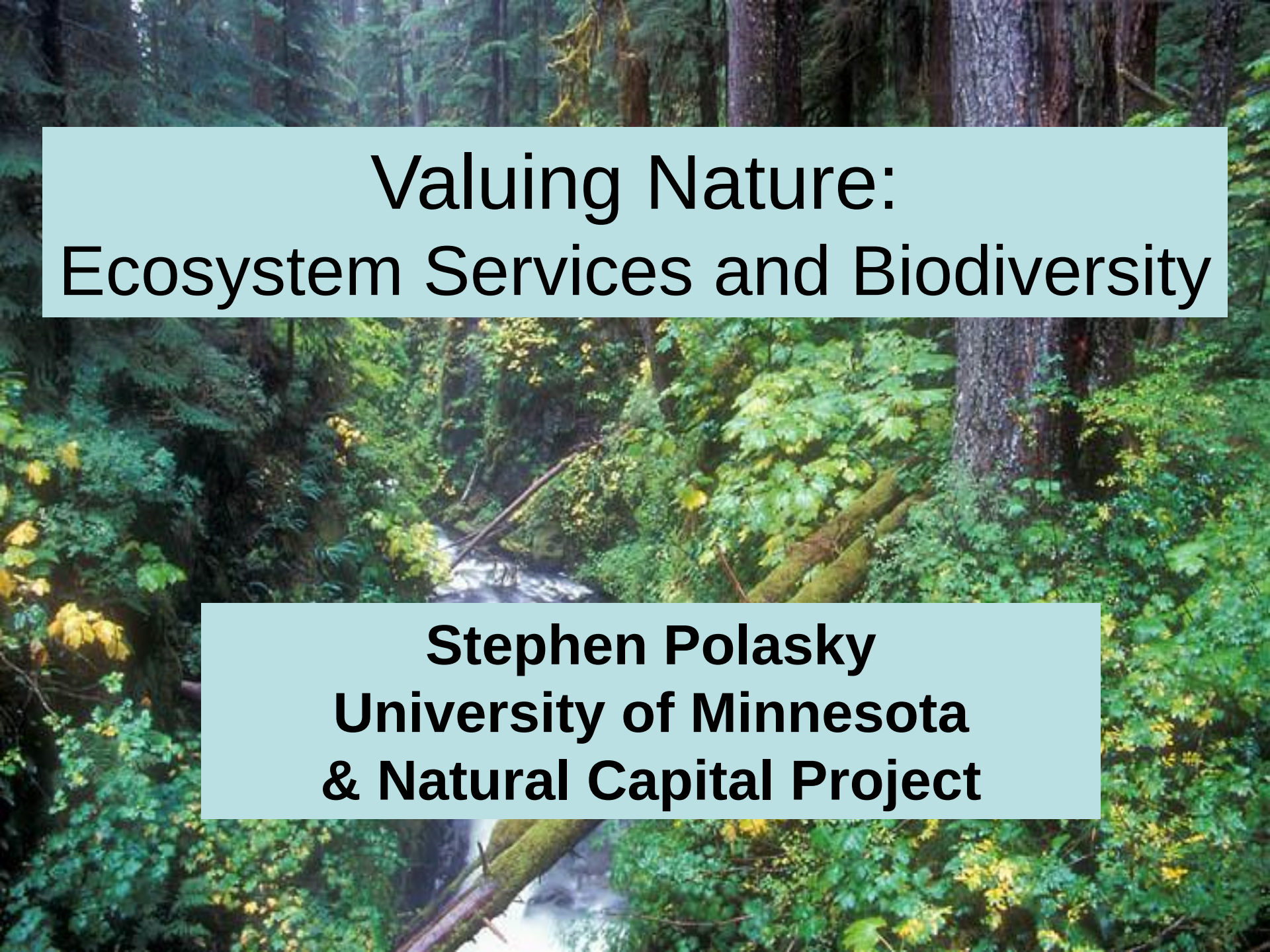


Valuing Nature:
Ecosystem Services and Biodiversity

Stephen Polasky
University of Minnesota
& Natural Capital Project

Why value nature?

- Putting a price tag on nature??
- Sounds like some misguided economic exercise
- “Economists know the price of everything and the value of nothing”
- Valuing nature is:
- Immoral? (Philosophical objections)
- Impossible? (Practical difficulties)
- Both?

Case for valuing nature

- Make a case for valuing nature
- Value does not necessarily mean monetary value
- Valuing something means assessing its impact on human wellbeing

Darwin, ecology and economics

- Valuing nature requires integration of ecology and economics to provide clear signals the consequences of actions – including impacts on ecosystems and biodiversity
- Integrating ecology and economics would have seemed natural to Darwin
- Darwin gained inspiration from early economists like Thomas Malthus
- Ecology, the study of nature's economy, and economics, the study of human economies, share much in common

Case for valuing nature

- Ecosystems provide a wide array of goods and services of value to people ("ecosystem services")
- Human actions affect ecosystems and the services they provide
- Often human actions impact ecosystem functions in ways that degrade ecosystem services

Case for valuing nature

- The provision of ecosystem services often is not factored into important decisions that affect ecosystems
- Distortions in decision-making damage the provision of ecosystem services making human society and the environment poorer

Case for valuing nature

- In market economies, firms are rewarded for producing commodities
- Firms are not rewarded for protecting environmental quality necessary for sustained provision of ecosystem services and conserving biodiversity

Case for valuing nature

- Unless society fixes this imbalance and begins to properly account for the value of nature we are unlikely to see fundamental change necessary to sustain ecosystem services and conserve biodiversity

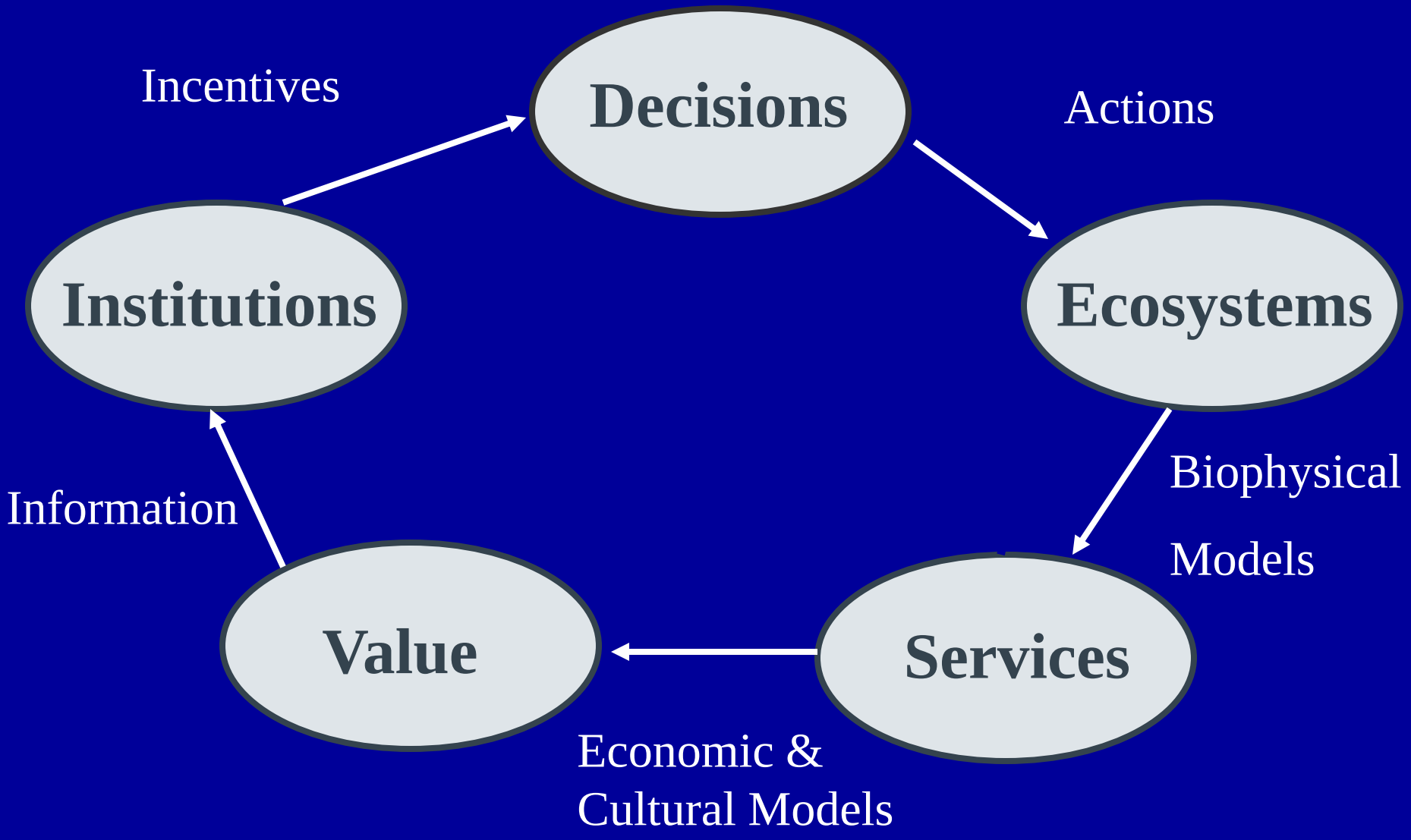
The three tasks for valuing nature

(Services provided by humans for nature…)

The three tasks

1. Improve understanding of the likely consequences of human actions on ecosystems and their ultimate impacts on ecosystem services and biodiversity
2. Express the value of these impacts in terms readily understood by policymakers and the general public
3. Tie understanding of impacts and values to incentives in order to “mainstream” ecosystem services into everyday decisions and longer term policies

Ecosystem services



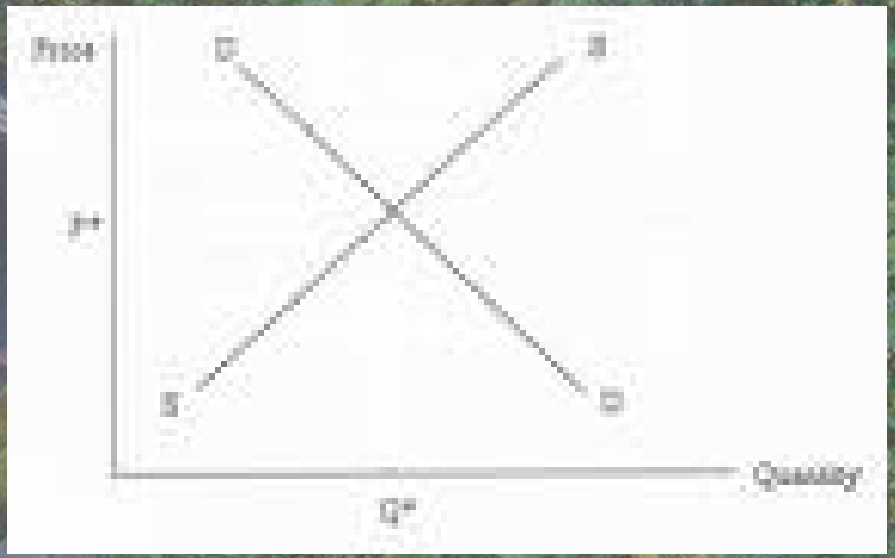
The Natural Capital Project:
Mainstreaming ecosystem services

The Nature Conservancy

WWF

Woods Institute for the Environment
Stanford University

Some notes on economic approach to valuing nature



Monetary valuation via markets

- Some ecosystem services, particularly provisioning services, are traded in markets and have observed prices
- Examples:
  - Value of increased fish harvest from improved water quality or protection of coastal wetlands
  - Value of increased crop production from pollinators

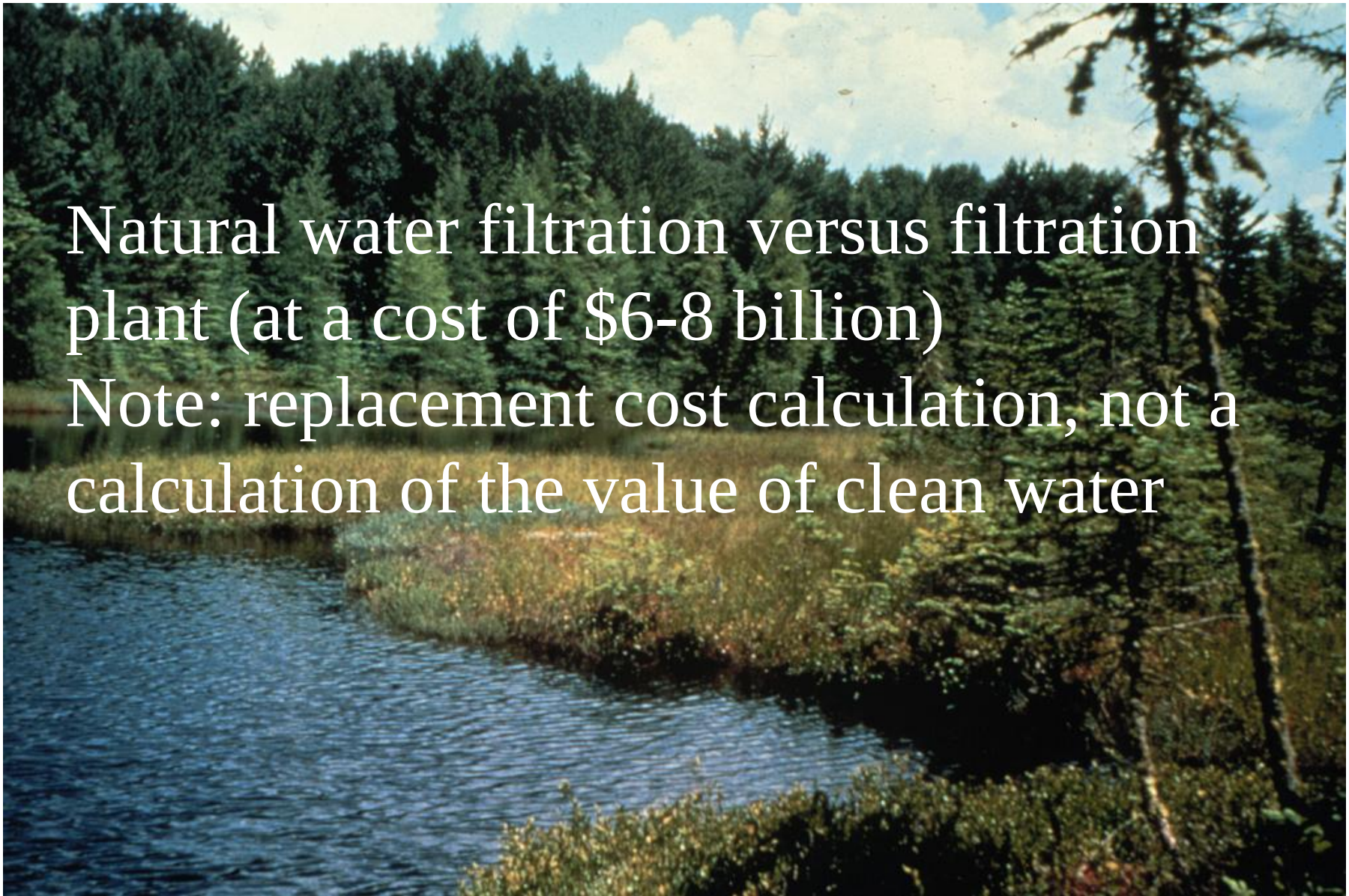
Ricketts et al. 2004. *PNAS* 101: 12579–12582

- Forest-based pollinators increased coffee yields by 20% within 1 km of forest
- Pollination also improved coffee quality
- During 2000–2003, pollination services from forest fragments translated into $60,000 (U.S.) per year for one Costa Rican farm
- This value is commensurate with expected revenues from competing land uses and far exceeds current conservation incentive payments

Non-market valuation

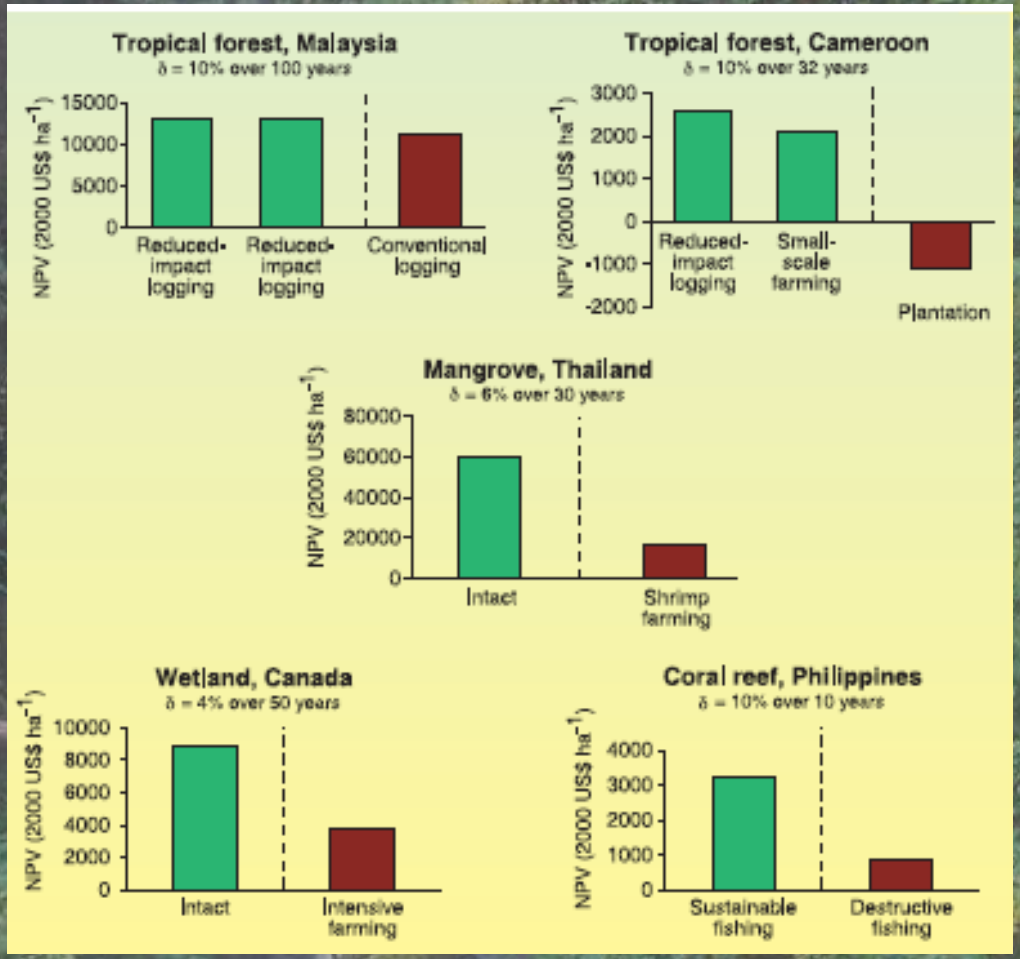
- Revealed Preference
  - Travel Cost Method
  - Hedonic Approach
  - Averting Behavior
- Stated Preference
  - Choice Experiments
    - Contingent Valuation,
    - Conjoint Analysis
- Replacement Cost

New York City Water Supply
Catskills Watersheds Example



Putting valuation of ecosystem services to work to inform decisions

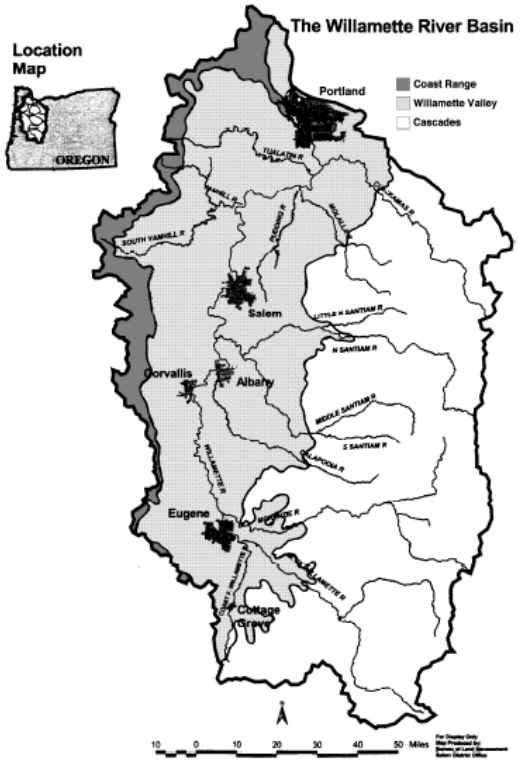
Comparison of value of ecosystem services under alternative management

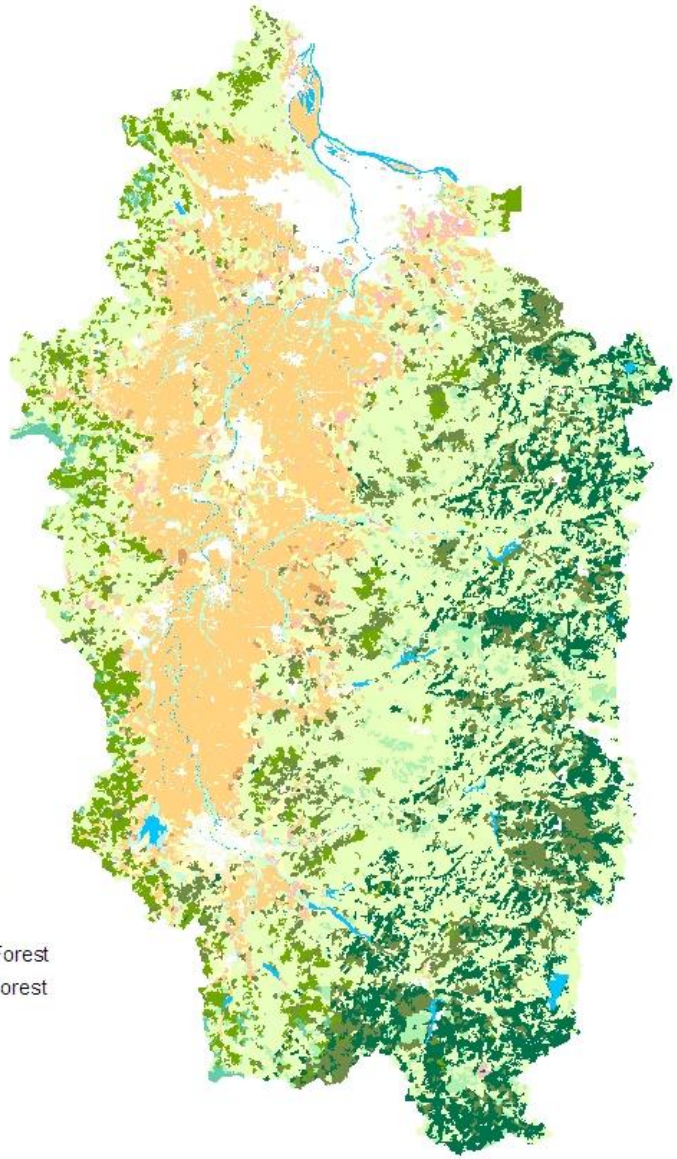


Balmford et al. 2002 *Science* 297: 950-953

Where to put things? Spatial land management with biological and economic objectives

Polasky et al. 2008. Biological Conservation 141(6): 1505-1524.





Willamette Basin

Current Land Cover

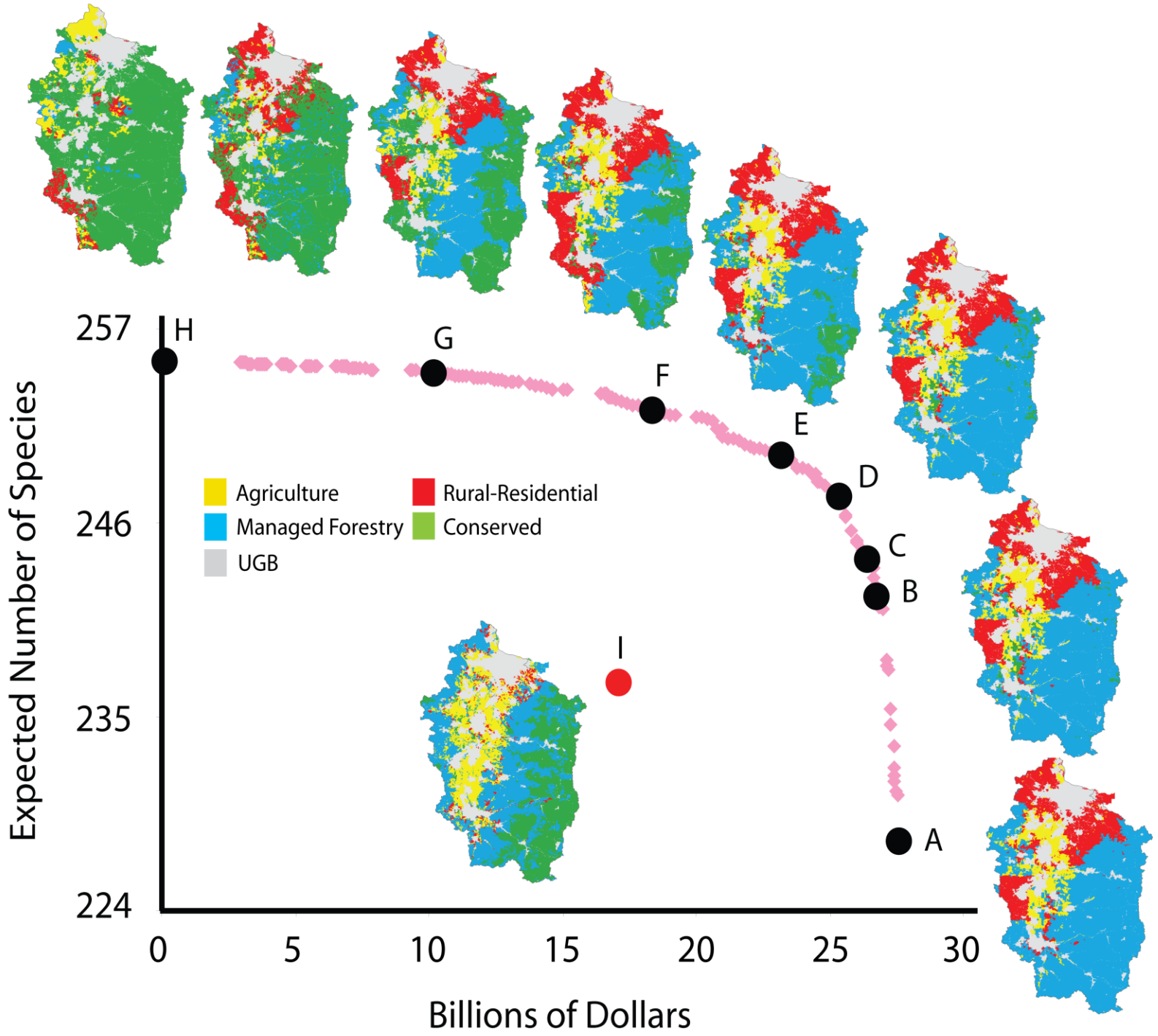
- Floating Vegetation
- Riparian Forest
- Low Structure Agriculture
- Meadow
- Deciduous, Mixed Close Forest
- Deciduous, Mixed Open Forest
- Oak Hardwood
- Scrub-Shrub
- Shrub-Riparian
- Conifer, 21-40 Years
- Conifer, 41-80 Years
- Conifer, 81-200 Years
- Conifer, 200 Plus Years
- Water

Biological model: effect of land use/land cover of species persistence

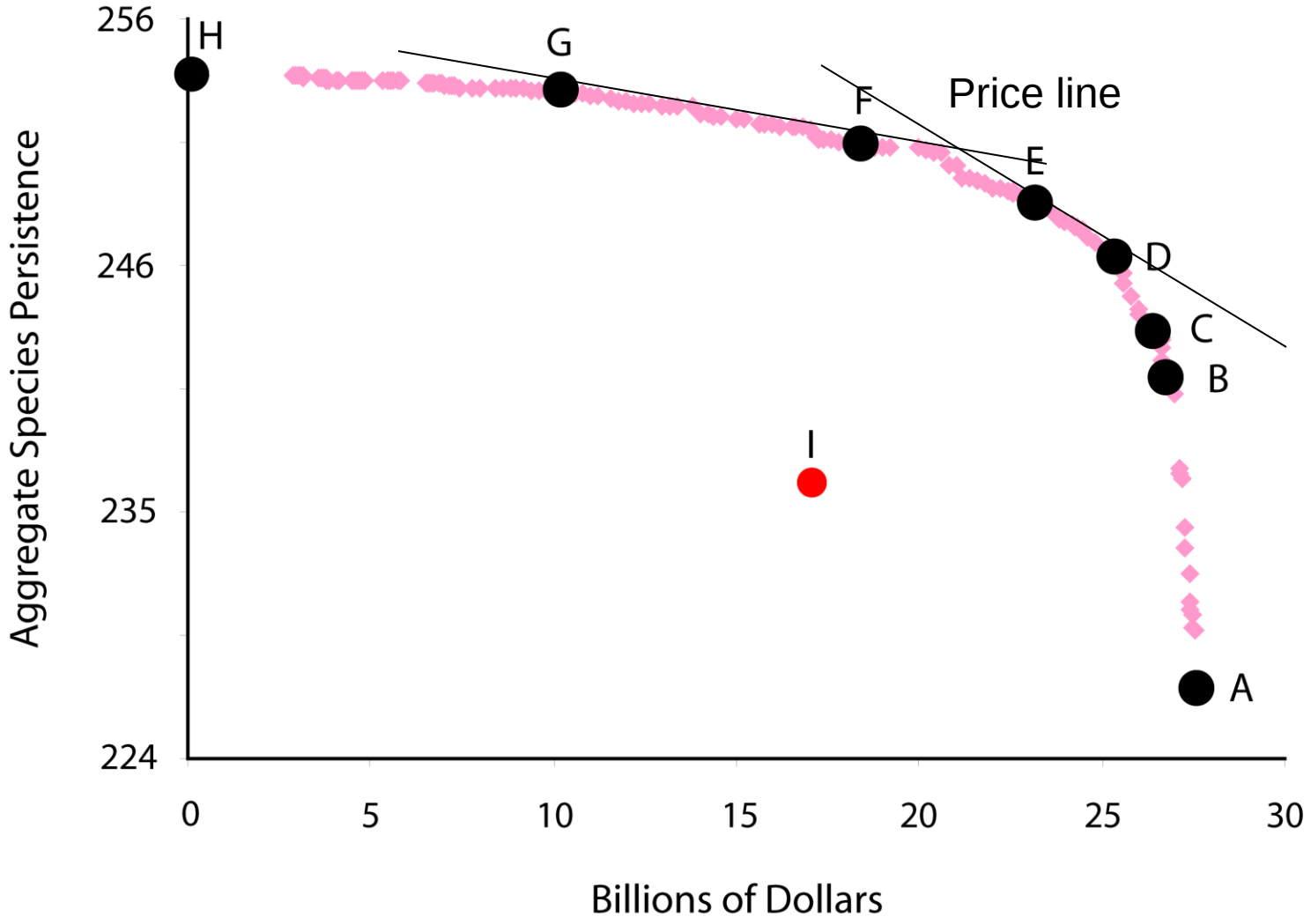
- Predict a land use pattern's ability to support viable populations of a large set of species
- Each species' appraisal of a land use pattern depends on three species-specific traits:
  - habitat compatibility (which includes geographic range, habitat type and special features like whether there is water access)
  - the amount of habitat required for a breeding pair
  - dispersal ability between suitable patches of habitat

Economic model: effect of land use on value of commodities produced

- Predict the present value of rents for a parcel generated by a land use of the parcel and the characteristics of the parcel
- The economic return for a land use pattern is the sum of the present value of rents over all of the parcels patches of habitat


257
246
235
224
Expected Number of Species
0
5
10
15
20
25
30
Billions of Dollars
H
G
F
E
D
C
B
A
I
Agriculture
Managed Forestry
UGB
Rural-Residential
Conserved

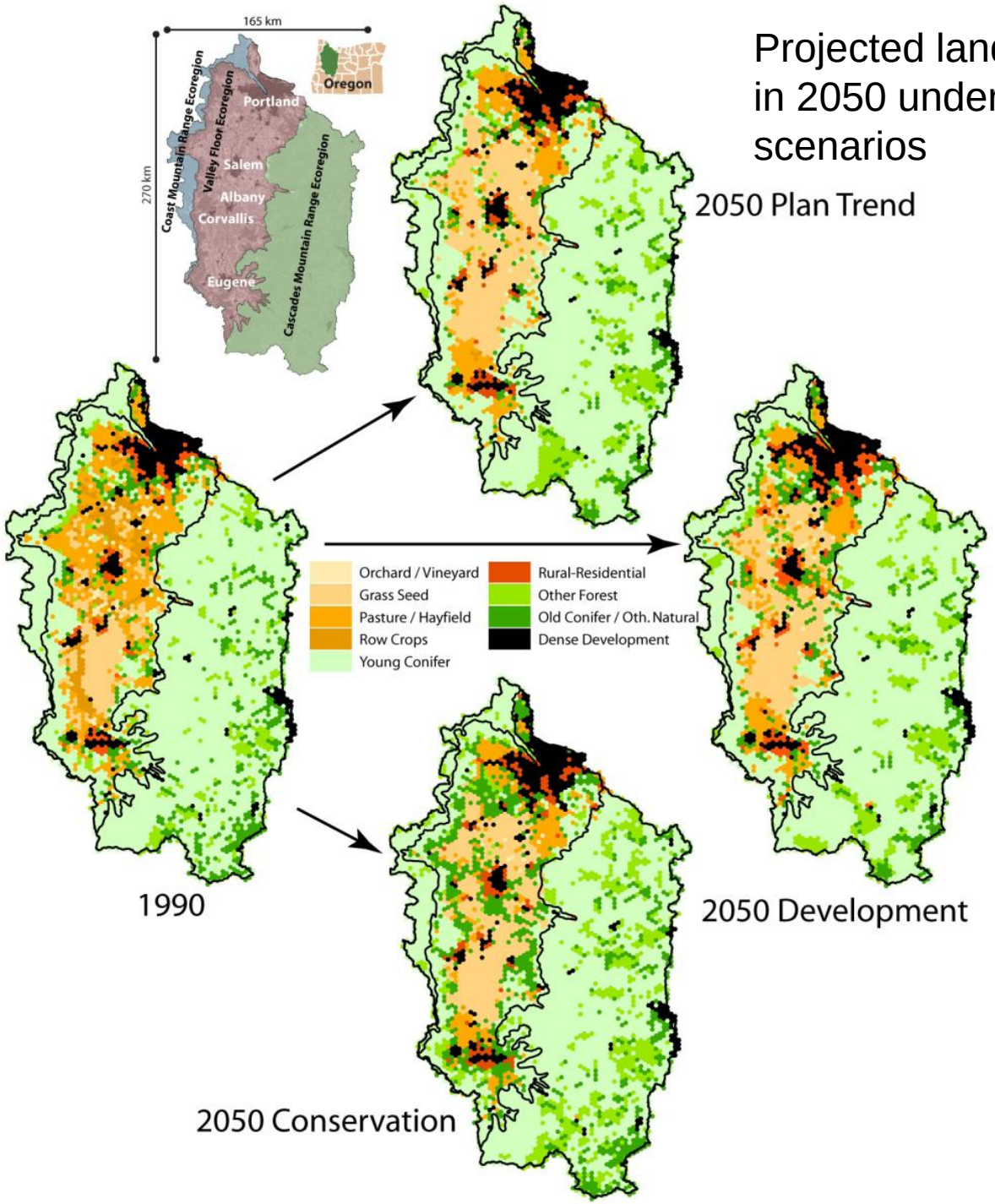
Tradeoff surface: species persistence and value of marketed commodities



Modeling multiple ecosystem services and tradeoffs at landscape scales

Nelson, et al. 2009. *Frontiers in Ecology and the Environment* 7(1): 4–11

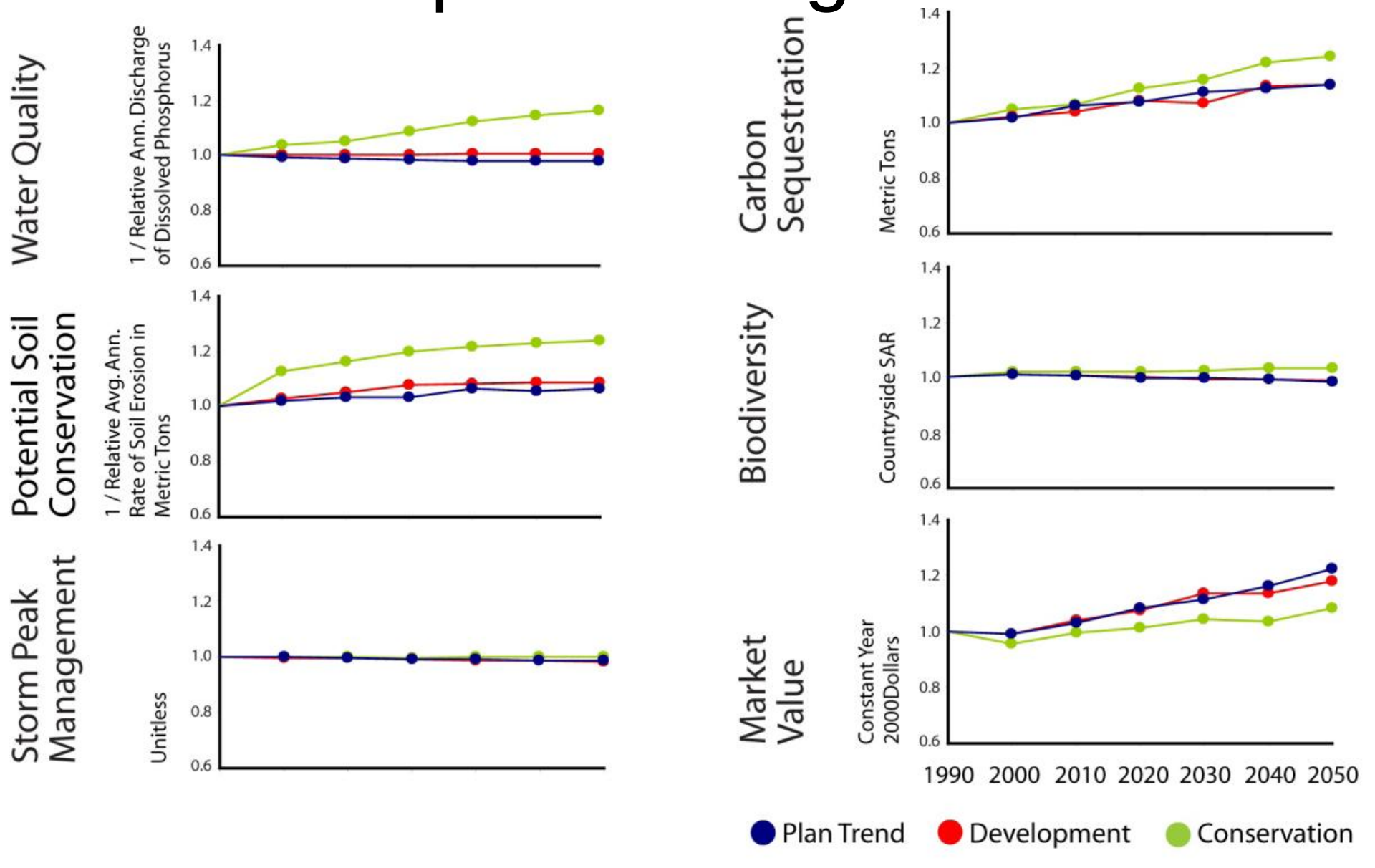
Projected land use change in 2050 under the three scenarios

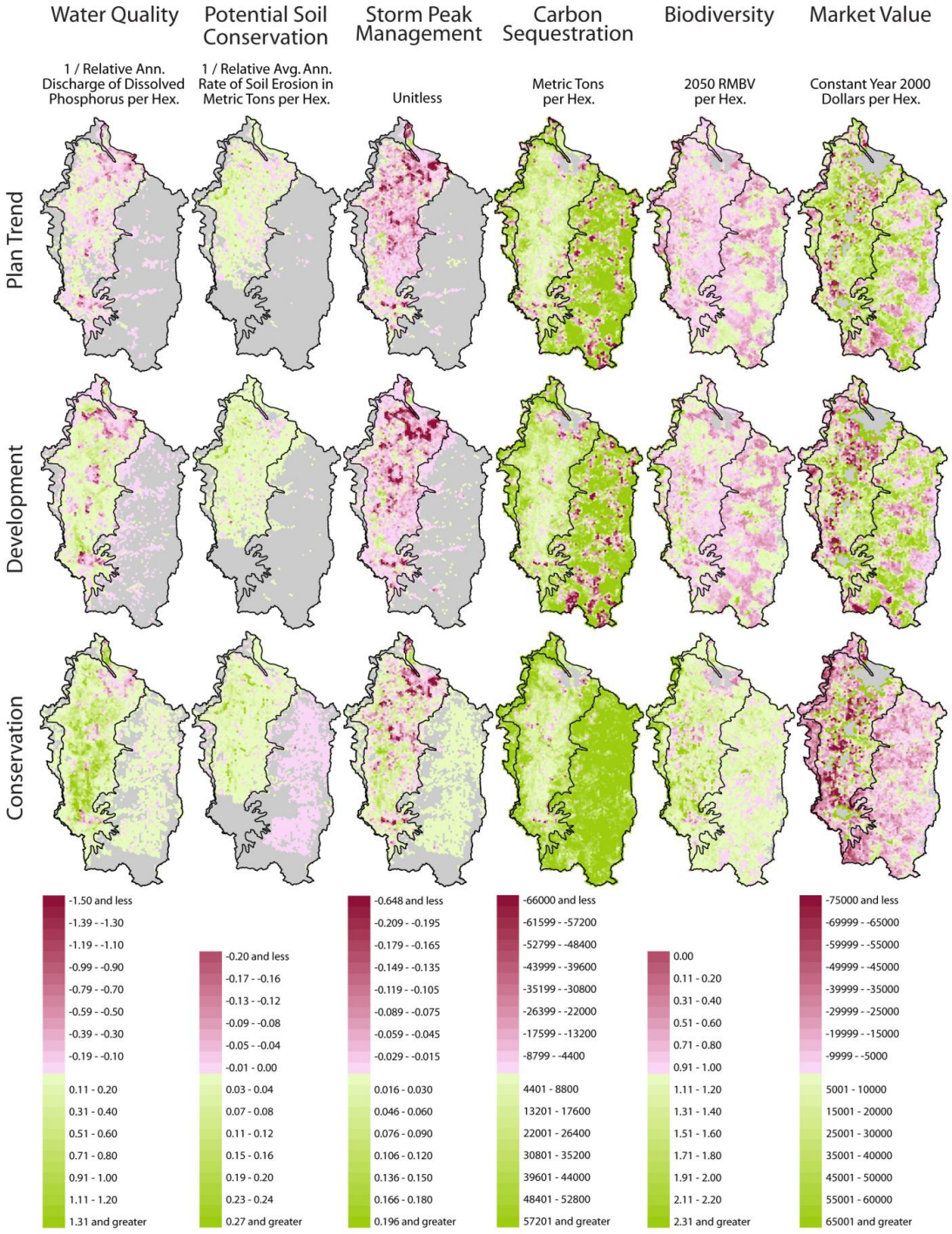


Modeling multiple services under alternative scenarios

- Model outputs: service provision and biodiversity
  - Water quality
  - Storm peak mitigation
  - Soil conservation (sediment retention)
  - Climate stabilization (carbon sequestration)
  - Biodiversity (species conservation)
  - Market returns to landowners (agricultural crop production, timber harvest and housing values)

Outputs through time





Maps of change in service provision

Total discounted economic value of commodities and carbon sequestration produced in the Basin from 1990 to 2050 under the three scenarios (values in billion $)

	Plan trend	Development	Conservation
Market commodity production	15.29	15.29	14.80
Carbon sequestration	0.90 (0.59-1.64)	0.80 (0.55 – 1.44)	1.60 (1.16 – 2.69)
Total	16.19	16.09	16.40

Market discount rate of 7%. Carbon discount rate of 5% (0%-10%). Carbon value $43/ton

Summary: mainstreaming nature

- 20th century record:
  - Rapid expansion of human economy
  - Notable gains in human welfare
  - But negative environmental consequences that threaten sustainability
- 21st century challenge:
  - Provide for human wellbeing
  - AND do so in a sustainable manner
- Requires understanding consequences of our actions in both near and long term – linkage of ecology and economics


Thank you