Master's Programme: Social-Ecological Resilience for Sustainable Development

Course 1: Social-ecological systems: challenges & approaches (15hp)

Course leader: Sarah Cornell

Last updated (BIG): 4th October 2018

Course Content

This course introduces students to the Anthropocene, one of several proposed terms for the new geological era in which we live, in which humanity has become the dominant force structuring the biosphere. It will address what this means for critical subsystems in the Earth system, for humanity, and for the development of Earth system governance. This course will define the research challenges that the Master's Programme Resilience in Social-Ecological Systems will address. The course will then explore alternative approaches to coupled social-ecological systems from several disciplinary backgrounds in, for example, anthropology, geography, economics, and ecology. Then the course will look at current approaches to measuring and monitoring how ecosystems support human wellbeing. Students will be introduced to theoretical concepts, methods for analysis, and conduct group and individual research projects that utilize these concepts and methods.

Course Learning outcomes

It is expected that the student, after taking the course, will be able to:

- understand and explain how humanity has changed the functioning of the Earth system
- explain what key research areas for sustainability science are
- compare and contrast different disciplinary approaches to social-ecological systems, and explain in what contexts they are more or less useful
- critique and apply methods for estimating human support from ecosystems, such as ecosystem services and ecological footprinting.

Course Modules

The course includes the following three modules, which are detailed in the following pages:
Module 1: Challenges of the Anthropocene (4 hp),
Module 2: Linking theory to research questions and design (4 hp),
Module 3: Ecosystem support of humanity (7hp).

General course reading

Walker, B.H. and D. Salt. 2006. Resilience Thinking: Sustaining Ecosystems and People in a Changing World. 174p. Island Press, Washington, D.C., USA.

Module 1: Challenges of the Anthropocene (4 hp)

Module leader: Sarah Cornell (sarah.cornell@su.se)
Instructors: Sarah Cornell SC, Tiina Häyhä TH,
Peter Sørgaard Jørgensen PSJ, David Armstrong McKay DAM, Jen Hinton JH

Module description

This module will introduce students to the global environmental situation from a social-ecological perspective. Students will learn about the Earth system and its functioning and history. They will be given an overview of the main strands of research that demonstrate how people have become a significant driver of global change processes, transforming the planet. The students will examine the main social and ecological trends in global change, and discuss how global change relates to benefits in human wellbeing and to emergent global risks. They will learn about multidisciplinary approaches to evaluating social-ecological questions, and be introduced to scientific visualization and the analysis of global datasets. They will be encouraged to reflect on the challenges and opportunities that a global perspective on environmental change presents for the research processes of sustainability science, and for current actions towards global sustainability.

Module content

Concepts	***Methods***	**Applications**
Week 1: Introducing the Anthropocene		
The Earth as a social-ecological system Entering the Anthropocene Tracking global environmental change Resilience in the Anthropocene	Systems analysis Integrative methods and theory Global data synthesis Visualization techniques	Framing research questions Graphics of social-ecological change
Week 2: Navigating the Anthropocene		
Measuring human development Sustainability science for policy and society Global governance, planetary boundaries and doughnuts	Transdisciplinary research design Stakeholder analysis Policy analysis	Overview of contemporary global challenges (reader)
Week 3: Research in the Anthropocene		
Environmentalist's paradox	Reflexive research methods	Outline research proposal

Class Schedule - *All lectures are in room 251 unless otherwise noted*

	Lectures	*Class exercises*	Home work
Week 1: Introducing the Anthropocene			
SEPTEMBER **Mon 3** **9:30-11:00** **11:00-12:00** **13:00-15:00**	**AM:** Module welcome, Roll call, Course Introduction [1.5 hr, TD, SC and CL] **AM:** Earth as a social-ecological system [1 hr, SC]	**PM:** Discussion of lecture, readings and module Q&A [1 hr] **PM:** Introduce the project groups, 'Anthropocene reader' and research proposals [1 hr]	
Tues 4 **10:00-12:00** **13:00-15:00**	**AM:** Entering the Anthropocene [2 hr, SC]	**PM:** Group Project Work [with SC]	Upload *initial outline* Anthropocene reader.
Wed 5 **10:00-12:00** **13:00-15:00**		**AM:** Group Project Work **PM:** Intro to data visualization: Gapminder and other data [2 hr].	
Thurs 6 **10:00-12:00** **13:00-15:00**	**AM:** Tracking global environmental change: Theory, models & data [2 hr, SC + DAM]	**PM:** Data analysis and visualization + peer review	
Fri 7 **10:00-12:00** **13:00-15:00**	**AM/PM:** What does resilience mean in the Anthropocene? I. Anthropocene risks [2 hr, PSJ] II. Real-world engagement [2 hr, APA]		Individual research question due. Email to SC.
Week 2: Navigating the Anthropocene			
Mon 10 **10:00-12:00** **13:00-15:00**	**AM:** The big picture of human development: [2 hr, TH]	**PM:** Planetary boundaries and doughnuts: sustainability science and governance in the Anthropocene [2 hr, TH + SC]	
Tues 11 **10:00-12:00** **13:00-15:00**	**AM:** Sustainability, societal shifts and pathways [2 hr, JH]	**PM:** Group Project Work	
Wed 12	**READING DAY + PROJECT WORK**		
Thurs 13 **10:00-12:00** **13:00-15:00**	**AM:** invited seminar, P Villarrubia, marine plastic as an emerging challenge	**PM:** Group Project Work	
Fri 14 **10:00-12:00** **13:00-15:00**	**AM:** The environmentalist's paradox (2 hr, Mod 1 Team)	**PM:** Group discussion on research proposals [with SC] **PM:** Group Project Work	Complete Anthropocene reader due. Upload and email SC.
Week 3: Research in the Anthropocene			
Mon 17 **10:00-15:00** **15:00-16:00**	**PM:** Module review	**AM/PM:** Presentations and peer review of Anthropocene readers	
Tues 18		**PM:** Individual online module evaluation [1.5 hr]	**Due 17:00** Individual research proposals. Email to SC.

Module learning outcomes

Upon completion of this module students will:

- Understand the concept and context of the Anthropocene
- Understand the unique characteristics of sustainability science
- Know where to find global environmental and social data
- Be able to visualize social-ecological information
- Be able to design a research plan to investigate social-ecological system phenomena.

Assessment and Grading

For this module 40% of your grade comes from the group project (compilation and review of the Anthropocene reader, review of data visualization), and 60% comes from the individual tasks (data visualization and research proposal).

Component	Learning Outcomes	Weighting (%)
Group Anthropocene reader – input to annotated bibliography (Pass/Fail)	1,2,3	10%
Group Anthropocene reader presentation (quality, clarity, address points, sensible) (Graded A-F)	1-5	20%
Peer review comments on readers and data visualizations (Pass/Fail)	1,3,4	10%
Individual research questions (Pass/Fail)	1,3, 5	10%
Data visualization/analysis (criteria: logic, clarity, importance) (Graded A-F)	1,2,3,4	20%
Final research proposals (clarity, address points, sensible) (Graded A-F)	1-5	30%
Module evaluation		Compulsory

Attendance of lectures and participation in all seminars is compulsory. Participation does not only mean attendance, the participant must have prepared for and take an active role in the seminar. The individual course evaluation at the end of the course is compulsory.

Criteria for assessment

The participant must achieve passing grades for all parts of the course in order to pass the course as a whole. Failure to submit on time will result in a maximum grade C. The maximum grade for grade Fx is E. The following grades are issued; the lower limits for each grade is expressed as a percentage of the maximum points available:

A 95% Excellent
B 85% Very good
C 75% Good
D 65% Satisfactory
E 60% Sufficient (pass)
Fx 50% Insufficient (fail)
F Below 50% Poor or insufficient conduct (fail)

A	requires excellent insight and deep understanding of how the module concepts are related to research of social-ecological systems. Excellence in analysis, assessment and synthesis in written and oral discussions
B	requires very good insight and deep of how the module concepts are related to research social-ecological systems. Shows skills in analysis, assessment and synthesis

C	requires good insight into the module concepts and how they are interrelated, as well as independent sound judgements and analytical skills in discussing them
D	requires additional skills in discussing and explaining the module concepts
E	is issued to participants who can recapitulate the contents of the course and define the basic concepts discussed in the different module components.

Reading List – *required readings should be done prior to lectures!*

[Note: The group project will require many documents to be added to these readings]

Lecture: Earth as a social-ecological system

Cornell, S., Downy, C., Fraser, E. and Boyd, E. 2012. Earth system science and society: a focus on the anthroposphere. In: *Understanding the Earth System: global change science for action*, eds. S. Cornell and I.C. Prentice. Cambridge University Press, chapter 1.

Lövbrand, E., Stripple, J. and Wimand, B. 2009. Earth System governmentality: Reflections on science in the Anthropocene. *Global Environmental Change* 19(1): 7-13

Lecture: Entering the Anthropocene

Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., Crumley, C. 2011. The Anthropocene: From global change to planetary stewardship. *Ambio* 40(7): 739-761.

Waters, C., Zalasiewicz, J., Summerhayes, C., Barnosky, A.D., Poirier, C. et al. 2016. The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science* 351: aad2622

Lecture: Tracking global environmental change

AMAP, 2011. *Snow, Water, Ice and Permafrost in the Arctic (SWIPA): Climate Change and the Cryosphere.* Arctic Monitoring and Assessment Programme, Oslo, Norway. https://www.amap.no/documents/doc/snow-water-ice-and-permafrost-in-the-arctic-swipa-climate-change-and-the-cryosphere/743 *Read chapter 11 (Callaghan et al.)*

European Environment Agency 2015. SOER 2015: *The European environment – state and outlook. Synthesis report.* EEA, Copenhagen, Denmark. https://www.eea.europa.eu/soer-2015/synthesis/report *Read chapter 2, skim-read chapter 3.*

Explore some data websites:

http://www.gapminder.org

http://www.google.com/publicdata/home

https://www.vets.ucar.edu/vg/index.shtml

Lecture: Big picture of human development

UNDP. Human Development Report 2016. Human Development for Everyone. Chapter 3: Reaching everyone—analytical and assessment issues. http://report.hdr.undp.org

Watch:

"Hans Rosling shows the best stats you've ever seen" http://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen.html***Recommended reading:***

UNDP. Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. http://hdr.undp.org/en/content/human-development-report-2014

UNDP. Human Development Report 2016. Human Development for Everyone. http://report.hdr.undp.org *Skim-read the report, especially chapter 6.*

Lecture: Planetary Boundaries and doughnuts

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F.S., III, Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32.

Häyhä, T., Lucas, P.L., van Vuuren, D.P., Cornell, S.E. and Hoff, H. 2016. From Planetary Boundaries to national fair shares of the global safe operating space — How can the scales be bridged? *Global Environmental Change* 40: 60-72.

O'Neill, D.W., Fanning, A.L., Lamb W.F. and Steinberger J.K. 2018. A good life for all within planetary boundaries. *Nature Sustainability* 1: 88–95

Watch:

"Doughnut economics – Kate Raworth" (RSA Animations)
https://www.youtube.com/watch?v=CqJL-cM8gb4

Lecture: Sustainability Science in action

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., and Thomas, C.J. 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science* 7(1): 25-43.

Cornell, S.E., Berkhout, F., Tuinstra, W., Tàbara, J.D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., Otto, I.M., Petersen, A., Pohl, C. and van Kerkhoff, L. 2013. Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy* 28: 60-70 http://dx.doi.org/10.1016/j.envsci.2012.11.008

Lecture: The environmentalist's paradox

Raudsepp-Hearne, C., Peterson, G.D., Tengö, M., Bennett, E.M., Holland, T., Benessaiah, K., MacDonald, G.K. and Pfeifer, L 2010. Untangling the Environmentalist's Paradox: Why is human well-being increasing as ecosystem services degrade? *BioScience* 60: 576-589.

Reading Day: The practice of science

Alon, U. 2009. How to choose a good scientific problem. *Molecular Cell* 35(6): 726-728.

Kates, R.W. 2011. What kind of a science is sustainability science? *Proceedings of the National Academy of Sciences*, 108(49): 19449-19450.

Nissani, M. 1992. Ten cheers for interdisciplinarity. *The Social Science Journal,* 34:201-216.

Master's Programme: Social-Ecological Resilience for Sustainable Development

Course 1: Social-ecological systems: challenges & approaches (15hp)

Module 2: Linking theory to research questions and design (4 hp)

Module leader: Sarah Cornell (sarah.cornell@su.se)

Instructors: Maria Tengö MT, Tim Daw TD, Andrea Downing ASD, Tim DuBois TdB, Michelle Dyer MD, and Maria Mancilla Garcia MMG

Brief description & module objectives

The course aims to train students to critically examine scientific papers and assess how they contribute to theory building; assess the value and relevance of the research question posed in relation to the theory; and identify the research design for answering the question posed. The module will explore scientific explanation and the use of different approaches to address a research question and explain a phenomenon. We also discuss epistemologies and how these relate to the types of research questions we address. Students will also begin discussing the approaches to studying social-ecological systems, the challenges of doing so, and the characteristics of questions that require a transdisciplinary approach.

Module content

Concepts	***Methods***	**Applications**
Week 1: Disciplines and research design		
Epistemology Disciplines Scientific explanation Theory, research question	Creating and integrating knowledge Meaning and visualization	Communication between colleagues Understanding approaches to research
Week 2: Understanding scientific process: ways of knowing, scientific explanation		
Knowledge types Research design: theory, question, methods, data Epistemological agility	Theorising Dissecting studies	Research design Linking problem to question to theory
Week 3: Understanding scientific process: the role of theory in transdisciplinarity		
Research design: theory, question, methods, data Transdisciplinarity: implications for research design	Dissecting studies Comparative analysis of different scientific frameworks used in sustainability science	Critically assessing research design Formulating relevant/ feasible/ interesting questions in SES context

Class Schedule - All lectures are in room 251 unless otherwise noted

	Lectures	*Class exercises*	Home work
Week 1: Introduction: Disciplines and Research Design			
SEPTEMBER **Wed 19** **10:00-11:00** **11:00-12:00** **13:00-16:00**	**AM:** Module Intro [SC, 30 mins]	**AM:** Intro group work [30 mins]: Backgrounds and disciplines **AM:** Reflections log [TD] **PM:** Gender and Resilience [MD]	
Thurs 20	**READING DAY**		Readings
Fri 21 **10:00-12:00** **13:00-16:00**	**AM:** Everyone can theorize! [SC, 1 hr]	**AM:** Class discussion on reading – Fang et al. **PM: Workshop 1:** Epistemology and research design [3 hr, SC, TdB]	
Week 2: Understanding scientific process, ways of knowing, epistemological agility			
Mon 24 **10:00-12:00** **13:30-16:30**	**AM:** What is Theory? Components of understanding, and the process of understanding and explanation [MMG, 2hr]	**PM:** Why do we use stats ? [TD, 2 hr]	Readings
Tues 25 **10:00-12:00** **13:00-15:00**	**AM:** Knowledge systems; Multiple Evidence Base [MT, 2hr]	**PM:** Class discussion on readings [MT, 2 hr]	
Wed 26	**READING DAY**		Prepare for Workshop 2
Thurs 27 **10:00-15:30**		**Workshop 2** [5 hr, MT, SC] [+ team]	
Fri 28 **10:00-12:00**		**Optional BBL:** Why are the planetary boundaries ungendered? [SC]	Prepare for Seminar
Week 3: Understanding scientific process: transdisciplinarity			
OCTOBER **Mon 1** **9:00-16:00** **16:00-17:00**	**PM:** Module Review [1 hr, SC]	**AM/ PM: Seminar** Transdisicplinarity [6 hr, ASD, PSJ, SC]	
Tues 2			Peer review + Individual Final Assignment
Wed 3			Peer review + Individual Final Assignment
Thurs 4		**PM:** Individual online module evaluation – no need to be at SRC [1.5 hr]	**Due 17:00:** Final assignments. Email to SC

Learning outcomes

Upon completion of this module students will:

1. Understand what scientific theory is, how it is used and developed through scientific research;
2. Be able to differentiate between approaches to scientific explanation and how this relates to research design, explanatory power and theory building;
3. Be able to compare and contrast different disciplinary approaches to social-ecological systems, and explain in what contexts they are more or less useful;
4. Begin to understand how SES research questions can be addressed using a transdisciplinary approach.

Assessment and Grading

Component	Weighting (%)	Learning Outcomes
Workshop 1	Pass/ fail	1,2
Workshop 2	15%	1-3
Seminar	Pass/ fail	1-4
Final Assignment	85%	1-4
Module Review	Compulsory	
	100%	

Attendance of lectures and participation in all seminars is compulsory. Participation does not only mean attendance, the participant must have prepared for and take an active role in the seminar. The individual module evaluation at the end of the module is compulsory.

Criteria for assessment

The participant must achieve passing grades for all parts of the course in order to pass the course as a whole. Failure to submit on time will result in a maximum grade C. The maximum grade for grade Fx is E. The following grades are issued, the lower limits for each grade is expressed as a percentage of the maximum points available:

A 95% Excellent
B 85% Very good
C 75% Good
D 65% Satisfactory
E 60% Sufficient (pass)
Fx 50% Insufficient (fail)
F Below 50% Poor or insufficient conduct (fail)

A	requires excellent insight and deep understanding of how the module concepts are related to research social-ecological systems . Excellence in analysis, assessment and synthesis in written and oral discussions
B	requires very good insight and deep of how the module concepts are related to research social-ecological systems. Shows skills in analysis, assessment and synthesis
C	requires good insight into the module concepts and how they are interrelated, as well as independent sound judgements and analytical skills in discussing them
D	requires additional skills in discussing and explaining the module concepts
E	is issued to participants who can recapitulate the contents of the course and define the basic concepts discussed in the different module components.

Reading List – *required readings should be done prior to lectures!*

Week 1: Disciplines, Theory and Research Design

Fang, X., Zhou, B., Tu, X., Qun Ma, and Wu, J. 2018. "What kind of a science is Sustainability Science?" An evidence-based re-examination. *Sustainability* **10**: 1478, doi:10.3390/su10051478

Fazey, I. 2010. Resilience and Higher Order Thinking. *Ecology and Society*, **15**(3): 9-31.

NOTE: This paper is useful as a background paper to the whole module, and we will discuss different aspects raised at different times.

Kates, R.W. 2011. What kind of a science is sustainability science? *Proceedings of the National Academy of Sciences*, **108**(49): 19449-19450. *(Read to refresh from module 1)*

Maffey, G. 2016. Freedom to range. *Nature* **535**: 583.

Recommended Reading

Midgley, M. 2003. Ch 1. How Myths Work, and Ch 2. Our Place in the World. *In: The Myths We Live By*. Taylor and Francis, 2003.

Week 2: Understanding scientific process – ways of knowing

Lecture: Theorising – from problem to theory – Maria M. Garcia

Flannery T. 2013. They're taking over! *The New York Review of Books.* September 26 2013.

Meyfroidt, P. et al. 2018. Middle-range theories of land system change. *Global Environmental Change* **53**: 52–67

Schlager, E. 2007. A Comparison of frameworks, theories, and models of policy processes. Chapter 10 in: Sabatier, P.A, *Theories of the Policy Process*, Westview Press, New York, ISBN: 9780786734245.

Recommended Reading

Swedberg, R. 2012. Theorizing in sociology and social science: turning to the context of discovery. *Theory and Society* **41**: 1-40.

Lecture: Knowledge Systems and Multiple Evidence Base – Maria Tengö

Carey, M., Jackson, M., Antonello, M. and Rush, J. 2016. Glaciers, gender, and science: A feminist glaciology framework for global environmental change research. *Progress in Human Geography* 40(6): 770-793. doi: 10.1177/0309132515623368

Cornell, S.E., Berkhout, F., Tuinstra, W., Tàbara, J.D., Jäger, J., et al. (2013) Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy* 28: 60-70 *(Read to refresh from module 1)*

Tengö, M., Brondizio, E., Elmqvist, T., Malmer, P., Spierenburg, M. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance – The Multiple Evidence Base approach. *Ambio* **43**: 579-591. 10.1007/s13280-014-0501-3

Recommended Reading

Tábara, D.J. and Chabay, I. 2013. Coupling human information and knowledge systems with social-ecological systems change: Reframing research, education, and policy for sustainability. *Environmental Science and Policy* 28: 71-81.

Workshop 2 – Maria Tengö and Sarah Cornell

Carey, M., Jackson, M., Antonello, M. and Rush, J. 2016. Glaciers, gender, and science: A feminist glaciology framework for global environmental change research. *Progress in Human Geography* 40(6): 770-793. *(Read to refresh)*

Masood, E. 2018. The battle for the soul of biodiversity. Nature, News Feature 22 August 2018 - https://www-nature-com/articles/d41586-018-05984-3

Haider, L.J., Hentati-Sundberg, J., Giusti, M., Goodness, J., Hamman, M., Masterson, V. Meacham, M., Merrie, A., Ospina, D., Schill, C. and Sinare, H. 2018. The undisciplinary journey: Early-career perspectives in sustainability science. *Sustainability Science* 13(1): 191–204

Recommended Reading

Andouin, M., Preiser, R. and Nienaber, S. 2013. Exploring the implications of critical complexity for the study of social-ecological systems. *Ecology and Society* 18 (3): 12-23.

Week 3: Transdisciplinarity

Further reading will be required for the Seminar – ***information will be provided in class.***

Module 3: Ecosystem Support of Humanity (7hp)

Module leader: Tim Daw TD

Instructors: Albert Norström AN, Magnus Nyström MN, Erik Andersson EA
Miriam Huitric MH, Jean-Baptiste Jouffray JB, Emma Sundström ES,
Cibele Queiroz CQ, Rodrigo Martinez Peña RM

Brief description

The purpose of this module is to explore the links between ecosystems and human wellbeing. It will look at current approaches to measuring and monitoring how ecosystems support human wellbeing e.g. ecosystem services (ES). The module starts with a brief introduction of the ecosystem dynamics that underlie ES. The module continues by scrutinizing what role biodiversity plays for resilience and hence the maintenance of ES in the face of change. The concept of ES is defined, explored, critiqued and tested in terms of measurability and applicability. Indicators of resilience, trade-offs between ES and the valuation of different types of services are explored across a range of different systems using case studies in three systems: urban, marine, and agricultural systems. The second half of the module familiarises students with a range of approaches to study ES and human wellbeing and provides opportunities for students to design, conduct and analyse empirical studies on ecosystem services and wellbeing. Quantitative and qualitative analysis will be introduced and the students will learn to use open-source software for statistical analysis and geographical information systems (GIS). There will be lots of in-class interactions, an assessed presentation, small group exercises, and an individual paper assignment.

Course content

Concepts	*Methods*	Applications
Week 1: Ecology, biodiversity and resilience		
ECOLOGY: Ecosystem processes, food webs, species traits, Trophic cascades, RESILIENCE, REGIME SHIFTS AND ALTERNATIVE STATES: Functional groups, redundancy, response diversity, alternative ecosystem states, ecological feedbacks, hysteresis, shifting baselines SPATIAL ECOLOGY AND THE IMPORTANCE OF SCALE: Connectivity, spatial patterns of diversity, complex landscapes, panarchy, spatial resilience Service providing units (SPUs)	Mean trophic level Measures of biodiversity e.g. species diversity, species richness Statistical analysis of large, longitudinal data sets Spatial analysis - network, patchwork	Coral reef regimes in Hawaii Landscape mosaics Group discussions Perspectives exercise - ecological maps Use-and-abuse your lecturers
Week 2: Measuring and monitoring ecosystem support of humanity: approaches & concepts		
Ecosystem services (ES) Ecosystem service bundles ES Tradeoffs	Indicators of ecosystems Qualitative and quantitative measures of ES Statistical reasoning, inference and testing Use of R commander for statistical analysis	ES in different systems Measuring ES HWB & ES links Coastal communities in E Africa
Week 3: Empirical investigations in ecosystem services and human wellbeing		
Human Wellbeing (HWB) Environmental justice, power and politics	Design a research project on Urban ES GIS Study design Field research Analysis of qualitative data	Field exercise on Reimersholme. In-class exercises Group work In-class written assignment
Week 4: Combining ecology and economics for analysis of HWB		
	Oral presentation Group work	Final assignment: Group work Group presentation Individual paper

Now Class schedule - All lectures are in room 251 unless otherwise noted

	Lectures	*Class exercises*	Home work
Fri 5th and Week 1: Ecology, biodiversity and resilience			
OCTOBER **Fri 5th** **11-12** **13-14.30** **14.45-15.45**	**AM**: Introduction to ecology–RM 1hr **PM:** Module intro **–** TD, 1hr	**PM**: Exploring ecological concepts in the field – RM 1.5 hr	**Readings before morning class** **Reflective journal**
Mon 8th **10:00-12:00** **13:30-15:30**	**AM:** Ecology for resilience thinking – MN, 2hr	**PM:** Review and small group discussion: clarifying and discussing main concepts from lecture – MN, 2hr	**Readings**
Tue 9th	**READING DAY**		
Wed 10th **10:00-12:00** **13:00-15:00**	**AM:** Detecting alternative regimes in coral reefs - a Hawaiian case study – JB, 2hr	**PM**: Review and small group discussion: clarifying main ecological concepts – JB, MN, RM 2hr	**Readings**
Thur 11th **10.30-12.00**		**AM:** Self-organised reflective journal small group discussion **AM:** In class reflections and personal evaluation 'Learning styles' TD 1.5hr	**Readings**
Fri 12th **9:00-12:00** **13:00-16:00**	**AM**: Intro to landscape ecology – EA, 1 hr	**AM+PM:** Field exercises and discussions. Spatial ecology and the importance of scale EA & RM, 2+4 hr	**Readings** **Reflective journal**
	Lectures	***Class exercises***	**Home work**
Week 2: Ecosystem services and related concepts			
Mon 15 **9:30-12:00** **13.30-16.00**	**AM:** Introduction to Ecosystem Services (ES) – TD, 2.5 hr	**PM:** Small group reviewing applications of ecosystem services and preparing questions for tomorrow's panel	**Readings**
Tue 16 **9:30-12:00** **14.00-16.00**	**AM:** ES tradeoffs, governance and social power relations – TD 2.5 hr	**PM:** Panel discussion 'Ecosystem services, from concepts to practice and policy' - TD and others, 2h	**Readings**
Wed 17 **9:30-12:00** **13.30-16:00**	**AM:** Human wellbeing concepts and approaches – TD 2.5 hr	**Lunchtime and PM:** Exercise: collecting wellbeing data. Exploring qualitative and quantitative data on wellbeing, TD, 2.5 hr	**Readings**
Thur 18th **9:00-11:00** **11:00-12:00**	**AM:** Urban social-ecological systems – EA 2 hrs	**AM:** ES discussion and review TD 1 hr	**Readings**
Fri 19 **9:30-12:00** **13:00-16:00**	**AM:** Assessment of multiple ecosystem services – CQ 2.5 hr	In class exercise on ES assessment and interactions – CQ 3 hr	**Readings** **Reflective journal**
	Lectures	***Class exercises***	**Home work**
Week 3: Empirical investigations in ecosystem services and human wellbeing			
Mon 22nd **9:00-12:00** **13:00-16:00**		**AM:** GIS training – ES 3hrs **PM:** Introduction to Reimersholme and field exercise, Planning data collection – TD,RM, CQ	
Tue 23 **9:00-17:00**	***Dress accordingly. We will be outside – rain or shine!!***	**Field exercise:** Urban ES: Stockholm & Reimersholme –TD, RM, CQ, ,	**Processing data**
Wed 24 **09:00-17:00**		**AM/ PM:** Data workshop – analysing quant data and use of GIS – ES,RM TD	**Coding Qual data**
Thurs 25 **09:00-17:00**		**AM/PM:** Workshop**:** ES & tradeoffs: work with field exercise data, TD, RM, CQ	**Upload all datsets**
Friday 26		Submit draft reports by 17.00	**Work on draft reports**

			Weekend homework: draft report peer review **Reflective journal**
	Lectures	***Class exercises***	**Home work**
Week 4: Reporting on urban ecosystem services			
Mon 29 **10-11:30**	AM: Feedback on draft reports. Introducing final assignment.	Circulate peer comments by 9am.	**Working on final assignment**
Tues 30			**Working on final assignment**
Wed 31		Hand in final assignment at 17.00	**Working on final assignment**
Thurs 1st Nov **9:00-17:00**		**Work on presentations**	
Friday 2nd **9:00-12:00** **13.00-14:00**		**AM:** Group presentations – TD, VM, 3hr **PM:** Module Review, Questions & Course Evaluation, TD 1hr **COURSE PUB!**	**Reflective journal**

Learning outcomes

Upon completion of this module students will:

1. Understand basic ecological functions and terms such as: trophic levels, connectivity, biodiversity and related concepts such as redundancy and some methods of measurement
2. Understand the ecosystem services as a conceptual lens for understanding human-nature relationships and be able to debate the strengths and weaknesses of different applications of this concept.
3. Understand the interconnection of different ecosystem services, the consequences of managing for only one benefit and the use of 'bundles' and 'tradeoffs' as a way to explore interconnections between ES and between people.
4. Be familiar with and apply methods for evaluating human wellbeing and it's connection to ecosystem services in urban, agricultural and marine systems
5. Have experience of sourcing or generating a range of social-ecological data, evaluating their strengths and weaknesses and exploring them with statistical software.
6. Conduct basic analysis of qualitative and quantitative data and understand the basic strengths of these.

Assessment and Grading

Component	Weighting (%)	Learning Outcomes
Class assignments: Exploring HWB, ES bundles and tradeoffs,	Compulsory	2,3,4,5
Class exercise: R commander for basic statistics	Compulsory	5
Field exercise: Ecosystem services in a city - Reimersholme	Compulsory	2,3,4,5
Workshop: Ecosystem services and Tradeoffs in Stockholm green spaces	Compulsory	2,3,4
Group final presentation	25%	1-5
Individual written Final Assignment	75%	1-5
Module Review	Compulsory	
Individual Course Evaluation	Compulsory	
	100%	

Attendance of lectures and participation in all seminars is compulsory. Participation does not only mean attendance, the participant must have prepared for and take an active role in the seminar. The individual module evaluation at the end of the module is compulsory.

Criteria for assessment
The participant must achieve passing grades for all parts of the course ailure to submit on time will result in a maximum grade C. The maximum grade for grade Fx is E.

The following grades are issued, the lower limits for each grade is expressed as a percentage of the maximum points available:

A 95% Excellent
B 85% Very good
C 75% Good
D 65% Satisfactory
E 60% Sufficient (pass)
Fx 50% Insufficient (fail)
F Below 50% Poor or insufficient conduct (fail)

A	requires excellent insight and deep understanding of how the module concepts are related to research social-ecological systems . Excellence in analysis, assessment and synthesis in written and oral discussions
B	requires very good insight and deep of how the module concepts are related to research social-ecological systems. Shows skills in analysis, assessment and synthesis
C	requires good insight into the module concepts and how they are interrelated, as well as independent sound judgements and analytical skills in discussing them
D	requires additional skills in discussing and explaining the module concepts
E	is issued to participants who can recapitulate the contents of the course and define the basic concepts discussed in the different module components.

Reading List – readings should be done prior to lectures – see guidelines for individual readings

Introduction to ecology with Rodrigo Martinez Pena
See readings on Mondo on Yellowstone case study…

Basic ecology resources for non Ecologists (If you have limited ecological training, please review these on Friday morning):
https://www.khanacademy.org/science/high-school-biology/hs-ecology/hs-introduction-to-ecology/v/ecology-introduction - *Super basic 10 minute intro to what ecology is.*

Begon, Michael, Colin R. Townsend, and John L. Harper. *Ecology: From Individuals to Ecosystems*. Sirsi) i9781405111171, 2006. – *One of several classic ecological texts that you could consult for an exhaustive overview of the field of Ecology, although with limited emphasis on resilience ideas.*

Week 1: Ecology, biodiversity and resilience

Rethink Feature: Running out of reef resilience? An accessible overview of coral reef ecology and resilience as background to Magnus and Jean Baptiste's studies
https://rethink.earth/running-out-of-reef-resilience/

1) (read) Jackson JBC, Kirby MX, Berger WH, *et al.* 2001. Historical overfishing and recent collapse of coastal ecosystems. Science 293:629–38.
This paper was an eye-opener that communicated what role humans has played in shaping (marine) ecosystems, and what we perceive a s"natural". Think about: authors' methodological approach for evidence of historical human impacts.

2) (read carefully) Scheffer M, Carpenter SR, Foley J, *et al.* 2001. Catastrophic shifts in ecosystems. *Nature* **413**: 591–696.
This seminal paper provides multiple cases of regime shifts in ecosystems, and describes the dynamics of what underpin those.

3) (read) Elmqvist T, Folke C, Nyström M, *et al.* 2003. Response diversity, ecosystem change and resilience. Front Ecol Environ 1:488–494.
This paper was the first to introduce the concept of response diversity in ecology. It takes a conceptual (multi-ecosystem) approach and defines what has come to define a key property of resilience - i.e. response diversity. Think about: how does the concept of response diversity translate into trans-disciplinary research/social-ecological systems?

4) (read) Nyström, M., A. V. Norström, T. Bleckner, M. *et al.* 2012.
Confronting feedbacks of degraded marine ecosystems. *Ecosystems* 15:695-710.
This paper gives an overview of feedbacks in aquatic ecosystems and what role they play for the stability of "unwanted" ecosystem regimes (and details to the lecture for those interested). It also explores ways of breaking feedbacks to reverse "undesirable" ecosystem regimes. Think about: i) at what scale(s) should a feedback analysis be conducted (when is it informative), and ii) what benefits/drawbacks does this approach entail?
P.S. The approach is relevant for any ecosystem - not only for the aquatic systems described here!

5) (read carefully) Folke C. 2016. Resilience. *Ecology and Society* 21(4):44.
This paper summarises the evolution of Resilience as a concept by a world leading authority (Carl F.). It describes its history, development, conflicts and challenges. The paper gives deep insights and some broad narratives of how resilience is used at SRC.

Lecture and field day: Spatial ecology and the importance of scale

Bengtsson, J. et al., 2003. Reserves, Resilience and Dynamic Landscapes. *AMBIO*, 32: 389–396.
Core reading: Underused text on landscape scale resilience in application. Interesting thoughts on spatial/temporal change and how flexibility can be promoted.

Dunning, J.B. et al. 1992. Ecological processes that affect populations in complex landscapes. *Oikos*, 65: 169–175.
Core reading: Outlines the basic ecological theory and processes that drive landscape dynamics. Provides definition and background to core consepts such as complementation, supplementation and neighbourhood effects.

Peterson, G. et al. 1998. Ecological resilience, biodiversity, and scale. *Ecosystems*, 1: 6-18.
Additional reading: Provides a theoretical bridge between Bengtsson and Dunning. The major contribution is the clear presentation of cross scale dynamics and how they work.

Week 2: Ecosystem services and related concepts

Lecture and discussion: Introduction to Ecosystem Services – Tim Daw

Lele, S., Springate-Baginski, O., Lakerveld, R., Deb, D., Dash, P. 2013. Ecosystem Services: Origins, Contributions, Pitfalls, and Alternatives. *Conservation and Society* **11**, 343. doi:10.4103/0972-4923.125752 – *Read this for a background and review of critiques of the ecosystem services concept*

Watch this video of Pavan Sukdev – a high profile proponent of economic analysis of ES (and a former member of the SRC board) stating why he thinks the approach is valuable. https://vimeo.com/58715497

McCauley, D. J. 2006. Selling out on nature. *Nature* 443(7107): 27-28. – *Read this short article to understand some of the critiques of ecosystem services from a conservation angle. Decide if you agree and come to class ready to discuss*

Díaz et al 2015. The IPBES Conceptual Framework — connecting nature and people. Current Opinion in Environmental Sustainability, Open Issue 14, 1–16. doi:10.1016/j.cosust.2014.11.002 – *Skim this to get an overview of the conceptual framework guiding IPBES, the huge, global ecosystem services science, policy, practise initiative. Decide whether you think this framework addresses some of the critiques.*

Hahn, T., C. McDermott, C. Ituarte-Lima, M. Schultz, T. Green, and M. Tuvendal. 2015. Purposes and degrees of commodification: Economic instruments for biodiversity and ecosystem services need not rely on markets or monetary valuation. *Ecosystem Services* **16**:74–82. *Nice review of the ways in which ES can be used – not always leading to commodification. Don't have to read in detail but make sure you look at and understand Table 1.*

Optional readings and references:

Bateman et al (2011) Economic Analysis for Ecosystem Service Assessments. *Environmental and Resource Economics* 48(2):177–218. *Good overview of economic valuation approaches*

Costanza et al (1997) The value of the world's ecosystem services and natural capital. *Nature*. 387 (6630): 253-260. *Classic and influential global valuation study*

McNally, C.G., Uchida, E., Gold, A.J. 2011. The effect of a protected area on the tradeoffs between short-run and long-run benefits from mangrove ecosystems. *Proceedings of the National Academy of Sciences* **108**, 13945 –13950. doi:10.1073/pnas.1101825108 *Example of an attempt to measure benefits from mangroves and how they changed over time with conservation*

Raudsepp-Hearne, C., and G. Peterson. 2016. Scale and ecosystem services: how do observation, management, and analysis shift with scale—lessons from Québec. *Ecology and Society* 21(3).

UNEP-WCMC. 2014. *The Importance Of Mangroves To People: A Call To Action*. Page 128 pp. United Nations Environment Programme World Conservation Monitoring Centre, Cambridge.

Lecture: ES governance, tradeoffs and social power relations

Watch this video for a basic introduction to tradeoffs in ecosystem services and wellbeing: http://www.stockholmresilience.org/news--events/seminars-and-events/whiteboard-seminars/2011-07-02-ecosystem-services-and-human-well-being.html

Watch this video about tradeoffs in ecosystem services in coastal kenya: https://youtu.be/Kln_T0l7jFo

Berbés-Blázquez, M., J. A. González, and U. Pascual. 2016. Towards an ecosystem services approach that addresses social power relations. *Current Opinion in Environmental Sustainability* **19**:134–143. *Argues that ES work has been somewhat blind to power and how to address this*

Dawson, N., Grogan, K., Martin, A., Mertz, O., Pasgaard, M., Rasmussen, L.V., 2017. Environmental justice research shows the importance of social feedbacks in ecosystem service trade-offs. *Ecology*

and Society 22. doi:10.5751/ES-09481-220312 *argues for need to consider justice, not just wellbeing – example from villages near a protected area in Lao*

Optional readings:

Daw, T. M., S. Coulthard, W. W. L. Cheung, K. Brown, C. Abunge, D. Galafassi, G. D. Peterson, T. R. McClanahan, J. O. Omukoto, and L. Munyi. 2015. Evaluating taboo trade-offs in ecosystems services and human well-being. *Proceedings of the National Academy of Sciences* **112**(22):6949–6954. *Paper describing the Pmowtick project case study where stakeholders' wellbeing is interconnected through a fishery. Modelling reveals awkward tradeoffs*

Mahajan, S.L., Daw, T., 2016. Perceptions of ecosystem services and benefits to human well-being from community-based marine protected areas in Kenya. Marine Policy 74, 108–119. doi:10.1016/j.marpol.2016.09.005 – *Originally an SRC masters project - example of using wellbeing to unpick social differences in benefits from protected areas*

Felipe-Lucia, M. R., B. Martín-López, S. Lavorel, L. Berraquero-Díaz, J. Escalera-Reyes, and F. A. Comín. 2015. Ecosystem Services Flows: Why Stakeholders' Power Relationships Matter. *PLOS ONE* **10**(7):e0132232. *Explores how different stakeholders have power to affect ES*

Lele, S., Srinivasan, V. 2013. Disaggregated economic impact analysis incorporating ecological and social trade-offs and techno-institutional context: A case from the Western Ghats of India. *Ecological Economics* **91:** 98–112. doi:10.1016/j.ecolecon.2013.03.023 *nicely worked example of how changes in ES affect different groups of people, plus interesting reflections on the role of valuation and deliberation*

Panel discussion: Ecosystem services, from concepts to application in policy and practise

Experts - selected readings will be forthcoming…

- Garry Peterson
- Åsa Gren
- Thomas Hahn
- Megan Mecham
- Pernilla Malmer
- Ana Paula Aguiar

Human wellbeing, concepts and approaches – Tim Daw

Have a play with : OECD's better life index http://www.oecdbetterlifeindex.org

Read this short feature about income, wellbeing and fisheries in coastal East Africa: https://rethink.earth/redefining-poverty-in-kenyas-fishing-villages/

In class we will use the SPACES data explorer, to explore some of this data from coastal communities in Kenya and Mozambique http://www.espa-spaces.org/resources/spaces-data-explorer/

Weeratunge, N., Béné, C., Siriwardane, R., Charles, A., Johnson, D., Allison, E.H., Nayak, P.K., Badjeck, M.-C., 2014. Small-scale fisheries through the wellbeing lens. Fish and Fisheries 15, 255–279. doi:10.1111/faf.12016 – *Skim for a Good introduction and overview of different approaches to wellbeing from different fields – useful overview even if you are not interested in fisheries!*

Optional readings

Daw, T. et al., 2011. Applying the Ecosystem Services Concept to Poverty Alleviation: The Need to Disaggregate Human Well-Being. *Environmental Conservation* **38**:370–379. *Draws attention to social difference and winners and losers from changes in ES plus some reflections on the nature of ES-wellbeing connections*

Chaigneau et al (in press) Understanding basic needs to reconcile poverty and ecosystem services, Manuscript – posted on Mondo - *Example of assessing wellbeing through a basic needs approach which generated the data used in the SPACES Data Explorer tool.*

McGregor, A., Coulthard, S., Camfield, L., 2015. Measuring what matters: The role of well-being methods in development policy and practice. ODI discussion paper. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9688.pdf - *A useful summary of wellbeing approaches in policy and practice*

Villamagna, A., Giesecke, C. 2014. Adapting Human Well-being Frameworks for Ecosystem Service Assessments across Diverse Landscapes. *Ecology and Society* **19**. doi:10.5751/ES-06173-190111 *Describes an attempt to evaluate wellbeing in an acceptable way for stakeholders in US*

Gough, I., McGregor, J.A., 2007. Wellbeing in developing countries: From theory to research. Cambridge University Press. *Detailed book on understanding and assessing wellbeing in developing countries.*

Robeyns, I. (2005). The Capability Approach: a theoretical survey. Journal of Human Development *6*, 93–117. *More in depth guide to the capability approach of Amartya Sen and others.*

Urban social-ecological systems – with Erik Andersson

No readings just watch these 3 short videos…
http://www.stockholmresilience.org/news--events/seminars-and-events/whiteboard-seminars/2013-06-04-what-is-urban-ecology.html whiteboard seminar with Tilman
https://www.youtube.com/watch?v=GnWREXqdjIs interview with Erik Anderson
Video: An Urbanizing Planet https://www.youtube.com/watch?v=mPi4zwEpswE

Optional readings:

Seto KC, Parnell S, Elmqvist T (2013) A Global Outlook on Urbanization. In: Elmqvist T et al. (Eds) Urbanization, biodiversity and ecosystem services: Challenges and opportunities. Springer, Oxford, UK, pp: 1–12

Bai X, Thomas Elmqvist T, Frantzeskaki N, McPhearson T, Simon D, Maddox D, Watkins M, Romero-Lankao P, Parnell S, Griffith C, Roberts D (2018) New Integrated Urban Knowledge for the Cities We Want. In: Elmqvist T et al. (Eds) Urban Planet, Cambridge University Press, Cambridge, UK, pp: 462-482

Assessment of multiple ecosystem services – with Cibele Queiroz

Bennett, E. M., G. D. Peterson, L. J. Gordon. 2009. Understanding relationships among multiple ecosystem services. *Ecology Letters* 12:1394–1404

Optional readings:

de Bello, F., Lavorel, S., Díaz, S. et al. (2010) Towards an assessment of multiple ecosystem processes and services via functional traits Biodivers Conserv 19: 2873. https://doi.org/10.1007/s10531-010-9850-9

Queiroz, C., Meacham, M., Nigell, K., Andersson, E., Norström, A., Norberg, J., Peterson, G. 2015 Mapping bundles of ecosystem services reveals distinct types of multi-functionality within a Swedish landscape *Ambio*, 44:89-101 *No need to read this in advance, it will be introduced during the session*