Mapping the value of nature:

Ecosystem services, conservation, and resource management

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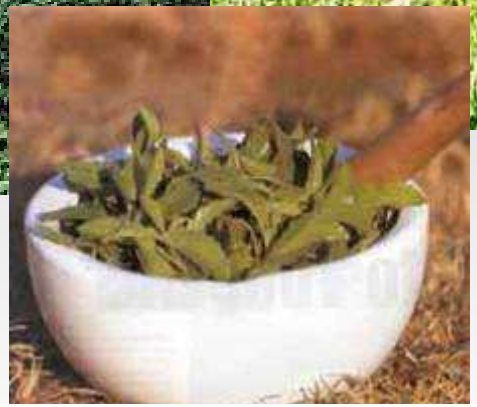
World Wildlife Fund – U.S.

natural capital PROJECT

Ecosystem Services






- Links nature to human welfare
- Motivates conservation
- Measures impacts of USFS work?

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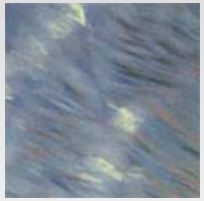
The Economist
Habemus Benedict XVI
PAGE 49
The China question
PAGES 12, 29 AND 41
The stockmarket's April stumble
PAGE 71
Republicans, Abe and Condi
LEXINGTON, PAGE 36
APRIL 23RD-29TH 2005
www.economist.com
Rescuing environmentalism (and the planet)

Outline

- Foundations
  - Global assessments
  - Case studies
  - Needs
- The Natural Capital Project
  - Overall goals
  - Mapping tool

Millennium Ecosystem Assessment





- Largest assessment of ecosystem health and consequences for human well-being
  - *1360 experts from 95 countries*
  - *Consensus of the world's scientists*
- Designed to meet needs of decision-makers in government, business, civil society
  - *Information requested through 4 international conventions*

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Main Findings

- 1. Humans have radically altered ecosystems in last 50 years.

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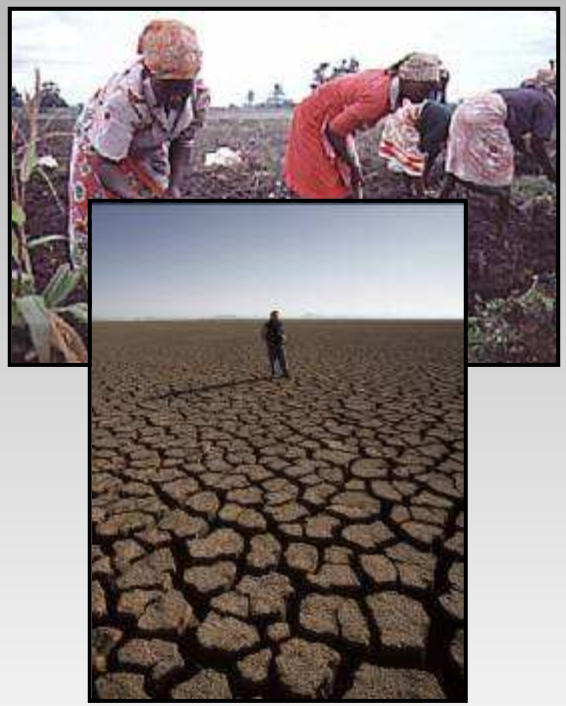
- 1. Humans have radically altered ecosystems in last 50 years.
- 2. Changes have brought gains but at growing costs.
  - Degradation of 60% of ecosystem services
  - Significant economic costs and growing harm to poor people
  - Increased risk of abrupt changes



Main Findings

- 1. Humans have radically altered ecosystems in last 50 years.
- 2. Changes have brought gains but at growing costs
- 3. Degradation of ecosystems could grow worse and is a barrier to achieving the MDGs.

Main Findings

- 1. Humans have radically altered ecosystems in last 50 years.
- 2. Changes have brought gains but at growing costs that threaten achievement of development goals.
- 3. Degradation of ecosystems could grow worse and is a barrier to achieving the MDGs.
- 4. Degradation can be reversed but requires changes in policies, institutions and practices that are not currently underway.

Other Global and regional syntheses

USA: >$320B/y (~5% of GDP)

Pimentel et al. 1997
BioScience 47: 747-757

Cape Floristic Region: >$1.4B/y (10% of GDP)

Turpie et al. 2003
Biol. Conserv. 112: 233-251

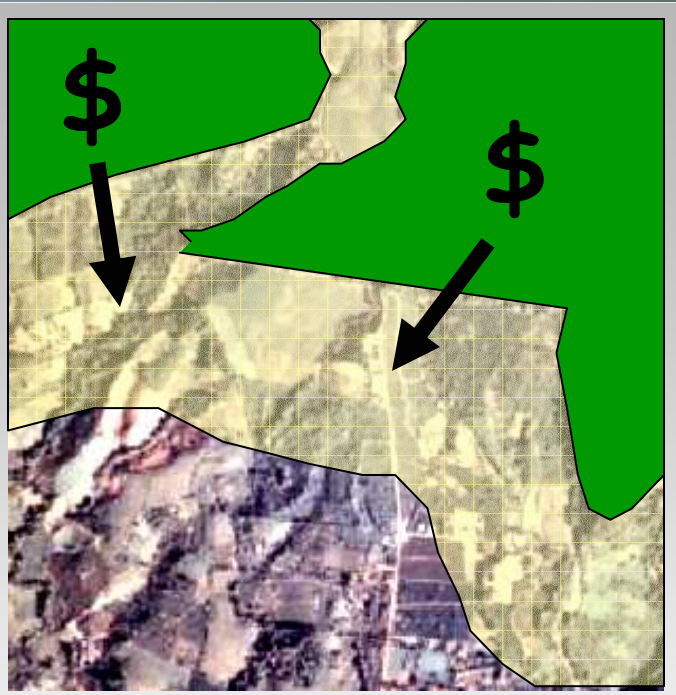
World: $38000B/y (>GDP)

Costanza et al. 1997
Nature 387: 253-260

Small scales, single services

Coffee near forest:

- 5x more bee spp.
- 2x more pollination
- 20% higher yields

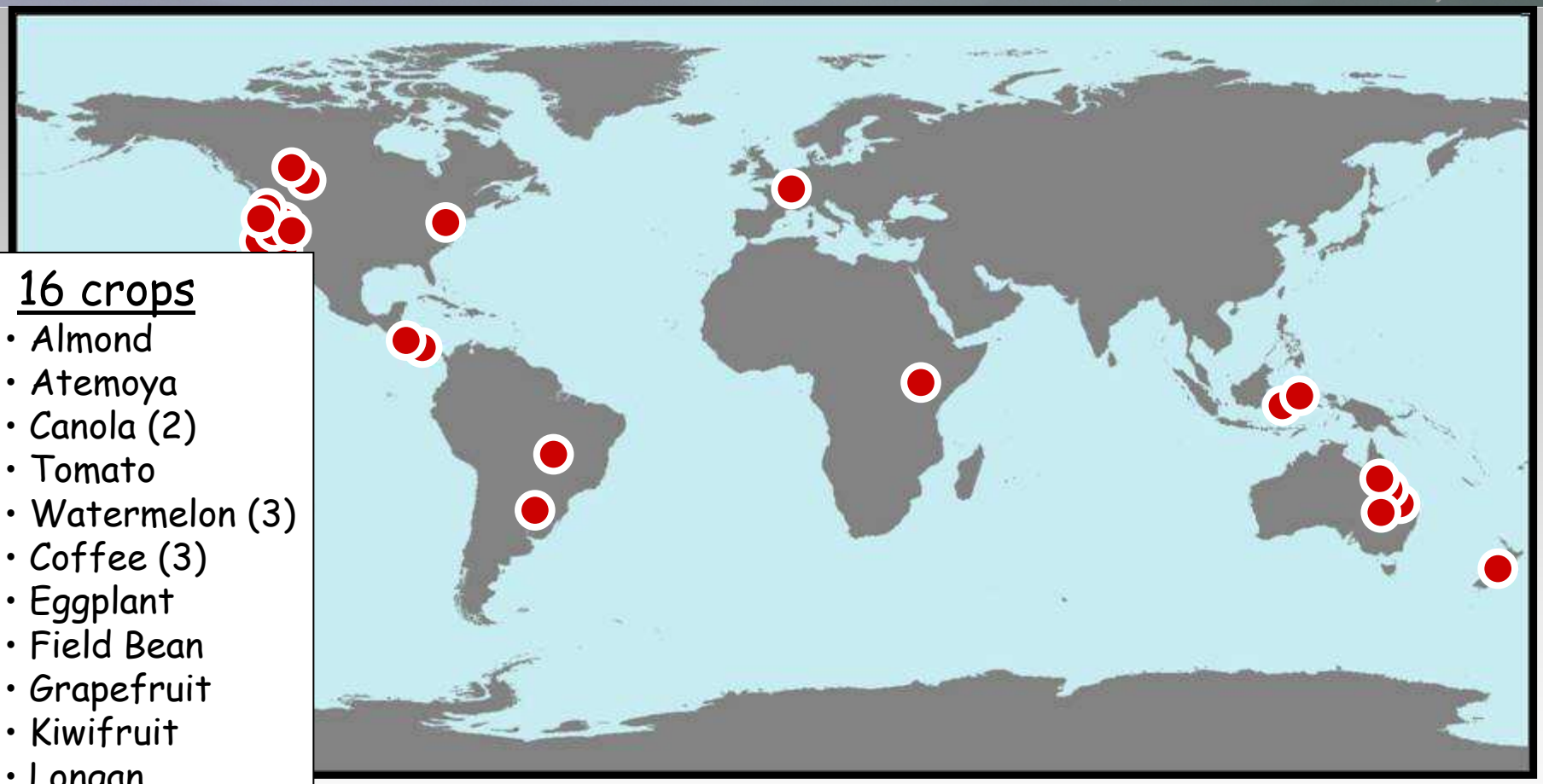


Lowerbound value of forest:

- $60,000/year to 1 farm

Ricketts et al. 2004. ***PNAS***

How general is this result?



16 crops

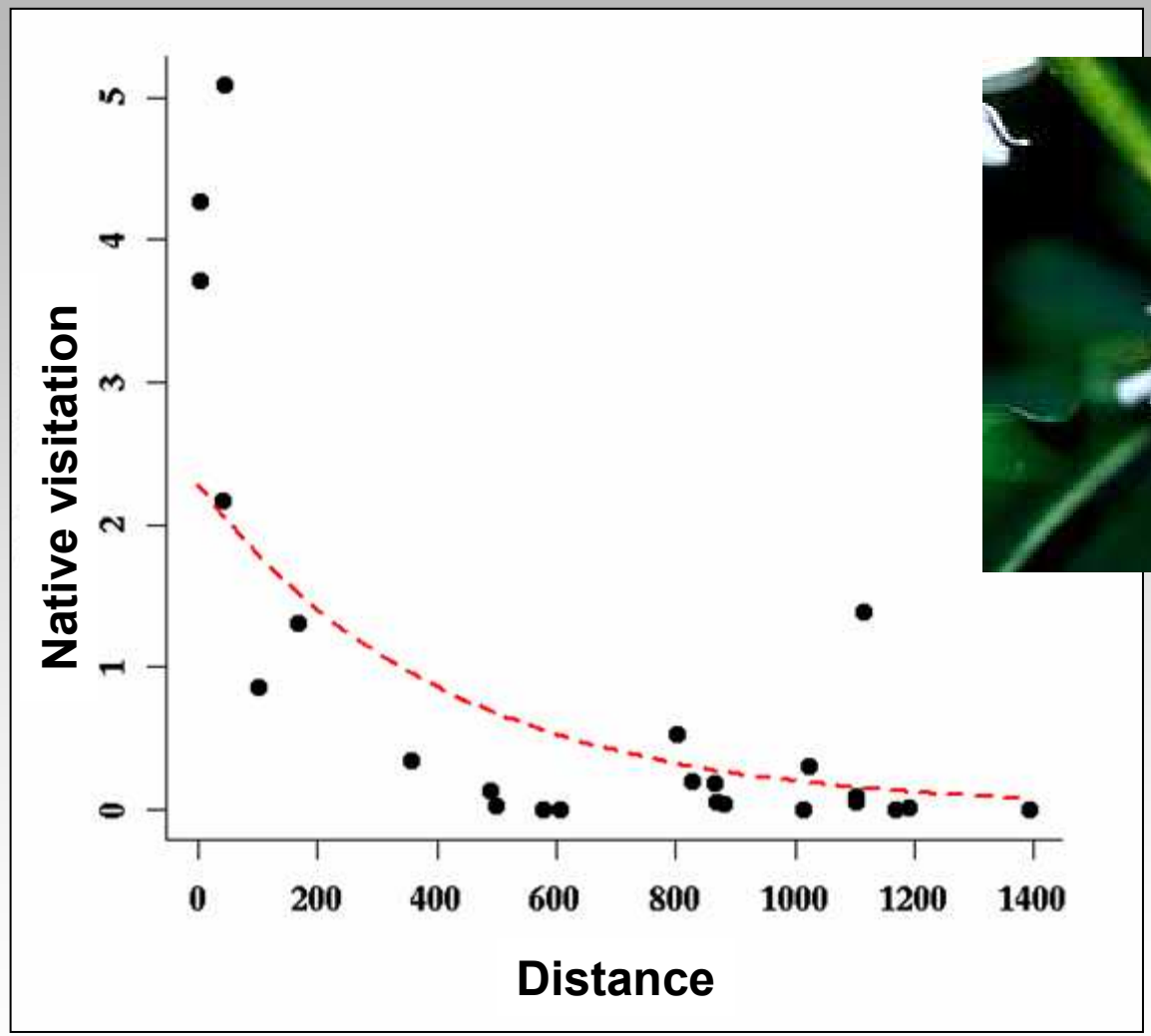
- Almond
- Atemoya
- Canola (2)
- Tomato
- Watermelon (3)
- Coffee (3)
- Eggplant
- Field Bean
- Grapefruit
- Kiwifruit
- Longan
- Macadamia (2)
- Muskmelon
- Oil palm
- Passion fruit
- Sunflower (2)

23 studies

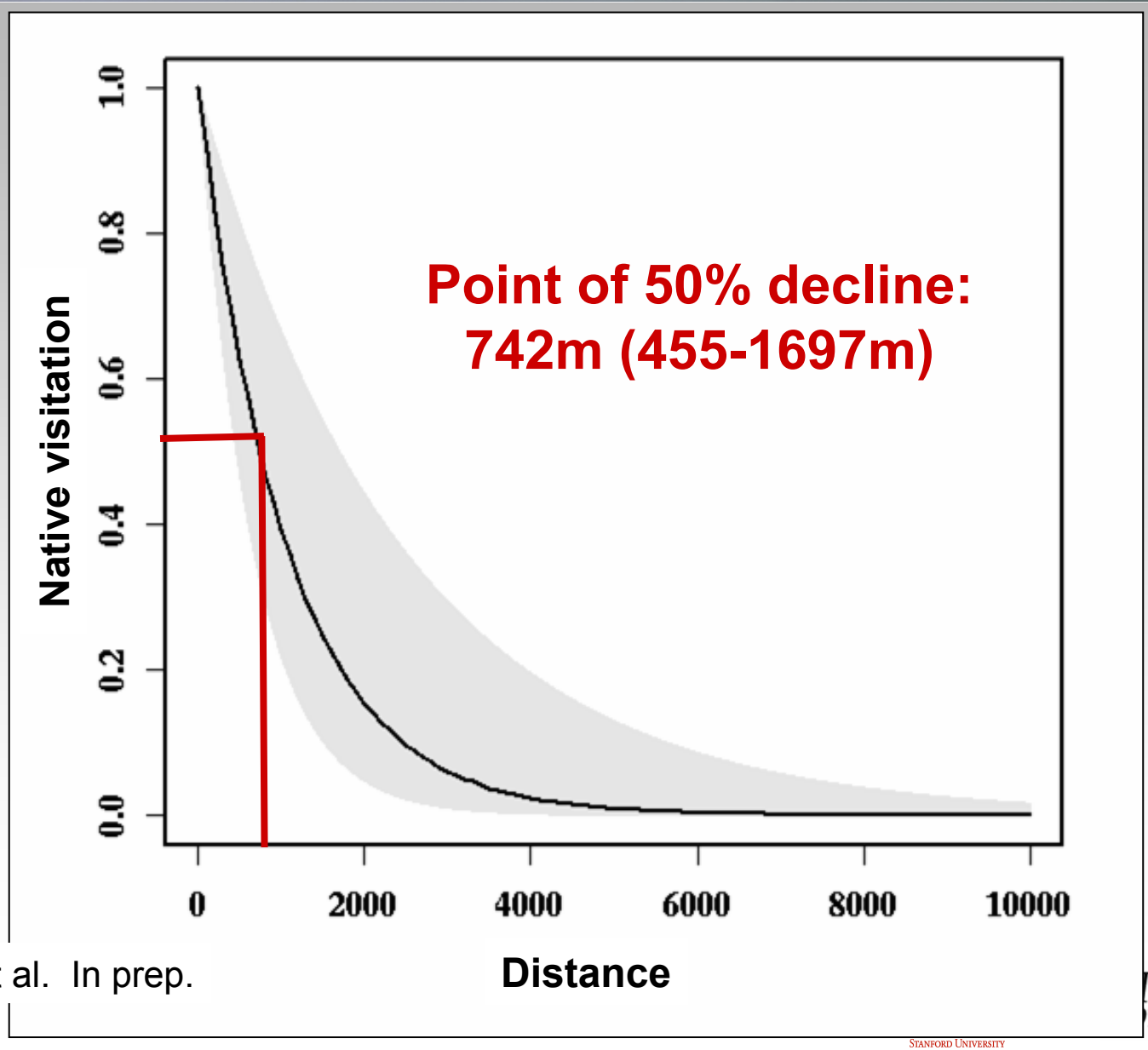
- 15 published, in press
- 8 in review, preparation

10 countries

Coffee in Costa Rica

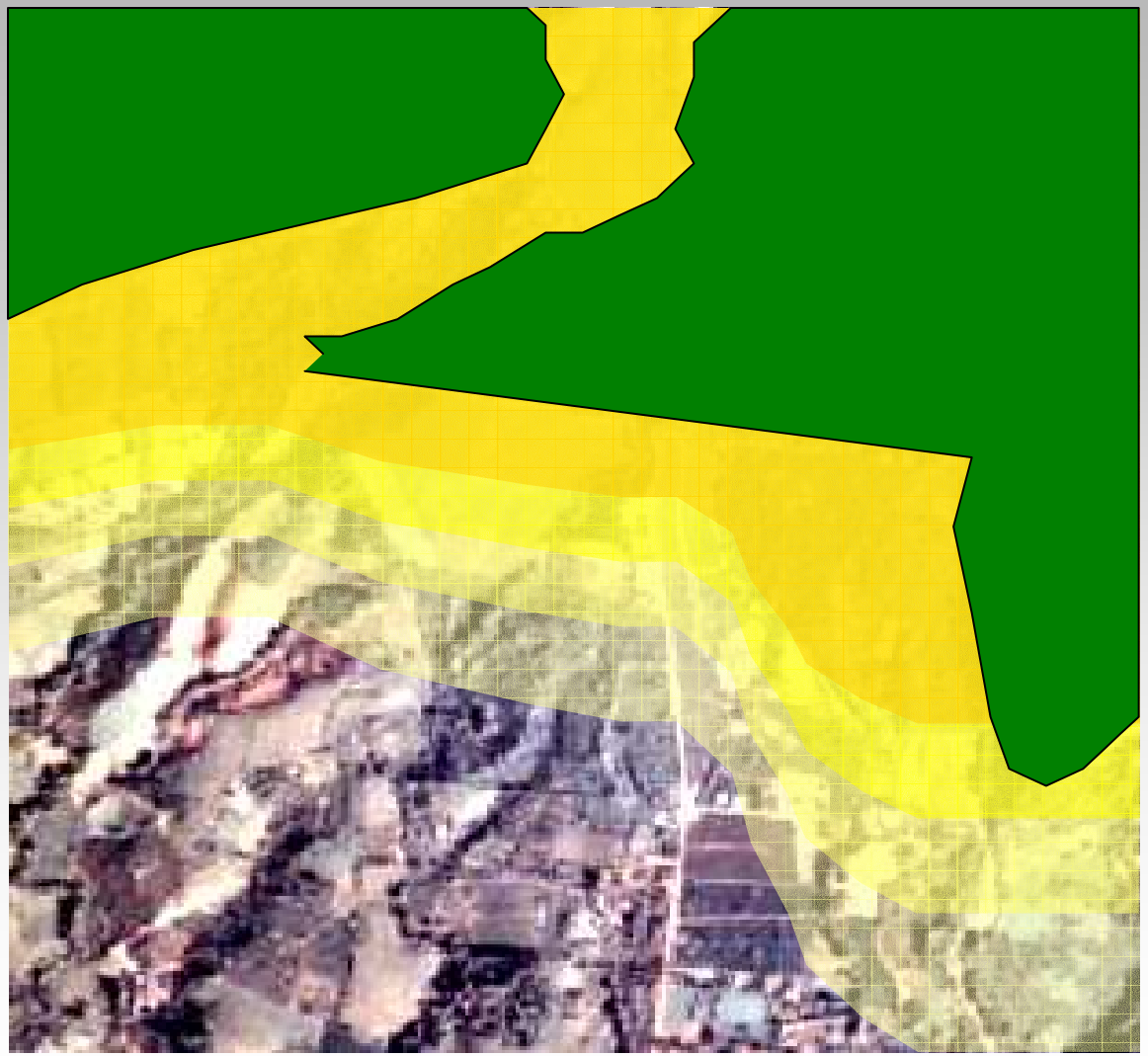


Consensus of all 23 studies

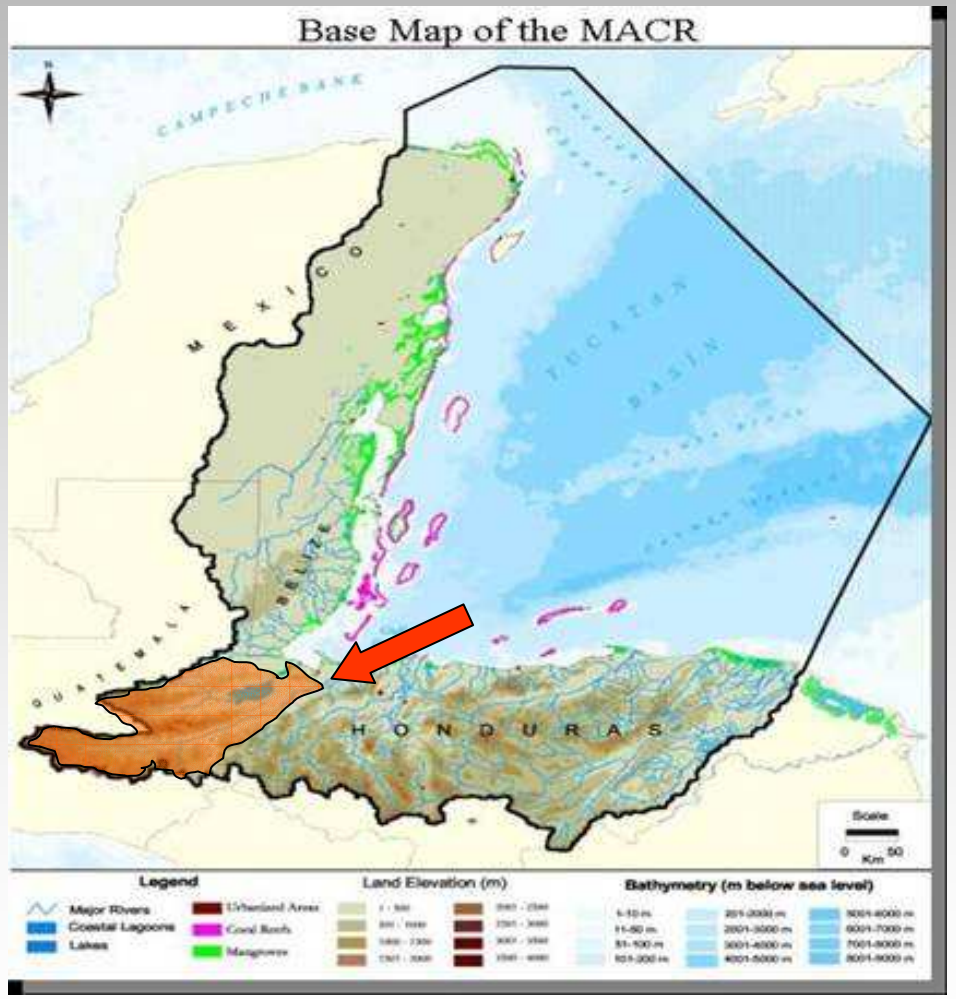


Ricketts, et al. In prep.

Map expected service delivery



Payment schemes (PES)



Upstream: Sierra de las Minas Biosphere Reserve

Downstream: Coke bottling plant, >20 other industrial water users, 500,000 people, coral

Declining water quality, quantity

Guatemala Water Fund

Service Payments

WATER FUND

Compensation to Forest Owners

Conservation Activities

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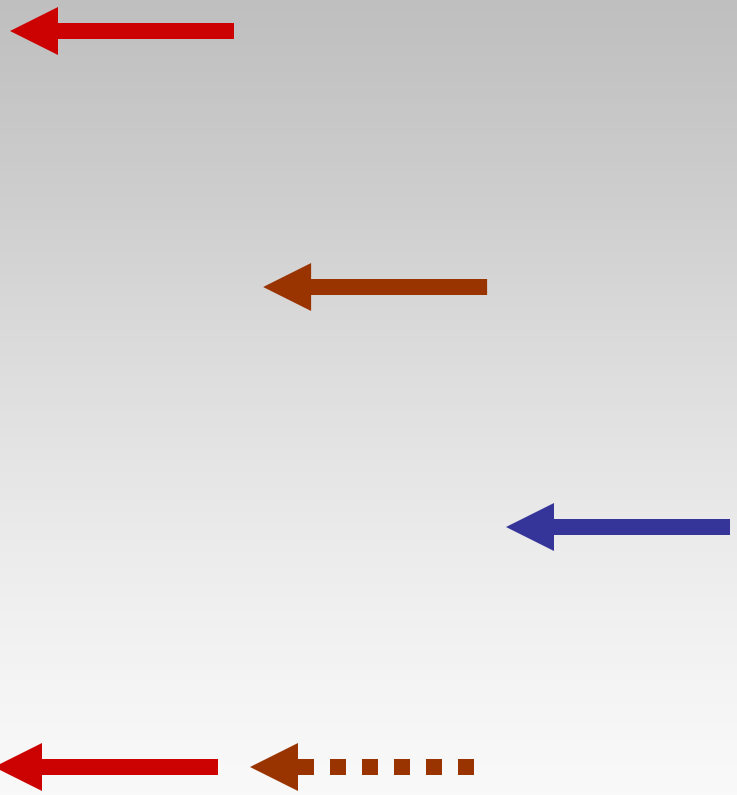
What's needed

MA Coffee Water

- Multiple services ("bundles")
  - Decisions involve trade offs
- Spatially explicit
  - Land use decisions are spatial
- Scales relevant to policy
  - Global, one forest patch less useful
- Interdisciplinary
  - Ecology, economics, and policy



Millennium Assessment Research Frontiers

- Many listed, under:
  - Basic Theory
  - Scale
  - Monitoring and data needs
  - Policy assessment
  - Economic instruments and valuation

- Key among them:
  - "Landscape level quantification of economic values of entire bundle of ecosystem services under alternative management regimes"

Carpenter et al, *Science*, October 2006

Outline

- ✓ Foundations
  - Global assessments
  - Case studies
  - Needs
- The Natural Capital Project
  - Overall goals
  - Mapping tool

The Natural Capital Project

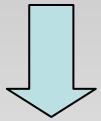
Goal:

Align conservation with economic forces and development goals

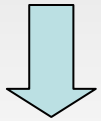
- Provide information, tools to make valuing nature easy
- Incorporate ecosystem services into decisions
- Change the way ecosystems are viewed

Ingredients needed

1. Ecology:
"what's where?"



2. Economics:
"what's it worth?"



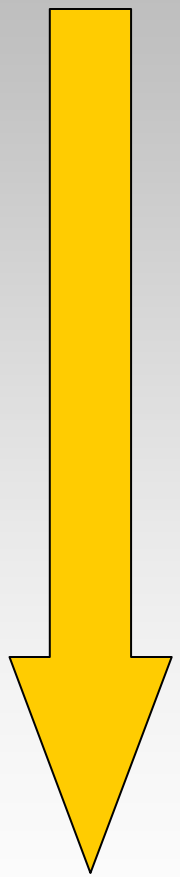
3. Policy & finance:
"who pays and how?"

Natural Capital Project

1. Ecology:
"what's where?"

2. Economics:
"what's it worth?"

3. Policy & finance:
"who pays and how?"



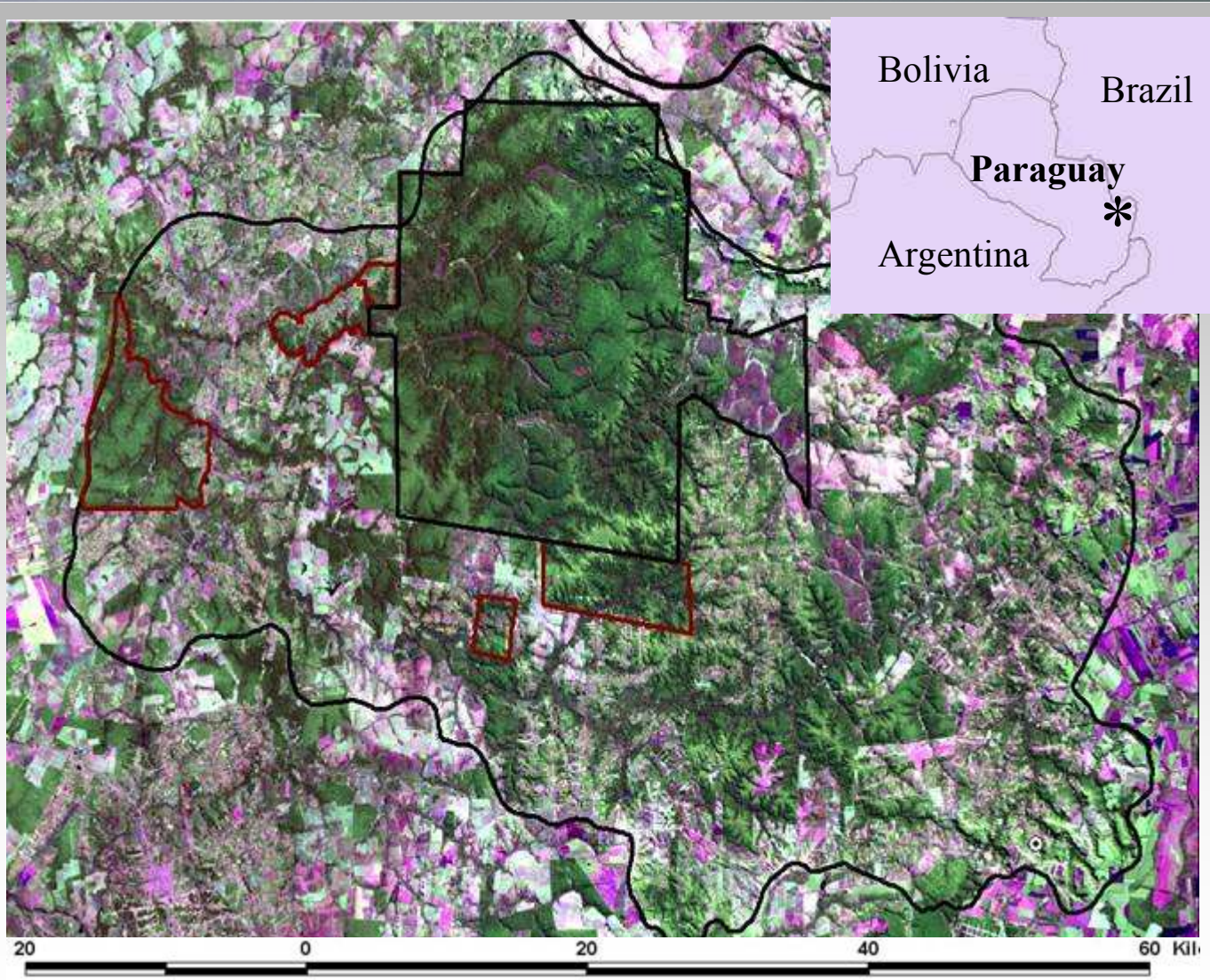
Multiple services

Spatially explicit
- map services, values
- map beneficiaries, flows

Two levels
- develop general tools
- apply them in field

natural capital PROJECT

Pilot #1: Mbaracayu Biosphere Reserve



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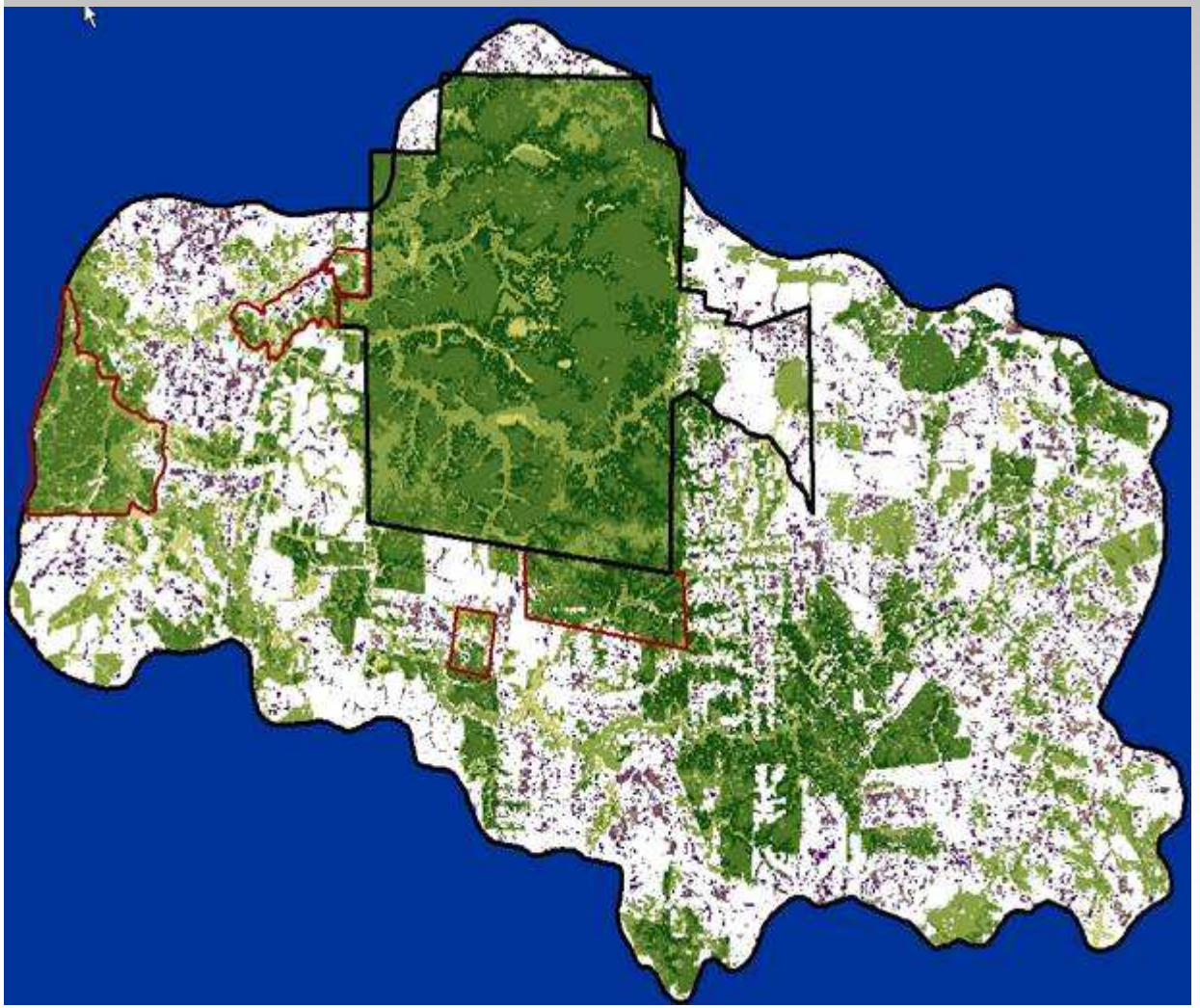
Sustainable bushmeat use

- habitat associations of game spp. (Hill et al. 2003)
- sustainable harvest rates (Robinson and Bennett 1999)
- local market value of domestic meat



Net Present Value ($ / ha)

- 0 - 2.08
- 2.09 - 4.77
- 4.78 - 8.32
- 8.33 - 16.13
- 16.14 - 18.03
- 18.04 - 19.77
- 19.78 - 22.19
- Non-forest

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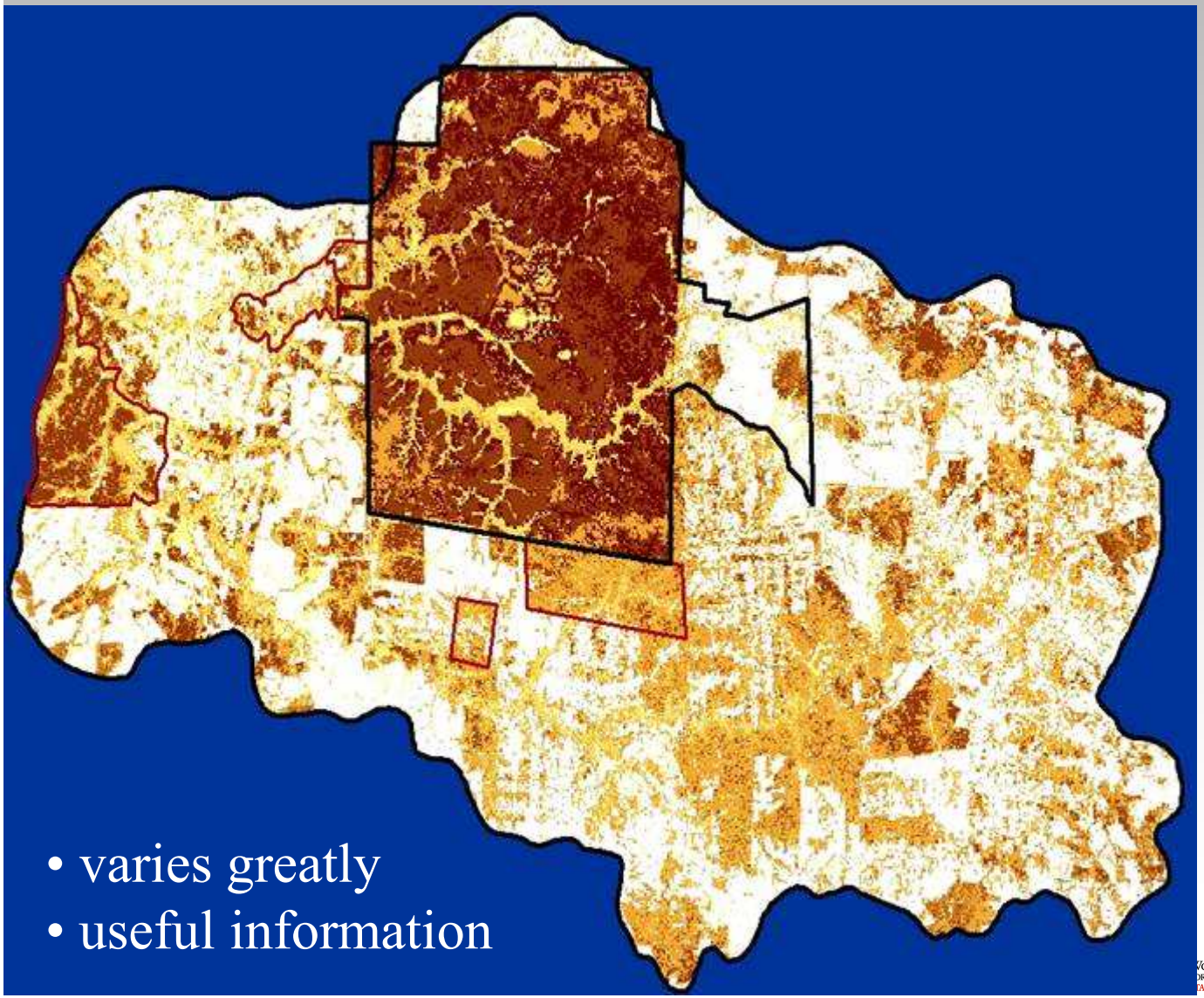
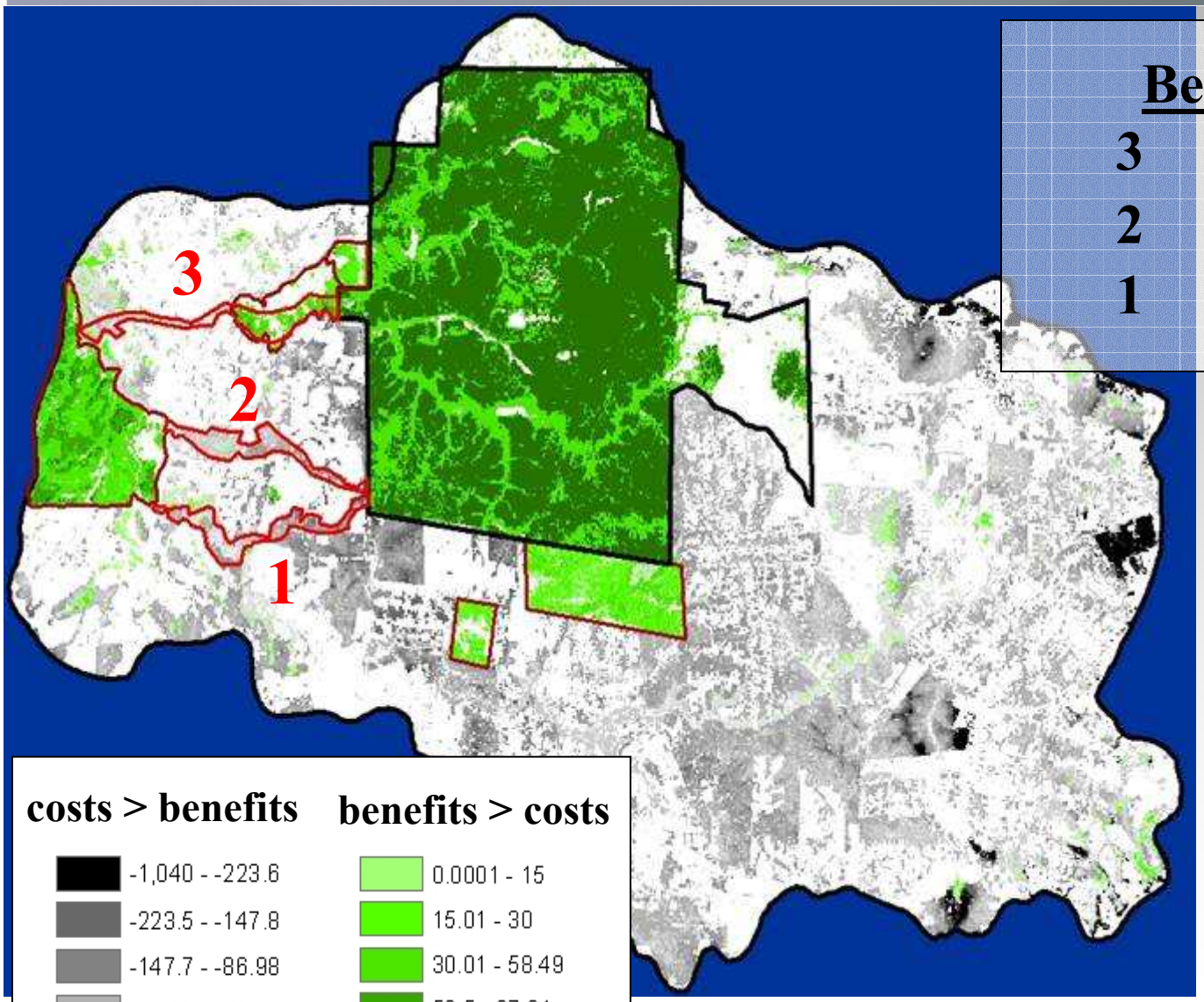
All 5 services



- varies greatly
- useful information

Naidoo and Ricketts. 2006. *PLoS Biology*

Comparing corridor options



	Benefits ($)	B / C
3	34,000	78%
2	55,000	48%
1	58,000	45%

Including only:

- bushmeat
- timber
- pharmaceuticals

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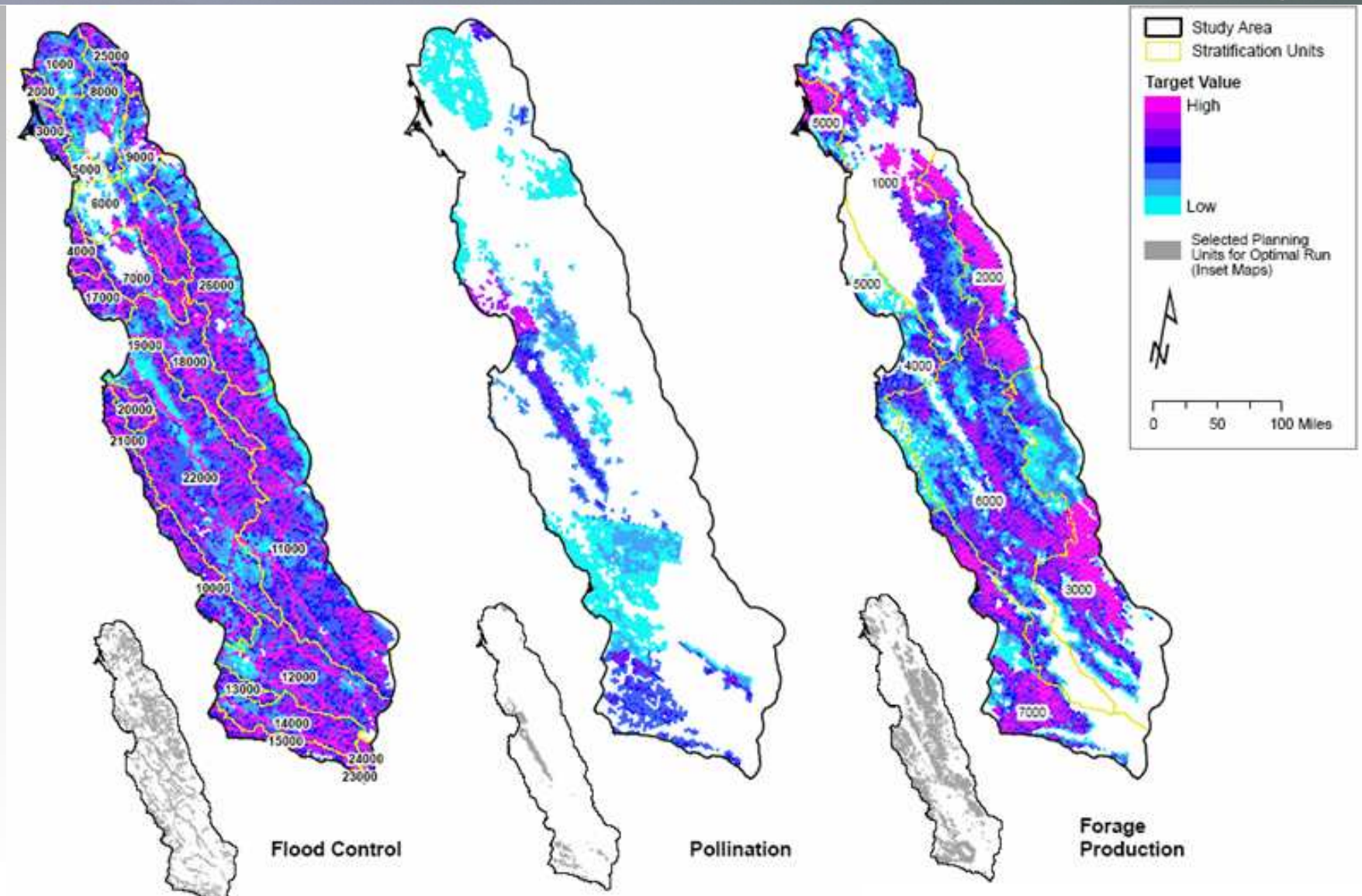
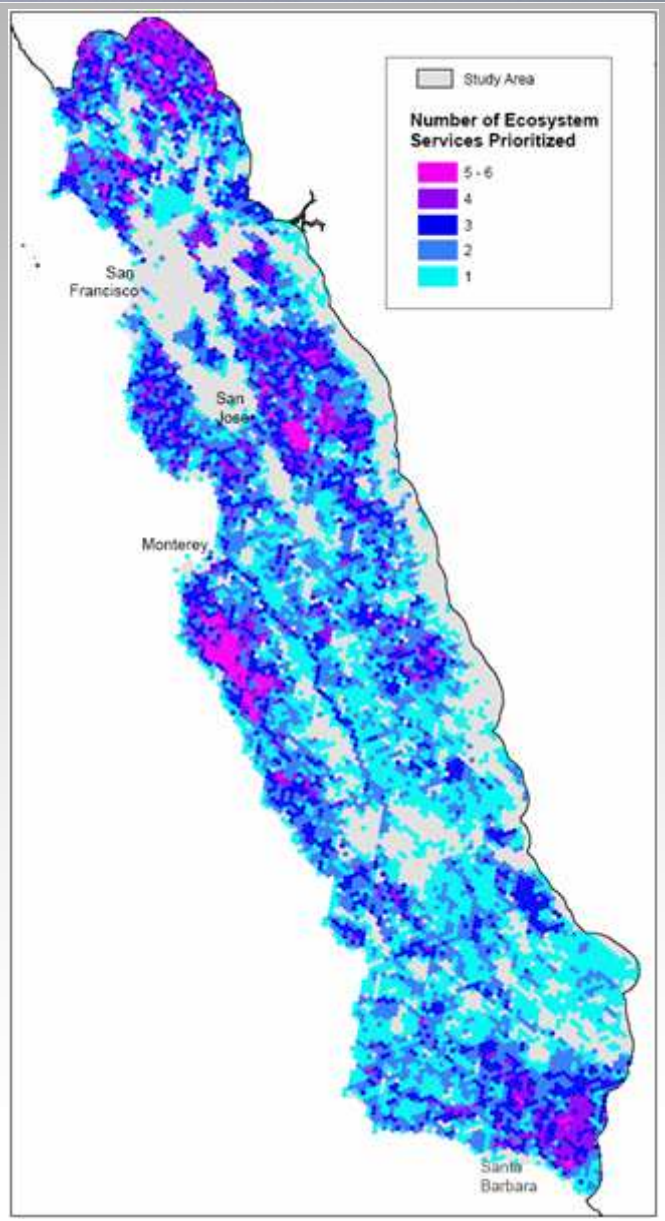
Pilot #2: Central California



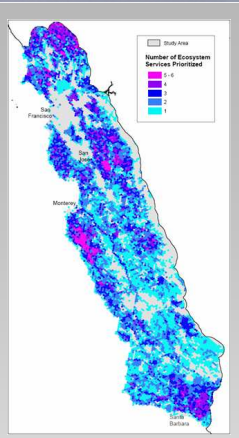
Chan, et al. 2006. *PLoS Biology*

Are goals aligned?

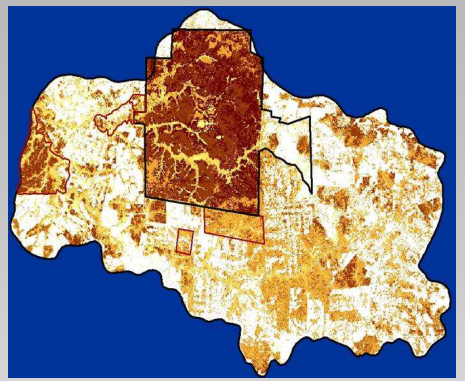


- <10% overlap in the sites best for biodiversity and those best for carbon storage or pollination.
- Optimizing for one service rarely captures high levels of others, or of biodiversity

Building from Pilots



InVEST



(Integrated Valuation of Ecosystem Services and Tradeoffs)

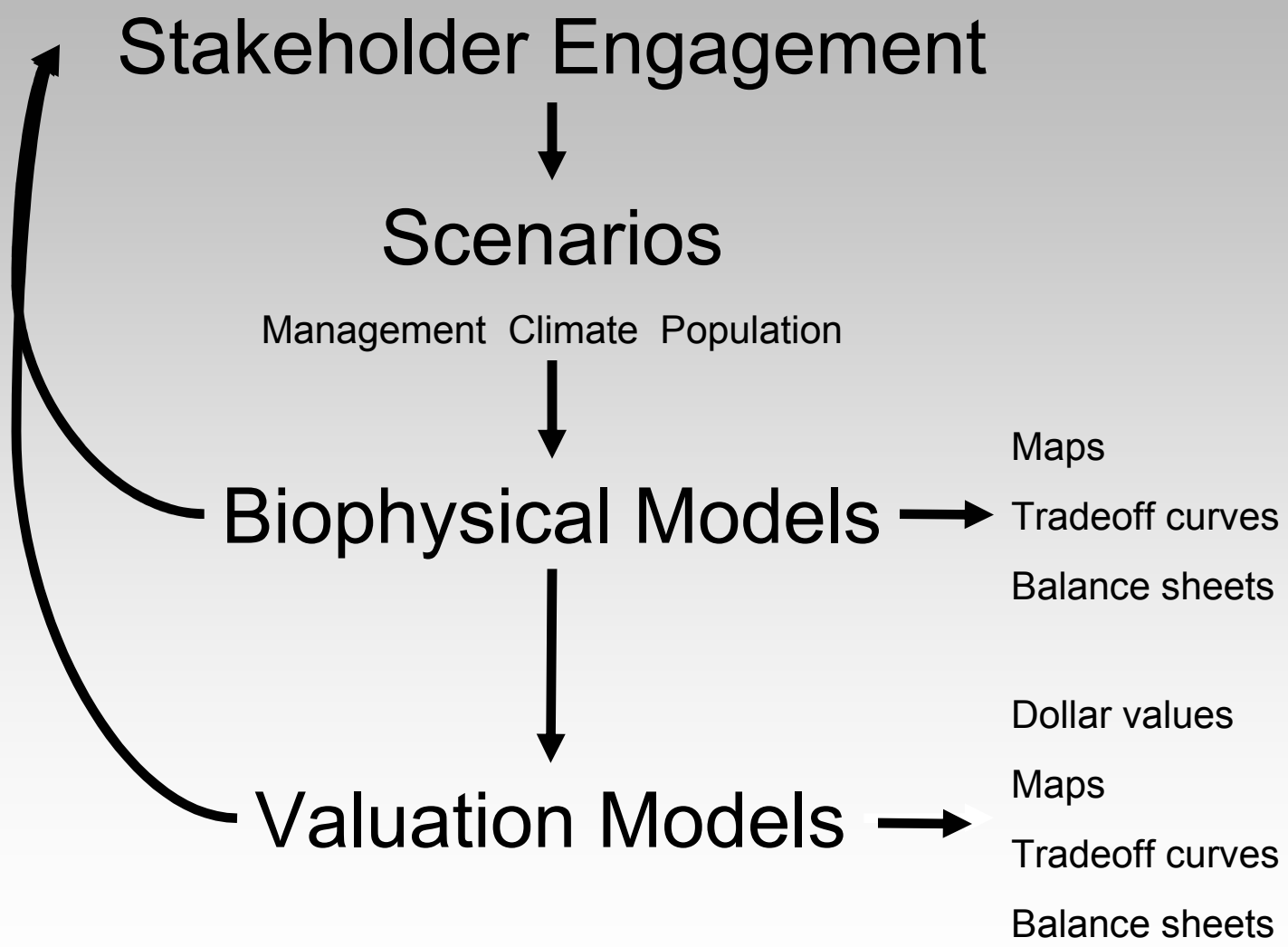
TNC: Peter Kareiva, Rebecca Shaw, Dick Cameron
WWF: Taylor Ricketts, Robin Naidoo
Stanford: Gretchen Daily, Heather Tallis, Guillermo Mendoza

Steve Polasky, Erik Nelson, Eric Lonsdorf, Paul Armsworth, Kai Chan

Questions for InVEST

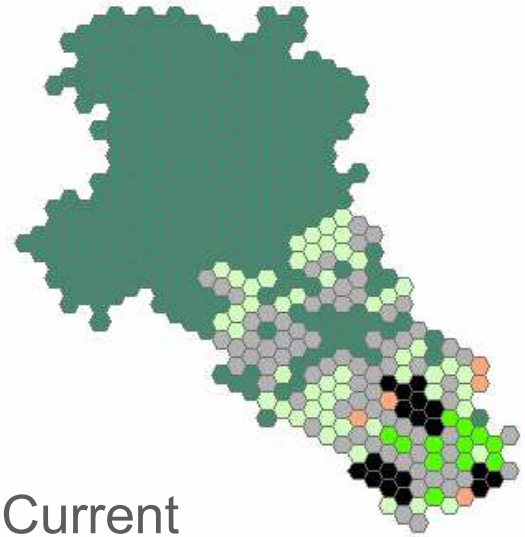
- What places provide the most biodiversity and ecosystem services?
- How would a proposed logging project affect ecosystem service delivery and biodiversity? How about climate change?
- What management configuration would optimize ecosystem services now and under likely changes?
- Who should pay whom under a proposed PES program, and how much?

InVEST

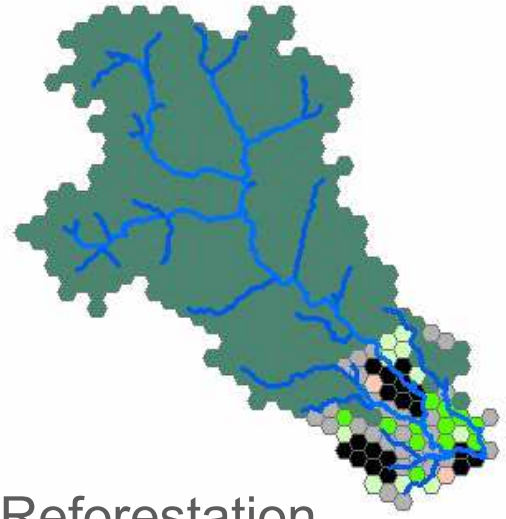

Stakeholder Engagement
Scenarios
Management Climate Population
Biophysical Models
Maps
Tradeoff curves
Balance sheets
Valuation Models
Dollar values
Maps
Tradeoff curves
Balance sheets

Scenarios are maps

- Changes in land cover or management resulting from:
  - Conservation action
  - Climate change
  - Population growth
  - etc.



Current

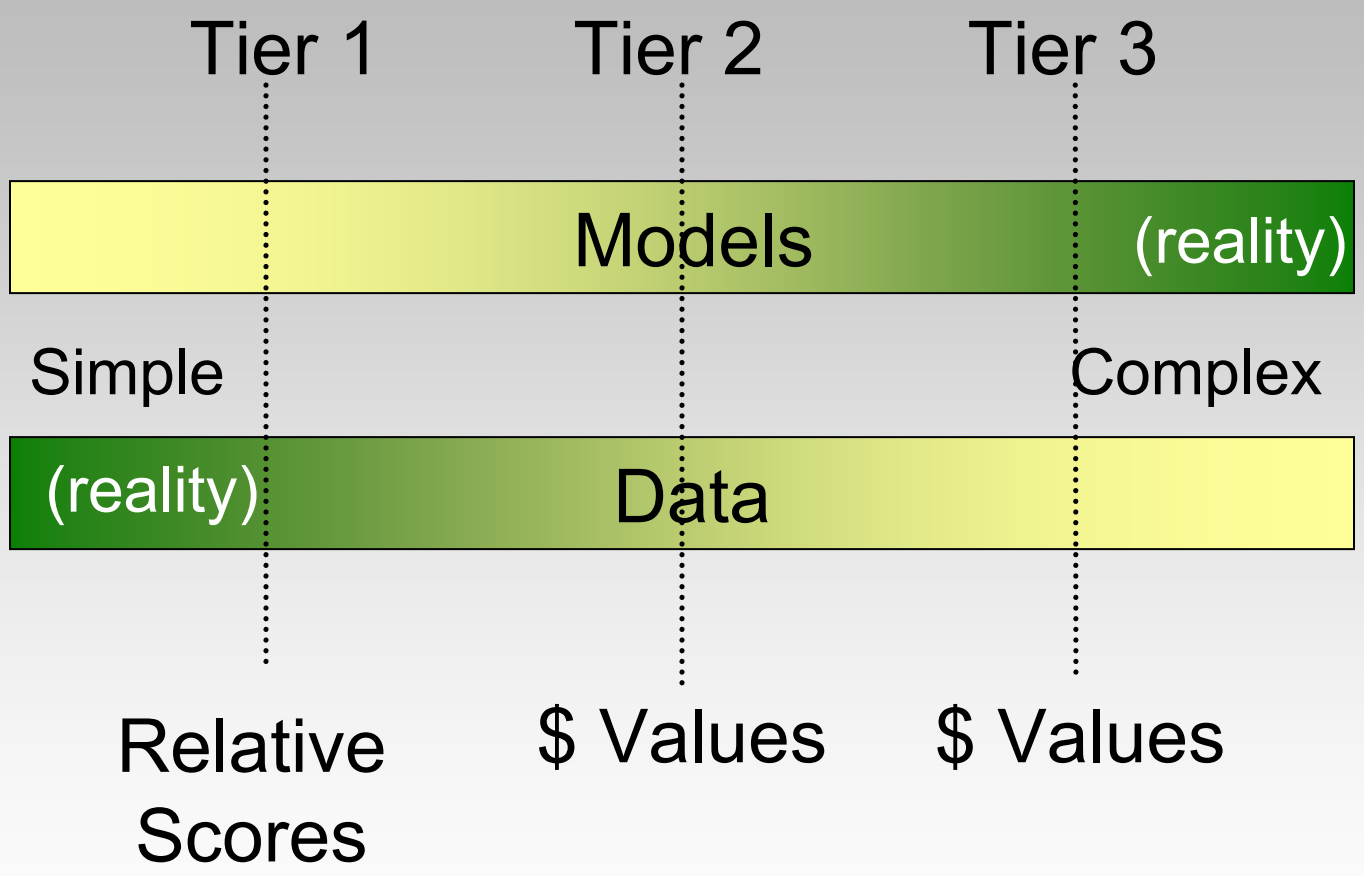


Reforestation

InVEST modules

- Biodiversity
- Pollination
- Carbon Sequestration
- Commodity Production
- Real Estate
- Water quality
- Water quantity and timing
- Recreation
- Cultural and Non-use

Tiered Approach



Field Application

Test driving the tools

We had:

- Core mapping team
- Field teams from Tanzania, California
- Service experts
- Preliminary data
- v.1.0 of models
- 5 days

How far did we get?

Eastern Arc Mountains

Biodiversity:

- Vertebrates: 93 Endemic, 72 threatened
- Plants: >1000 endemic, ~1000 threatened
- High deforestation pressure

Ecosystem services

- Water: 50% of power, 10-25% of drinking
- Flood control
- Carbon storage
- Non-timber forest products ($100/person/year)

Biodiversity (tier 2)

- Species richness & rarity index based on:
  - Land cover map
  - Species distributions
  - Land cover suitability for each species
  - Spatial rarity of each species

  - Developed at the meeting

Carbon storage

- Based on:
  - Land cover distribution map
  - Storage value for each land cover (above-ground, below-ground, and soil)

VEGCODE	VEGTYPE	AG C (tons C/ha)	BG C (tons C/ha)	soils C (tons C/ha)	Total	Notes
Airport	Airport	0	0	0	0	Expert opinion
BSL	Bare Soils	0	0	10	10	Expert opinion
Gb	Bushed Grassland	5	1	20	26	Expert opinion
Gbs	Bushed Grassland Seasonally Inundated	10	2	25	37	Expert opinion
B(et)	Bushland with Emergent Trees	20	5	20	45	Expert opinion
BSc	Bushland with Scattered Cropland	10	2	15	27	Expert opinion
Wc	Closed Woodland	60	15	35	110	from ipcc
Cbc	Cultivation with Bushy Crops	5	1	15	21	Expert opinion
Chc	Cultivation with Herbaceous Crops	0	0	12	12	Expert opinion
Ctc	Cultivation with Tree Crops	10	2	20	32	Expert opinion
Bd	Dense Bushland	25	6	20	51	Expert opinion
GSc	Grassland with Scattered Cropland	0	0	12	12	Expert opinion

Timber & NTFPs

- Based on:
  - Land cover suitability
  - Pressure index (accessibility and population density)
- Assigned relative stock value for 8 products:
  - Fuel wood (charcoal and fire wood)
  - Construction (poles and timber)
  - Non-use products (medicinal plants, hunting, mushrooms and pet trade)

How far are we?

Now Next

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"what's where?"

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Similar efforts

- Nicholas Institute:
  - Tools for Joint Production of Ecosystem Services
  - www.env.duke.edu/institute/pastevents.html
- The Gund Institute:
  - Ecosystem Service Dynamics, Modeling and Valuation to Facilitate Conservation
  - www.uvm.edu/giee
- Research Triangle Institute:
  - Multiple ecosystem service modeling projects
  - www.rti.org/index.cfm

Other resources

- Natural Capital Project website
  - www.NaturalCapitalProject.org
- Fuller Symposium on Ecosystem Services (Oct. 2006)
  - www.worldwildlife.org/fellowships/fuller_symposium_2006.cfm
- Ecosystem Marketplace
  - www.ecosystemmarketplace.com
- Millennium Ecosystem Assessment
  - http://www.maweb.org
- Papers cited in this talk
  - Available from Amanda or me

Thanks…