Course list and detailed course descriptions  
(under revision)

N.B. Below is the course list as of academic year 2019-2020. 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 highlighted in yellow 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 live may be limited or courses may take place online. For 2020-2021 courses for which an online alternative has been confirmed it will indicate ‘online alternative available’. For courses without such indication you are free to contact the respective teacher to get an answer.

Course list per semester and per Partner

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.

<table>
<thead>
<tr>
<th>Semester 1 (S1)</th>
<th>Semester 2 (S2)</th>
<th>Semester 3 (S3)</th>
<th>Semester 4 (S4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULB-VUB</td>
<td>UdA</td>
<td>ULB-VUB</td>
<td>All European Partners</td>
</tr>
<tr>
<td>SU-MNHN</td>
<td>UDsch</td>
<td>SU-MNHN</td>
<td></td>
</tr>
<tr>
<td>UdG</td>
<td>UNIVANTA</td>
<td>UNIFI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UNIré</td>
<td>UdG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RUH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UMT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**Compulsory:**

**MODULE: ULB-VUB**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of biological data</td>
<td>5</td>
</tr>
<tr>
<td>(online alternative available)</td>
<td></td>
</tr>
<tr>
<td>The Earth system and its interactions</td>
<td>5</td>
</tr>
<tr>
<td>(online alternative available)</td>
<td></td>
</tr>
<tr>
<td>Social-ecological systems</td>
<td>5</td>
</tr>
<tr>
<td>(online alternative available)</td>
<td></td>
</tr>
</tbody>
</table>

**Optional (at least 15 ECTS to be chosen):**

**MODULE: ULB-VUB**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>River and lake ecology (botanical and zoological aspects)</td>
<td>5</td>
</tr>
<tr>
<td>(online alternative available)</td>
<td></td>
</tr>
</tbody>
</table>
### Course list

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation and evolution of plants (until academic year 2020-2021, discontinued thereafter)</td>
<td>5</td>
</tr>
<tr>
<td>Tropical parasitology and entomology</td>
<td>5</td>
</tr>
<tr>
<td>Marine biology (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Plant-soil interactions (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Global change biology (online alternative available)</td>
<td>3</td>
</tr>
<tr>
<td>Governance and policy in development and cooperation (online alternative possible)</td>
<td>3</td>
</tr>
<tr>
<td>Conservation genetics</td>
<td>3</td>
</tr>
<tr>
<td>Biology of animal societies</td>
<td>5</td>
</tr>
<tr>
<td>Behavioural ecology in natural and man-made environment (lecture slides available online)</td>
<td>5</td>
</tr>
<tr>
<td>Plant responses to environmental stress (not available in year 2020-2021)</td>
<td>5</td>
</tr>
<tr>
<td>Pédologie et écosystèmes</td>
<td>5</td>
</tr>
<tr>
<td>Genomics, proteomics, evolution (Bioinformatics) (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Toxins in amphibians and reptiles (online alternative available)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Back to Semester Overview**

### S1 course list at the Sorbonne Université (SU) and the Muséum National d’Histoire Naturelle (MNHN)

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistiques et traitement des données</td>
<td>3</td>
</tr>
<tr>
<td>Langue étrangère</td>
<td>3</td>
</tr>
</tbody>
</table>

**COMPULSORY (1 ‘Mention’ to be chosen):**

| MENTION: Ecologie de la Conservation – Ingénierie écologique : Recherche et Expertise (ECIRE) | ECTS |
| Ecologie                                                              | 9    |

| MENTION: Ecologie Evolutive et Fonctionnelle (EEF)                     | ECTS |
| Ecologie                                                              | 9    |

| MENTION: Ecophysiologie et Ecotoxicologie (EPET)                       | ECTS |
| Ecophysiologie                                                        | 9    |

| MENTION: Systématique, Evolution, Paléontologie (SEP)                 | ECTS |
| Taxonomie et phylogénie                                               | 9    |

**OPTIONAL (1 Module to be chosen):**

| MODULE: SU                                                            | ECTS |
| Climat et biotope (c/o Grandes Questions Environnementales)          | 3    |
| Géomatique, SIG, Télédétection                                       | 3    |
| Fondamentaux en Biodiversité et Evolution                            | 9    |

| MODULE: MNHN                                                          | ECTS |
| 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    |
S1 course list at the Université de Guyane (UdG)

COMPULSORY:

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction à l’environnement tropical</td>
<td>3</td>
</tr>
<tr>
<td>Origine et maintien de la biodiversité</td>
<td>5</td>
</tr>
<tr>
<td>Théories de l’écologie</td>
<td>3</td>
</tr>
<tr>
<td>Analyse des données biologiques</td>
<td>6</td>
</tr>
<tr>
<td>Botanique tropicale</td>
<td>3</td>
</tr>
<tr>
<td>Écologie fonctionnelle</td>
<td>3</td>
</tr>
<tr>
<td>Gestion des forêts tropicales</td>
<td>4</td>
</tr>
<tr>
<td>Outils pour la recherche</td>
<td>3</td>
</tr>
</tbody>
</table>

S2 course list at Université des Antilles (UdA)

COMPULSORY:

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Caribbean insular ecosystems</td>
<td>15</td>
</tr>
<tr>
<td>Geomatics</td>
<td>3</td>
</tr>
<tr>
<td>Thesis proposal</td>
<td>3</td>
</tr>
<tr>
<td>Skills and qualifications in tropical biodiversity</td>
<td>9</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction à l’écotoxicologie</td>
<td>3</td>
</tr>
<tr>
<td>Ecologie comportementale</td>
<td>3</td>
</tr>
<tr>
<td>Interactions durables</td>
<td>3</td>
</tr>
<tr>
<td>Ecophysiologie en milieu contraint</td>
<td>3</td>
</tr>
</tbody>
</table>

S2 course list at Université de Dschang (UDsch)

COMPULSORY:

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Central African terrestrial ecosystems</td>
<td>15</td>
</tr>
<tr>
<td>Geomatics</td>
<td>3</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylogénie et systématique</td>
<td>5</td>
</tr>
</tbody>
</table>
### EMMC IN TROPICAL BIODIVERSITY AND ECOSYSTEMS – Course list

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eco</strong>systems aquatiques (Ecologie des milieu humides tropicaux)</td>
<td>5</td>
</tr>
<tr>
<td>Biodiversity conservation*</td>
<td>3</td>
</tr>
<tr>
<td>Natural resource evaluation methods*</td>
<td>3</td>
</tr>
<tr>
<td>Ecosystèmes terrestres (Ecologie Forestière, Sylviculture tropicale)</td>
<td>5</td>
</tr>
<tr>
<td>Socio-economic analysis and elaboration of a management plan for forests and community forests*</td>
<td>3</td>
</tr>
<tr>
<td>Forest management and certification*</td>
<td>3</td>
</tr>
<tr>
<td>Ethnobotanique (Plantes mellifères, pollens et production des miels, Plantes Médicinales et ethnopharmacologie, Méthodes et techniques ethnobotaniques)</td>
<td>5</td>
</tr>
<tr>
<td>Ethnobotanique et valorisation des ressources naturelles</td>
<td>3</td>
</tr>
</tbody>
</table>

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

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**S2 course list at Université d’Antananarivo (UNIVANTA)**

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Malagasy forest ecosystems</td>
<td>15</td>
</tr>
<tr>
<td>Thesis proposal</td>
<td>3</td>
</tr>
<tr>
<td>Geomatics</td>
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<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Floristic biodiversity of Madagascar</td>
<td>3</td>
</tr>
<tr>
<td>Terrestrial fauna biodiversity</td>
<td>3</td>
</tr>
<tr>
<td>Biogeography</td>
<td>3</td>
</tr>
<tr>
<td>Primatology: evolution of extant malagasy prosimians - parasites and primates behavior</td>
<td>3</td>
</tr>
<tr>
<td>Biodiversity offset</td>
<td>3</td>
</tr>
<tr>
<td>Fundamental bases ethnobotany and indigenous and local knowledge</td>
<td>3</td>
</tr>
<tr>
<td>Applied Palynology</td>
<td>3</td>
</tr>
<tr>
<td>Wood anatomy in the tropics</td>
<td>3</td>
</tr>
<tr>
<td>Plant reproductive ecology and pollination in the tropics</td>
<td>3</td>
</tr>
</tbody>
</table>

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

N.B. From academic year 2020-2021 onwards.

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Tropical forest ecosystems of Reunion Island and the South West Indian Ocean Region</td>
<td>15</td>
</tr>
<tr>
<td>Thesis proposal</td>
<td>3</td>
</tr>
<tr>
<td>Geomatics</td>
<td>3</td>
</tr>
<tr>
<td>Skills and qualifications in tropical biodiversity</td>
<td>9</td>
</tr>
</tbody>
</table>
Skills and qualifications in tropical biodiversity is composed of the following modules:

<table>
<thead>
<tr>
<th>Module</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological data analysis</td>
<td>3</td>
</tr>
<tr>
<td>Tropical plant health ecology and management</td>
<td>3</td>
</tr>
<tr>
<td>Molecular evolution</td>
<td>3</td>
</tr>
</tbody>
</table>

**S2 course list at University of Ruhuna (RUH)**

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Module</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Sri Lankan terrestrial and aquatic ecosystems</td>
<td>15</td>
</tr>
<tr>
<td>Geomatics</td>
<td>3</td>
</tr>
<tr>
<td>Thesis proposal</td>
<td>3</td>
</tr>
<tr>
<td>Skills and qualifications in tropical biodiversity</td>
<td>9</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Module</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity of wetlands in Sri Lanka, conservation and policies</td>
<td>3</td>
</tr>
<tr>
<td>Wood science and technology</td>
<td>3</td>
</tr>
<tr>
<td>Plant physiology, biochemistry and plant breeding techniques</td>
<td>3</td>
</tr>
<tr>
<td>Ecotoxicology and Environmental science</td>
<td>3</td>
</tr>
<tr>
<td>Coastal zone management</td>
<td>3</td>
</tr>
<tr>
<td>Indigenous knowledge on plant science</td>
<td>3</td>
</tr>
<tr>
<td>Forest Ecology and Management</td>
<td>3</td>
</tr>
<tr>
<td>Microbial ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

**S2 course list at Universiti Malaysia Terengganu (UMT)**

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Module</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical biodiversity and ecosystems field school: Malaysian mangrove ecosystems</td>
<td>15</td>
</tr>
<tr>
<td>Geomatics</td>
<td>3</td>
</tr>
<tr>
<td>Thesis proposal</td>
<td>3</td>
</tr>
<tr>
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<td>9</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Module</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuarine and mangrove ecology</td>
<td>3</td>
</tr>
<tr>
<td>Conservation of marine endangered species</td>
<td>3</td>
</tr>
<tr>
<td>Tropical oceanography</td>
<td>3</td>
</tr>
<tr>
<td>Lake and Terrestrial ecology</td>
<td>3</td>
</tr>
</tbody>
</table>
**S3 course list at the Université Libre de Bruxelles (ULB) and the Vrije Universiteit Brussel (VUB)**

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific presentation skills and career planning (taught/teleclass by ULB-VUB)</td>
<td>5</td>
</tr>
<tr>
<td>Social-ecological systems (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Global change biology (online alternative available)</td>
<td>3</td>
</tr>
</tbody>
</table>

**OPTIONAL (at least 17 ECTS to be chosen):**

<table>
<thead>
<tr>
<th>Module: ULB-VUB</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>River and lake ecology (botanical and zoological aspects) (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Variation and evolution of plants (until academic year 2020-2021, discontinued thereafter)</td>
<td>5</td>
</tr>
<tr>
<td>Tropical parasitology and entomology</td>
<td>5</td>
</tr>
<tr>
<td>Marine biology (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Plant-soil interactions (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Governance and policy in development and cooperation (online alternative available)</td>
<td>3</td>
</tr>
<tr>
<td>Conservation genetics</td>
<td>3</td>
</tr>
<tr>
<td>Biology of animal societies</td>
<td>5</td>
</tr>
<tr>
<td>Behavioural ecology in natural and man-made environment (lecture slides available online)</td>
<td>5</td>
</tr>
<tr>
<td>Plant responses to environmental stress (not available in year 2020-2021)</td>
<td>5</td>
</tr>
<tr>
<td>Pédologie et écosystèmes</td>
<td>5</td>
</tr>
<tr>
<td>Genomics, proteomics, evolution (Bioinformatics) (online alternative available)</td>
<td>5</td>
</tr>
<tr>
<td>Toxins in amphibians and reptiles (online alternative available)</td>
<td>3</td>
</tr>
<tr>
<td>Guided self-study (online alternative available)</td>
<td>6</td>
</tr>
</tbody>
</table>

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

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

**RECOMMENDED :**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation aux techniques avancées de collecte et d'inventaire systématique</td>
<td>3</td>
</tr>
<tr>
<td>Diversité et histoire des lignées chlorophyllennes (DIVEG)</td>
<td>6</td>
</tr>
<tr>
<td>Xylologie-paléoxylologie: systématique et paléoécologie</td>
<td>3</td>
</tr>
<tr>
<td>Floristique tropicale (FLORATROP)</td>
<td>3</td>
</tr>
<tr>
<td>Ecologie Tropicale (ECOT)</td>
<td>6</td>
</tr>
</tbody>
</table>

**OPTIONAL (at least 6 ECTS to be chosen):**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration et description de la biodiversité</td>
<td>3</td>
</tr>
<tr>
<td>Taxinomie et nomenclature</td>
<td>3</td>
</tr>
<tr>
<td>Formalisation des connaissances en systématique et paléobiodiversité</td>
<td>3</td>
</tr>
<tr>
<td>Morphologie cladistique informatisée</td>
<td>3</td>
</tr>
<tr>
<td>Phylogénie moléculaire</td>
<td>6</td>
</tr>
</tbody>
</table>
### S3 course list at the Università degli Studi di Firenze (UNIFI)

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Conservation Biology</td>
<td>6</td>
</tr>
<tr>
<td>Methods in Landscape Analysis</td>
<td>6</td>
</tr>
<tr>
<td>Scientific presentation skills and career planning (taught/teleclass by ULB-VUB)</td>
<td>3</td>
</tr>
</tbody>
</table>

**OPTIONAL (at least 15 ECTS to be chosen):**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change biology</td>
<td>3</td>
</tr>
<tr>
<td>Pedology</td>
<td>3</td>
</tr>
<tr>
<td>Advances in tropical botany</td>
<td>3</td>
</tr>
<tr>
<td>Animal phylogeography</td>
<td>3</td>
</tr>
<tr>
<td>Primatology (until academic year 2020-2021, discontinued thereafter)</td>
<td>3</td>
</tr>
<tr>
<td>Migrations and orientation in tropical environments (not available in year 2020-2021)</td>
<td>3</td>
</tr>
<tr>
<td>Tropical climatology</td>
<td>3</td>
</tr>
<tr>
<td>Social insects in tropical environments</td>
<td>3</td>
</tr>
</tbody>
</table>

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### S3 course list at the Université de Guyane (UdG)

**COMPULSORY:**

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity informatics</td>
<td>6</td>
</tr>
<tr>
<td>Modélisation des formes et analyse des données morphométriques</td>
<td>3</td>
</tr>
<tr>
<td>Enjeux patrimoniaux, économiques et scientifiques de la connaissance des espèces</td>
<td>3</td>
</tr>
<tr>
<td>Partenaires institutionnels et associatifs de la gestion et de la conservation de la biodiversité</td>
<td>3</td>
</tr>
<tr>
<td>Ecologie moléculaire et génétique évolution des organismes marins</td>
<td>6</td>
</tr>
<tr>
<td>Origines de la vie</td>
<td>3</td>
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<tr>
<td>Biogéographie Paléobiogéographie</td>
<td>3</td>
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<tr>
<td>Enjeux professionnels en ingénierie écologique et biologie de la conservation</td>
<td>3</td>
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<tr>
<td>Gestion des populations et écosystèmes</td>
<td>6</td>
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<tr>
<td>Structure et histoire paléontologique des clades de Métazoaires</td>
<td>3</td>
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<tr>
<td>Phylogénie des Métazoaires: evolution des plans d’organisation</td>
<td>3</td>
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<tr>
<td>Les crises biologiques: comprendre le passé et l’actuel</td>
<td>3</td>
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<tr>
<td>Ecologie de la restauration</td>
<td>3</td>
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<tr>
<td>Fonctionnement et dynamique des socio-écosystèmes</td>
<td>6</td>
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<tr>
<td>Etnoécologie</td>
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<tr>
<td>Evolution des cycles de vie</td>
<td>6</td>
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<tr>
<td>Ecologie et évolution des interactions hôte-parasite</td>
<td>3</td>
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<tr>
<td>Morphonétrie et analyses des formes</td>
<td>3</td>
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<tr>
<td>Morphologie fonctionnelle: évolution et adaptation</td>
<td>3</td>
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<tr>
<td>Conservation ex-situ</td>
<td>3</td>
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Back to Semester Overview
<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
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</thead>
<tbody>
<tr>
<td>Introduction à l'environnement tropical</td>
<td>3</td>
</tr>
<tr>
<td>Origine et maintien de la biodiversité</td>
<td>5</td>
</tr>
<tr>
<td>Théories de l'écologie</td>
<td>3</td>
</tr>
<tr>
<td>Analyse des données biologiques</td>
<td>6</td>
</tr>
<tr>
<td>Botanique tropicale</td>
<td>3</td>
</tr>
<tr>
<td>Écologie fonctionnelle</td>
<td>3</td>
</tr>
<tr>
<td>Gestion des forêts tropicales</td>
<td>4</td>
</tr>
<tr>
<td>Outils pour la recherche</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific presentation skills and career planning¹ (taught/teleclass by ULB-VUB)</td>
<td>3/5</td>
</tr>
<tr>
<td>Thesis</td>
<td>30</td>
</tr>
</tbody>
</table>

¹ For students starting at SU-MNHN this course will be accounted for in the course list of S3 at ULB-VUB or UNIFI. Students who did their S1 in Brussels or Florence and their S3 in Paris will have the choice to follow the 3 or 5 ECTS variant of the course in order to come to a total of at least 120 ECTS for the Master.
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).

Specific comments

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.

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.

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.
## 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.ac.be)

## Course website:

## Semester:
S1

## Tuition language:
English

## Number of credits (ECTS):
5

### 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:

### 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:**

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<thead>
<tr>
<th>Assessment breakdown: breakdown</th>
<th>please note the general comment on assessment</th>
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<tbody>
<tr>
<td>Oral assessment: 100%</td>
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</table>
Course title: Variation and evolution of plants
Course ID: BIOL-F-438
University: Université Libre de Bruxelles
Faculty: Sciences
Department: Biologie des Organismes
Name and e-mail address of the instructor(s): Pierre Meerts (Pierre.Meerts@ulb.ac.be) and Nausicaa Noret (Nausicaa.Noret@ulb.ac.be)
Semester: S1 or S3 (until academic year 2020-2021)
Tuition language: English
Number of credits (ECTS): 5

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

Course objectives:
To understand plant evolution through the study of evolutionary mechanisms specific to plants.
To provide the methodological basis for non ambiguous identification and correct designation of taxons.

Learning outcomes:
Education level: Basic
Ecosystem focus: Plant
Biological level: Organism
Basics of herbarium taxonomy. Understanding of the general principles, as well as the genetic and evolutionary mechanisms, leading to intra- and interspecific plant diversity. Principles of plant molecular phylogeny. Plant genomes evolution.

Course material, text books and further reading:
Several articles are also accessible to students via the virtual university website.

Prerequisites:
Elements of botany; basics of genetics.

Table of contents:

Assessment breakdown:
Written assessment: 100%
Course title: Conservation genetics
Course ID: WE-DBIO-10951
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): Ludwig TRIEST (ltriest@vub.ac.be)
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 20 hrs
- Exercises: 13 hrs

Course objectives:
The overall objective of the course is to introduce the students in the genetics of biodiversity (as compared to species and ecosystem diversity). Therefore, basic knowledge about DNA, genes, and genomes are essential. This course will place emphasis on ecological genetics and on conservation genetics (impacts of habitat loss and fragmentation).

The objective of the course is to understand the genetics of populations, the effect of population sizes on inbreeding and drift, the effect of habitat fragmentation and isolation on genetic differentiation, the methods of gene flow, hybrid detection and the estimation of evolutionary significant units within species. Emphasis will be on marine and freshwater populations from both tropical and temperate ecosystems.

Learning outcomes:
- Understand the genetics of populations, the effect of population sizes on inbreeding and drift, the effect of habitat fragmentation and isolation on genetic differentiation, the methods of gene flow, hybrid detection and the estimation of evolutionary significant units within species. Students should be able to apply these general principles to case studies on various groups of organisms.

Course material, text books and further reading:
Owown notes and powerpoint slides are available and mainly based on own case-studies. Recommended textbooks are:

Learning materials will also comprise recent research papers (level of international journals Molecular Ecology and Conservation Genetics) for working out an assignment or for exercises on data treatment of allelic data in populations.

Prerequisites:
None

Table of contents:
This course gives a brief theoretical and practical introduction to molecular methods used in ecology at population level (Enzyme electrophoresis, RAPD, ISSR, AFLP, nuclear SSRs, chloroplast marker genes, mitochondrial DNA), evolutionary genetics of natural populations and genetic structuring of populations. More detailed topics focus on the evolution in small populations, population fragmentation, loss of genetic diversity in small populations, resolving taxonomic uncertainties, defining management units, case-studies on genetics and the management of wild populations. Selected topics are about: genetic drift and inbreeding; population fragmentation, gene flow and
mating systems; quantitative trait evolution, hybridisation and introgression; intraspecific phylogeography; exercises on data treatment using various population genetics freeware.

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<th>Assessment breakdown:</th>
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<td>Oral assessment: 100%</td>
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</table>
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): Jean-Louis Tison (Jean-Louis.Tison@ulb.ac.be)
Course website:
e_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 Earth's 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:
None
please note the general comment on prerequisites

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 glacialis. 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

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<th>Assessment breakdown:</th>
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<tbody>
<tr>
<td>breakdown</td>
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<tr>
<td>Oral assessment: 100%</td>
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</tbody>
</table>
Course title: Social-Ecological Systems
New course based on Tropical biocomplexity: natural dynamics, indigenous interactions and sustainable management and on Biocomplexity and Systems Ecology.

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 (fdahdouh@ulb.ac.be) and Jean-Louis Deneubourg
Course website: http://www.ulb.ac.be/sciences/biocomplexity/education/SES_BIOL-F4005/
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 30 hrs
- Exercises: 6 hrs
- Projects: 12 hrs

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, redundancy, 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:

and current international research publications
Prerequisites:
None

general comment on prerequisites

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:

<table>
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<th>Oral assessment: 60% (theory, paper discussion, individual-based model discussion)</th>
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</table>

Please note the general comment on assessment breakdown.
Course title: River and lake ecology (botanical and zoological aspects)
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): Ludwig Triest (ltriest@vub.ac.be) and Isabelle George (Isabelle.George@ulb.ac.be)
Course website:
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 24 h
- Exercices : 12 h

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

Learning outcomes:
Education level: Specialised  Ecosystem focus: Interactions  Biological level: Ecosystem
please note the general comment on learning outcomes
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 Kaiiff 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:
None
please note the general comment on prerequisites

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 (macroinvertebrates 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.

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<th>Assessment breakdown:</th>
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<tr>
<td>breakdown</td>
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<tr>
<td>Oral assessment: 100%</td>
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</table>
Course title: Marine biology
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): Philippe Dubois (Philippe.Dubois@ulb.ac.be) and Marc Kochzius (Marc.Kochzius@vub.ac.be)
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

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

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

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

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 discuss human impact on them.

Assessment breakdown:
Oral assessment: 100%
**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.ac.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:
- 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:

### Prerequisites:
Good notions of general entomology

### Table of contents:
- Generalities.  
- Tropical climates.  
- Particularities of tropical conditions for agriculture.  
- Pesticide use in the tropics  
- 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:
- Oral assessment: 100%

*please note the general comment on prerequisites, learning outcomes, course material, and assessment breakdown.*
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.ac.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:
Education level: Specialised  Ecosystem focus: Animal  Biological level: Community

Students are expected to acquire (1) an overall view of the diversity of social organization patterns 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:

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

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.ac.be)
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:
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

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:

<table>
<thead>
<tr>
<th>Breakdown</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Oral assessment</td>
<td>100%</td>
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Please note the general comment on assessment.
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.ac.be)  
Course website:  
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.  

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

Table of contents:  

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.ac.be)
Semester: S1 or S3
Tuition language: English
Number of credits (ECTS): 5

Course breakdown and hours:
- Lectures: 36 hrs

Course objectives:
To get an overview 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 environment. 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:

Prerequisites:
None

Please note the general comment on prerequisites

Table of contents:

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):** Iris Stiers (istiers@vub.ac.be)  
**Semester:** S1 or S3  
**Tuition language:** English  
**Number of credits (ECTS):** 3

**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*

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 (health, food security, natural disturbances)
Exercises:
Group discussion around case studies based on reading assignments

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<tr>
<th>Assessment breakdown</th>
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<tr>
<td>Oral assessment with written preparation: 80%</td>
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<tr>
<td>Participation in group discussions: 20%</td>
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</table>
**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 ([nverbru@ulb.ac.be](mailto:nverbru@ulb.ac.be))  
**Course website:**  
**Semester:** S1 or S3  
**Tuition language:** English  
**Number of credits (ECTS):** 5

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<thead>
<tr>
<th>Course breakdown and hours:</th>
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<tr>
<td>- Lectures: 24 hrs</td>
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<tr>
<th>Learning outcomes:</th>
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| please note the [general comment](#) on learning outcomes  
Upon successful completion of the course the student must have:  
the necessary tools to understand mechanisms of plant responses to different environmental stresses. |

<table>
<thead>
<tr>
<th>Course material, text books and further reading:</th>
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| No specific textbook is used.  
Course slides and research articles |

<table>
<thead>
<tr>
<th>Prerequisites:</th>
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<tbody>
<tr>
<td>None</td>
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<th>Content:</th>
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<tr>
<td>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.</td>
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<th>Assessment breakdown:</th>
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| 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 (tdrouetd@ulb.ac.be)  
**Course website:**  
**Semester:** S1 or S3  
**Tuition language:** French  
**Number of credits (ECTS):** 5

### Course breakdown and hours:
- Lectures: 36 hrs

### Learning outcomes:
- 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:
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:
- 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 ([jflot@ulb.ac.be](mailto:jflot@ulb.ac.be)) and Matthieu Defrance ([matthieu.dc.defrance@ulb.ac.be](mailto:matthieu.dc.defrance@ulb.ac.be))

**Course website:**

**Semester:** S1 or S3

**Tuition language:** English

**Number of credits (ECTS):** 5

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**Course breakdown and hours:**
- Lectures: 24 hrs
- Exercises, practicals: 24 hrs

**Learning outcomes:**
Upon successful 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.

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**Course material, text books and further reading:**

Course slides and research articles


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**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://linuxcommand.org/lc3_learning_the_shell.php)
- [http://www.cs.usfca.edu/~parrt/course/601/lectures/unix.util.html](http://www.cs.usfca.edu/~parrt/course/601/lectures/unix.util.html)
- [http://cs.nyu.edu/courses/fall06/G22.2245-001/syll/syll.html](http://cs.nyu.edu/courses/fall06/G22.2245-001/syll/syll.html)

**Content:**

11 sessions:

1. Crash course on command line processing
2. Crash course on omics processing using R
3. Quiz; reference genome and read mapping
4. Genomics and variant calling
5. Transcriptomics and RNA-seq
6. Epigenomics and ChIP-seq
7. 1st oral presentation
8. Sequencing technologies comparison
9. De novo assembly, theory
10. De novo assembly, practical
11. 2nd oral presentation

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

**Assessment breakdown:**

please note the [general comment](http://cs.nyu.edu/courses/fall06/G22.2245-001/syll/syll.html) 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

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 herpetology, 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.

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<th>Assessment breakdown:</th>
<th>please note the general comment on assessment breakdown</th>
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<tr>
<td>Oral assessment with written preparation (100%)</td>
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</table>
**Course title:** Guided self-study  
**Course ID:** WE-DBIO-14647  
**University:** Vrije Universiteit Brussel  
**Faculty:** Wetenschappen en Bio-ingenieurswetenschappen  
**Department:** Biologie  
**Name and e-mail address of the instructor(s):** President of the Department  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 6

### Course breakdown and hours:
- Projects: 72 hrs

### Course objectives:
The course aims at understanding the fundamental or applied basis of one particular issue in science related to tropical biodiversity and ecosystems.

### Learning outcomes:
- **Education level:** Specialised  
- **Ecosystem focus:** Methods and tools

To able to find and discus all necessary scientific information with respect to a scientific topic related to tropical biodiversity and ecosystems, to state and justify the scientific problem and to design ways to assess this by formulating scientific questions and true or expected results. To be able to defend the findings orally.

### Course material, text books and further reading:
Scientific literature.

### Prerequisites:
None

### Table of contents:
Several possibilities are offered:
1. A topic can be chosen for an in-depth literature study by the student in agreement with the coordinator and a supervisor. The topic does not have to be in line with the research of the supervisor but must fall within his/her capacity. This study represents about 13-15 days of full-time work for the student with regular supervision sessions to monitor the progress of the student. The student is guided progressively toward one highly specialized research topic (not “a bit of everything approach”). For example, first the student should learn the basis by reading several book chapters on the topic, then a few recent reviews. The student will then read, analyze and fully understand at least 5 detailed recent scientific papers related to the same specialized topic. Topics in the light of MSc or PhD research can be accepted. The student will have to present a written document and present it orally.
2. For students with particular shortcomings (e.g. because of atypical previous studies), it should be a study of a series of book chapters aiming at filling that particular gap of knowledge.
3. Alternatively, the student can choose to follow a course of his choice external to the TROPIMUNDO program (after approval of the coordinator). The teacher must be informed and must transmit the exam points to the exam coordinator and teacher.

For both (2) and (3) the student will still have to present the topic or the external course as detailed in (1).

### Assessment breakdown:
- **Written assessment:** 50%  
- **Oral assessment:** 50%
### Course title: Statistiques et traitement des données

**Course ID:** TC03  
**University:** Muséum National d’Histoire Naturelle  
**Faculty:** Enseignement supérieur / Recherche  
**Department:** Systématique et Evolution  
**Name and e-mail address of the instructor(s):** Michel Baylac (michel.baylac@mnhn.fr)  
**Course website:** to be posted  
**Semester:** S1  
**Tuition language:** French  
**Number of credits (ECTS):** 3

### Course breakdown and hours:
- Lectures: 15h  
- Exercises: 15h

### Course objectives:
The course aims at analysing data using uni-, bi- and multivariate statistics. The course includes an introduction to the statistical package R, with lectures on its language, its graphical interface and its statistics.

### 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 the statistical software package R for basic data analysis.

### Course material, text books and further reading:
- Course notes.  
- Internet R resources.

### Prerequisites:
None

### Table of contents:
Based on existing knowledge of the bases of probability and statistics, this course aims to detail the use of statistics applied to the treatment of experiment and observation data in life sciences. The course will present an overview of experimental design, exploratory data analysis, and of the most important tools in parametric and non-parametric statistics.

### Assessment breakdown:

**Written assessment:** 100%

Please note the general comment on learning outcomes, prerequisites, and assessment breakdown.
Course title: Taxonomie et phylogénie
Course ID: SEP01 / MU202
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) & Pascal Tassy (pascal.tassy@mnhn.fr)
Course website: to be posted
Semester: S1
Tuition language: French
Number of credits (ECTS): 9

Course breakdown and hours:
- Lectures: ca. 60 hrs
- Exercises: ca. 50 hrs

Course objectives:
Enseignement centré sur l'exposé des idées, principes et méthodes de base propres à la systématique, plus que sur la présentation de ses résultats. Les cours concernent l'ensemble des étapes du travail des systématiciens de la collecte des spécimens, à la représentation des phylogénies et des clés d'identification, et sont accompagnés de TD appliqués à des groupes taxonomiques variés. Les bases de la phylogénétique avec une présentation comparatives des différentes méthodes d'analyse (cladistique, phénétique, probabiliste, analyse-à-trois-éléments).

Learning outcomes:
- Education level: Basic
- Ecosystem focus: Interactions
- Biological level: Organism

Connaitre les bases méthodologiques (taxonomiques) pour une identifier un organisme de façon non ambigue et de designer correctement les taxons (végétales ou animales).
Comprendre et pourvoir situer la phylogénie des organismes et pouvoir les comparer entre eux. Etre capable d’utiliser des methods d’analyses phylogénétiques.

Course material, text books and further reading:
Littérature scientifique sur la taxonomie animale et végétale, sur leur phylogenies, et sur les methodologies de classification.

Prerequisites:
- None

Table of contents:
- Les principes de base et les objets de la systématique : organismes, taxons, caractères ; Brève histoire de la systématique et des classifications ; De l'observation des données aux descriptions taxonomiques ; Utilisation, constitution des collections ; Nomenclature biologique ; Clés et autres méthodes d'aide à l'identification ; Introduction à la formalisation et l'informatisation des connaissances (bases de données et de connaissance).
- Concepts fondamentaux : notions d'homologie, alignement de séquences, apomorphie-plésiomorphie, monoparaphylie, mesures de l'homoplasy, enracinements, tests phylogénétiques des scénarios évolutifs, biogéographie, classifications phylogénétiques.
- Manipulation en TD de logiciels d'analyse phylogénétique.
Assessment breakdown: please note the *general comment* on assessment breakdown
Written and/or oral assessment: 100%.
Course title: Langues étrangères
Course ID: TC02 (MNHN) ou MXAN1 (SU)
University: Muséum National d’Histoire Naturelle or Sorbonne Université
Faculty: Enseignement supérieur / Recherche
Department: Hommes, Natures, Sociétés (MNHN) or Département des Langues (SU)
Name and e-mail address of the instructor(s): Philippe Hindley (hindley@mnhn.fr), Véronique Charrière (veronique.charriere@SU.fr)
Course website: to be posted
Semester: S1
Tuition language: French or English or another language.
Number of credits (ECTS): 3

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

Course objectives:
L’objectif est d’améliorer le niveau en langues parlé et écrit des étudiants de master, en particulier dans les domaines scientifiques dans lequel ils ont choisi de se spécialiser.
Apprendre à comprendre un article scientifique et à rédiger rapidement en Anglais.

Les enseignements prendront 2 formes :
- Des applications très concrètes: analyses d’articles scientifiques, écoute et compréhension d’émisions scientifiques, débats, présentations orales (avec correction). Expression orale en petits groupes.
- Des approfondissements spécifiques sur des points de grammaire ou de langage particuliers soulevés lors de ce travail par les étudiants eux-mêmes.

Learning outcomes:
Education level: Specialised
Ecosystem focus: Human
Biological level: Global
S’améliorer dans une langue (compréhension, parlé, écriture).

Course material, text books and further reading:

Prerequisites:
Aucun

Table of contents:
L’objectif principal du programme anglais scientifique est de rendre les étudiants opérationnels en anglais dans un milieu scientifique. Les étudiants ont 30 heures de cours au premier semestre dispensés en 2 sessions d’une heure et demie chacune par semaine. La première session est assurée par un scientifique. Les étudiants, en utilisant une méthodologie scientifique, apprennent à donner une communication scientifique en anglais en faisant des présentations orales à partir d’articles de recherche. La deuxième session, assurée par un linguiste, est centrée sur la langue. Les étudiants apprennent à : aborder (lecture et écrit) un article de recherche ; concevoir un poster scientifique ; rédiger des emails, des rapports et des lettres formelles. Ils travaillent également leurs compétences de compréhension et d’expression orales dans un contexte scientifique.

Assessment breakdown:
L’évaluation : travail sur les présentations orales (40%) ; travail sur la langue (20%) et l’examen final (40%).
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


Course material, text books and further reading:
Panorama de la Physique (2007) Ed Belin

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:
please note the general comment on assessment breakdown
Written assessment: 50%
Oral assessment: 50%
**Course title:** Géomatique, SIG, Télédétection  
**Course ID:** MU012  
**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):** Alain Rabaute ([alain.rabaute@SU.fr](mailto:alain.rabaute@SU.fr)); Rémi Michel ([remi.michel@SU.fr](mailto:remi.michel@SU.fr))  
**Course website:** to be posted  
**Semester:** S1  
**Tuition language:** French  
**Number of credits (ECTS):** 3  

<table>
<thead>
<tr>
<th>Course breakdown and hours:</th>
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<tbody>
<tr>
<td>Lectures: 14 hrs</td>
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<tr>
<td>Exercises: 16 hrs</td>
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<th>Course objectives:</th>
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<tbody>
<tr>
<td>Objectifs : Formation des étudiants aux méthodes numériques en appliquant le traitement du signal, de l’image et les SIG à des thèmes et des données issus des Sciences de la Terre et des Sciences de la Vie.</td>
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<tr>
<th>Learning outcomes :</th>
<th>please note the <a href="#">general comment</a> on learning outcomes</th>
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<tbody>
<tr>
<td>Education level: Basic</td>
<td>Ecosystem focus: Interactions</td>
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</table>

| Connaître les bases mathématiques et algorithmiques liées aux SIG et à la télédétection, et introduction aux principaux outils et logiciels |  

<table>
<thead>
<tr>
<th>Course material, text books and further reading:</th>
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<tbody>
<tr>
<td>Analyse spatiale de l'information géographique (2011) Régis Caloz et Claude Collet, PPUR</td>
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<tr>
<th>Prerequisites:</th>
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<tbody>
<tr>
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<tr>
<th>Table of contents:</th>
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<tbody>
<tr>
<td>Que sont les SIG et la télédétection ? Quelles données pour les SIG ? Quels traitements ? Quelles applications en Sciences de la Terre et Sciences de la Vie ?</td>
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<th>Assessment breakdown:</th>
<th>please note the <a href="#">general comment</a> on assessment breakdown</th>
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<tbody>
<tr>
<td>Written assessment: 60%</td>
<td>Oral assessment: 40%</td>
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Course title: Fondamentaux en Biodiversité et Evolution (FOBEE)
Course ID: 4UB22
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

Course breakdown and hours:
Lectures, exercises, practicals and group work: ca. 84 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.
Le cours intègre une semaine introductive à l’épistémologie qui a comme objectif prioritaire l’acquisition d’un large éventail de connaissance en philosophie des sciences. Les étudiants développeront :
- des connaissances de base en philosophie des sciences (fondements épistémologiques) ;
- la compréhension des problématiques spécifiquement épistémologiques et transdisciplinaires concernant les fondements de la connaissance, l’unité théorique et méthodologique des sciences naturelles et des sciences humaines ;
- une capacité analytique permettant de comprendre les références philosophiques dans les textes scientifiques.

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.
Acquérir une culture épistémologique permettant:
- de repérer l’arrière-plan épistémologique des questionnements scientifiques et de développer ses capacités d’analyse et de synthèse.
- d’entretenir un rapport et un regard critique, autonome et interdisciplinaire sur les connaissances scientifiques.

Course material, text books and further reading:
None

Prerequisites:
None

Table of contents:

Assessment breakdown:
Written and /or oral assessment: 100%
**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, Développement 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:
Aucun

Please note the general comment on prerequisites

### 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 biologistes
- 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 Créaté-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 |
| Séminaire: Les 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:**

- Oral assessment: 100%

Please note the general comment on assessment breakdown.
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.

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 Zaragueta (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:  
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<tr>
<th>Education level</th>
<th>Ecosystem focus</th>
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<tbody>
<tr>
<td>Basic</td>
<td>Interactions</td>
<td>global</td>
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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:  
None

### Table of contents:  

### 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:
Approfondir 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-faîres 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:

Assessment breakdown:
please note the general comment on assessment breakdown
Written assessment: 100%
**Course title:** Diversité et histoire des lignées chlorophylliennes (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

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**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 des principaux 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 épidistémologique, les différentes classifications (systèmes artificiels, classifications naturelles traditionnelles, gradistes ou cladistes) 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 chlorophylliennes. Pouvoir lier cette évolution aux événements clés géologiques.

**Course material, text books and further reading:**

Notes de cours. Articles scientifiques.


**Prerequisites:**
- please note the general comment on prerequisites

Aucun

**Table of contents:**


**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.

Prerequisites: Aucun
please note the general comment on prerequisites

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. Être capable de trouver les sources scientifiques et médiatiques sur cette thématique.

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

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:**  
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:**  
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:**  
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:
- Exposition des bases théoriques des systèmes nomenclaturaux ; nomenclatures zoologique et botanique ; systèmes alternatifs de nomenclature (Phylocode, etc.). Le niveau de ce cours est avancé.

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

### 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:
- 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:**  
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.  
Articles 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, parcinomie, 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: |
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| 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:
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:
Aucun

Table of contents:

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 of 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  

Connaitre les bases théoriques et applications de morphométrie 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:**  

**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, économique 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:**  
Aucun

please note the general comment on prerequisites

**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 œuvre 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  
Connaitre pour gérer : quels enjeux dans les hydrosystèmes ?
Bryologie et évaluation biocénologique 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:**

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</table>
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 œuvre 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 œuvre 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:

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.

Education level: Specialised  Ecosystem focus: Human  Biological level: Global

Course material, text books and further reading:

Notes de cours. Ressources en ligne.

Prerequisites:

Aucun

Table of contents:


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 microévolution 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:
**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:
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 dit « 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)

**University:** Muséum National d'Histoire Naturelle

**Faculty:** 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

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**Course breakdown and hours:**

- Lectures: 30 hrs

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**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.

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**Learning outcomes :**

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.

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**Course material, text books and further reading:**

Notes de cours. Ressources en ligne.

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**Prerequisites:**

Aucun

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**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.

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**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

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<td>Étude des principes et des méthodes de la biogéographie et de la paléobiogéographie marine et continentale dans un contexte historique. Biogéographie systématique.</td>
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<td>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.</td>
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<th>Assessment breakdown:</th>
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<tr>
<td>Written or oral assessment: 100%</td>
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</table>
Course title: Enjeux professionnels 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’Études, 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:
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:
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 (durableitü+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.

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<th>Assessment breakdown:</th>
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<td>Written or oral assessment: 100%</td>
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# Structure et histoire paléontologique des grands clades de Métazoaires

**Course ID:** SEP5/NU949  
**University:** Muséum National d'Histoire Naturelle  
**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:
- 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:
- 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:
- 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:

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:
Aucun

Table of contents:

Assessment breakdown:
Written or oral assessment: 100%
## Course title: Les crises biologiques : comprendre le passé et l’actuel

**Course ID:** SEPS1/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:
- bitte 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:
- bitte 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.  

### Assessment breakdown:
- bitte note the [general comment](#) on assessment breakdown  
  - Written or oral assessment: 100%
### Course title: Ecologie de la restauration

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<td>Sorbonne Université et Muséum National d’Histoire Naturelle</td>
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<td>Faculty:</td>
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<td>Department:</td>
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<tr>
<td>Name and e-mail address of the instructor(s):</td>
<td>François Sarrazin (<a href="mailto:sarrazin@mnhn.fr">sarrazin@mnhn.fr</a>) &amp; Nathalie Frascaria-Lacoste (<a href="mailto:nathalie.frascaria@u-psud.fr">nathalie.frascaria@u-psud.fr</a>)</td>
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<td>Tuition language:</td>
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<td>Number of credits (ECTS):</td>
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### 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:
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:
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:
Written assessment: 100%

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**general comment** on learning outcomes

**general comment** on prerequisites

**general comment** on assessment breakdown
**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 :**  
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:**  
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:**  
Written or oral assessment: 100%
**Course title:** Etnoécologie  
**Course ID:** ETNO  
**University:** Muséum National d'Histoire Naturelle  
**Faculty:** 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

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<tr>
<td>Lectures: 20 hrs</td>
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<td>Practicals: 6 hrs</td>
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<th>Learning outcomes:</th>
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<td>Please note the general comment on learning outcomes</td>
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</table>
| Education level: Specialised  
Ecosystem focus: Human  
Biological level: Ecosystem |
| 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. |

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<th>Course material, text books and further reading:</th>
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<th>Table of contents:</th>
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| Ethnoécologie  
Relation sociétés-nature  
Ressources naturelles  
Dynamiques contemporaines des sociétés. |

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<tr>
<td>Written assessment: 100%</td>
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</table>
**Course title:** Applied Conservation Biology  
**Course ID:** BIO/07  
**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):** Giacomo Santini (giacomo.santini@unifi.it)  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 6

**Course breakdown and hours:**  
- Lectures and exercises: 36 hrs  
- Lab work: 12 hrs

**Course objectives:**  
To learn about biodiversity patterns, community structure and functioning at different spatial scales; know the fundamentals of population dynamics and their use in species conservation; identify the main threats faced by ecosystems and understanding their origin. This course also aims at explaining the fundamentals of patterns and processes underlying populations dynamics. The course starts with a first part on demographic characteristics and simple models of population growth and dynamics to include explanations of how communities are structured later.

**Learning outcomes:** please note the general comment on learning outcomes  
**Education level:** Specialised  
**Ecosystem focus:** Animal  
**Biological level:** Community  
Knowledge of the main causes of species loss and environmental degradation; to be able to understand and analyze conservation plans for species and ecosystems. Upon completion of this course the student should also be able to understand ecological patterns and process, to be able to analyze them using advanced statistical methods and to use basic mathematical population models.

**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:**  

**Assessment breakdown:** please note the general comment on assessment  
**Written assessment:** 100%
Course title: Methods in Landscape Analysis
Course ID: GEO/04
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): 6

Course breakdown and hours:
• Lectures: 32h
• Exercises: 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:
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:
None

Table of contents:
The course is subdivided in two moul: 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:
written assessment 100%
### Course title: Advances in Tropical botany

**Course ID:** BIO/01  
**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):** 3

### 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:

<table>
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<tr>
<th>Education level: Basic</th>
<th>Ecosystem focus: Plant</th>
<th>Biological level: Organism</th>
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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:
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:
Oral presentation and assessment: 100%

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*please note the general comment on learning outcomes*

*please note the general comment on prerequisites*

*please note the general comment on assessment breakdown*
Course title: Tropical climatology
Course ID: AGR/02
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): 3

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:
Applied Agrometeorology, 2010, Kees Stigter (Ed.), Springer (Berlin) (D)
Lecture notes edited by the Instructor

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: Pedology
Course ID: AGR/14
School: Scienze Matematiche Fisiche e Naturali – School of Sciences
Department: Dipartimento di Scienze della Terra – Department of Earth Sciences
University: Università degli Studi di Firenze
Name and e-mail address of the instructor(s): Stefano Carnicelli (stefano.carnicelli@unifi.it)
Course website: to be posted
Semester: S3
Tuition language: English
Number of credits (ECTS): 3

Course breakdown and hours:
- Lectures: 16h
- Projects: 8h

Course objectives:
The target is to make the students able to understand the soils of the humid zones of the tropics, with special focus on the wetlands. Students are expected to be able to gauge soil problems within a given ecosystem and to require and successfully manage specialized assistance.

Learning outcomes:
Education level: Basic
Ecosystem focus: Interactions
Biological level: Ecosystem

Students should be able to diagnose the main soil conservation problems in the humid tropics by direct field observation and literature reference. They also should be able to select appropriate specialist help and to write suitable, technical, terms of reference.

Course material, text books and further reading:
Basic theory explanation and project data will be provided during the course, being necessary and sufficient for exams. Further reading will be assigned on individual or small group basis, in the frame of project activity.

Prerequisites:
None

Table of contents:
Lectures:
General concepts on soil stability
Soils of the littoral environment; mangrove soils, beach ridge and dune soils
  - Sulphidic and sulfuric soil materials, development of sulphate acidity
  - Soil salinity and sodicity
Organic soils, different types of tropical peats and associated alluvial soils
  - Problems of drainage
  - Long-term peat subsidence
Soils of the rainforest: Ferralsols, Nitisols, Acrisols, Plinthosols, rainforest Umbrisols and Cambisols
  - Fertility and acidification of rainforest soils
  - Soil erosion in the humid tropics

Project:
Evaluation of real field situation; data gathering and organization, with database and GIS applications; drafting a report and a further investigation project.

Assessment breakdown:
Written assessment 50%

Please note the general comment on course objectives, learning outcomes, prerequisites, and assessment breakdown.
Project assessment 50%
**Course title:** Social insects in tropical environments  
**Course ID:** BIO/05  
**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 Turillazzi (stefano.turillazzi@unifi.it)  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 3

### Course breakdown and hours:
- Lectures: 18 hrs
- Lab works: 6 hrs

### Course objectives:
Social insects constitute important elements in tropical environments. The course aims to promote the knowledge of the biology of the most important social insects groups and their impact on various tropical environments, especially on forests. The course will focus especially on social Hymenoptera and termites. Evolution of social behaviour will be treated in a general and in particular groups.

### Learning outcomes:
**Education level:** Specialised  
**Ecosystem focus:** Animal  
**Biological level:** Community

Knowledge of Social Insects distribution and biodiversity especially on arguments regarding the importance of these organisms for ecosystems equilibrium. Knowledge of potential exploitation of some species for alimentary purposes.

### Course material, text books and further reading:
Hoelldobler and Wilson: The Superorganism  
Additional readings from current journal articles.

### Prerequisites:
None

### Table of contents:

### Assessment breakdown:
- Oral assessment 50%
- Project and exercise assessment 50%


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Please note the [general comment](#) on learning outcomes  
Please note the [general comment](#) on prerequisites  
Please note the [general comment](#) on assessment
**Course title:** Climate change biology  
**Course ID:** BIO/05  
**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):** Giacomo Santini (giacomo.santini@unifi.it)  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 3

<table>
<thead>
<tr>
<th>Course breakdown and hours:</th>
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<tbody>
<tr>
<td>Lectures: 18 hrs</td>
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<tr>
<td>Exercises: 6 hrs</td>
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<tr>
<th>Course objectives:</th>
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<tbody>
<tr>
<td>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.</td>
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<td>Education level: Specialised</td>
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<tr>
<td>Ecosystem focus: Animal</td>
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<tr>
<td>Biological level: Global</td>
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<tr>
<td>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 characteristics of the species and the effect of climate change.</td>
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<tr>
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<table>
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<tr>
<td>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.</td>
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<th>Assessment breakdown:</th>
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<tr>
<td>Oral assessment: 100%</td>
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Please note the general comment on learning outcomes, prerequisites, and assessment breakdown.
**Course title:** Primatology  
**Course ID:** BIO/08  
**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):** Roscoe Stanyon (roscoe.stanyon@unifi.it)  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 3  

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

**Course objectives:**  
Exploration of primate taxonomy and phylogeny. Knowledge of biodiversity, geographic distribution and ecology of primates. Understanding the relationship between ecology and social organization; the structure of social groups; and the evolution of behaviour. Understanding conservation issues in primates and the factors that make many primate species vulnerable to extinction. Appreciation of genetic tools for primate management and conservation.  

**Learning outcomes:**  
Knowledge of primate distribution and biodiversity within an evolutionary framework. Broaden students’ understanding of the social dimensions of ‘living environments’. Better understanding of conservation issues and capacity to critically discuss and assess issues. Clearer framework of our own species place in nature.  

**Course material, text books and further reading:**  

**Prerequisites:**  
None  

**Table of contents:**  
1) Primate Taxonomy and phylogeny and biogeography. 2) Primate life histories and reproduction. 3) Primate reproductive units, social organization and communities. 4) Primate habitats and ecosystems. 4) activity patterns, habitat use 5) evolution of primate behaviour and comparison between species. 6) Primate conservation and management.  

**Assessment breakdown:**  
Oral assessment 50%  
Project, exercise and excursion assessment 50%
Course title: Animal phylogeography
Course ID: BIO/05
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

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<th>Course breakdown and hours:</th>
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<tr>
<td>Lectures: 20 hrs</td>
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<td>Exercises: 4 h</td>
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<tr>
<td>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.</td>
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<tbody>
<tr>
<td>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.</td>
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<tbody>
<tr>
<td>Scientific papers.</td>
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<td>Duplicated lecture notes.</td>
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<tbody>
<tr>
<td>Lectures:</td>
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<td>Exercises:</td>
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<tr>
<td>Principal software for the analysis of sequence data. Case studies.</td>
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<td>Oral assessment: 100%</td>
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</table>
**Course title:** Migrations and orientation in tropical environments  
**Course ID:** BIO/05  
**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):** Alberto Ugolini (alberto.ugolini@unifi.it)  
**Course website:** to be posted  
**Semester:** S3  
**Tuition language:** English  
**Number of credits (ECTS):** 3

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**Course breakdown and hours:**  
- Lectures: 24 hrs

**Course objectives:**  
Learn the fundamentals of animal orientation and circular statistics. In particular, orientation, homing and navigation mechanisms at tropical latitudes will be considered.

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

Different strategies and mechanisms adopted by some biological models to solve autoecological problems of spatial and temporal nature.

**Course material, text books and further reading:**  
Currently no textbook is recommended. Students are recommended to attend the lessons. Reading of selected scientific papers should help them in learning.

**Prerequisites:**  
Please note the general comment on prerequisites  
None

**Table of contents:**  
Kinetic and tactic behaviour: classification and examples; Strategies to find a goal; elaboration and interpretation of circular data; uni- and pluri-directional orientation; the sun compass and the magnetic compass: their use at tropical latitudes; homing behaviour and mechanisms; true navigation; migrations.

**Assessment breakdown:**  
Please note the general comment on assessment breakdown  
- Oral assessment: 100%
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): 3

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:
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:
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:
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):** 5

**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 évolution 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:

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

Please note the general comment on assessment breakdown.
**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: Analyse des données biologiques  
Course ID:   
University: Université de Guyane française (UDG)  
Faculty: 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): 6

**Course breakdown and hours:**  
- Lectures: 50 hrs  
- Exercises: 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:**  
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  

**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.
Assessment breakdown:

- Oral assessment: 0%
- Written assessment: 70%
- Projects/Presentations/Reporting: 30%

Please note the general comment on assessment breakdown.
Course title: Botanique tropicale
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): 3

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 plaçant 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 %
Course title: 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): 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 générale et biologie végétale

Table of contents:
- Interface sol-plante :

- 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.
Diversité fonctionnelle

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**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):** 4

**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.

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<tr>
<td>Written assessment: 50 %</td>
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<tr>
<td>Projects/Presentations/Reporting: 50 %</td>
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**Course title:** Outils pour la recherche  
**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):** 3

**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  

**Prerequisites:**  
please note the general comment on prerequisites  
Aucun

**Table of contents:**  
- Initiation Bibliographique  
- Rédaction d’article  
- Initiation R

**Assessment breakdown:**  
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<td>Projects/Presentations/Reporting</td>
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<tr>
<td>Course title: Tropical biodiversity and ecosystems field school: Caribbean insular ecosystems</td>
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<td>University: Université des Antilles</td>
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<tr>
<td>Faculty: UFR Sciences Exactes et Naturelles</td>
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<tr>
<td>Department: Biology</td>
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<tr>
<td>Name and e-mail address of the instructor(s): D. Imbert (<a href="mailto:daniel.imbert@univ-ag.fr">daniel.imbert@univ-ag.fr</a>)</td>
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<tr>
<td>Semester: S2</td>
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<tr>
<td>Tuition language: English and French</td>
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<td>Number of credits (ECTS): 15</td>
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</tbody>
</table>

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 Caribbean 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:
- Master ecological knowledge on Caribbean island ecosystems
- Design and implement field protocols for biodiversity assessment and management

Course material, text books and further reading:
- Schnell R., 1987. La lore et la vegetation de l’Amérique Tropicale
- Snedaker SC & Snedaker JG, 1984. The mangrove ecosystem: research methods

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:**
- 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 (notation 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)
### Assessment breakdown:

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Please note the [general comment](#) on assessment.
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, chimie minérale, chimie 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

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</table>
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 ?
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:

- Oral assessment: 1/3
- Written assessment: 2/3

Please note the general comment on assessment breakdown.
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:  

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 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:
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:
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:
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

<table>
<thead>
<tr>
<th>Education level</th>
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<td>Methods and tools</td>
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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  

### 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 (lpafack@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 %
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### Course breakdown and hours:
- Lectures: 20 hrs
- Projects: 10 hrs

### Course objectives:

### Learning outcomes:
- Comprendre l’écologie des milieu humides dans les forêts tropicales africaines.
  
  **Education level:** Specialised  
  **Ecosystem focus:** Plant  
  **Biological level:** Community

### Course material, text books and further reading:
- Course notes.

### Prerequisites:
- None

### Table of contents:

### Assessment breakdown:
- Written and/or oral assessment: 100 %
**Course title:** Biodiversity conservation  
**Course ID:** MSRN5113/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%
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<td>Department: Plant Biology</td>
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<tr>
<td>Name and e-mail address of the instructor(s): Jonas Yves Pinta (<a href="mailto:jonasypinta@yahoo.fr">jonasypinta@yahoo.fr</a>)</td>
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<td>Tuition language: English</td>
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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:

| 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 found 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:
- Textbooks 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:
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:
- 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 asessment 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:
- To learn deeply notions on sylviculture and forest ecology.
- To learn more about the sustainable management of forest biodiversity.

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:
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:
- 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:
- 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:
- 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:
- 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 goal 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.ac.be)  
**Course website:** to be posted  
**Semester:** S2  
**Tuition language:** English  
**Number of credits (ECTS):** 5

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**Course breakdown and hours:**  
- Lectures: 30 hrs  
- Exercises, Practicals & individual work: 20 hrs

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**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

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

Comprendre les méthodes et techniques appliquées dans l’étudiant 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

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**Course material, text books and further reading:**  
Course notes.  
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  
Videos on the topic  
Visits to the medicinal plants garden

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**Prerequisites:**  
please note the general comment on prerequisites  
None

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<th><strong>Plantes mellifères, pollens et production des miels</strong></th>
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<td>Scientific evidences on the efficiency of some medicinal plants, advantages and inconvenients</td>
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<td>Plant selection for extraction of active principles</td>
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<tr>
<td>Common medicinal plants</td>
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</tbody>
</table>

**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:
- Videos on the topic  
- Visits to the medicinal plants garden

### 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 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 and hours:
- Lectures: 14hrs
- Exercises: 30hrs
- Excursions: 90hrs
- Projects: 40 hrs

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:

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 assessment
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:

<table>
<thead>
<tr>
<th>Assessment Breakdown</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Oral assessment</td>
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</table>

Please note the general comment on assessment breakdown.
**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  
(srkotondraompiana@gmail.com; solofo.rakotondraompiana@univ-antananarivo.mg)  
**Course website**: -  
**Semester**: S2  
**Tuition language**: English  
**Number of credits (ECTS)**: 3

**Course breakdown and hours:**  
- Lectures: 25 hrs  
- Exercises: 20 hrs  
- Projects: 05 hrs

**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;
- Properties 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
- Exercises: 5 hrs
- Excursions: 10 hrs
- Projects: 10 hrs

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)

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<thead>
<tr>
<th>Assessment breakdown:</th>
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<tr>
<td>Oral assessment: 25 %</td>
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<td>Written assessment: 50 %</td>
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<tr>
<td>Projects/Presentations/Reporting: 25 %</td>
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</table>
**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 and hours:
- Lectures: 24 hours  
- Exercises: 3 hours  
- Excursions: 3 hours

### 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:
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:

### 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 Andrianariminisa 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 and hours: 120
- Lectures: 
- Practice: 
- Projects:

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:
### 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:
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 and hours:
- Lectures: 20 hours
- Exercises: 8 hours
- Excursions: 2 hours

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 endemcity 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:
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:
Prerequisites:
To attend the proposed course, the student must have knowledge on biology, ecology and/or systematic biology.

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 and hours:
- Lectures: 20 hrs
- Exercises: 10 hrs
- Excursions: 360 hrs
- Projects: 72 hrs
- 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:
EMMC IN TROPICAL BIODIVERSITY AND ECOSYSTEMS – Course list

- C. Combes -2005- The art of being a parasite. *The University of Chicago Press*
- LEE P.C. Editor 2004 Comparative Primate Socioecology Cambridge University Press


**Prerequisites:** please note the [general comment](#) on prerequisites

S1 Conservation genetics (ULB & VUB); 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 deciduous 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 and hours:
- Lectures: 15 hrs
- Exercices: 10 hrs
- Excursions: 25 hrs
- Projects: 25 hrs

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.

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<tr>
<th>Assessment breakdown:</th>
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<tr>
<td>Written assessment:</td>
<td>50% Final exam at the end of the semester</td>
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<tr>
<td>Projects reporting:</td>
<td>50% report on laboratory work and fieldworks</td>
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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 and hours:
- Lectures: 15 hrs
- Exercises: 15 hrs
- Excursions: 10 hrs
- Projects: 20 hrs

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 and hours:
- Lectures: 2 hrs  
- Exercises: 20 hrs  
- Excursions: 8 hrs  
- Projects: 10 hrs

### 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:
**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:
Notion on general palynology

### Table of contents:
- Generality on pollen and spores and practical applications  
- Aeropalynology  
- Pollen and allergise  
- Phytopathogenic Spores  
- Paleocology

### 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 and hours:
- Lectures: 10 hrs
- File course: 30 hrs
- Projects: 10 hrs

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

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 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:

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.


**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. 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.**


**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

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**Assessment breakdown:**

- Oral assessment: 25 %
- Written assessment: 50 %
- Projects/Presentations/Reporting: 25 %

Please note the general comment on assessment breakdown.
**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, visualize 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 %
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<td>Projects/Presentations/Reporting: 100 %</td>
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**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:
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:
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:
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:
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:

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 chloroplas 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.

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<td>Projects/Presentations/Reporting: 50 %</td>
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*please note the [general comment](#) on assessment breakdown*
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 (ljr@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:
2. Sri Lankan ecosystems (http://www.terrestrial-biozones.net)
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)
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<td>Projects/Presentations/Reporting:</td>
<td>50 %</td>
</tr>
</tbody>
</table>

- Beach vegetations, lagoons (Matara – Hambantota)
- Vegetation dynamics
- Natural dynamics (Kahandamodara)
- Human induced (Kalametiya, Dondra, Garanduwa)
- Resilience strategies
- Kalametiya, Dondra
- Group wise presentations
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:
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](mailto:lpj@bot.ruh.ac.lk)) and Prof. Saman Chandana (epschandana@gmail.com)  
**Course website:** [www.tropimundo.eu](http://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:**  

**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:**
<table>
<thead>
<tr>
<th>Course list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Concepts on Wetland Ecology</td>
</tr>
<tr>
<td>Definition and classification of Wetlands</td>
</tr>
<tr>
<td>Wetlands in Sri Lanka</td>
</tr>
<tr>
<td>Biodiversity in Wetland Systems</td>
</tr>
<tr>
<td>Wetland Functions and Values</td>
</tr>
<tr>
<td>Major threats to wetlands in Sri Lanka</td>
</tr>
<tr>
<td>Wetland conservation and major issues</td>
</tr>
<tr>
<td>Policy status in wetland conservation in Sri Lanka</td>
</tr>
<tr>
<td>Case studies: Kalametiya lagoon, Garanduwa mangrove ecosystem</td>
</tr>
</tbody>
</table>

**Assessment breakdown:**

- Oral assessment: 30%
- Written assessment: 50%
- Projects/Presentations/Reporting: 20%

*please note the general comment on assessment breakdown*
### 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](http://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 properties  
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:

<table>
<thead>
<tr>
<th>Education level:</th>
<th>specialise</th>
<th>Ecosystem focus:</th>
<th>Plant</th>
<th>Biological level:</th>
<th>organism</th>
</tr>
</thead>
</table>

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:
- 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:
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:
- 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:

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:

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Oral assessment</td>
<td>-</td>
</tr>
<tr>
<td>Written assessment</td>
<td>70%</td>
</tr>
<tr>
<td>Projects/Presentations/Reporting</td>
<td>30%</td>
</tr>
</tbody>
</table>

please note the general comment on assessment breakdown
**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:**  
- 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:** please note the general comment on assessment breakdown
<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Oral assessment</td>
<td>30%</td>
</tr>
<tr>
<td>Written assessment</td>
<td>50%</td>
</tr>
<tr>
<td>Projects/Presentations/Reporting</td>
<td>20%</td>
</tr>
</tbody>
</table>
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:
- 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:
3. Coastal zone management plan, Coastal conservation and coastal resource management department, Sri Lanka
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:
- 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:
Oral assessment: 30 %
Written assessment: 50 %
Projects/Presentations/Reporting: 20 %
## 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 Izazti 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:

**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:
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:  
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 Field 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:
Upon completion of the course students will be able to:
1. recognize and explain GIS framework, including 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, reflection, 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, aquatics 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 exercises and reports;
7. describe remote sensing application and summarize methods and results in a written assignment.

Course material, text books and further reading:

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 paleoceanography 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:
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:

Prerequisites: please note the general comment on prerequisites
Table of contents:

Introduction to the Tropical Ocean
• Importance of Tropical Ocean Research
• 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:

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 Nurzia 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:
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:

Prerequisites:
None

Table of contents:
1. Introduction to UMTROP 404 (course rules, examination scheme and other regulations)
2. Introduction to different estuaries and wetlands
<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>3. Introduction to mangrove and mangrove ecosystem</td>
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<tr>
<td>4. Factors influencing the mangrove establishment and growth</td>
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<tr>
<td>5. Mangrove landforms</td>
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<tr>
<td>6. Mangrove forest categories</td>
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<tr>
<td>7. Zonation in mangrove forests</td>
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<tr>
<td>8. Mangrove distribution in Malaysia</td>
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<tr>
<td>9. Mangrove conservation and management</td>
</tr>
<tr>
<td>10. Mangrove ecosystem functions, services and its Inter-connectivity</td>
</tr>
<tr>
<td>11. Current issues on the mangrove ecosystem in Malaysia and other regions</td>
</tr>
<tr>
<td>12. Mangrove carbon sequestration and response to climate change</td>
</tr>
<tr>
<td>13. Legislation, Policy implementation and limitations for mangrove conservation and management in Malaysia</td>
</tr>
<tr>
<td>14. Research and updates</td>
</tr>
</tbody>
</table>

**Assessment breakdown:**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab report</td>
<td>10%</td>
</tr>
<tr>
<td>Mangrove activity with local community</td>
<td>30%</td>
</tr>
<tr>
<td>Group seminar</td>
<td>20%</td>
</tr>
<tr>
<td>Final exam</td>
<td>40%</td>
</tr>
</tbody>
</table>

**TOTAL:** 100%

*Please note the general comment on assessment breakdown.*
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:

Prerequisites: please note the general comment on prerequisites
None

Table of contents:
### Lectures:

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The concept of marine biodiversity and importance of conserving marine endangered species (turtles, marine mammals &amp; corals)</td>
<td>1 hr</td>
</tr>
<tr>
<td>2.</td>
<td>Biology of sea turtles (phylogeny, population genetics, reproduction, physiology, locomotion, migration and habitat utilization)</td>
<td>3 hrs</td>
</tr>
<tr>
<td>3.</td>
<td>Research and management of sea turtle for conservation</td>
<td>2 hrs</td>
</tr>
<tr>
<td>4.</td>
<td>Threats to sea turtles (natural threats, human impacts)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>5.</td>
<td>Biology and ecology of cetaceans</td>
<td>2 hrs</td>
</tr>
<tr>
<td>6.</td>
<td>Biology and ecology of sirenians</td>
<td>2 hrs</td>
</tr>
<tr>
<td>7.</td>
<td>Interactions between marine mammals and man</td>
<td>2 hrs</td>
</tr>
<tr>
<td>8.</td>
<td>Status and conservation of marine mammals in Malaysia</td>
<td>1 hr</td>
</tr>
<tr>
<td>9.</td>
<td>Introduction to coral reef (distribution, biology of coral formation)</td>
<td>3 hrs</td>
</tr>
<tr>
<td>10.</td>
<td>Inter-connectivity of corals and other marine organisms</td>
<td>2 hrs</td>
</tr>
<tr>
<td>11.</td>
<td>Perspective on coral reef</td>
<td>2 hrs</td>
</tr>
<tr>
<td>12.</td>
<td>Coral reef resilience and analysis</td>
<td>2 hrs</td>
</tr>
</tbody>
</table>

### 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:
- Tagging
- Monitoring of sea turtle nesting and data recording
- Eggs and hatchlings

Dedicated boat sighting survey of cetaceans, 12hrs:
- Systematic line transect method.
- Marine Mammals Daily Boat Survey Effort Record
- Marine Mammals Sighting Form

Coral reef underwater video survey and the use of corals health index in coral reefs conservation, 12 hrs

### Assessment breakdown:

- Mid-term exam (15%)
- Final exam (35%)
- Report/assignments
  - Turtle (practical and field trip report) (15%)
  - Coral (practical and field trip report) (20%)
  - Marine mammal (assignment and field trip report) (15%)

Please note the general comment on assessment breakdown.
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:

**Prerequisites:**

None

**Table of contents:**

**Lectures schedule:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to course on lake and terrestrial Ecology (examination scheme and other regulations)</td>
</tr>
<tr>
<td>2.</td>
<td>Introduction to the history and definition of lake and terrestrial ecosystem</td>
</tr>
<tr>
<td>3.</td>
<td>Factors influencing lake and terrestrial ecosystem</td>
</tr>
<tr>
<td>4.</td>
<td>Lake research and updates</td>
</tr>
<tr>
<td>5.</td>
<td>Integrated catchment management: carrying capacity and issues</td>
</tr>
<tr>
<td>6.</td>
<td>Natural and man-made Lakes</td>
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<tr>
<td>7.</td>
<td>Lake stratification</td>
</tr>
<tr>
<td>8.</td>
<td>Terrestrial biodiversity surrounding lakes</td>
</tr>
<tr>
<td>9.</td>
<td>Forest conservation and management</td>
</tr>
<tr>
<td>10.</td>
<td>Threats to the lake and terrestrial ecosystem</td>
</tr>
<tr>
<td>11.</td>
<td>Lake associated fauna</td>
</tr>
<tr>
<td>12.</td>
<td>Large animals biodiversity, conservation and management</td>
</tr>
</tbody>
</table>

**Assessment breakdown:**

Oral assessment: 20 %
Written assessment: 40 %
Final Examination: 40 %
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 and Università degli Studi di Firenze
Faculty: Sciences
Department: Biology / Natural sciences
Name and e-mail address of the instructor(s): Farid Dahdouh-Guebas (fdahdouh@ulb.ac.be)
Course website: http://www.ulb.ac.be/sciences/biocomplexity/education/Scientific_presentation_skills_and_career_planning_BIOL-F-537/
Semester: S3
Tuition language: English
Number of credits (ECTS): 3/5

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
• Popular scientific articles
• Talking to the media

5. *Pre- and post-research presentation and defence skills*:
• Public speaking skills (from what 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

7. *National and international funding*:
• Privileged partners
• Conventions
• Networks
• Sources for funding
• Project budgets
<table>
<thead>
<tr>
<th>Assessment breakdown:</th>
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<tbody>
<tr>
<td>please note the <strong>general comment</strong> on assessment breakdown</td>
</tr>
</tbody>
</table>

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 and Università degli Studi di Firenze  
**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:** to be posted  
**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:

- **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:


### Prerequisites:

- Scientific Presentation Skills and Career Planning

**please note the general comment on prerequisites**

### Table of contents:

Depending on the exact topic.  
A Thesis Proposal template is provided along with Thesis Guidelines.

### Assessment breakdown:

- **100% Scientific presentation exercise (oral presentation and/or written document)**

**please note the general comment on assessment breakdown**
**Course title:** Masters thesis  
**Course ID:** MEMO-F-538  
**University:** Université Libre de Bruxelles, Vrije Universiteit Brussel, Sorbonne Université, Muséum National d’Histoire Naturelle and Università degli Studi di Firenze  
**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:** to be posted  
**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.

<table>
<thead>
<tr>
<th>Course breakdown and hours:</th>
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<tbody>
<tr>
<td>• Projects: 360 h</td>
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<table>
<thead>
<tr>
<th>Course objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To design, carry out, present and defend scientific research.</td>
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</table>

<table>
<thead>
<tr>
<th>Learning outcomes:</th>
<th>please note the general comment on learning outcomes</th>
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</thead>
<tbody>
<tr>
<td>Education level: Basic</td>
<td>Ecosystem focus: Methods and tools</td>
</tr>
<tr>
<td>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.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course material, text books and further reading:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course <strong>Scientific presentation skills and career planning</strong></td>
</tr>
<tr>
<td>Peer-reviewed scientific papers in the field of the thesis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisites:</th>
<th>please note the general comment on prerequisites</th>
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</thead>
<tbody>
<tr>
<td>S2 course <strong>Thesis Proposal</strong></td>
<td></td>
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<tr>
<td>All other courses of S1, S2 and S3 of the student’s Trajectory.</td>
<td></td>
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</table>

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<tr>
<th>Table of contents:</th>
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<tbody>
<tr>
<td>Depending on the exact topic.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment breakdown:</th>
<th>please note the general comment on assessment breakdown</th>
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</thead>
<tbody>
<tr>
<td>50% Written document</td>
<td></td>
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<tr>
<td>50% Oral presentation</td>
<td></td>
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</table>