

Quantitative and Computational Methods in Ecology & Evolution: Introduction

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Silwood Park

Imperial College
London

October 2, 2017

WHY ECOLOGY AND EVOLUTION?



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

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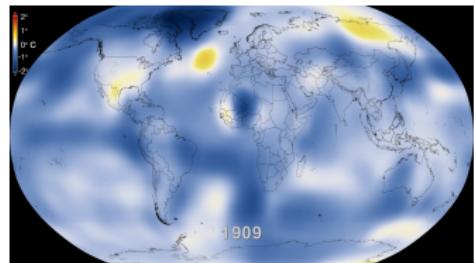
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- Species invasions and ecosystem collapse

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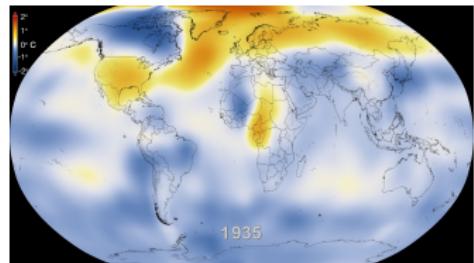
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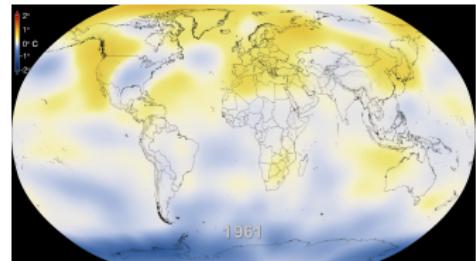
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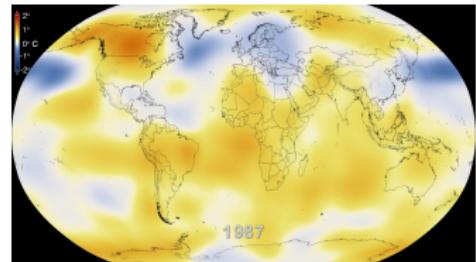
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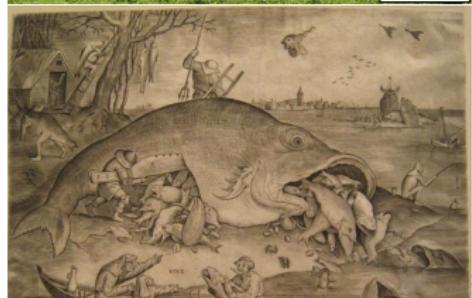
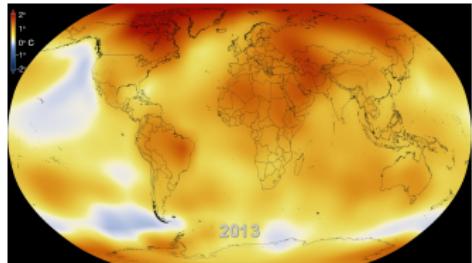
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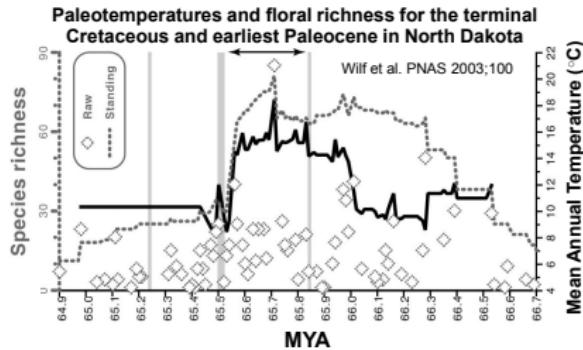
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- Overexploitation of ecosystems



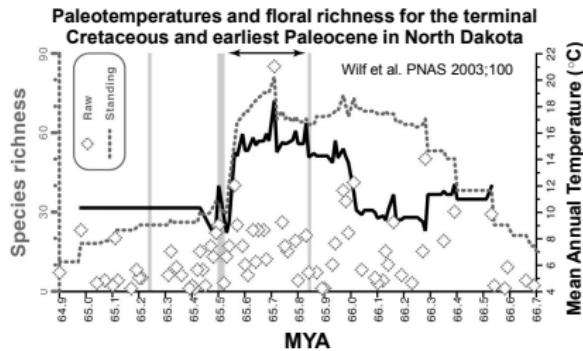
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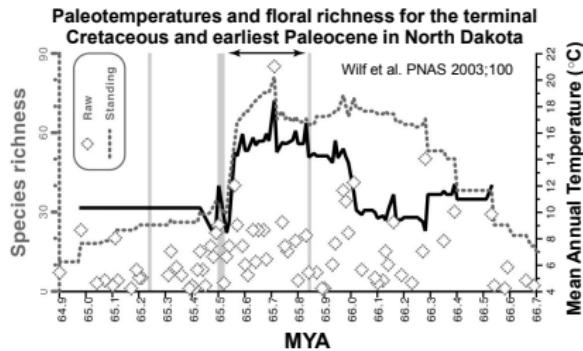
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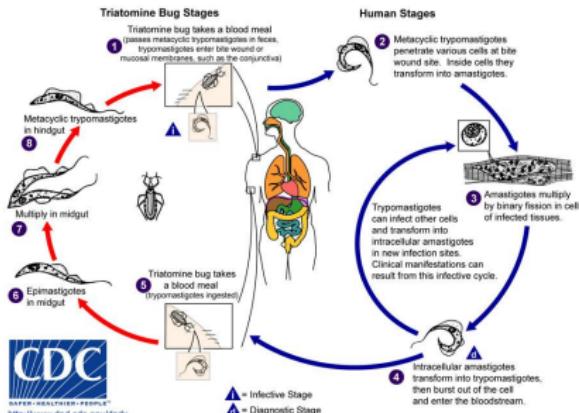
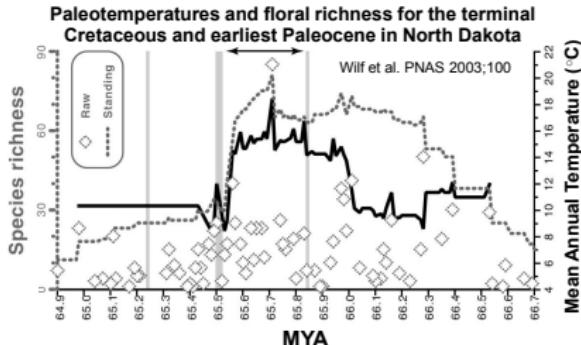
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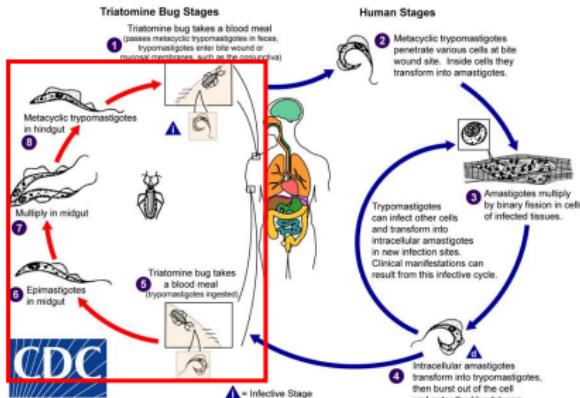
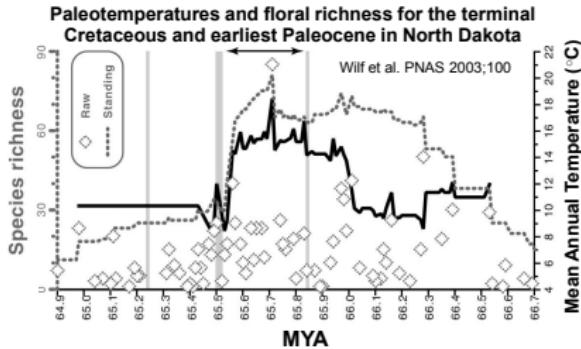
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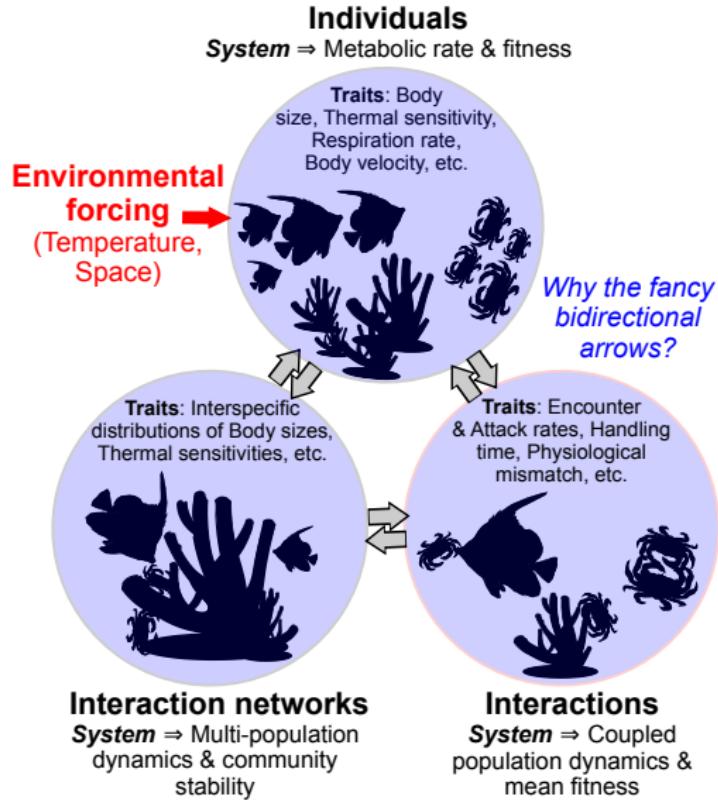


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It is hard for me to say confidently that, after fifty more years of explosive growth of computer science, there will still be a lot of fascinating unsolved problems at peoples' fingertips, that it won't be pretty much working on refinements of well-explored 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)

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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's Git repository

<https://bitbucket.org/mhasoba/silbiocompmasterrepo>

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)
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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

<i>Course Director</i>	Dr. Samraat Pawar (ext. 42213, s.pawar@imperial.ac.uk)
<i>Course Co-Director</i>	Dr. James Rosindell (ext. 42242, j.rosindell@imperial.ac.uk)
<i>Postgraduate Administrator</i>	Mrs. Amanda Ellis (ext. 42251, amanda.ellis@imperial.ac.uk)
<i>Postgraduate Tutor</i>	Dr. Julia Schroeder (julia.schroeder@imperial.ac.uk)
<i>Director of Postgraduate Studies</i>	Dr. Niki Gounaris (ext. 4 5209, k.gounaris@imperial.ac.uk)
<i>Course Tutor</i>	Ms. Elise Damstra (e.damstra16@imperial.ac.uk)
<i>Course Representative</i>	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 laptop computer and peripherals – *If you want it*
- You will also be provided a USB stick with Ubuntu 16.04 64 bit – *If you need it*
- If you are using your own laptop – use Ubuntu/Lubuntu/Xubuntu 14.04 64 bit or higher, or Mac OS
 - If using Mac OS, remember that not all commands behave the same between Mac OS and Linux
- Make sure you can access secured Imperial College wireless (use college name and password) — external Bootcampers, use Eduroam or a guest account (ask me later)
- Get an bitbucket or github account (read their Git tutorials (quite intuitive)) — free private repos using your college email account

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 main tool, you are expected to achieve a high degree of mastery of it!
- Return it to Martin Selby at end of Course (CMEE) / Bootcamp (QMEE)
- We expect it to be undamaged
- 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 some 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 (useical)!
 - Usually one or more demonstrators will be available during practicals
 - Most lectures in CPB or Hamilton Comp room in first 9 weeks, then Wallace Room after MRes cohort finishes

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 12 seminars (seminar diary) due after seminar series ends in summer
- 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)
- There bi-weekly Social Seminar Series (Beer, Pizza, Talks!) is also a great platform to give a talk.

WORKSHOPS AND SYMPOSIA

- 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 – freesymp.org):
 - Week 1 of September, organized by Masters + PhD students
 - More details in Silwood Masters Student Guidebook

ASSESSMENT AND MARKING

Activity	MSc CMEE	MRes CMEE
<i>Lectures + practicals, with assessment</i>	Required for first 20 weeks	Required for first 9 weeks, optional attendance in MSc modules within reason thereafter
<i>Exams</i>	Required	Not required
<i>Project report (Dissertation)</i>	Required	Required
<i>Seminars</i>	Required, seminar diary required for a minimum 12 weeks	Required, seminar diary required for a minimum 12 weeks
<i>Workshops</i>	All optional	All optional

WARM-UP FOR REST OF THE WEEK

- Get Linux on your computer (if applicable)! (google - “Install Ubuntu”)
- Lots of UNIX tutorials out there. Try
<https://software-carpentry.org/lessons/> (Chapter “shell”).
- 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. L^AT_EX:
http://openwetware.org/wiki/Word_vs._LaTeX

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

REST OF THE COURSE/BOOTCAMP

- A number of Readings/Resources on the git repo
- Read, Read, Read about concepts and models in Ecology & Evolution!
- Happy QMEE (Boot)campers — if you plan to attend any of the weeks beyond the Bootcamp, please let Ibi Wallbank know!
 - We may be able to lend you a/the laptop for a longer period in that case

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QUESTIONS?



(soon to be) Famous CMEE Fungus