Summary of Week 5 – University of Minnesota Group, Version 1

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with
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EEB 8990 Sustainability Science: An interdisciplinary introduction
Fall Term 2010 – M/W 3-4:30pm, Institute on Environment
Course website: https://groups.nceas.ucsb.edu/sustainability-science

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This summary of Session six of *Sustainability Science: An Interdisciplnary Introduction*, is centered on the discussion of chapter 2.3 "Natural Capital, Services and Human Wellbeing" of *Sustainability Science: An Introduction*, as presented October 11, 2010. The discussion presented is comprised of remarks from chapter lead author Steve Carpenter (UW Madison), Patty Balvanera (CIEco) and University of Minnesota Students. As a framework, we will focus primarily on the three central topics of the chapter, as identified by discussant Patty Balvanera and the University of Minnesota Students. This document represents the summary of the information and discussion presented in conjunction with chapter 2.3.

Chapter 2.3 and Steve Carpenter's remarks
Chapter 2.3 focuses on the interrelationships and multitude of services derived from the Earth's (abiotic) systems and ecosystems. As defined in the chapter, natural capital is the capacity of the Earth to produce the flows of goods services upon which humans depend. These are divided into 4 broad categories: supporting services (e.g. nutrient cycling, soil formation, primary production), provisioning services (e.g. food, fuel, fresh water, wood and fibre), regulating services (e.g. climate regulation, flood regulation, disease regulation, water purigication), and cultural services (e.g. educational, recreational, spiritual). The degree to which human well-being is dependent on many of these services, coupled with the sizeable impacts of anthropogenic activities on their provisioning, solidifies the importance of understanding natural capital in the context of sustainability science.

Steve Carpenter's presentation on October 11, 2010 was based upon the content of chapter 2.3. Using the ideological framework of natural capital, he focused on the question of whether or not the global human-environment system is on a sustainable trajectory. This question is admittedly difficult due to our lack of knowledge of the interactions between life support systems, impacts of human actions on life support systems, and how policy affects human actions. Fitting this overarching theme, four topics were enumerated, to serve as the basis for the presentation: defining ecosystem services, defining and discussing the problem of scale, thresholds and big changes, and lastly, a discussion of unknown futures and scenarios.

Ecosystem Services –

Ecosystem services are benefits gained from ecosystems, ranging from resources like food to cultural benefits from nature. The concept of ecosystem services has roots in natural resources decades ago. Some useful figures presented described services as a series flows and offered examples of changes in natural capital depending on management and use of ecosystems.

System Definition and Problem of Scale –
Though systems analysis may be complicated, there is a logical approach to limit unnecessary difficulties therein. These were a series of questions including defining questions, establishing spatiotemporal scale, enumerating input and drivers and possible outputs. Throughout this process, checking and rechecking objectives is essential. Establishing scale is highly dependent on matching scale to the process being examined (e.g. watershed to ecology and state level in society). Practical difficulties can arise if there are mismatches in scale between the costs and benefits of certain human actions.

Thresholds and Big Changes –
Big changes in ecosystems are often non-linear unanticipated (e.g. desertification and anoxic events), and can sometimes be irreversible. Though relatively surprising, many of these big changes are driven by conscious human activity. Extrapolating big changes to future scenarios reveals that very few possibilities are shared within society.

Conclusions –
At this point, no discipline has a monopoly or cogent method on how carry out these types of analyses. For this reason, interdisciplinary cooperation is of the utmost importance.

Patty Balvanera and UM Students –
Patty and the University of Minnesota Students established three main themes within the chapter around which to build their discussions. These (in general) are: 1) flows (of Earth system and ecosystem services) 2) tradeoffs (between multiple ecosystem services, or between ecosystem services and other metrics of development (e.g. GDP)) and 3) (human) interventions. For each of these topics, Patty and the University of Minnesota students approached the issues from a biophysical and socio-economic perspective respectively.

Patty Balvanera-
1) Major advances needed in sustainability science are centered on attempting to quantify ecosystem services and establishing links between flows of ecosystem services to biodiversity and ecosystem functioning. Understanding these interrelationships will help us understand how to sustain the flow of ecosystem services in future global change scenarios.

2) Tradeoffs need to be understood in the context of three different scales: spatial, reversibility and temporal.

3) Interventions should come in the form of proactive human management. These include the design of multifunctional systems and the restoration of ecosystem services.

UM Students –

Each previously established topic was presented by a single student from the University of Minnesota. Due to time constraints, only the first two such topics were presented.

1)David Bael – Flows
Direct links can be drawn between the biophysical (ecosystem services) and human wellbeing. From this, improved ecosystem service valuation methods should be able to better economically quantify the value of natural capital, making tradeoffs more explicit in the market. Current ecosystem services valuation approaches often directly or indirectly attempt to measure stated preferences (e.g. the preferences implied by responses to a survey) or revealed preferences (e.g. the preferences that can be inferred from price data). However, significant challenges lie in correct valuation for a multitude of reasons (e.g. discounting and uncertainty are contentious and difficult to measure, the societal valuations of many ecosystem services are difficult to convert into market-compatible metrics (e.g. dollars)).

2)Suhyun Jung – Tradeoffs
Especially in light of the failure of markets to incorporate the values of many ecosystem services, there are often tradeoffs inherent to human activities/policy decisions between (traditional) economic development and ecological sustainability. However, improved valuations have and will continue to reveal the existence of both win-win (e.g. where revenue can increase with stewardship), and lose-lose solutions (e.g. too much tourism can degrade ecological resources, which in turn reduces the touristic value of the landscape). There can also be tradeoffs between the provisioning of multiple services (e.g. provisioning services vs. regulating/cultural services – the value lost in air/water quality (regulating) following the clear cutting of a forest for lumber (provisioning)). InVEST, a GIS-based software developed by the Natural Capital Project, is an recent example of a tool that can be used to evaluate various tradeoffs among ecosystem services related to land-use.

3)Barrett Colombo – Interventions
Daily et al. (2009) provide a useful framework for incorporating ecosystem services into decision-making, in which decisions are impacted cyclically by natural scientists' characterization of ecosystems and modeling of their services, and social scientists' development of economic and cultural models for values that inform institutions. This flow of information modifies institutions, and institutions can then alter their incentive structure to encourage different decisions. Aspects of technology and management interventions most in need of development include identifying areas where payments for ecosystem services are most likely to achieve biodiversity and conservation objectives, developing scenarios of alternative future uses, and long-term monitoring of biodiversity. Institutions must reorganize to include stakeholders in an adaptive governance system, and develop incentive programs for protecting ecosystem services. In addition, the relative benefits and limitations of policy or finance mechanisms need to be accurately characterized.