# Design is everything: Structuring ecosystem service markets to achieve ecological objectives

Timm Kroeger

Conservation Economics Program, Defenders of Wildlife and
SUNY College of Environmental Science and Forestry

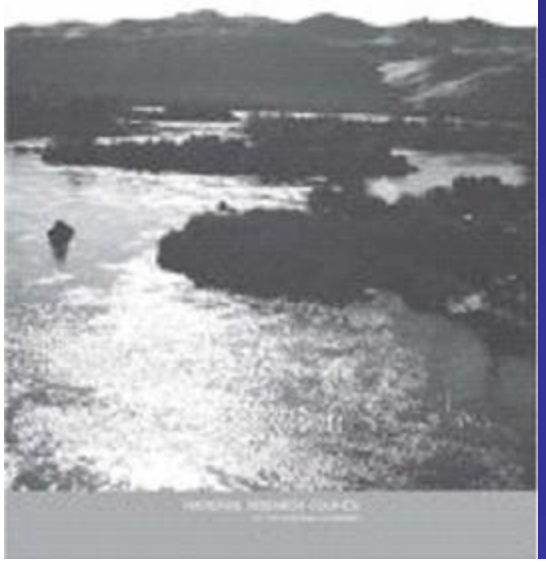
ESA 91st Annual Meeting, Memphis, TN, August 6-11, 2006

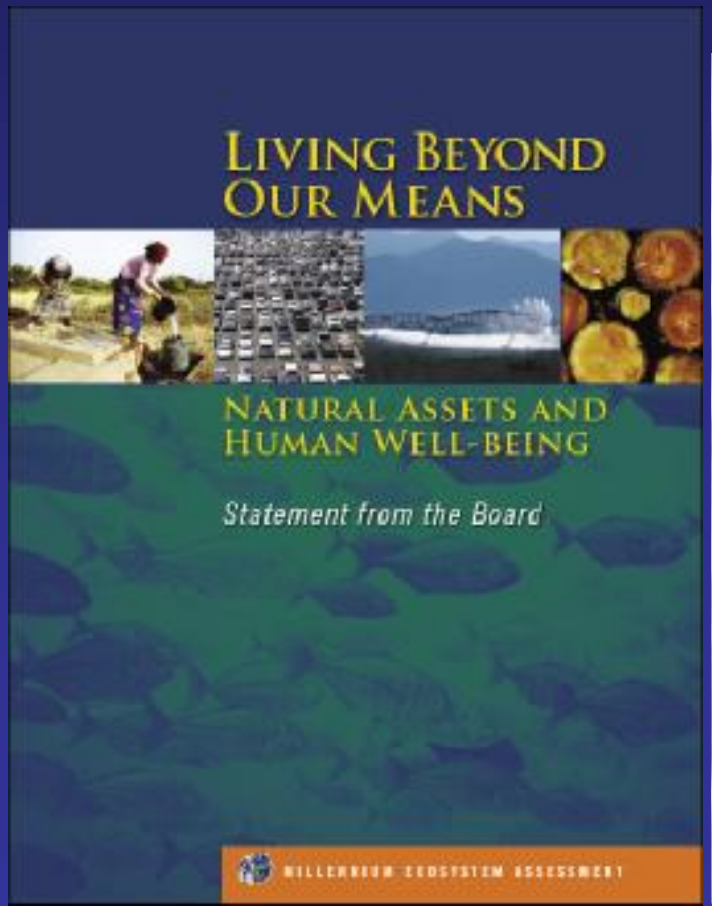
# Overview

- Ecosystem services (ES) – some background
- Ecosystem *functions* vs. ecosystem *services* vs. ecosystem *service values*
- Market-based approaches to ES provision
- Characteristics of ES relevant to commodification
- Designing Ecosystem Service markets
- ES markets – promise, challenges, and perils

# Ecosystem Services (ES) – some background

- Increased recognition of importance and decline of many ecosystem services (NRC report, Millennium Ecosystem Assessment, EPA report)




# Ecosystem Services (ES) – some background

- **Lack of protection of ecosystem services via markets (market failure) or regulation (institutional failure)**

***Market Failure***

- Many ES are public goods

- Their value cannot be captured by providers in free markets

- Few created markets for public goods (e.g., wetlands), most poorly designed

***Institutional Failure***

- Policies and institutions do not (sufficiently) encourage land management for ES provision

- Ecological boundaries don't match political boundaries

- Extending institutional boundaries beyond traditional reach is politically difficult

***More on this later…***

# Ecosystem Services (ES) – some background

- **Increased interest in exploring market-based approaches to conserving ES**

Reasons:

- Political
- Potential for cost savings compared to command-and-control approaches (based on evidence from experiences with Clean Air Act, Clean Water Act and economic theory)

## Ecosystem Services (ES) – some background

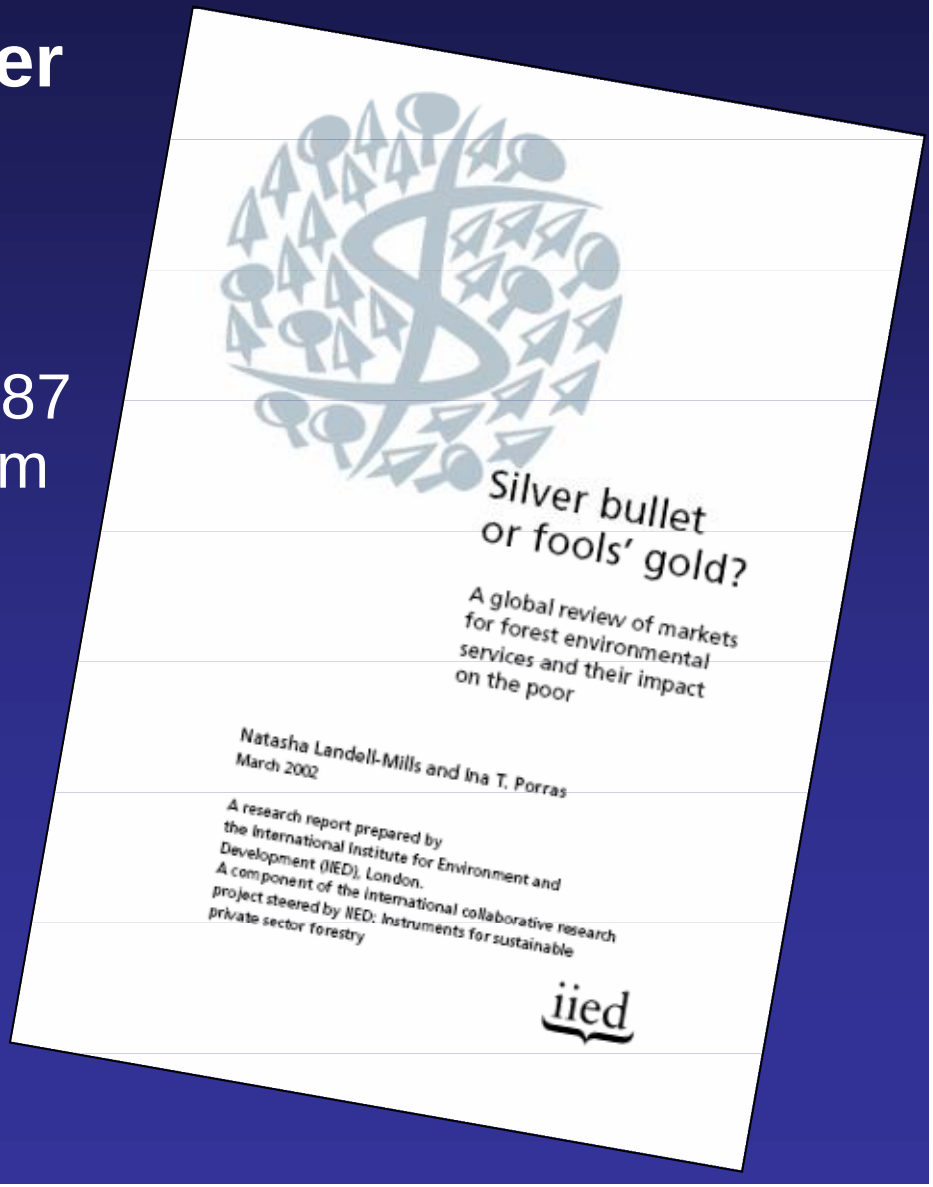
- **Federal initiatives to move toward promoting ecosystem service provisioning**

> "Today, I am announcing that USDA will seek to broaden the use of markets for ecosystem services through voluntary market mechanisms. I see a future where credits for clean water, greenhouse gases, or wetlands can be traded as easily as corn or soybeans."
>
> Mike Johanns, U.S. Secretary of Agriculture, August 30, 2005

→ Shift from Farm Bill commodity programs to Green Box payments?

# Ecosystem Services (ES) – some background

- **Large and growing number of ES payment schemes around the world**
  - in 2002, a survey identified 287 cases worldwide of ecosystem service payments for forest services alone

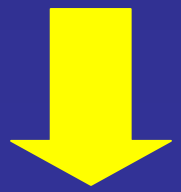


# Examples of existing market-based approaches for ES

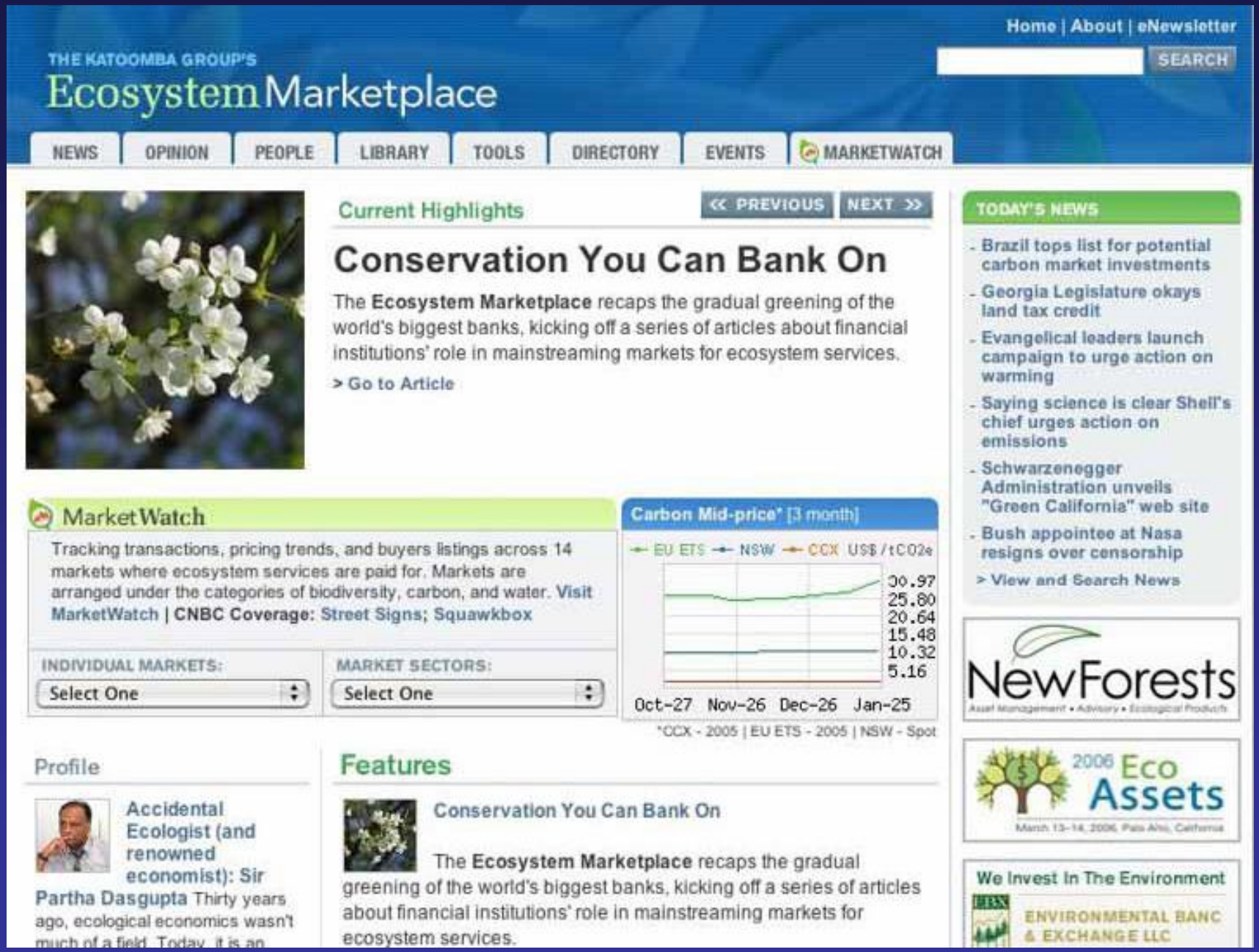
| *Ecosystem service* | *Examples:* | *Payments cover this service completely?* |
|---|---|---|
| Water quality / quantity maintenance | Australia, Costa Rica, Colombia, Ecuador, France, Mexico, U.S. | no |
| Soil retention/formation | Costa Rica, U.S. | no |
| Soil quality maintenance | U.S. | no |
| Carbon uptake | Costa Rica, Colombia, EU, Nicaragua, Mexico, | no |
| Biodiversity conservation | Australia, Costa Rica, Colombia, EU, Guyana, Nicaragua, Peru, U.S. | no |
| Pollination | U.S. | no |
| Flood mitigation | U.S. (CWA 404 wetlands) | no |
| Aesthetic natural amenities | Australia, Canada, U.S. | no |
| Water regulation | - | no |
| Provision of recreational opportunities | Canada, U.S. | no |
| Provision of fiber | everywhere | yes, except open access resources |
| Air purification | - | no |
| Waste assimilation – surface and groundwater, natural lands | - | no |
| Provision of habitat for wild species used commercially/for subsistence | - | no |
| Biological control | - | no |
| ... | | |

# Ecosystem Services (ES) – some background

- The Katoomba Group's Ecosystem Marketplace
  - "Bloomberg" for emerging markets in ecosystem services
  - Carbon markets, water markets, biodiversity (species habitat) markets, easements, other conservation transactions
  - Daily news updates



http://www.ecosystemmarketplace.com/



# Ecosystem functions vs. ecosystem services vs. ecosystem service values

- *Ecosystem Functions*:

  Biophysical processes in an ecosystem

- *Ecosystem services*:

  Outputs of ecosystem functions that directly or indirectly benefit humans

- *Ecosystem service values*: the utility humans receive from ecosystem services (the value of the beneficial outputs)

# Ecosystem functions vs. ecosystem services vs. ecosystem service values

Examples:

| Ecosystem *function* | Ecosystem *service* | Ecosystem *service value* |
|---|---|---|
| **Habitat provision to pollinators** | **Pollination of crops** | **Value of harvested crops (or avoided cost of artificial pollination)** |
| **Absorption of wave energy** | **Buffering of tidal surges** | **Avoided/reduced damage to humans, human structures, crops, livestock** |

**Service values are context-specific**!

# Market-based approaches to ecosystem service provision

**The Idea:**

"The marketing of ecosystem goods and services is basically an effort to turn such recipients [who benefit for free] … into buyers, thereby providing market signals that serve to help protect valuable services."

(Brown *et al*., 2006:1)

Market-based approaches to ES provision

So why is designing ES markets a challenge?

**Need to determine:**

- ***Who*** pays ***whom***?
- ***When***?
- ***for what***? and
- ***how much***?

# Market-based approaches to ES provision

Types of market-based approaches for ES provision: ***Who pays whom?***

- Individual to Individual (incl. firms and NGOs)
- Mitigation markets (regulation-driven)
- Government payment schemes

Who pays whom? - Some examples

- **Individual to individual**

  Driven by self interest, not regulation:

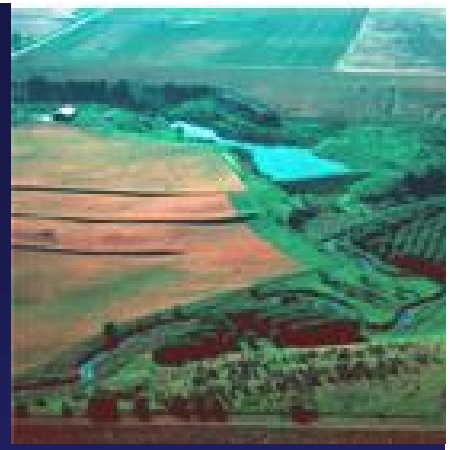
  – Perrier-Vittel, world's largest bottler of mineral water, pays farmers to use less intensive dairy farming techniques to reduce pollution of its springs (France)
  – Costa Rica hydropower plant La Mangera S.A. pays upstream farmers to implement land management practices to reduce soil erosion

Who pays whom? – Some examples

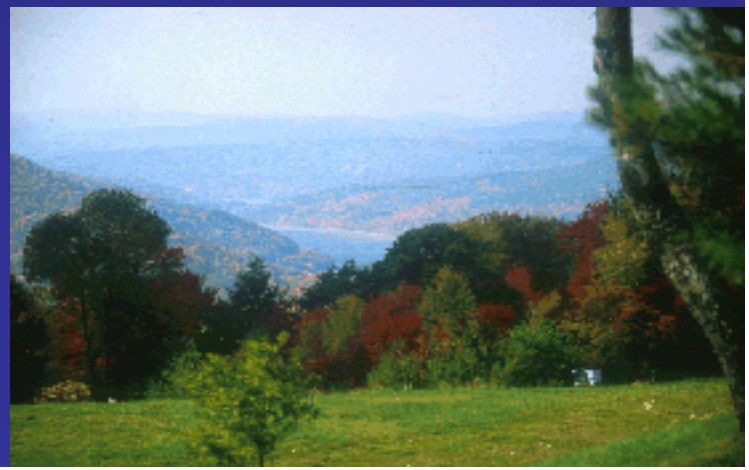
- **Mitigation markets – purely government constructed, regulation driven**
  - Clean Water Services, an OR utility, pays farmers to plant shade trees along Tualatin River to reduce water temperature loading, to comply with U.S. Clean Water Act
  - U.S. Wetland Mitigation Banking – developers must offset filled wetlands to comply with Clean Water Act
  - Kyoto's Clean Development Mechanism – actors in developed countries buy GHG reduction credits produced by developing countries

    Also: EU, UK, Australia and Norway GHG emission trading schemes  Total in 2005: >US$ 9 billion

Who pays whom?  - Some examples



- **Government payment schemes**
  - Australia's Bushtender program, U.S. Conservation Reserve and Wetlands Reserve Programs - pay land owners for conservation of natural vegetation in specified areas
  - NY City – pays landowners in upstream watersheds for agricultural easements and new water quality initiatives on small farms



# Market-based approaches to ES provision

One-off deals vs. “real” markets (Kyoto’s CDM, U.S. wetland mitigation banking)

One-off, tailor-made deals:

- require highly specific information
- intense negotiations

➡ have high transaction costs.

Large-scale provision of ES through payments needs “real” markets: standardized product, many sellers and buyers, large number of exchanges

# Market-based approaches to ES provision

Most ecosystem service payments to date are based on government created markets or government payment schemes

- Reason: many ecosystem services are **public goods**
  - Non-rival: provision to one person does not diminish benefits to others (flood protection, biodiversity conservation) and
  - Non-exclusive: impractical to prevent people from using them (e.g., provision of habitat for pelagic fish; scenic views, stable climate)

Their property rights are insufficiently defined to attract private investment, because benefits cannot be captured by owner

## Problem for ES conservation through "free" markets:

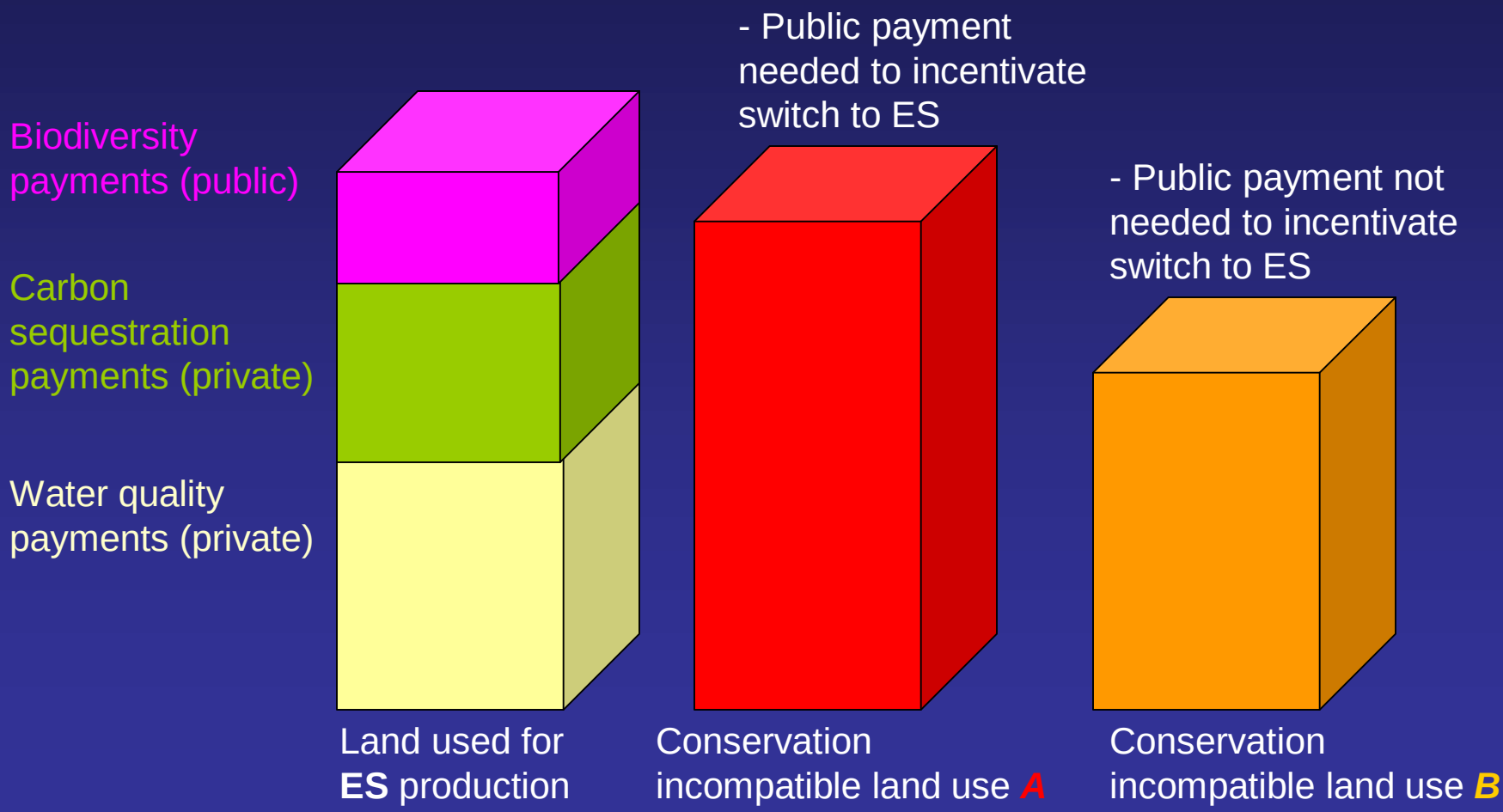
- Private incentives insufficient for ES conservation

  private funds will only support production of marketable ES (not public goods)

- Public funds for payment for ES are limited and no match for scale needed, but can complement private incentives

# Combining private and public payments for ecosystem services

## Income to landowner from ES vs. conventional land use



## Problems for ES conservation through “free” markets:

But:

- payment gap likely: public funds not sufficient to cover all public good ES

Solution:

Create ES markets for public good ES through regulation: government constructed markets

But not easy:

-property-rights issues

-need clear legal base for regulation of different ES

# Designing ES markets

The objective of the market will drive market design:

- Definition of service units (the “currency” of each ES)
- Exchange rules (trading areas, trading ratios)

Hence the question is:

**What is the objective of the market?**

# Designing ES markets – objectives

- **High exchange volume** (a “thick” or “robust” market) and low transaction costs for buyers and sellers?
  - Desirable, but **not** the primary goal.

- **Attainment of ecological objectives!**

  - **Protect ES values.**
    - ES values lend themselves better as a basis for economic incentives than ES because they represent the benefits people derive from the services

# Designing ES markets

Specific challenges:

- Measurement of service flows
- Pricing of services
- Securitization of service contracts
- Stacking of services
- Bundling of services

# Measurement of Ecosystem Service flows

**ES assessment methodologies must be robust**:

- reasonably accurate
- reasonably inexpensive

**Must be applicable by the land owner, not only trained ES technicians/ scientists**

Technology and understanding of service provision by ecosystems are improving

*Kadyszewski, 2005*

# Pricing of Ecosystem Services

Prices…

- based on total economic value (social value) of services?
- market-defined, i.e. based on supply and demand?

Specific ES market design issues- Pricing

# It depends!

**Distinguish between regulated and unregulated services**:

- Regulated ES: ensure exchanges are based on full social value of resources

➡ Stipulate adequate ES currency and exchange rules

Problem: Valuation of service flows often difficult

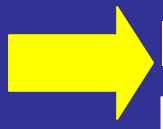
- Non-regulated ES: “free” market determines service price;

Use reverse auction for cost-effective allocation of public payments for public good services – e.g., EcoTender, BushTender)

## Design challenge for constructed ES markets (mitigation, govt. payments):

"The problem with ecosystem service markets is that the market itself does not define the units of trade (whereas conventional markets do). Instead, units of trade … have to be defined by governments, governments being the trustees of environmental quality… In a conventional market, the buyer is concerned selfishly about the quality of the 'unit' they buy. In an ecosystem market, the environmental good is a public good and the buyer is therefore indifferent to its quality. The buyer is concerned only about satisfying the regulator's definition of an adequate unit."

Boyd and Banzhaf (2006:3)



Importance of defining adequate service units (currencies), backed by credible monitoring and enforcement

# Pricing of Ecosystem Services

- Regulated ecosystem services:

If currency used to measure service values is not able to take into account nonfungibilities of service values, exchange restrictions are needed to restrict damaging trades

Example: Wetlands mitigation banking in U.S.

- wetland *acre* effectively is the currency used
- but does not capture differences in services and value of different wetlands
- agency uses exchange restrictions to limit harmful trades

  - Ø trades restricted to the same watershed
  - Ø very small geographic size of markets
  - Ø market thinness, little competition, higher prices

# Pricing of Ecosystem Services

- Valuation is often difficult and complex **…**

## Pricing of Ecosystem Services

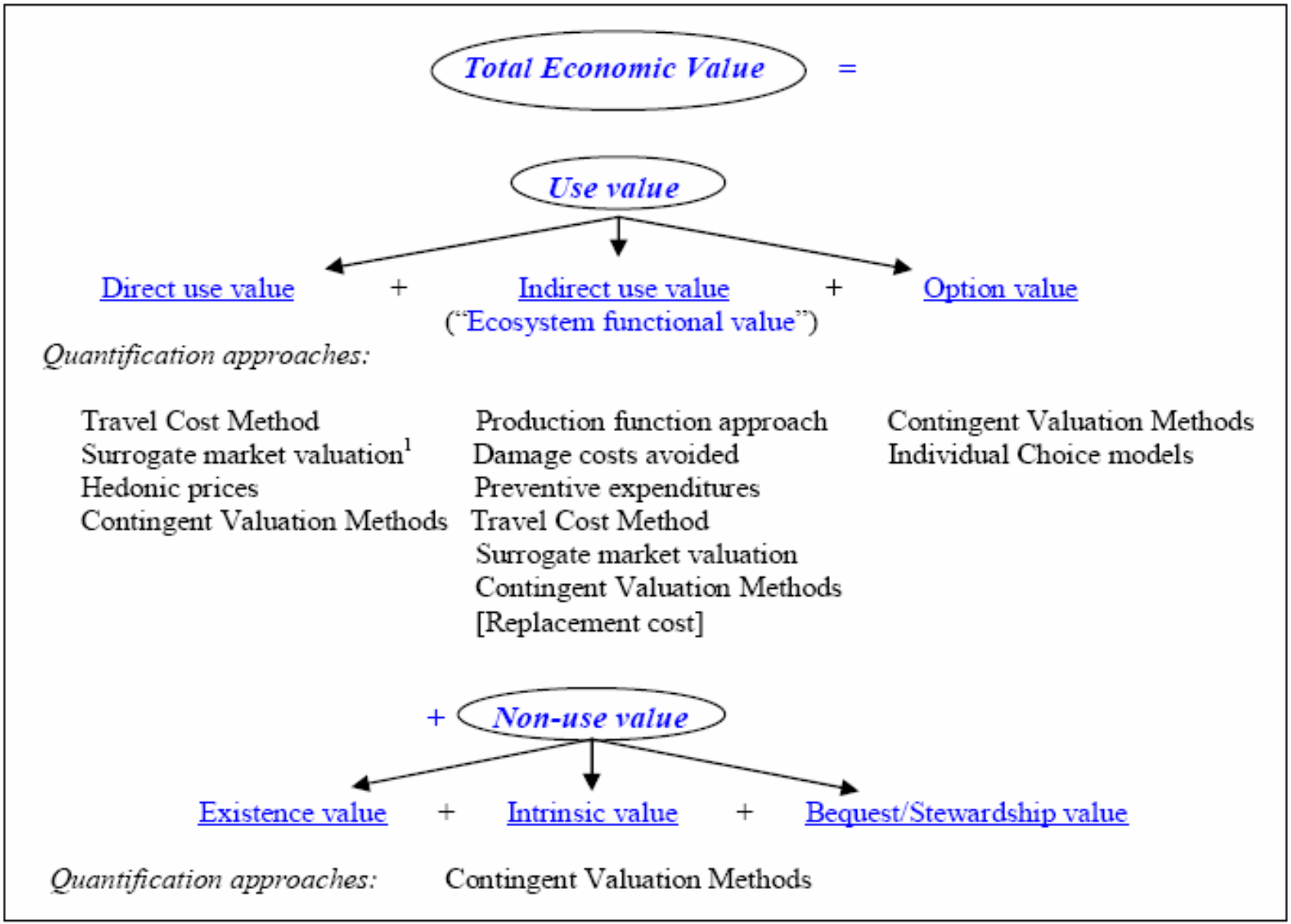
Identify economic values of ecosystem service…

- Valuation is often difficult and complex

**TEV** = **Use Value** + **Passive-use Value**

| | |
|---|---|
| Direct Use Value | Existence Value |
| + | + |
| Option Value | Stewardship Value |
| + | + |
| Indirect Use Value | Bequest Value |

# Quantify values: no lack of methods, but often complex and costly



## Pricing of Ecosystem Services

- practical approaches will necessarily be imprecise but often will be the only feasible option (e.g., use of value functions based on meta-analyses of service values)

## Pricing of Ecosystem Services

- technology (e.g., GIS) expected to increase feasibility of more practical and precise valuation
- ES quantification and valuation on the cutting edge research front in environmental economics/science.

## Pricing of Ecosystem Services

But currently:

- Very few, if any, of ES payments are based on actual full social values. This reduces competitiveness of services production with competing land uses.

## Pricing of Ecosystem Services

- Still, even regulated markets with ES prices based on full values have their problems:
  - Equity issues (ES values could migrate across the landscape, e.g. because of property price differentials); may require market restrictions (trading zones)

Specific ES market design issues

## Securitization

- Insurance/bonds to guarantee fulfillment of ES provision contract

Example: The Environmental Trust (CA)

What happens when a nonprofit corporation with responsibility for long-term stewardship of conservation banks files for bankruptcy?

- Need to establish guidelines for financial security and clear chain of liability

# Stacking of services

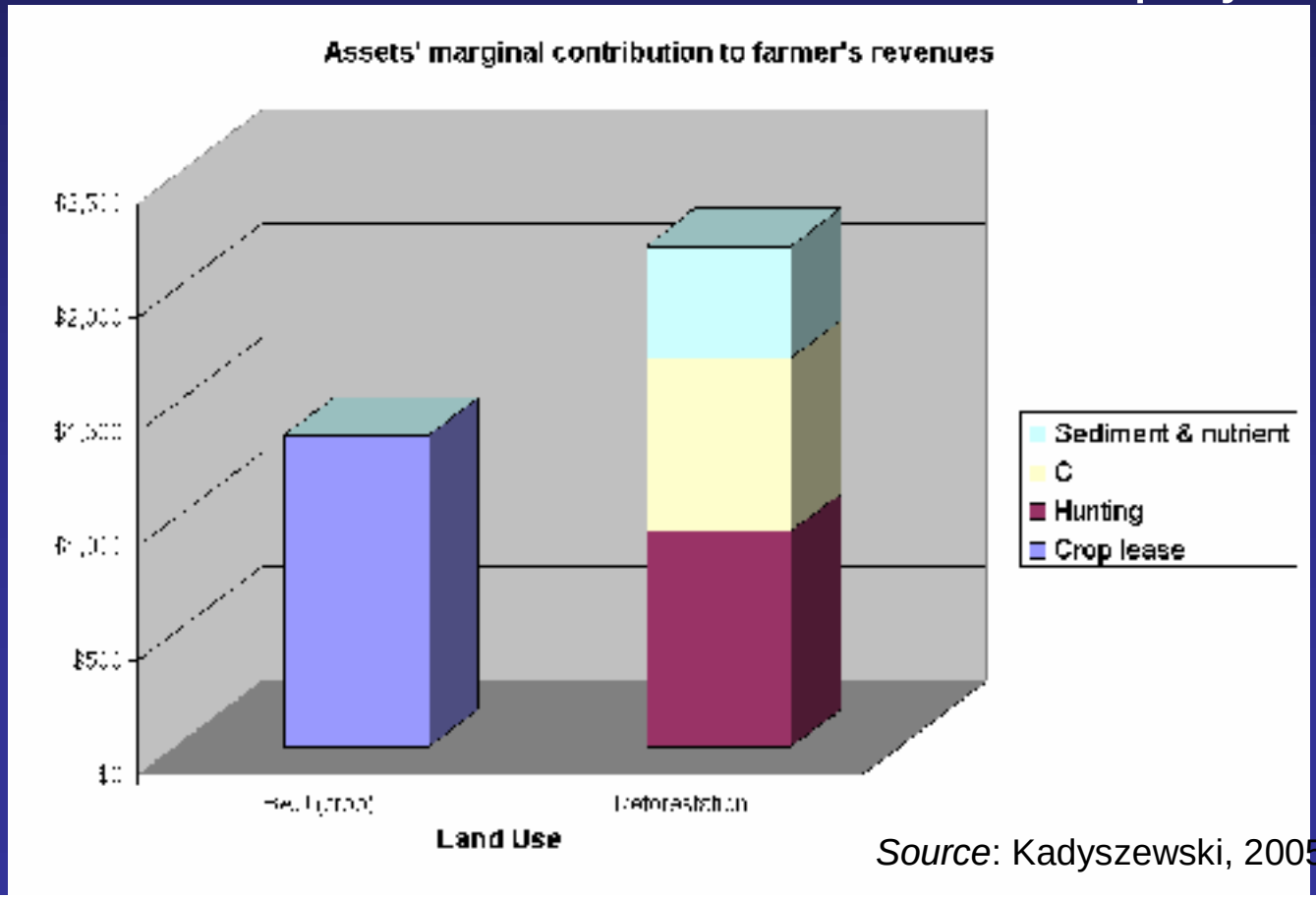
- Payments for different ecosystem services provided by a given land area

Example: Winrock International's *Carbon, Habitat and Water* project in Arkansas

# Stacking of services

-Payments for different ecosystem services provided by a given land area

Winrock International's *Carbon, Habitat and Water* project (AK)




*Source*: Kadyszewski, 2005

# Stacking of services

- Potential: allows land owners to maximize income from conservation.
- But: Requires legal support - currently, agencies often refuse to allow stacking of credits

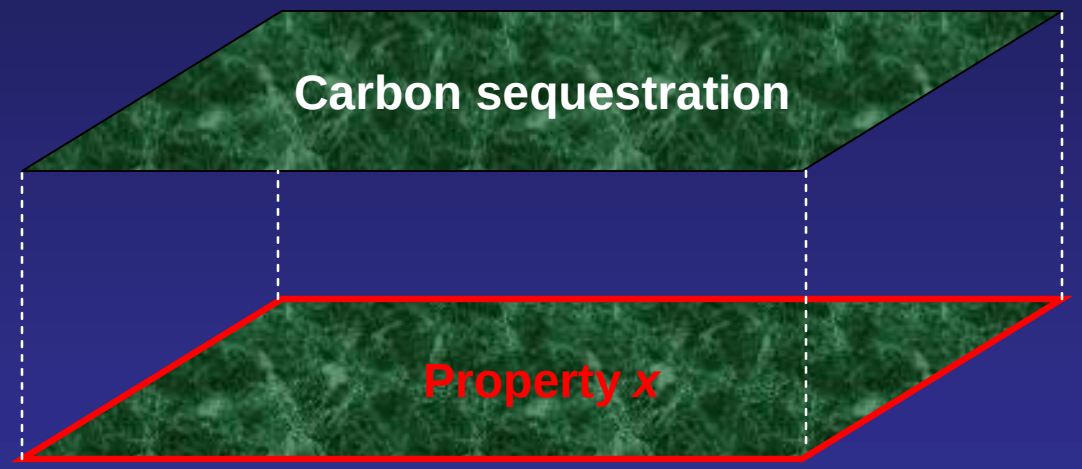
Issues:

- Size of service unit areas
- Different size of units for different services may present challenge in some cases
  - Minimal contiguous habitat unit for a species crosses property boundaries

# Stacking of services

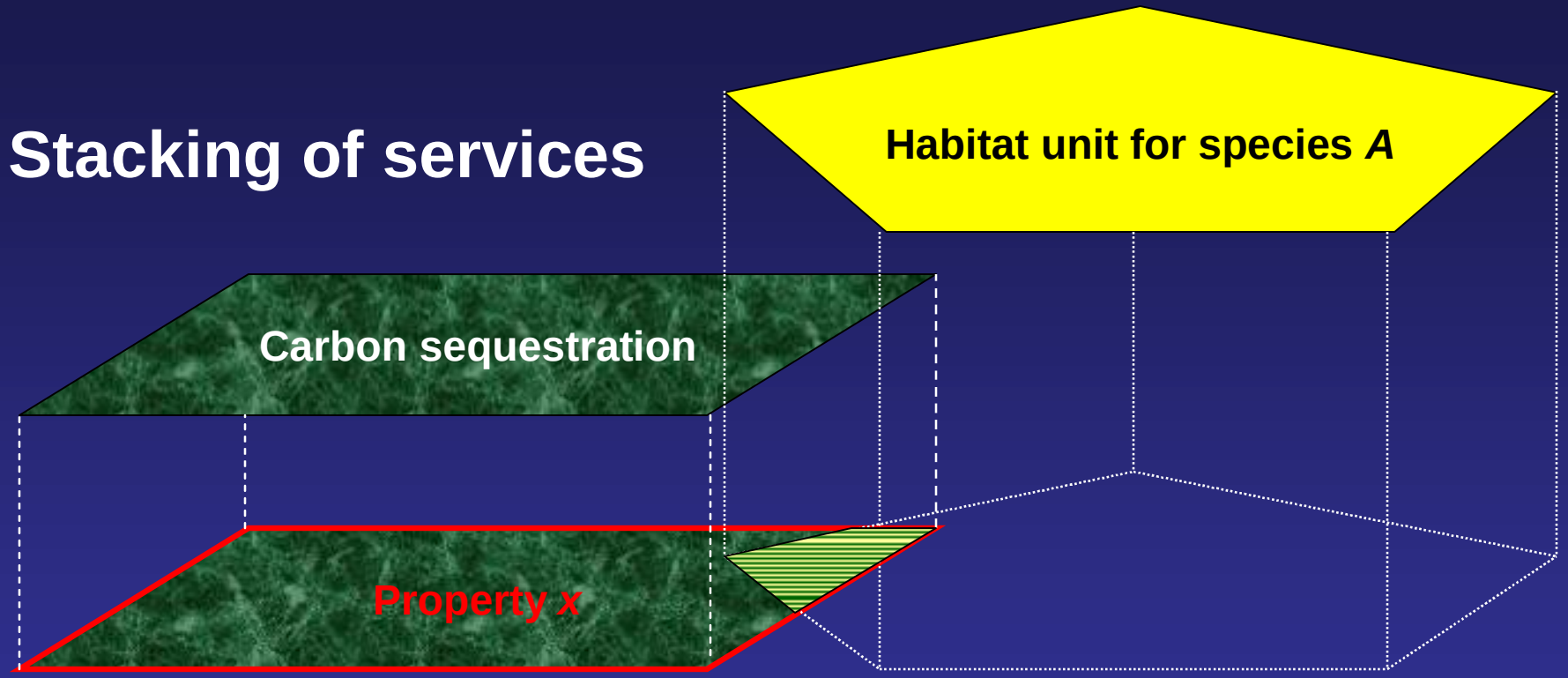
Example: landowner ***X*** wants to conserve his property to produce carbon sequestration services and habitat provision services for species *A*

# Stacking of services



Specific ES market design issues

# Stacking of services




Unless neighboring landowners cooperate in habitat provision for species *A*, habitat service may not be provided and no partial credit will accrue to any landowner.

- No limits of course on stacking of non-regulated services – pollination, habitat for game species, landscape scenery, recreation…

  …if only more of those were marketable…

# Bundling of ecological services

- Potential solution for protection of ES that suffer from market failure:
  - Identify marketable (private benefit) services that are co-products of nonmarketable (public good) services

Empirical examples of bundling:

- Carbon sequestration and biodiversity protection
- Water quality preservation and biodiversity protection
- Landscape beauty preservation and biodiversity protection

# Conclusions

Using markets and payments for the protection of ecosystem services -

Promises,

Challenges,

Perils

# Conclusions

## Promises

- attract more financing and increase private incentives for protection of ecosystem and their services
- Make conservation more competitive with alternative land uses

# Conclusions

## Challenges

- Increase marketability of services
  - close gaps in measurement and valuation of flows
  - make ES measurement and valuation user friendly
- Require mitigation markets and govt. payment schemes to employ strong currencies that capture the full economic value of services
- Close gaps in incentives for production of public good ecosystem services
  - Sufficient funds public funding for public good ES?
  - Identify and use bundling opportunities

# Conclusions

## Perils

- relying on “free” markets does not ensure protection of ecosystem services (myopia, market power, imperfect information, uncertainty, threshold effects, public good services)
- Govt. created mitigation markets and payment schemes are subject to pressures of political economy (“cheap” and weak currencies, insufficient control of exchanges, weakening of conditions for payments - but holds true for all regulation)
- Mitigation markets and govt. payment schemes require sufficient funding for public agencies or NGOs to monitor and enforce compliance

**Timm Kroeger**
**Conservation Economics Program**
**Defenders of Wildlife**

**(202) 772-3204**
**tkroeger@defenders.org**