Contents

1 Course Overview
  1.1 Course Administration
  1.2 Course Aims
  1.3 Learning Outcomes
  1.4 Transferable Skills
  1.5 Course Activities and Assessment
  1.6 External Examiner Names and Contacts
  1.7 Background Reading

2 Course details, timetables, and module descriptions
  2.1 Teaching Staff
  2.2 Outline timetable and important dates
  2.3 Taught theme descriptions
    2.2.1 Induction
    2.2.2 Field Course at Silwood
    2.2.3 Biological computing in R
    2.2.4 Statistics in R
    2.2.5 GIS
    2.2.6 Social Context and Policy
    2.2.7 Ecology and Global Change
    2.2.8 Environmental microbiology I
    2.2.9 Environmental microbiology II
    2.2.10 Biological control and Integrated Pest Management
    2.2.11 Generalized Linear Models
    2.2.12 Advanced Statistics
    2.2.13 Environmental Impact Assessment
    2.2.14 Surrey Wildlife Trust Group Project
    2.2.15 Agroecology
Along with this handbook, you will receive a copy of the Student Handbook 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 FrEE 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 Handbook 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 Handbook.

**Welfare and Advice**
Imperial has a wide support network for students. The Student Handbook 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 Handbook provides details.

Electronic copies of both of these handbooks 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, industry and government partner organisations who are major employers of ecology graduates to ensure that you have the cutting edge skills most desired for PhDs and job opportunities.

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

1.1 Course administration

<table>
<thead>
<tr>
<th>Masters Course Director</th>
<th>Professor Tim Barraclough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postgraduate Administrator</td>
<td>Mrs. Amanda Ellis</td>
</tr>
<tr>
<td>Postgraduate tutor</td>
<td>Dr. Julia Schroeder</td>
</tr>
</tbody>
</table>

The course runs for one year from the 2nd October 2017 through to 22nd September 2018. The taught components of the course (lectures and practicals/workshops) typically start at 0900 and finish by 1700 but this varies from week to week – details for each week are provided in provisional timetables in this handbook. Please check Blackboard 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 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 Handbook.

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.

MSc website

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: Students will acquire knowledge and understanding of:

a) basic and applied ecology as it relates to ecosystem management and function;

b) ecological models and their application to predict dynamics and guide population management;

c) research techniques, including information retrieval, experimental design and statistics, modelling, sampling, laboratory and field safety, stakeholder engagement;

d) detailed knowledge and understanding of the essential facts, concepts, principles, theories and policy relevant to the student’s chosen area of specialisation;

e) management and communication skills, including problem definition, project design, decision processes, teamwork, written and oral reports, scientific publications.

MSc programme: Acquisition of 1a - 1c is through lectures, seminars, workshops, practicals, coursework, industry visits and fieldwork during the taught part of the course (October-March). Acquisition of 1d is through coursework (October-September) and the individual research project (April-September). Acquisition of 1e is throughout the whole course through presentations, direct contact with industry partners and stakeholders, fieldwork and the independent research project. Throughout the course, students are encouraged to undertake independent reading both to supplement and consolidate what is being taught/learnt and to broaden their individual knowledge and understanding of the subject.

Assessment of the knowledge base is through a combination of unseen written exams (1a-1c), assessed coursework and practical write-ups (1a-1c, 1e), students’ individual project write-ups (1d-1e), industrial partner assessments (1d-1e), and an oral exam by the external examiner (1a-1e).

Intellectual Skills: Students will be able to:

a) analyse and solve applied ecological problems using an integrated multidisciplinary approach;

b) integrate and evaluate information;

c) formulate and test hypotheses using appropriate experimental design and statistical analysis of data;

d) plan, conduct and write-up a programme of original research.

MSc programme: Intellectual skills are developed through the teaching and learning methods outlined above and through the learning programme set out in this handbook. Information sifting and sorting, analysis and problem solving skills are promoted through the use of resource packs in the group project exercises and workshops embedded in the course. Experimental design and statistical skills are developed in lectures, computer-based practical work in the core course, coursework and group field projects, and subsequently in the individual research projects.
Individual, formative and summative feedback is given to students on all work produced including oral presentations. Assessment is through exams, coursework and the individual research projects.

**Practical Skills** Students will be able to:

a. plan and execute safely a series of experiments;
b. use laboratory and field-based methods to generate data;
c. devise theoretical models for given problem and implement them in computer simulations;
d. analyse experimental results and determine their strength and validity;
e. prepare technical and lay reports;
f. give technical and lay presentations;
g. use the scientific literature effectively;
h. use computational tools and packages.

Practical skills are developed through the teaching and learning programme outlined in this handbook. Practical experimental skills (3a to 3d) are developed through laboratory, computer-based and project work. Skills 3e and 3f are taught and developed through feedback on reports written and presentations made as part of coursework assignments and interaction with industrial partners. Skill 3g is developed through lectures, coursework reports and essays, group project exercises and the individual supervised research project. Skill 3h is taught and developed through course-work exercises and project work. Practical skills are assessed through practical write-ups, course-work reports and the research project dissertation.
1.4 Transferable Skills

Students will be able to:

a) communicate effectively through oral presentations, written reports and scientific publications;
b) appreciate the needs and value of stakeholders;
c) deliver solutions appropriate to a client remit and communicate findings in a variety of accessible formats;
d) manage resources and time;
e) apply statistical and modelling skills;
f) management skills: decision making, problem definition, project design and evaluation, risk management, teamwork and coordination;
g) integrate and evaluate information from a variety of sources;
h) transfer techniques and solutions from one discipline to another;
i) use Information and Communications Technology;
j) learn independently with open-mindedness and critical enquiry;
k) learn effectively for the purpose of continuing professional development.

Transferable skills are developed through the teaching and learning programme outlined in this handbook. Skills 4a to 4d are taught through coursework and developed through feedback on reports, essays, oral presentations and research project progress meetings. Skill 4e is taught through lectures and practical work and developed, as appropriate, during individual research project. Skills 4f to 4h are developed through project work in lab teams. Skill 4i is developed through computer-based exercises, projects and other coursework activities and individual learning. Skill 4i is developed throughout the course within a framework of staged coursework deadlines and the research project planning. Although not explicitly taught, skills 4j and 4k are encouraged and developed throughout the course, which is structured and delivered in such a way as to promote this.

Skills 4a to 4d are assessed through coursework, workshop presentations, industry partner assessments and the oral examination. Skill 4e is assessed through coursework and project work. Skills 4f to 4h are assessed in workshops. Skills 4i to 4k are assessed through the industry partner assessments.

All students must attend the taught modules (detailed below) in both the Autumn and Spring Term. Students must also attend Thursday afternoon seminars appropriate to the course. These will be notified on Blackboard throughout the course. Students are of course welcome and encouraged to attend any additional seminars as they wish. MSc students must also complete a 4 month research project running during the summer from June until September.

1.5 Course activities and assessment

Assessment of this work will be based on two written examinations (30% of marks), the four 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 http://goo.gl/GWtgy6, or as a tab delimited text file at http://goo.gl/awH7Vf. There is also a list of staff research interests available at http://goo.gl/okOvZS, or as a tab delimited text file at http://goo.gl/aVGHs4. The projects spreadsheet 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 26/01/18.

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

Examinations (30% of overall mark)

The examinations are timetabled to follow immediately after the Christmas vacation and two reading weeks dedicated to revision in Term 2.

January essay exam (15%) Week of Jan 8th 2018
This assessment will examine work done during the first 8 weeks of the Autumn term and seminars from the Autumn term. You will have to choose two essay questions out of a choice of six. This is a closed book exam.

Spring exam (15%) Week of March 26th 2018
This exam will be a single compulsory structured question which will ask you to apply the knowledge and skills gained throughout the whole of the taught course to a problem based on one of the spring term modules. The question will consist of three main elements: 1) ecological theory relevant to the question, 2) data interpretation, 3) application to a “real world” problem. NB, this is an open book exam, i.e., you may bring in your course notes for use during the exam.

Coursework (20% of overall mark)

Applied Ecology presentations (5%), Due 23rd November 2017 2 pm
Two modules in term 1 address biodiversity and community ecology. You will develop a presentation that applies your recently gained theoretical knowledge to an ecological problem of your choice. Assessed presentations will take place at the end of week 8.

Microbiology/Biocontrol POSTnote (5%) Due 12th December 2017 10 am
This piece of written course work will follow the format of government POSTnote on an applied ecology, conservation ecology, or microbiology. [http://www.parliament.uk/mps-lords-and-offices/offices/bicameral/post/publications/postnotes/]

Ecological Impact Assessment(5%) Due 2nd March 2017 10 am
Within this module, run by Ecological consultancy Thompson Ecology, the students will put together an ecological impact assessment of a model site. Individuals will be primarily assessed on their individual contribution to the assessment, although this assessment will also take into account group work and team skills.

Taxonomy Diary (5%) Due 11th May 2017 10 am
Throughout the whole course you should develop a taxonomic diary. This can be based on recording and identifying specimens that you have personally seen along with notes on identification and ecological significance or be based on desktop research on a group you are interested in. You can choose to specialize in a taxonomic group or to be taxonomically broad. The method of presentation of the data collected is at your discretion, but should be electronic, visually appealing and easily navigated (e.g., Prezi, website, or linked electronic notebook). Note that this piece of work is equally weighted to the other pieces of coursework and so the time you input should be similar.

The two written pieces of coursework will be submitted electronically via Blackboard.
Research project (50% of overall mark)

The research project must be completed and written up in the style and formatting of a scientific research paper. Full details of academic regulations and project assessment are given in section 3.7 (Programme Regulations). 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 will also be held for each student, this is mandatory but not assessed.

To obtain a pass you must pass all three components (i.e. a mark of 50% or higher). To obtain a Merit you must attain 60% or higher in both the taught and research elements of the course. Where a student attains an average mark of 60% or higher, and 60% in at least two of the three components (exam, course-work and research project) they may receive a Merit grade at the discretion of the exam board. To obtain Distinction you must attain 70% or higher in both the taught and research elements of the course. Where a student attains an average mark of 70% or higher, and 70% in at least two of the three components and none less than 60% they may receive a Distinction grade at the discretion of the exam board. These regulations are set out in more detail in the MSc degree regulations provided in this handbook and on Blackboard.

1.6 External vivas and examiners

All students will 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. The dates are shown above and these vivas form a part of both the exam moderation process and oversight of the course by the External Examiner, currently Dr Matt Heard (CEH Wallingford).

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 for you to submit complaints or representations direct 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

Please only use the link above, to ensure that information can only be accessed by staff/students with a College login. The externals name and institution should continue to be included.
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. Here are the details of the staff who will be convening each module with lectures coming from others.

<table>
<thead>
<tr>
<th>IMPERIAL COLLEGE STAFF</th>
<th>IMPERIAL COLLEGE STAFF</th>
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<tbody>
<tr>
<td>Tim Barraclough</td>
<td>Evolution of species diversity, speciation, evolution in multi-species systems</td>
</tr>
<tr>
<td>Catalina Estrada</td>
<td>Field experiments, field ecology, chemical ecology, insect ecology</td>
</tr>
<tr>
<td>Samraat Pawar</td>
<td>Systems biology and theoretical ecology</td>
</tr>
<tr>
<td>Julia Schroeder</td>
<td>Social behaviour and genetic variation</td>
</tr>
<tr>
<td>Robert Ewers</td>
<td>Tropical forest ecology</td>
</tr>
<tr>
<td>Guy Woodward</td>
<td>The impacts of stressors on the structure and function of aquatic ecosystems</td>
</tr>
<tr>
<td>Tom Bell</td>
<td>Community ecology and microbial ecology</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>EXTERNAL PARTNERS</th>
<th>EXTERNAL PARTNERS</th>
</tr>
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<tbody>
<tr>
<td>Richard Arnold</td>
<td>Technical Director at Thomson Ecology <a href="http://www.thomsonecology.com">www.thomsonecology.com</a></td>
</tr>
<tr>
<td>Stephen Fry</td>
<td>Stephen is the Senior Warden at Surrey Wildlife Trust</td>
</tr>
<tr>
<td>Dr Sean T Murphy</td>
<td>Sean is the Regional Director of CABI at Egham and has over 20 years of experience in developing and implementing projects in biocontrol and integrated pest management.</td>
</tr>
<tr>
<td>Bryony Taylor</td>
<td>Bryony is one of our MSc graduates, and now works for CABI <a href="http://www.cabi.org">www.cabi.org</a> using Integrated Pest Management for natural control of pest species on a variety of international projects.</td>
</tr>
<tr>
<td>Dr Richard Shaw</td>
<td>Richard completed his PhD at Silwood on plant ecology and now works for CABI on the biological control of weeds and invasive plants.</td>
</tr>
<tr>
<td>Dr Gavin Siriwardena</td>
<td>Gavin is Head of Land Use research at the British Trust for Ornithology <a href="http://www.bto.org/about-bto/our-staff/gavin-siriwardena">http://www.bto.org/about-bto/our-staff/gavin-siriwardena</a>. He specialises in the analysis of long-term data sets, farmland bird declines, agrienvironment schemes and migration ecology.</td>
</tr>
</tbody>
</table>
2.2 Outline Timetable and Important Dates

We strive to adhere to the schedule printed below, but sometime due to unforeseen circumstances or acts of the flying spaghetti monster we may have a make small changes to the timetable within a module. It safe to assume that coursework will occur between the hours of 0900 and 1700 with the exception on Wednesday afternoons which are free. Please be sure to confirm all dates/locations/times with iCalendar (AKA iCal) [http://www.imperial.ac.uk/timetabling/view/icalendar](http://www.imperial.ac.uk/timetabling/view/icalendar)

<table>
<thead>
<tr>
<th>#</th>
<th>Week Starting</th>
<th>EA Module Title</th>
<th>Convenor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 Oct</td>
<td>Induction</td>
<td>Amanda Ellis</td>
</tr>
<tr>
<td>2</td>
<td>9 Oct</td>
<td>Field Ecology Skills</td>
<td>Catalina Estrada</td>
</tr>
<tr>
<td>3</td>
<td>16 Oct</td>
<td>Biological Computing in R</td>
<td>Matteo Fumagalli</td>
</tr>
<tr>
<td>4</td>
<td>23 Oct</td>
<td>Statistics in R</td>
<td>Julia Schroeder</td>
</tr>
<tr>
<td>5</td>
<td>30 Oct</td>
<td>GIS</td>
<td>Marcus Rowcliffe</td>
</tr>
<tr>
<td>6</td>
<td>6 Nov</td>
<td>Social context and policy</td>
<td>Colin Prentice</td>
</tr>
<tr>
<td>7</td>
<td>13 Nov</td>
<td>Conservation Ecology</td>
<td>Rob Ewers</td>
</tr>
<tr>
<td>8</td>
<td>20 Nov</td>
<td>Environmental microbiology I</td>
<td>Tom Bell</td>
</tr>
<tr>
<td></td>
<td>23 Nov</td>
<td><em>Applied Ecology Presentation Due</em></td>
<td></td>
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<tr>
<td>9</td>
<td>27 Nov</td>
<td>Environmental microbiology II</td>
<td>Tom Bell</td>
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<tr>
<td>10</td>
<td>4 Dec</td>
<td>Biological Control and IPM</td>
<td>Tim Barraclough</td>
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<tr>
<td></td>
<td>11 Dec</td>
<td>Reading Week and Winter Exam</td>
<td></td>
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<tr>
<td>11</td>
<td>15 Jan</td>
<td>Generalised linear models</td>
<td>Julia Schroeder</td>
</tr>
<tr>
<td>12</td>
<td>22 Jan</td>
<td>Advanced statistics</td>
<td>Joe Tobias</td>
</tr>
<tr>
<td>13</td>
<td>29 Jan</td>
<td>Environmental Impact Assessment</td>
<td>Thompson Ecology</td>
</tr>
<tr>
<td>14</td>
<td>5 Feb</td>
<td>Surrey Wildlife Trust Group Project</td>
<td>Surrey Wildlife Trust</td>
</tr>
<tr>
<td></td>
<td>8 Feb</td>
<td><em>Microbiology/Biocontrol PostNote Due</em></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>2 Mar</td>
<td><em>Ecological Impact Assessment(5%) Due</em></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>5 Mar</td>
<td>Agroecology</td>
<td>Tim Barraclough</td>
</tr>
<tr>
<td></td>
<td>12 Mar</td>
<td>Reading Week and Winter Exam</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>11 May</td>
<td><em>Taxonomy Diary Due</em></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>2 April</td>
<td>Research Project Starts</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>30 Aug</td>
<td>Project Hand in (electronic)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>4 Sept</td>
<td>Project Hand in (hard copy)</td>
<td></td>
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<tr>
<td>21</td>
<td>12-14 Sept</td>
<td>FrEE Symposium (final presentations)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>17-21 Sept</td>
<td>Project Vivas (internal and external)</td>
<td></td>
</tr>
</tbody>
</table>

2.3 Taught theme descriptions

Course Induction
Monday 2\textsuperscript{nd} October — Friday 6\textsuperscript{th} October
Convenor: Amanda Ellis (amanda.ellis@imperial.ac.uk)

The induction and welcome programme for the EA Masters course runs in the first week of term, alongside the first module of the core taught course.

Timetable:

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900-1000</td>
<td>Welcome to Silwood Park (Fisher/Haldane)</td>
</tr>
<tr>
<td>1000-1100</td>
<td>Course-specific Welcome (Fisher/Haldane)</td>
</tr>
<tr>
<td>1100-1300</td>
<td>Silwood Treasure Hunt (Silwood Field)</td>
</tr>
<tr>
<td>1300-1400</td>
<td>Buffet Lunch (Hamilton Foyer)</td>
</tr>
<tr>
<td>1400-1600</td>
<td>The Big Picture: Group Discussion (Hamilton Foyer)</td>
</tr>
</tbody>
</table>

Tuesday 3\textsuperscript{rd} October
Field Course at Silwood  
**Monday 9th October — Friday 13th October**  
**Convenor: Catalina Estrada** (c.estrad@imperial.ac.uk)  
The aim of this module is to allow you to become familiar with a wide range of basic techniques used to assess an ecosystem's productivity and describe its animal and plant populations and communities. The course will take place at Silwood Park. Our campus, with about 100 ha of land, has several types of natural habitats including grassland, scrubland and woodlands. It is also an active place of field research, hosting multiple long-term experiments and sites for global studies. Please wear the suitable clothes and footwear for outdoor activities and according with the weather forecast. Long trousers, waterproof boots, waterproof jacket, hat, sun cream and water are recommended.

We aim to:  
* Learn general field sampling techniques for plants, insects and other invertebrates  
* Learn to plan field surveys to describe and compare natural communities  
* Learn basic taxonomic sorting and identification of common organisms in Silwood Park grounds (insects, plants, aquatic invertebrates)  
* Learn to estimate an ecosystem productivity  
* Get familiar with Silwood Park ecosystems, and field experiments

**Reading:**

- 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  
Monday 16\textsuperscript{th} October — Friday 20\textsuperscript{th} October  
Convenor: Matteo Fumagalli (m.fumagalli@imperial.ac.uk)

In this module, 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 module 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  
Monday 23\textsuperscript{rd} October — Friday 27\textsuperscript{th} October  
Convenor: Julia Schroeder (julia.schroeder@imperial.ac.uk)

In this module we will build upon the introduction to R you received in "Biological computing in R" and review 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 module is shared with most courses and runs in two blocks A and B like the previous module.

We will cover:

1. the difference between response and explanatory variables and between ordinal, categorical and continuous variables;
2. the underlying structure of statistical testing using both parametric and non-parametric approaches;
3. tests for assessing differences between samples and correlation between samples;
4. analysis of categorical data;
5. and fitting and assessing linear models of continuous response variables.
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:
Main reference:

  A gentler introduction:


GIS
Monday 30th October— Friday 3rd November
Convenor: Robert Ewers (r.ewers@imperial.ac.uk)
This week will teach key skills in using and handling GIS data, along with basic remote sensing to generate GIS data and the use of GIS data in a range of applications. We will use the open source GIS program QGIS (http://www.qgis.org/). We will look at creating and georeferencing both vector and raster data and how to use GIS tools to create a workflow to carry out simple analyses.

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

Social context and policy
Monday 6th November— Friday 10th November
Convenor: Colin Prentice (c.prentice@imperial.ac.uk)
This module is designed to encourage students to adopt a broad perspective on the implications of environmental science, especially global change science, for society; and to understand how scientific information feeds in (along with other aspects) to policy making at national and international levels. It includes a discussion element – students will work in groups to present an interpretation of a specific area of controversy, and brief presentations will be followed by collective discussion.

At the end of this module, you should have gained:

An appreciation of the importance, and also the limits, of scientific information for policy making.
An overview of major contemporary issues in climate policy, and climate-change impacts on biodiversity and human health.
Understanding of how land-use influences ecosystems, biodiversity and the carbon cycle.
Knowledge of the history and current status of climate-change mitigation efforts, including the role of the Intergovernmental Panel on Climate Change.
**Reading:**

The following book is a must-read: insightful and provocative, in the best sense.


**Conservation Ecology**  
**Monday 13th November — Friday 17th November**  
**Convenor:** Rob Ewers ([r.ewers@imperial.ac.uk](mailto:r.ewers@imperial.ac.uk))

This module will explore the link between ecological principles and conservation decision making. We'll emphasise the issue of habitat loss, and look at ways to predict extinctions, how to decide where to locate reserves, and how to monitor biodiversity to assess conservation success or failure. The aims of the module are:

1. Understand how to apply the species-area relationship to predict extinction rates  
2. Understand how thresholds in habitat amount can cause step-changes in conservation problems  
3. Understand how to choose biodiversity indicators

**Reading:**


**Environmental microbiology I and II**  
**Monday 20th November — Friday 1st December**  
**Convenor:** Tom Bell ([thomas.bell@imperial.ac.uk](mailto:thomas.bell@imperial.ac.uk))

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

**Reading:**


Biological Control and Integrated Pest Management
Monday 4th December—Friday 8th December
Convenor: Tim Barraclough (t.barraclough@imperial.ac.uk)
One of the most economically important applications of ecological knowledge is in the management of pests and invasive species. This is particularly true of management solutions that do not use synthetic pesticides. In this 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.

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:
  ISBN: 9780521875950 (hardback): Good resource for overview of IPM

Generalised linear models
Monday 15th January—Friday 19th January
Convenor: Julia Schroeder (julia.schroeder@imperial.ac.uk)
This module builds on the basic linear models introduced in the previous term to introduce some key concepts that allow linear models to be applied to a wider range of research problems. This will include using generalised linear models to handle count and binomial data - where residuals are not expected to follow a normal distribution - and the use of structured models to allow for non-independence in data and to control for known sources of variation in data.

Reading:
Advanced Statistics
Monday 22nd January — Friday 26th January
Convenor: Joe Tobias (j.tobias@imperial.ac.uk)
In this module we will explore more advanced topics in statistics. On each day a member of staff will cover a type of statically analysis which they use in their research. For each topic we will discuss how the typical applications of the method in biological research, the theory underpinning each test, and then in the afternoon, undertake a practical exercise applying this method in R.

Environmental Impact Assessment
Monday 29th January — Friday 2nd February
Convenor: Thompson Ecology and Tim Barraclough (t.barraclough@imperial.ac.uk)
A Preliminary Ecological Appraisal (PEA) of a proposed development site is the first step an Ecologist takes towards completing an Ecological Impact Assessment. This one week course will give an overview of how to undertake a PEA, i.e. a desk study and an extended Phase 1 habitat survey, and how to produce the associated report in a professional style. Some basic botany will be covered, as well a description of the habitat classification systems, survey methods and how to write up a report; making it an ideal introduction to impact assessment. The course will involve a practical session at Riverside Park in Guildford, following which you will be given two weeks to prepare and submit your reports for final assessment.

Reading:
- CIEEM EcIA guidelines: http://www.cieem.net/ecia-guidelines-terrestrial-

Surrey Wildlife Group Project
Monday 5th February — Friday 2nd March
Convenor: Surrey Wildlife Trust with Tim Barraclough (t.barraclough@imperial.ac.uk)
In this module you will work on a group field project to collect data relevant to informing conservation issues at Chobham Common National Nature Reserve. This course will be run in conjunction with Surrey Wildlife Trust who manage this Reserve. Surrey Wildlife will help direct research projects and provide support on site. Students will present results of their findings at the end of the course.

Timetable:

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<th>Monday 6th February to Friday 3rd March</th>
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<td>You will work together on a group project with a combination of fieldwork, data collection, analysis and report-writing. Expect to work 1000 to 1700 on Monday, Tuesday, Thursday Friday, and 1000 to 1300 on Wednesday. The project will culminate with a presentation to the Chobham Common team on Friday 2nd March. More details will be announced in January.</td>
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Agroecology
Monday 5th March — Friday 9th March
Convenor: Tim Barraclough (t.barraclough@imperial.ac.uk)
*For the practicals on Tuesday/Wednesday: we will proceed come rain or shine so please be prepared with appropriate outdoor gear (umbrellas and raincoats!).

Reading List