

THE NATURAL WORLD

Is it a service or does it
need to be served?



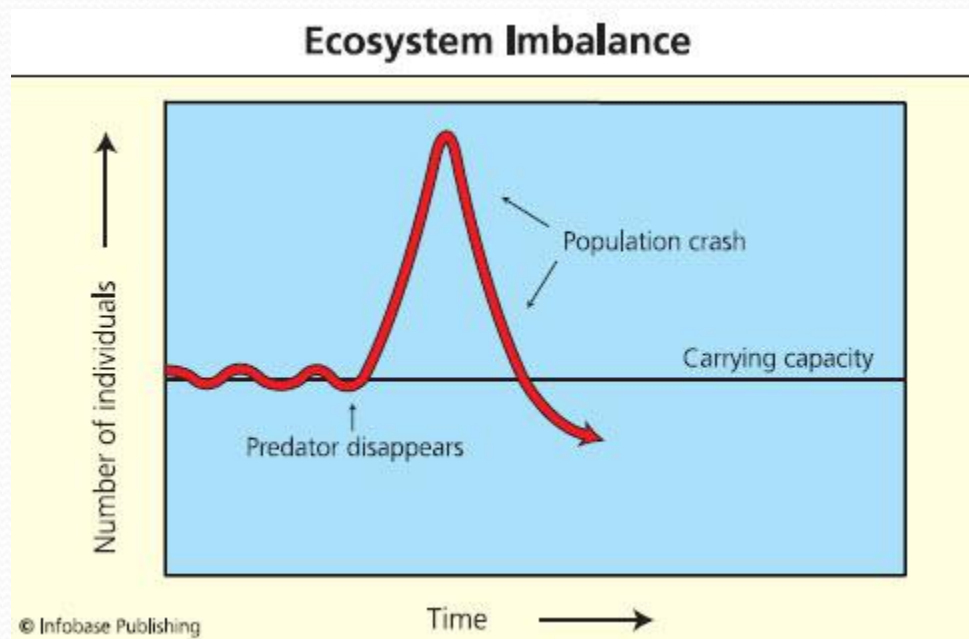
Ecosystem services



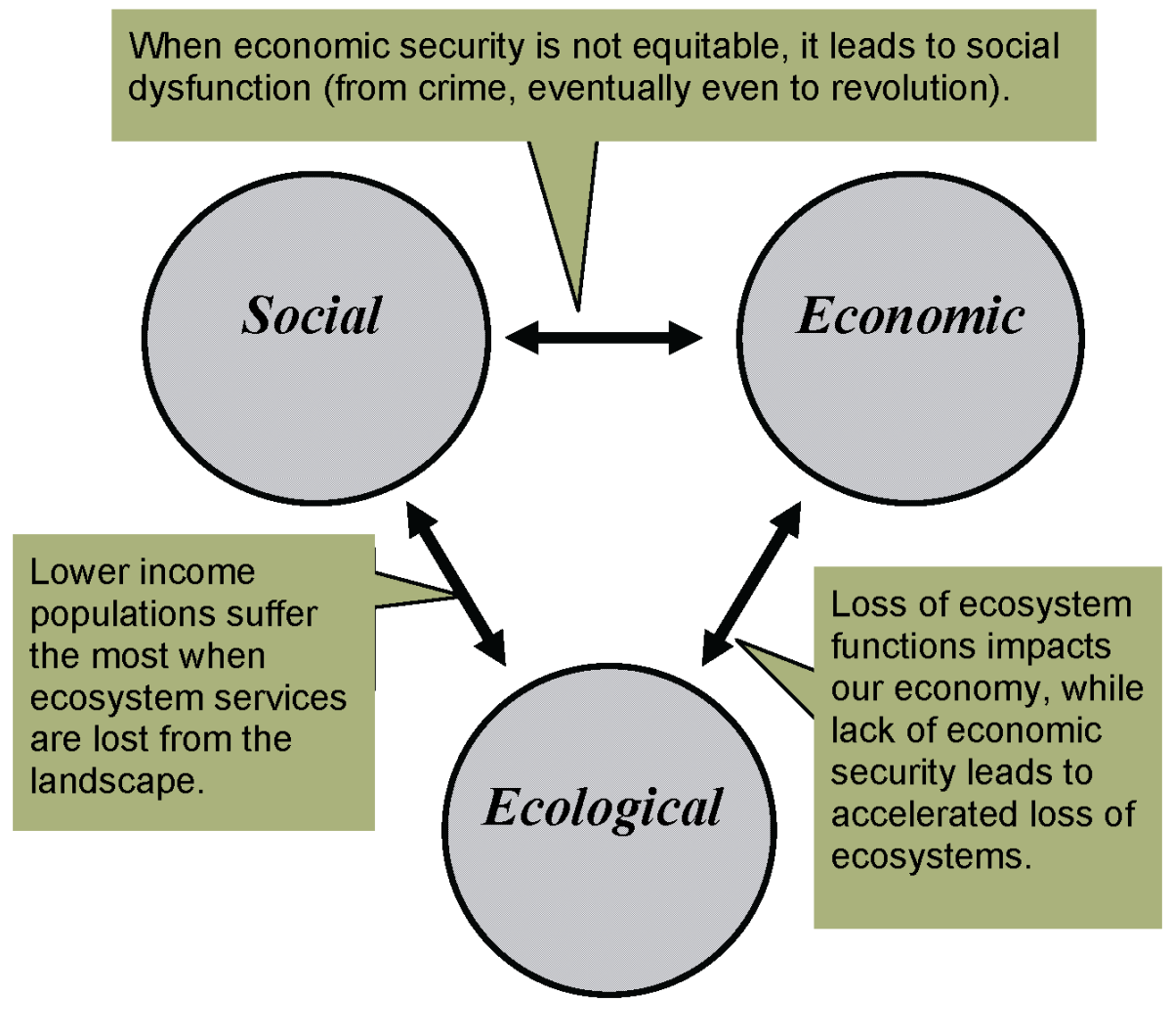
An overview and evaluation

Human carrying capacity?

- Prey species that are not held in check by predation deplete their food and other resources, and this leads to stress, competition, disease, and starvation, which are all characteristics of ecosystem imbalance

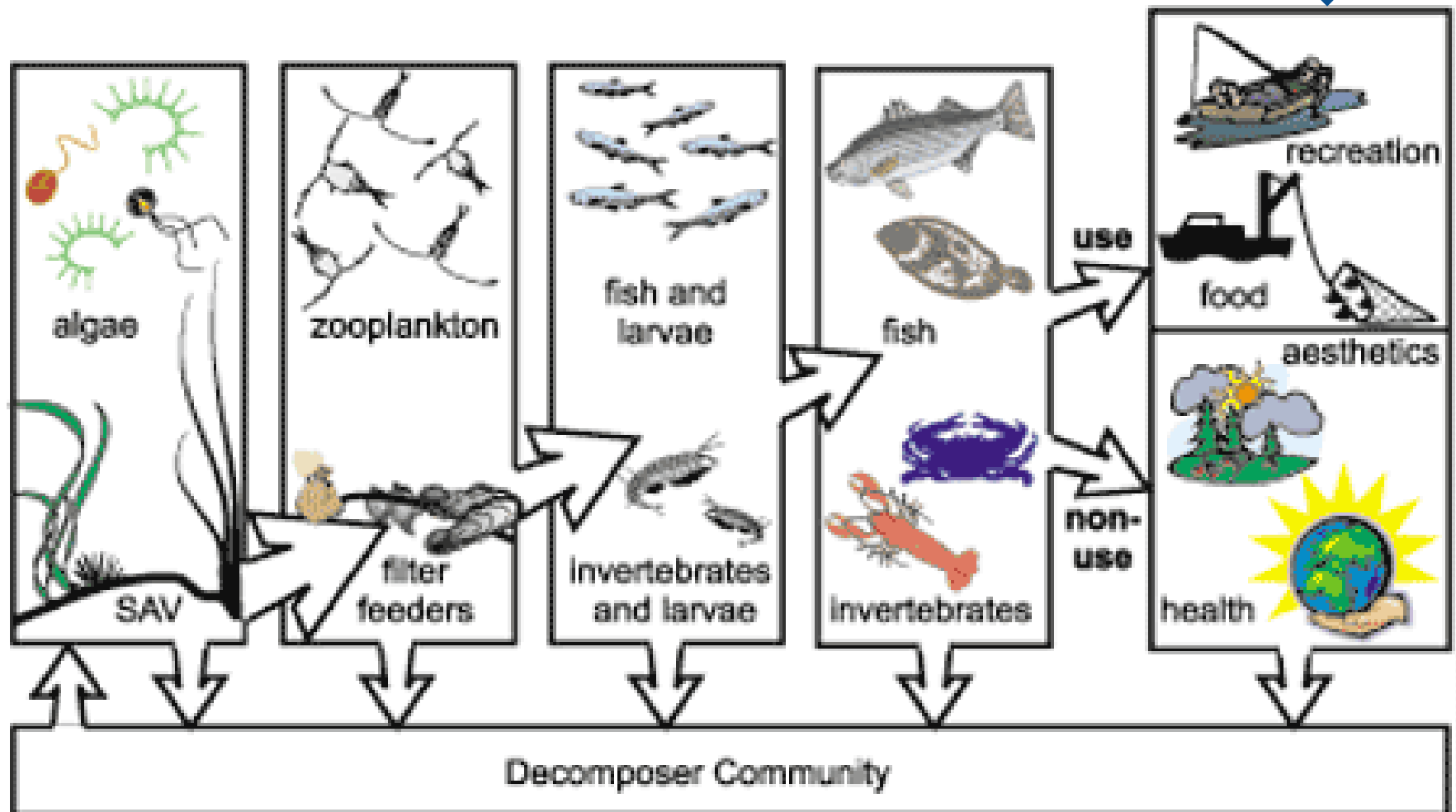


SD and services



Nested Ecosystem services

Can we
measure
these?

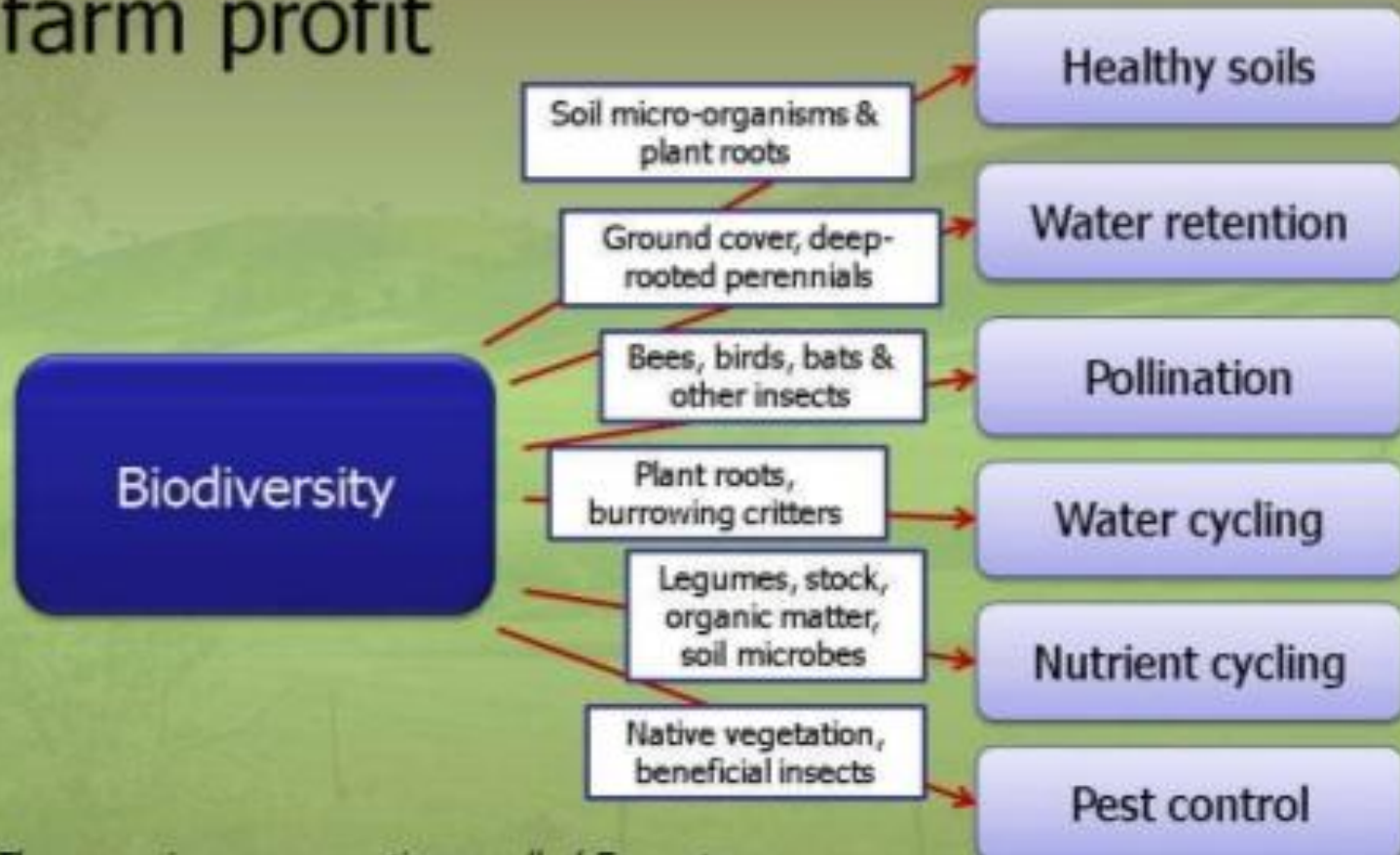


Why have an economic evaluation of ecosystem services

- Ecosystems provide a wide array of goods and services of value to people
 - In groups of two, list them
- Provision of ecosystem services often is not factored into important decisions that affect ecosystems
 - Why? In your groups consider this statement
- Distortions in decision-making damage the provision of ecosystem services making human society and the environment poorer
 - Groups. What do you think this means?

Multiple functions

How biodiversity supports farm profit



UK National Ecosystem Assessment

- The benefits that we derive from the natural world and its constituent ecosystems are critically important to human well-being and economic prosperity, but are consistently undervalued in economic analyses and decision making.
- Ecosystem and ecosystem services are constantly changing, driven by societal changes – demographic, economic, socio-political, technological and behavioural- which influence demand for goods and services and the way we manage our natural resources.
- (UKNEA, 2014: 7)

Multiple Purposes for ESV in Relation to Policy Making

Monitor changes in natural capital and the impact of this on human welfare ex. Natural Capital Accounting

Natural Resource Damage Assessment

PES



Payments for Environmental Services

Evaluation of proposed policies/projects

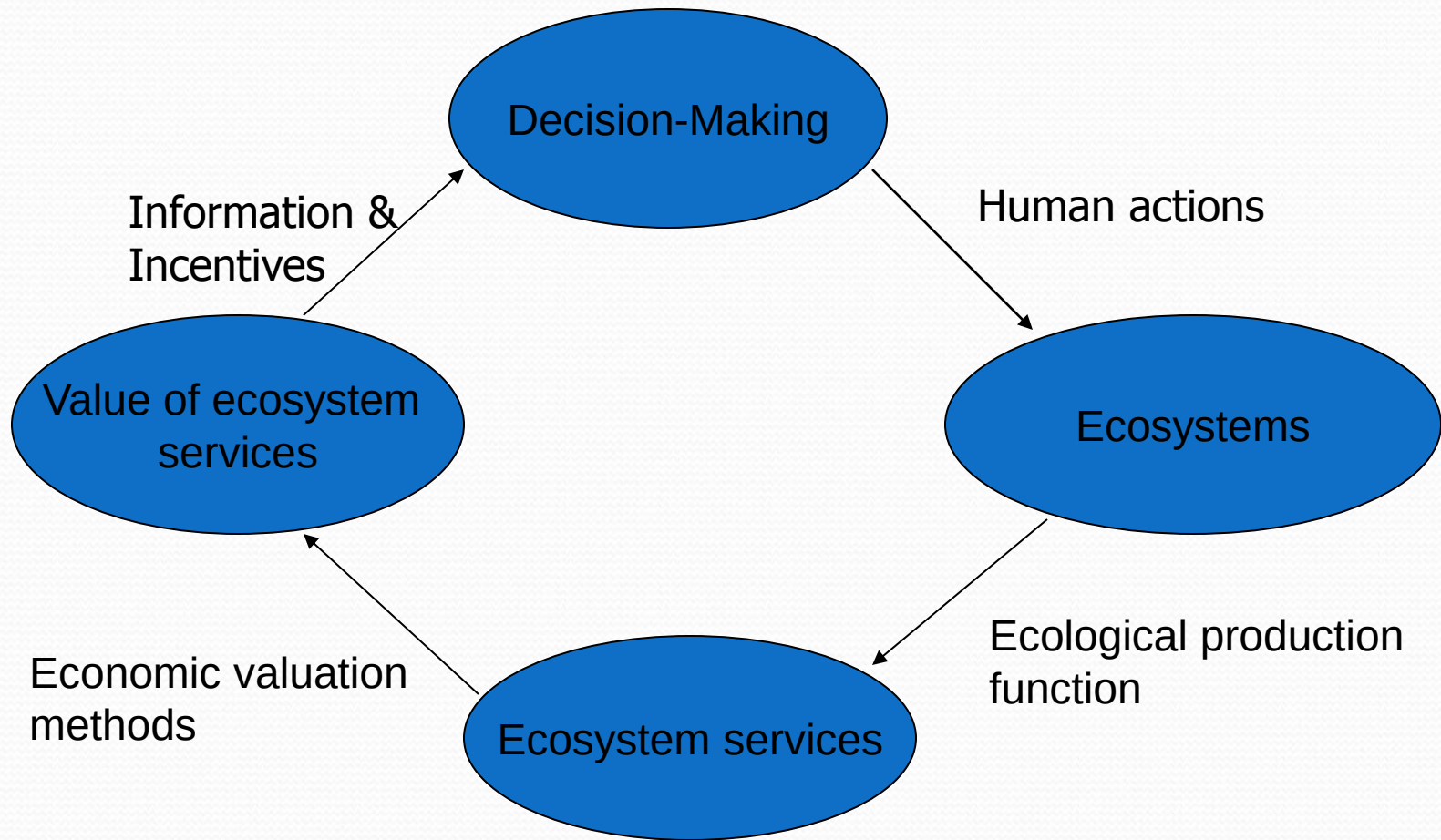
Cost-Benefit Analysis

Cost-Effectiveness Analysis

Multi-criteria Analysis

- Ecosystems are being degraded at a high rate –climate change exacerbating this and ES are under pressure. Demand for ecosystem services is increasing– Population growth– Improvement in living standards (Winslow, 2013)

A framework for mapping & valuing ecosystem services



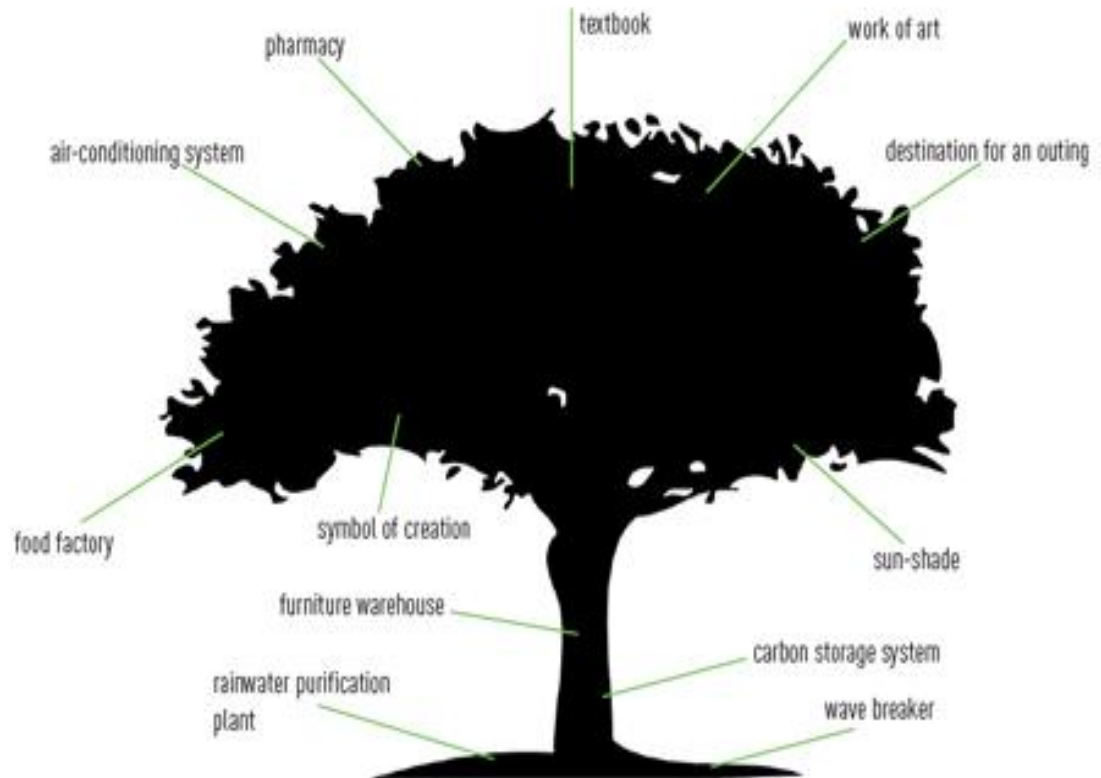
Desired endpoints for mapping ecosystem services

- Generating an accounting system for the full set of services from ecosystems
- Understanding how provision of services are affected by human actions
- Evaluating the synergies and tradeoffs among different services
- Understanding the spatial pattern of the production of services
- Understanding the spatial pattern of benefits from services
- Assessing the relative value of services
- Linking information about the provision and value of services to incentives

Two main issues

1. **Valuation:** how can we assess the relative value (importance) of various ecosystem services?
2. **Incentives:** how can we provide rewards for providing ecosystem services?

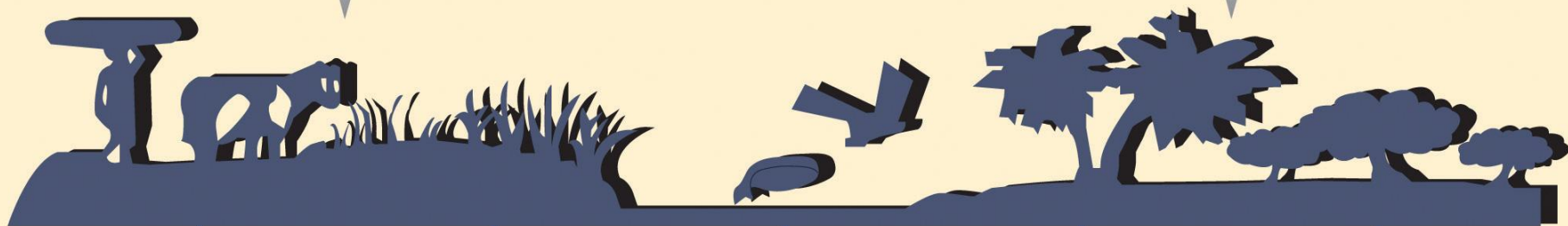
The tree – a service station for human beings



Total Economic Value

Use Value

Nonuse Value



Direct Use Value

Resources used directly

- Provisioning services (i.e., water, fish)
- Cultural and amenity services (i.e., recreation)

Indirect Use Value

Resources used indirectly

- Regulating services (i.e., flood prevention, water purification)

Option Value

Our future possible use

- All services (including supporting services)

Bequest Value

Future generations' possible use

- All services (including supporting services)

Existence Value

Right of existence

- Supporting services (i.e., pandas, blue whales, wild eagles)

Economic valuation

- **Seminar: Basic concepts of economic value**
- Combining ecological production functions with economic valuation methods can generate estimates of the value of ecosystem services in monetary terms
- (Note: money is not necessary – what is necessary is a common metric)
- Common metric facilitates analysis of tradeoffs

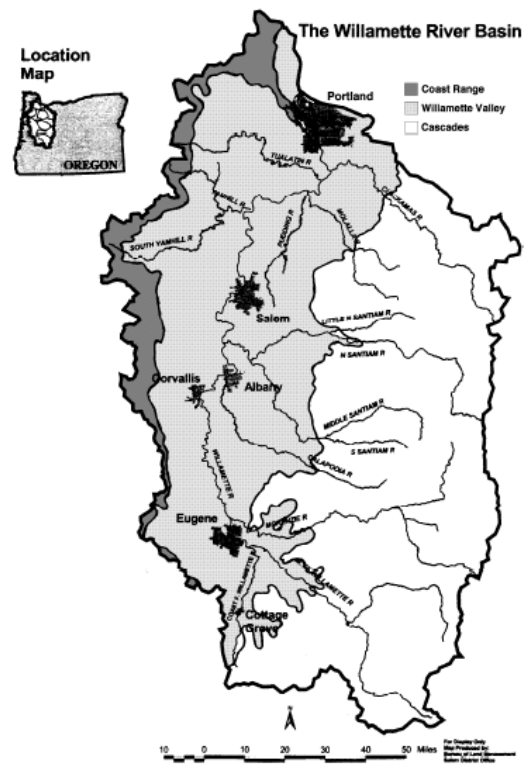


What should we attempt to value in monetary terms?

- Do we need to try to evaluate everything in monetary terms?
- No
- Value of species preservation is probably best left in its own terms rather than attempting a conversion to money



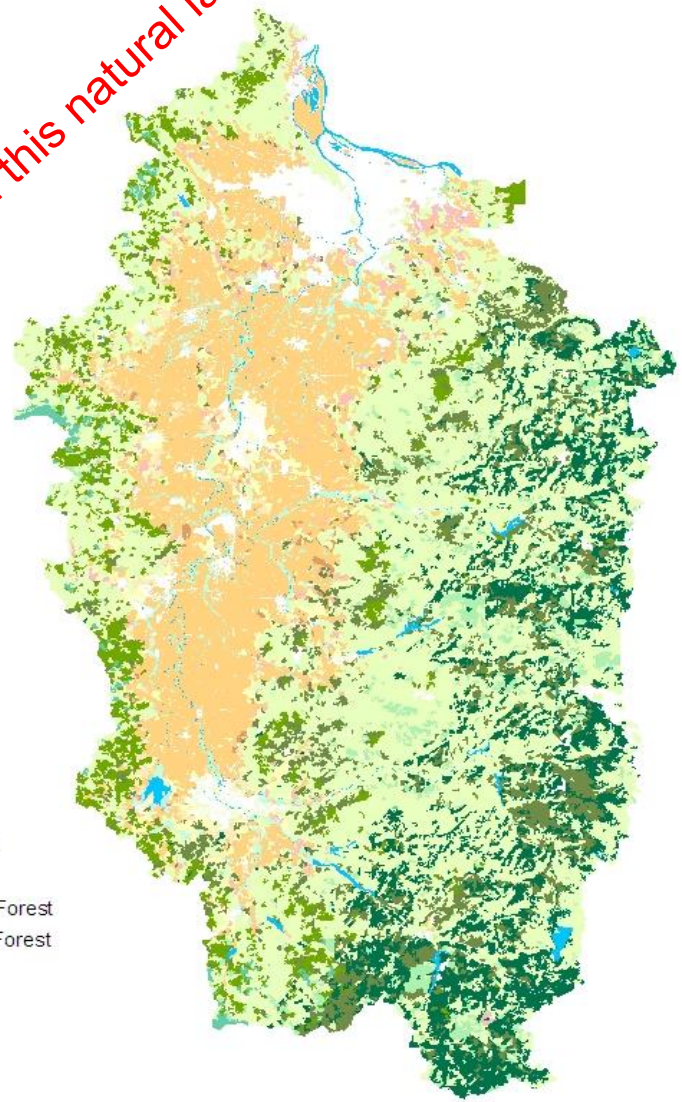
Example: Spatial Land Management with Biological and Economic Objectives

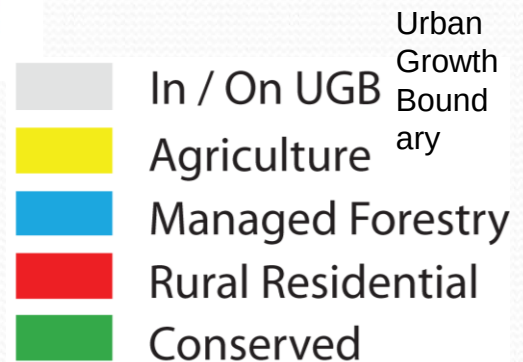
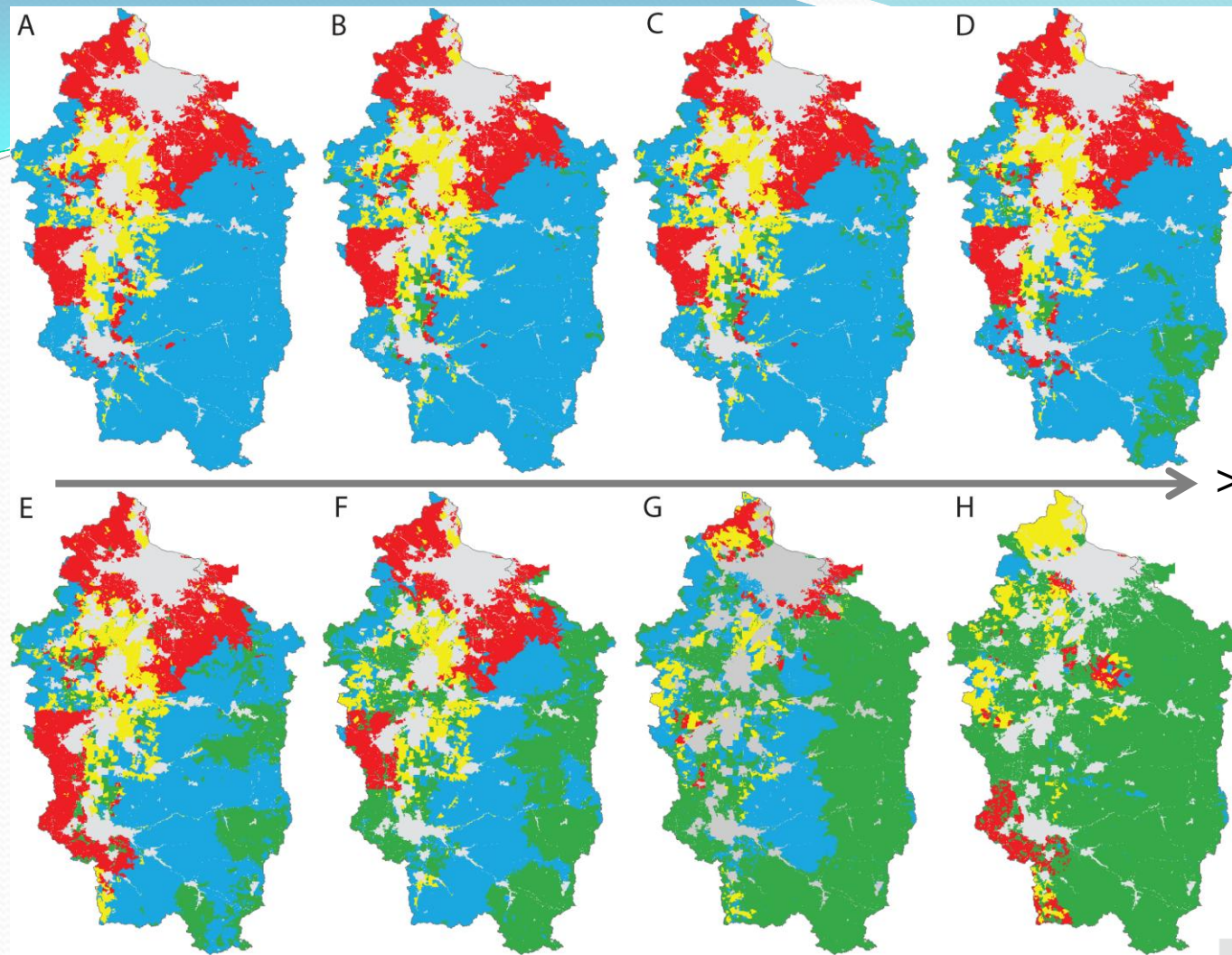


List the 'values' derived from this natural land use

Willamette Basin Current Land Cover

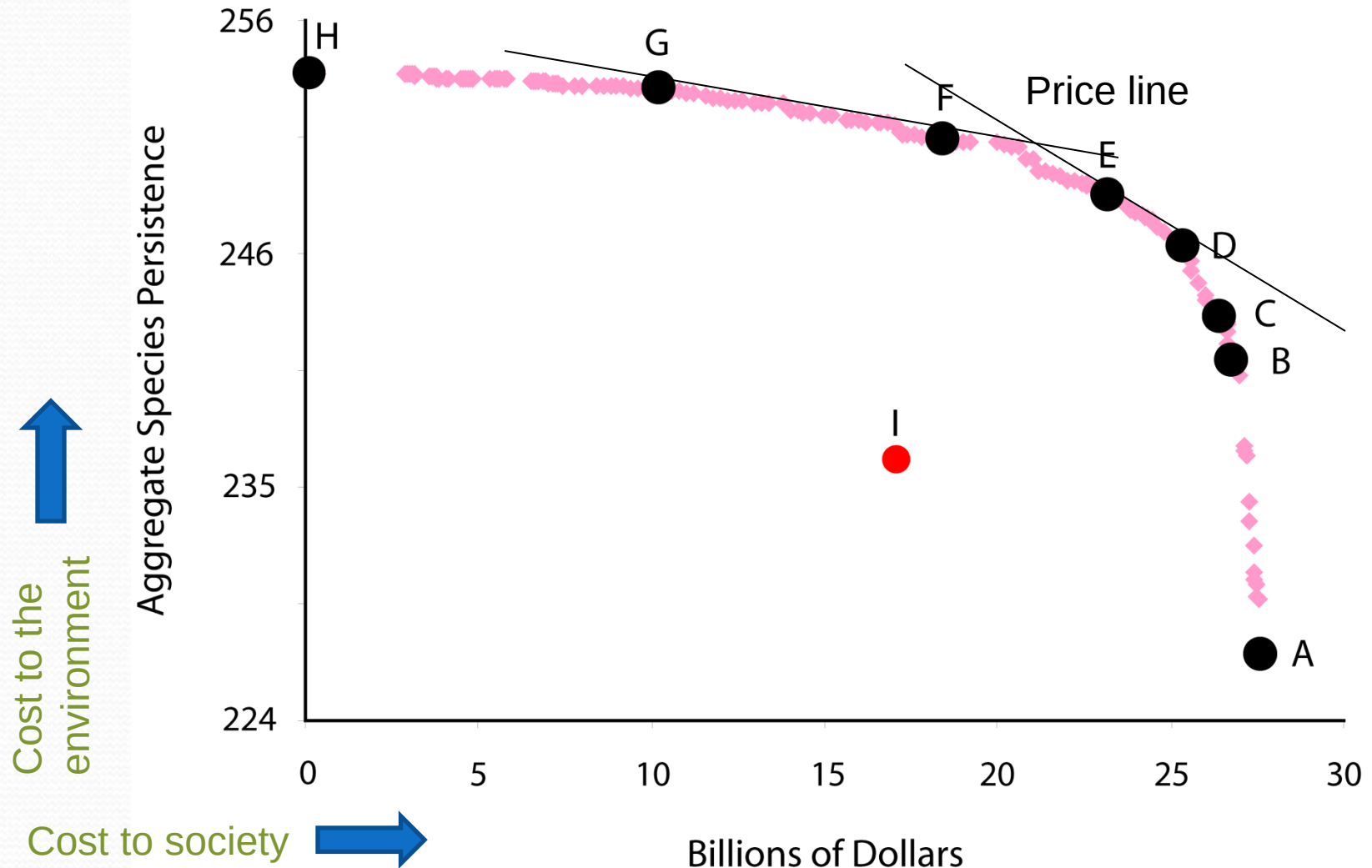
- Floating Vegetation
- Riparian Forest
- Low Structure Agriculture
- Meadow
- Deciduous, Mixed Close Forest
- Deciduous, Mixed Open Forest
- Oak Hardwood
- Scrub-Shrub
- Shrub-Riparian
- Conifer, 21-40 Years
- Conifer, 41-80 Years
- Conifer, 81-200 Years
- Conifer, 200 Plus Years
- Water





Different scenarios for the future. Which one is the most economically and environmentally sustainable?

Tradeoff surface: species persistence and value of marketed commodities

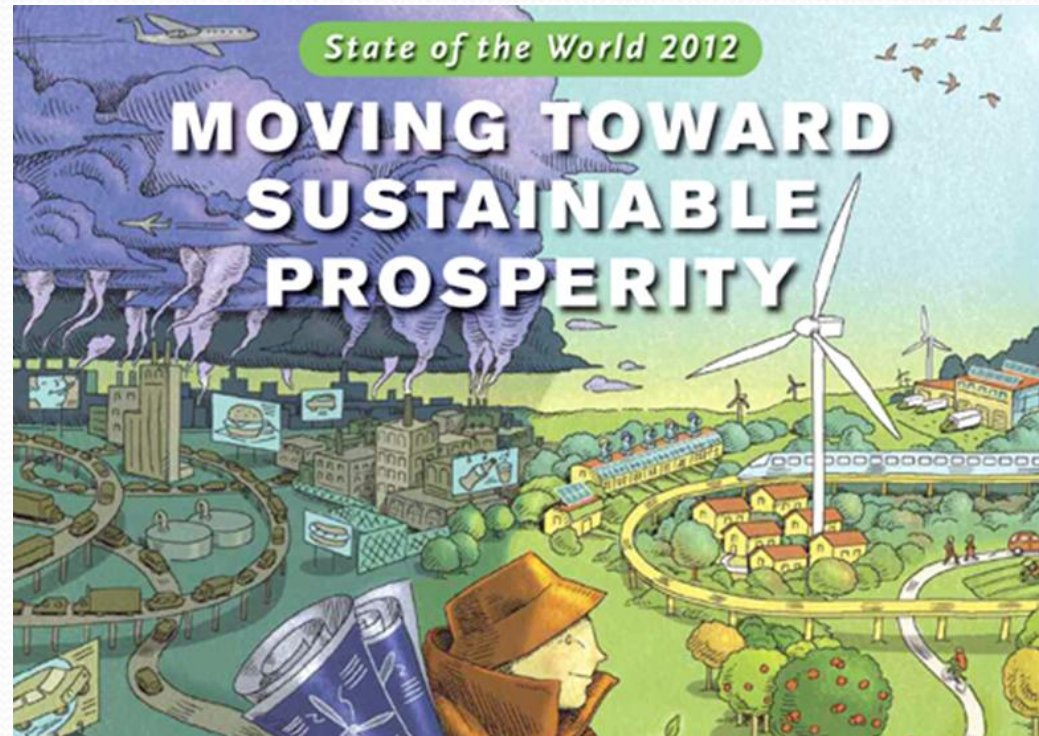


Monetary valuation via markets

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

Non-market valuation

- **Summary** (explained on following slides)
- **Revealed Preference**
 - Travel Cost Method
 - Hedonic Approach
 - Averting Behavior
 - etc
- **Stated Preference**
 - Choice Experiments
 - Contingent Valuation,
 - Conjoint Analysis
- **Replacement Cost**



Revealed Preference: Travel Cost Method

- Assumption that people make repeated trips to recreational sites until the marginal utility derived from a trip equals the marginal costs of a trip.
- Assumes people have homogeneous preferences
- Cost trip vs degree of preference
- Uses concentric circles based on the % of people who would travel to a site Recreation is only a part of an areas ecological value (Stynes, 1990)

Revealed preference example: hedonic approach

- Some purchased goods as composite goods whose values depends on many characteristics and amenities are internalised
- Example: value of a house depends upon
 - Structural characteristics (e.g., sq feet, age, # of bedrooms...)
 - Environmental characteristics (e.g., air quality, access to open space...)
- Controlling for other characteristics, how does house price vary with environmental characteristic of interest (Pearce and Markandya, 1989).
- Often used to measure the negative impact of e.g. pollution

Revealed preference example: Averting behaviour

- Expenditures made to avert or mitigate negative effects from the reduction of a natural quality
- assumption that people perceive the negative effects of environmental deterioration on their welfare and that they are able to adapt their behaviour to avert or reduce these effects.
 - *E.G. People experience the negative effects of ozone depletion and that they will buy products such as hats and suncream to prevent damage to their health.*
 - *The willingness to pay for a clean environment is deducted from people's purchases of products and services to avert the negative effects of pollution.*
- Validity is criticised because of this assumption and the fact that people tend to 'pay' when the problem is greater (threshold e.g. sunscreen).
- Based on the 'willingness' to pay and hence is normally focused on health related environmental issues.

Revealed preference

- Advantages:
 - Based on observable behavior for decisions with real consequences
- Disadvantages:
 - May only apply to a small set of ecosystem services (e.g., recreation)
 - Questions about specification of empirical equation (explanatory variables, functional form...)
 - Are individuals fully informed about choices?

Stated preference approaches

- **Choice experiments:** survey asking individual to make choices
 - **Contingent valuation:**
 - Survey method of peoples preferences
 - Hence it's a hypothetical market
 - offer a choice about whether individual would pay a specified price for a specified increase in an ecosystem service
 - Works best for goods that resemble normal commodities
 - **Conjoint analysis:**
 - Respondents are given different hypothetical scenarios
 - Bundles of services and price and ask which is preferred/rank
 - Statistically tested to create a 'value' (Orme, 2006, Harpman, 2010)
- *Refer to Economic Valuation and conjoint analysis files on Moodle*

Stated preference approaches

- Advantages

- Direct question about values
- Applicable to ecosystem services for which there is no direct observable behavior (“non-use” values)
- Good for decision making support
- Helps assess non-use value of nature

- Disadvantages

- Hypothetical – would people really pay what they say they will?
- How well informed are respondents?
- How much are responses influenced by question format?
(Wierstra et al, 1995)

Replacement costs

- What would it cost to replace an ecosystem service with human engineered solution?
- Example: Catskills/New York City water supply
- To be valid, must meet three conditions:
 - Human engineered solution provides equivalent quality/quantity of service
 - Solution is least cost alternative of providing the service
 - Individuals in aggregate would be willing to incur the cost if ecosystem service were not available
 - Also Damage Cost Avoided and Substitute Costs

Case Study Replacement Cost Method:

Soil Erosion in Korea

The Situation

As relatively flat farmland in Korea is lost to urban growth and industrial development, farming has moved into the hilly upland areas. Heavy soil erosion has occurred on these upland areas, due to inadequate soil management techniques and errors in field layout and construction.

The Challenge

Resource managers needed to evaluate the benefits of proposed new soil management techniques. These benefits include the benefits of retaining the soil and nutrients on the upland areas, and the benefits of protecting downslope areas from damage by the eroded soil.

The Analysis

The replacement cost method was used, with the costs of physically recovering and replacing lost soil, nutrients, and water taken as a measure of minimum benefits from preventing erosion and the resulting soil, nutrient and water losses. Researchers measured the cost of physically replacing lost soil, nutrients, and water in upland areas, and the cost of compensating for downstream losses.

First, the researchers calculated the annual soil loss per hectare, nutrient loss/hectare, and water runoff/hectare. Second, they calculated the expected losses, in terms of replacement costs, if the new management practices were not implemented. The cost of recovering and replacing eroded soil was estimated as W80,000 per hectare per year; the cost of fertilizer and spreading to replace lost nutrients was estimated as W31,200 per hectare per year; the cost of annual field maintenance and repair was estimated as W35,000 per hectare per year; the cost of damage to downstream fields in lost production (valued at market price) was estimated as W30,000 per hectare per year; and the cost of supplemental irrigation to replace lost water was calculated as W92,000 per hectare per year. Thus, the total cost of soil erosion under existing management is W268,200 per hectare per year. The net present value of the annual replacement of soil and nutrients with existing practices, using a 15 year time horizon, was calculated as W2,039,662.

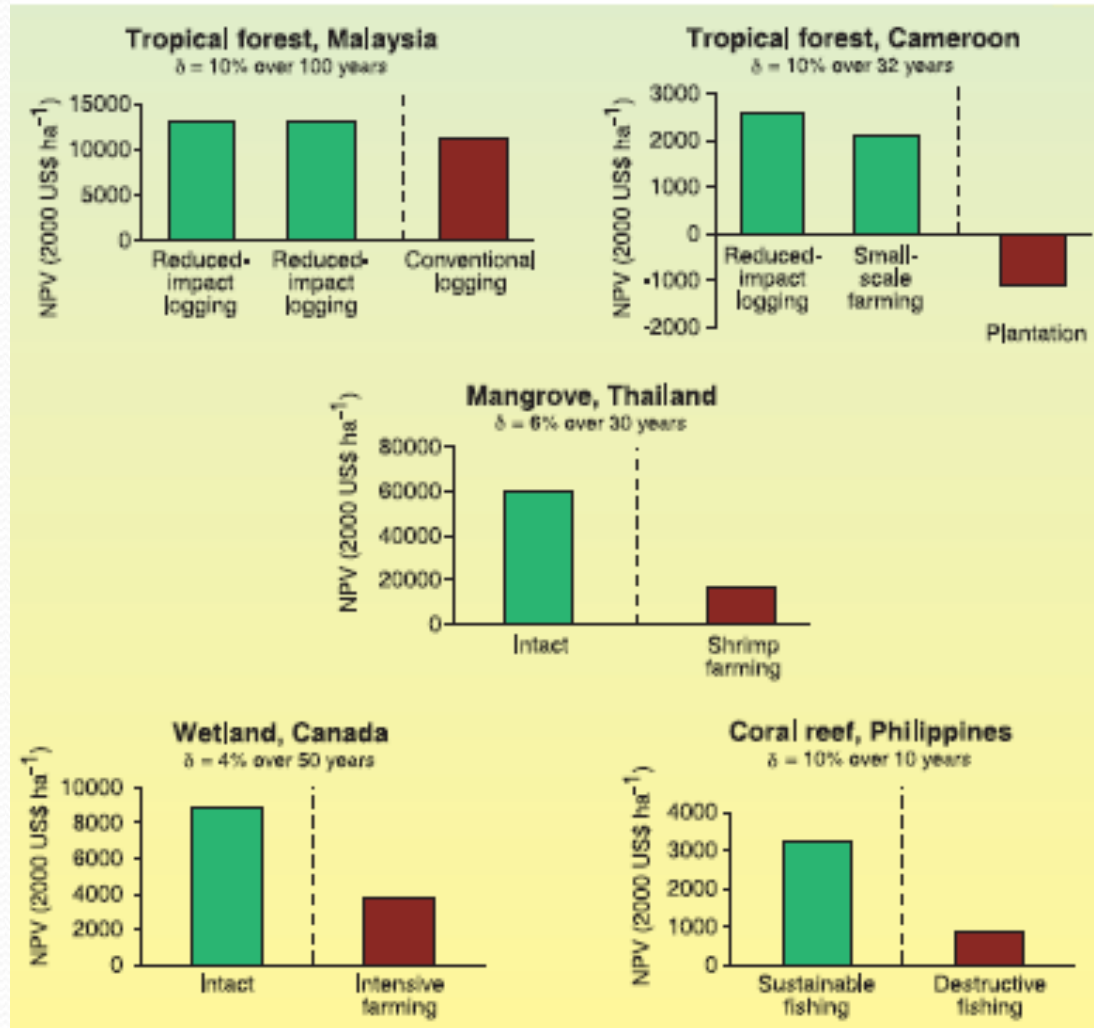
Next, the researchers calculated costs with the new management techniques. These costs included the cost of compensation payments, soil replacement, nutrient replacement, and mulching. The net present value of the costs of new management techniques was estimated to be W1,076,742.

The Results

The researchers found that the cost of new management techniques is about half the replacement cost. Thus, the proposed preventive steps are worth implementing

http://www.ecosystemvaluation.org/cost_avoided.htm 2014

Use of valuation: comparison of alternatives



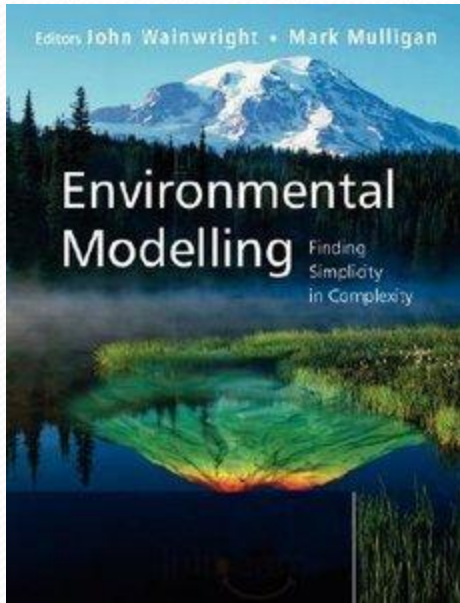
Balmford et al. 2002.

“Economic reasons
for
conserving wild
nature”

Science 297: 950-953

Balmford's (2009) figures for MPA running costs, this equates to an extra US\$15m/yr running costs. These are direct opportunity costs to conservation practitioners, there's also indirect costs to fisheries and other resource users as well.

Modelling



Farber et al (2006: 118): “Full modelling is costly in terms of data and measurability requirements. A practical alternative is to consider service changes, or gradients, from the status quo provided by a finite set of options. This may not provide for the global optimum, but may result in the choice of superior management options within a viable set of those options”.

**Research:
Environmental
Modelling
and
Observation**



Data Collection Costs

Decision makers need to compare the cost of collecting ecosystem service data relative to the increased efficiency of the program due to this data.— A South African based study by Grantham et al. (2008) found that a small investment in ecosystem data for conservation planning can improve project performance, there is a diminishing return to investment.

Also:

The way information is shared can be as important as the amount of information collected (House & Phillips, 2009; 2012, Tallis and Polansky, 2011)

ES providers



ARIES

Artificial Intelligence for Ecosystem Services

- Web-based Tools:–
 - EVT: Ecosystem Valuation Toolkit–
 - SERVES: Simple and Effective Resource for Valuing Ecosystem Services
- EnviroAtlas can be used to forecast impacts on natural resources due to future population growth and climate change
- Consulting firms have proprietary tools:
 - EcoMetrix,
 - EcoAim,
 - ESValue



No universally agreed tool

Therefore decision makers need:

- Development and support of data archives
- Agreement on metrics
- Training and education on understanding and accepting uncertainty in relation to ESV
- Training on tools and valuation and coordination with tool developers
- Policy guidance on when to use ESV tools and tool choice
- Credible, Replicable and Legally defensible ESV tools

(Bagstad et al. 2012)

But in the US 79% of 'interested' employees were aware of ES and 40% have seen them used in EIA's (esp. freshwater) (Winslow, 2012) the main problem is clear guidance

Valuation and incentives

- Demonstrating the value of ecosystem services is important: can improve human decisions
- **BUT**, valuation by itself does not guarantee better decisions
- Need to be concerned WHO makes decisions and what benefits (costs) they face
- Question of incentives
- In pairs list incentives that could be used in ES

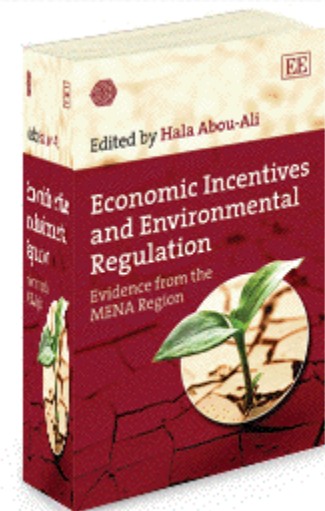


Providing incentives for ecosystem services and conservation

- Many ecosystem services do not generate a return for the landowner or decision-maker
- Unless there is some form of reward for the provision of ecosystem services, the landowner may choose a destructive land use



WWW.PHDCOMICS.COM



Example: wetlands

- Landowner calculus
 - Drain wetland – gain value of agricultural production
 - Leave wetland – no value
- Societal calculus
 - Preserving the wetlands provides habitat, water filtration, water storage, coastal protection, flood alleviation...
- Mismatch between what is in individual's best interest and what is in society's best interest



Providing incentives for ecosystem services and conservation

- Payments for ecosystem services (carrots)
 - Costa Rica
 - Carbon markets
- Payments from those who damage ecosystem services (sticks)
 - Land development tax (or zoning)



Link to policy

- Market forces alone do not provide incentives for provision of most ecosystem services
 - Exceptions (pollination services)
- Providing incentives typically requires some explicit policy
 - Example: Carbon market (“cap-and-trade” system of carbon permits) – the trading of carbon credits only exists because of the cap on carbon emissions



Link to conservation

- Partnership of interests: ecosystem service provision and conservation of biodiversity often align
- Partnership in action: mobilise additional resources for conservation



CONSTITUENTS OF WELL-BEING

ECOSYSTEM SERVICES

Supporting

- NUTRIENT CYCLING
- SOIL FORMATION
- PRIMARY PRODUCTION
- ...

Provisioning

- FOOD
- FRESH WATER
- WOOD AND FIBER
- FUEL
- ...

Regulating

- CLIMATE REGULATION
- FLOOD REGULATION
- DISEASE REGULATION
- WATER PURIFICATION
- ...

Cultural

- AESTHETIC
- SPIRITUAL
- EDUCATIONAL
- RECREATIONAL
- ...

LIFE ON EARTH - BIODIVERSITY

Security

- PERSONAL SAFETY
- SECURE RESOURCE ACCESS
- SECURITY FROM DISASTERS

Basic material for good life

- ADEQUATE LIVELIHOODS
- SUFFICIENT NUTRITIOUS FOOD
- SHELTER
- ACCESS TO GOODS

Health

- STRENGTH
- FEELING WELL
- ACCESS TO CLEAN AIR AND WATER

Good social relations

- SOCIAL COHESION
- MUTUAL RESPECT
- ABILITY TO HELP OTHERS

Freedom of choice and action

OPPORTUNITY TO BE ABLE TO ACHIEVE WHAT AN INDIVIDUAL VALUES DOING AND BEING

ARROW'S COLOR

Potential for mediation by socioeconomic factors

Low

Medium

High

ARROW'S WIDTH

Intensity of linkages between ecosystem services and human well-being

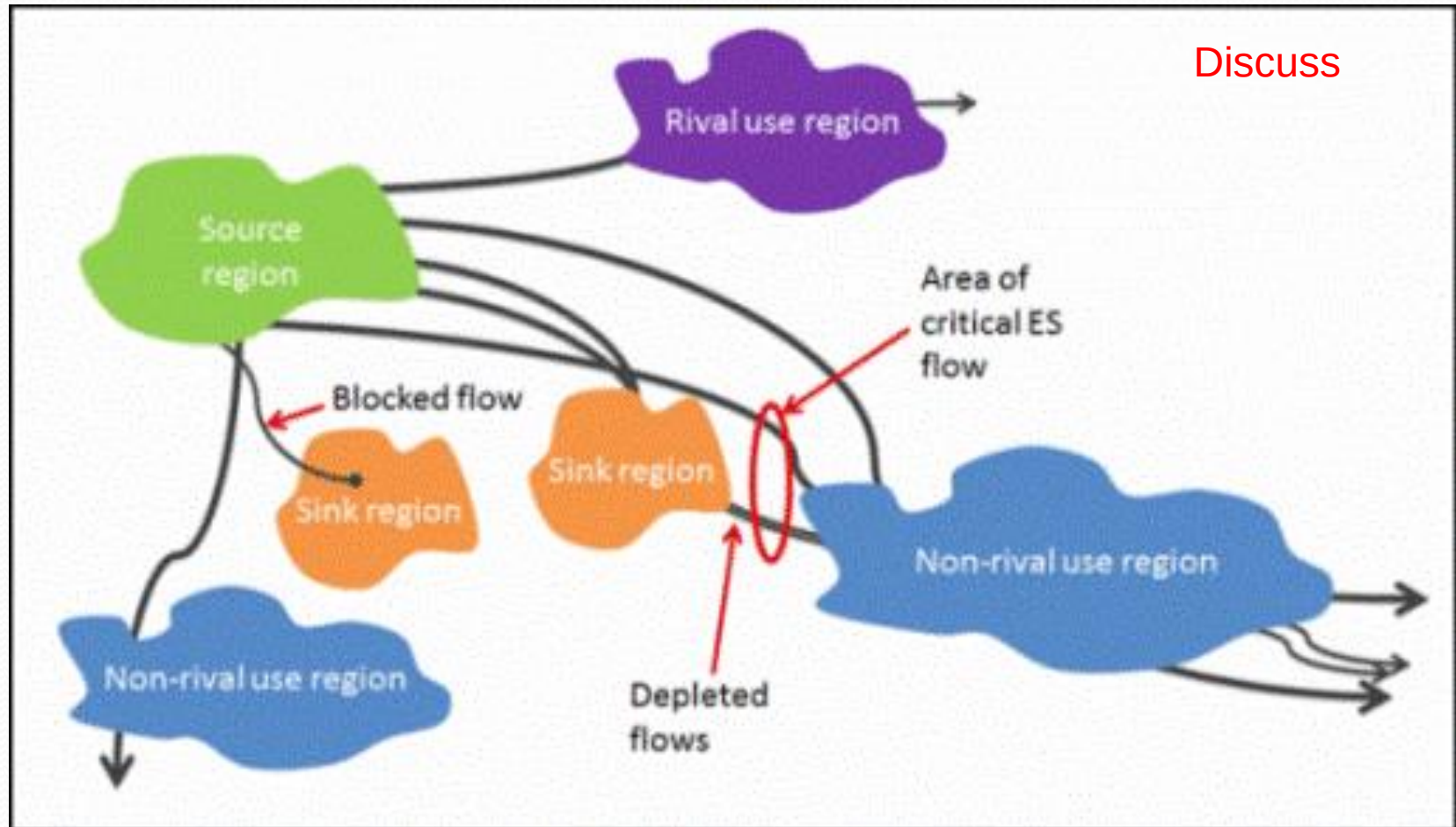
Weak

Medium

Strong

Source: Millennium Ecosystem Assessment

Geographical complexity of ES



Link to conservation:

- Correct accounting for ecosystem services alone is enough to promote decisions that support conservation
 - No need for Conservation Action Planning funds if payments for ecosystem services can be arranged
- Ecosystem services align with conservation but are not enough to tip the balance
 - Conservation Action Planning can partner with programs for ecosystem service payments
- Ecosystem services do not align with conservation
 - Conservation Action Planning is on its own

Obstacles and Limitations of ES

- Difficult to circumscribe and isolate ES at local level.
- Provisioning and flow of ES cut across policy-relevant boundaries.
- Challenging to conduct ES research that is applicable in policy contexts.

Requires integration of multiple disciplines

Methodology issues can affect credibility of valuation estimates

- Full Cost Benefit Analysis (CBA)is sometimes precluded by legislative standards.
- Lack of consensus on goals in environmental regulation: efficiency? justice? job creation? Etc

(Winslow, 2013)

Some other considerations

Practical:

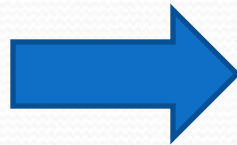
Is some number better than no number? How to deal with uncertainty?— How much accuracy is needed?— What are costs of incorrect decision?— ESV helps inform decisions but does **not** make decisions.

Philosophical:

Don't ecosystems have untold value?— But will these be included if no number is attached? How can we measure aesthetics, ethics (Hargrove, 2013), feelings etc.

Is valuation enough?

Partner mapping



Evaporated evidence

- Evidence based policy making is often unsuccessful and is quickly 'evaporated' if the evidence is inconvenient or unfavourable.
(Porrit, 2010 when he was Chair of the Sustainable Development Commission)
- This is a concern because ecosystem evaluation is based on facts and values (King, 2010)
- Policy makers depend on scientists 'value free' opinion
- Spin becomes an important tool.
- Important for 'natural capitalism' but many have no monetary substitute (Hawkin et al, 2000) difficult and imprecise valuation.
- Resource productivity amount of output from a given resource (Hawkin et al, 2000) e.g. tides long term productivity
- Classic economics uses *extraction, production and distribution* with its associated environmental costs e.g. waste = cost

Conclusion



Some additional refs

- Bagstad, K.J., Semmens, D., Winthrop, R., Jaworski, D., and Larson, J. (2012). Ecosystem Services Valuation to Support Decision making on Public Lands — A Case Study of the SanPedro River Watershed , Arizona Scientific Investigations Report
- Iovanna, R., & Griffiths, C. (2006). Clean water, ecological benefits, and benefits transfer: A work in progress at the U.S. EPA. *Ecological Economics*, 60(2), 473–482.
- Liu, S., Costanza, R., Farber, S., & Troy, A. (2010). Valuing ecosystem services: theory, practice, and the need for a trans disciplinary synthesis. *Annals of the New York Academy of Sciences*, 1185, 54–78.
- Tallis, H., & Polasky, S. (2009). Mapping and valuing ecosystem services as an approach for conservation and natural-resource management. *Annals of the New York Academy of Sciences*, 1162, 265–83.
- UK National Ecosystem Assessment <http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>

Seminar

- To what extent is the UK National Ecosystem Assessment (87 pages on Moodle) based on principles of Ecosystem Services?
- In groups of 3 construct a poster that addresses the above Q.
- Highlight the main parts of the document that uses economic value and the sections that are based on other value discourses.

