Imperial College London

Masters in Ecology, Evolution and Conservation

(MSc)

Programme Guidebook

2020 – 2021

Department of Life Sciences, Imperial College London, Silwood Park Campus, Ascot, Berkshire, SL5 7PY, UK

Table of Contents

Along with this Guidebook, you will receive a copy of the Student Guidebook for the Silwood Park Campus Masters Courses (aka the Silwood Masters Guidebook), containing (among other things) the following important information:

Introduction to the department
Key contacts can be found in the Student Guidebook.

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

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! There are a range of options for providing feedback and getting support on your academic studies and the Student Guidebook provides details.

Thesis Guidelines
How to prepare you thesis, including word limits, formatting, etc.

Project and Supervision Guidelines
How to choose a project, student research budgets, what to expect (and not to expect!) from supervisors.

Electronic copies of both of these Guidebooks are available on the course website and on Blackboard.

1. Course overview

The first six weeks provide core concepts and skills through lectures, practicals and group-based activities. After this, we provide taught content in a wide range of current topics in ecology, evolution and conservation. The research projects undertaken by students provide the opportunity to develop a larger piece of independent research, based either in a lab within Imperial College, or with another institution in the UK, or in another country.

For full time students, the course runs for one year from the start of October 2020 through to the end of September 2021. The taught components of the courses (lectures online and in person, and practicals/workshops online and in person) typically start at 09.00 and finish by 16.00 but this varies from week to week. Even for remote teaching, and asynchronous assignments, we expect you to be able to read emails, check on teams and blackboard, during this time period. If that is problematic, please contact your course director.

An electronic timetable is provided by Imperial College. Wednesday morning is either used for taught material or reserved for private study. Wednesday afternoons are typically reserved for sports, leisure activities or private study (but this may be subject to change on the odd occasion).

Part time students are encouraged to seek a meeting with one of the course directors to plan the part-time course schedule based on individual needs and to ensure the best outcome of the course.

A research seminar series is held at Silwood Park most Thursdays by visiting academics. There are often additional internal seminars throughout the year. As a component of the course, you are expected to attend these research seminars. We also run a journal club and a scientific writing club. Both are initiated by staff, but we expect you to run these clubs independently after the first few sessions.

Teaching materials and other course materials are usually provided on the online Blackboard virtual learning environment. Paper copies of lecture notes and handouts are not provided. You will receive printing credit on your ID security card. Online meetings take place in Microsoft Teams, or similar, and arrangements are made by the individual module providers, and provided in the electronic timetable (celcat).

The course **requires considerable additional study in your own time for reading scientific publications and preparing coursework.** We expect you to work full time during both, the taught and project components.

Please be aware that many projects, due to the nature of the experiments or data collection, will require out-of-hours work, for example maintaining greenhouse experiments, catching birds early in the morning, feeding animals on the weekend, or running laboratory procedures that take longer than 8 hours. Out of hour work is not necessarily mandatory, but if you commit to a project that requires it, we expect it of you, and your performance counts for the project mark. **If you cannot commit to out of hours for work for personal or medical reasons, we advise you to choose a project that does not require out of hours' work. Similarly, if you cannot attend in person, we also advise you to choose a project that does not require you to be personally present. Several such projects are offered.** You must confirm the expected working hours with the project supervisor before committing to a project.

The full course specifications for the MSc are available on Blackboard and from the course websites. The following sections provide a summary of the courses, and assessment structures.

MSc website
https://www.imperial.ac.uk/life-sciences/postgraduate/masters-courses/masters-in-ecology-evolution--conservation-msc-and-mres/

Blackboard e-learning website
http://bb.imperial.ac.uk

1.1 Course Administration

MSc Course Director	Dr Julia Schroeder (julia.schroeder@imperial.ac.uk) Dr Matteo Fumagalli (m.fumagalli@imperial.ac.uk)
Postgraduate Administrator	Mrs. Amanda Ellis (amanda.ellis@imperial.ac.uk)
Senior Tutor Silwood	Dr Will Pearse (will.pearse@imperial.ac.uk)
Senior Tutor South Kensington	Dr Southall, Tony D (t.southall@imperial.ac.uk)
Director of Postgraduate Studies	Dr Niki Gounaris (k.gounaris@imperial.ac.uk)

1.2 Course aims

The *aims* of the EEC MSc courses are to:

- Develop an understanding of the fundamental principles underlying research in ecology, evolution and conservation.
- Provide broad training in practical and analytical research skills relating to ecology, evolution and conservation.
- Show how these principles and skills can be applied to solve real problems facing the biosphere.
- Prepare students for a career in conservation or applied biology.
- Prepare for PhD studies and make an informed choice of research topic.

1.3 Learning Outcomes

Developing a broad understanding of the direction and principles of current research areas, by participating in taught modules.

To acquire knowledge and understanding of many of the following:

- An understanding of basic and applied aspects of theoretical ecology as it applies to population dynamics, community dynamics, succession, habitat structure and ecosystem function
- An understanding of modern evolutionary theory and the methods of phylogenetic reconstruction and genomics as applied to ecological and evolutionary problems.
- An understanding of the broad issues concerning conservation of the biosphere and biodiversity, from local to global scales.
- An ability to choose an appropriate ecological or evolutionary model to answer a particular question for conservation
- An ability to generate, analyse and interpret typical ecological and evolutionary data and databases met in conservation work
- A broad appreciation of the scientific opportunities within the Division of Biology, Imperial as a whole, collaborating research and conservation institutions and globally in the area of ecology, evolution and conservation.
- A range of transferable skills including communication skills (oral and written); project design, implementation and evaluation, team project coordination; computing, statistics and mathematical modelling; specific research skills.

Further knowledge-based skills:

- Basic and applied ecology as it relates to population and community dynamics and ecosystem function;
- Ecological models and their application to predict dynamics and guide population management;
- Evolutionary theory as it relates to the origins and dynamics of diversity;
- Methods of evolutionary analysis, especially molecular approaches for population studies and phylogenetics;

- Research techniques, including information retrieval, experimental design and statistics, modelling, sampling, 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.

Experimental based skills:

- Analyse and solve ecological, evolutionary and practical conservation problems using an integrated multidisciplinary approach
- 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.
- Plan and know how to execute safely a series of experiments
- Know how to use laboratory and field–based methods to generate data
- Devise theoretical models for given problem and implement them in computer simulations
- 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

Transferable skills:

- Communicate effectively through oral presentations, written reports and scientific publications
- Apply statistical and modelling skills
- Management skills: decision making, problem definition, project design and evaluation, risk management, teamwork and coordinatio
- 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

Throughout the course, students are encouraged to undertake independent reading of primary, and secondary literature to supplement and consolidate course content and to broaden their individual knowledge and understanding of the subjects. Assessment of the knowledge takes place through a combination of written exams, assessed coursework and practical write-ups, and the students' individual project write-ups. At the end of the year the student will be examined by viva voce, and some by visiting external examiners.

Information sifting and sorting, analysis and problem-solving skills are promoted through the core course. Experimental design and statistical skills are developed in lectures, computer-based practical work in the core courses, the coursework and mini-projects, and subsequently in the individual research projects. Individual, formative and summative feedback is given to students on all work produced including oral presentations.

1.4 Course assessments

Students must attend ten weeks of taught modules in the Autumn Term and a further six weeks of taught modules and a two-week mini project during the Spring Term. Over this period, students must also complete three pieces of assessed coursework. Exams will be after the first two terms. Students are expected to attend Thursday seminars, which can form the basis of questions in essay exams. Students must complete a five-month research project running during the summer from April until September.

Assessment is based on two examinations (30% of final mark), the coursework (20%) and the research project (performance, report, viva and final presentation) (50%). We expect students attend all lectures or practicals, and to complete all coursework.
The assessed components and their percentage contribution to your overall mark are described below, along with the *key dates and deadlines* for this year.

Taught element

Examinations component (30% of overall mark)
The examinations are timetabled in Term 2 after two reading weeks dedicated to revision. One exam requires you to write essays, therefore it is essential that you are able to write a logically structured essay. The scientific writing week, and peer-review sessions will guide you how to do that well. All exams require you to synthetically, critically and analytically assess existing research, to revise for that it is advised to attend the peer-run journal club and critically assess articles from the primary literature. All examinations are open book.

Essay exam (15%)
This essay exam assesses all content from the first 6 months. You are expected to write two essay answers, and one computing tests, for which you will have to submit an R script or similar. An excellent answer to an essay exam question will comprehensively demonstrate analytical, synthetical 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.
Tuesday 30th March 2021 10:00 – 13:00 March essay exam

Multiple choice exam (15%)
This will be a multiple-choice exam, that examines all weeks taught. You will have two hours to complete it.
Monday 29rd March 2021 10:00 – 12:00 Multiple choice exam

Coursework component (20% of overall mark)

Mini-project report (10%)
During the spring term, each student will work independently on a research question using existing data and analyse this using basic methods. You will have to present a short-written, formal scientific report (4 pages of scientific report including references, figures, with a minimum font Times New Roman pt 11, and 2.5cm margins) of the mini project. We expect the scientific part (first 4 pages) to contain an abstract, introduction, methods, results, discussion, and list of references.
A 5th page of text should follow with an essay detailing your assessment of what you learned during the mini-project about your working style, about what went wrong, what went well, and what consequences you will draw from this for your main project. This can include your own project management style, how to overcome procrastination, a reflection of your strength and weaknesses and how you will seek support for the latter in your main project.
You are also expected, as a separate document, to submit a complete R script, extensively commented, to generate all results, tables and graphs in your report, together with the dataset(s). The script must reliably generate the results from the dataset on any computer. These instructions, and exemplary reports from past students will be available on Blackboard.
You must submit report and presentation **as pdf files** on Blackboard (Assignment submission -> Mini project report.

Mini-project Report and presentation Hand In deadline: Thursday 25th Feb 2021 by 13:00

Mini-project presentation (5%)
Each student will give a 10-minute presentation to introduce their mini-project research, explain their methods, show what their findings were, discuss the interpretation and any limitations, and briefly state how they would extend their research with more time and money. The presentation must be submitted at the same time as the report, so you will need to manage your time wisely.
You must submit both, report and presentation **as pdf files** on Blackboard (Assignment submission -> Mini project presentation dropbox.
The presentation and assessment will take place on
Mini-project presentations: Friday 26st Feb 2021 from 10:00

Seminar diary (5%)
Students must aim to attend all the Thursday seminars, even if one is rescheduled to a day other than Thursday. You will write an essay of 1A4 page on a minimum of 6 of these seminars and create a "seminar journal" for submission as part of the coursework mark. This essay collection will be marked for your **synthetical**, **critical** and **analytical** treatment of the seminar. That means, we expect you to not only re-iterate the content, but also to **put it into the wider scientific context** (to do that, you'd need to read papers from people other than the seminar speaker), **to evaluate the logical arguments made**, formulate **the hypothesis tested**, and try to understand and **criticize the figures and tables, examine the underlying data and data structure for its suitability for the analysis** (in terms of sample size, data structure etc.). All this will help you hone your critical scientific ability. The Seminar diary is due at the end of the Spring term (submit on Blackboard).
March 26th 2021 Seminar diary deadline

Research element
Research project (50% of overall mark)
Research project performance (10% of project mark)
Your project supervisor will assign a grade based on your work over the course of the project, including any field, lab or desk-based research as well as how well you worked within a laboratory or group.

Research proposal
Each student must write a project outline in the style of a grant application. You must use your thesis project, and you should discuss your proposal with your supervisor. Make sure you contact your thesis supervisor early and agree on a project explicitly and early. **Guidelines to the proposal format are in the student guidebook.** You will need to submit it online and email a copy to the Postgraduate Administrator.
Friday, 12th March 2021 by 13:00: Research proposal deadline

Research project report (60% of project mark)
The research project must be completed and written up in the style and formatting of a scientific research paper. All students need to also submit a complete R script, extensively and clearly commented, to generate all results, tables and graphs in your report, together with the dataset(s). The script must reliably generate the results from the dataset on any computer.

Research project final presentation (10% of project mark)
Each student will give a final conference-style presentation, and the performance will contribute to the final mark.

Research project viva (20% of project mark)
Each student will have a 25-30-minute viva with two internal examiners and your performance in the viva will contribute to the final mark.

Assessment

These regulations are set out in detail in the MSc EEC Programme Specifications, and in the Academic and Examination Regulations for Master's level degrees on the College's website. In short, you need to pass each element of the course to pass the course. The details can be found here:

http://www.imperial.ac.uk/about/governance/academic-governance/regulations/

Deadlines for the hand-in of research project reports, the final presentations, and vivas can be found in the student Guidebook, and detailed dates and times will be communicated later.

The current External Examiners are:
Dr Hannah Dugdale – University of Leeds
Dr Rachel White – University of Brighton

2. Expectations

2.1 What we expect from you during course:

For the course to run successfully and smoothly, information flow needs to be kept up. We therefore expect you to be excellent communicators. To ensure this ***we expect you to read your imperial emails, check in on Blackboard and Teams at least daily and reply if needed in a timely manner*.** Late notices about changes to the course timetable can occur due to unforeseen circumstance, so check it on Sunday evenings or Monday morning before a module.
A lot of the course content can be found on blackboard, in this guidebook, and the Master Student Guidebooks. Only if you still cannot find an answer should you email the Postgraduate administrator, or the course, or module convener.

Attend the courses. ***You will be examined on the content of the modules***. Furthermore, we have taken great care in selecting courses that will teach you skills required to tackle your projects. Missing out on this will lead to you struggling during your project. If you cannot attend the courses, notify the course convener.
If you are struggling do not hide it, but rather talk to one of us, a warden, or a tutor. We can often help. An academic tutor will be available (usually during a weekly drop-in slot) to answer technical questions.

2.2 What we expect from you during project work:

- **Take responsibility for your projects, own them!** Become responsible for the success of your project. This begins with choosing a topic early on. Communicate well, and regularly, with your supervisors. Check your email regularly and ***reply in a timely fashion***. The goal of this post-graduate course is that you turn into an independent researcher – to learn how to be independent you need to be pro-active, take initiative and feel responsible for your own projects. Your supervisors are here to help you accomplish this goal, but this is not a course where you will be spoon-fed. Furthermore, we also want you all become professionals – and thus we expect you to now already act like professionals!
- **Work hard, think for yourself, and take initiative.** Research cannot be accomplished with a lazy attitude. Imperial College is a top ranked university and **we expect that you will strive for excellence.** That includes being willing to put in the hard work even if it is uncomfortable at times. We give you the support you need but you must come forward yourself if you hit a problem – we cannot magically know that you struggle.
- **Display initiative.** You are the person who drives and strives to understand your project topic better. We expect you to push your research forwards, and to be curious about science.
- **Expect hurdles and set-backs.** Research is, by definition, a venture into the unknown, and it involves a lot of trial and error. All projects will encounter unforeseen circumstances. This is inevitable when carrying out novel and exciting projects! Note that failed experiments and analyses are not necessarily reasons for a bad mark, as we are marking you on your thinking, your approach and your effort rather than a specific result *per se*. Reaching out to others, talking about it, and being pro-active about finding ways to solve these problems will certainly help and ultimately, are what research is about.
- **Be willing to grow. Be self-critical** of your own work and results and use these skills in being sceptical of results in the literature. Start discussions with your peers about these!
- **Read relevant papers**. Search for relevant scientific papers, above and beyond the ones that your reading list suggests. A good routine to adopt is to read at least one paper every day, whether surrounding your topic or as outside reading.
- **Hone your writing skills**. Start writing parts of your thesis early on, and do not procrastinate writing. Writing usually should be revisited and edited several times, as only through this kind of repeated examination your work achieves excellence. Take part in the journal club and the peer-review sessions. ***Swap your essays with your peer and criticize each other's work***. This is an excellent activity to improve your writing skills.
- **Ask for feedback early**, and not in the last week before the hand-in deadline. Your supervisor will have more than your work to read, and you need some time to apply their comments, so give it a at least 14 days.

- **Be an active part of your supervisor's research group**. That includes attending group meetings, talking with your colleagues about research, asking for help and helping others. Notify your supervisor or course director of unforeseen (and foreseen) periods of absence.
- **Ask for help if needed**. We have a large range of support and advice available to you (tutors, health care, career advice, student support, immigration and visa services, counselling services, disability advisory services, chaplaincy centre, English language support, financial advice) but it is important you let us know if you have any issues.
- **Be aware of safety** always and follow safety procedures.

2.3 What you can expect from your project supervisors

- To be supportive of you both intellectually and personally
- To ensure that you have a clear idea of the aims and objectives in your projects at the start of your project
- To provide a safe and adequate work environment
- To be available (or provide an identified substitute) to talk about your research problems
- To help and guide you, be a sounding board and help you develop your confidence in your own abilities and research skills, to enable you to learn to work more independently and to make independent decisions confidently
- To help develop your skills in technical writing, presentations, problem definition and solving, statistical analysis and critical thinking
- To help you to realize projects that you think of yourself if possible
- To read your report and make constructive comments on both style and intellectual content given you provide it to us early enough before the submission deadline
- To expose you to scientific work of the highest quality, and give you all you need for you to become an excellent graduate

2.4 What is expected from all of us, students and academics:

- To adhere College policies and procedures
- To keep up research and academic integrity

3. Course details

3.1 Taught course module overview

Week	Starting	Module	Convenors
1	5 Oct 2020	Silwood Campus Introduction	Amanda Ellis
1	5 Oct 2020	Introduction to EEC	Richard Gill, Julia Schroeder
2	12 Oct 2020	Field Ecology Skills	Catalina Estrada
3	19 Oct 2020	Biological Computing in R	Josh Hodge
4	26 Oct 2020	Statistics in R	Julia Schroeder
5	4 Nov 2020	Spatial Analyses and Geographic Information Systems (GIS)	David Orme
6	9 Nov 2020	Genomics and Bioinformatics	Matteo Fumagalli
7	16 Nov 2020	Landscape Ecology and Conservation	Cristina Banks-Leite
8	23 Nov 2020	Phylogenetic reconstruction	Ian Kitching, Mark Carine
9	30 Nov 2020	Lundy Island Field Trip	Julia Schroeder
10	7 Dec 2020	Scientific Writing	Julia Schroeder
11	14 Dec 2020	Christmas Reading Week	-
12	21 Dec 2020	Winter Break	-
15	11 Jan 2021	Directed Reading	-
16	18 Jan 2021	Generalised Linear Models	Julia Schroeder, Josh Hodge
17	25 Jan 2021	Advanced Statistics	Josh Hodge
18	1 Feb 2021	Population Ecology and Quantitative Genetics	Julia Schroeder
19	8 Feb 2021	Evolutionary and community ecology	Joe Tobias
20	15 Feb 2021	EEC Miniprojects	Julia Schroeder, Matteo Fumagalli
22	1 Mar 2021	Ecology and Global Change	Guy Woodward
23	8 Mar 2021	Behavioural Ecology	Richard Gill
24	15 Mar 2021	Spring Reading Weeks	

26	29 Mar 2021	Spring Exams
27	5 Apr 2021	EEC MSc Project
49	7 Sep 2021	FrEEC Symposium

Other:

Start	End	Module	Convenors
5 Oct 2020	10 Jul 2021	Thursday Research Seminars	-
4 Nov 2020	10 Mar 2021	Silwood Masters Workshops	Samraat Pawar

3.2 Taught module descriptions

Descriptions of the content and learning objectives of the weekly lectures. The day-level timetables other than for the first week will be available through the iCalendar (AKA iCal) service after week one under: http://www.imperial.ac.uk/timetabling/view/icalendar

Delivery notes:
Please be aware that all students will have the opportunity for an on-campus experience with some teaching activities being delivered remotely and some on campus. However, all activities that are delivered on-campus will have a remote option or provision for any students who cannot attend in person.

The College will deliver the programme to ensure the approved learning outcomes are met and will take steps to make alternative arrangements in any extreme circumstances where this is not possible

Lecture recordings will be provided online. Practicals, where students get hands-on support, will take place in-person in Silwood Park, subject to the requirements (at the scheduled time of the sessions) of public health guidance and College guidelines on social distancing and any health and safety measures).

Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a remote option for students who cannot take part in person, or as back-up in case we are not safely able to teach in-person. Q&A sessions will take place to allow ample opportunity for any further student questions.

Some field trips and placements may be cancelled, postponed, rescheduled or amended, or delivered remotely. Thus, in exceptional circumstances, projects may have to be undertaken remotely rather than within a lab setting. These delivery notes apply to all module, except when the module outlines other arrangements.

The induction and welcome program for the EEC Masters courses runs in the first week, alongside the first module of the core taught course.

COVID-19 Safety: https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/biological-safety/covid-19-guidance/

https://www.imperial.ac.uk/about/covid-19/students/learning-experience/undergraduates-and-postgraduate-taught/programme-details-for-academic-year-2020-21/msc-ecology-evolution-and-conservation-offer-holders/

Ecology, Evolution and Conservation

Convenors: Amanda Ellis
Week: 1
Dates: 2020-10-05 to 2020-10-09
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

These are the campus-wide components of the induction week, common to all of the Silwood Park Masters programmes. You will be introduced to key teaching and administration staff. Presentations will demonstrate 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.

Introduction to EEC

Convenors: Richard Gill, Julia Schroeder
Week: 1
Dates: 2020-10-05 to 2020-10-07
Courses: MSc EEC, MRes EEC

Description

Two introductory lectures will run alongside the Campus Induction week and covers introduction to the course staff and to the specifics of the Ecology, Evolution and Conservation MSc and MRes programmes

Reading

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

Field Ecology Skills

Convenors: Catalina Estrada
Week: 2
Dates: 2020-10-12 to 2020-10-16
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE

Description

In this module you will experience planning and implementing field research, become familiar with basic field research methods and learn about data management. You will also get familiar with the Silwood Park campus grounds fields and long-term experiments. The campus, with about 100 ha of land, is recognized as an important refuge for wildlife and has several types of natural habitats including grassland, wetland and woodlands. It is also an active place of field research, hosting multiple long-term experiments and study

sites for global studies. The course will take place outdoors at the campus grounds or in a suitable area near you if are taking this course remotely.

Aims

- Planning field research with emphasis on experimental design, time and data management
- Map reading and navigation
- General field sampling techniques
- Recording techniques and analysis of field data
- Taxonomic sorting and identification of common organisms
- Communicating your research

Reading

These are reference book for designing and planning ecological work aiming to survey populations and communities in a variety of habitats:

- Wheater Cp, Bell JR & Cook PA (2011) Practical Field Ecology. Jhon Wiley & Sons, Inc. 362p. Available online with Imperial College libraries
- Sutherland WJ (ed) (2006) Ecological census techniques: a handbook. Second edition. Available online with Imperial College libraries Main document used for learning data management
- British Ecological Society (2018) Guides to better science: Data management. 37p Available at the British Ecological Society or Blackboard

This book chapter contains the history of Silwood Park grounds, ecosystems and research:

- Crawley MJ (2005) Silwood Park and its history. In: Crawley MJ, ed. The Flora of Berkshire. Harpenden, Hertfordshire, UK: Brambleby Books, 215–253.

Check this link at Imperial College website to know more about Silwood long-term field studies: http://www.imperial.ac.uk/silwood-park/research/field-experiments/

Module delivery

Lectures and resources for field practicals will be available online (Blackboard) and I expect to meet with you at least twice in live sessions using Microsoft Teams. Field activities are run in groups, so it is important that you check the module materials on Monday early morning of the week module, the latest.

Additional information

Please wear suitable clothes and footwear for outdoor activities and according with the weather forecast. *Long trousers, waterproof footwear, waterproof coat, water, a charged mobile phone and a rucksack are recommended in Silwood Park.*

Biological Computing in R

Convenors: Josh Hodge
Week: 3
Dates: 2020-10-19 to 2020-10-23
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc TBE, MRes Biosys

Description

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.

Aims

- 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 and structures and control flows.
- Learn how to write and debug efficient R scripts and functions.
- Learn how to use R packages.

Reading

- The Use R! series (the yellow books) by Springer are really good. In particular, consider: ‘A Beginner’s Guide to R’, ‘R by Example’, ‘Numerical Ecology With R’, ‘ggplot2’ (we’ll see this in another week), ‘A Primer of Ecology with R’, ‘Nonlinear Regression with R’, ‘Analysis of Phylogenetics and Evolution with R’.
- 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.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park.

Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Statistics in R

Convenors: Julia Schroeder
Week: 4
Dates: 2020-10-26 to 2020-11-03
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Description

In this week we will build upon the introduction to R you received in "Biological computing in R" week and learn to apply 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 consists of short lectures and a range of longer practicals that you will have to work on by yourself, interactively with large or small groups. There will be the opportunity to byo – bring your own data – and discuss different ways of analysing the same question. Practicals will not only involve running statistical analyses, but importance is also placed on biological interpretation.

Aims

In this week you will learn how to use statistics to better understand ecology, evolution and conservation. You will learn to apply and interpret the results of pametric tests, including descriptive statistics, t-test, correlations, and linear models).

Reading

There are a wide range of introductory books for R. See later statistics and computing modules 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:

- Beckerman, Andrew P. and Petchey, Owen (2012) Getting Started with R : An introduction for biologists Oxford University Press.
- Crawley, Michael J (2012) Statistics: An Introduction Using R. John Wiley.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park. Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Spatial Analyses and Geographic Information Systems (GIS)

Convenors: David Orme
Week: 5
Dates: 2020-11-04 to 2020-11-06
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE

Description

This module will teach key skills in using and handling GIS data, along with core concepts in GIS and remote sensing. 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. We will primarily be using R for data manipulation and analysis: you will already be familiar with R by this stage and it provides an open-source, scriptable and powerful engine for GIS. We will touch on the use of QGIS as a graphical interface for GIS that is better for data display.

Aims

At the end of this module you should have:

- Familiarity with a range of GIS data types
- Confidence in obtaining and handling GIS data
- Practical experience in creating maps
- Be able to perform basic data analyses and hypotheses testing in the spatial domain

Reading

- **Core text**: Geocomputation in R https://bookdown.org/robinlovelace/geocompr/
- GIS overview: Longley, PA (2011) Geographical information systems and science. Wiley.
- Coordinate systems: Van Sickle, G (2010) Basic GIS coordinates. CRC Press [https://www.dawsonera.com/abstract/9781420092325]

Genomics and Bioinformatics

Convenors: Matteo Fumagalli
Week: 6
Dates: 2020-11-09 to 2020-11-13
Courses: MSc EA, MSc EEC, MRes EEC, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Description

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.

Aims

This module provides an understanding of:

1. genomic data collection methods, and how to choose the data collection technique most appropriate to your question.
2. the wealth of data available to biologists in public genomic databases.
3. how genetic structure develops within and between populations and how to characterise it.
4. how demographic history affects genomic variation, and how to infer past population expansions and contractions from genomic data.
5. how migration affects genomic variation, and how patterns of gene flow can be inferred from genomic data.
6. how natural selection affects genomic variation, and how selection can be identified from genomic data.

Reading

Nielsen, Slatkin, 2013. An Introduction to Population Genetics: Theory and Applications. Oxford University Press, Oxford.

Module delivery

The content will be provided via online lectures and practicals. Lectures will be either live and 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.

Landscape Ecology and Conservation

Convenors: Cristina Banks-Leite
Week: 7
Dates: 2020-11-16 to 2020-11-21
Courses: MSc EA, MSc EEC, MRes eeChange

Description

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.

Aims

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

- Pardini, R et al. (2010) Beyond the Fragmentation Threshold Hypothesis: Regime Shifts in Biodiversity Across Fragmented Landscapes. PLoS ONE. 5 (10), e13666.
- Banks-Leite, C., et al. (2014) Using ecological thresholds to evaluate the costs and benefits of set-asides in a biodiversity hotspot. Science 345:1041–1045.
- De Coster et al. (2015) Atlantic forest bird communities provide different but not fewer functions after habitat loss. Proceedings of the Royal Society B-Biological Sciences 282:20142844.
- Pfeifer et al (2017) Creation of forest edges has a global impact on forest vertebrates. Nature 551:187–191.
- Orme, C. D. L. et al. (2019) Distance to range edge determines sensitivity to deforestation. Nature Ecology and Evolution 3:886-891
- Betts, M. et al (2019) Extinction filters mediate the global effects of habitat fragmentation on animals. Science 366:1236-1239

Phylogenetic reconstruction

Convenors: Ian Kitching, Mark Carine
Week: 8
Dates: 2020-11-23 to 2020-11-27
Courses: MSc EEC, MSc TBE, MRes Biosys

Description

This module considers the theory and practice of phylogenetic reconstruction under the principle of parsimony, and with particular reference to the analysis of morphological data. The principles of cladistics are introduced and the methods used to construct and assess cladograms explained.

Aims

Upon completion of this module, students should be able to:

- Understand the theory of cladistic analysis for phylogenetic reconstruction;
- Collect data suitable for a cladistic analysis;
- Code data appropriately;
- Analyse data fully using a range of methods;
- Assess the support accorded to a cladogram and its included groups.

Reading

- Kitching, I.J., Forey, P.L., Humphries, C.J. and Williams, D.M. (Eds), 1998. Cladistics (Second edition). The theory and practice of parsimony analysis. Systematics Association Publication 11. Oxford University Press, Oxford.
- Schuh, R.T. & Brower, A.V.Z. 2009. Biological systematics: principles and applications (second edition). Comstock Publishing Associates, Cornell University Press.
- Williams, DM & Ebach, MC 2020. Cladistics A Guide to Biological Classification (third edition). Cambridge University Press

General background reading

- Ax, P. 1987. The phylogenetic system. John Wiley & Sons, Colchester.
- Eldredge, N. & Cracraft, J. 1980. Phylogenetic patterns and the evolutionary process. Columbia University Press, New York.
- Gould, S.J. 1977. Ontogeny and phylogeny. Belknap Press of Harvard University Press, Cambridge, Massachusetts.
- Hennig, W. 1966. Phylogenetic systematics. University of Illinois Press, Urbana. Humphries, C.J. (Ed.) 1988. Ontogeny and Systematics. British Museum (Natural History), London.
- Nelson, G.J. & Platnick, N.I. 1981. Systematics and biogeography: cladistics and vicariance. Columbia University Press, New York.
- Rieppel, O. 1988. Fundamentals of comparative biology. Birkhauser Verlag.
- Platnick, N.I. & Funk, V.A. 1983. Advances in cladistics, volume 2. Proceedings of the Second Meeting of the Willi Hennig Society. Columbia University Press, New York.
- Schuh, R.T. 2000. Biological systematics: principles and applications. Princeton University Press.
- Scotland, R.W. & Pennington, R.T. 2000. Homology and systematics. Coding characters for phylogenetic analysis. Systematics Association Special Volume 58. Taylor & Francis, London.

- Scotland, R.W., Siebert, D.J. & Williams, D.M. (Eds) 1994. Models in phylogeny reconstruction. Systematics Association Special Publication No. 52. Oxford University Press, Oxford.
- Wiley, E.O. 1981. Phylogenetics: the theory and practice of phylogenetic systematics. Wiley Interscience, New York.
- Wiley, E.O., Siegel-Causey, D., Brooks, D.R. & Funk, V.A. 1991. The compleat cladist. A primer of phylogenetic systematics. University of Kansas Special Publication No. 19.

Lundy Island Field Trip

Convenors: Julia Schroeder
Week: 9
Dates: 2020-11-30 to 2020-12-04
Courses: MSc EEC

Description

This is a field trip to Lundy island, if the situation permits. If it is not possible to go, we will run this week as a virtual field course, which will cover the same learning aims. The virtual field course will also run for single students who may not be able to go to Lundy because of travel restrictions. However, it is intended that all students go. Note that in the case that the course runs both, remotely, and in person, the remote option will not be able to have synchronous contact with the convenor, as Lundy has very limited internet access. There will be other staff and GTAs teaching the field course.

If possible, we will visit Lundy Island in the Bristol Channel. This small, rocky outcrop with an interesting natural history will allow us to better understand life history biology, and population dynamics. We will collect ornithological data and will prepare a presentation of our findings. The entire island is designated as a “Site of Special Scientific Interest” because of its unique natural history.

Aims

- You will learn about life history evolution.
- You will gain a better understanding about life-history traits, trade-offs, about fitness, how to measure fitness, and how to measure behaviours.
- You will conduct observations and a mark-recapture analysis in a real-life research setting, and analyse a behavioural trade-off.
- You will learn how to collect life-history data in birds.

Additional information

- We need to leave Silwood very early on Monday to make it in time to catch our Helicopter. 4:00am means 4:00 in the middle of the night. Please be at the meeting point in time.

- Lundy is not connected to the mainland power grid, and therefore, electricity is limited. There is a generator so we will have power during daytime, but it usually shuts down at night. Therefore, bring headlights or a small torch so you can find your way back from the tavern to the accommodations without falling off a cliff.
- There is no doctor or pharmacy on the island. If you have a medical emergency you will have to call an emergency helicopter and you will be flown out, which, depending on your medical insurance, can be very expensive. If you suffer from any health issues that might be problematic in these circumstances, please contact the convenor early on.
- Lundy is remote, and the mobile phone network coverage is poor. It is likely that you will have no coverage, not even for text messages. There is no internet on Lundy. There is a pay phone in the tavern that you can use for emergencies.
- We will be flying by helicopter so luggage is limited to one luggage item per person that should not exceed 10kg. Luggage exceeding this may not be taken over, or you will have to pay rather high extra costs. Everyone can have one (small!) carry-on item that could be a laptop-bag or a camera backpack.
- We will stay in accommodations with shared bed rooms (2 to 14 people). There is tap water (hot and cold), although it can be limited under certain circumstances and therefore if possible, do limit showering to 3-5 Minutes each.
- There is a pub (Marisco Tavern) on Lundy, which will provide us with warm food for dinner.
- There is no cash machine or ATM on Lundy, or on the heliport on the mainland. You can, however, pay by card in the shop and tavern.
- Lundy is a windy, rocky outcrop in the Bristol Channel and it is end of November. It will be cold and wet. Do not underestimate the cold – with the wind chill it will easily be below freezing. We will spend long times outdoors, standing around, catching and monitoring birds. Bring warm clothing, gloves, hats and scarfs. It is highly recommended to bring sturdy outdoor shoes with **insulating** insoles, and **windproof, warm winter jackets**. It is highly recommended to bring **long ski underwear**. You will be cold. Thanks to the weight limitation of luggage, this means it is best to only bring functional clothing. Ask your convenor for advice for packing if in doubt.
- If you have, bring binoculars. There is a library in the tavern that holds some bird and other organismic ID guide books.
- Bring your laptop.
- There is a small, albeit real, possibility that a helicopter cannot fly on any given day, due to weather conditions. This could happen on our trip to and from Lundy. The former is not so problematic, but do expect it. If this happens on our return trip, **this could mean that we will not return to the mainland before Saturday**. It is important that you consider this and do not make any plans on the weekend that you cannot miss. When the helicopter cannot go there is no way to leave the island and then we are stuck. Consider this especially when you think about health/medical/travel/care issues (how much of a medical drug taken daily to bring,

GP appointments, plane tickets, children or pets that are being cared for in your absence ect). Rumour has it that once the helicopter could not go on two consecutive days, and while we keep our fingers crossed that that is just a rumour, keep in mind that this is a possibility when making plans.

- Generally, it is a field trip to a remote location. Expect changes in the time table, expect no luxurious conditions, expect to be exposed to the elements. Field biology can be rough, due to the environmental component. We will try to make everything go as smoothly as possible, but we cannot guarantee that everything will run according to plan.

Scientific Writing

Convenors: Julia Schroeder
Week: 10
Dates: 2020-12-07 to 2020-12-11
Courses: MSc EA, MSc EEC

Description

This module will provide you with essential skills of scientific writing that you need for the exams, coursework, and thesis writing.

Aims

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 his module.

Reading

- "They say/I say: The Moves that Matter in Academic Writing." Gerald Graff, Cathy Birkenstein, Russel Durst. Norton & Company. 2015.
- "The Elements of Style" William Strunk Jr. Spectrum Inc. Classic Edition 2017.
- "Successful Scientific Writing: A Step-By-Step Guide for the Biological and Medical Sciences." Janice R. Matthews. Cambridge University Press, 2015.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park. Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Christmas Reading Week

Convenors: None
Week: 11
Dates: 2020-12-14 to 2020-12-19
Courses: MSc EEC, MRes TFE, MSc TBE

Winter Break

Convenors: None
Week: 12
Dates: 2020-12-21 to 2021-01-09
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Directed Reading

Convenors: None
Week: 15
Dates: 2021-01-11 to 2021-01-16
Courses: MSc EEC

Generalised Linear Models

Convenors: Julia Schroeder, Josh Hodge
Week: 16
Dates: 2021-01-18 to 2021-01-22
Courses: MSc EA, MSc EEC, MRes TFE, MSc CMEE, MSc TBE

Description

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.

Aims

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

- Bolker et al. (2009). Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology & Evolution 24: 127-135.
- Crawley, MJ (2012) The R Book. John Wiley. http://imperial.eblib.com/patron/FullRecord.aspx?p=1120574.
- Zuur, Ieno, Walker (2009) Mixed effects models and extensions in Ecology with R (2009)
- Gelman, Hill (2007) Data analysis using regression and multilevel/hierarchical models.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park. Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Advanced Statistics

Convenors: Josh Hodge
Week: 17
Dates: 2021-01-25 to 2021-01-29
Courses: MSc EEC, MRes TFE, MSc TBE

Description

This module will present a series of single day workshops by members of staff on the use of the particular statistical techniques used in their research. The week aims to build familiarity with more complex statistics and with using R and to introduce a wider range of statistical methods that may be of use in projects and in later research.

Each day will introduce the research need for the methods, describe how the method is applied and then use research data to learn the use of the method in practice.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park. Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Population Ecology and Quantitative Genetics

Convenors: Julia Schroeder
Week: 18
Dates: 2021-02-01 to 2021-02-05
Courses: MSc EEC

Description

Understanding what governs population sizes in the wild across years is crucial to better understand how and why species persist. Assessment of population dynamical processes and predicting the future development of populations is crucial for conservations.

Quantitative genetics are important for understanding which traits are phenotypical flexible, and which ones are not, for predicting if, and how traits can evolve, what constraints evolutions, and whether populations can adapt to new environmental circumstances. This module will introduce classical population ecology, demographics, and population modelling and quantitative genetics.

We will combine a mix of lectures with practical exercises and data analysis from ongoing experiments at Imperial.

Aims

You will learn how to write short simulations to examine simple population dynamics. You will gain a better understanding of how to analyse sources of variance on phenotypic traits, and how to model relatedness matrices to quantify the additive variance component. You will learn to apply simple models to better understand fitness and selection. You will learn about variance-covariance models to examine selection in wild populations.

Reading

- Begon M., Mortimer M. & D. J. Thompson (2009). Population Ecology: A Unified Study of Animals and Plants. Wiley Blackwell, Oxford
- Rockwood, L. L. Introduction to Population Ecology (2006). Wiley Blackwell, Oxford.
- Roff, D. (1997). Evolutionary Quantitative Genetics. Chapman and Hall, New York.
- Charmantier, A., Garant, D. & L. E. B. Kruuk (eds) (2014) Quantitative Genetics in the Wild. Oxford University Press, Oxford

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park. Student groups may be formed and rotated to ensure compliance with social distancing. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions.

Evolutionary and community ecology

Convenors: Joe Tobias
Week: 19
Dates: 2021-02-08 to 2021-02-12
Courses: MSc EEC

Description

This module begins by exploring the diversification of plant and animal species and their assembly into ecological communities, focusing on the underlying mechanisms that generate patterns of species richness and community structure across space and time. Different sessions will examine the relative roles of environmental conditions, life history, and species interactions within and between trophic levels. We will then consider the implications for ecosystem function and discuss how these insights can help us to understand and manage complex ecosystems in the face of environmental change.

Reading

- Cavander-Bares et al. 2009 The merging of community ecology and phylogenetic biology. Ecology Letters 12:693-715
- Naeem et al. 2012 The functions of biological diversity in an age of extinction. Science. 336:1401-6

EEC Miniprojects

Convenors: Julia Schroeder, Matteo Fumagalli
Week: 20
Dates: 2021-02-15 to 2021-02-26
Courses: MSc EEC

Description

The miniprojects provide an opportunity to practice independent research skills before the start of the MSc research project. A mini project consists of a research question that you work on, and analyse data for it, and present it. You can use any sort of data that you would like to. The focus of this module is on you to get your hands dirty by starting to analyse and write up results by yourself.

These two weeks provide time to work on your projects and scheduled support for project development and guidance on analysis and writing

Module delivery

This is an independent learning module, where students are expected to work on their projects. There will be an introductory synchronous meeting online, with an asynchronous options for Q&A.The presentation will take place either in person or remotely, depending on the circumstances.

Ecology and Global Change

Convenors: Guy Woodward
Week: 22
Dates: 2021-03-01 to 2021-03-05
Courses: MSc EA, MSc EEC

Description

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

- Foley, J. A. et al. (2005). Global consequences of land use. Science, 309: 570-574.
- Atkin, O. K. et al. (2015). Global variability in leaf respiration in relation to climate, plant functional types and leaf traits. New Phytologist 206: 614-636.
- Woodward, G. et al. (2012). Continental-scale effects of nutrient pollution on stream ecosystem functioning. Science, 336: 1438-1440.
- Woodward, G. et al. (2010). Ecological networks in a changing climate. Advances in Ecological Research, 42: 71-138.
- Kordas, R. L., Harley, C. D. & O'Connor, M. I. (2011). Community ecology in a warming world: the influence of temperature on interspecific interactions in marine systems. Journal of Experimental Marine Biology and Ecology, 400: 218-226.
- Gray, C et al. (2014). Ecological networks: the missing links in biomonitoring science. Journal of Applied Ecology, 51: 1444-1449.
- O'Gorman, E. J. et al. (2012). Impacts of warming on the structure and functioning of aquatic communities: individual-to ecosystem-level responses. Advances in Ecological Research, 47:81-176

Behavioural Ecology

Convenors: Richard Gill
Week: 23

Dates: 2021-03-08 to 2021-03-12
Courses: MSc EA, MSc EEC

Description

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.

Aims

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

Reading

- Martin and Bateson. 2007. Measuring Behaviour: An Introductory Guide. Cambridge University Press.
- Fjerdingstad & Keller 2004 Relationships between phenotype, mating behavior, and fitness of queens in the ant *Lasius niger*. Evolution, 58(5), 2004, pp. 1056–1063
- Jones et al. 1998. Fisherian Flies: benefits of female choice in the lekking sand fly. Proc RSoc. 265. 1651-1657.
- Ketterson et al. 1992. Testosterone and Avian Life Histories: Effects of Experimentally Elevated Testosterone on Behavior and Correlates of Fitness in the Dark-Eyed Junco (*Junco hyemalis*) The American Naturalist, Vol. 140, No. 6 pp. 980-999

- Malo et al. 2005. Antlers honestly advertise sperm production and quality. Proc R Soc B. 272, 149–157
- Keller 2005 Levels of Selection, Princeton University Press, part of the series: Monographs in Behavior and Ecology
- Krebs, Davies and West. An Introduction to Behavioural Ecology. 4th Edition. 2012. Wiley-Blackwell
- Bourke 2011 Principles of Social Evolution (Oxford Series in Ecology and Evolution)

Spring Reading Weeks

Convenors: None
Week: 24
Dates: 2021-03-15 to 2021-03-27
Courses: MSc EA, MSc EEC, MSc CMEE, MSc TBE

Spring Exams

Convenors: None
Week: 26
Dates: 2021-03-29 to 2021-04-03
Courses: MSc EA, MSc EEC, MSc CMEE, MSc TBE

EEC MSc Project

Convenors: None
Week: 27
Dates: 2021-04-05 to 2021-08-28
Courses: MSc EEC

FrEEC Symposium

Convenors: None
Week: 49
Dates: 2021-09-07 to 2021-09-09
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Project Vivas

Convenors: None
Week: 50

Dates: 2021-09-13 to 2021-09-17
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Thursday Research Seminars

Convenors: None
Dates: 2020-10-05 to 2021-07-10
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

This is a research seminar series that runs at Silwood Park. It runs on Thursdays 13.00 and seminars are typically presented by visiting academics. Masters students are expected to attend these seminar series – they will expose you to a much greater breadth of relevant topics and potential project ideas than happens within a single course.

Silwood Masters Workshops

Convenors: Samraat Pawar
Dates: 2020-11-04 to 2021-03-10
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

A Workshop series focused on Project management and Job/PhD application skill sets

4. Research projects

Research project topics are generally part of ongoing active research within the Department and across a range of academic partners. As a result, research project topics are often developed around the first two terms for MSc summer projects. Find more information about the research projects in the Master Student's Guidebook.

4.1 External organization research areas

The examples below give outlines of project areas from some recent partners. More projects with external partners are likely to arise during the course. In the first instance, please contact the course directors about possible projects with external organizations.

Centre for Ecology and Hydrology, Wallingford
Research areas for projects are based around ecological modelling of UK systems, often with practical or policy implications. Previous topic areas include the following:

- Are extinction risks of plant species larger on the edge of distributions than in the centre? Based on Atlas data of the UK and the Netherlands we will look at spatial patterns in range decay of over a wide range of species over the last 50 years. Next to geographical patterns, a range of alternative environmental indicators for correlated extinction will need to be explored. Such information could feed into priorities to set in conservation of declining species.

- Dynamics of butterfly range expansion. Understanding landscape effects on colonisation and extinction can help us to facilitate species movements under changing climates. This project will investigate how landscape structure affects the colonisation of new sites at leading range margins. In addition, local extinctions will be related to landscape characteristics.

- Managing habitats for butterfly populations. Butterfly populations are highly sensitive to land management and understanding the long term effects management regimes can aid conservation. This project will investigate how nature reserves managed in different ways affect butterfly population dynamics. For example, does a heterogeneous management regime lead to more robust and stable populations?

- Floral homogeneity in the UK: the effects of non-native plants and urbanisation. Biotic homogenisation is regarded as a potential cause of biodiversity loss and is strongly linked with the arrival and dominance of non-native plants and animals and urbanisation. Using an extensive dataset on plant distributions at a tetrad scale collected at 2 time periods by the Botanical Society of the British Isles (BSBI) throughout the UK we will calculate similarity indices and look at spatial and temporal trends in similarity for native and non-native plants to investigate whether there is any signs of homogeneity in the British flora and what the mechanisms behind this are addressing questions such as: Are habitats that are more similar associated with higher numbers of alien species? Are urban habitats more similar than habitats in the wider countryside? Have plant communities become more homogeneous over time in the UK?

UNEP-World Conservation Monitoring Centre (UNEP-WCMC)
A wide range of projects addressing global/regional biodiversity and ecosystem services issues, including: international agreements synergies, conservation priority setting, international trade and regional economies, drylands and livelihood support, wildlife trade and social networks, access and benefit sharing, protected area targets and social values, monitoring deforestation and degradation, and more.

Institute of Zoology
The Institute of Zoology (IoZ) is a world-renowned research centre working at the cutting edge of conservation biology, and specialising in scientific issues relevant to preserving animal species and their habitats. As the scientific research division of the Zoological Society of London (ZSL), we undertake fundamental and applied research in five thematic areas:

- Behavioural and Population Ecology

- Biodiversity and Macroecology
- Evolution and Molecular Ecology
- People, Wildlife and Ecosystems
- Wildlife Epidemiology

Natural History Museum
Museum scientists are researching the solar system, Earth's geology and life in novel ways, using the unique combination of their expertise, collections and cutting-edge techniques. - See more at: http://www.nhm.ac.uk/our-science/our-work.html

Royal Botanic Gardens Kew
Kew is a global resource for plant and fungal knowledge. We have one of the largest and most diverse collections of plant and fungal specimens (living and preserved) in the world. Our unique combination of extensive collections, databases, scientific expertise and global partnerships gives us a leading role in facilitating access to fundamental plant and fungal information. The core purpose of our science stems from a simple but often overlooked truth: all our lives depend on plants.

5. Contingency plans

Given the uncertain nature of current world events, we ask you to please be patient with us in case we need to change something last minute. It might be that we cannot provide a certain content or event in the way described because it may have become unsafe, or even illegal. This is true in particular for the field course, but also for any events in a setting that is difficult to do with social distancing. Therefore, there is a possibility that we will change things if needed. We however will ensure that intended learning outcomes, as laid out in the programme specifications, are met.