Prerequisites: please note the general comment on prerequisites

- Knowledge of ecosystem functioning
- Landscape and biodiversity conservation
- Notion of mining
- Sustainable development.

Table of contents:

The exact course content may slightly change but will focus on one or more of the following topics.

Theory:

1. Existing international requirements and standards on large investments
2. Biodiversity Offsets
3. Landscape ecology applied to reserve design

Practicals:

1. Analysis of existing international case studies on biodiversity offsets.
2. International performance standards: IFC, Equator Principles, BBOP standards
3. Metrics of Habitat Hectare, Net Positive Impact approaches

Projects:

Assessment breakdown: please note the general comment on assessment breakdown

Student participation and attitude + /Presentations/Reporting: 100 %

Course title: Biogeography
Course ID: SBGM29BIOGEO
University: University of Antananarivo, Madagascar
Institute/School: Domaine of sciences and Technologies, Mention: Zoologie and Biodiversity of Animals
Name and e-mail address of the instructors:
Pr. RASELIMANANA Achille, e-mail : araselimanana@vahatra.mg, Tel. : 03373 34170
Dr. RAHERILALAO Marie Jeanne
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
20		8	2				

Course summary
Why is Madagascar home to so many unique animals? Madagascar geography, geology, and climate have provided opportunities for species to evolve and to diversify differently through a long-time period of isolation. If Madagascar's terrestrial fauna origins have befuddled researchers for several decades, explications to species distribution patterns and high endemicity remain vague. This matter will be addressed in the following course by elucidating biogeographical processes: *vicariance* or *dispersal*?

Course objectives:
- understanding species spatial and geographic distribution causes and the processus
- acquiring knowledge on conservation priority for potential site (representativity notion and viability)

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

Upon completion, student will be able to:
- explore and interpret any species distribution pattern
- implement biogeographical analyses
- value the importance of biogeography in the field of biodiversity conservation management

Course materials, text books and further reading:

-Boumans, L., David R. Vieites, D.R., Glaw, F. & Vences, M. 2007. Geographical patterns of deep mitochondrial differentiation in widespread Malagasy reptiles. *Molecular Phylogenetics and Evolution*, 45: 822-839.
-Brown, J. H. & Lomolino, M.V. 1998. *Biogeography*. Second edition. Sinauer Associates, Inc. 361 Publishers, Sunderland.
-Brown, J.H. & Gibson, A.C. 1983. *Biogeography*. St Louis, MO: Mosby.
-Lomolino, M.V. & Heaney, L.R. (eds.). 2004. Frontiers of Biogeography. *New directions in the geography of nature.*Sinauer Associates, Inc. Publishers, Sunderland.
-MC.Coyne, J. A. & Orr, H. A. 2004. *Speciation.* Sinauer Associates, Inc. Publishers, Sunderland.
-Raselimanana, A. P. 1995. The Malagasy gerrhosaurid lizards: diversity, ecology, and biogeography. In *Environmental change in Madagascar*, eds. Patterson, B. D., Goodman, S.M. & Sedlock, J. (eds.), pp: 12. The Field Museum Press, Chicago.
-Raselimanana, A. P. & Vences, M. 2003. Introduced reptiles and amphibians. In *The natural history of Madagascar*, eds. S. M. Goodman & J.P. Benstead, pp. 949-951. The University of Chicago Press, Chicago.
-Raxworthy, C.J. &Nussbaum, R.A. 1996. Patterns of endemism for terrestrial vertebiutes in eastern Madagascar.*Biogéographie de Madagascar1, 3: 69-383.*
-Vences, M., Glaw, F. & Raselimanana, A. P. 2003. *Ptychadena*, Mascarene grass frog. In *The natural*

history of Madagascar, GoodmanS. M. & Benstead, J. P. (eds.), pp: 927-928. The University of Chicago Press, Chicago.
-Vences, M., Raselimanana, A. P. & Glaw, 2003.*Hoplobatrachus*, Indian tiger frog. In *The natural history of Madagascar*, Goodman, S. M. & Benstead, J. P. (eds.), pp. 926-927. The University of Chicago Press, Chicago.
-Wilme, L., Goodman,S. M. & Ganzhorn, J. U. 2006. Biogeographic Evolution of Madagascar's Microendemic Biota. *Science*, 312:1063-1065.
-Yoder, A. D., Hanley, C. Heckman, K., Rasoloarison, R., Russell, A. Ranivo, J., Olson, L. E., Soarimalala, V., Karanth, P., Raselimanana, A. P. & Goodman, S. M. 2005. A multidimensional approach for detecting species patterns in Malagasy vertebrates. *Proceedings of the National Academy of Sciences, USA,* 102: 6587-6594.

Prerequisites:
To attend the proposed course, the student must have knowledge on biology, ecology and / or systematic

Table of contents:
The exact course content may slightly change but will focus on one or more of the following topics.

Theory:
I-Concept, Model and biogeographical processes
1. Generality: Definition, historical, principles and biogeographical characteristics
2. Biogeographical analyses
3. Speciation and evolution (species concept, speciation types, factors and pace, Resilience)
4. Dispersion, ecological barrier
5. Extinction and substitution

II-Islands biogeography
1. Islands biogeography theory
2. Insularity syndrome and causes
3. dynamic equilibrium theory and Mac Arthur and Wilson models
4. Edge effect on species.

III-Biogeography and conservation strategy
1. Islands biogeography theory and conservation
2. Population viability
3. Zones isolation, barrier and corridor
4. spatial configuration of a conservation area: form and representativity
5. Threat and loss of insular ecosystems.

Practicals:
Debates and discussions

Projects:
Speciation mechanisms
Species conservation strategy

Assessment breakdown:
please note the general comment on assessment breakdown
Student participation and attitude + Projects/Presentations/Reporting: 100 %

Course title: Primatology, evolution of extant Malagasy prosimians – parasites and primate behaviour
Course ID: -
University: University of Antananarivo
Faculty: Sciences
Department: Zoology and Animal Biology
Name and e-mail address of the instructor(s):
Dr RAZAFINDRAIBE Hanta email: razafindraibehanta @gmail.com
Pr Lydia Laurence RABETAFIKA rabetafikalaurence@gmail.com
Course website:
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
20		10	36		72		

The costs for the Course are in part met by the University, but students will be asked to contribute for transport, accommodation, entrance fees to National Parks etc…Students will also be asked to contribute to shared food costs if necessary.

Course summary:
For the past decades, the most-needed research was the answer to the question “how many species of lemurs do exist?” To decipher this, scientists rush to lemur taxonomy and related systematic revision. Recently, new species have been described to join the 105 species. Madagascar hosts five endemic families of lemurs dispatched in 15 genera, with 94% included in the threatened category of IUCN red list. They have undergone a wide radiation and adapted to quite different ways of life. The structure of different lemur communities, with respect to their ecological correlates, can be correctly predicted by using evolutionary hypotheses.

Course objectives:
To make students: (i) aware of one of the Malagasy Biodiversity representative: The Lemurs; (ii) To be in touch with the field monitoring reality and biodiversity conservation; (iii) To see an actual case of how evolution drives to diversity variation
- Analyze complex links between the behavior of host and parasitism.
- Adopt a simple typology of the behavior of hosts based on the defense strategy of the host when it receives the parasite (before or after the establishment of the pathogen), on the parasite transmission mode and on its location in or on the host.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Animal Biological level: Community

Upon completion of the course a student must be able to be introduced to the main field methods on species monitoring; to assess biodiversity in the field as an outcome of evolution action
- To Understand the behavioral strategies used by the host to reduce the risk of infection (prophylactic strategies)
- To Understand the behavioral strategies of infected hosts to counter the infection or reduce the pathogenic effects (therapeutic strategies)
- To Understand the phenomenon of "parasitic manipulation" (change of behavior of the host for the sole benefit of the parasite).

Course material, Text books and further reading:
-E.E. Lewis, J.F. Campbell and M.V.K. Sukhdeo -2008- The behavioural ecology of parasites. CABI *Publishing.*
-F. Thomas, J.F. Guégan et F. Renaud -2007- Ecologie et évolution des systèmes parasités ; cours biologie. *Edition De Boeck Université*

-J. Moore -2002- Parasites and the behavior of animals. *Oxford Series in Ecology and evolution. Oxford Univ*ersity Press.
-R. Siiter -1998- Introduction to animal behavior. *Brooks/Cole Publishing Company.*
-P.N. Lehner -1996- Handbook of ethological methods. Second edition. *Cambridge University Press.*
-C.A. Toft, A. Aeschlimann and Liana Bolis -1993- Parasite-host associations – coexistence or conflict? *Oxford University Press.*
-C. Combes -2005- The art of being a parasite. *The University of Chicago Press*
-Lisa Gould & Michelle L. Sauther, 2006 Lemurs Ecology And Adaptation Springer Science & Business Media, LLC
-LEE P.C. Editor 2004 Comparative Primate Socioecology Cambridge University Press
-Mark Ridley 2004 Evolution Third Edition by Blackwell Science Ltd
The University of Chicago Press "The Natural History of Madagascar". 2003 Chicago, Illinois, USA
-R.A. Mittermeier, E.E. Louis Jr, M. Richardson, C. Schwitzer, O. Langrand, A.B. Rylands, F. Hawkins, S. Rajaobelina, J. Ratsimbazafy, R. Rasoloarison, C. Roos, P.M. Kappeler, J. Mackinnon. 2010 Lemurs of Madagascar. 3rd edition, Conservation International, Tropical Field Guide Series
S.M. Goodman. 2008 "Paysages naturels et biodiversité de Madagascar" Traduction de Lucienne Wilmé. Publications scientifiques du Museum, Paris, WWF
-CHARLES W. FOX, DEREK A. ROFF, AND DAPHNE J. FAIRBAIRN, Editors, 2001 Evolutionary Ecology Concepts and Case Studies by Oxford University Press

Prerequisites: please note the general comment on prerequisites

S1 Bases de la taxonomie (SU & MNHN); S1 Anatomie comparée: adaptation et évolution des structures anatomiques animales (SU & MNHN);

Table of contents:
- The exact course content may slightly change but will focus on one or more of the following topics.

Theory:
- Presentation of the diversity and evolution of Malagasy Prosimian
- Systematics & speciation in Lemurs
- Morphological & Behavioral adaptation of different Lemur groups
- Outline of host-parasite co-evolution of Lemurs parasites
- Définitions: Parasitism; parasite; parasite-host associations
- Behaviors before infection: parasitism avoidance strategies
- Behaviors that reduce parasite survival: removal or mitigation of pathogenic effects.
- The phenomenon "parasitic manipulation"

Practicals:
Many visits to the field *i.e.* tropical forest will be planned during this practical parts, encompassing dry decidious and humid evergreen forests;
- To introduce students on species monitoring (nocturnal & diurnal species) and on interaction of different species with the ecosystem where they are living;
- Non invasive techniques of sampling could be introduced to students and interaction with local communities interviews on conservation issues can also be planned depending on feasibility
- Parasites and behavior of lemurs (self-medication; geophagy; grooming...)
-Parasites (Blood and intestinal) of lemurs: identification of morphology on blood smear and on feces; Systematic.

Projects:
- Inventory of lemurs parasites (identification and Systematic).
- Evaluation of the health of lemurs: the impact of the infection on the behavior of lemurian hosts

Assessment breakdown:please note the general comment on assessment breakdown
Student participation and attitude + Projects/Presentations/Reporting: 100 %

Course title: Wood anatomy in the tropics
Course ID: WATROP
University: University of Antananarivo
Faculty: Science
Department: Plant Biology and Ecology
Name and e-mail address of the instructor(s):
Bakolimalala RAKOUTH, ba.rakouth@gmail.com
Harisoa Ravaomanalina, harisoa.ravaomanalina@gmail.com
Course website: -
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
15		10	25		25		

Course summary
Currently, the demand for wood is increasing at local, regional and global levels. However all over the world, wood trade requires high level of identification and traceability to ensure their sustainable management. Madagascar like any tropical island is very rich in wood resources that need to be correctly identified and classified. Learning technics to assess technological properties of woods will improve their uses and valorization. Upon completion of this course, the students will be able to apply their knowledge in other tropical context.

Course objectives: Students will learn the anatomical characteristics of tropical woods in order to know:
* plant identification and classification
* datation through dendrochronology
* technological properties
* sustainable uses and valorization

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Students will learn how to identify tropical woods from anatomical characteristics and solve taxonomical problems in order to improve plant classification. They will learn technological properties and qualities of woods that can be important for economic use and decision making for sustainable management of natural resources.

Upon completion of the course a student must be able to identify and classify some important tropical woods, to date where applicable, to assess technological properties used in sustainable management and valorization.

Course material, text books and further reading:
scientific papers, CDs, atlas (Atlas des bois de Madagascar).

Prerequisites: Bachelor in Biology. Please note the general comment on prerequisites

Table of contents:
Generality on trees in the tropics
Malagasy ecosystem rich in trees
Wood anatomical characteristics
Technological properties
Dendrochronology

Sustainable management and valorization.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment: 50 % Final exam at the end of the semester

Projects reporting: 50 % report on laboratory work and fieldworks

Course title: **Fundamental bases ethnobotany and indigenous and local knowledge**
Course ID: ETHNOFOND
University: University of Antananarivo
Faculty: Science
Department: Plant Biology and Ecology
Name and e-mail address of the instructor(s): Verohanitra RAFIDISON (verohani@yahoo.fr)
Course website: -
Semester: S2
Tuition language: French
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
15		15	10		20		

Course summary
It is an EU of apprehending for students an attitude of organizing ideas, critical and entrepreneurial spirit for an ethnobotany project focused on biodiversity conservation and sustainable development of human communities. It develops the basic knowledge on ethnobotany, ethnobiology and ethnoecology. It promotes the control of the different techniques to implement the collect, the process and the analyze of the ethnobotanical data.

Course objectives:
Understand the fundamentals of ethnobotany and its relations with other scientific disciplines. Learn the basics ethnological, anthropological ethnobotany. Know the ethnobotany relations with the disciplines of plant sciences. Learn data collection techniques and their ethnobotanical treatments

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Human Biological level: Ecosystem

Students will learn the fundamentals of ethnobotany, various methods to be used for research in ethnobotany. They will learn to choose the appropriate investigation techniques to local populations and the processing of data.

Upon completion of the course a student must be able to master the fundamentals of ethnobotany, will be able to determine the various methods to be used for research in ethnobotany and will choose the appropriate investigation techniques to local populations and the appropriate processing of data.

Course material, text books and further reading:
scientific papers, Master books.

Prerequisites: Bachelor in Biology. please note the general comment on prerequisites

Table of contents:
I-Definition of local knowledge and traditional knowledge
Traditional knowledge and ethnobotany ethnoecology
II -Techniques recording of local knowledge
A - Quick Evaluation ethnobotany
B - Interviews (investigative techniques, different types of interviews, guides importance, importance of knowledge of local dialects, respect for traditional uses)
C - Writing questionnaires or survey forms
III – Ethnotaxonomy or popular biological classification
Nomenclatures analysis, bases Popular classification
Comparison between popular and scientific classification

Scientific analysis of popular classification

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 25 %
Written assessment: 50 %
Projects/Presentations/Reporting: 25 %

Course title: Applied Palynology
Course ID: PALYAPPLI
University: University of Antananarivo
Faculty: Sciences
Department: Plant Biology and Ecology
Name and e-mail address of the instructor(s): RAMAVOVOLOLONA (ramavoperle@yahoo.fr)
Course website: -
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
2		20	8		10		

Course summary
Generalities on pollen, multiple application of palynology, with focus particularly on aeropalynology, dispersal study of airborne pollen and spores with their relation with climatic factors and vegetation. Pollen and allergies and identification of allergenic plants, pathogenic spores in agriculture; Notions on paleoecology, some examples from Madagascar will be studied for each application.

Course objectives: Learn the various application possibilities of palynology in health sciences, agriculture, phytopathology and paleoecology.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Plant Biological level: Organism

Understand the different application possibilities of palynology and use the consequences in development. Acquire methods and technics in palynology and practical application: Aeropalynology, Pollen and allergy, the plants with allergenic pollen, phytopathogenic spores; importance of paleoecological studies with examples from Madagascar.

Upon completion of the course a student must be able to do palynologic préparation, they will know allergenic plants and translate pollinic calendars and diagrams.

Course material, text books and further reading: polycopies and CD on pollens, aeropalynology, allergies to pollen, spores of fungi, paleoecology, bibliography.

Prerequisites: please note the general comment on prerequisites
Notion on general palynology

Table of contents:
Generality on pollen and spores and practical applications
Aeropalynology
Pollen and allergise
Phytopathogenic Spores
Paleoecology

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 25 % oral presentation
Written assessment: 50 % Final exam at the end of the semester
Projects/Presentations/Reporting: 25 % report on laboratory work and documentations)

Course title: Plant reproductive ecology and pollination in the Tropics
Course ID: -
University: University of Antananarivo
Faculty: Sciences
Department: Plant Biology and Ecology
Name and e-mail address of the instructor(s): Elisabeth Rabakonandrianina Ph.D rabakonandrianina@gmail.com
Website: -
Semester: S2
Tuition language: English
Number of credits (ECTS): 2

Course breakdown in hours:

Theory	Practical	Exercise	Excursion	Internship	Project	Seminar	Personal assignment
10					10		30

Course summary
Madagascar is one of the world hotspots when species endemism and degree of threat are considered. A high and unique relation between plants and animals is an important factor for this. The study of reproductive ecology including pollination and reproductive biology is of great importance to understand the high degree of endemism and explosive speciation of the tropical flora. Such study includes the identification of the population reproducing part, the reproductive system of the plant namely its breeding system. In addition the vital relation with the visitors and the behavior of the latter is investigated.

Course objectives:
To learn about the reproductive ecology of plant, combining, the reproductive biology, and to plant /animal interaction leading to pollination.
To know the various pollination adaptation in the tropics.

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Organism

The students know the vital relation between plants and animals especially the pollination syndromes as presented by the floral adaptation. The structure of the population is understood as well as the plant breeding system and various pollination syndromes in tropical ecosystems.

Course material, text books and further reading:
- The sex life of plants. Bastiaan Meeuse and Sean Morris; faber and faber London. Boston
- Eggli U.2002 Illustrated handbook of succulent plants: Dicotyledons. Spinger Verlag. Berling Heidelberg
- Proctor M, Yeo P., Lack a. The natural history of pollination. British wildlife publishing, Rotherwick, Hampshire.

Prerequisites: Notion on general reproductive ecology and biology of plant, and to plant /animal interaction

Table of contents:
Population study
Adaptation and pollination syndromes

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 30 %
Written assessment: 20 %
Projects: 50 %

Course descriptions at Université de La Réunion (UNIRé)

Course title: Tropical biodiversity and ecosystems field school: Tropical forest ecosystems of Reunion and the South West Indian Ocean islands
Course ID: H4BE206 [FIELDSCHOOL]
University: University of La Réunion
Faculty: Faculté des Sciences de l'Homme et de l'Environnement
Department: Ecologie Terrestre
Name and e-mail address of the instructor(s): THIERRY PAILLER (thierry.pailler@univ-reunion.fr)
Course website: https://ufr-she.univ-reunion.fr/departements/ecologie-terrestre/master-best-bee/m1-best-t
Semester: S2
Tuition language: English
Number of credits (ECTS): 15
IMPORTANT: The costs for the Course (travel, accommodation) are in part met by the University, but students will be asked a maximum of 200 EUR to contribute to shared food and transportation costs if necessary.

Course breakdown and hours:
- Lectures: 42 hrs
- Exercices: 9 hrs
- Excursions : 84 hrs

Course objectives: The field school aims to put the student in real situations of study or analysis as he will meet in a professional environment. The context will be that of field expertise in a natural environment. This course aims to teach the student the mastery of diagnostic tools. Understand biodiversity and the functioning of tropical forest ecosystems through regional case studies of the main biotas of Madagascar's biodiversity hotspot; acquire methodologies for measuring the diversity and dynamics of animal and plant communities in tropical environments; integrate this knowledge into operational programs implemented by natural environment managers. To acquire knowledge on the methods of studies of the chemical mediation intervening in the insect plants interactions. To gain knowledge of the different strategies developed by plants to reproduce with pollinators as well as the evolutionary consequences. Train experts in taxonomy (identification, nomenclature, classification) and evolution (speciation, reproductive biology, adaptation, convergence, biogeography, ...) of flowering plant species in South West Indian Ocean. Mastery of techniques related to expertise in tropical botany (Herbarium, sampling, referencing of specimens, ...).

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Organism to Global

Upon completion of the course a student must be able to understand the functioning of tropical forest ecosystems. Measure the biological diversity of complex systems. Evaluate the impact of natural and anthropogenic disturbances. To know the diversity of the major faunal groups of the hotspot of the South West of the Indian Ocean. Apply this knowledge to studies conducted by natural environment managers. Botanical diagnosis, dissection of plant organs, microscopy, sampling and inventory techniques of plants, collection and referencing of specimens.

Course material, text books and further reading:
Michael Simpson. 2019. **Plant Systematics**. Academic Press. 780pp. ISBN: 9780128126288
John Kricher. 2011.**Tropical Ecology**. Princeton University Press. 704 pp. ISBN 9780691115139.
Pat Willmer. 2011. **Pollination and Floral Ecology**. Princeton University Press ; 778pp. ISBN: 9780691128610

Prerequisites: please note the general comment on prerequisites
General knowledge in Biology, Ecology ad Evolution at the Bachelor level.

Table of contents:

Plant communities:
Biological diversity: typology of tropical forests, species richness, global distribution, explanatory factors, tropical forests of the SWIO zone,
Structure and functioning of plant communities: spatio-temporal variability (horizontal: disturbances, succession, vertical), regeneration (life cycle, process: dispersal, germination, etc.), plant / plant interactions (facilitation, competition).
Plant / environment interactions:
specific strategies (functional traits), eco-physiology and plant responses to the biotope (illumination, water, temperature, soil),
Animal Communities:
Ecology of arthropods: diversity and functioning of communities, sampling methods, social insects. F
tropical island aunes: native vertebrates of the Madagascar hotspot.
Anthropogenic threats (degradation, deforestation, invasions), consequences (fragmentation, habitat loss, extinctions) and re-mediation (REDD +).
Nature of the interactions (mutualism, symbiosis, antagonism, parasitism, predation), origin of the interactions, interactions animal plants interactions plants microorganisms, role of the interactions in the evolution, specialization of the interactions.
Chemical ecology of insect plant interactions: molecules involved in plant x insect relationships; CGSM: sample collection, principle and analysis of results; Physiology and ecology of the insect plant relationship; EAG: operating principle and analysis of results. Ecology and evolution of interactions: Pollination and dispersal in the islands; Mycorrhizal symbiosis; Evolution of mutualisms in an island environment; Case study: biotic interactions in Apis mellifera;
Species concept and classification.
Taxonomy, Nomenclature, Herbarium: Code of Botany, Description of new species, Management of collections (Databases, Herbarium techniques, DNA library, ...). Classification of large plant families: tools and methods of analysis: (morphology, cytology, plant anatomy), classification principles. Vascular flora of SWIO: Magnoliids: Laurales; Piperales / Monocots: Alismatales; Pandanales; Liliales; Asparagales / Commelinids: Arecales, Poales, Zingiberales: (Core eudicots: Rosids: Fabidae Oxalidales, Malpighiales, Fabales, Rosales / Rosids: Malvidae: Myrtales, sapindales, Malvales / Asterids: Ericales, Gentianales, solanales, Boraginales, Asterales, Escaloniales, Apiales.
FIELD: 1 week in MADAGASCAR and 1 week in REUNION (Marelongue Station): techniques of studies, inventories and sampling of the biodiversity of Madagascar and the surrounding islands: Ecology of plant communities; forest inventories; analysis of different strata and litter; Ecology of pollinator plant interactions, pollinator observation method, characterization of floral biology (morphology, color, odor, nectar), study of the reproductive system and pollen flow; Inventories of the entomofauna; sampling and conditioning technique; identification criteria, Botany

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 25 %
Written assessment: 50 %
Projects/Presentations/Reporting: 25 %

Course title: Geomatics
Course ID: H4BE207 [GEOMAT]
University: University of La Réunion
Faculty: Faculté des Sciences de l'Homme et de l'Environnement
Department: Ecologie Terrestre
Name and e-mail address of the instructor(s): OLIVIER FLORES (olivier.flores@univ-reunion.fr)
Course website: https://ufr-she.univ-reunion.fr/departements/ecologie-terrestre/master-best-bee/m1-best-t
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures: 4 hrs
- Exercices: 0 hrs
- Practical Classes : 21 hrs
- Projects: 20 hrs

Course objectives:
The main objective of the course is to learn the principles of geomatics and geographic information systems (GIS) and their use for spatial data analysis.

Learning outcomes :
Education level: Basic Ecosystem focus: Methods & Tools

Upon completion of the course a student must be able to :
– Understand the concepts of geomatics and GIS and how to use a GIS software (QGIS)
– Manipulate, vizualize and analyze spatial data
– Georeference remote sensing images
– Understand spatial data analysis of vector and raster data, including remote
– Master a number of common spatial data analyses
– Use GIS tools to produce synthetic spatial information in thematic maps

Course material, text books and further reading:

Prerequisites:

Table of contents:
- Lectures :
- Introduction to geomatics and geographical information systems (GIS)
- Introduction to remote sensing and satellite image analysis

- Practicals
- First steps in GIS using Quantum GIS (QGIS)
- Exploring and visualizing vector and raster data for thematic maps production
- Image georeferencing
- Creating layers based on GPS data and digitalization
- Spatial analyses based on vector and raster data
- Manipulate and analyze remote sensing images

Assessment breakdown:

Oral assessment: 0 %
Written assessment: 0 %
Projects/Presentations/Reporting: 100 %

Course title: Ecological data analysis
Course ID: H4BE208 [ECODATA]
University: University of La Réunion
Faculty: Faculté des Sciences de l'Homme et de l'Environnement
Department: Ecologie Terrestre
Name and e-mail address of the instructor(s): OLIVIER FLORES (olivier.flores@univ-reunion.fr)
Course website: https://ufr-she.univ-reunion.fr/departements/ecologie-terrestre/master-best-bee/m1-best-t
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 10 hrs
- Practical classes : 15 hrs

Course objectives:
The main objective of the course is to complete students training and understanding of common methods for statistical modeling and multivariate analysis applied to the study of ecological data.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Methods & Tools

Upon completion of the course a student must be able to:
– Know how to handle and describe ecological data
– Understand and perform efficient graphical and numerical data exploration
– Perform and validate basic statistical analyses
– Produce standardized statistical results depending on the methods
– Assess and criticize the results (conditions of applications, limits)

Course material, text books and further reading:
– Statistical textbooks

Prerequisites: please note the general comment on prerequisites

Table of contents:
– Correlation analysis
– Principles of statistical modeling applied to multiple linear regression
– Analysis of variance and associated analyses (ANCOVA, MANOVA)
– Generalized Linear Models
– Model evaluation and comparison
– Multivariate analyses : ordination and classification analyses

Assessment breakdown:
Written assessment: 50 %
Projects/Presentations/Reporting: 50 %

Course title: Tropical plant health ecology and management
Course ID: H4BE209 [PLANTHEALTH]
University: University of La Réunion
Faculty: Faculté des Sciences de l'Homme et de l'Environnement
Department: Ecologie Terrestre
Name and e-mail address of the instructor(s): Stéphane Poussier (stephane.poussier@univ-reunion.fr)
Course website: https://ufr-she.univ-reunion.fr/departements/ecologie-terrestre/master-best-bee/m1-best-t
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 16 hrs
- Oral assessment: 3 hrs
- Practical classes: 11 hrs

Course objectives:
The main objective of this course is to acquire knowledge on the ecology, diversity and systematics of the main plant pests (pathogenic microorganisms, insects). The second objective is to understand the different plant protection strategies applied to reduce the socio-economic and environmental impact of plant pests.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: Plant Biological level: (Micro)Organism

Upon completion of the course a student must be able to:
- design and implement plant protection strategies based on knowledge of diversity, systematics and ecology of major plant pest groups. Ability to
- apply methods of identification / detection of phytopathogenic agents in a laboratory.

Course material, text books and further reading:
Powerpoint presentations, scientific articles

Prerequisites: please note the general comment on prerequisites
Bachelor's degree with a major in Biology, Natural Sciences, Environmental Sciences, or equivalent from an accredited university, as well as proficiency in English and/or French equivalent to Common European Framework of Reference for Languages level B2.

Table of contents:
Presentation of the main socio-economic and environmental impact of plant pests. Ecology, systematic, diversity of the main groups of plant pests: arthropods, fungi, bacteria, phytoplasmas, viruses. Examples of diseases in anthropised environments (cultivated and urban). Diversity and systematics of arthropods of agronomic interest. Plant protection strategies: regulation, diagnostic techniques, prophylaxis, biological control, chemical control, plant defense stimulators ...
TP: Identification / detection of pathogens on plants / seeds. Oral presentation of tropical plant diseases by students.

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 50 %
Written assessment: 50 %

Course title: Molecular evolution
Course ID: H4BE210 [MOLEVOL]
University: University of La Réunion
Faculty: Faculté des Sciences de l'Homme et de l'Environnement
Department: Ecologie Terrestre
Name and e-mail address of the instructor(s): Pascale Besse (pascale.besse@univ-reunion.fr)
Course website: https://ufr-she.univ-reunion.fr/departements/ecologie-terrestre/master-best-bee/m1-best-t
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 18 hrs
- Exercises: 8 hrs
- Practical classes : 9 hrs

Course objectives:
The objective of the course is to provide students with knowledge on the mechanisms of evolution of the different sequences composing a genome. This understanding is necessary to be able to choose appropriate molecular DNA sequences to be used for population genetics studies, to construct molecular phylogenies or to develop barcoding tools. The concepts and limits of the different methods will be presented together with an initiation to molecular phylogeny.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialized Ecosystem focus: Plant / Animal Biological level: Organism

Upon completion of the course a student must be able to
apply his-her knowledge on the various sequences composing a genome and their mechanisms of evolution, in order to be able to choose with a critical mind and with discernment the appropriate sequences to be used for specific evolutionary questions and applications (microevolution, macroevolution, barcoding..) in different organisms. They must also be able to use specific software (DNA sequences analyses, phylogeny...) for this purpose.

Course material, text books and further reading:
- Besse, P. (Ed.). (2014). *Molecular plant taxonomy: methods and protocols*. Humana Press.
- Nei, M., & Kumar, S. (2000). *Molecular evolution and phylogenetics*. Oxford university press.
- Page, R. D., & Holmes, E. C. (2009). *Molecular evolution: a phylogenetic approach*. John Wiley & Sons.
- Tamura, K., Stecher, G., Peterson, D., Filipski, A., & Kumar, S. (2013). MEGA6: molecular evolutionary genetics analysis version 6.0. *Molecular biology and evolution*, *30*(12), 2725-2729.

Prerequisites: please note the general comment on prerequisites

Table of contents:
MOLECULAR EVOLUTION :
Nuclear genome: heterogeneity and the C-value paradox, different sequences (tandemly repeated *Satellite, minisatellites, microsatellites, ribosomal DNA, telomeres..* or dispersed_*transposable elements, Lines, Sines..*). Mode and rate of evolution of these sequences (neutral theory, molecular clock, concerted evolution, genic conversion, unequal crossing over...) Special focus on microsatellite sequences evolution. Role of these sequences (selfish DNA hypothesis...).
Mitochondrial and chloroplast genomes: sequences, rates and modes of evolution.
CHOOSING SEQUENCES:
For population genetics
For phylogeny (and introduction to phylogenetic methods)

For DNA barcoding (in plants and animals, concepts and limits)
Exercises = scientific papers analysis: results analysis, discussion and critical reading.
Practical classes = Phylogenetic analysis of ribosomal DNA sequences, FISH (Fluorescent in situ hybridisation) technique presentation and results analyses.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 50 %
Projects/Presentations/Reporting: 50 %

Course descriptions at University of Ruhuna (RUH)

Course title: Field School in Tropical Biodiversity and Ecosystems: Sri Lankan terrestrial and aquatic ecosystems
Course ID: RUH-FSTBE
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Senior Prof. LP Jayatissa (lpj@bot.ruh.ac.lk), Dr. KAS Kodikara (kodikara@bot.ruh.ac.lk),
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 15
IMPORTANT: The costs for the Course are in part met by the University, but each student will be asked to contribute a maximum of 100000 LKR for transport, accommodation in shared chalets, etc… Students will also be asked to contribute to shared food costs if necessary.

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises: 15 hrs
- Excursions : 120 hrs
- Projects: 30 hrs (report)

Course objectives:
1. To offer an opportunity to learn Ecology and Ecophysiology of different aquatic and terrestrial tropical ecosystems by giving special attention to the morphological, and physiological adaptations and common biological features
2. Give the understanding on biogeographic and evolutionary trends of these tropical ecosystems
3. Give the field observation on Ecosystem resilience against natural environmental variations and anthropogenic pressure

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions; Biological level: ecosystem

Upon completion of the course a student must be able explain the unique Ecology and biological features of different ecosystems and distinguish them by their morphological and eco-physiological features. Also, to build up and discuss different ecosystem resilience strategies and their level of success in response to environmental changes

Course material, text books and further reading:
1. G.A.D. Perera (2014) Ecology of Sri Lankan Dry Forests: Implications for the Conservation Management of Northernmost Dry Forests Proceedings of Jaffna University International Research Conference (JUICE-2012), pp. 263-269, published: March 2014, Sri Lanka
2. Sri Lankan ecosystems (http://www.terrestrial-biozones.net)
3. Gunathilake N. et al (2008). Biodiversity of Sri Lanka. J.Natn.Sci.Foundation Sri Lanka 2008 **36** Special Issue 25-62.
4. Articles published in biology related journals

Prerequisites: please note the general comment on prerequisites
Will be of advantage to students who have studied Plant Ecology, Advance plant Ecology or General biology

Table of contents:
- Introduction to different aquatic and terrestrial ecosystems in Sri Lanka (general Ecology, biological features)
- Field training session on different ecosystems
  Mangroves (Pambala)
  Salt marshes (Negombo)

Sand dunes (Magama)
Beach vegetations, lagoons (Matara – Hambantota)
- Vegetation dynamics
Natural dynamics (Kahandamodara)
Human induced (Kalametiya, Dondra, Garanduwa)
- Resilience strategies
Kalametiya, Dondra
- Group wise presentations

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: -
Written assessment: 50 %
Projects/Presentations/Reporting: 50 %

Course title: Geomatics
Course ID: RUH-GEO
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Prof. Kanthi Yapa, Mrs. SK Madarasinghe
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures: 20 hrs
- Exercises: 15 hrs
- Excursions : 12 hrs
- Projects: 03 hrs (report)

Course objectives:
To offer hand-on experience on basic GIS and remote sensing techniques coupling with novel unmanned aerial vehicles (drones) and their application to study vegetation dynamics and biological conservation

Learning outcomes :
Education level: basic Ecosystem focus: methods and tools

Upon completion of the course a student must be able to understand basic concepts of information acquisition, projection and handling with suitable techniques. Also, tools and skills in remote sensing and image processing, data treatment, analysis and interpretation.

Course material, text books and further reading:
1. Reddy MA (2008) Remote sensing and geographical information systems. Third Edition, India
2. Articles published in GIS related journals (case studies)

Prerequisites: please note the general comment on prerequisites
Will be of advantage to students who have studied (any) sciences

Table of contents:
- Introduction to Geographical Information Systems (GIS) [definitions, terminology, Coordinate system)
- Basic principles of Remote sensing (introduction, electromagnetic remote sensing process, Energy interactions, remote sensing platforms, sensors)
- Spatial data modelling (vector GIS models)
- Digital image processing (image resolutions, preprocessing, projections, transformations, image processing, classifications)
- Spatio-temporal change analysis (introduction, area estimation, GIS for coastal zone management)
- Introduction to Global Positioning System (GPS)
- Fundamentals of GPS
- Data collection
-Current issues and trends of GIS and RS
- Case studies

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: -
Written assessment: 70 %
Projects/Presentations/Reporting: 30 %

Course title: Biodiversity of wetlands in Sri Lanka, conservation and policies
Course ID: RUH-BCPW
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Senior Prof. LP Jayatissa (lpj@bot.ruh.ac.lk) and Prof. Saman Chandana (epschandana@gmail.com)
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 15 hrs
- Exercises: 03 hrs
- Excursions : 12 hrs
- Projects: N/A

Course objectives:
1. To understand the basic ecology and biodiversity of the wetlands
2. To give knowledge on different types of wetlands in Sri Lanka, their ecology, development and biodiversity
3. To develop an ability to determine the need of wetland conservation in response to unprecedented habitat degradation
4. To review the policy status relevant to wetland conservation in Sri Lanka

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions Biological level: ecosystem

Upon completion of the course a student must be able to:
- explain the basic ecological principles and the level of biodiversity of different wetlands, and also to review the policy enforcement in wetland conservation
- identify and differentiate the functioning of different ecosystems
- explain biological interactions in terms of different ecosystem contexts

Course material, text books and further reading:
1. Kotagama S.W. and Bambaradeniya C.N.B. (2006) An overview of the wetlands of Sri Lanka. Central Environmental Authority, Sri Lanka
2. Ramsar wetlands on Sri Lanka (2013) Central Environmental Authority. Sri Lanka
3. Wetland conservation in Sri Lanka (2003) IUCN portals, Sri Lanka

……
4. Fraser, L.H. and P.A. Keddy (Eds). The World's largest wetlands: Ecology and Conservation.
5. Cambridge University Press, UK Kar, Devashish. (2013). Wetlands and lakes of the world Springer. New Delhi, India

……..
Articles in following journals
- Biological Conservation Diversity and Distributions
- Journal of Wetland Ecology
- Wetland Ecology and Management

Prerequisites: please note the general comment on prerequisites
A knowledge in Ecology/Biodiversity and Conservation will be an advantage to students

Table of contents:

-Basic Concepts on Wetland Ecology
-Definition and classification of Wetlands
-Wetlands in Sri Lanka
-Biodiversity in Wetland Systems
-Wetland Functions and Values
-Major threats to wetlands in Sri Lanka
-Wetland conservation and major issues
-Policy status in wetland conservation in Sri Lanka
-Case studies: Kalametiya lagoon, Garanduwa mangrove ecosystem

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 30 %
Written assessment: 50 %
Projects/Presentations/Reporting: 20 %

Course title: Wood Science and Technology
Course ID: RUH-WT
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Dr. KAS Kodikara (kodikara@bot.ruh.ac.lk)
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures: 15 hrs
- Exercises: 09 hrs
- Excursions : -
- Projects: 03 hrs (report)

Course objectives:

1. To provide knowledge on structure of wood and associated proprieties
2. To provide basic knowledge on wood seasoning and preservation
3. To provide hand-on experience about wood sectioning, common wood defects and grading

Learning outcomes : please note the general comment on learning outcomes
Education level: specialise Ecosystem focus: Plant Biological level: organism

Upon completion of the course a student must be able to identify different wood structures (both anatomy based and macro-scale). Also, to explain different wood seasoning and preservation techniques and their common uses in wood technology.

Course material, text books and further reading:

-Brown HP., Panshin AJ., Forsaith CC. Textbook of Wood Science, Commercial timbers of United States.
-Bc. Vladislava Muselíková, Wood technology, Faculty of Education, Masaryk University, Brno
-Maclain T., Brown T. Wood Science and technology, Department of Wood Science and Engineering
Articles published in peer-reviewed journals related to wood science and technology

Prerequisites: please note the general comment on prerequisites
Will be of advantage to students who have studied plant sciences/biological Sciences

Table of contents:

- Structure of wood,
- Physical properties of wood,
- Mechanical properties of wood,
- Grading of woods/timber,
- Common and specific uses of woods,
- Wood seasoning and wood preservation
- Defects of woods,
- Wood based industries in Sri Lanka

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 30 %
Written assessment: 50 %
Projects/Presentations/Reporting: 20 %

Course title: Plant physiology, biochemistry and plant breeding techniques
Course ID: RUH-PBB
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Dr. N.P. Dissanayake; Dr. KAS Kodikara (kodikara@bot.ruh.ac.lk
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 15 hrs
- Exercises: 09 hrs
- Excursions : -
- Projects: 03 hrs (report)

Course objectives:
1. To provide knowledge on key physiological steering processes, biochemical interactions
2. To provide key practical skills in the fields of Plant Physiology and Biochemistry

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: Plant Biological level: community

Upon completion of the course a student must be able to explain the variations of internal water transportation under different environmental conditions, the behavior of stomatal physiology and its plasticity in response to changing environmental conditions (as a function of stomatal conductance). Also, should be able to analyze the natural variation of allelochemical profiles quantitative and qualitative changes in allelo-chemicals of some selected invasive plant species and to apply different growth hormones to improve germination, growth and the productivity in plants.

Course material, text books and further reading:
1. S.K. Singh (2009) Plant physiology, published by Campus Books International (2009)
2. V. Verma (2008), Text book of Plant Physiology, Ann Books in India (2008), Bidwell, Plant physiology , McMillan publishers, New York

Articles published in plant physiology related peer-reviewed journals

Prerequisites: please note the general comment on prerequisites
Will be of advantage to students who have studied plant sciences/biological sciences

Table of contents:
- Plant water relations
– Cell water relations,
- Soil water relations,
- Stomatal physiology,
- Mineral nutrition,
- Phloem translocation.
- Energy relations in cells and plants
- Respiration,
- Photosynthesis,
- Nitrogen metabolism, fatty acid metabolism.
- Plant growth and development – plant growth and growth measurements,
- Plant growth hormones and their applications,

- Photoperiodism and vernalization, plant movements, physiology of flowering, seed and bud dormancy
- Antioxidants and free radicals (stress physiology)
- Conventional breeding methods)
-

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: -
Written assessment: 70 %
Projects/Presentations/Reporting: 30 %

Course title: Ecotoxicology and Environmental science
Course ID: RUH-EEC
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Prof. Mangala De Silva
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures: 21 hrs
- Exercises: 09 hrs
- Excursions : 06 hrs
- Projects: 03 hrs (report)

Course objectives:

1. To provide knowledge on major sources of pollution and their impacts on living environment
2. To provide knowledge on methods in assessing environmental pollution, level of toxicity etc.
3. To improve analytical thinking on different remedies over environmental pollution

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions Biological level: ecosystem

Upon completion of the course a student must be able to explain major sources of pollution and their assessments. Also, to come up with different practically working remedies in mitigating level of pollution in different ecosystems.

Course material, text books and further reading:

- Spoolman BM. (2012). Environment Science, 8th Edition.
- Wright RT., Boorse DF. Environment Science towards a sustainable future, 13th Edition
- Levin SA., Harwell MA., Kelly JR., Kimball KD. (Eds.). Ecotoxicology: problems and approaches

In addition,
Articles published in peer-reviewed journals related to Environment science and Ecotoxicology

Prerequisites: please note the general comment on prerequisites
Will be of advantage to students who have studied plant sciences/biological sciences

Table of contents:

- Introduction to Ecotoxicology and environmental science (terminology and basic concepts)
- Environmental pollution and contamination (sources/Impacts/control)
- Toxicity and toxicity testing
- Fate of toxicants (under different environmental conditions)
- Bio-indicators and bio-monitoring,
- Bio-toxins (including major phyto-toxins)
- Environmental impact assessment (EIA) (with some case studies)
- Global environmental issues with special reference to Sri Lanka,
- Introduction to waste treatment methods,
- Bioremediation
- Environmental issues (local/global)
- Case studies (wetland pollutions): Kalametitya, Negombo

Assessment breakdown: Oral assessment: 30% Written assessment: 50 % Projects/Presentations/Reporting: 20 %	please note the general comment on assessment breakdown

Course title: Coastal zone management
Course ID: RUH-ECZM
University: University of Ruhuna, Matara, Sri Lanka
Faculty: Science
Department: Botany
Name and e-mail address of the instructor(s): Senior Prof. LP Jayatissa (lpj@bot.ruh.ac.lk)
Course website: www.tropimundo.eu
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:

- Lectures: 12 hrs
- Exercises: 03 hrs
- Excursions : 12 hrs
- Projects: 03 hrs

Course objectives:

1. To learn about integrated approach in coastal zone management aiming the sustainability of coastal ecosystems
2. To develop an ability to understand all the aspects related to best practices in conservation and management of coastal ecosystems.
3. To give a skill to plan an integrated management program for a coastal ecosystem/area under threat.

Learning outcomes : please note the general comment on learning outcomes
Education level: specialised Ecosystem focus: interactions Biological level: ecosystem

Upon completion of the course a student must be able to
- explain the sustainable development of coastal ecosystems and follow the integrated approach in management of the coastal ecosystems which are at risk
- understand the different components of the coastal ecosystem, their functions and interactions/inter-dependence
- understand and explain the biology of coastal ecosystem and its uses and the way of maximizing the uses through integrated coastal management activities

Course material, text books and further reading:

1. Cicin-Sain, C. and Knech, R.W., Integrated coastal and Ocean management; concepts and practices, Island Press, Washington D.C.
2. White A.T., Deheregoda C.K.M., Coastal zone and fisheries management in Sri Lanka: prospects for integration. University of Jayawardenapura, Colombo, Sri Lanka
3. Coastal zone management plan, Coastal conservation and coastal resource management department, Sri Lanka
4. Yuan Li., Zhenming G., Fan X., Zhang L. (2014). Ecosystem based coastal zone management: a comprehensive assessment of coastal ecosystems in the Yangtze Estuary coastal zone. Ocean
Coast Manag 95:63–71
5. Ecosystem-based and integrated coastal zone management - challenges and possibilities, Stockholm resilience centre, Sweden
6. Ecosystem based integrated coastal zone management for Tuticorin coast, Asian coast examples, India
Articles in following journals
- Journal of Wetland Ecology
- Wetland Ecology and Management

Prerequisites: please note the general comment on prerequisites
Knowledge in Ecology, and Environmental Science will be of advantage to students

Table of contents:

- Marine and Maritime Geomorphology and coastal ecosystems
- Fundamentals of Coastal Management
- Human Social Interactions & interventions on Coastal resources and relevant fundamentals
- Marine Spacial Planning and Conflict resolution
- Management of Coastal erosion
- Management of Coastal disasters (Mitigation, and adaptation, including the use of natural barriers against ocean surges)
- Tourism and Coastal management
-Integrated approach in coastal management
    (a) Introduction and need of integrated approach
    (b) Fundamentals of integrated management
    (c) Guidelines for the development of integrated coastal management programs
    (d) DPSIR framework, Stakeholder analysis, addressing issues related to enabling conditions etc
    (e) Case studies (positive and negative, covering all the relevant sectors)

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 30 %
Written assessment: 50 %
Projects/Presentations/Reporting: 20 %

Course descriptions at Universiti Malaysia Terengganu (UMT)

Course title: Tropical biodiversity and ecosystems field school: Malaysian mangrove ecosystems
Course ID: UMTROP 401
University: Universiti Malaysia Terengganu
Institute/School: Institute of Oceanography and Environment (INOS)
Name and e-mail address of the instructor(s):
Assoc. Prof. Dr. Behara Satyanarayana (satyam@umt.edu.my) (Course coordinator)
Dr. Nursalwa Baharuddin (nursalwa@umt.edu.my)
Dr. Fatin Izzati Minhat (fatinminhat@umt.edu.my)
Dr. Siti Tafzilmeriam Binti Sheikh Abdul Kadir (sititafzil@umt.edu.my)
Semester: S2
Tuition language: English
Number of credits (ECTS): 15
IMPORTANT: The costs for the Course are in part met by the University, but students will be asked to contribute a maximum of 2000 MYR for road transport, boat rental and other logistic arrangements**.** Also, students will be asked to share the costs of their food and accommodation.

Course breakdown and hours:

- Planning and arrangements : 72 hrs
- Lecture and scientific discussions : 24 hrs
- Field excursions and exercises : 312 hrs -
  1. Hands-on module with different scientific equipment for Physico-chemical water quality, land elevation and vegetation inventory measurements
  2. Visit to mangrove charcoal production and export companies
  3. Ecotourism assessment
  4. Community based mangrove awareness program/interaction
  5. Visit to different aged mangrove stands and check for thinning and clear-felling operations
  6. Mangrove herbarium
  7. Mangrove associate fauna collection and identification (e.g. molluscs, benthic foraminifera)
  8. Cage/pond aquaculture systems, fish hatchery and commercially important fisheries
  9. Spotting of marine endangered species (e.g. dolphins)
  10. Stratigraphic analysis of the mangrove sediment
  11. Promotion of TROPIMUNDO, etc.
- Vegetation data collection from different aged stands in managed and unmanaged mangrove ecosystems: 48 hrs
- Result analyses, comprehensive report preparation and submission on time: 174 hrs

Course objectives:

- to expose the students to mangrove environment
- to recognise and identify mangrove biodiversity and its association patterns
- to test /apply mangrove theoretical knowledge/concepts in the field
- to validate mangrove loss and gain scenarios practically
- to appreciate 'sustainability' in mangrove forest resources use and management

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student would be able to -

- become conversant with both qualitative and quantitative sampling techniques for mangrove surveillance
- assess any mangrove ecosystem for appropriate conservation and management directives
- provide scientific direction to the local mangrove managers and policy makers
- frame his/her own research ideas for pursuing a higher academic qualification (e.g. Ph.D.)

Course material, text books and further reading:

Samuel C.S., Jane G.S. (eds.), 1984. The mangrove ecosystem: research methods. UNESCO.
Tomlinson P.B., 1986. The botany of mangroves. Cambridge University Press.
Saenger P., 2002. Mangrove ecology, silviculture and conservation. Kluwer Academic Publishers.
Singh V.P. , Odaki K., 2004. Mangrove ecosystem : structure and function. Scientific Publishers.
Kathiresan K., Qasim S.Z., 2005. Biodiversity of mangrove ecosystems. Hindustan publishing corporation.
Mazda Y., Wolanski E., Ridd P.V., 2007. The role of physical processes in mangrove environments. Manual for preservation and utilization of mangrove forests. Terrapub.
Clough B., 2013. Continuing the journey amongst mangroves. ISME, Mangrove Educational Book Series No. 1.
Ong J.E., Gong W.K., 2013. Structure, Function and Management of Mangrove Ecosystems. ISME, Mangrove Educational Book Series No. 2.
Baba S., Chan H.T., Aksornkoae S., 2013. Useful products from mangrove and other coastal plants. ISME, Mangrove Educational Book Series No. 3.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

The exact course content may slightly change but will focus on one or more of the following topics.

Theory:
1. Environmental settings (water, sediment) in the mangrove wetland
2. Mangrove taxonomy and characteristics
3. Mangrove conservation and management (with sustainable use and exploitation)
4. Invited talk (e.g. Matang mangroves after a century of conservation and management)

Practical:
1. Ecotourism in mangroves
2. Observation of the physico-chemical conditions of water and sediment
3. Visit to replanted, thinning and clear-felling mangrove sites
4. Mangrove charcoal production and export
5. Mangrove dependent population and their livelihood
6. Role of local communities in mangrove conservation and management (including local knowledge on ethnobotany and ethnomedicine)
7. Vegetation inventory
8. Phenology in different mangrove species
9. Mangrove species distribution vs. inundation frequency (along the river/creek)
10. Mangrove zonation
11. Exposure to Canopy cover and EarthTrack mangrove Mobile Apps.

Projects:
1. Community based mangrove awareness, interaction and management
2. Ecotourism as part of the sustainable mangrove management
3. Mangrove stakeholder analyses (perceptions, livelihood, etc.)
4. Comparison of vegetation structure and biomass between the sites with different ages
5. Comparison of mangrove fauna and its biomass between the sites with different aged forest stands
6. Remote sensing data application for mangrove monitoring, conservation and management

Assessment breakdown: please note the general comment on assessment breakdown
Student participation and attitude + Projects/Herbarium/Presentations/Comprehensive report: 100 %

1. Student participation and attitude 10%

2. Mangrove herbarium 10%
3. Open evaluation of the Filed School report / scientific insights / Q&A 10%
4. Submission of comprehensive reports / Lab work
    i) Mangrove report (20 pages) 50%
    ii) Mollusc report (5 pages) 10%
    iii) Foraminifera lab 5%
    iv) Fishing gear experiment 5%

Course Title: Geomatics (Remote Sensing and GIS)
Course Id: UMTROP402
University: Universiti Malaysia Terengganu
Institute/School: Institute of Oceanography and Environment (INOS)
Name and e-Mail Address Of The Instructor(S):
Assoc. Prof. Dr. Aidy @ Mohamed Shawal Bin M. Muslim (aidy@umt.edu.my) (Course coordinator)
Dr. Mohammad Shawkat Hossain (shawkat@umt.edu.my)
Mr. Mohd Nasir Bin Mohamad (m.nasir@umt.edu.my)
Semester: S2
Tuition Language: English
Number of Credits (Ects): 3

Course Breakdown and Hours:
- Lectures: 21 hours
- Exercises: 33 hours
- Excursions : 24 hrs
- Projects: 6 hrs

Course objectives:
1. To introduce the concepts of earth observation and remote sensing data acquisition techniques
2. To introduce the concepts of digital spatial data manipulation, processing and visualisation
3. To apply satellite data manipulation and visualisation methods to terrestrial, coastal and marine areas

Learning outcomes: please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Upon completion of the course students will be able to:
1. recognize and explain GIS framework, cincluding map project and data models at a basic level;
2. recognize and describe principles of remote sensing, including the characteristics of electromagnetic spectrum (EM); the radiation, relfection, and scattering of EM; how EM radiation interacts with media/substances, geometries; properties of aerial photographs and imagery;
3. recognize and explain remote sensing data acquisition techniques, storage and basic processing;
4. apply statistical relationships describing computational principles related to remote sensing;
5. identify key applications of marine, acquatic and terrestrial remote sensing approaches and datasets;
6. demonstrate practical skill and conceptual understanding in using GIS and remote sensing image analysis software through lab excercises and reports;
7. describe remote sensing application and summarize methods and results in a written assignment.

Course material, text books and further reading:
Cracknell A.P. (1983) Remote sensing applications in marine science and technology. D. Reidel Pub. Co.
Lillesand T.M., Ralph W.K., 1999. Remote sensing and image interpretation. John Wiley & Sons.
Sabins F.F., 1997. Remote sensing: principles and interpretation. W.H. Freeman & Co.
Sample V.A., 1994. Remote sensing and GIS in ecosystem management. Island Press.
Lunetta R.S., Lyon J.G., 2004. Remote sensing and GIS accuracy assessment / edited by Boca Raton, Fla.: CRC Press.
Richardson L.L., Ellsworth F.L., 2006. Remote sensing of aquatic coastal ecosystem processes: science and management applications. Dordrecht: Springer.
Lillesand T.M., 2008. Remote sensing and image interpretation. Hoboken: John Wiley.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Lecture topics:
Part I
- Introduction to Geographical Information System (GIS)
- Background and Definition of GIS
- Components and Application of GIS
- Geographic Data Concepts
- Introduction
- Spatial Data Model
- Geo-Relational Vector Data Model
- ESRI Vector Data Model
- Topological Data Model
- Tin Data Model, Region, Routes
- Raster Data Model
- GIS Data Source
- Introduction
- Data Transfer, Geographic Data Format
- Data Conversion and Photogrammetric
- GPS and DGPS

Part II
- Introduction to Remote Sensing
- Introduction
- Elements of Remote Sensing
- Principles of Remote Sensing
- Physical Basis of Remote Sensing
- Digital Image Processing
- Introduction
- Digital Data and Image Resolution
- Remote Sensing Data Analysis
- Digital Image Processing
- Radiometric Corrections
- Image Classification
- Remote sensing and its integration in GIS for coastal zone management
- Introduction
- Basic Map Concepts and Database Design
- Data Capture and Implementation
- Database Management
- Performing satellite image analysis for watershed management, mapping flood affected areas, monitoring environment and other coastal and marine-based applications
- Presentation of documents consisting of text, maps, graphs and tables to present the method used in data processing and findings useful for coastal zone management.

Practical:
Lab Exercises:
Part I
- Introduction to ArcGIS
- Digitizing and Georeferencing
- Forest planning for sensitive wildlife species
- Timber harvest planning using GIS

Part II
- Introduction to IDRISI
- Image enhancement
- Image rectification

- Image classification
- Ground truthing and accuracy assessment
- Change detection

Assessment breakdown: please note the general comment on assessment

Module-based assessment in the Lab (10 x 5; for 5 modules) = 50 marks
Written exam based on theory = 25 marks
Oral presentation of project group work = 25 marks

Course title: Tropical oceanography
Course ID: UMTROP403
University: Universiti Malaysia Terengganu
Institute/School: Institute of Oceanography and Environment (INOS)
Name and e-mail address of the instructor(s):
Assoc. Prof. Dr. Mohd Fadzil Mohd Akhir (mfadzil@umt.edu.my) (Course coordinator)
Assoc. Prof Dr. Ong Meng Chuan (ong@umt.edu.my)
Dr. Nur Hidayah Binti Roseli (nurhidayahroseli@umt.edu.my_
Dr. Nurulnadia Mohd Yusoff (nurulnadia@umt.edu.my)
Dr. Fatin Izzati Minhat (fatinminhat@umt.edu.my)
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 24 hrs
- Exercises: 4 hrs
- Excursions : 24 hrs
- Projects: 18 hrs

Course objectives:
1. Describe the basic concepts related to the physical, chemical and geological processes of the ocean especially near the tropical region.
2. Provide understanding on the dynamics of oceanic processes and its influence towards productivity and nutrients.
3. Provide understanding on the paleooceanography and changes in sea-level in different time scale
4. Provide guidance in equipment handling techniques, analysis and presentation of physical oceanographic data.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

Upon completion of the course a student must be able to:
1. Explain and make conclusions about the physical processes that influence the distribution of sea water characteristics and circulation.
2. Explain the basic concepts of the relationship between ocean processes and productivity/nutrients.
3. Explain the theories of sediment distribution and sea level changes
4. Communicate effectively and master writing skills and presentation.
5. Master skills of information technology for oceanography information processing.
6. Master skills in conducting physical oceanography equipment and data analysis software.

Course material, text books and further reading:
1. Tom Garrison. (2001). Essentials of Oceanography (2nd edition). USA.
2. S. Pond and G.L. Pickard, 1983. Introductory Dynamical Oceanography. Elsevier
3. Robert H. Stewart, 2007. Introduction To Physical Oceanography. Dept. of Oceanography, Texas A & M University.
4. Riley, J.P. and R. Chester, 1971. Introduction to Marine Chemistry. Academic Press. London.
5. R. Chester and T.D. Jickells, 2013. Marine Geochemistry. Wiley-Blackwell
6. Jim Murray, 2001. Chemical Oceanography Lecture Note. Univ. Washington.
7. John. H. Sampson and J. Sharples, 2012. Introduction to the Physical and Biological Oceanography of Shelf Seas. Cambridge University Press
8. Bischof, J. (2000). Ice drift, ocean circulation and climate change. Springer Science & Business Media.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:

Introduction to the Tropical Ocean
- Importance of Tropical Ocean Reserach
- Instrumentation for Physical Oceanography

Physical Forcing
- Air-sea interaction
- Heat budget

Ocean Circulation
- Ekman Dynamics
- Gyre Circulation
- Global Ocean conveyor belt
- Regional Current system

Upwelling Dynamics
- Large scale upwelling system
- Regional scale upwelling

South China Sea and other case studies
- Current Circulation and monsoon influence
- Influence of climate on tropical seas dynamics

Seawater chemistry in tropical sea
- Seawater composition
- Salinity variations
- Nutrient cycle
- Carbon cycle

Primary Productivity
- Productivity processes
- Distribution of primary productivity

Pollution
- Marine pollution
- Emerging pollutants
- Heavy metals pollution
- Current issues – global and Malaysia

Paleocenography
- The history Quaternary sea level
- Geological records for future predictions
- Sea level changes

Assessment breakdown: please note the general comment on assessment breakdown
Oral assessment: 10 %
Written assessment: 50 %
Projects/Presentations/Reporting: 40 %

Course title: Estuarine and Mangrove Ecology
Course ID: UMTROP404
University: Universiti Malaysia Terengganu
Institute/School: Institute of Oceanography and Environment (INOS)
Name and e-mail address of the instructor(s):
Assoc. Prof. Dr. Behara Satyanarayana (satyam@umt.edu.my) (Course coordinator)
Dr. Wan Nurzalia Wan Saelan (wannurzalia@umt.edu.my)
Dr. Izwandy Bin Idris (izwandy.idris@umt.edu.my)
Semester: S2
Tuition language: English
Number of credits (ECTS): 3
Important: This course may in part be taught during the UMT Field School

Course breakdown and hours:
- Lectures (in class): 18 hrs
- Exercises (practicals in the campus) : 27 hrs
- Projects (seminar, lab report preparation and submission) : 25 hrs.

Course breakdown and hours:
- Lectures (in class): 28 hrs
- Exercises (practicals in the campus) : 12 hrs
- Projects (seminar, lab report preparation and submission) : 30 hrs.

Course objectives:
1. To explain the ecological significance of estuaries and mangroves
2. To teach mangrove biodiversity and distribution
3. To provide knowledge on mangrove facilitating areas, seed establishment and growth
4. To enlighten the natural and the anthropogenic threats to the mangrove ecosystems
5. To teach mangrove conservation and management
6. To share local policy enforcement and limitations for mangrove conservation in Malaysia

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

Upon completion of the course a student must be able to:
1. Educate others on the ecological importance of the mangrove ecosystems and adjacent estuaries
2. Deal with mangrove taxonomy
3. Assess mangrove diversity and distribution
4. Extend support for mangrove conservation and management efforts

Course material, text books and further reading:
Tomlinson P.B., 1986. The Botany of Mangrove. Cambridge University Press.
Hogarth P.J., 1999. The biology of mangroves. Oxford University Press.
Kathiresan K., Qasim S.Z., 2005. Biodiversity of mangrove ecosystems. Hindustan publishing corporation.
Singh V.P., Odaki K., 2004. Mangrove ecosystem : structure and function. Scientific Publishers.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
1. Introduction to UMTROP 404 (course rules, examination scheme and other regulations)
2. Introduction to different estuaries and wetlands

3. Introduction to mangrove and mangrove ecosystem
4. Factors influencing the mangrove establishment and growth
5. Mangrove landforms
6. Mangrove forest categories
7. Zonation in mangrove forests
8. Mangrove distribution in Malaysia
9. Mangrove conservation and management
10. Mangrove ecosystem functions, services and its Inter-connectivity
11. Current issues on the mangrove ecosystem in Malaysia and other regions
12. Mangrove carbon sequestration and response to climate change
13. Legislation, Policy implementation and limitations for mangrove conservation and management in Malaysia
14. Research and updates

Assessment breakdown: please note the general comment on assessment breakdown

1. Lab report 10%
2. Mangrove activity with local community 30%
3. Group seminar 20%
4. Final exam 40%

TOTAL: 100%

Course title: Conservation of Marine Endangered Species
Course ID: UMTROP405
University: Universiti Malaysia Terengganu
Institute/School: Institute of Oceanography and Environment (INOS)
Name and e-mail address of the instructor(s):
Assoc. Prof. Dr. Saifullah A. Jaaman (saifullahaj@umt.edu.my) (Course coordinator)
Assoc. Prof. Dr. Zainudin Bachok (zainudinb@umt.edu.my)
Dr. Mohd Uzair Bin Rusli (uzair@umt.edu.my)
Semester: S2
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 24 hrs
- Exercises: 4 hrs
- Excursions : 36 hrs
- Projects: 6 hrs

Course objectives:
i. To provide an introduction to the biology of sea turtles, conservation and research techniques, as well as to provide practical experience by participating in the ongoing sea turtle conservation and research at Redang Island.
ii. To provide an introduction to the biology and ecology of cetacean and sirenian, and to discuss current issues on the interactions between animals and man and prospects in ecotourism.
iii. To introduce coral reef biology and its importance to marine ecosystem.

Learning outcomes : please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

Upon completion of the course a student must be able to explain, discuss and debate intelligently issues pertaining to the conservation of marine endangered species, and the challenge faced by the international conservation efforts.

Course material, text books and further reading:
Charles R. C. Sheppard, Simon K. Davy, Graham M. Pilling. 2009. The biology of coral reefs. Oxford University Press, 339 p.
Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly. 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.
Gales, N. et al. 2003. Marine mammals: fisheries, tourism, and management issues. Collingwood, Vic. : CSIRO.
Isabelle M. Côté, John D. Reynolds. 2006. Coral Reefs Conservation (Conservation Biology 13). Cambridge University Press, Cambridge 568 p.
Jaaman, S. A. 2010. *MARINE MAMMALS IN EAST MALAYSIA: Distribution and Interactions with Fisheries*. VDM Verlag Dr. Muller Aktiengesellschaft & Co. KG., Saarbrucken, Germany. ISBN: 978-3-639-22208-1. 284 pages.
Jefferson, T. A., Webber, M. A. and Pitman R. L. 2008. *Marine Mammals of the World: A Comprehensive Guide to Their Identification*. San Diego: Academic Press.
Lutz, P. L. and J. A. Musick 1997. Biology of Sea turtles. CRC Press.
Lutz, P. L., J. A. Musick and J. Wyneken. 2003. Biology of Sea turtles Vol. II. CRC Press.
Roberts, Julian. 2007. Marine Environment Protection and Biodiversity Conservation, Springer: London .
Rodgers, Christopher. 2013. The Law of Nature Conservation, Oxford: London.
Stephen A. Bortone. 2014. Interrelationships Between Corals and Fisheries. CRC Press, 321 p.
Wyneken, J., K.S. Lohmann and J.A Musick. 2013. Biology of sea turtles Vol. lll. CRC Press.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Lectures:

No. Topic

1. The concept of marine biodiversity and importance of conserving marine endangered species (turtles, marine mammals & corals), 1 hr
2. Biology of sea turtles (phylogeny, population genetics, reproduction, physiology, locomotion, migration and habitat utilization), 3 hrs
3. Research and management of sea turtle for conservation, 2 hrs
4. Threats to sea turtles (natural threats, human impacts), 2 hrs
5. Biology and ecology of cetaceans, 2 hrs
6. Biology and ecology of sirenians, 2 hrs
7. Interactions between marine mammals and man, 2 hrs
8. Status and conservation of marine mammals in Malaysia, 1 hr
9. Introduction to coral reef (distribution, biology of coral formation), 3 hrs
10. Inter-connectivity of corals and other marine organisms, 2 hrs
11. Perspective on coral reef, 2 hrs
12 Coral reef resilience and analysis, 2 hrs

Practical/Field work (will be conducted at Matang waters, Chagar Hutang Turtle Sanctuary and around Bidong and Redang Islands)**:**

Topic

Research and management of sea turtles for conservation, 12 hrs:
i. Tagging
ii. Monitoring of sea turtle nesting and data recording
iii. Eggs and hatchlings

Dedicated boat sighting survey of cetaceans, 12hrs:
i. Systematic line transect method.
Ii. Marine Mammals Daily Boat Survey Effort Record
Iii. Marine Mammals Sighting Form

Coral reef underwater video survey and the use of corals health index in coral reefs conservation, 12 hrs

Assessment breakdown: please note the general comment on assessment breakdown

1. Mid-term exam (15%)
2. Final exam (35%)
3. Report/assignments
   - Turtle (practical and field trip report) (15%)
   - Coral (practical and field trip report) (20%)
   - Marine mammal (assignment and field trip report) (15%)

Course title: Lake and terrestrial Ecology
Course ID: UMTROP 406
University: Universiti Malaysia Terengganu
Institute/School: Kenyir Research Institute
Name and e-mail address of the instructor(s):

Prof. Dr. Mhd Ikhwanuddin bin Abdullah (ikhwanuddin@umt.edu.my) (Course coordinator)
Prof. Emeritus Dr. Faizah Sharoum (faizah@umt.edu.my) (Advisor)
Dr. Nor Azman Kasan (norazman@umt.edu.my)
Dr. Chong Ju Lian (julian@umt.edu.my)
Dr. Nik Mohd Shibli Bin Nik Jaafar (nik.shibli@umt.edu.my)
Dr Bryan Raveen Nelson, a/L Nelson Bernett (bryan.nelson@umt.edu.my)
Assoc Prof. Dr Gopalasamy Reuben Clements (reubenc@sunway.edu.my)

Semester: 2
Tuition language: English
Number of credits (ECTS): 3
Important: This course may in part be taught during the fieldwork

Course breakdown and hours:

- Lectures (Classroom, 10 weeks): 20 hrs.
- Exercises (Practical): 30 hrs.
- Projects (Assignments): 16 hrs.
- Presentation (Oral): 4 hrs.

Total: 70 hrs.

Course objectives:

1. To explain the significance of lakes and terrestrial ecology
2. To teach lacustrine biodiversity and distribution
3. To provide knowledge on terrestrial and aquatic biodiversity in lake ecosystem
4. To enlighten the natural and the anthropogenic threats to the lake and terrestrial ecosystems
5. To teach terrestrial and lake conservation and management

Learning outcomes: please note the general comment on learning outcomes
Education level: Specialised Ecosystem focus: Environment Biological level: Global

Upon completion of the course a student must be able to:

1. To impart knowledge on lacustrine and terrestrial ecosystem
2. Biodiversity of terrestrial and aquatic ecosystem
3. Lake carrying capacity and ecology support system
4. Lake and terrestrial conservation and management

Course material, text books and further reading:

1. James S. A., Firooza P. and Susan A. 2012. Wetland Environments: A Global Perspective. Wiler-Blackwell. United Kingdom.
2. Nor Azman Kasan. 2012. Wetland's Nutrient Retention Capacity. 1st Edition, LAP LAMBERT Academic Publishing, Saarbrucken, Germany
3. Kenneth N.B., Peter F.F. and Joseph A.M. 2012. Hydrology and the Management of Watersheds, 4th Edition. Wiley-Blackwell. United Kingdom.

4. Ian M., Atle H., Paul K. and Paul, J.W. 2013. Ecohydraulics: An Integrated Approach. Wiley-Blackwell. United Kingdom.

Prerequisites: please note the general comment on prerequisites

NoneC:\Documents and Settings\Farid\My Documents\DATAVIP\BIOGRAFY\PROJECTS\INTERNATIONAL\EC\ERASMUS_MUNDUS\TROPIMUNDO_Course_List.docx - UNIFI_BIO03

Table of contents:

Lectures schedule:

No.	Lecture
1.	Introduction to course on lake and terrestrial Ecology (examination scheme and other regulations)
2.	Introduction to the history and definition of lake and terrestrial ecosystem
3.	Factors influencing lake and terrestrial ecosystem
4.	Lake research and updates
5.	Integrated catchment management: carrying capacity and issues
6.	Natural and man-made Lakes
7.	Lake stratification
8.	Terrestrial biodiversity surrounding lakes
9.	Forest conservation and management
10.	Threats to the lake and terrestrial ecosystem
11.	Lake associated fauna
12.	Large animals biodiversity, conservation and management

Assessment breakdown:

Oral assessment: 20 %

Written assessment: 40 %

Final Examination: 40 %

Course descriptions at the Université de la Nouvelle Calédonie (UNC)

Course title: Tropical biodiversity and ecosystems field school: biodiversity and habitats of the South-Pacific archipelago of New-Caledonia
Course ID: TROPIMUNDO
University: University of New-Caledonia
Faculty: Sciences and Technologies
Department: Biology and Ecology
Name and e-mail address of the instructor(s):
Course website: www.unc.nc (MOOLE/ MASTER SDSS).
Semester: 2
Tuition language: English
Number of credits (ECTS): 15

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS
30			80		20		

Course objectives:
In this field school the undergraduate students will discover an overview of the main aquatic and terrestrial ecosystems of New-Caledonia. This archipelago of the southern Pacific Ocean is exceptional either for its threaten biodiversity (2nd hotspots in species number), its variety of ecosystems resulting of its complex geological history, and for its lagoon classified at the World Heritage Site (UNESCO). In addition to unique ecosystems, like the mining maquis or more generally all the New Caledonian lateritic environment, this archipelago hosts all the specific environmental and biological features of the Insular Pacific Region that are however stressed by the anthropogenic and extensive mining activities. Accordingly, this course comprises lectures dedicated to the biogeographic, evolutionary and specificities of the New-Caledonian ecosystems, knowledges that will be put in perspective with the geological substrate and geomorphological originalities of their immediate environment. The influence of mining and anthropogenic activities on these ecosystems, but also its counterpart, the ecosystems restauration, will also be discussed. This course will also include a two weeks field training highlighting the distinct environmental settings of New Caledonia, biocenotic structure, ecological functioning, and ecosystem resilience in response to natural or anthropogenic disturbances in New-Caledonia.

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to :
- have an overview of the different ecosystems of New-Caledonia and to :
- Master ecological knowledge on tropical island ecosystems and lateritic environments
- Analyse the links between the environmental characteristics of a tropical region and its ecosystems functioning
- Design and implement field protocols for biodiversity assessment and management

Course material, text books and further reading:
Will be available on the Master's WEBSITE (MOODLE).

Prerequisites: please note the general comment on prerequisites
Basic knowledge in biology, ecology and geology

Table of contents:

Theory (lectures):
- Characterization of the main New Caledonian ecosystems

Practicals:
Two-weeks teambuilding training sessions (field and lab) on various New-Caledonian ecosystems:
- coral reefs and lagoon environment,
- coastal and mangroves,
- terrestrial including mining maquis, lateritic environments, humid and dry forest, bush-like environments;

Project:
Each student will implement a project mainly fed by his own experience along the field training sessions.

Assessment breakdown: please note the general comment on assessment breakdown

Oral assessment: 20%
Written assessment: 50 %
Projects/Presentations/Reporting: 30%

Course title: Geomatics (Spatialization of environmental data)
Course ID: CCSE-UE8
University: University of New-Caledonia
Faculty:
Department: Sciences and Technologies
Name and e-mail address of the instructor(s): Pascal DUMAS (pascal.dumas@unc.nc)
Course website: www.unc.nc (MOOLE/ MASTER SDSS).
Semester: S2
Tuition language: French
Number of credits (ECTS): 4 3

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS
26		8	16				

Course objectives:
Geographic Information Systems: To know the functionalities of the main tools on the GIS market, the use and processing of digital terrain models.
Digital mapping: Assimilate the basics of cartography, know the semantics used,for the creation of cards and knowing how to visualize a message obtained thanks to a system geographic information.
Remote sensing: Know the characteristics of the aerospace images available and their application areas. Present the basic techniques of digital processing of pictures.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods & Tools

Upon completion of the course a student must be able to :
- present an overview of the techniques used in the field of information geographical (acquisition, processing and use);
- to design the tools adapted to a problem with a geographical and environmental component.
- design a cartographic product from geographical databases
- present the basic techniques of digital processing of images and particularly the tools most commonly used to improve the image (contrast, noise), detect and recognize the main structures that make up (outlines, textures, areas).

Course material, text books and further reading:
Will be available on the Master's WEBSITE (MOODLE).

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
GIS: GIS theory and practice: databases, GIS, spatial analysis operators, networks and DEM, advanced methods of spatial analysis, programming in GIS.
Digital mapping: Cartographic representation, Traditional representations of relief, The fourth dimension of the card, Writing and positioning, Project or production management,Application Specifications, Cartographic Design, Specifications, The Chain of digital cartography from data acquisition to printing.
Remote sensing : Physical bases of remote sensing, reflectance, backscattering, Notions on sensors: spectral resolution, spatial resolution, temporal resolution, aerial photographs, space images, processing of optical satellite images, radar systems (notions of synthetic aperture images and scatterometer), signatures spectral and temporal.

Specific remote sensing applications: processing of radar images, geometry of images, multi-spectral image classification, 3D reconstruction. General thematic applications (agriculture, forestry, coastline, urban planning, environments, natural, epidemiology and health, geomorphology.

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment: 100%

Course title: Integrated management of water and the land-sea continuum
Course ID: CCSE-UE7
University: University of New-Caledonia
Faculty:
Department: Sciences and Technologies
Name and e-mail address of the instructor(s): Cyril Marchand (cyril.marchand@unc.nc)
Course website: www.unc.nc (MOODLE/ MASTER SDSS).
Semester: S
Tuition language: French
Number of credits (ECTS): 4

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS
24		14	10				

Course objectives:
Acquisition of basic notions on superficial and underground flows.
The coastal area and the specific associated risks – Presentation of the methods acquisition of basic data on the physical environment useful for the study of risks specific to the coastal area.

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to :
-

Course material, text books and further reading:
Will be available on the Master's WEBSITE (MOODLE).

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
Hydrology et hydrogeology : The subject presents advanced concepts and techniques in hydrogeology and hydrologie with a focus on surface and groundwater hydrology. This course will focus on today's major water resources issues in the world. It is intended to provide the students with an advanced understanding of the concepts and techniques necessary to identify, quantify, map and monitor the natural hydrological processes and assess the impact of activities. Special topics include dryland salinity, the impact of land use and climate change, water quality and pollution, recharge of aquifers, irrigation water, water resources development and environmental protection.

Coastal linear management and coastal development: Geomorphology of the littoral space. Coastal meteo-oceanological environment. Hazard/Vulnerability/Risk – Anthropogenic and natural risks – Prevention and treatment – Conflicts of use.
Sedimentary acoustics – Sampling and processing of bottom and subsurface data surface marine – Physico-chemical measurements of the water layer – Meteo-oceanological sensors

Assessment breakdown: please note the general comment on assessment breakdown

Written assessment: 100%

Course title: Pacific studies and gender perspectives
Course ID: DDPS 2
University: University of New-Caledonia
Faculty:
Department: Sciences and Technologies
Name and e-mail address of the instructor(s): Valerie Burtet (valerie.burtet@unc.nc)
Course website: www.unc.nc (MOOLE/ MASTER SDSS).
Semester: 2
Tuition language: English
Number of credits (ECTS): 4

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS
40							

Course objectives:
Developping a common pacific vision and culture

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Interactions Biological level: Ecosystem

Upon completion of the course a student must be able to :
- have an overview of the different pacific nations, organisations, populations and culture/custody.

Course material, text books and further reading:
Will be available on the Master's WEBSITE (MOODLE).

Prerequisites: please note the general comment on prerequisites
Basics knowledge in statistics

Table of contents:
- Diversity and complexity of the island states and territories of the Pacific region.
- The Contemporary Pacific: Society, Politics and Development;
- Main challenges that Pacific populations are facing in regard to SustainableDevelopment

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course title: Echantillonnage et analyse de données environnementales multivariées
Course ID: CCSE-UE2
University: University of New-Caledonia
Faculty:
Department: Sciences and Technologies
Name and e-mail address of the instructor(s): Laurent Wantiez and Nazha Selmaoui-Folcher (laurent.wantiez@unc.nc AND nazha.selmaoui@unc.nc)
Course website: www.unc.nc (MOOLE/ MASTER SDSS).
Semester: S2
Tuition language: French
Number of credits (ECTS): 4

Course breakdown and hours:

Theoretical lectures	Practical training	Exercices	Excursions	Interships	Projects	Seminars	Personal assignments
THE	TP	EX	EXC	STG	PRJ	SEM	PRS
22	24				4		

Course objectives:
Develop the ability to analyze environmental data and learn techniques for analyzing qualitative and quantitative data (discrete or continuous)

Learning outcomes : please note the general comment on learning outcomes

Education level: Specialised Ecosystem focus: Methods and Tools

Upon completion of the course a student must be able to :
- analyse some qualitative and quantitative data: statistical techniques relevant to the analyzes, factorials, multiple correspondence analyses.

Course material, text books and further reading:
Will be available on the Master's WEBSITE (MOODLE).

Prerequisites: please note the general comment on prerequisites
Basic knowledge in statistics

Table of contents:
Environmental sampling strategies (with data from PW of Biology or Geology);
Data analysis and processing multivariate; learning and using R
*This subject will include in particular a tutored project (4H) to be delivered in English in the form of a poster and/or oral communication using PW data sampled in UE 5.
Quantitative data analyses: Univariate and multivariate analyses, regression and linear multiple auto-regression.
Principal component analysis, analysis discriminant and classification.
Qualitative data analysis: statistical techniques relevant to the factorial analysis, multiple correspondence analyses.

Assessment breakdown: please note the general comment on assessment breakdown
Written assessment: 100%

Course descriptions for courses common to Université Libre de Bruxelles (ULB), Vrije Universiteit Brussel (VUB), Sorbonne Université (SU), Muséum National d'Histoire Naturelle (MNHN), Università degli Studi di Firenze (UNIFI), Université de Guyane (UdG), Université des Antilles (UdA), Université de La Réunion (UNIRé) and Université de la Nouvelle Calédonie (UNC) and related to the Master Thesis

Course title: Scientific presentation skills and career planning
Course ID: ULB BIOL-F537 / VUB 4018805DNR
University: Université Libre de Bruxelles, Vrije Universiteit Brussel, Sorbonne Université, Muséum National d'Histoire Naturelle, Università degli Studi di Firenze, Université de Guyane, Université des Antilles, Université de La Réunion, Université de la Nouvelle Calédonie
Faculty: Sciences
Department: Biology / Natural sciences
Name and e-mail address of the instructor(s): Farid Dahdouh-Guebas (Farid.Dahdouh-Guebas@ulb.be)
Course website: https://www.ulb.be/fr/programme/m-biore#programme
Semester: S3
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 16h
- Projects: 24h

Course objectives:
This course aims at teaching students how to find and select essential scientific information to make a scientific presentation (e.g. preparation of research proposal, writing of an assignment, report or thesis, thesis findings to be presented in an international conference), under which form to present methods and results (text, tabulation, illustration and their content and layout) and how to defend them assertively. It also introduces common standards and practices and explains why it is important to follow them in Sciences. A huge chapter is spent to writing and layout skills and to plagiarism. This course also prepares you for stay within academia (academic career) or for the challenges young graduates face on the employment market (non-academic career).

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods and tools

Upon finalising this course the student should master presentation skills (designed and spoken) and assertiveness in defending own research results. In addition the student should be fully aware of scientific standards and procedures in the career of a scientist or beyond academia.

Course material, text books and further reading:
Course entirely based on experience and course material available on the Internet. All information will be given in class.

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
1.Scientific proposals:
- Rationale / Background / Problem situation / Context of the subject
- Literature review (source types, Boolean and proximity operators)
- Use of the Internet (what can we trust out there ?)
- Research objectives (disambiguation of purpose, aim, goal, scope, objective, target and ambition)
- Scientific questions and hypotheses
- A selection of 24 examples of logical fallacies

•What does 'a model' mean and what is 'modelling' ?
•Planning a research strategy and schedule

2. Fieldwork, desk work and analysis in scientific research:
•What precedes my research ?
•Methodology
•Field- and labwork
•Samples and sampling strategies (categories)
•Analysis tools
•Making a deadline
•Back-up your data

3. Writing and layout skills:
•Basic components of a paper, thesis or proposal (in-depth overview per section from the front cover page to the back cover)
•Scientific and biological standards
•How to work and write scientifically (managing your work, scientific standards from different domains, ISO standards for official codes)
•Citation, paraphrasing and plagiarism (rigorous overview with examples, regulations and penalties)
•How to present data and how to present data badly (text and non-text illustrations in written documents and posters)
•Reference systems (Copyrights, Creative Commons, Plagiarism-detection software)

4. Scientific publication:
•Extracting a manuscript from a thesis
•The peer-review process (from what precedes writing of a paper to its final publication)
•Selecting an appropriate scientific journal (incl. Open Access and Open Source)
•Quality indices (common bibliometric measurements for evaluation of journals, researchers and institutes)
•Internet sources for scientific publishing and indexing
•Publication conflict avoidance
•Popular scientific articles
•Talking to the media

5. Pre- and post-research presentation and defence skills:
•Public speaking skills (from waht you say to how you say it))
•Public presentation of data
•Use of didactical material
•Presentation and defence (of proposals, of finished research)
•Q&A

6. Academic currencies:
•The academic career
•Grading systems
•Scientific publications (SLOSS, FIORI,...)
•Conference presentations
•Awards
•Curriculum vitae design for academic and non-academic purposes (how to advertise your skills ?)
•Time management
•Cultivating healthy relationships in research

7. National and international funding:
•Privileged partners
•Conventions
•Networks
•Sources for funding

- Project budgets

Assessment breakdown: please note the general comment on assessment breakdown

100% Oral presentation and defence of the written thesis, irrespective of the scientific level or difficulty. The evaluation can be in the form of a scheduled presentation and Q&A session (such as an oral presentation at a scientific symposium) or in the form of an informal poster presentation with Q&A (such as a poster presentation at a scientific symposium).

Course title: Thesis proposal
Course ID: BIOL-Y-119
University: Université Libre de Bruxelles, Vrije Universiteit Brussel, Sorbonne Université, Muséum National d'Histoire Naturelle, Università degli Studi di Firenze, Université de Guyane, Université des Antilles, Université de La Réunion, Université de la Nouvelle Calédonie
Faculty: Sciences
Department: Biology / Natural sciences
Name and e-mail address of the instructor(s): Joint supervision by selected teaching staff members of the S3 and S4 HEI.
Course website: https://www.ulb.be/fr/programme/m-biore#programme
Semester: S2
Tuition language: English
Number of credits (ECTS): 3
Important notice:
The thesis proposal is due by the end of S2 but there is no *a priori* relationship between the thesis proposal and the S2 country or S2 institute. As will be explained upon your arrival, the thesis proposal depends on the research lab in which you will carry out your thesis and may even have links outside the TROPIMUNDO Consortium.

Course breakdown and hours:
- Projects: 36 h

Course objectives:
This course is merely a preparation to the Master thesis and aims at clearly formulating what the student intends to investigate and place it into a literature-based context.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods and tools

Upon finalising this course the student should know what his MSc thesis will cover and how to execute it.

Course material, text books and further reading:
Knisely, K. (2009). *A Student Handbook for Writing in Biology.* Third Edition. W.H. Freeman and Sinauer Associates. 224 pp.

Prerequisites: please note the general comment on prerequisites
Scientific Presentation Skills and Career Planning

Table of contents:
Depending on the exact topic.
A Thesis Proposal template is provided along with Thesis Guidelines.

Assessment breakdown: please note the general comment on assessment breakdown
100% Scientific presentation exercise (oral presentation and/or written document)

Course title: Masters thesis
Course ID: MEMO-F-538
University: Université Libre de Bruxelles, Vrije Universiteit Brussel, Sorbonne Université, Muséum National d'Histoire Naturelle, Università degli Studi di Firenze, Université de Guyane, Université des Antilles, Université de La Réunion, Université de la Nouvelle Calédonie
Faculty: Sciences
Department: Biology / Natural sciences
Name and e-mail address of the instructor(s): Joint supervision by selected teaching staff members of the S3 and S4 HEI.
Course website: https://www.ulb.be/fr/programme/m-biore#programme
Semester: S4
Tuition language: English
Number of credits (ECTS): 30
Important notice:
The thesis is due by the end of S4 but there is no *a priori* relationship between the thesis and the S2 country or S2 institute. As will be explained upon your arrival, the thesis proposal depends on the research lab in which you will carry out your thesis and may even have links outside the TROPIMUNDO Consortium.

Course breakdown and hours:
- Projects: 360 h

Course objectives:
To design, carry out, present and defend scientific research.

Learning outcomes : please note the general comment on learning outcomes
Education level: Basic Ecosystem focus: Methods and tools

Upon finalising the thesis the student should be able to design research questions and fieldwork protocols and to carry them out in an independent way. The student will know how to analyse raw data or metadata using appropriate methods and tools and how to present the results clearly and interpret them in a wider context using an in-depth survey literature of peer-reviewed scientific literature. The student will also have learnt to extract the essential for a summary. Finally the student will have gained assertiveness by defending his research findings.

Course material, text books and further reading:
Course Scientific presentation skills and career planning
Knisely, K. (2009). *A Student Handbook for Writing in Biology.* Third Edition. W.H. Freeman and Sinauer Associates. 224 pp.
Peer-reviewed scientific papers in the field of the thesis.

Prerequisites: please note the general comment on prerequisites
S2 course Thesis Proposal
All other courses of S1, S2 and S3 of the student's Trajectory.

Table of contents:
Depending on the exact topic.

Assessment breakdown: please note the general comment on assessment breakdown
50% Written document
50% Oral presentation