Imperial College London

MSc Course in Ecological Applications

Program of Study 2020-2021

Contents

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

Introduction to the department and facilities

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

Academic regulations

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

Thesis writing and submission guidelines

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

Welfare and Advice

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

Student Feedback and Representation

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

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

1 Course Overview

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

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

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

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

1.1 Course administration

Masters Course Director	Professor Tom Bell
Co-Convenor	Dr Lauren Cator/Dr Bonnie Waring
Postgraduate Administrator	Mrs. Amanda Ellis
Postgraduate tutor	Dr Will Pearse
Blackboard e-learning website	https://bb.imperial.ac.uk

The course runs for one year from the 5th October 2020 through to 17th September 2021. The taught components of the course (lectures and practicals/workshops) typically start at 1000 and finish by 1700 but this varies from week to week – details for each week are provided in your electronic timetables. Please check Blackboard and your College e-mail regularly for the most up-to-date information. Wednesday morning is either used for taught material or reserved for private study and Wednesday afternoon is normally reserved for sports, leisure activities or private study.

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

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

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

The full programme specifications for the MSc are available on Blackboard and from the course websites below, but the following sections provide a summary of the programme and assessment structure.
http://www3.imperial.ac.uk/lifesciences/postgraduate/courselist/ecologicalapplications

The course *objectives* are that, on completion of the course, graduates will have:

- An understanding of basic and applied aspects of theoretical ecology as it applies to ecosystem health and function, conservation planning and monitoring, ecological policy and legislation, management of manmade and natural ecosystems.
- An ability to choose an appropriate ecological model to answer a particular question for ecological management or conservation.
- An ability to design, implement and evaluate field protocols.
- An ability to communicate effectively with a wide range of stakeholders, and appreciate their value and needs.
- An appreciation of the value of taxonomic skills, and a working knowledge of their application.
- An ability to generate, analyse and interpret typical ecological and conservation databases.
- A broad appreciation of the scientific opportunities within the Division of Biology, Imperial as a whole, collaborating research, industry and conservation institutions and globally in the area of applied ecology.
- A range of transferable skills including: communication skills (oral and written); project management, team project coordination; computing, statistics and mathematical modelling; specific research skills.

1.2 Course aims

The *aims* of the EA Masters programme are:

- To develop understanding of the fundamental principles underlying research in theoretical and applied ecology.
- To provide broad training in practical and analytical research skills relating to applied ecology.
- To show how these principles and skills can be applied to solve real problems facing the biosphere.
- To prepare students for a career in conservation or applied ecology.
- To prepare for PhD studies and make an informed choice of research topic.

1.3 Learning Outcomes

Knowledge and Understanding

- Ecological principles of population and environmental management and control;
- Social and economic dimensions of policy and management and their evaluation;
- Research techniques, including information retrieval, experimental design and statistics, modelling, sampling, taxonomic keys, bioassays, environmental microbiology, molecular biology, laboratory and field safety;
- Detailed knowledge and understanding of the essential facts, concepts, principles and theories relevant to the student's chosen area of specialisation;
- Management and communication skills, including problem definition, project design, decision processes, teamwork, written and oral reports, scientific publications.

Skills and other Attributes

Intellectual Skills

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

Practical Skills

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

1.4 Transferable Skills

Students will be able to:

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

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

1.5 Course activities and assessment

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

An online list of research project titles is provided at: https://silwoodmasters.info/project_proposals
The projects list will provide broad details of research projects but the precise topics of projects will be finalised in discussion between the student and potential supervisors. Project descriptions will appear throughout the year but you are also encouraged to discuss your own research ideas with staff to develop your own proposal. Project titles and supervisors should be confirmed to the course directors by 25/01/2020.

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

Course Delivery Statement

All students will have the opportunity for an on-campus experience with some teaching activities being delivered remotely and some on campus. 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 teaching delivery statements apply to all course modules unless specific differences are noted under individual modules below

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-ecological-applications-offer-holders/

Examinations (30% of overall mark)

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

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

- Essay exam (15%)
  This essay exam assesses all content from the first 6 months. You are expected to write between one and three essay answers, and between one and two computing tests. An excellent answer to an essay exam question will comprehensively demonstrate analytical, synthetic and critical treatment of the material, and be between one and three pages long. We expect that these essays are well written, structured, logical, and concise. We expect you to demonstrate your knowledge including outside reading of the primary literature, to be evidenced in the content of your answer. You will have to choose three essay questions out of a choice of more questions.
  Provisionally Tuesday 30th March 2020 10:00 – 13:00 March essay exam

- Multiple choice exam (15%)
  This will be a multiple choice exam, that examines all weeks taught.
  Provisionally Monday 29th March 2020 10:00 – 12:00 Data interpretation exam

Coursework (20% of overall mark)

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

- Research Proposal (10%) Due Feb 5th 2021 at 5 pm
  At the conclusion of the Literature Review and Project Proposal Modules you will produce a project proposal for the project you intend to undertake in the summer term. The proposal should take the form of a BBSRC Case for Support. The proposal should include:
    - Background- introduction of the topic of research and explanation of its wider context. This should demonstrate a knowledge and understanding of the past and current work on the subject (which you will have obtained in the Lit Review week)
    - Programme and methodology- identify the overall aims of the project and individual measurable objectives that you will use to assess progress, the methodology you will use to address these, statement of timeliness and novelty.
    - Programme of work with timeline of how each milestone will be realised.

  The proposal should be a maximum of 6 pages, single spaced using 11 point Arial font. Figures and table are allowed (and good ones are encouraged). We expect that about three-quarters of this

proposal will be taken up by the Background, Aims, and Objectives and that students may only be able to give basic details of the methodology at this point. The key objective of the assignment is to get practice effectively communicating a knowledge gap (including its importance and applied value), proposing a project to address this gap, and identifying the key hypotheses that must be addressed by your experiments.

- Mini-Project Report (10%) Due March 15th at 5 pm
  You will be provided with data about the Silwood Mesocosms. [INSERT MORE DETAIL HERE] and identify a question that interests you about this data set and run the analysis required to address this question (drawing on the analysis skills you have acquired in the Autumn modules). You will prepare a technical report for policy-makers explaining the policy implications of your findings supported by your analysis. The report should be no more than 2 pages single spaced using 11-point Arial font and may include any figures that believe are useful for communicating your results. The key objectives of the assignment are to give you a chance to practice using your analysis skills and communicating scientific results in a format that is useful for policy makers.

Research project (50% of overall mark)

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

1.6 External vivas and examiners

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

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

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

External examiners reports can be found here:

www.imperial.ac.uk/staff/tools-and-reference/quality-assurance-enhancement/external-examining/information-for-staff "

2 Course details and timetables

2.1 Teaching staff

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

Cristina Banks-Leite	Community/behavioural ecology	c.banks@imperial.ac.uk
Tom Bell	Microbial ecology	thomas.bell@imperial.ac.uk
Lauren Cator	Behavioural ecology and disease ecology	l.cator@imperial.ac.uk
Catalina Estrada	Field experiments, field ecology	c.estrada@imperial.ac.uk
Robert Ewers	Tropical forest ecology	r.ewers@imperial.ac.uk
Matteo Fumagalli	Genomics	m.fumagalli@imperial.ac.uk
Samraat Pawar	Systems biology and theoretical ecology	s.pawar@imperial.ac.uk
Richard Gill	Pollinator ecology and evolution	r.gill@imperial.ac.uk
Julia Schroeder	Social behaviour and genetic variation	julia.schroeder@imperial.ac.uk
Bonnie Waring	Soil microbiology and biogeochemistry	b.waring@imperial.ac.uk
Guy Woodward	Aquatic ecosystems	guy.woodward@imperial.ac.uk

2.2 Outline Timetable and Important Dates

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

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

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

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

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

#	Week Starting	EA Week Title	Convenor
1	5 Oct	Induction and Introduction to EA	Amanda Ellis/Tom Bell
2	12 Oct	Field Ecology Skills	Catalina Estrada
3	19 Oct	Biological Computing in R	Josh Hodge
4	26 Oct	Statistics in R	Julia Schroeder
5	2 Nov	Geographic Information Systems (GIS)	David Orme
6	9 Nov	Genomics and Bioinformatics	Matteo Fumagalli
7	16 Nov	Landscape Ecology and Conservation	Cristina Banks
8	23 Nov	Environmental Microbiology I	Tom Bell
9	30 Nov	Environmental Microbiology II	Tom Bell
10	7 Dec	Scientific Writing	Julia Schroeder
11	14 Dec	Biocontrol and IPM	Lauren Cator
	21 Dec	Winter Break	
15	11 Jan	Agroecosystems	Bonnie Waring
16	18 Jan	General Linear Models	Julia Schroeder
17	25 Jan	Literature Review	Tom Bell
18	1 Feb	Project Proposals	Tom Bell
	5 Feb	***Project Proposals Due***	
19	8 Feb	Surrey Wildlife Trust Project	Stephen Fry
20	15 Feb	Mini Project	Tom Bell
21	22 Feb	Mini Project	Tom Bell
22	1 March	Ecology and Global Change	Guy Woodward
23	8 March	Behavioural Ecology	Richard Gill
	15 March	**Mini-Project Report Due**	
24	15 March	Reading and Revision Period Starts	
	29/30 March	Spring Examinations	
27	5 April	Research Project Starts (to continue after Easter Break)	
	26 August	Project Hand in (electronic)	
47	7-9 Sept	FrEEC Symposium (final presentations)	
48	13-17 Sept	Project Vivas (internal and external)	

2.3 Taught theme descriptions

Module details

Silwood Campus Introduction

Convenors: Amanda Ellis

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 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.

Introduction to the Ecological Applications MSc

Convenors: Tom Bell

Description

This module runs alongside the Campus Induction week and covers introductions to the course staff and to the specifics of the Ecological Applications programme.

Field Ecology Skills

Convenors: Catalina Estrada

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

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

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

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

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

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

Environmental microbiology

Convenors: Tom Bell

Description

Bacteria comprise the most abundant and diverse organisms on the planet. Bacteria also provide vital services, such as remediation of pollutants, and also underpin all ecosystems as important primary producers and decomposers. The two weeks will be focused on methods for surveying bacterial communities, as well as isolation and characterisation of target species.

Reading

- Fierer, N., Bradford, M. A. and Jackson, R. B. (2007), Toward an ecological classification of soil bacteria. Ecology, 88: 1354–1364. doi:10.1890/05-1839
- Griffiths, R. I., Thomson, B. C., James, P., Bell, T., Bailey, M., Whiteley, A. S., Lane, B. & Gifford, C. 2011 The bacterial biogeography of British soils. 13, 1642–1654. (doi:10.1111/j.1462-2920.2011.02480.x)

- Wooley, John C., Adam Godzik, and Iddo Friedberg. A primer on metagenomics. PLoS Comput Biol 6.2 (2010): e1000667.

Module delivery

Lectures will be pre-recorded and delivered via blackboard and will be coupled with in person questions and answer sessions for students on campus and online questions and answer sessions for remote students on Teams.

Scientific Writing

Convenors: Julia Schroeder

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.

Biocontrol and Integrated Pest Management

Convenors: Lauren Cator

Description

One of the most economically important applications of ecological knowledge is in the management of pests and invasive species. This is particularly true of management solutions that do not use synthetic pesticides. In this module you will be introduced to the theory of biocontrol and integrated pest management. We will hear from experts actively working in this exciting field.

Aims

By the end of this module students should:

- Be able to discuss the theoretical underpinnings of Biocontrol and IPM
- Describe what makes a good candidate for a Biocontrol agent,
- Discuss how biocontrol can be integrated with more conventional control methods,
- Be familiar with current applications this theory

Reading

A good resource for overview of IPM

- Radcliffe, EB, WD Hutchinson, RE Cancelado. 2009. Integrated pest management: concepts, tactics, strategies and case studies. Cambridge, UK ; New York : Cambridge University Press. ISBN: 9780521875950 (hardback).

Agroecosystems

Convenors: Bonnie Waring

Description

This module will provide an introduction to research in the field of agroecology and the agritech approaches, focusing particularly on plant-soil interactions, soil biogeochemistry, and plant-pathogen interactions. It will

include lectures and discussions sessions from Silwood staff as well as staff from across the department who are currently conducting research in this growing area.

Generalised Linear Models

Convenors: Julia Schroeder, Josh Hodge

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.

Literature Review and Project Proposals

Convenors: Tom Bell

Description

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

Surrey Wildlife Trust Project

Convenors: Stephen Fry

Description

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

EA Miniprojects

Convenors: Tom Bell

Description

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

Ecology and Global Change

Convenors: Guy Woodward

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

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)

Series module details

Thursday Research Seminars

Convenors: None

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

Description

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