

Ecosystem Dynamics and Functions

Semester 1, 2011/12 Tuesdays 0900-1300, Crew Annex room 3

Course organiser: Dr Casey Ryan

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Teaching staff: Dr Meriwether Wilson (MeW), Prof Mat Williams (MaW), Dr Clare Howard (CH) and Dr Casey Ryan (CR)

Location

1st meeting: 0900 Sept 20th. Room 3 Crew Annex

All sessions will be held in the Crew Building Annexe, Room 3, 09:00-13:00 on Tuesdays. In Week 3 and 6 we will be in the field. Often we will move to a computer lab after 0900.

The Crew Building Annexe is a single storey suite of class rooms immediately to the north of the Crew Building. The location of the Crew Building is shown at: <http://www.ed.ac.uk/maps/buildings/crew-building>.

Course description:

We all depend on a vast range of services provided by ecosystems, from food and medicines to a stable climate, clean water and storm protection. This course provides an introduction to the ecosystem ecology underlying these services, in particular looking at how ecosystems are structured and function. The course has a very practical ethos and involves fieldwork and analysis of real data from around the globe. It is suitable for students with a wide range of backgrounds.

The course looks at the dynamic nature of ecosystems, which often behave as complex systems. Different ways of representing and modelling such systems are explored through practical exercises and case studies from guest lecturers. The course provides students with the core ecological knowledge needed for Ecosystem Valuation and Management in semester 2.

Summary of Intended Learning Outcomes:

1. An understanding of fundamental principles of ecosystem ecology, including how ecosystem structure relates to function, and the dynamics of ecosystems.
2. Practical knowledge of how to measure and model ecosystem structure and function, manage data, and analyse large ecological data sets.
3. Appreciation of the diversity of ecosystem functions and expressions across different time, space and biome scales, illustrated through targeted case studies.
4. Appreciation for how ecosystems respond to and feed back on, global change drivers including climate change, land use change, and biodiversity loss.

Course Outline

W1	Tue-Sep-20	Overview of Ecosystem Concepts and Global Change In week one we explore the concept of an ecosystem and the intellectual foundations of ecosystem science. Examples of the role that ecosystems play in the earth system and in supporting human wellbeing are examined. The role of ecosystems in global change and the idea of the Anthropocene is presented.	CR
W2	Tue-Sep-27	Ecosystems and the global carbon cycle The role of marine and terrestrial ecosystems in the global carbon cycle is analysed. In particular we look at how the structure and function of ecosystems determines how much carbon is stored in different parts of the biosphere and how the fluxes between different components are being altered.	CR
W3	Tue-Oct-04	Fieldwork practical: the structure of forests We will visit the nearby Braidburn to conduct ecological measurements of the forest, including tree inventories and soil sampling. Students will collect a data set relating to forest structure and learn how to summarise the data in Excel.	CR
W4	Tue-Oct-11	The global nitrogen cycle Humans have caused unprecedented change to the nitrogen cycle, doubling the amount of available nitrogen on the planet. This has allowed us to feed a rapidly growing population, but has considerable adverse effects on the environment and human health. Managing the nitrogen cycle is complex and we explore the issues from the perspectives of different groups.	CH
W5	Tue-Oct-18	Biodiversity, niches and species We look at how the diversity of life varies from the small-scale to the global (biogeography) and how this can be measured and analysed. Examples will be drawn from marine systems including Micronesian Islands, the Red Sea, the Black Sea and urban waterfronts.	MeW
W6	Tue-Oct-25	Fieldwork practical: the biodiversity of coasts The methods and concepts from week 5 are put into practice on the seashore of East Lothian. This will involve an early start.	MeW
W7	Tue-Nov-01	Biodiversity, traits and ecosystem function Since 1992, researchers have developed increasingly sophisticated ways to understand how biodiversity is linked to the functioning of ecosystems. We look at the empirical data and the theory of how diversity affects ecosystem productivity and resilience, and how this affects ecosystem services.	MaW
W8	Tue-Nov-08	Ecosystems as dynamic systems Here we look at ways of representing the complexity of ecosystems and approaches to understanding feedbacks, non-linearity and stable states. We analyse ecosystems stocks and flows by drawing Forrester diagrams <ul style="list-style-type: none"> • Guest lecture: Prof Andy Dugmore <i>Norse Greenland as an example of complex socio-environmental systems</i> • Data clinic: advice and practice in managing large datasets, as part of assignment 2. 	MaW
W9	Tue-Nov-15	Modelling human-ecological systems: an example of the global carbon cycle We will draw together our knowledge of the C cycle and system modelling to explore the impacts of different climate mitigation techniques. <ul style="list-style-type: none"> • Guest Lecture: Prof Sandy Tudhope <i>the complexity of coral reef systems</i> • Data clinic continued. 	MaW
W10	Tue-Nov-22	Student presentations on ecosystem structure Presentations on the structure and diversity of forest ecosystems from around the globe (Brazil, Mozambique, Tanzania, USA, Canada and Scotland).	CR
W11	Tue-Nov-29	Overview, feedback and exam preparation We will draw together the threads of the course and look at the challenges facing ecosystem science. Students can reflect on the course and provide feedback.	CR

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Assessment

A1	20%	3-page policy brief on key issue of ecosystem functioning	Due Thurs Nov 3rd 14:00. E-submission on WebCT only.
A2	40%	Ecosystem structure practical including a group presentation (20%) and individual write up (20%)	Presentations in week 10 , individual write ups due Thurs Nov 24th 14:00. E-submission on WebCT only.
Exam	40%	Examination	Scheduled for the period 12 th - 21 st h December 2011.

Fieldwork

For weeks 3 and 6 we will be outside whatever the weather. You will need to bring good shoes, very warm clothes and waterproofs. You will also need to bring writing materials. Note that pencil is preferable, as it does not run in the rain. Full details of the fieldwork will be given in the week before each trip.

Reading lists

Reading lists will be provided for each week on WebCT.

The following text is used throughout the course:

- Chapin, Matson and Mooney (2002) *Principles of terrestrial ecosystem ecology*. Springer

Other literature which gives a flavour of the course content includes:

- Steffen, W., J. Grinevald, P. Crutzen and J. McNeill (2011). "The Anthropocene: conceptual and historical perspectives." *Philosophical Transactions of the Royal Society A*. 369(1938): 842-867.
- Curtis, A (2011). The Use and Abuse of Vegetational Concepts. Part 2 in the BBC TV documentary series All Watched Over By Machines Of Loving Grace. Available online.
- Gruber N, Galloway JN (2008) An Earth-system perspective of the global nitrogen cycle. *Nature* 451: 293-296
- Mumby, P. J. et al (2007) Thresholds and the resilience of Caribbean coral reefs. *Nature* Vol 450 1 Nov 2007.
- Hooper, D.U. et. al. (2005) Effect of Biodiversity on Ecosystem Functioning: A Consensus of Current Knowledge. *Ecological Monographs*, 75 (1), 2005, pp 3 - 35.
- Post, ERO et al (1999). Ecosystem consequences of wolf behavioural response to climate. *Nature* 401(6756): 905-907.
- Biggs, R., Carpenter, S.R., Brock, W.A. (2009) Turning back from the brink: Detecting an impending regime shift in time to avert it. *PNAS* vol 106, no.3, 826-831.