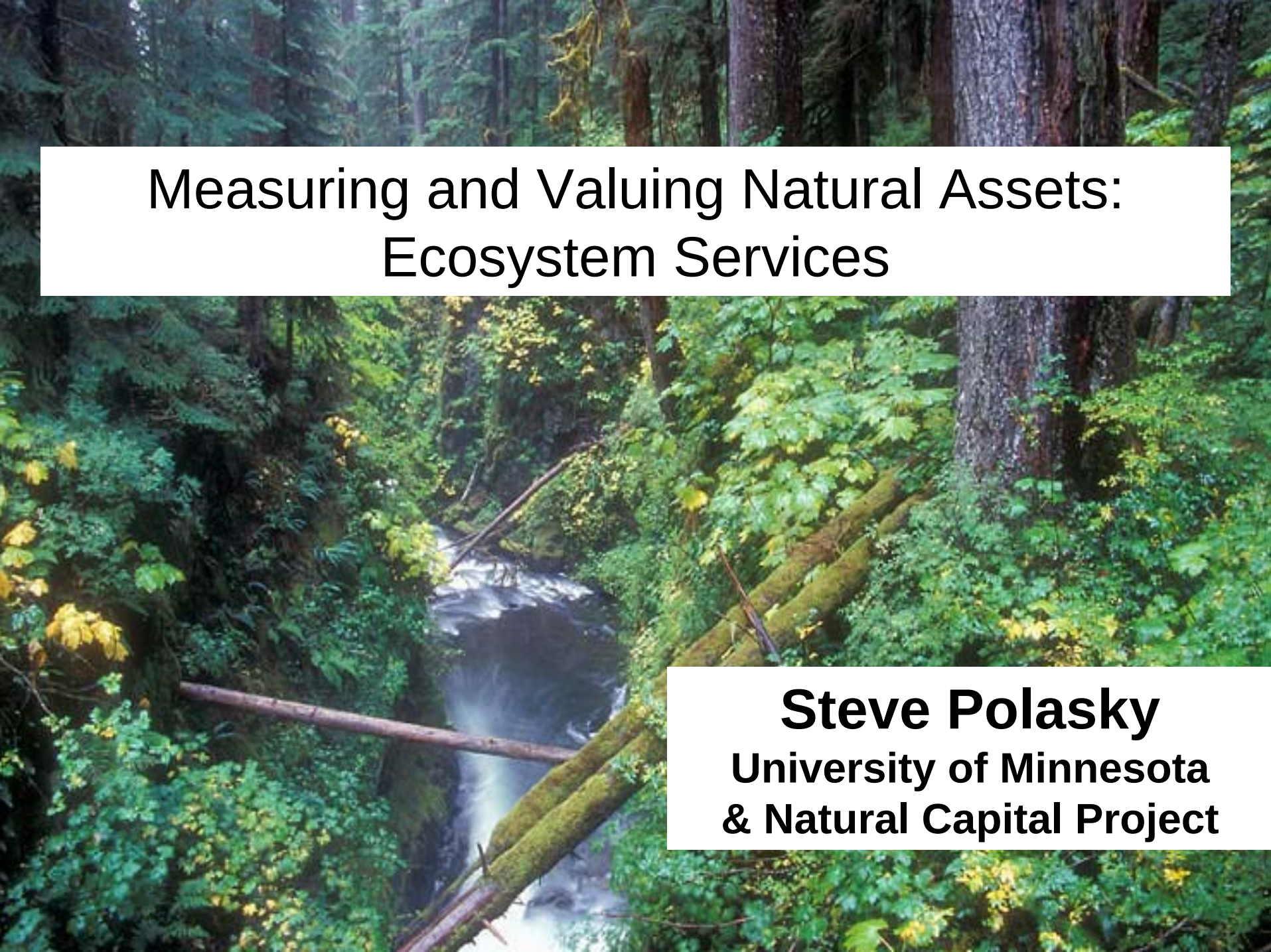

Measuring and Valuing Natural Assets: Ecosystem Services

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& Natural Capital Project

Introduction

- Ecosystems, including agricultural systems, provide a wide array of goods and services of value to people
  - Food production
  - Water quantity/quality
  - Carbon sequestration
  - Recreation
  - Aesthetics
- Land use and land management affect the bundle of ecosystem services (both intentional and unintentional effects)

Introduction

- The provision of many important ecosystem services often is not factored into important land-use and land-management decisions
- Distortions in decision-making damage the provision of ecosystem services making human society and the environment poorer
- Development of a set of tools to predict impact of decisions on provision and value of bundle of services

The Natural Capital Project: Mainstreaming ecosystem services

Woods Institute for the Environment
Stanford University

WWF

The Nature Conservancy

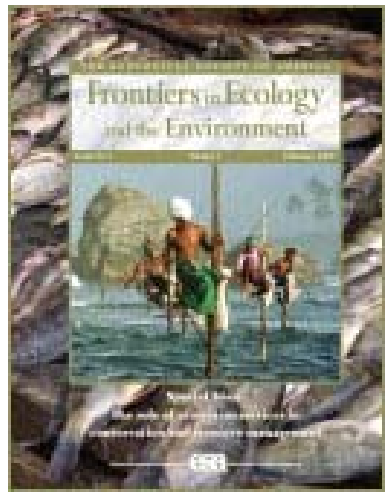
Institute on the Environment
University of Minnesota
Driven to Discover℠

natural capital PROJECT

ALIGNING ECONOMIC FORCES WITH CONSERVATION

"InVEST"
Integrated **V**aluation of **E**cosystem **S**ervices and **T**radeoffs

http://www.naturalcapitalproject.org/InVEST.html



Frontiers of Ecology and Environment Feb 2009

InVEST: Integrated Valuation of Ecosystem Services and Tradeoffs

- Set of computer-based models
- Biodiversity and multiple services
- Driven by future scenarios
- Spatially explicit
- Biophysical and economic outputs
- Flexible and transferable

Example application

- Polasky et al. 2011. The Impact of Land Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota. *Environmental and Resource Economics*
- Use InVEST to analyze how changes in land use in Minnesota affect ecosystem services
- Compare the impact on ecosystem services & biodiversity from:
  - Actual land use change from 1992- 2001
  - Alternative land use change scenarios

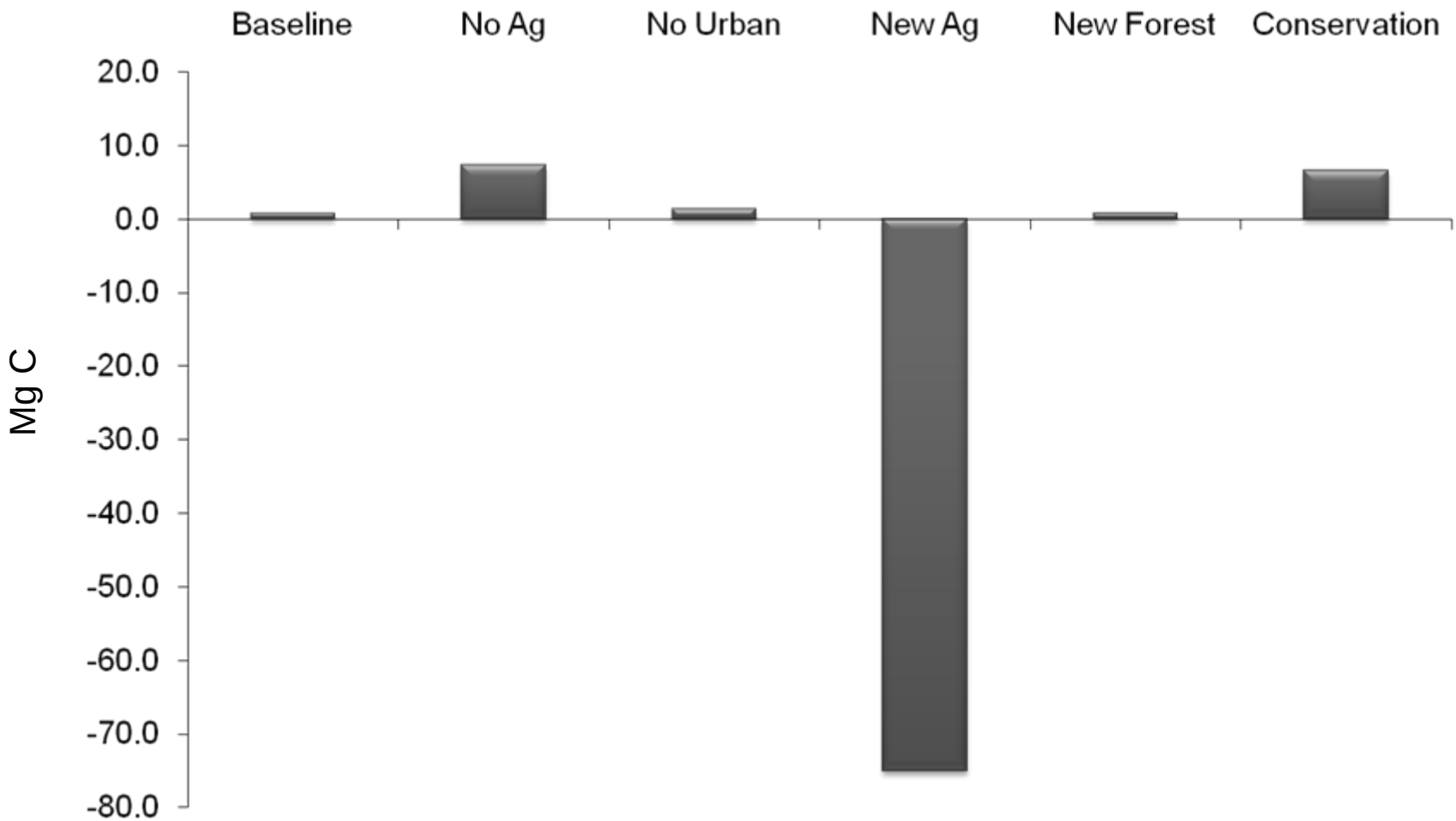
Land use scenarios

- Use National Land Cover Database (NCLD) for 1992 to 2001 for data on actual land use change in Minnesota
- Alternative land use scenarios:
  - No agricultural expansion
  - No urban expansion
  - Agricultural expansion into highly productive soils
  - Forestry expansion into highly productive forest parcels
  - Conservation: low productivity ag land and ag land within a 100 m buffer of waterways in MN River watershed were converted to pre-settlement vegetation

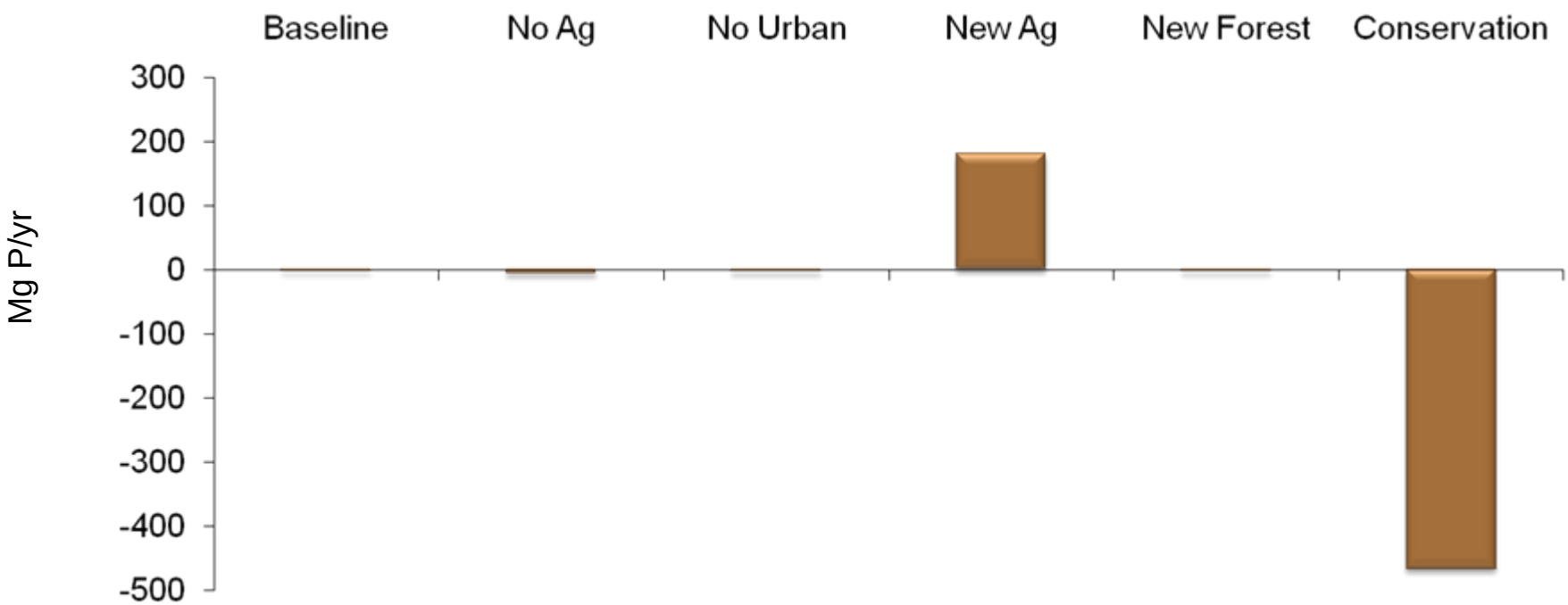
InVEST outputs

- Ecosystem services
  - Carbon sequestration
  - Water quality (phosphorus exports in the Minnesota River Basin)
- Biodiversity
  - Grassland bird habitat
  - Forest bird habitat
  - Overall biodiversity (all natural habitat)
- Returns to landowners
  - Value of agricultural production
  - Value of timber production
  - Value of urban/suburban development

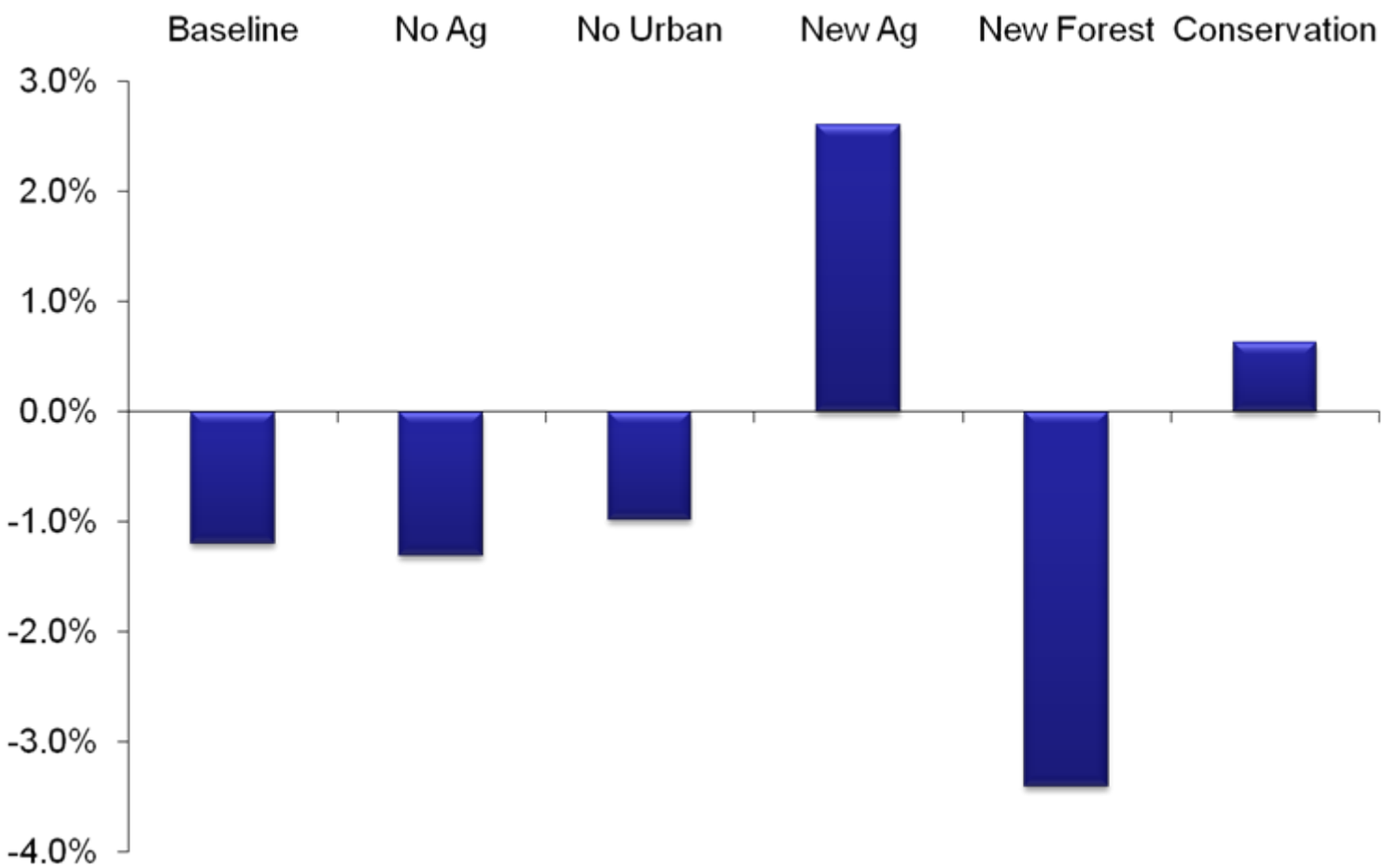
Change from 1992 to 2001 by scenario: carbon sequestration



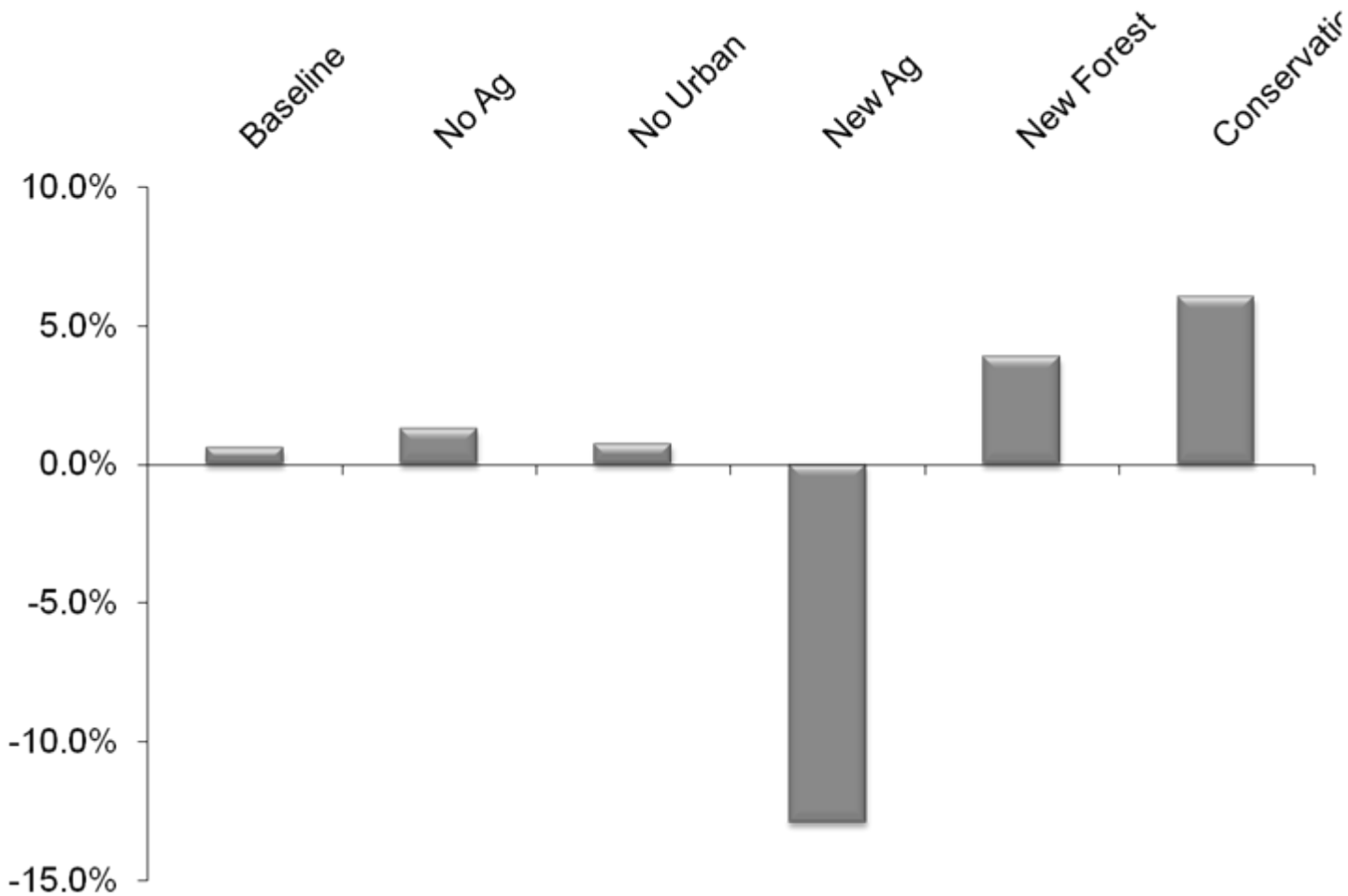
Change in phosphorus exports to mouth of Minnesota River



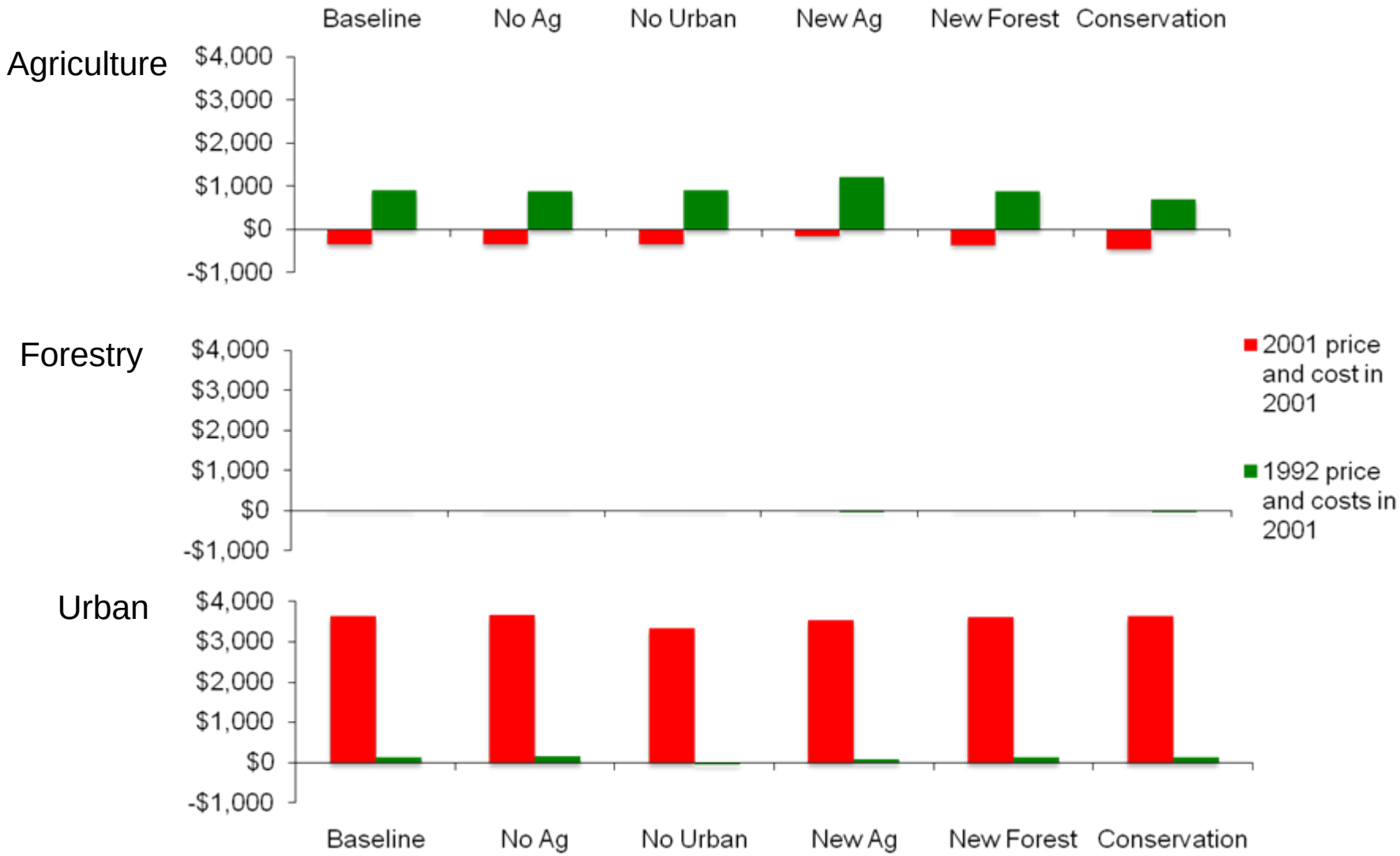
Percentage change in habitat quality for grassland breeding birds



Percentage change in habitat quality for forest breeding birds



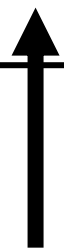
Change from 1992 to 2001 by scenario: market returns to agriculture, forestry, urban



Million 1992 US $

Annual value from land use change scenarios 1992-2001

	Actual land use	No ag expansion	No urban expansion	Ag expansion	Forest expansion	Conser-vation
Change in total value: carbon, water quality, ag & forest production, urban using actual prices (M1992 $)	$3,328	$3,407	$3,040	$2,742	$3,300	$3,380
Change in returns to landowners: ag & forest production, urban using actual prices (M1992 $)	$3,320	$3,343	$3,027	$3,418	$3,292	$3,221



Summary

- The failure to incorporate the value of ecosystem services in land use planning can result in poor outcomes
  - Low level of ecosystem services
  - Low value of total goods and services from landscape
- Tradeoffs among goods and services
- Agricultural land has a bigger effect on ecosystem service value and biodiversity than urban land
  - Result is largely due to the fact that there is far more agricultural land than urban land

Summary

- Spatially explicit analysis of multiple services
- Joint provision of services: one landscape, many consequences
- Tools to address impact of decisions on provision and value of bundle of goods and services