MSc and MRes in Computational Methods in Ecology & Evolution: Introduction

Samraat Pawar & James Rosindell

Silwood Park

Imperial College
London

October 3, 2016

Why Ecology and Evolution?

Big Fish Eat Little Fish, 1557, Pieter van der Heyden

BECAUSE WE LIVE IN "INTERESTING" TIMES

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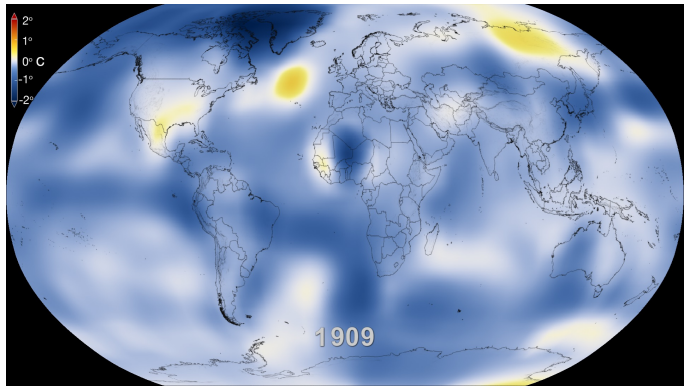
- Climatic warming and fluctuations



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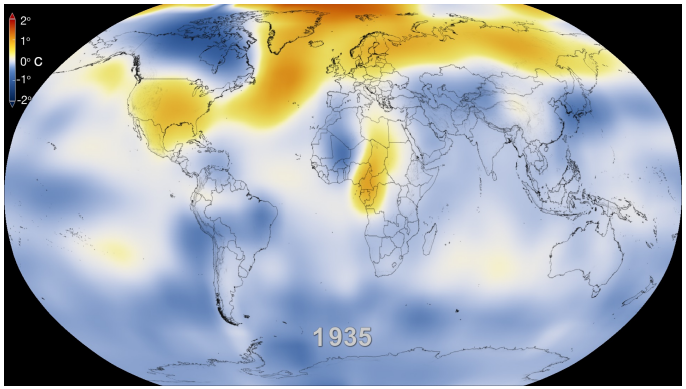

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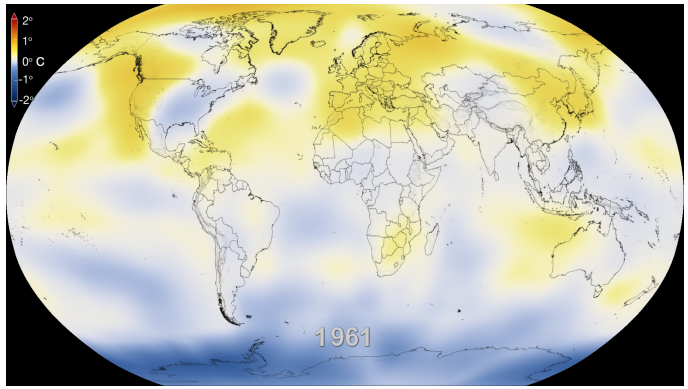

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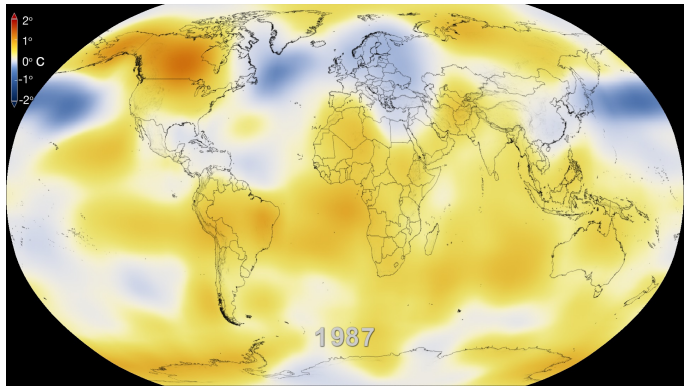

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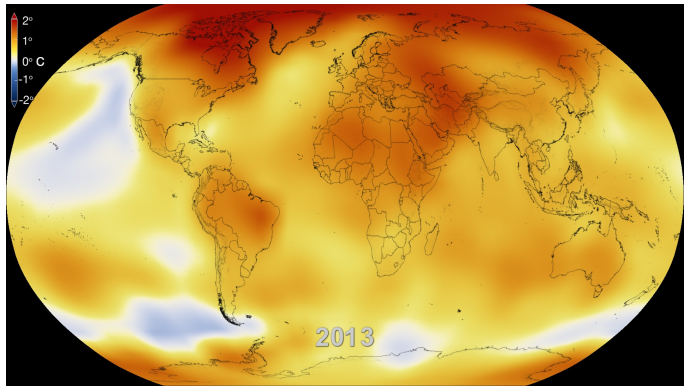
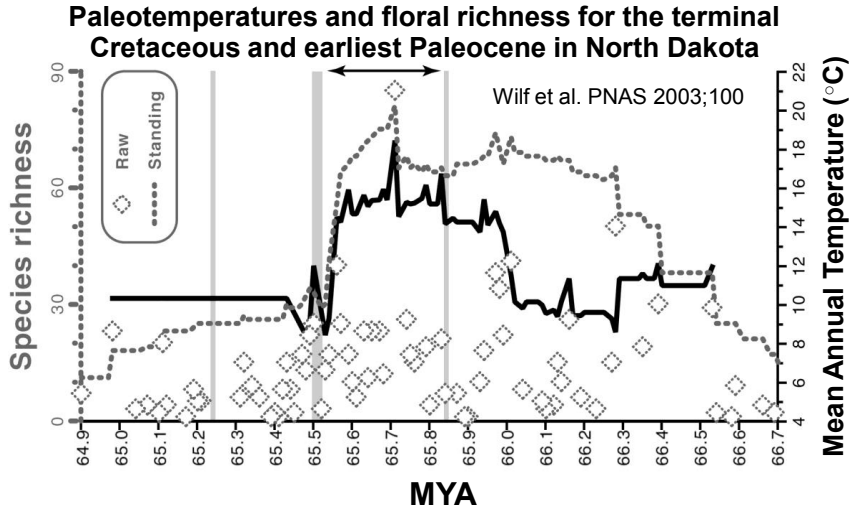


- Species range shifts and invasions

- Overexploitation of ecosystems

Some worrying effects on (complex) biological systems

- Loss or collapse of ecosystem function



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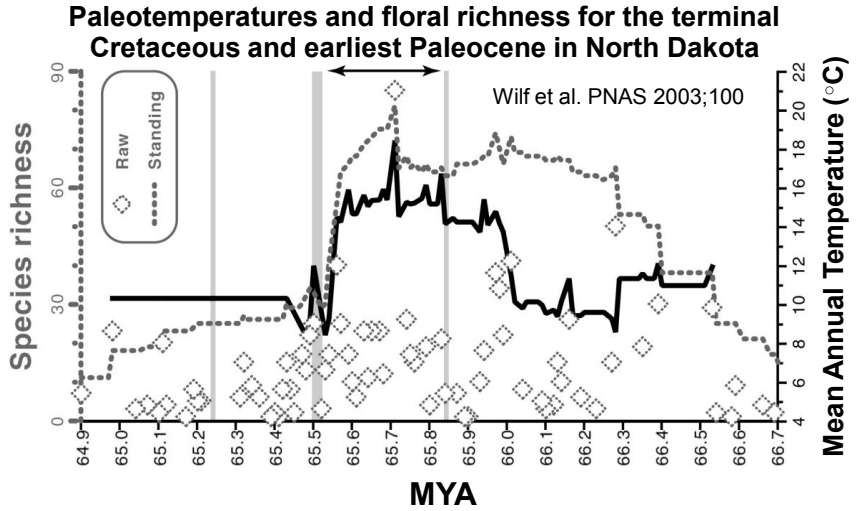
- Loss or collapse of ecosystem function
- Loss of ecosystem recovery or succession



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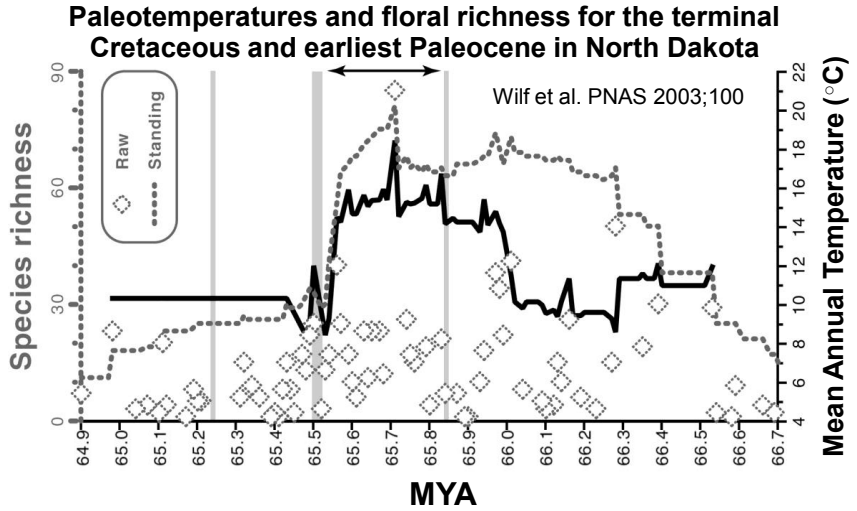

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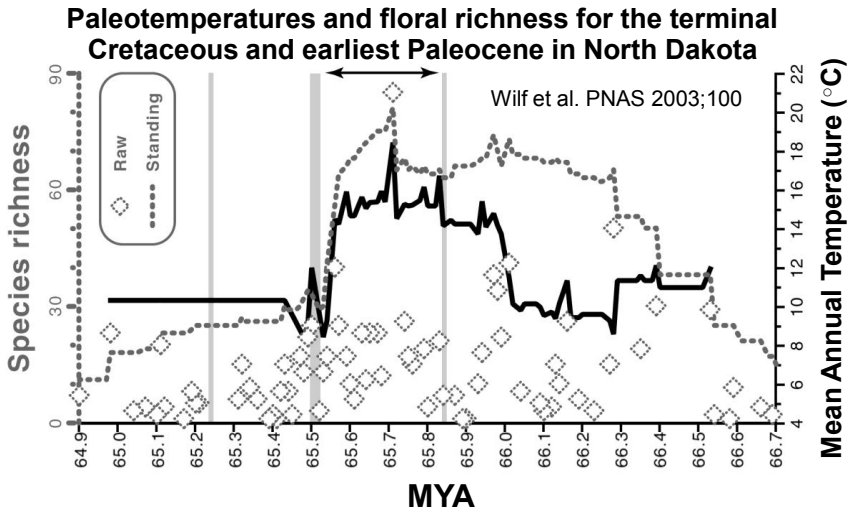

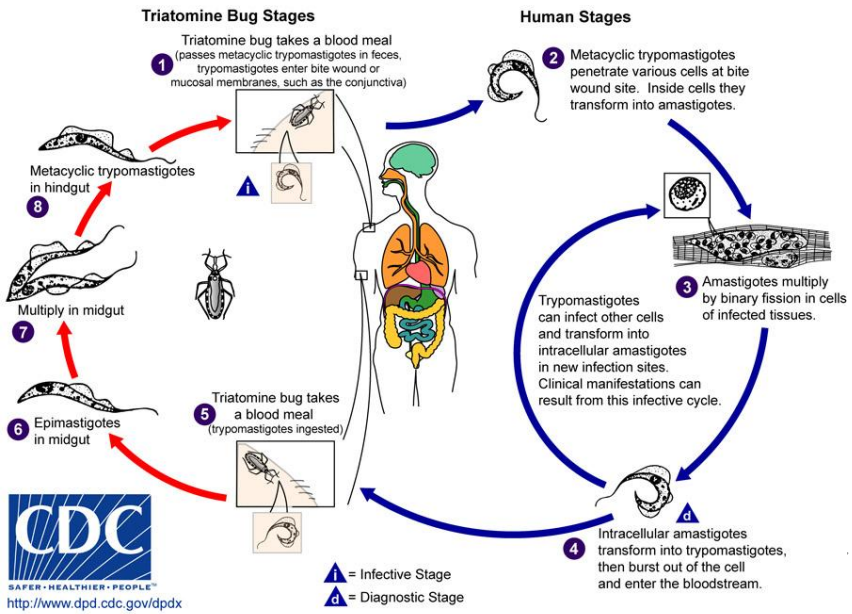

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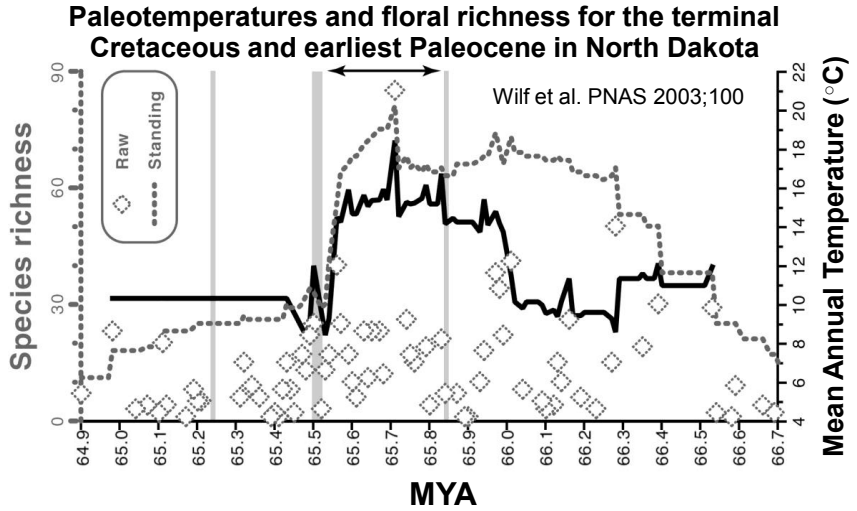

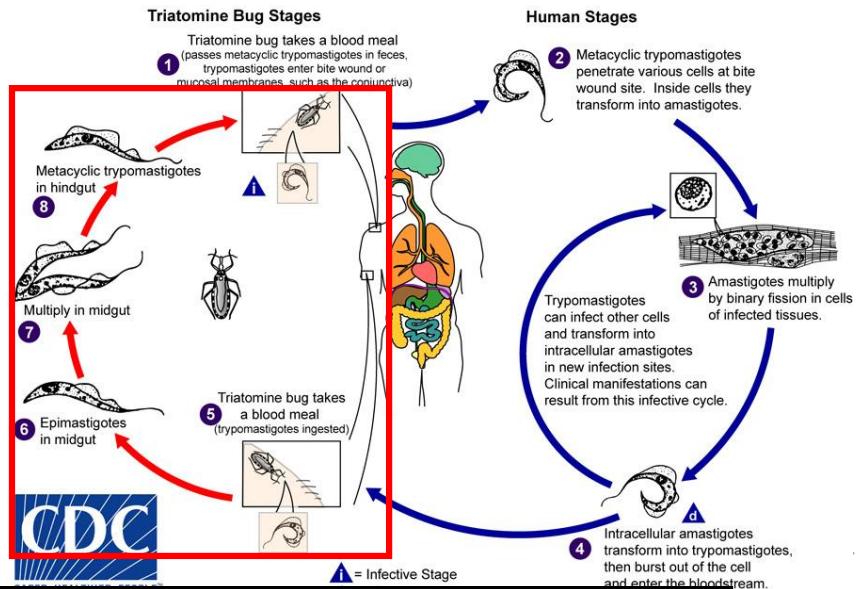

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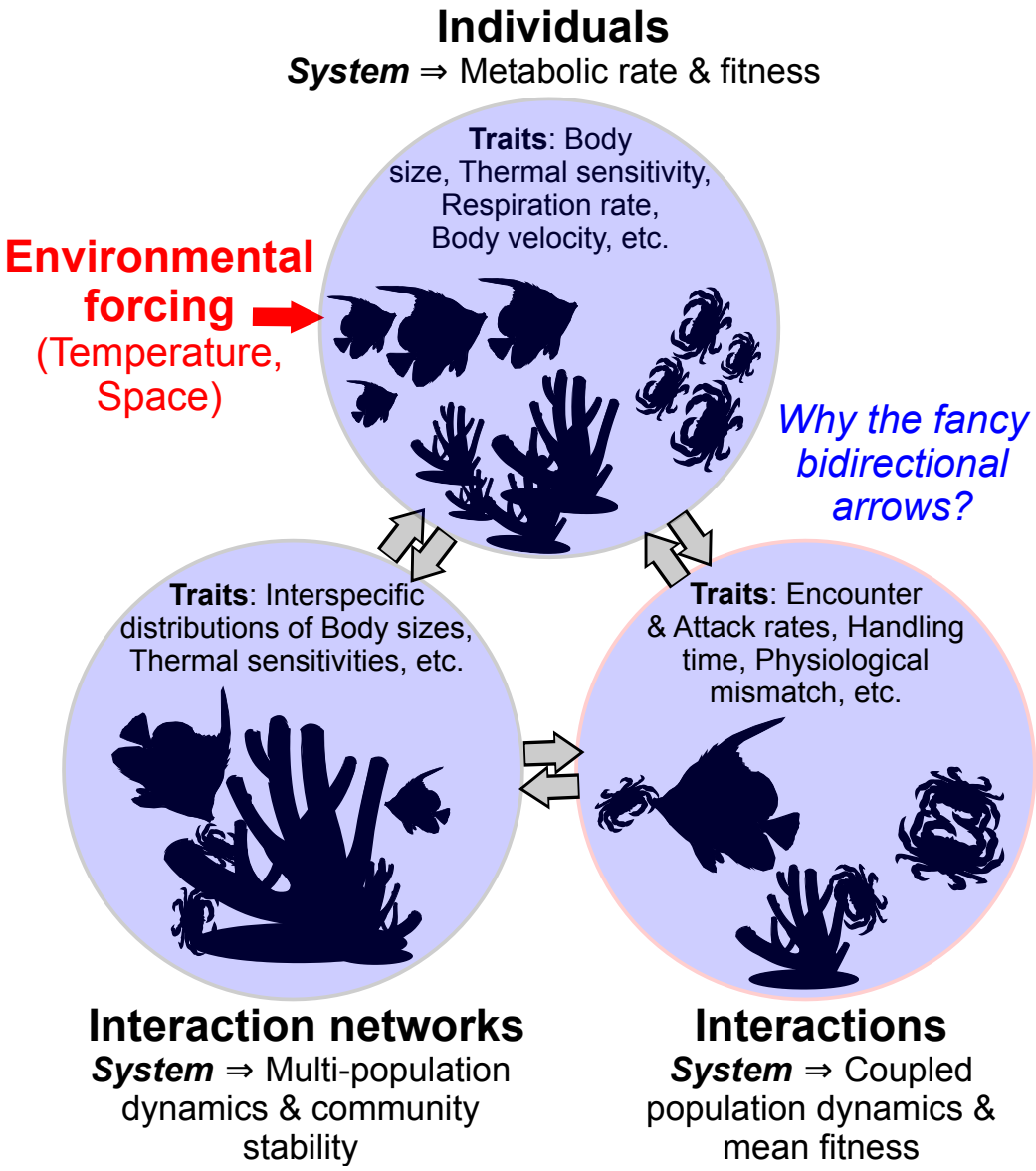

WHY *Computational* ECOLOGY AND EVOLUTION?

Open access, freely available online

Essay

Mathematics Is Biology's Next Microscope, Only Better; Biology Is Mathematics' Next Physics, Only Better

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Read it! (its on the course repository)

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ergo, Computing!

But above all, it's about the biology!

It is hard for me to say confidently that, after fifty more years of explosive growth of computer science, there will still be a lot of fascinating unsolved problems at peoples' fingertips, that it won't be pretty much working on refinements of well-explored things. Maybe all of the simple stuff and the really great stuff has been discovered. It may not be true, but I can't predict an unending growth. I can't be as confident about computer science as I can about biology. Biology easily has 500 years of exciting problems to work on, it's at that level. (Donald Knuth)

OK, but why Computational Ecology and Evolution at *Silwood*?

A wide range of theoretical and empirical research (big data!):

- Evolution and Developmental Genetics (Abzhanov)
- Genetics and behavior (Schroeder)
- Tropical biology (Ewers, Banks-Leite)
- Vector borne diseases (Cator, Burt)
- Phylogenetics, genomics (Savolainen, Fumagalli)
- Human genetics (Hodgson)
- Behavior (Cator, Gill)
- Paleontology (Brazeau)
- Food webs, networks (Woodward, O'Gorman, Pawar)
- Metabolic theory, population biology (Pawar)
- Pollinator behavior and ecology (Gill)
- Neutral theory, scientific visualization (Rosindell)
- Population genetics (Burt, Schroeder, Hodgson, Barraclough, Fumagalli)
- Conservation biology (Knight, Mills, Banks-Leite, Ewers)
- Microbial systems (Bell, Barraclough)

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- **Many more PIs across are multiple campuses!**

What you will learn

- Competence in stat-of-art quantitative methods for addressing modern biological problems
- How to select the correct quantitative tool to address a specific biological problem
- An ability to develop, analyse, numerically simulate, fit models to data and interpret
- Quantitative models of biological systems, including statistical and mathematical models
- Techniques in Population biology, Population genetics, Genomics and Geographical Information Systems
- How to design and conduct research, with the necessary computational workflows – *please have a look at past projects!*

Course Administration

Course Director	Dr. Samraat Pawar (ext. 42213, s.pawar@imperial.ac.uk)
Course Co-Director	Dr. James Rosindell (ext. 42242, j.rosindell@imperial.ac.uk)
Postgraduate Administrator	Mrs. Amanda Ellis (ext. 42251, amanda.ellis@imperial.ac.uk)
Postgraduate Tutor	Dr. Julia Schroeder (julia.schroeder@imperial.ac.uk)
Director of Postgraduate Studies	Dr. Niki Gounaris (ext. 4 5209, k.gounaris@imperial.ac.uk)
Course Tutor	Mr. Samual D Thompson (samuel.thompson14@imperial.ac.uk)
Course Representative	Up to you (see Silwood Masters Guidebook)

Add 020 759 to extension numbers to call from external phones

Getting started

- You each should receive a computer, bag, mouse, keyboard, room key, power supply, stand if you want it
- Turn it on – its Ubuntu 14.04 64 bit
- If you are using your own laptop – use Ubuntu 14.04 64 bit or higher
- Make sure you can:
  - Access secured imperial wireless (use college name and password)
  - Access the library website
  - Access Blackboard (bb.imperial.ac.uk) and give it a spin
- Get an account at bitbucket.org using your imperial college account, read their Git tutorials (very intuitive!)
- You will be assisted by very capable demonstrators – also, learn collaboratively with your your classmates!

Computer guidelines and rules

- You are responsible for your computer hardware and software
- You should be able to install all necessary (open source) software
- Your computer is your tool, you are expected to achieve a high degree of mastery of it!
- You return it to Jim Culverhouse at end of course
- We expect it to be undamaged
- Please lock Seminar room 2 (we will keep it open for study) when not in it – should happen automatically (talk to Jim Culverhouse)
- Please do not leave your computer in any room (other than your residence!) overnight, starting now

Handbook and Lectures

- Printed guidebooks may become outdated, download updated ones from the bitbucket repo
- Please check key dates for coursework and reports
- Lectures:
  - 2 1-hr lectures in the morning (1000 – 1230, except in come cases)
  - 3-hour practical in afternoon, except on Wednesdays
  - Lecturers will stay for at least 1 hour of practical session
  - There may be deviations from this – check updated timetables!
  - Usually one more demonstrators will be available during practicals
  - All lectures in this room (Wallace) or CPB, except where noted

SEMINARS

- Thursday seminars at 1300 hrs in this building (web link in guidebook)
- Students must attend Thursday seminars – 1/2 page summary each of min 16 seminars (seminar diary) due at end of course
- You are encouraged to give talks for feedback / discussion at other times of the week, especially in the Spring — great for running ideas past peers (you can give multiple short ones).

Seminars and Workshops

- Workshops organized by us are all optional, but strongly recommended – check guidebook
- Some important ones this week.
- Summer graduate symposium on Frontiers in Ecology and Evolution (FrEE):
  - Week 1 of September, organized by Masters + PhD students
  - More details in Silwood Masters Student Guidebook

Assessment and Marking

Activity	MSc CMEE	MRes CMEE
Lectures + practicals, with assessment	Required for first 20 weeks	Required for first 9 weeks, optional attendance in MSc modules within reason thereafter
Exams	Required	Not required
Project report (Dissertation)	Required	Required
Seminars	Required, seminar diary required for a minimum 16 weeks	Required, seminar diary required for a minimum 16 weeks
Workshops	All optional	All optional

Assessment and Marking

	MSc CMEE		MRes CMEE	
Component	% of Course	% of Component	% of Course	% of Component
Coursework				
Computing	13.75	55	13.75	55
CMEE Mini-project	6	24	6	24
HPC Long Practical	5	20	5	20
Seminar Diary	0.25	1	0.25	1
Coursework Total	25	100	25	100
Exams				
Exam 1	10	40	–	–
Exam 2	15	60	–	–
Exam Total	25	100	–	–
Project				
Final Report + Presentation	35	70	52.5	70
Viva	12.5	25	18.75	25
Supervisor mark	2.5	5	3.75	5
Project Total	50	100	75	100

IMPORTANT DATES

Date	Activity/Item due
9 Dec, 5PM	MRes: Project proposal
15 Dec, 5PM	MSc, MRes: HPC Long Practical
17 Feb, 5PM	MSc, MRes: CMEE Miniproject
7 April, 5PM	MSc, Project proposal
25 Aug, 5pm	MSc, MRes: Seminar Diary

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Further important dates, including thesis submission are same across all Silwood Masters courses – **please refer to the Silwood Student Guidebook**

WARM-UP FOR REST OF THE WEEK

- Lots of UNIX tutorials out there. Try `http://software-carpentry.org/lessons.html` (Chapter "shell"). (watch video tutorials or read pdfs)
- Excellent book on Git: `http://git-scm.com/book`, also, `https://www.atlassian.com/git/`
- See `http://www.andy-roberts.net/writing/latex/benefits`
- Also, Word vs. LaTeX: `http://openwetware.org/wiki/Word_vs._LaTeX`

More extensive list in guidebook and Course notes (did you get my email?)

QUESTIONS?

(soon to be) Famous CMEE Fungus