

# The Economics of Ecosystems and Biodiversity from local Services to Global Values

(Ru)dolf de Groot

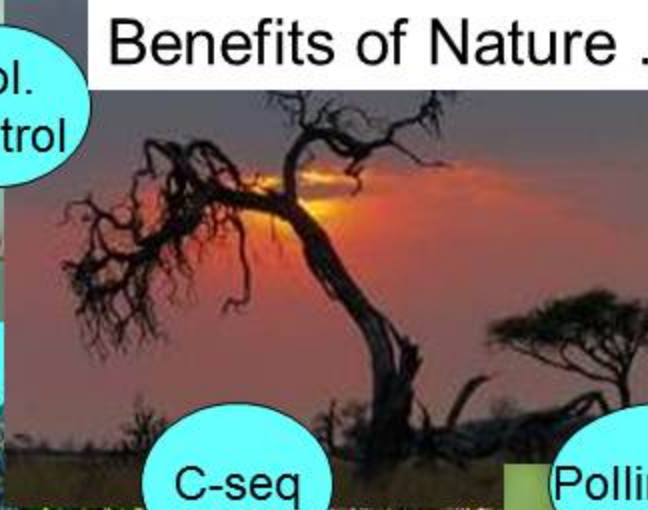
Environmental Systems Analysis Group (ESA),  
Wageningen University, The Netherlands

Ecosystem Services, Human Values & Global Change,  
Public conference, Prague, 24-27 April 2012



# Benefits of Nature ....

Biol. control



Recreation



Habitat & nursery

C-seq

Pollination



Air quality



**Value ??**

Inspiration



Water



Medicines & models

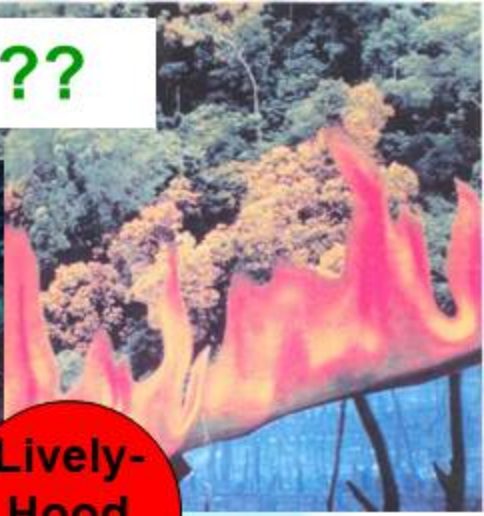
Food



# “Priceless” but Valuable ..... ??



Flooding cost



Lively-Hood loss



Water pollution cost



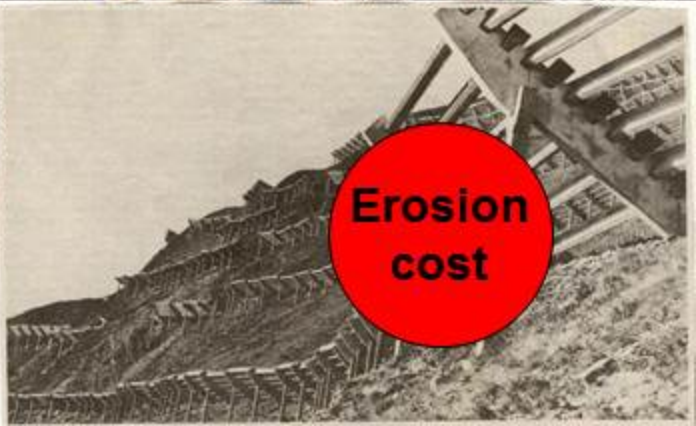
Cost of ecosystem loss 2-5% of GDP per year (*Science*, 2002)  
(damage-costs, replacement & restoration costs, etc)



Air pollution cost



Crop loss



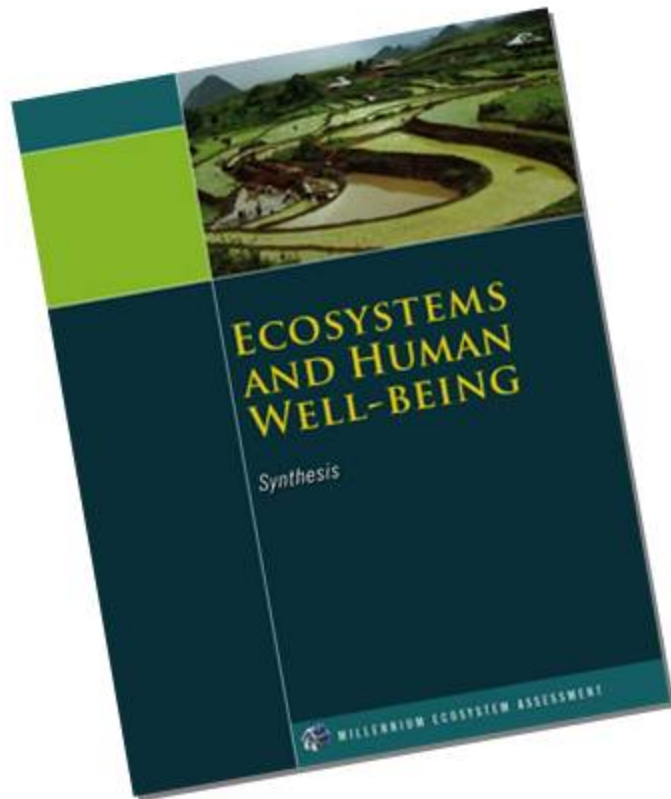
Erosion cost

# Global Assessments

Millennium Ecosystem Assessment

2001 – 2005

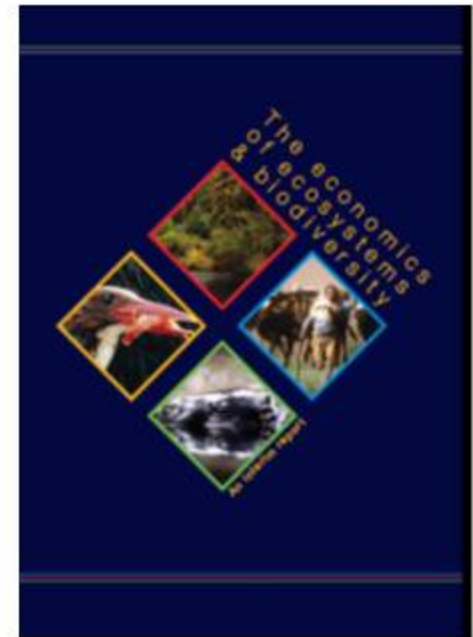
[www.maweb.org](http://www.maweb.org)



TEEB study

2008-2010+..

([www.teebweb.org](http://www.teebweb.org))

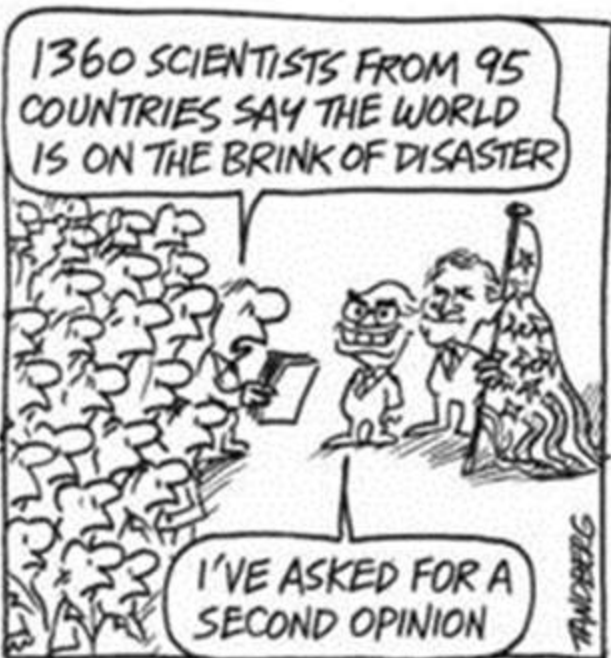


# The Economics of Ecosystems & Biodiversity

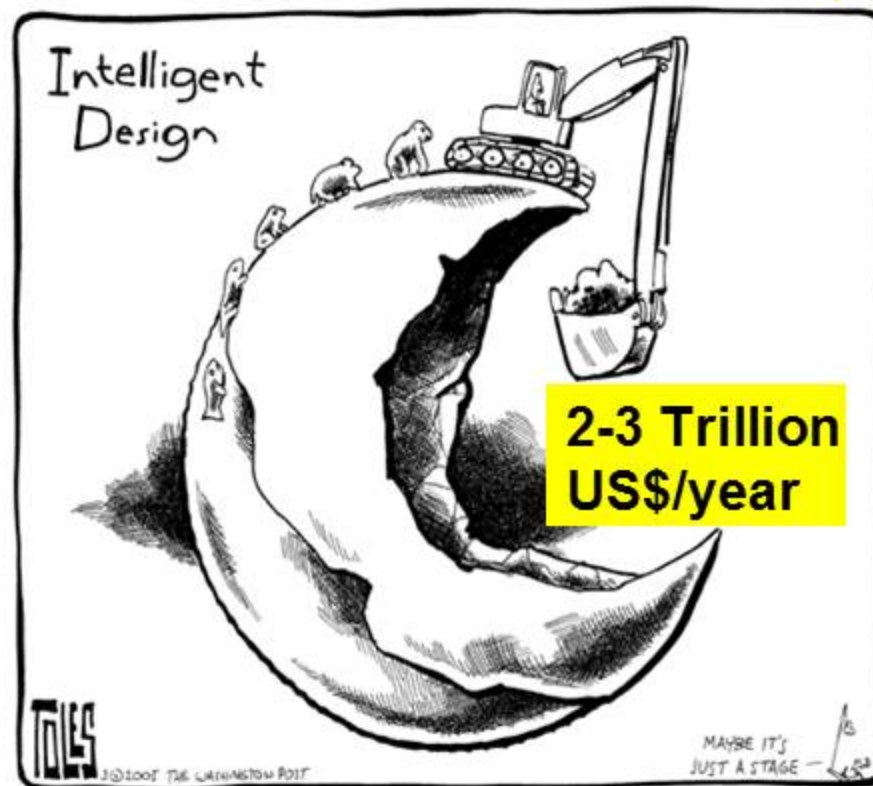


Millennium Ecosystem Assessment:

➤ 60% of ecosystem services are in decline



The Australian, 30 March 2005



## Nature loss 'dwarfs bank crisis'

By Richard Black

Environment correspondent, BBC News website,  
Barcelona

9 Oct 2010

09 Oct

# The Economics of Ecosystems & Biodiversity



 HELMHOLTZ  
CENTRE FOR  
ENVIRONMENTAL  
RESEARCH - UFZ

“Society must urgently **replace its defective economic compass** so that it does not jeopardize human well-being and planetary health through the under-valuation and consequent loss of ecosystems and biodiversity.”

Pavan Sukhdev, TEEB Study Leader  
29.5.2008, CBD COP9



[www.teebweb.org](http://www.teebweb.org)





2008 – 2010 [www.teebweb.org](http://www.teebweb.org)

Potsdam 2007-Meeting of the Environmental Ministers of the G8+5

## “Potsdam Initiative – Biological Diversity 2010”

*The economic significance of the global loss of biological diversity*

- analysing the global economic **benefit of biological diversity**,
- the **costs of the loss of biodiversity** and
- the **failure to take protective measures versus the costs of effective conservation.**

Stern (2006):

“Invest 2% of GDP/year to avoid damage of 20%”

**Sponsors:** UNEP & EU  
Germany + several other EU  
Countries (& Japan)



COP 10 MOP 5  
Nagoya, Japan 2010

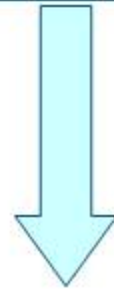
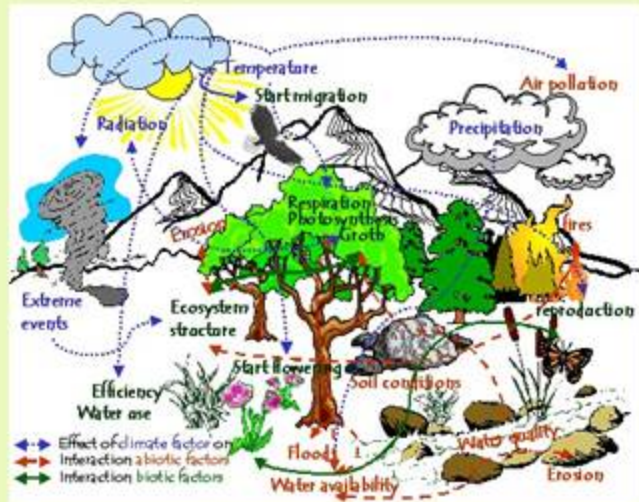
Life in Harmony, into the future  
いのちの共生を、未来へ



# Linking Biodiversity and Human Wellbeing

**Institutions & human judgments** determining (the use of) services

## Ecosystems & Biodiversity



## Service

(eg. flood-protection, products)



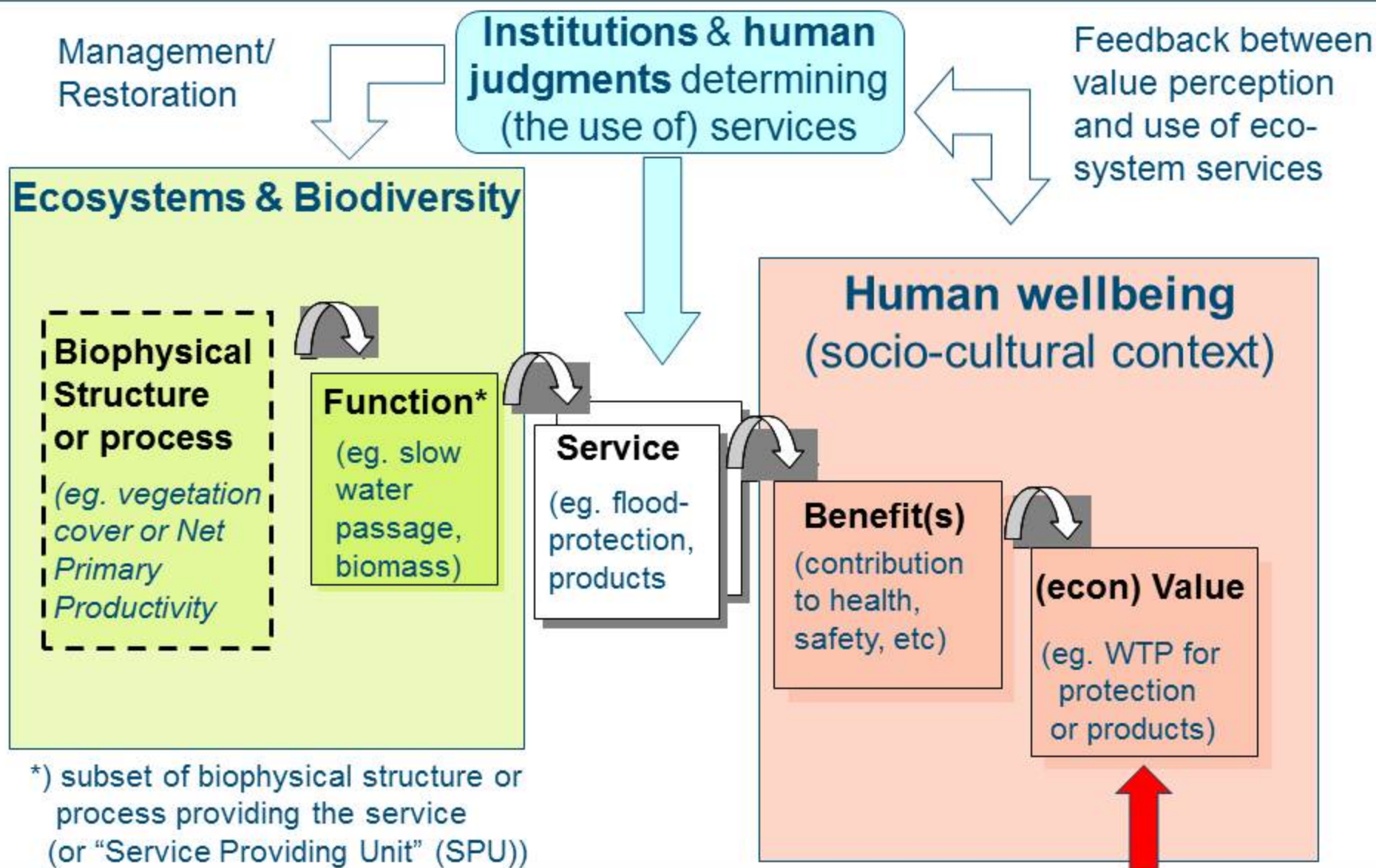
## Human wellbeing (socio-cultural context)

- Health
- Safety
- Livelihood





# Linking Biodiversity and Human Wellbeing



# How measure economic (monetary) value ?

## 1. Market Price



Food

(eco)tourism



## 3. Questionnaire based

Spiritual value /habitat service



**WTP** for protecting Humpback Whales:  
57 \$/pp/year (1993)

## 2. Shadow Price

Water purification **Replacement cost**



**Replacement Cost:**  
Artificial treatment would cost **2.000 \$/ha/year**

**Pollination:**



"It takes 20-25 people to Perform the work of two bee-colonies"

Coastal Protection



**Avoided damage Cost:** 36 million \$ (Maldives-2004).

**Replacement cost** 10 million \$/km

# The Economics of Ecosystems & Biodiversity



## Total Economic Value of Tropical Forest

6.000 US\$/ha/y

Ecosystem Service	D Value	27%	In Value	66%	Use No Value #	7%
<b>TOTAL: 5,935 US\$/ha/year (n = 132)</b>	1,666	79	3,890	40	397	12
<b>PROVISIONING SERVICES</b>	1,285	59				
1 Food	67	21				
2 Water	143	3				
3 Raw materials	412	27				
4 Genetic resources	483	4				
5 Medicinal resources	181	4				
6 Ornamental resources						
<b>REGULATING SERVICES</b>			3,890	40		
7 Influence on air quality			230	2		
8 Climate regulation			2,191	11		
9 Moderation of extreme events			63	3		
10 Regulation of water flows			18	4		
11 Waste treatment / water purification			177	6		
12 Erosion prevention			694	9		
13 Maintenance of soil fertility			508	3		
14 Pollination			10	2		
15 Biological control			9	1		
<b>HABITAT SERVICES</b>					397	12
16 Lifecycle maintenance (esp. nursery service)					13	1
17 Maintenance of genetic diversity (gene pool prot.)					397	12
<b>CULTURAL SERVICES</b>	381	20				
18 Aesthetic information						
19 Opportunities for recreation and tourism	381	20				
20 Inspiration for culture, art and design						
21 Spiritual experience						
22 Information for cognitive development						

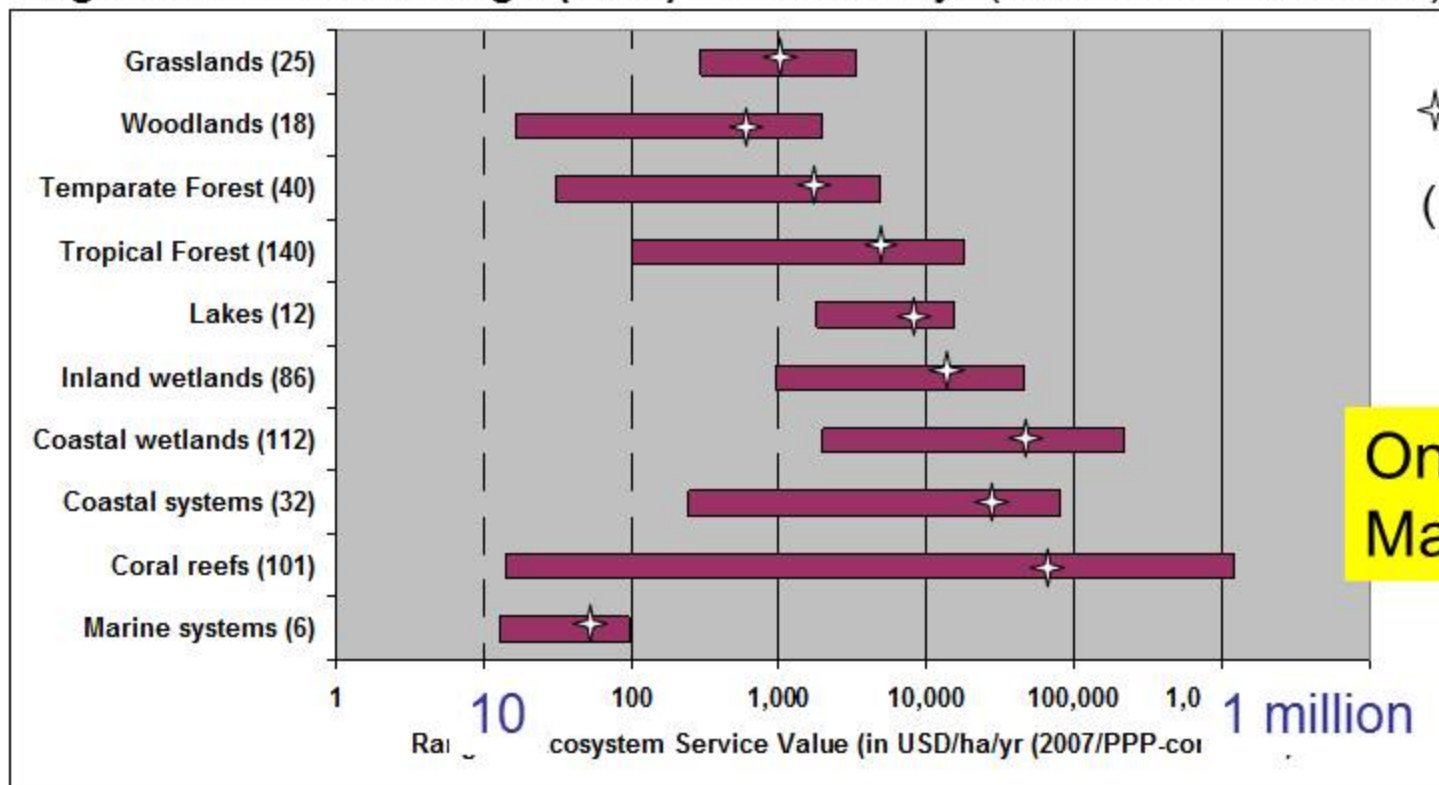


Clearcut brings  
one-time profit  
of ca 5.000 \$/ha

# The Economics of Ecosystems & Biodiversity



Log-scale of value range (TEV) in US\$/ha/yr (2007 PPP corrected)



✦ = Average value  
 () = number of used estimates (600 out of > 1300)

Only 25-30% Market values

Woodlands

**776** US\$/ha/yr [raw materials & water regulation]

Mangroves

**46,239** US\$/ha/yr [water purification & nursery]

Coral Reefs

**92,775** US\$/ha/yr [tourism & storm protection]

# Total (Economic) Value of Ecosystems



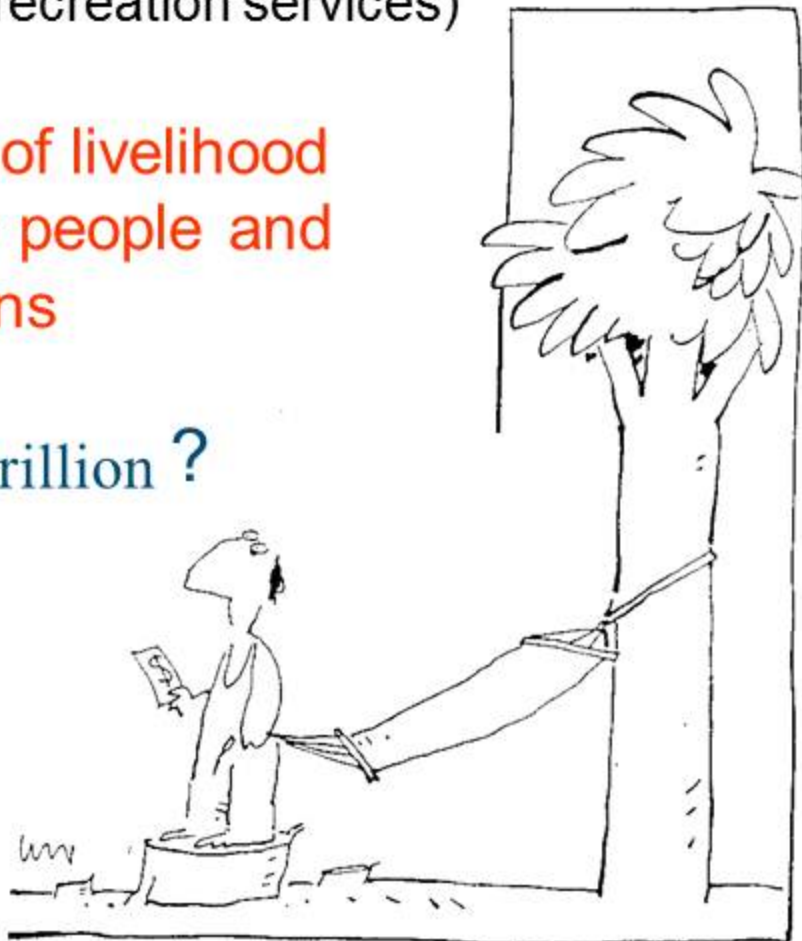
Only about 20% “in the market”  
(some provisioning & recreation services)

-> live at expense of livelihood  
& health of poor people and  
future generations

Total: 33 trillion ?

(Coast.)Wetlands	10.000 - 30.000 \$/ha/y
Forests (tropical)	1.000 - 4.000 \$/ha/y
Drylands	200 - 300 \$/ha/y

(Costanza et al, 1997, WWF, 2002, etc)



“Total Value of the World’s Ecosystem Services and Natural Capital”

# Trade-offs among ecosystem services

mangroves:

46.239 US\$/ha/yr [waste treatment & nursery]

Private benefits <-> public costs



## Mangrove Services:

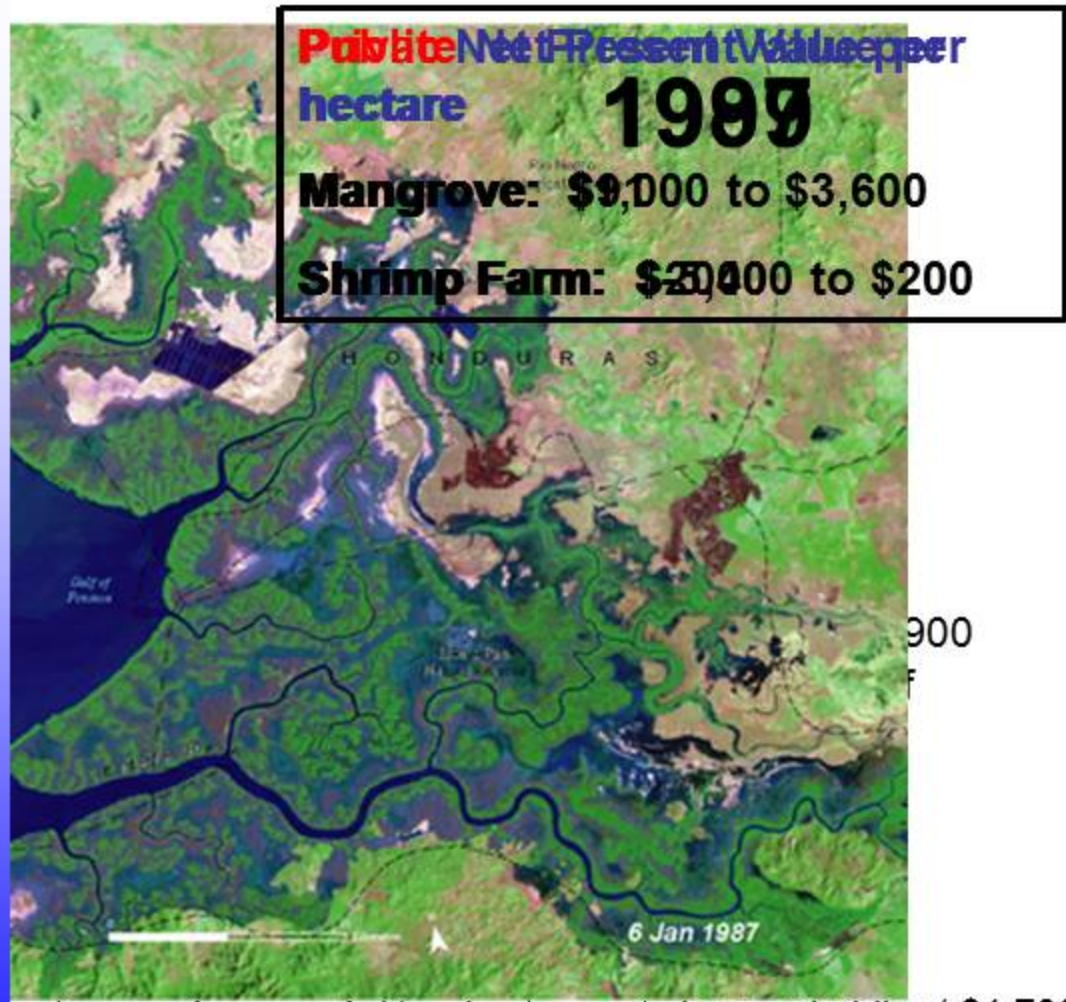
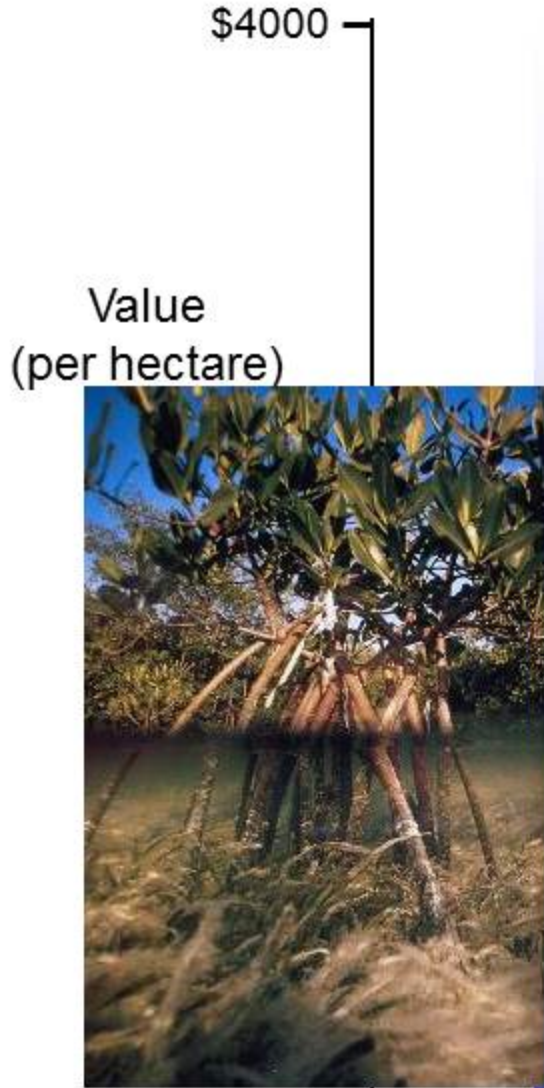
- nursery and adult fishery habitat
- fuelwood & timber
- carbon sequestration
- traps sediment
- detoxifies pollutants
- protection from erosion & disaster

Source: Millennium Ecosystem Assessment (2005)



*NPV Mangrove Mexico 600.000 US\$/ha  
sold for recreational development  
for 1.000 US\$/ha (Nature, 2008)*

# Private benefits <-> public costs



Source: Millennium Ecosystem Assessment; Sathirathai and Barbier 2001

# Conversion <-> sustainable management: “honest” CBA

## Net Present Value/ha



“The **total economic value** of managing ecosystems more sustainably is often higher than the value associated with conversion”



Balmford et al (2002, Science Vol 297)  
„Economic reasons for conserving wild nature“



# Why continues ??

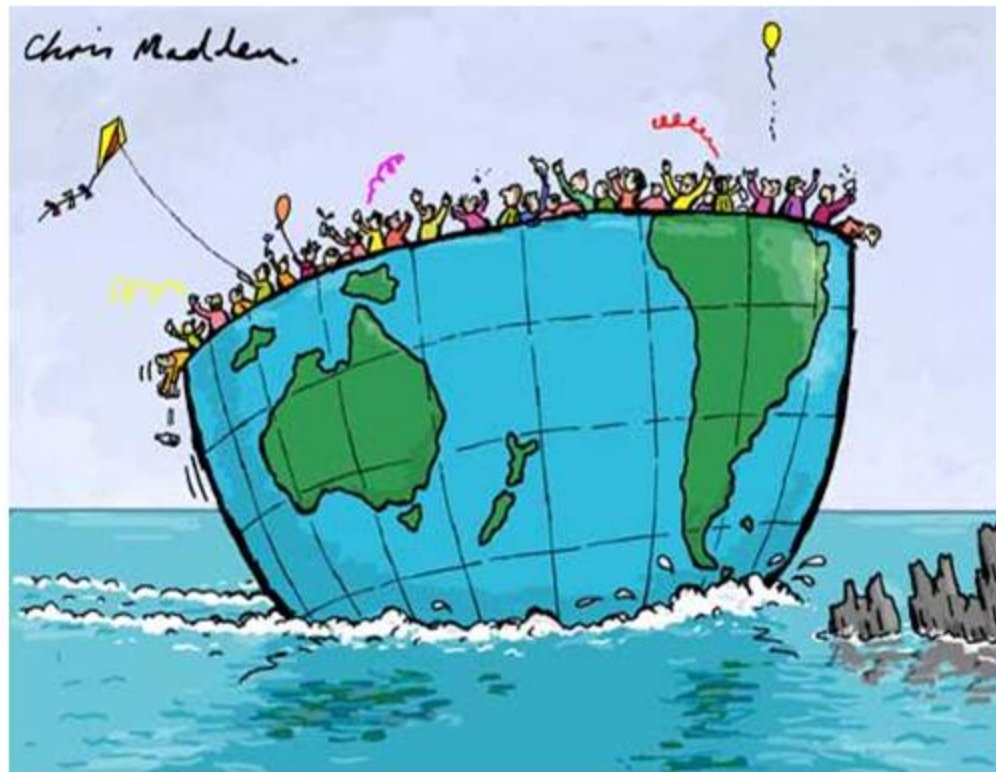
„Society must urgently replace its defective economic compass“  
(Pavan Sukhdev, TEEB study leader, 2007)

## “Out-dated economics”

- “Free” services” (75%)
- Neglect of externalities
- Perverse subsidies
- Wrong assumptions (paradigms) about people & markets

Lack of data and not easily accessible

=> Fragmented knowledge



THE SHIP OF FOOLS AND THE ROCKS OF  
SHORT-TERM ECONOMIC PLANNING

# Guidelines & Standards -> Case studies

To implement ES in policy and practice (and change economic 'logic') we need guidelines and standards based on examples of 'good practice'



Workshop tomorrow

Global Network of "case studies & learning sites" where ecosystem service assessments are put into practice



- IUCN/CEM  
("ecosystem approach")
- CI, WWF, Stanford:  
(Natural Capital Project/InVest)
- and many others



# ESP Biome Expert Groups

Contribute to the further development of the **Ecosystem Service Value Database (ESVD)** [provide new, empirical data, check existing data]

Contribute to the development of a **Global Network of field sites** [with IUCN-CEM]

Serve as a **Review Committee** for the ESVD and contribute to intern. assessments (eg. TEEB Nat. studies, Sub Global Assessment (follow-up MA), IPBES).

	Biome	WG Lead(s)* NB: for details, see separate Biome-files	Remarks/ related networks / case
1	Marine/Open Oceans	Linwood Pendleton (USA), [Tropical] Salman Hussain (UK). [Temperate]	(DEMM, VECTORS), (Stanley) MESP
2	Coral reefs	Pieter van Beukering (NL) Luke Brander (UK/ HongKong)	
4	Coastal wetlands	Piran White (UK) Luke Brander (NL/ Hong Kong)	Spalding)/WI e Capital)
7 & 8	Forests (Temp & Tropical)	Alistair McVittie (UK) Mike Christie (UK)	



# Case study: Ecosystem Restoration Baviaanskloof

## Multi-functional use

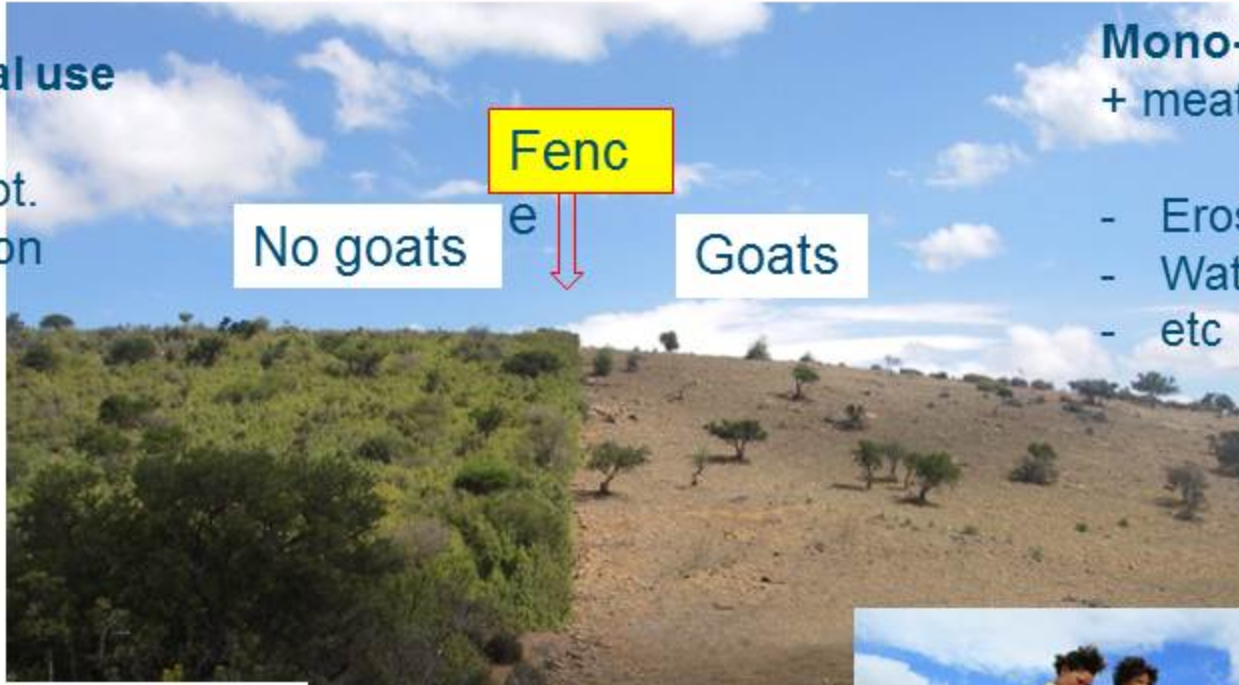
- + sust. grazing
- + watershed-prot.
- + C-sequestration
- + (eco)tourism
- + etc.

= .....US\$

## Mono-functional use

+ meat & mohair

- Erosion
- Water-shortage
- etc



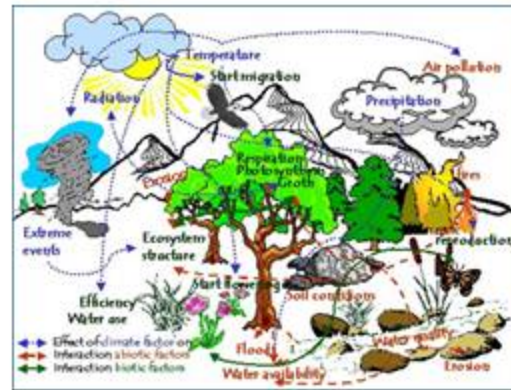
## 'learning village' & nursery



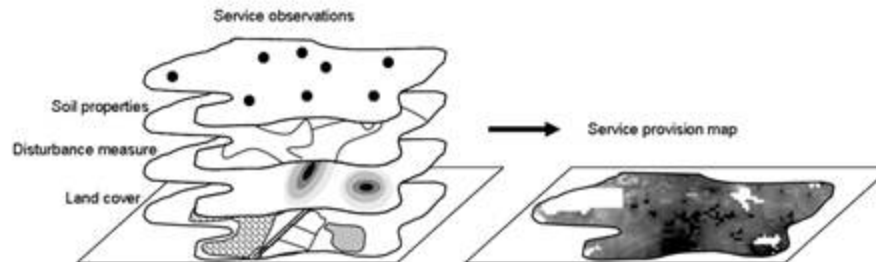
“Working for Woodlands”  
“Working for Water & Food”

# Some challenges [this afternoon ...]

Need for good Indicators  
(to determine ES-capacity)



Mapping & Modelling  
(trade-off analysis & upscaling)



Awareness raising  
Ecological Footprint



# Indicators: How quantify Services (and Functions)

Function ->  
State Indicators

Actual Service ->  
Performance Indicators

Influence of vegetation (forests) on air quality



Capacity of an average broadleaved forest in the Netherlands to filter aerosols (dust particles) is **30-70 Tons/ha/year**

Leaf Area Index

No. of dust particles captured

<u>Concentration</u>	<u>parts/M<sup>3</sup></u>
- in forest	500
- in open field	5.000 (10x)
- in industrial area	> 10.000 (20x)

or  
Air quality

# sustainable use/thresholds

How many bees & birds can we lose ...?



How much wood can we cut ...?

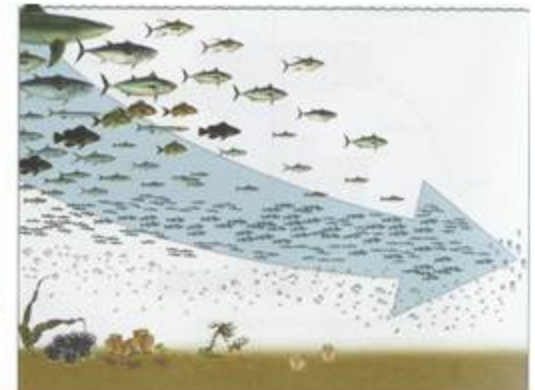
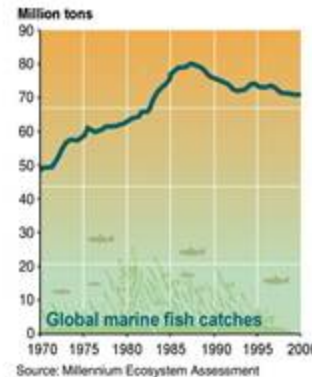
(or how much can we pollute the air ...)

## Thresholds and tipping points ?

How much coral can we destroy ...?



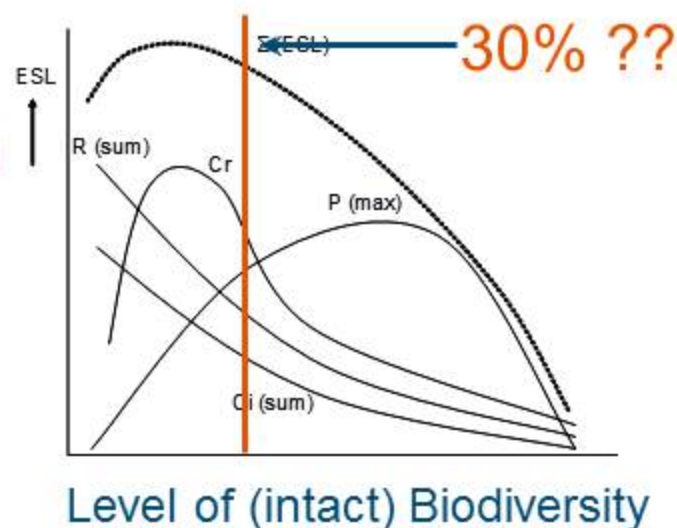
How much fish can we catch ...?



# What is the role of biodiversity in ecosystem services?

Service Providing Unit (SPU)  
(Luck et al, 2003)  
[www.rubicode.net](http://www.rubicode.net) (2006-2009)

**Local:** how many Bleu Jays do we need to maintain the (oak) forest ...?



(& impact of management / LU change)

**Regional -> global:**  
Where is tipping point  
before we loose (most/  
essential) services ..?



# Conservation still seen as a cost ...

Expenditures on all Protected Areas (2002): 6-9 billion \$/y  
**needed 45-50 billion \$** (1 [incl. 5-19 billion \$/y for Marine PA]

Valentines day in USA 2005: 13 billion US\$

and on cigarettes 2009: 50 billion US\$



**Benefits:** >> 1,5 - 4,5 trillion\* (return 1: 30-100)



## How turn value into real money ...?



- Reward providers of “free services”
- Make “polluter” pay for biod. loss
  - Carbon credits (800 US\$/ha/y)
  - PES (payment for use of ES)
  - REDD (conservation payments)
  - Etc.

### Policy Measures (TEEB D1 & D2)

- Adjust **taxing and subsidy-system** (farming for nature, green investments etc)
- Adjust **SEEA, Greening GDP** (or better replace by other welfare-measures)
- From CDM to **Green Development Mechanism** (compensate loss of biod)

### Awareness raising / TEEB for consumers (D4)

- Fair prices, eg. Eco-labelling (e.g Fair Trade, FSC, MSC)



# The Economics of Ecosystems & Biodiversity



Make biodiversity a business case (TEEB D3-report)

## Business opportunities:

- (eco) tourism
- Resources (food, water, etc)
- Pharmaceutical products
- Biotechnology/bio-mimicry (nature as "model")



IWOKRAMA

800.000 US\$ profit in 2008



**Investing in nature (restoration) pays !**



**„Every dollar invested .... saves anywhere between 7,5 and 200 US\$ in damage & repair costs“**  
TheEconomist  
(23 April 2005)



[www.ES-partnership.org](http://www.ES-partnership.org)