Ecology, Evolution & Conservation Masters in Research (EEC MRes)

Programme Guidebook: 2018 – 2019

Department of Biological Sciences, Imperial College London, Silwood Park Campus, Ascot, Berkshire, SL5 7PY, UK
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This Guidebook provides you with course specific information. However, for you to successfully undertake your MRes you will also need to refer to the Silwood Masters Guidebook which contains important details for course completion, including:

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

**Academic regulations**
The EEC MRes course specific regulations 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. 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 your thesis, including structure, 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.

**The FrEEC Symposium**
All about the student-run Frontiers in Ecology, Evolution and Conservation (FrEEC) summer symposium at Silwood. This applies only to your second summer project.

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

For full time students, the course runs for one year from the start of October 2018 through to the end of September 2019. The taught components of the courses (lectures / practicals / workshops) typically start at 10.00 and finish by 16.30, but this can vary, and it is important to check your emails daily in case of any unforeseen circumstances that may arise. Details for each of the first 6 weeks are provided in this Guidebook, and an electronic timetable is provided on Blackboard.

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).

A research seminar series is held at Silwood Park on Thursdays at 1pm 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.

There is a monthly Silwood social seminar series held typically on the first Tuesday of the month, which is an opportunity for PhD student and postdoc researchers to present their work to a research audience. This is a great way to learn more about the research environment that will be surrounding you over the next year and you can learn about the research of the group you may be joining as part of your projects. The seminar comes with free drinks and food, set in an informal environment.

i) The first six weeks provide core concepts and skills through lectures, practicals and group-based activities. The aim of this teaching is provided you with key basic skills that can used and improved upon when undertaking your assessed research projects. Teaching materials and other course materials are usually provided on the online Blackboard virtual learning environment. Paper copies of lecture notes and handouts are normally not provided. You will receive printing credit on your ID security card. We expect you to work full time during both, the taught and project components.

ii) The two (Winter and Summer) research projects (each running for 4.5 - 5 months) that follow provide the opportunity to develop a larger piece of independent research, based either in a lab within Imperial College, or with another institution. 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. You must confirm the expected working hours with the project supervisor before committing to a project.

iii) Support will be provided during your two research projects in the form of drop-in sessions. During the first Winter project period a number of drop-in sessions will be organised for you to get information on how to approach your research projects, guidance on your analyses and writing, informal discussion about your progress on the course and any other questions you may have. There will also be support provided by PhD students on a regular basis if you have questions concerning hypothesis testing, methodological design and data analyses.
MRes website
http://www3.imperial.ac.uk/lifesciences/postgraduate/courselist/ecologyresearch

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

1.1 Course Administration

MRes Course Director
Dr Richard Gill (r.gill@imperial.ac.uk)
Postgraduate Administrator
Mrs. Amanda Ellis (amanda.ellis@imperial.ac.uk)
Senior Tutor Silwood
Dr Julia Schroeder (julia.schroeder@imperial.ac.uk)
Senior Tutor South Kensington
Dr Neil Fairweather (n.fairweather@imperial.ac.uk)
Director of Postgraduate Studies
Dr Niki Gounaris (k.gounaris@imperial.ac.uk)

1.2 Course aims

Assessment of the knowledge base is through the written reports, presentation and viva voce after the completion of each of the two projects (end of March/start April & end of August/start of September). Marks for each project will be equally weighted, each contributing 50% of the final mark. At the end of the year a subset of the students will also be examined by viva voce by visiting external examiners.

The aim of the EEC MRes is to:
• Develop an understanding of some 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 world problems facing the biosphere.
• Prepare students for a career in using research-based approaches to understanding the biological processes that underpin the natural world
• Help to fill key evidence and knowledge gaps in evolution and ecology.
• Think about how to apply such knowledge to help target conservation action.
• Prepare students for higher level research positions, such as PhD studentships.
• Guide students to realise their areas of interest and research potential.

1.3 Learning Outcomes

Developing independent research skills to be able to solve outstanding questions in ecology and evolution, and use this information to inform conservation and mitigative actions.

Acquire knowledge and understanding of many of the following:
• Basic and applied aspects of theoretical ecology as it applies to population and/or community dynamics, and ecosystem function
• Modern evolutionary theory and the methods of phylogenetic reconstruction and genomics.
• Broad issues concerning conservation of the biosphere and biodiversity, from local to global scales.
• Ability to choose an appropriate ecological or evolutionary model to answer a particular question for conservation
• Ability to generate, analyse and interpret ecological and evolutionary data and databases met in conservation work
• The scientific opportunities within the Department of Life Sciences at Imperial College that can allow interdisciplinary approaches to addressing pressing issues in the natural sciences.
• 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 execute safely a series of experiments
- 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 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.
1.4 Course assessments

Students following the MRes must attend the first 6 weeks of taught modules in the Autumn Term. Students may optionally attend some additional lectures on the MSc, but they must let the respective module organiser know. Attendance at research seminars is expected for MRes students, unless you are conducting your project off-site.

MRes students must complete two research projects: the Winter project, running between November and March; and the Summer Project, running between April and September. The projects must be with different supervisors and we recommend undertaking projects that tackle different questions and require using different skills to provide you with an enhanced learning experience and broader skill set.

Assessment of the MRes is based solely on the two research projects (50% each).

Before you officially start a project, you must submit a 2-page project proposal with details and plans to the director Richard Gill. This plan is not part of your final mark, but it is to be taken seriously and is compulsory before projects can start. Only the winter project proposal needs to be submitted before November 12th, the summer project proposal will not be required until April 2019. Detail on the proposal will be provided in an introductory lecture.

Research project performance (10% of one 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 project report (60% of one project mark)
The research project must be completed and written up in the style and formatting of a scientific research paper.

Research project final presentation (10% of one 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 one project mark)
Each student will have a 25-30 minute viva with two internal examiners and your performance in the viva will contribute to your final mark.

To pass the course, you must pass each project (i.e. a mark of 50% or higher).

MRes Project dates and deadlines
Deadlines for the hand-in of research project reports, the final presentations, and vivas should be presented in the student Guidebook.

FrEEC summer symposium
You will give your ‘summer research project final presentation’ at a graduate symposia. These are timetabled presentations, arranged as a mini-conference. For any career, but especially in research, it is important you get the opportunity to practice presenting your research, and this will be assessed by two internal examiners. The length of the presentation varies with the number of students and sessions held, but typically you can expect a 10 minute talk with 2-3 minutes of questions.
External vivas and examiners
A sample of students will undertake a final 15-20 minute viva with one of the External Examiners, to be held between the internal summer project viva and the final meeting of the Board of Examiners. Although the external vivas are mandatory for all students, they do not form part of your assessment. These vivas form a part of the exam moderation process.

The current External Examiners are:
Dr Julia Day – University College London
Dr Hannah Dugdale – University of Leeds
Dr Rachel White – University of Brighton
2. Expectations

2.1 What we expect from you during courses:
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 email 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. 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 six-week taught course. If you are struggling do not hide it, but rather talk to one of us, a warden, or a tutor. We can often help.

2.2 What we expect from you during projects 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 these Masters courses 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. We give you the support you need to do this 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 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, is what research is about.
- Think critically of science, and use these skills in being sceptical of results in the literature. Start discussions with your peers about these.
- Think outside the box. Learn to use your initiative to develop novel ways to address a problem.
- 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 over a number of rounds, as only through this kind of polishing does it achieve excellence.
- Swap your essays with your peers and criticize each other’s work. This is an excellent activity to improve your writing skills. Your supervisor needs a certain amount of time to read and comment on your work.
- 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.
- 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.
- **Learn from others research.** No, I do not mean steal ideas, but you can learn from other people’s approaches and apply them to your questions and system. Attend the departmental seminars and the social seminars.

- **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** at all times and follow safety procedures.

### 2.3 What you can expect from your project supervisors

- To be supportive of you both intellectually and personally
- To guide your thoughts in gaining 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

Dates for the winter project report submission, presentation and viva deadlines, and the drop-in sessions will be sent to you via email within the first six weeks of the course.

3.1 Taught course module overview

Shared between MSc and MRes (week starting):
1 01/10/18 Ecology, Evolution and Conservation Induction
2 08/10/18 Field ecology skills
3 15/10/18 Biological computing in R
4 22/10/18 Statistics in R
5 29/10/18 Spatial Analysis and GIS
6 05/11/18 Genomics and bioinformatics

Winter Project Start Date:
7 12/11/18 Winter Project

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

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

Ecology, Evolution and Conservation

Module: 1 (starting Monday 1st October)

Convenor: Amanda Ellis

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
• Ecology Letters
Field ecology skills

Module: 2 (starting *Monday 08th October*)

Convenor: Catalina Estrada

Description:

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. The course will take place at Silwood Park fields. 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.

Please wear the suitable clothes and footwear for outdoor activities and according with the weather forecast. You must wear long trousers and fieldwork shoes (e.g rubber boots, sturdy shoes). Waterproof jacket, hat, sun cream and water are recommended.

Aims:

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:

- [http://www.imperial.ac.uk/visit/campuses/silwood-park/research/silwood-lte/](http://www.imperial.ac.uk/visit/campuses/silwood-park/research/silwood-lte/) - Check this link at Imperial College website to know more about Silwood Park long-term field studies
Biological computing in R

Module: 3 (starting Monday 15th October)

Convenor: Josh Hodge

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

Module: 4 (starting Monday 22nd October)

Convenor: Julia Schroeder

In this module we will build upon the introduction to R you received in the Biological Computing in R week (or the Q/CME 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 many data analyses you will do in the future. This module is shared across multiple 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 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:


Spatial Analyses and Geographic Information Systems (GIS)

Module: 5 (starting Monday 29th October)

Convenor: Rob Ewers

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 land use change modelling. 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.

Aims:

By the end of this week you should have:

- Familiarity with a range of GIS data types
- Confidence in obtaining and handling GIS data
- Familiarity with open source tools for GIS
- Practical experience in applying GIS to ecological questions

Reading:

Genomics and bioinformatics

Module: 6 (starting Monday 5th November)

Convenor: Jason Hodgson

Aims:
Genetic data contain information about who organisms are, their relationships to other organisms, their population histories, and their histories of adaptation. Thus, genetic data and genetic techniques are central to addressing many questions in evolution, ecology, and conservation. New technologies allow for genetic characterization at the genomic level, and these data allow for an understanding of population processes at resolutions not possible in the past. The goal of this module is to introduce students to the types of questions that can be addressed with genomic data, and the methodologies that are available for answering these questions. Learning will be accomplished through a mix of lectures, computer practicals and group discussions.

Learning outcomes:
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, how to characterise it, and how to interpret the results of common analyses such as STRUCTURE and PCA.
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.
7. how phylogenetic relationships among species can be inferred, and what this information can tell us about evolution and conservation efforts.

Reading:

Population structure


Demography


Phylogenomics


**Natural Selection**


**Ecology and conservation**


For other modules running throughout the year that you may be interested in attending, please be proactive and look at the guidebooks for the other courses.

Details on research projects are provided in the Silwood Masters Guidebook, and will be covered in an introductory lecture and drop-in sessions by Richard Gill.