# Climate Change Science and Adaptation in the Context of Ecosystem Services

Robert J. Johnston Clark University





# Ecosystem Services and Climate Change– Linking Science and Action

- It is often assumed that ecosystem services research is relevant to climate change mitigation and adaptation.
  - However, the link between science and action is sometimes given insufficient attention.
- Example: The impact of recent federal mandates to incorporate ecosystem services information "where appropriate" is reduced by some agency decision-making contexts which restrict the use of this information.
- To be useful, coordinated climate and ecosystem services research must recognize the institutional frames within which decisions are made.

#### The Importance of Spatial Scale

- The manifestation and relevance of ecosystem service values depend on *spatial scale*.
- What is the scale at which an ecosystem service is relevant? What is the scale at which decisions are made?
- Scale Disconnect: The value of carbon sequestration (e.g., social cost of carbon) used in an attempt to motivate coastal climate adaptation *at the local level*.
  - This value may be of minimal relevance for decisions at that scale.

Who realizes different types of ecosystem service values?
 Where are they located? Where are decisions made?

### Example #1: Species Conservation Value



## Example #2: Delaware Bay Beach Preservation

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Scenario	Sand, Fill and Demolition (PV, \$mill)	Housing Acquisition Payments (paid by State) (PV, \$mill)	Housing Acquisition Payments (received by property owners) (PV, \$mill)	Recreation (PV, \$mill)	Housing Services (PV, \$mill)	Reduction in Additional Flood and Erosion Damages (PV, \$mill)	Net Benefits (PV, \$mill; sum of A through F)	Net Benefits not Including Additional Flood and Erosion Damages (PV, \$mill)
Beach Nourish- ment	-\$61.1	-\$0	\$0	\$16.1	\$18.2	\$2.7	-\$24.1	-\$26.8
Basic Retreat	-\$0.5	-\$61.3	\$61.3	\$10.8	-\$43.1	\$3.0	-\$29.8	-\$32.8
Enhanced Retreat	-\$4.5	-\$149.1	\$149.1	\$10.8	-\$130.9	\$10.6	-\$114.0	-\$124.6

 Values are relative to no action. Society is better off doing nothing and allowing beaches to disappear, although local residents lose.

## Example #3: Coastal Adaptation in Connecticut





GIS Maps: A. Abdulrahman

# Example #3: Coastal Adaptation in Connecticut

	Waterford	Old Saybrook
	Value	Value
Wetlands (per acre saved)	\$13.15***	\$1.24*
Beaches (per acre saved)	\$19.85***	\$19.67**
Seawalls (per mile built)	NS	NS
Homes (per home not		
flooded)	NS	\$0.19***

Results show willingness to pay (value) per household, per year, for public policies to accomplish these changes.
Values depend on scale.

### Scale and Adaptation / Mitigation

- Many *adaptation* decisions are local in nature, and are motivated by benefits and costs that manifest at that scale.
- The challenge for local *mitigation* actions is that costs are borne locally but benefits are distributed globally.
- The actions that are optimal depend on the scale of consideration (e.g., aggregation of values).
- From a self-interest perspective, the best local action is often to free-ride on the mitigation actions of others.
- ♦ All values are not relevant to all people.

#### Uncertainty, Values and Actions

- Climate change leads to uncertainty regarding the future resilience of ecosystems and values.
- What are the implications for decisions?
- Should society "double down" to protect ecosystem services subject to uncertain collapse (e.g., regime shift)?
- When should we give up and allow ecosystems to collapse or disappear due to climate change?
- This issue is particularly difficult when there is a possibility of unknown thresholds and tipping points.
- Example: A fishery threatened by a catastrophic harmony of climate change and overfishing.
  - Should restrictions be increased or relaxed?

#### **Ecosystem Service Values and Climate Change**

- It is not generally sufficient to simply measure ecosystem services or ecosystem service values.
  - To influence actions, one must consider the institutional contexts within which decisions are made.
- How is information on ecosystem services relevant to decisions made by different people at different scales?
- How is this relevant to mitigation and adaptation?
- How does uncertainty influence the decisions that might be made based on ecosystem services information?
- Consideration of such issues can help ensure that ecosystem services information leads to better climaterelated decisions.

Robert J. Johnston Director, George Perkins Marsh Institute Professor, Department of Economics Clark University 950 Main St. Worcester, MA 01610 Phone: (508) 751-4619 Email: rjohnston@clarku.edu