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Along with this handbook, you will receive a copy of the **Student Guidebook for the Silwood Park Campus**, containing the following important information for all living and working at Silwood.

**Introduction to the department and facilities**

For information about key contracts, weekly seminars, key dates, the FrEEC Symposium and information on the library, IT, and health and safety.

**Academic regulations**

The regulations for the EA course are provided in this handbook, but the Student Guidebook provides information about the general regulations. This includes academic integrity, plagiarism, employment during your studies and complaint and appeals procedures.

**Thesis writing and submission guidelines**

All information about project organization, thesis writing and submission, final presentations, and vivas are in the Silwood Guidebook.

**Welfare and Advice**

Imperial has a wide support network for students. The Student Guidebook provides details of the available support and key contacts and links.

**Student Feedback and Representation**

We are very grateful for feedback on the course and will ask you for it at regular intervals! However, there are a range of options for providing feedback and getting support on your academic studies and the Student Guidebook provides details.

Electronic copies of both guidebooks are available on the course Blackboard website.
Course Overview

Welcome to Silwood Park and the Masters programme in Ecological Applications.

The MSc course in Ecological Applications was a new addition to our Masters suite in 2013, drawing on ecological expertise from researchers across the college and our partner organisations.

The impetus behind the course is to produce independent researchers with the skills and knowledge most relevant to the application of ecological theory to real world problems. The course has been designed in collaboration with a variety of NGO, charity, and industry partner organisations who are major employers of ecology graduates to ensure that you have the cutting edge skills most desired for PhDs and job opportunities.

The course puts a strong emphasis on developing the practical, analytical and management skills required by public and private sector ecologists in a core framework of ecological theory. The taught course has a strong practical or project work content that is delivered in concert with external organisations to give direct experience of a variety of applied ecology careers paths. This is then followed by a long research project with one an internal Imperial academic, or an external partner supported by an internal supervisor with complementary expertise.

1.1 Course administration

<table>
<thead>
<tr>
<th>Masters Course Director</th>
<th>Professor Tom Bell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postgraduate Administrator</td>
<td>Ms. Fathima Uddin</td>
</tr>
<tr>
<td>Postgraduate tutor</td>
<td>Dr. Will Pearse</td>
</tr>
<tr>
<td>MSc course coordinator</td>
<td>Dr. Mike Tristem</td>
</tr>
<tr>
<td>Blackboard e-learning website</td>
<td><a href="https://bb.imperial.ac.uk">https://bb.imperial.ac.uk</a></td>
</tr>
</tbody>
</table>

The course runs for one year from the 4th October 2021 through to 16th September 2022. The taught components of the course (lectures and practicals/workshops) typically start at 1000 and finish by 1700 but this varies from week to week – details for each week are provided in your electronic timetables. Please check Blackboard and your College e-mail regularly for the most up-to-date information. Wednesday morning is either used for taught material or reserved for private study and Wednesday afternoon is normally reserved for sports, leisure activities or private study.

In addition to the formal taught and research components of the programme, there is a research seminar series run at Silwood Park. Department seminars (which usually run between 1-2pm on Thursdays) are presented by a mix of internal and external researchers. These seminars are excellent way to hear about cutting edge research, meet leading scientists from all over the world, and to engage actively with the scientific process. We expect all Masters students to attend these seminars. You can find more information about seminars and journal clubs at Silwood in the Silwood Student Guidebook.

Teaching materials and other course materials are provided using the online Blackboard virtual learning environment (see link above). Paper copies of lecture notes and handouts are not normally provided but you will receive printing credit for use during the course on your security card.

It is anticipated that reading and coursework will require additional study in your own time. During research projects, you are expected to work full time on the project, including Wednesday afternoons. Some projects may require out-of-hours work, for example maintaining greenhouse experiments.

The full programme specifications for the MSc are available on Blackboard, but the following sections provide a summary of the programme and assessment structure.

The course objectives are that, on completion of the course, graduates will have:
• An understanding of basic and applied aspects of theoretical ecology as it applies to ecosystem health and function, conservation planning and monitoring, ecological policy and legislation, management of manmade and natural ecosystems.

• An ability to choose an appropriate ecological model to answer a particular question for ecological management or conservation.

• An ability to design, implement and evaluate field protocols.

• An ability to communicate effectively with a wide range of stakeholders, and appreciate their value and needs.

• An appreciation of the value of taxonomic skills, and a working knowledge of their application.

• An ability to generate, analyse and interpret typical ecological and conservation databases.

• A broad appreciation of the scientific opportunities within the ICL Department of Life Sciences as a whole, collaborating with research, industry and conservation institutions and globally in the area of applied ecology.

• A range of transferable skills including: communication skills (oral and written); project management, team project coordination; computing, statistics and mathematical modelling; specific research skills.

1.2 Course aims

The aims of the EA Masters programme are:

• To develop understanding of the fundamental principles underlying research in theoretical and applied ecology.

• To provide broad training in practical and analytical research skills relating to applied ecology.

• To show how these principles and skills can be applied to solve real problems facing the biosphere.

• To prepare students for a career in conservation or applied ecology.

• To prepare for PhD studies and make an informed choice of research topic.

1.3 Learning Outcomes

Knowledge and Understanding

• Ecological principles of population and environmental management and control;

• Social and economic dimensions of policy and management and their evaluation;

• Research techniques, including information retrieval, experimental design and statistics, modelling, sampling, taxonomic keys, bioassays, environmental microbiology, molecular biology, laboratory and field safety;

• Detailed knowledge and understanding of the essential facts, concepts, principles and theories relevant to the student’s chosen area of specialisation;

• Management and communication skills, including problem definition, project design, decision processes, teamwork, written and oral reports, scientific publications.

Skills and other Attributes
Intellectual Skills

- Analyse and solve ecological-based problems using an integrated multidisciplinary approach, applying professional judgements to balance costs, benefits, safety and social and environmental impact;
- Integrate and evaluate information;
- Formulate and test hypotheses using appropriate experimental design and statistical analysis of data;
- Plan, conduct and write-up a programme of original research.

Practical Skills

- Plan and execute safely a series of experiments;
- Use laboratory and field-based methods to generate data;
- Analyse experimental results and determine their strength and validity;
- Prepare technical reports;
- Give technical presentations;
- Use the scientific literature effectively;
- Use computational tools and packages.

1.4 Transferable Skills

Students will be able to:

- Communicate effectively through oral presentations, computer processing and presentations, written reports and scientific publications;
- Apply statistical and modelling skills;
- Management skills: decision processes, objective criteria, problem definition, project design and evaluation, risk management, teamwork and coordination;
- Integrate and evaluate information from a variety of sources;
- Transfer techniques and solutions from one discipline to another;
- Use Information and Communications Technology;
- Manage resources and time;
- Learn independently with open-mindedness and critical enquiry;
- Learn effectively for the purpose of continuing professional development.

All students must attend the taught weeks in both the Autumn and Spring Term. Students must also attend Thursday afternoon seminars appropriate to the course. Students are of course welcome and encouraged to attend any additional seminars as they wish. MSc students must also complete a 5-month research project running during the summer from April until end of August.

1.5 Course activities and assessment

Assessment of this work will be based on written examinations (30% of overall mark), two pieces of assessed coursework (20%) and the research project report, presentation and viva (50%). Students should not skip lectures or practicals to complete coursework.

An online list of research project titles is provided at:
The projects list will provide broad details of research projects but the precise topics of projects will be finalised in discussion between the student and potential supervisors. Project descriptions will appear throughout the year but you are also encouraged to discuss your own research ideas with staff to develop your own proposal. Project titles and supervisors should be confirmed to the course directors by 28/01/2022.

The assessed components and their percentage contribution to your overall mark are described below, along with the key dates and deadlines for this year.

Students will have the opportunity to undertake laboratory or field based research at Imperial College London as part of their independent project so long as they adhere to college regulations for accessing laboratory and field sites. We will additionally be providing a wide range of computational or data-based projects that can be conducted remotely.

Examinations (30% of overall mark)

There will be two examinations: an Essay Exam, and a Multiple Choice Exam.

The examinations are timetabled to follow two reading weeks dedicated to revision in Term 2. We will deliver these using the Timed Remote Assessment System through Blackboard. Detailed instructions about taking these exams will be sent to students in a timely manner prior to the examinations. Examination dates are provided in the Silwood Masters Student Guidebook.

- **Essay exam (15%)**
  This essay exam assesses all content from the first 6 months. You will be expected to write between one and three essay answers, and between one and two computing tests. Any alterations to this format will be communicated to students in a timely manner. An excellent answer to an essay exam question will comprehensively demonstrate analytical, synthetic and critical treatment of the material, and be between one and three pages long. We expect that these essays are well written, structured, logical, and concise. We expect you to demonstrate your knowledge including outside reading of the primary literature, to be evidenced in the content of your answer. You will have to choose three essay questions out of a choice of more questions.

- **Multiple choice exam (15%)**
  This will be a multiple choice exam, that examines all weeks taught.

Coursework (20% of overall mark)

Two pieces of coursework will be evaluated: a Research Proposal, and a Mini Project Report. Written pieces of coursework will be submitted electronically via Blackboard

- **Research Proposal (10%) Due Feb 25th 2022 at 5 pm**
  You will produce a proposal for the project you intend to undertake in the summer term. The proposal should include:
  
  - Introduction to the project and proposed idea- you should introduce the topic and explain the wider context of the project. This should demonstrate a knowledge and understanding of the past and current work on the subject.
  
  - Programme and methodology- identify the overall aims of the project and individual measurable objectives that you will use to assess progress, the methodology you will use to address these, explaining the timeliness and novelty of the specific experiments, observations, or theory that you propose. Explain the anticipated outputs of each component of the research, including which stakeholders will benefit from those outputs if relevant.
Programme of work: provide a timeline of how each milestone will be realised using a Gantt Chart if appropriate.

Budget: include a brief budget for conducting the research. If some precise costs are not known, an estimated cost may be included.

References. See Silwood Masters Guidebook for details.

The proposal should be a maximum of *4 pages*. Figures and table are allowed (and good ones are encouraged). We expect that about three-quarters of this proposal will be taken up by the background, aims, and objectives and that students may only be able to give basic details of the methodology at this point. The key objective of the assignment is to get practice effectively communicating a knowledge gap (including its importance and applied value), proposing a project to address this gap, and identifying the key hypotheses that must be addressed by your experiments.

• **Mini-Project Report (10%) Due March 15th at 5 pm**

You will be provided with an applied ecology dataset. You will need to and identify a question that interests you about this data set and run the analysis required to address this question (drawing on the analysis skills you have acquired in the Autumn modules). You will prepare a technical report for policy-makers explaining the implications of your findings supported by your analysis. Since the report is intended to be read by non-scientists, the language and figures should be appropriate for an informed lay audience. The report should be no more than 3 pages (excluding references) single spaced using 11-point Arial, 2 cm margins, font and may include any figures that believe are useful for communicating your results. The key objectives of the assignment are to give you a chance to practice using your analysis skills and communicating scientific results in a format that is useful for non-scientists.

**Research project (50% of overall mark)**

The research project must be completed and written up in the style and format of a scientific research paper. Full details of academic regulations and project assessment are given in the Silwood Masters Student guidebook. In brief, your project grade will be based on your supervisor’s assessment of the project (10% of the project mark), a mark on the written project agreed by two independent markers (60% of the project mark), a mark for your final research presentation (10%) as well as your performance in a viva voce examination (20%). A second viva with an external examiner may also be held for each student, which will be mandatory but not assessed.

1.6 **External vivas and examiners**

Students may be asked to undertake a final 30 minute viva with an External Examiner, to be held between the internal summer project viva and the final meeting of the Board of Examiners. These vivas form a part of both the exam moderation process and oversight of the course by the External Examiner, who is appointed from outside of the college.

It is common for Master’s level students to have some form of academic or social interaction with their external examiners at some point during or after their studies as well as during the assessment process itself.

It is inappropriate to submit complaints or representations directly to external examiners or to seek to influence your external examiners. Inappropriate communication towards an examiner would make you liable for disciplinary action.
2 Course details and timetables

2.1 Teaching staff
You will be taught by Imperial staff members and external partners from a very diverse set of research backgrounds. Current external partners include Syngenta, CABI, and the Surrey Wildlife Trust. Below are listed the main academic staff who will be teaching on the course.

<table>
<thead>
<tr>
<th>Lecturer</th>
<th>Topic</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cristina Banks-Leite</td>
<td>Community/behavioural ecology</td>
<td><a href="mailto:c.banks@imperial.ac.uk">c.banks@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Tom Bell</td>
<td>Microbial ecology</td>
<td><a href="mailto:thomas.bell@imperial.ac.uk">thomas.bell@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Lauren Cator</td>
<td>Behavioural ecology and disease ecology</td>
<td><a href="mailto:l.cator@imperial.ac.uk">l.cator@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Catalina Estrada</td>
<td>Field experiments, field ecology</td>
<td><a href="mailto:c.estrad@imperial.ac.uk">c.estrad@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Robert Ewers</td>
<td>Tropical forest ecology</td>
<td><a href="mailto:r.ewers@imperial.ac.uk">r.ewers@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Alex Sandoval</td>
<td>Genomics</td>
<td></td>
</tr>
<tr>
<td>Samraat Pawar</td>
<td>Systems biology and theoretical ecology</td>
<td><a href="mailto:s.pawar@imperial.ac.uk">s.pawar@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Richard Gill</td>
<td>Pollinator ecology and evolution</td>
<td><a href="mailto:r.gill@imperial.ac.uk">r.gill@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Julia Schroeder</td>
<td>Social behaviour and genetic variation</td>
<td><a href="mailto:julia.schroeder@imperial.ac.uk">julia.schroeder@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Bonnie Waring</td>
<td>Soil microbiology and biogeochemistry</td>
<td><a href="mailto:b.waring@imperial.ac.uk">b.waring@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Guy Woodward</td>
<td>Aquatic ecosystems</td>
<td><a href="mailto:guy.woodward@imperial.ac.uk">guy.woodward@imperial.ac.uk</a></td>
</tr>
</tbody>
</table>

2.2 Outline Timetable and Important Dates

We strive to adhere to the schedule printed below, but sometimes due to unforeseen circumstances we may have to make small changes to the timetable within a week.

For in-person students: In-person coursework and practicals will occur between 0900 and 1700 GMT.

For remote students: Live online sessions (e.g. question-and-answer sessions will be offered during normal working hours in your time zone (08:00 to 18:00 local time).

Wednesday afternoons are kept free to allow students the opportunity to read up on topics that have caught their interest or to catch up on lecture material.

Please be sure to confirm all dates/locations/times with iCalendar (AKA iCal)
http://www.imperial.ac.uk/timetabling/view/icalendar

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<tr>
<th>#</th>
<th>Week Starting</th>
<th>EA Week Title</th>
<th>Convenor</th>
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<tr>
<td>1</td>
<td>4 Oct</td>
<td>Induction</td>
<td>Tom Bell</td>
</tr>
<tr>
<td>2</td>
<td>11 Oct</td>
<td>Field Ecology Skills</td>
<td>Catalina Estrada</td>
</tr>
<tr>
<td>3</td>
<td>18 Oct</td>
<td>Biological Computing in R</td>
<td>Josh Hodge</td>
</tr>
<tr>
<td>4</td>
<td>25 Oct</td>
<td>Statistics in R</td>
<td>Julia Schroeder</td>
</tr>
<tr>
<td>5</td>
<td>1 Nov</td>
<td>Geographic Information Systems (GIS)</td>
<td>David Orme</td>
</tr>
<tr>
<td>6</td>
<td>8 Nov</td>
<td>Genomics and Bioinformatics</td>
<td>Alex Sandoval</td>
</tr>
<tr>
<td>7</td>
<td>15 Nov</td>
<td>Landscape Ecology and Conservation</td>
<td>Cristina Banks</td>
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<tr>
<td>8</td>
<td>22 Nov</td>
<td>Environmental Microbiology I</td>
<td>Tom Bell</td>
</tr>
<tr>
<td>9</td>
<td>29 Nov</td>
<td>Environmental Microbiology II</td>
<td>Tom Bell</td>
</tr>
<tr>
<td>10</td>
<td>6 Dec</td>
<td>Scientific Writing</td>
<td>Julia Schroeder</td>
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<tr>
<td>11</td>
<td>13 Dec</td>
<td>Biocontrol and IPM</td>
<td>Lauren Cator</td>
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Winter Break
2.3 Taught theme descriptions

Course Induction
Convenor: Tom Bell (thomas.bell@imperial.ac.uk)
This module introduces fundamental principles and approaches for ecology, evolution and conservation. In part, it demonstrates the range of research within the department and helps you to start thinking about possible topics for your research projects. The week also includes a number of important induction events.

Reading:
Recent issues of Trends in Ecology and Evolution and Ecology Letters

Field Course at Silwood
Convenor: Catalina Estrada (c.estra@imperial.ac.uk)
The aims of this module is that you get experience planning and implementing field research, become familiar with a wide range of basic field research methods in Ecology and learn about data management. We will learn about field research at Silwood, including multiple long-term experiments and study sites for global studies.

We aim to:
* Learn to plan field research to describe and compare natural communities
* Learn general field sampling techniques for statics and mobile organisms
* Learn basic taxonomic sorting and identification of common organisms in Silwood Park grounds
* Learn to estimate ecosystem productivity
* Get familiar with Silwood Park fields and experiments

Reading:
Biological Computing in R
Convener: Josh Hodge (j.hodge@imperial.ac.uk)

In this week, you will learn how to use this freely available statistical software with strong programming capabilities. R has become tremendously popular in Biology due to several factors: (i) many packages are available to perform all sorts of statistical and mathematical analysis, (ii) it can produce beautiful graphics, and (iii) it has a very good support for matrix-algebra (you might not know it, but you use it!). So with R, you have an expanded and versatile suite of biological computing tools at your fingertips, especially for automating statistical analysis and the generation of figures. Therefore, R should become an indispensable component of your biological research workflow.

In this week we will:

- Learn how to use R for data exploration
- Learn how to use R for data visualization and producing elegant, intuitive, and publication quality graphics.
- Learn R data types & structures and control flows.
- Learn how to write and debug efficient R scripts and functions.
- Learn how to use R packages.

Reading:

- Ben Bolker’s ‘Ecological Models and Data in R’ is also very good.
- For more focus on dynamical models: Soetaert & Herman. 2009 ‘A practical guide to ecological modelling: using R as a simulation platform’.
- There are excellent websites. Besides CRAN (containing all sorts of guides and manuals), you should check out www.statmethods.net and en.wikibooks.org/wiki/R_Programming and google ‘R Graph Gallery’ for various sites showing graphing options and code.

Statistics in R
Convener: Julia Schroeder (julia.schroeder@imperial.ac.uk)

In this week we will build upon the introduction to R you received in "Biological computing in R" week (or the Q/CMEE Bootcamp: Biological Computing in R week) and learn a core set of statistical methods that are of wide use in research projects. These statistical tests will form the basis for any data analysis you will do in the future. This week is shared with most courses and runs in two blocks A and B.

Aims:

- Basic statistics for ecology and evolution, with a focus on applicability. Mostly parametric tests (descriptive statistics, t-test, ANOVA, correlations, linear models, hypothesis testing).

Reading:
There are a wide range of introductory books for R. See later statistics and computing weeks for more specialist texts but, for this week, the following are good introductory and reference texts that are available in Silwood library and as an e-book through Imperial:

Main reference:


Spatial Analyses and Geographic Information Systems (GIS)
Convenor: David Orme
This week will teach key skills in using and handling GIS data, along with basic remote sensing to generate GIS data and the use of GIS data in a range of applications. We will use the open source GIS program QGIS (http://www.qgis.org/). We will look at creating and georeferencing both vector and raster data and how to use GIS tools to create a workflow to carry out simple analyses.

At the end of this week you should have:
1. Familiarity with a range of GIS data types
2. Confidence in obtaining and handling GIS data
3. Familiarity with open source tools for GIS
4. Practical experience in applying GIS to ecological questions

Reading:

Genomics and Bioinformatics
Convenor: Alex Sandoval
Population genomic data contain valuable information on how species relate to each other and how they evolved and adapted to their environment. As such, the study how genetic diversity within species is central to addressing many questions in evolution, ecology, and conservation. New sequencing technologies allow for the generation of large-scale genomic data which are pivotal for an understanding of population processes at deep resolutions. The goal of this module is to introduce students to the types of questions that can be addressed with population genomic data, and the theory and computational methodologies that are available for answering these questions.

The content will be provided via online lectures and practicals. Lectures will be either live or recorded. Additionally, there will be recordings for preparatory and advanced material. If allowed, some lectures and practical sessions will be delivered in person. Nevertheless, the online material will be available to all and will cover all content.

Learning outcomes:
1. Describe how genomic data is generated and the challenges associated to its analysis
2. Understand the theory of population genomics and its applications to estimate evolutionary parameters, including population structure, demography and natural selection.

3. Implement bioinformatic pipeline to perform evolutionary inferences from genomic data.

**Landscape and Ecology and Conservation**

Convenor: Cristina Banks ([c.banks@imperial.ac.uk](mailto:c.banks@imperial.ac.uk))

This module is designed to introduce concepts from landscape ecology and how these can be applied into the conservation and management of natural systems. The week starts with the essence of how habitat transformation leads to the loss of biodiversity. Topics covered include how biodiversity is influenced by habitat area quantity and quality, isolation, edge effects, and how local patterns are modulated by processes occurring at the landscape and regional scales. We also will discuss how these aspects of habitat change influence individuals, species, communities and ecosystem functioning. The second part of the week focuses on using knowledge obtained in the first part to preserve biodiversity and natural ecosystems. Topics covered include biodiversity indicators, creation of habitat corridors and reforestation/restoration. We will discuss cases where findings have been implemented into policy.

By the end of the module, you will have gained a better understanding of the complexities of habitat transformation, and how habitat change can influence species and ecosystems in non-linear and unpredictable ways. You will also learn to sift through the myriad of biodiversity responses to habitat loss and degradation to obtain a simple and coherent message that can used into policy making.

**Reading**


**Environmental Microbiology I and II**

Convenor: Tom Bell ([thomas.bell@imperial.ac.uk](mailto:thomas.bell@imperial.ac.uk))

Bacteria comprise the most abundant and diverse organisms on the planet. Bacteria also provide vital services, such as remediation of pollutants, and also underpin all ecosystems as important primary producers and decomposers. The two weeks will be focused on methods for surveying bacterial communities, as well as isolation and characterisation of target species. Lectures will be pre-recorded and delivered via blackboard and will be coupled with in person questions and answer sessions for students on campus and online questions and answer sessions for remote students on Teams.

**Reading:**


Scientific Writing
Convenor: Julia Schroeder (j.schroeder@imperial.ac.uk)
This module will provide you with essential skills of scientific writing that you need for the exams, coursework, and thesis writing.
After taking part in this module, you will be able to critically review a text and identify problematic parts. You will be able to analyse the logical flow of the text, spot problems and solve them. You will have the knowledge of how to successfully write an essay or a scientific report. A weekly student-led peer-review meeting will result from this module.

Reading


Biological Control and Integrated Pest Management
Convenor: Lauren Cator (l.cator@imperial.ac.uk)
One of the most economically important applications of ecological knowledge is in the management of pests and invasive species. This is particularly true of management solutions that do not use synthetic pesticides. In this week you will be introduced to the theory of biocontrol and integrated pest management. We will hear from experts actively working in this exciting field.
By the end of this week students should: Be able to discuss the theoretical underpinnings of Biocontrol and IPM, Describe what makes a good candidate for a Biocontrol agent, Discuss how biocontrol can be integrated with more conventional control methods, Be familiar with current applications this theory

Reading:

Agro-ecosystems
Convenor: Bonnie Waring (b.waring@imperial.ac.uk)
This module will provide an introduction to research in the field of agroecology and the agritech approaches, focusing particularly on plant-soil interactions, soil biogeochemistry, and plant-pathogen interactions. It will include lectures and discussions sessions from Silwood staff as well as staff from across the department who are currently conducting research in this growing area.

Generalised linear models
Convenor: Julia Schroeder (julia.schroeder@imperial.ac.uk)
This module builds on the basic linear models introduced in the previous term to introduce some key concepts that allow linear models to be applied to a wider range of research problems. This will include using generalised linear models to handle count and binomial data - where residuals are not expected to follow a normal distribution - and the use of structured models to allow for non-independence in data and to control for known sources of variation in data. You will learn how to analyse and interpret linear models, linear mixed models, general linear models and generalised linear mixed models. You will be able to apply
and choose the right model for your question and data, and you will be able to assess which variables to model as random or fixed factors.

**Reading:**


**Literature Review and Project Proposals**

Convenor: Tom Bell ([thomas.bell@imperial.ac.uk](mailto:thomas.bell@imperial.ac.uk))

Students will conduct independent literature reviews on the subject of their intended Research Project for the summer term. Building off of this literature review the students will develop a project proposal based off a BBSRC standard grant format for their summer proposal. Students will exchange drafts and offer constructive feedback on the proposal. At the end of the week, students will deliver a short (5 minute) elevator pitch to their classmates. Lectures will be delivered on Blackboard with both in person and remote live question and answer sessions. Small group work will be conducted in person as allowed by current guidelines or using Teams.

**Surrey Wildlife Trust Group Project**

Convenor: Surrey Wildlife Trust with Stephen Fry ([stevefry@stephenfryconsulting](mailto:stevefry@stephenfryconsulting))

In this module students will learn more about conservation efforts in the Thames Valley. Students will engage with learn about the types of data relevant to informing conservation issues at Chobham Common National Nature Reserve. This course will be run in conjunction with the Surrey Wildlife Trust who manage this Reserve.

**Mini-Project**

Convenor: Tom Bell ([thomas.bell@imperial.ac.uk](mailto:thomas.bell@imperial.ac.uk))

Students will be provided with multiple years of data from one of Silwood's Mesocosom. You will choose one of these data sets and a research question that interests you. You will conduct independent analysis of this data set and create a report that would be useful for a policy maker based on your findings. Lectures will be delivered on blackboard with both in person and remote live question and answer sessions.

**Ecology and Global Change**

Convenor: Guy Woodward ([g.woodward@imperial.ac.uk](mailto:g.woodward@imperial.ac.uk))

We will investigate the major drivers and consequences of global change across all levels of biological organisation – from genes to ecosystems and the entire biosphere. The material covered here will link the teaching closely to ongoing research at Imperial, so the students are exposed to the cutting edge of our understanding of this field. The course will address current issues related to climate change, biodiversity loss, resource overexploitation, land-use change and chemical pollution, both in isolation and also in combination, where we will explore synergies among multiple stressors. We will combine a mix of lectures with practical exercises and data exploration from ongoing experiments at Imperial. Teaching will be delivered by a spectrum of researchers, both at Imperial and with our collaborators based at other institutes, to give as broad a diet as possible to the students during this course. Students will then give a brief presentation at the end of the week.

**Reading:**


**Behavioural Ecology**

Convenor: Richard Gill (r.gill@imperial.ac.uk)

Whether it is the dance of the honeybee, the dawn chorus of birds or the march of the penguins, the behaviour of animals has long captured the human imagination and the attention of ecologists. In this module we will explore the methods used by behavioural ecologists to test hypotheses about the evolutionary and ecological forces that shape behaviour and the morphological traits enabling such behaviour to be effectively carried out. The course will touch upon a variety of behavioural ecology topics and provide case studies to show how experiments can be designed effectively and how behaviour can be appropriately quantified to test the question(s) posed.

The course will use insect systems to study animal behaviour and ecology, in which students will design and undertake observations to test hypotheses they have raised. This includes studying bumblebees and/or mosquitoes, but ultimately this will depend on weather and insect stock conditions, so will be determined closer to the start of the module.

Learning Objectives

1. To think about the ultimate and proximate explanations for why specific behavioural and morphological traits exist. Understanding how these traits link to organism fitness, but also the challenges in measuring fitness.

2. How to approach designing an experiment that can appropriately measure and quantify behaviour in order to test your hypothesis, whilst understanding the compromises associated with lab and field studies.

3. The processes involved in collecting behavioural data, understanding the value of your data and how different components can be used to investigate different aspects of organism life-history.

4. Visualisation of data to guide downstream analysis, and an understanding of what are true independent replicates.

**Reading:**


Keller 2005 Levels of Selection, Princeton University Press, part of the series: Monographs in Behavior and Ecology
