The concept of Total Economic Value and its application in Cost-Benefit Analysis

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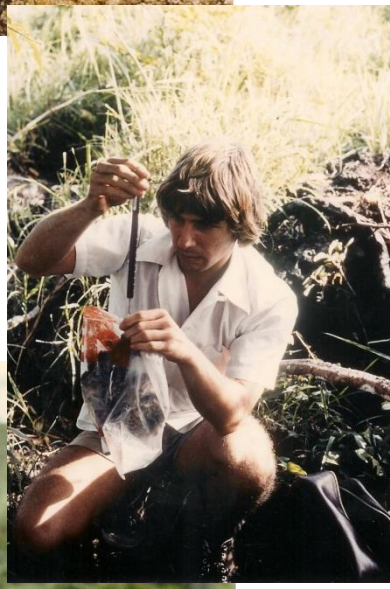
MSc Biology – Landscape Ecology (Utrecht Univ.)

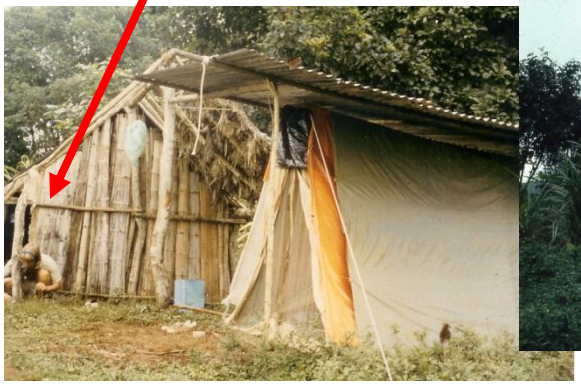
1978- 1980: Galapagos (Ecuador)

me ..



„Ecology of Galapagos owls“ (79-80)

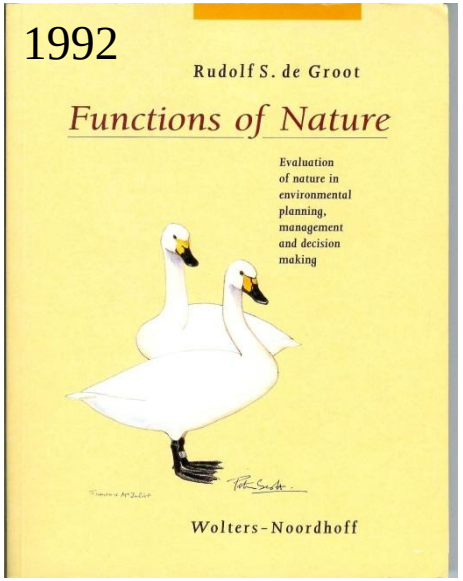
me again ..



PhD: how combine conservation and economic development ?

Increasing visitor numbers & (income)

Need to better understand the **full value** (ecological, AND socio-economic) of conserving natural ecosystems



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NEED MORE COMPLETE (HONEST) COST-BENEFIT ANALYSIS

"Pristine"

Multi-funct.

Extensive use

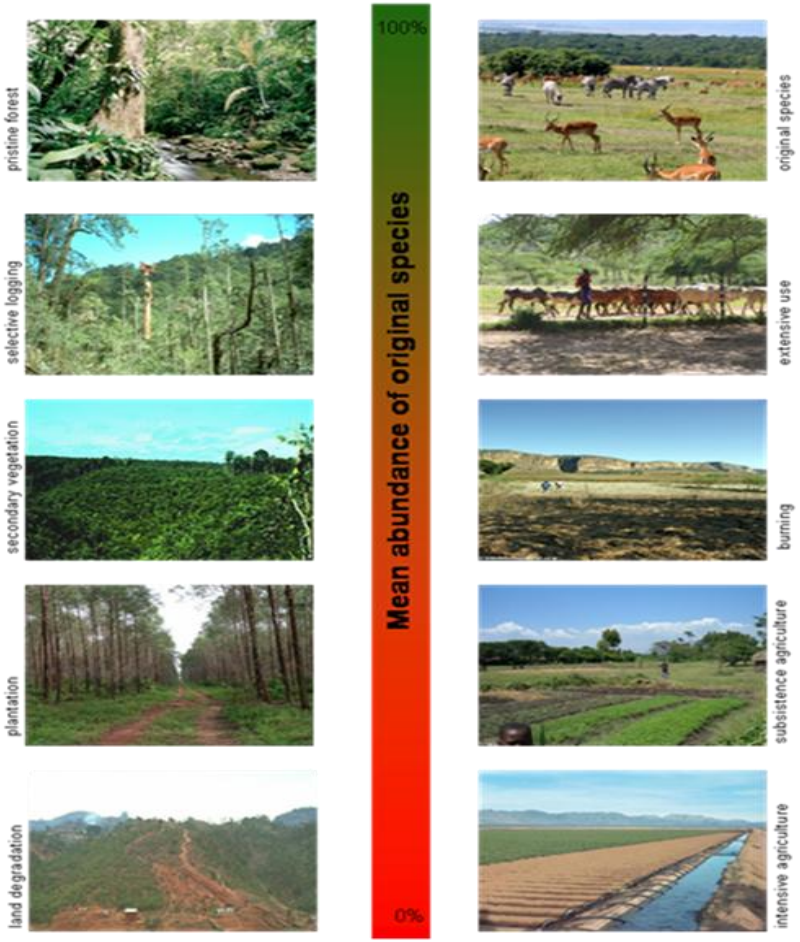
Intensive use

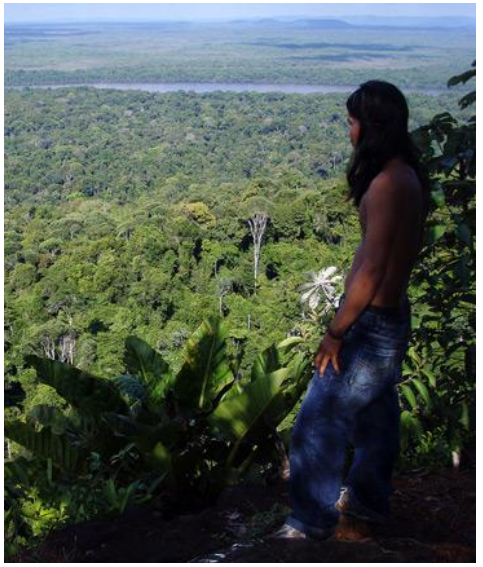
Mono-funct.

Degraded

FOREST

GRASSLAND





Trade offs ?

Oil Palm Plantations

(& other "energy crops"

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How to measure ‘Total Value’ (importance)

Ecological value /<u>importance</u>

(role in ecosystem)

Intrinsic [= “in” nature] /existence [= in/by humans] value

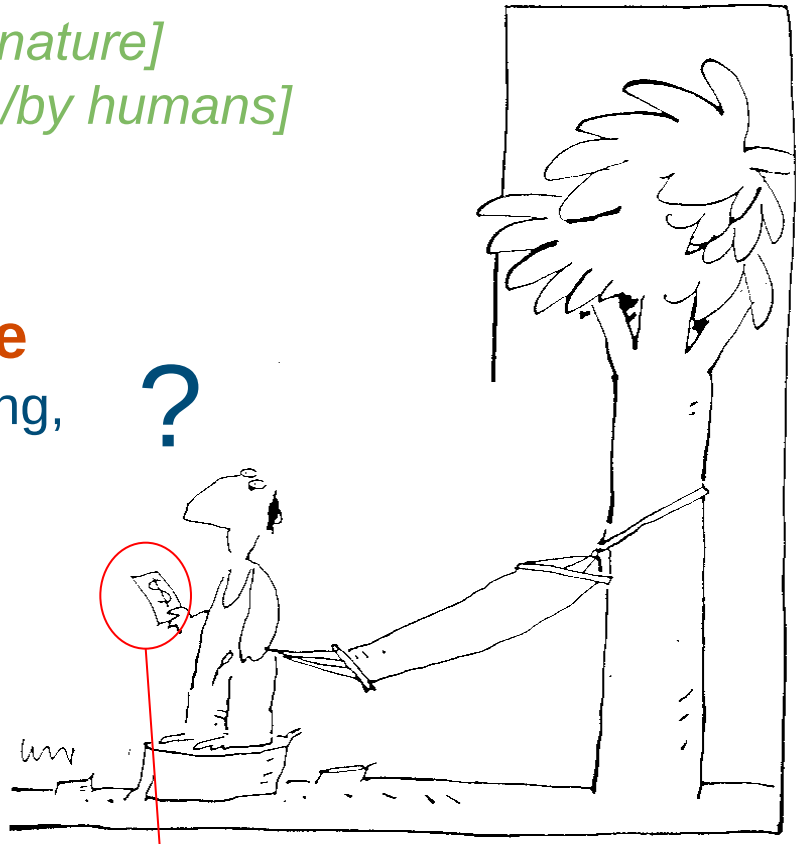
Cultural value

(traditional whaling, Inspiration etc.)

Economic value

Effect on welfare and ‘the’ economy usually/conveniently expressed in monetary units.

Whale: meat, tourism (DUV), biol. control (IUV), donations (NUV)



Additional value (information) in decision making process *[but very important/trade-offs]*

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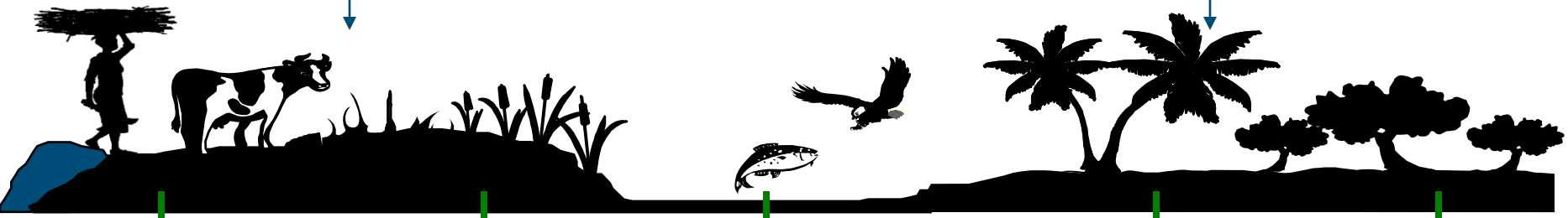
TOTAL ECONOMIC VALUE

USE VALUE

NON-USE VALUE



DIRECT USE VALUE
goods&services used directly

- ✓**Provisioning** eg. fish, timber
- ✓**Non extr. use** eg. cultural & amenity services

INDIRECT USE VALUE
Services used indirectly

- ✓**Regulating services** (eg. flood prev., erosion prot., pollination)

OPTION VALUE
Pot. use within own generation

- ✓(eg. discovery of new pharmaceutical applic.)

BEQUEST VALUE
Importance to Future generations

- ✓**All services**

EXISTENCE VALUE
Right of existence of other species

- ✓**Supporting services** (eg. habitat for Panda, Blue whales)

Market values mainly limited to direct use

Monetary Valuation Methods

1. Market Price

Food

Tourism

2. Shadow Price

Water purification

3. Questionnaire based

Habitat / supporting

WTP for protecting Humpback Whales: 57 $/pp/year (USA, 1993)

Pollination

Globally: 190 billion $ damage costs for lost natural crop pollination

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Total Economic Value of Tropical Forest

6.000 US$/ha/year

27% 66% 7%

Ecosystem Service	Direct Use Value	#	Indirect Use Value	#	Non-Use Value	#
TOTAL: 5,935 US$/ha/year (n = 132)	**1,666**	**79**	**3,890**	**40**	**397**	**12**
PROVISIONING SERVICES	**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						
REGULATING SERVICES			**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*		
HABITAT SERVICES					**397**	**12**
16 Lifecycle maintenance (esp. nursery service					*13*	*1*
17 Maintenance of genetic diversity (gene pool prot.)					397	12
CULTURAL SERVICES	**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						

In ADDITION* to intrinsic and cultural values

*) or not ...??

we are still cutting & degrading tropical forests and other natural ecosystems

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TEV* of ecosystem services (22) by biome (12)

Biome / Ecosystem Service	Marine	Coral Reefs	Coastal	Mangroves	Other Wetlands	Fresh water	Tropical Forest	Other Forests	Woodlands
1) Food provision	24 (6) 0 - 44	470 (22) 0 - 3.818	3.248 (12) 1 - 13.043	693 (8) 0 - 2.744	442 (16) 0 - 981	69 (3) 13 - 68	75 (19) 0 - 552	126 (8) 0 - 552	2.824 (5) 0 - 8.369
2) Water provision			*1.413 (1)*	*1.990 (1)*	2.739 (4) 15 - 5.210	1.864 (2) 1.110 - 2.619	143 (3) 6 - 411	148 (3) 0 - 442	
3) Raw material provision		400 (5) 0 - 1.990	8 (4) 0 - 36	511 (5) 3 - 326	698 (12) 1 - 2.436	*1 (1)*	431 (26) 1 - 1.418	24 (6) 1 - 45	541 (9) 3 - 645
4) Provision of genetic resources		*20.434 (1)*			*12 (1)*		483 (4) 7 - 1.756	*2 (1)*	
5) Provision of medicinal resources					*92 (1)*		181 (4) 11 - 562	11 (3) 0 - 11	
6) Provision of ornamental resources		264 (3) 151 - 347			*10 (1)*				*12 (1)*
7) Air quality regulation				*231 (1)*		*0 (1)*	230 (2) 10 - 449		497 (2) 90 - 903
8) Climate regulation	56 (2) 2 - 54	648 (3) 2 - 646		5.926 (4) 2 - 10.407	468 (7) 3 - 1.285	*59 (1)*	1.965 (10) 10 - 3.218	257 (9) 2 - 1.447	219 (2) 3 434
9) Moderation of extreme events		25.200 (9) 3 - 34.408	37.339 (2) 700 - 73.979	515 (2) 37 - 993	3.544 (10) 238 - 10.264		14 (2) 6 - 8	52 (2) 0 - 104	
10) Regulation of water flows					535 (2) 5 - 530		2.675 (6) 1 - 5.235	1 (2) 0 - 1	
11) Waste treatment (esp. water purification)		42 (2) 3 - 81		11.576 (2) 2.334 - 9.242	3.586 (10) 42 - 9.368	1.221 (2) 105 - 2.337	177 (6) 0 - 506	15 (4) 0 - 68	262 (4) 0 - 786
12) Erosion prevention		*189.470 (1)*		448 (2) 141 - 756	*89 (1)*		694 (9) 7 - 1.084	2 (2) 0 - 3	*55 (1)*
13) Maintenance of soil fertility	84 (2) 3 - 165	*3 (1)*	19.368 (3) 2.002 - 29.520	*220 (1)*	634 (3) 31 - 344	*1 (1)*	508 (3) 1 - 501		
14) Pollination					*17 (1)*		10 (2) 5 - 14	*439 (1)*	
15) Biological control	4 (2) 0 - 7	4 (2) 0 7	*55 (1)*		*16 (1)*		*9 (1)*	*16 (1)*	
16) Habitat for migratory species, incl. nursery			108 (2) 33 - 183	106 (3) 3 - 266			*13 (1)*		*499 (1)*
17) Maintenance of genetic diversity	6 (2) 1 - 11	13.541 (7) 0 - 57.133	*83 (1)*	174 (2) 27 - 321	648 (9) 0 - 2.247	*320 (1)*	373 (12) 3 - 5.151	225 (7) 0 - 2.504	*1 (1)*
18) Aesthetic information	*0 (1)*	7.425 (4) 0 - 27.484							*3.733 (1)*
19) Opportunities for recreation and tourism	76 (6) 0 - 511	79.099 (29) 0 - 1.063.946	13.780 (5) 70 - 40.268	1.128 (3) 493 - 713	950 (11) 1 - 3.715	649 (5) 322 - 1.166	381 (20) 1 - 1.171	758 (5) 1 - 2.934	
20) Inspiration for culture and art		0 (2) 0 - 0			*595 (1)*			*0 (1)*	
21) Spiritual experience									
22) Information for cognitive development		2.154 (4) 0 - 6.461	*41 (1)*						
TOTAL	250 (20)	129.245 (92)	73.852 (28)	21.077 (31)	14.245 (84)	3.803 (12)	8.338 (128)	1.618 (51)	4.343 (22)

> 225 studies

> 1.250 data-points

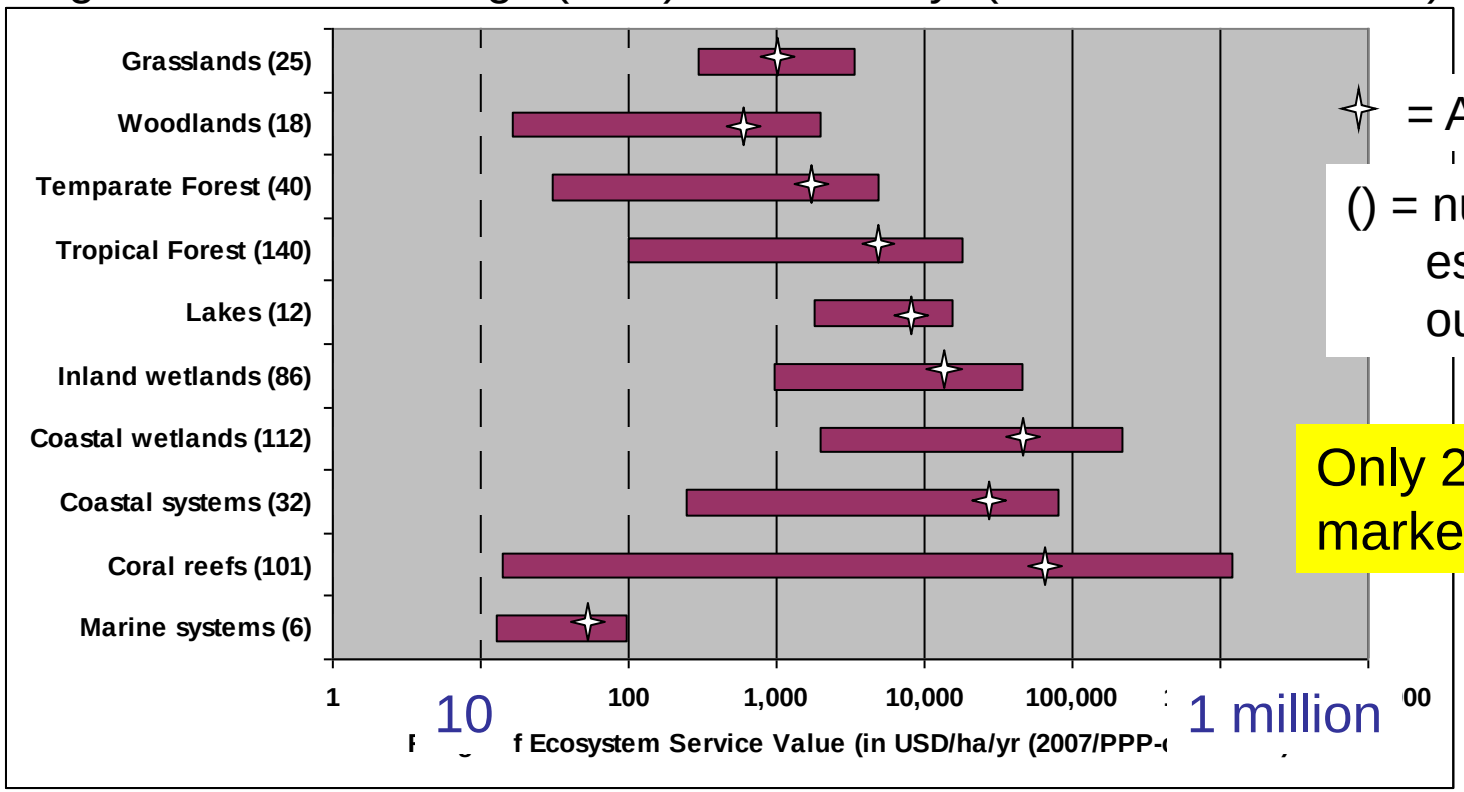
Used for analysis: 522

Ongoing process …

*) Average Potential Sustainable Use Value ….

The Economics of Ecosystems & Biodiversity

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



De Groot, et al., 2012

Oceans **49** US$/ha/yr [climate regulation & fishery]

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

Coral Reefs **92.775** US$/ha/yr [tourism & storm protection

Millennium Ecosystem Assessment

Trade-offs among ecosystem services

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

Mangrove Services:

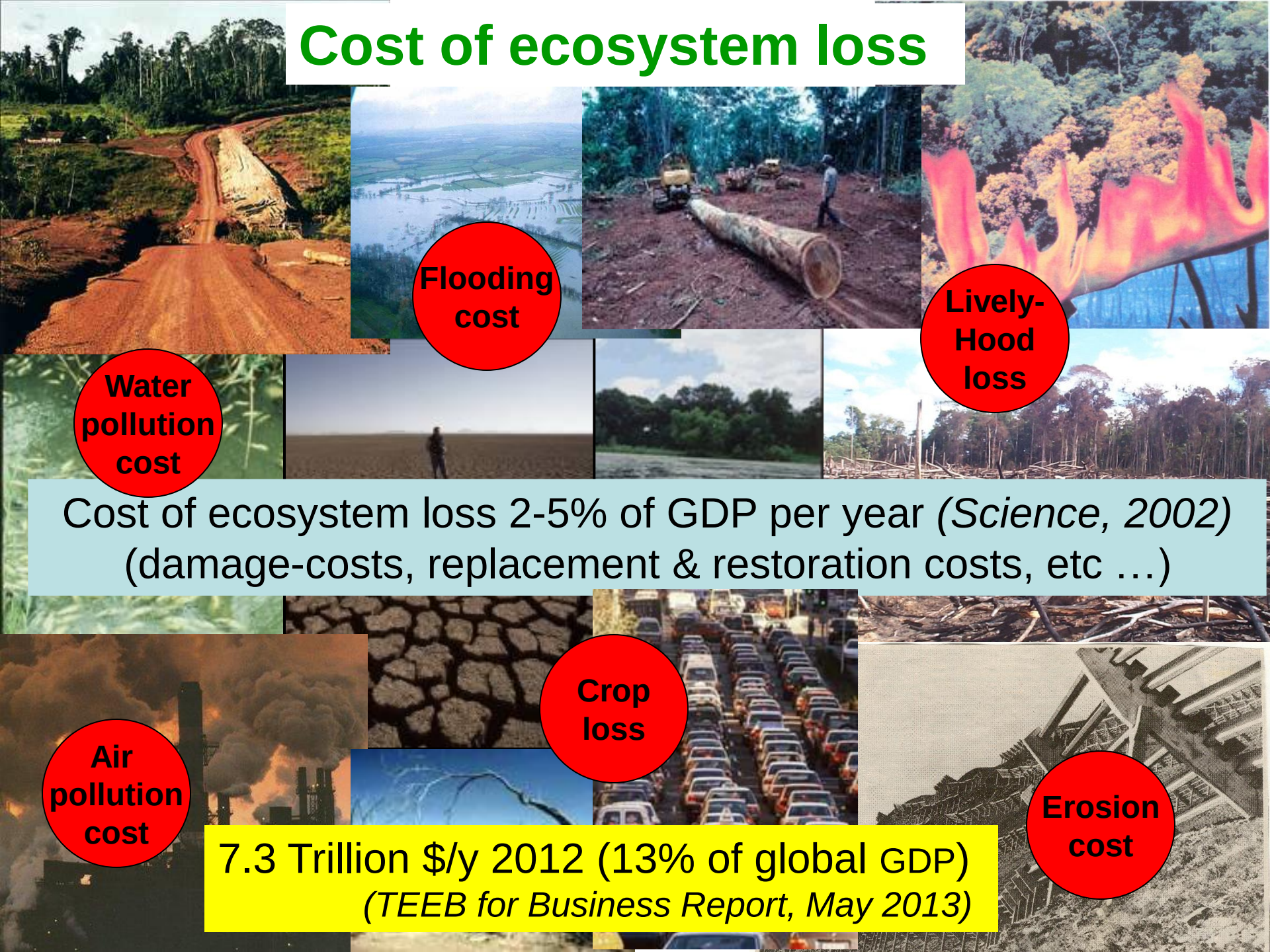
- nursery and adult fishery habitat
- fuelwood & timber
- carbon sequestration
- traps sediment
- detoxifies pollutants
- protection from erosion & disaster

[redacted] shrimp

crops

NPV Mangrove Mexico 600.000 US$/ha
sold for recreational development
*for **1.000 US$/ha** (Nature, 2008)[<0,2% of TEV]*

Cost of ecosystem loss



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

7.3 Trillion $/y 2012 (13% of global GDP)
(TEEB for Business Report, May 2013)

NATURA 2000 **COST** estimates

Building on the results of the Member States questionnaire, the **annual costs** of implementing the Natura 2000 network were estimated as **€5.8 billion** per year for the EU-27**.**
(Gantioler, 2010)

Average: 63€/ha/y (range: 10 – 800€/ha/y)
incl. acquisition & infrastructure dev. (30%) + management

Marine sites:
< 3 €/ha/y.

Question: is money spent on e.g. employment a “cost’?

Natura 2000 **BENEFITS**

"A number of examples have demonstrated that the benefits can be **3–7 times** larger than the costs"

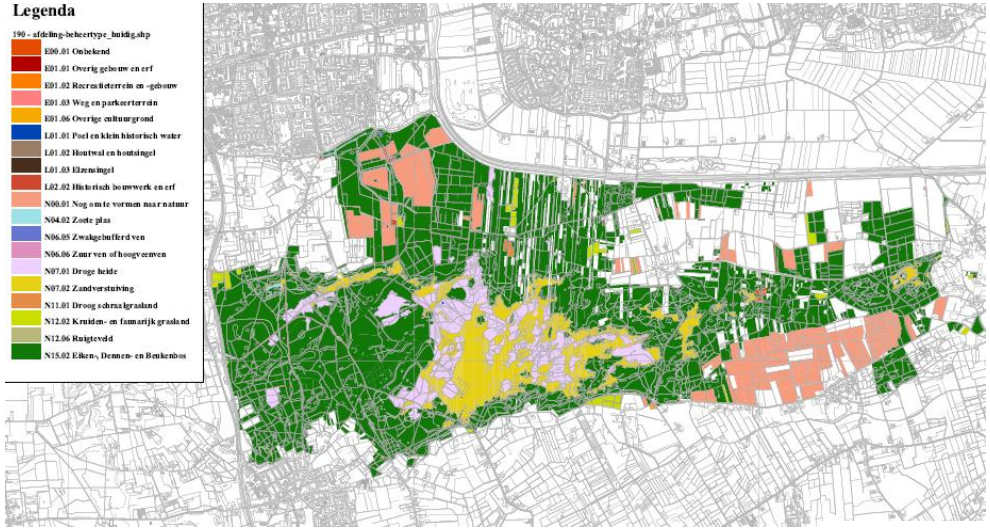
According to a study in **Ireland**, the aggregate benefits provided by the Burren park's limestone pavements and the orchid rich grasslands were estimated to amount to €4,420 / ha / year . The total benefit from the Park is estimated to be **€65 million** per year or about **3 times as much as the cost** of Government support (**Gantioler, 2010)**

The protection of all 300 Natura 2000 sites throughout **Scotland** was estimated to have an overall **benefit cost ratio of around 7** over a 25-year period (Jacobs, 2004). Total benefits were estimated at **£210 million per year,** however, 99% is non-use value (**Gantioler, 2010)**

In 2008 a study was carried out in **France** to determine costs and benefits of the Natura 2000 site 'Plaine de la Crau'. The calculated overall net benefits amounted to €142ha/year, which was **around seven times higher than the costs associated with the site**. (Hernandez & Sainteny, 2008).

De Loonse en Drunense Duinen (3500 ha)

(The Netherlands)



100 x

Cost per ha: 142 euro/yr
Benefits per ha: 15.338 euro/yr

Important Ecosystem Services

- Recreation
- Air filtration
- Real estate value increase (proximity to Natura 2000)
- CO_2 sequestration
- Water-filtration

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Conservation still seen as a cost …

"**Current" expenditures** on all Protected Areas (incl. bilateral agreements, GEF, etc): < 10 billion US$/y (1

Needed : 45-50 billion $ (2 < 0.1%

Global GDP: ca 50 Trillion US$ (2009) (1

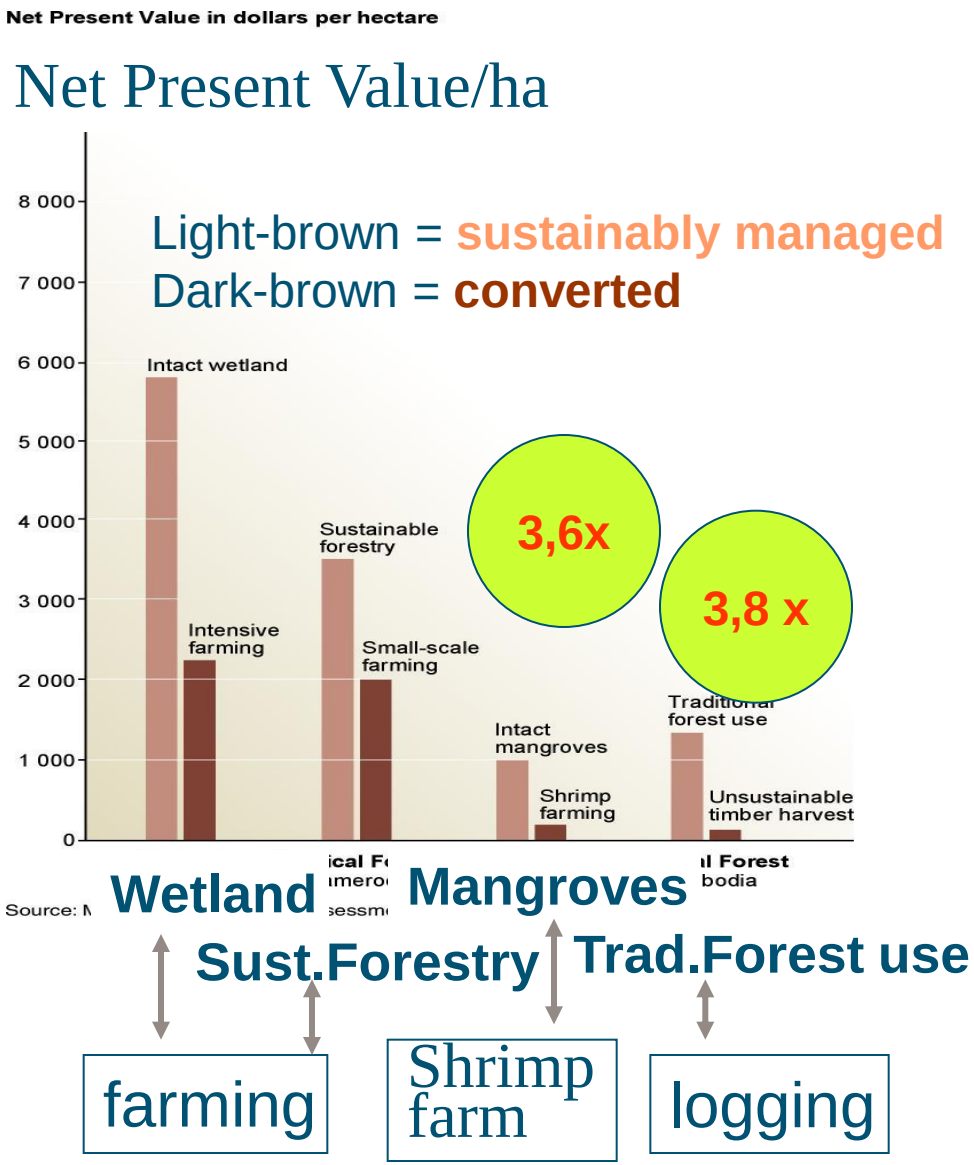
Valentines day in USA 2012: 17 billion US$

Globally on cigarettes: 2009: 50 billion US$

Benefits: >> 1,5 - 4,5 trillion (3 (return 1: 30-100)

1) EASAC, 2009, 2) Balmford et al., 2002. Science, 3) TEEB, 2010

Conversion <-> sustainable management: “honest” CBA



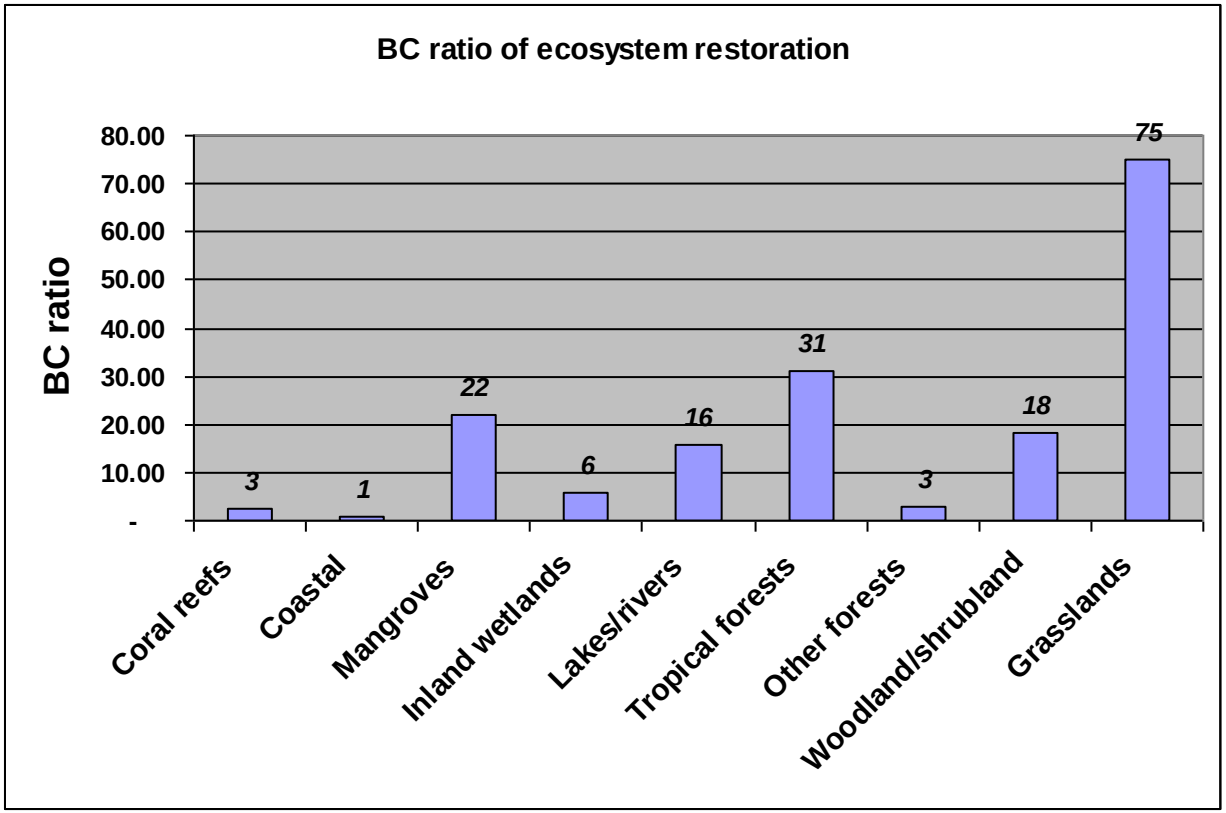
“The **total economic value** of managing ecosystems more sustainably is often higher than the value associated with conversion”

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

Net-Benefits of Ecosystem **Restoration**

Blignaut et al. screened 20.000 publ.; 95 selected for further analysis *

Benefit – Cost Ratio of Ecosystem Restoration



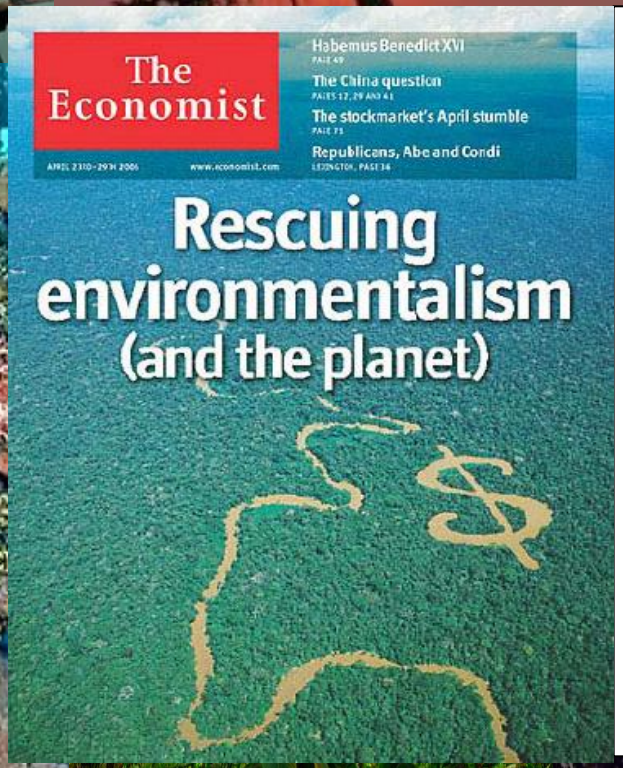
Grasslands: 75 x

Coral reefs: 3 x

Assumptions: high cost scenario, average benefit scenario, time horizon = 40 years (including 10% annual operation costs; discount rate = 1 %)

* De Groot et al., 2013, Cons Biol.

Investing in nature (restoration) pays !



„Every dollar invested .... saves any-where between 7,5 and 200 US$ in damage & repair costs“

TheEconomist
(23 April 2005)

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