Overview of Ecosystem Services
9th Annual LTER Mini-Symposium, 4 March 2010

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Main Points

Global environmental science is reorganizing.
★ Place-based social-ecological science is central.

Ecosystem services and natural capital are among the useful frameworks for this research.

Many important shifts in ecosystem services are big, surprising, and hard to reverse.

Scenarios integrate diverse knowledge about change in natural capital and ecosystem services.
“The global scientific community must take on the challenge of delivering to society the knowledge and supporting information necessary to assess the risks humanity is facing from global environmental change, and to understand how society can effectively mitigate dangerous changes and cope with the change we cannot manage.”
Examples of research questions:

What are the implications for natural capital and human well-being of intensification of agriculture, forestry, aquaculture and fisheries?

What are the effects of governance, policies and practices on natural capital and human well-being?

What are the implications of urbanization for natural capital and human well-being at regional and global scales?
Ecosystem Services

Benefits that people obtain from ecosystems:
  Provision of food, fiber, water, pharmaceuticals etc.
  Regulation of water flow and quality, air quality, climate, soil fertility, disease etc.

Cultural values
Ecosystem Services

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Natural Capital

The capacity of an ecosystem to provide services
Natural Capital and Ecosystem Services of an Agricultural Watershed

Crops, Freshwater flows, Fish & Wildlife, Recreation etc.

Natural Capital
Soil
Hydrology
Vegetation
Habitat
Biotic Interactions etc.

Human Use and Management
Institutions, incentives, regulations
Markets
Operators
Equipment etc.

Changes in Land Cover, Ecosystem heterogeneity, Water infiltration & runoff,
Carbon storage, Nutrient flows, Soil fertility, Biota, etc.

Ecosystem Services: Food & Fiber Production, Freshwater, Flood Regulation,
Nutrient Regulation, Carbon Sequestration, Recreation, Aesthetics, etc.

Carpenter et al., in review
Natural Capital and Service Flows Depend on How an Ecosystem is Used:

Land Use Scenarios

Balance Services:

Intensive Food:

Key:

Water Recharge
Water Quality
Flood Control
Food
Carbon Storage
Natural Capital & Ecosystem Services: Connections Across Scales

Connections to Larger Systems

Local Human-Environment Dynamics

Direct and Indirect Human Drivers
Population, Consumption
Technology
Land Use
Nutrient release
Species introduction etc.

Natural Capital
Climate
Ocean dynamics
Hydrology
Biogeochemistry
Biodiversity etc.

Ecosystem Services
Provisioning
Regulating
Cultural etc.

Human Wellbeing
Material security
Health
Social relations
Personal security
Freedom etc.

Connections to Smaller Systems

Carpenter et al., in review
Changes in Natural Capital and Ecosystem Services Can be Big, Fast and Inconvenient.
Tipping Elements of the Earth System

Big changes in ecosystem services are hard to predict.

- Lack of information
- Nonlinearity
- Stochasticity
- Human volition
All Possible Futures

Unasked Questions

Imaginable Outcomes

Recognized Uncertainties

Models & Observations

Based on
Sample Perspectives

Cluster the Samples

Condense to a few Scenarios
SCENARIOS

DRIVERS
- Climate: Variability, Change, Atmospheric CO₂
- Land-use patterns & change: Current, Presettlement, Projected 2030, Increased corn (biofuels), Increased grasses (biofuels), Increased urbanization
- Agricultural management: Varied N fertilizer, Manure and P mgmt, Crop residue mgmt

MODELS + DATA
- Agro-IBIS (terrestrial)
- THMB (aquatic/hydrology)
- Lake Water Quality Model

ECOSYSTEM SERVICES
- Provisioning: Food production, Bioenergy production, Freshwater supply
- Regulating: Flood mitigation, Climate regulation: C sequestration, Climate regulation: albedo, Groundwater recharge, Groundwater/surface water quality
- Cultural: Terrestrial aesthetics, Lake recreation

VALUE OF ALTERNATIVE LANDSCAPES
- Model of Local Land Market: Residential and Ag land value
- Contingent valuation survey: Lake water quality, open space
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