

Ecosystem services: an introduction.

Erik P.C. ROMBAUT, Master in Biology , Asst. Prof. , LUCA.
Hoger Architectuurinstituut Sint-Lucas (LUCA, school of Arts),
Hoogstraat 51, B-9000 Gent / Paleizenstraat 65-67, B-1030 Brussels.
KaHo Sint-Lieven (Odisee), Hospitaalstraat 23, B-9100 Sint-Niklaas.
+ 32 (0)3 7707147. erik.rombaut@scarlet.be

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Ecosystem services

...

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

... what is it all about ?

- The carrying capacity of our planet for humanity is based on “**provisioning services**” , which have been increased by human interventions (such as: irrigation, fertilization, etc. for agriculture, ...).
 - These provisioning services depend entirely on the “**supporting and regulating services**” , which decreased enormously due to human impact (pollution, extinction,...).
 - There is a clear link between ecosystem services (delivered for free by nature) and human economy. Ecosystem services deal with the benefits mankind gets (for free) from ecosystems.
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Ecosystem services: the benefit, humanity gets from ecosystems

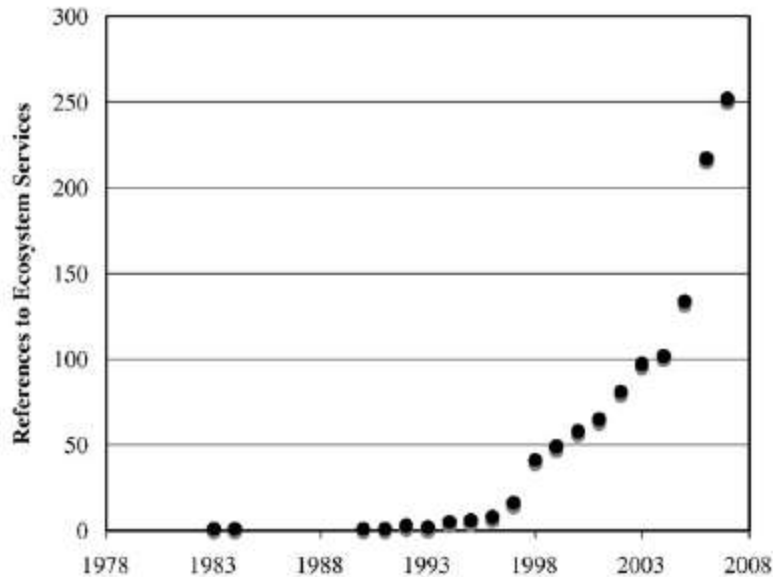
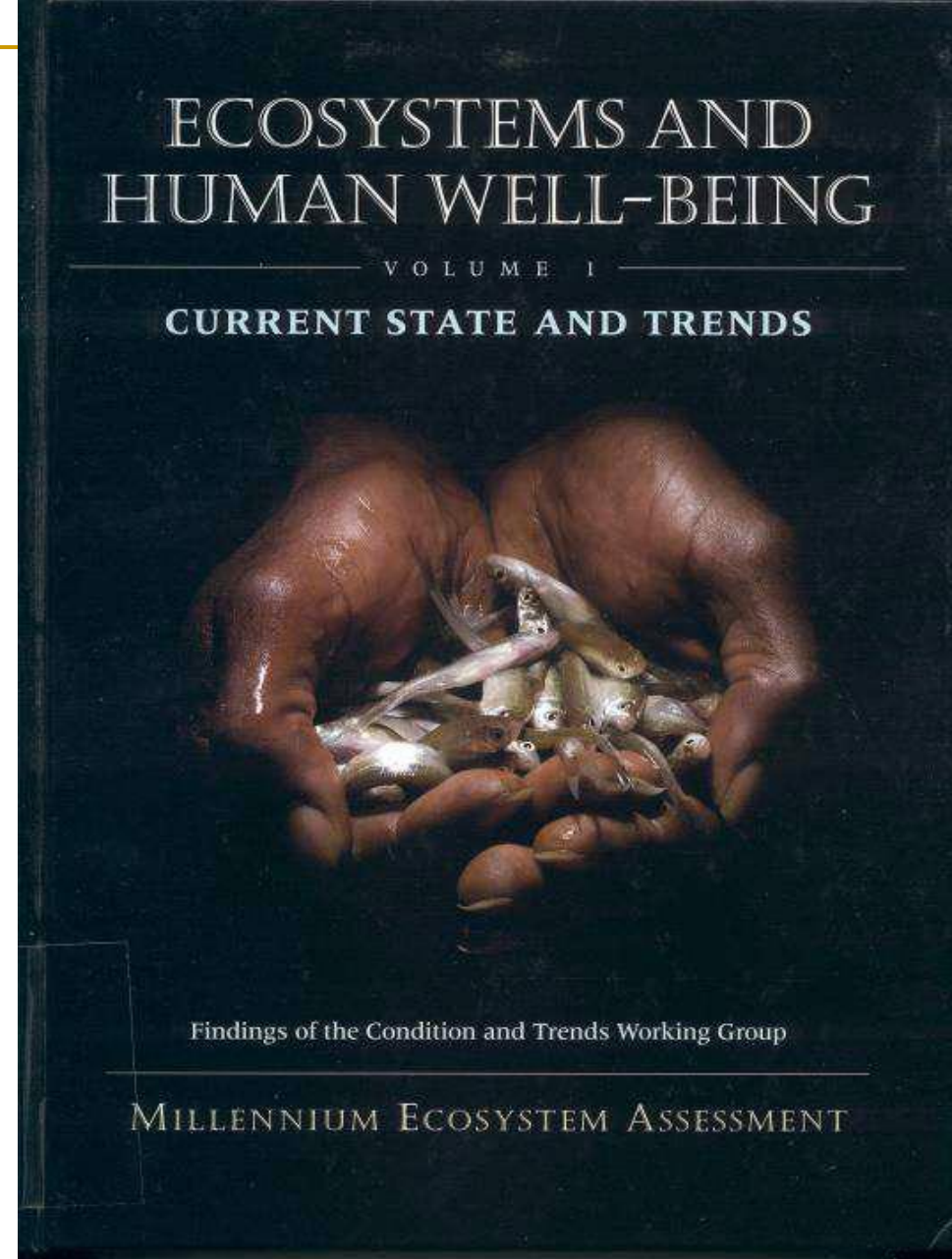
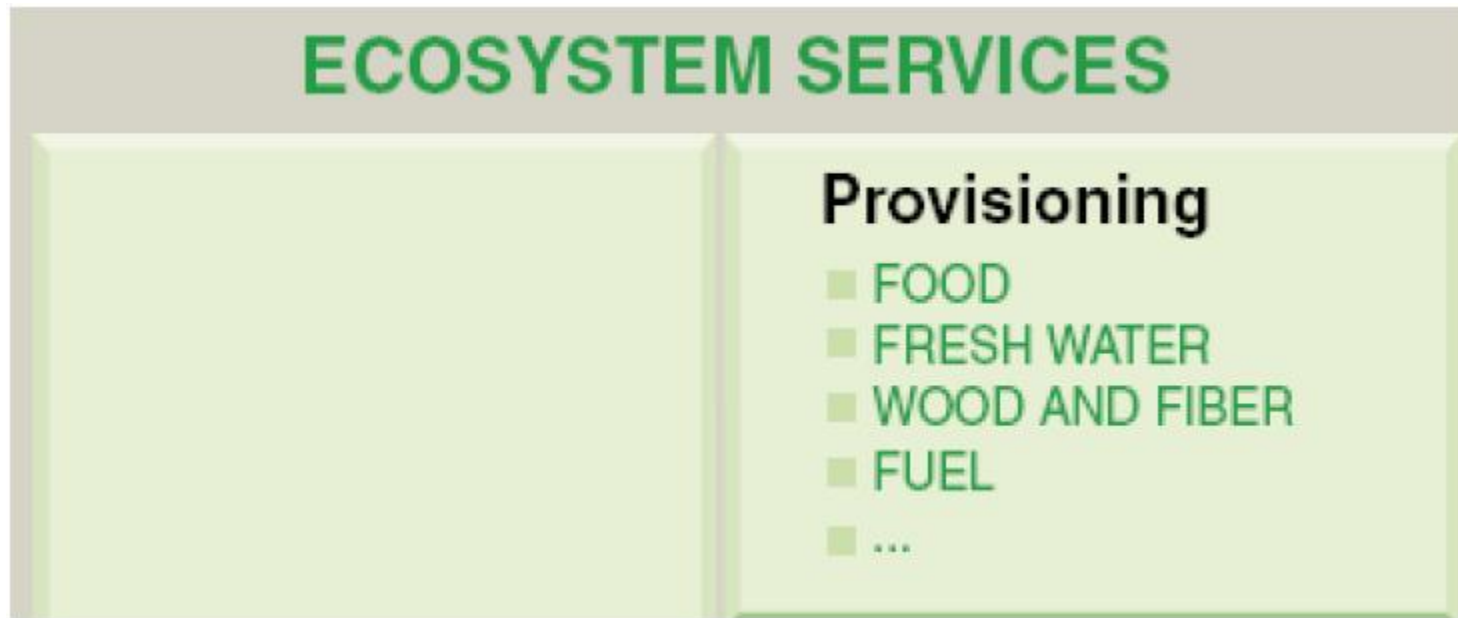


Fig. 1 – Number of papers using the term “ecosystem services” or “ecological services” in an ISI Web of Science search through 2007. “Environmental services” as a search term, was left out as it returned publications related to hospital environments. Therefore, the graph is indicative but clearly an underestimate.



See also: Jacobs et al. (ed.), 2014. Ecosystem Services: Global Issues, Local Practices. Elsevier, 422 pp. Ill. ISBN 978-0-12-419964-4

Provisioning services





For this meal, more than 30 species of plants or animals were needed. All of these species are depending on others, in ecosystems





1 Dag



2 dagen



6 dagen



19 dagen

TONG



28 dagen



ECOSYSTEM
RESI

5 mm

During its growth, the common 'Dover' sole (*Solea solea*) itself, depends on many other organisms as a food source



Several planktonic organisms as food source for the common sole

Plankton



Bosmina



Daphnia



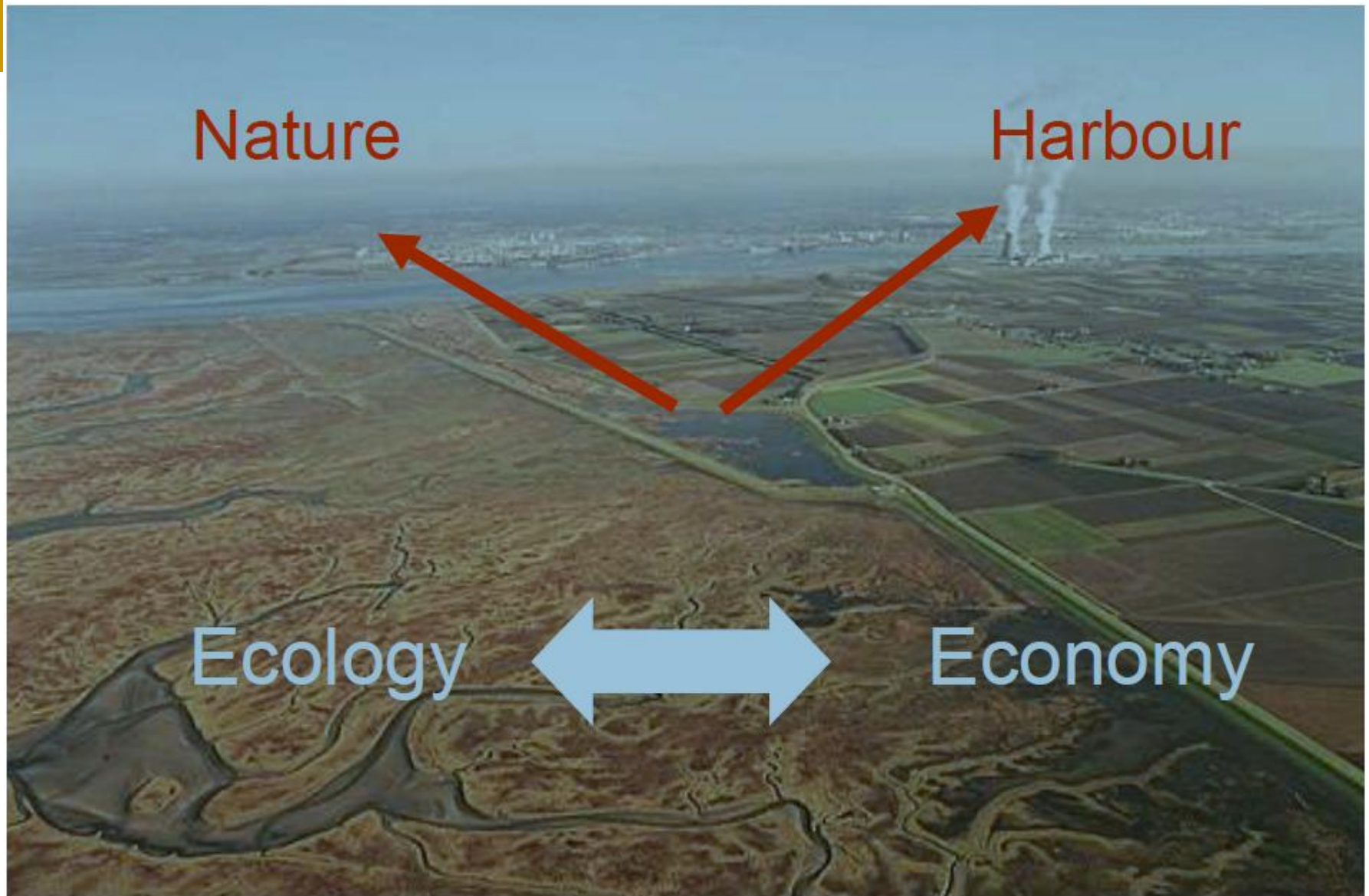


Antwerp
harbour
80 km from
the North
see

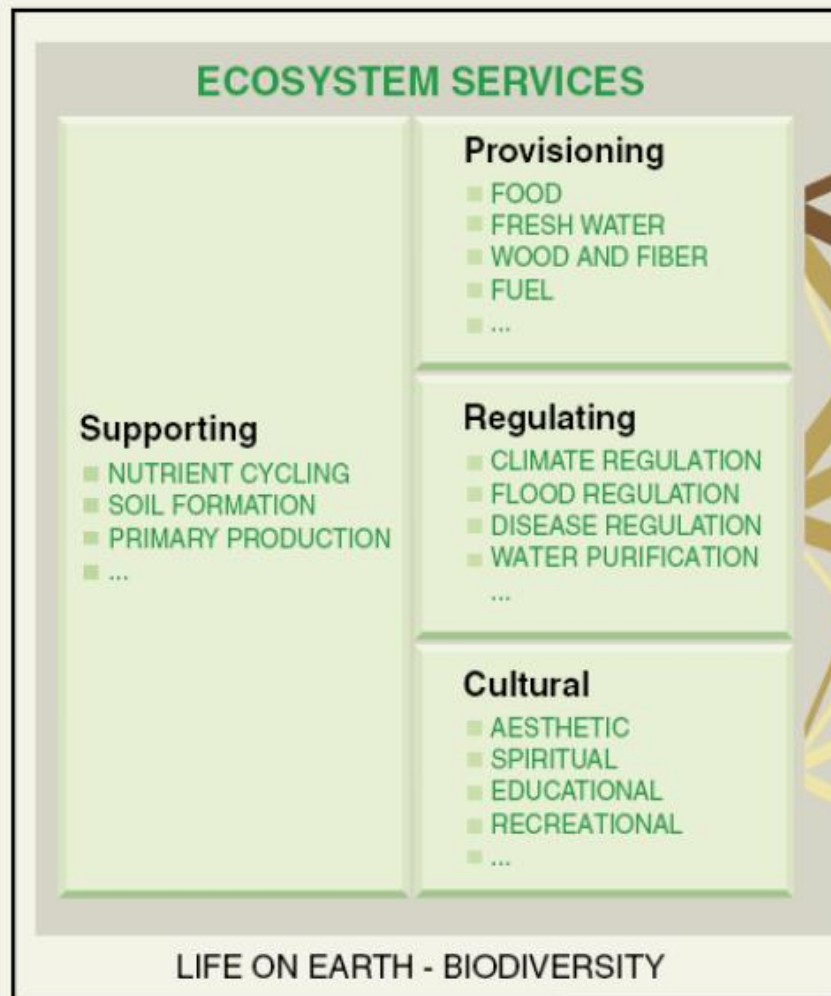
Many of the needed species
live and reproduce in the
estuary of the Scheldt (e.g.
salt marshes of Saeftinghe)



mudflats and tidal marshes of Saeftinghe



So, ecology is serving the 'food'economy (for free !): there is no contradiction between ecology and economy



CONSTITUENTS OF WELL-BEING

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

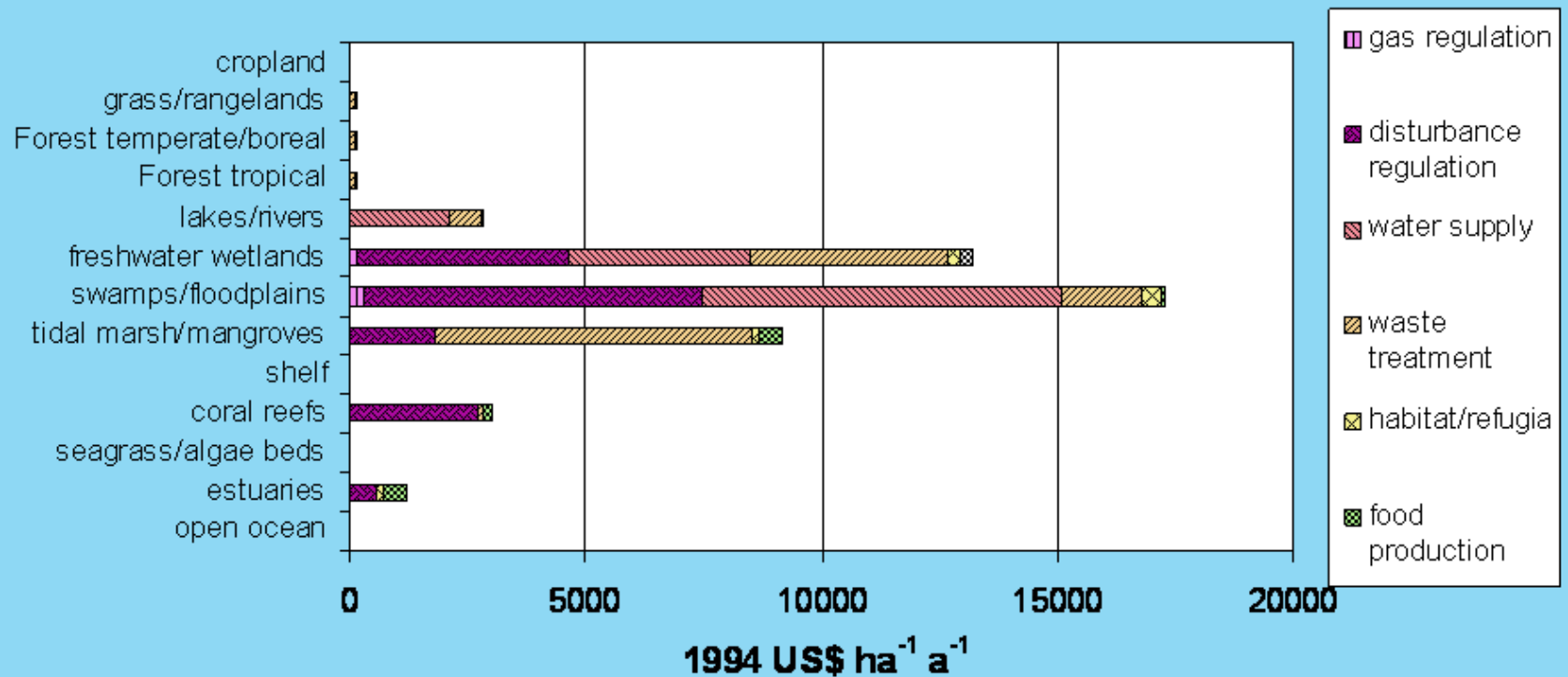
- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

Source: Millennium Ecosystem Assessment

Average annual global value of selected ecosystem services



(Costanza et al., Nature 1997)

Mangrove woodland: coastal protection in tropical regions against tsunamis and flooding, without financial implications, for free.



-
- Pavan Sukhdev, the Deutsche Bank economist leading a European study on ecosystems, reported that we are losing natural capital worth between US\$ 2 trillion and US\$ 5 trillion every year as a result of **deforestation** alone.
 - The losses incurred so far by the financial sector amount to between US\$ 1 trillion and US\$ 1.5 trillion. Sukhdev arrived at his figure by estimating the value of the services — such as locking up carbon and providing fresh water — that forests perform, and **calculating the cost of either replacing them technically, or living without them.**
 - So the credit crunch (financial crises) is petty when compared to the nature crunch (biodiversity crises, extinctions).
-

Example:Chao Praya River basin , Thailand. Table to be supplemented with the 2011 floods

Main features of the major floods in the lower Chao Phraya River basin

		1942	1983	1995
Human Intervention	Forest cover ^a	166,000 km ²	106,000 km ²	92,000 km ²
	Area denuded	--	60,000 km ²	74,000 km ²
	Reservoir capacity	Nil	23,000 million m ³	24,000 million m ³
	Flood protection	2,230 km ²	12,900 km ²	14,400 km ²
	Urban area ^b	51 km ²	389 km ²	528 km ²
Natural Causes	Rainfall upstream	Exceptionally Heavy	Unusually heavy (Sep.to Nov.)	Unusually heavy to Exceptionally heavy
	Rainfall in Bangkok	Normal	Unusually heavy (Aug.to Nov.)	Normal to unusually Heavy
	Tides	Normal spring tide with additional seasonal effects	Normal spring tide with additional seasonal effects	Normal spring tide with additional seasonal effects

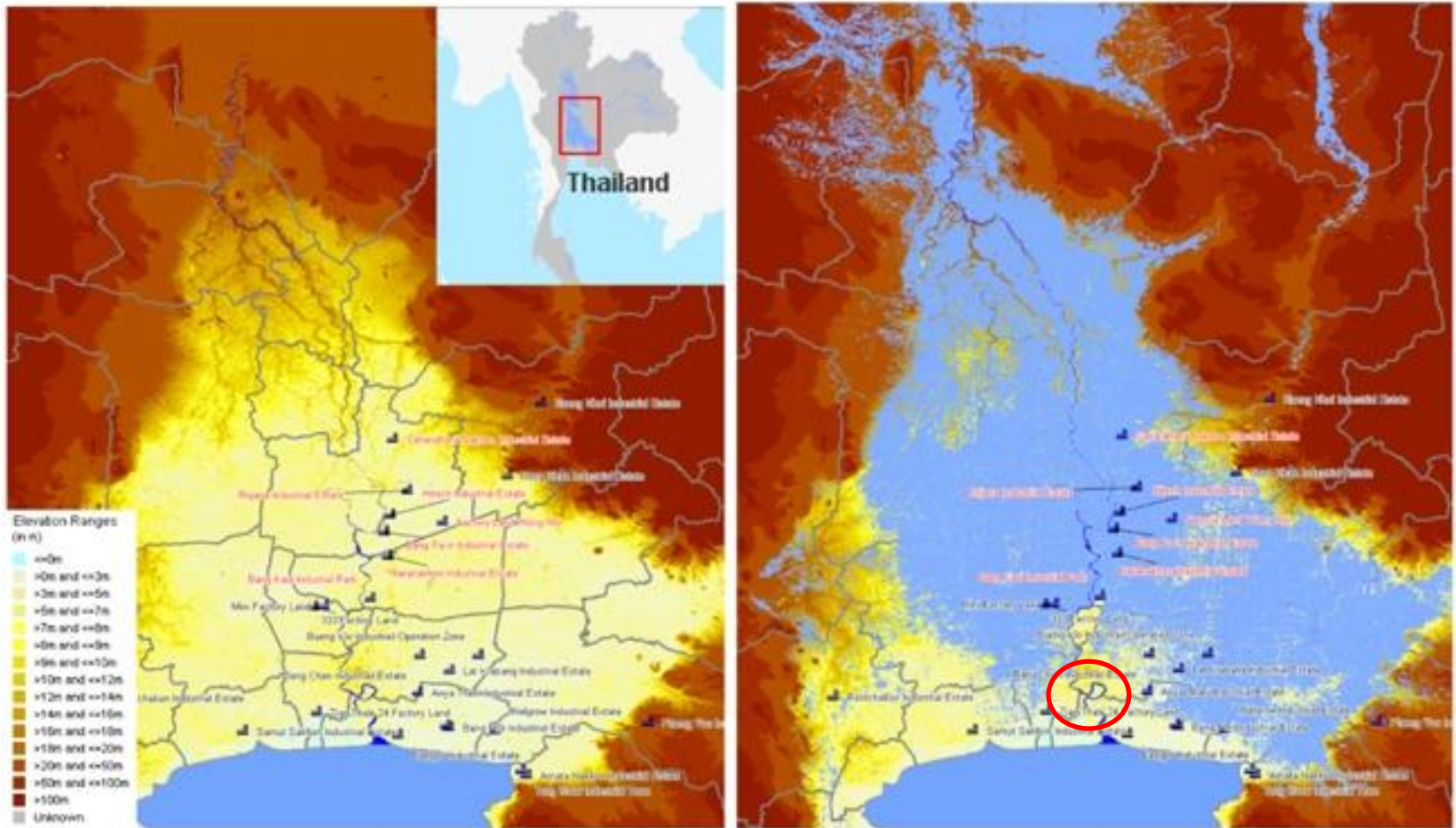
^a Northern and central regions of Thailand.

^b Bangkok area only.



Thailand flooding 2011.

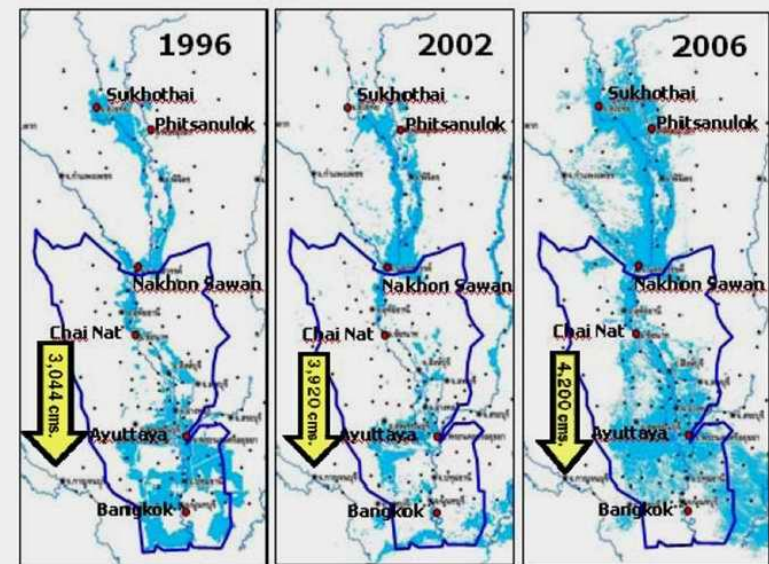
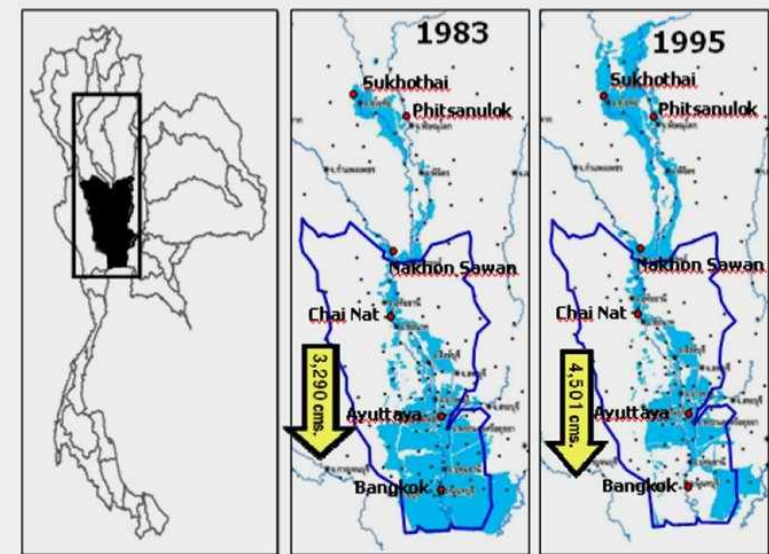
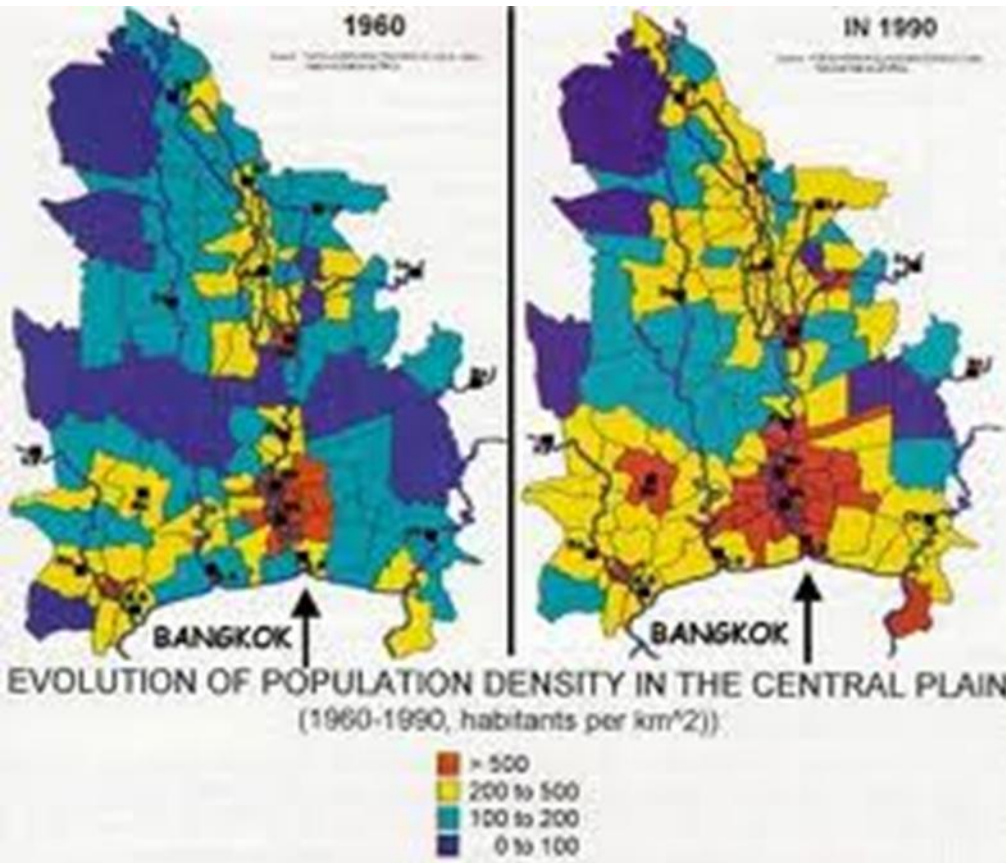
ELEVATION MAP AND FLOODING EXTENT 2011 FLOOD



Source: NASA SRTM and Thailand Flood Monitoring System

○ Bangkok

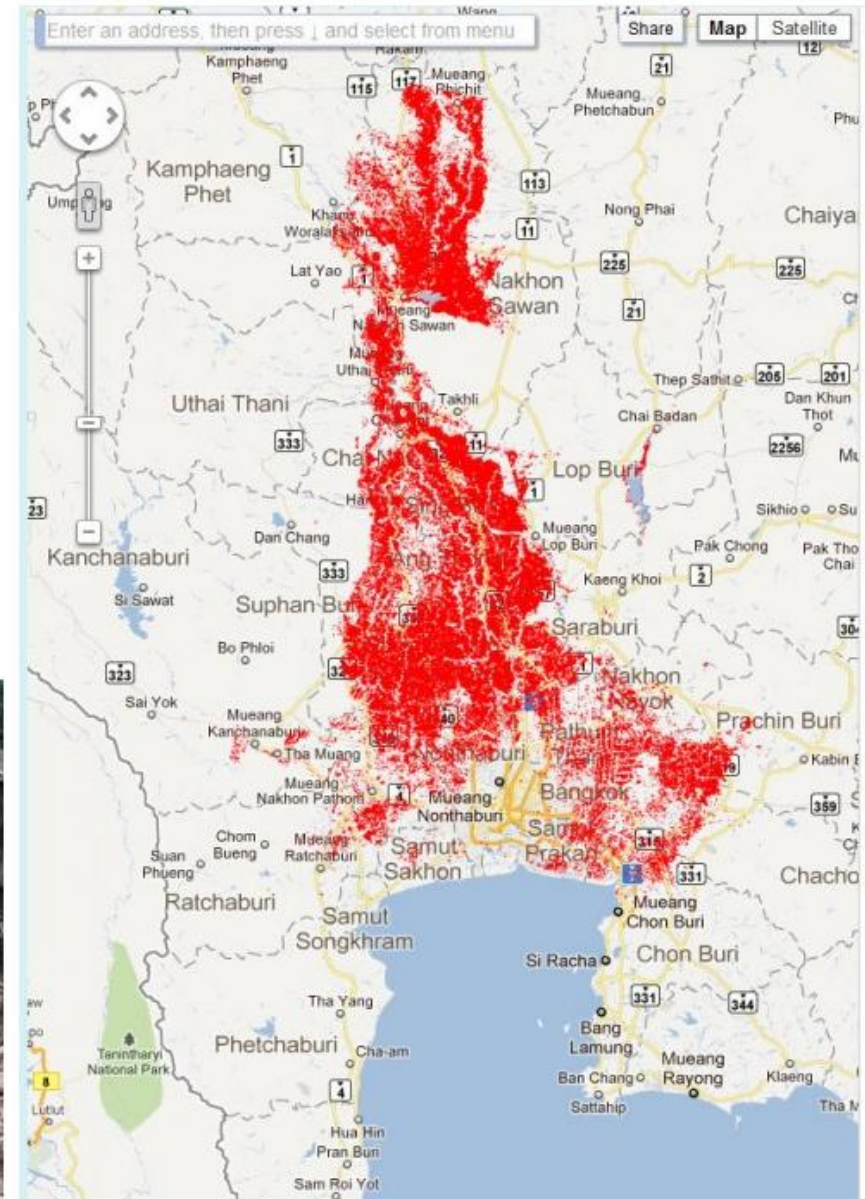
Bangkok and surroundings 1960's – 1990's



4,200 cms. → Flow at downstream of Chao Phraya

★ Chao Phraya barrage

Flooding Thailand nov 2011.



- October 29, 2012: In 2011, Thailand experienced its worst flooding in years, leaving more than **800 people dead** and causing severe damage across northern and central regions of the country. The floods, lasting a few months, severely damaged and disrupted manufacturing operations in Thailand. Flooding also forced seven huge industrial estates in central regions to close, causing **damage to the industrial sector in the billions of U.S. dollars**. It is interesting to note that prior to 2011, none of the industrial parks in Thailand had been flooded over the past 40 years. During the last major flood in 1995, the dykes in the industrial parks kept floodwaters out. In last year's flooding, however, heavy machinery was reportedly not brought in to raise the height of dykes for fear of damaging them and instead sandbags were used, which ultimately gave way to the floodwaters.
- Damage and disruption to the manufacturing sector was massive after defenses protecting several industrial estates were breached. The Labour Ministry said that **more than 14,000 businesses nationwide had to close because of the floods**. Factories in the provinces of Ayutthaya and Pathum Thani were particularly badly hit. Reports said around 1,300 factories across central Thailand were affected by the floods, disrupting manufacturing supply chains inside and outside of Thailand. Many of these industrial estates housed both local and international factories and businesses, with large numbers manufacturing electronic components and car parts.
- **The production of cars, electronics and other goods was suspended for months as hundreds of factories were under water**. Disruption to supply chains also halted operations, causing a knock on effect on global manufacturing. The disruption to operations lasted several months and had an impact on production similar to that caused by the Tohoku earthquake in March 2011. Thailand plays a critical role in the global supply chain and companies needed to organize alternative production facilities or supply routes for parts.

Thailand economy shrinks 9% on flood impact

Thailand's economy contracted sharply in the fourth quarter of last year after the kingdom's worst floods in half a century pummelled manufacturing and tourism in south-east Asia's second largest economy, official figures released on Monday showed.

Thailand.
Flooding nov 2011

<http://www.nationmultimedia.com/business/Global-fallout-of-Thai-floods-30167951.html>
<http://www.globalpost.com/dispatch/news/regions/asia-pacific/thailand/120220/thailand-economy-shrinks-9-flood-impact>

Effect of Thai floods on Japanese companies

		Status	Effects
Automobiles	Honda	Factory submerged	No prospect of recovery
	Toyota	Parts not supplied by flood-damaged manufacturer	Until Saturday. Considering air shipment of parts and other measures
	Nissan		Until Wednesday
	Isuzu		Until Friday
Electronics	Nikon	Digital camera factory submerged	No prospect of recovery
	Sony		
	Canon	Printer-related factory submerged	Considering production at a different factory in Thailand and other areas
	Nidec	Two electronic parts factories submerged and employees at four factories evacuated	Considering production in China and other countries
	TDK	Electronic parts factory submerged	Considering production at a different factory in Thailand
Food	Ajinomoto/ Calpis	Jointly established beverage plant submerged	



Honda vehicles are seen submerged at the flooded Honda factory in the Rojuna Industrial district in Ayutthaya, Thailand on November 14, 2011.

Thailand's the worst flooding in half a century has forced a number of parts makers and Japanese manufacturers to halt production in Thailand, raising fears the flooding may affect manufacturing worldwide.

So, as in *Europe* flooding in *Thailand* has mainly the same causes

- Natural causes, combined with man-made causes:

As in Europe, the main natural causes in Thailand are overbank flow of the rivers, heavy (heavier) rainfalls and stronger tides due to sea level rising.

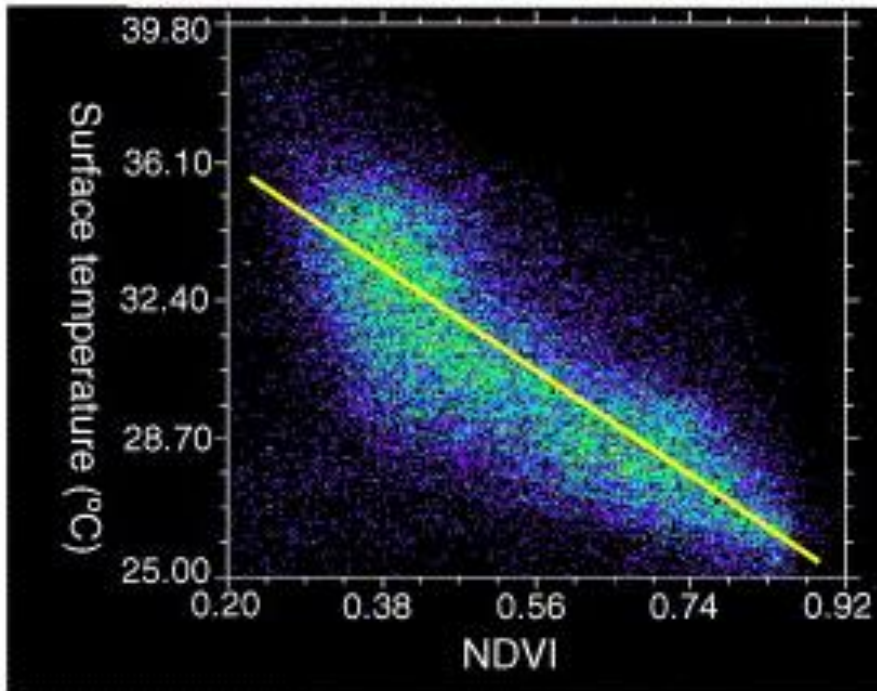
As in Europe , the most common man-made causes in Thailand are deforestation, uncoordinated urban development, over-abstraction of groundwater, and destruction of flood embankments.

As in so many other concentric growing unplanned cities, also **Bangkok** suffers from the urban heat island effect and summer smog, raising sea level, sinking city in the muddy soil because of extracting groundwater under the heavy built-up area.

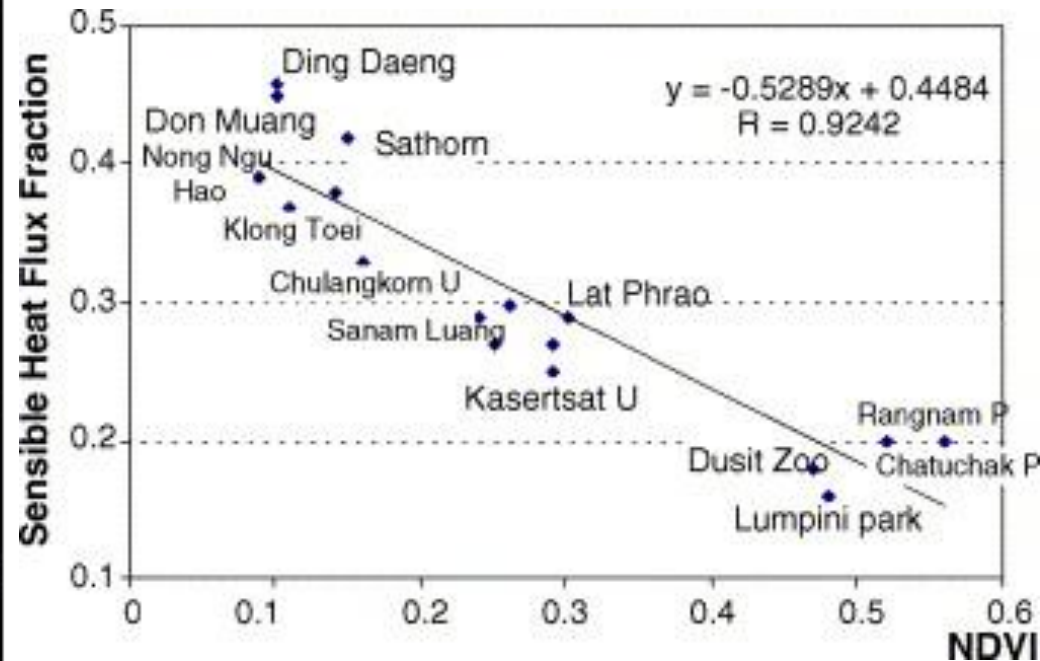


Effects of vegetation on UHI-effect: The example of

Bangkok (International Journal of Applied Earth Observation and Geoinformation Volume 8, Issue 1, January 2006, Pages 34–48)



Scatterplots of day-time surface temperature vs. vegetation index for Bangkok in February 2002.



Effects of vegetation cover on the sensible heat fluxes in 18 sampled Bangkok's neighborhoods.

Source: Assessment with satellite data of the urban heat island effects in Asian mega cities, by Hung Trana, et al, Daisuke Uchihamab, Shiro Ochib, Yoshifumi Yasuokab

Regulating services....

Regulating Services

Benefits obtained from regulation of ecosystem processes

Air Quality Regulation

Climate Regulation

- Global (CO₂ sequestration)
- Regional and local

Erosion regulation

Water purification

Disease regulation

Pest regulation

Pollination

Natural Hazard regulation



... such as pollination

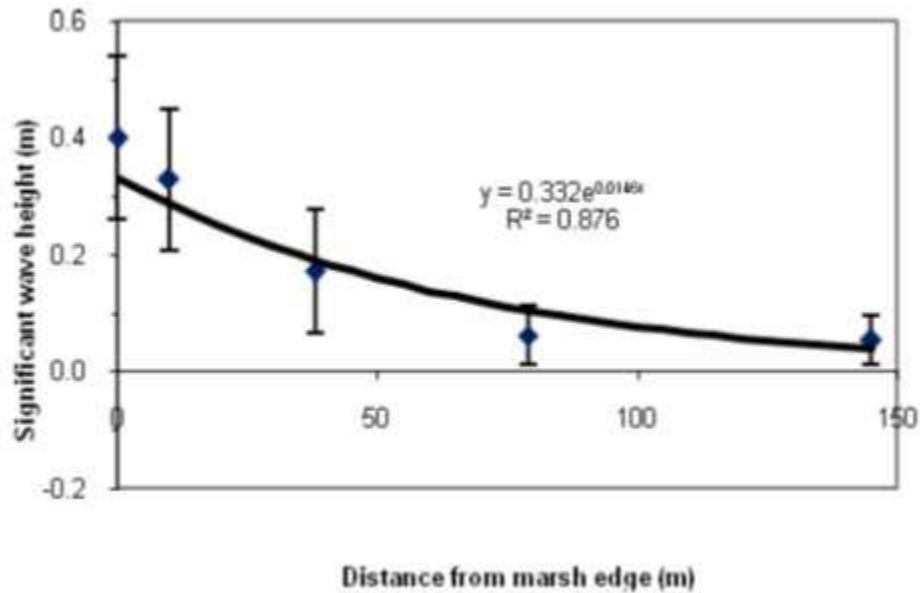


Enhancing the production of more than 75 % of crops.



...such as coastal protection

Coastal vegetation (salt marshes) tempers wave energy

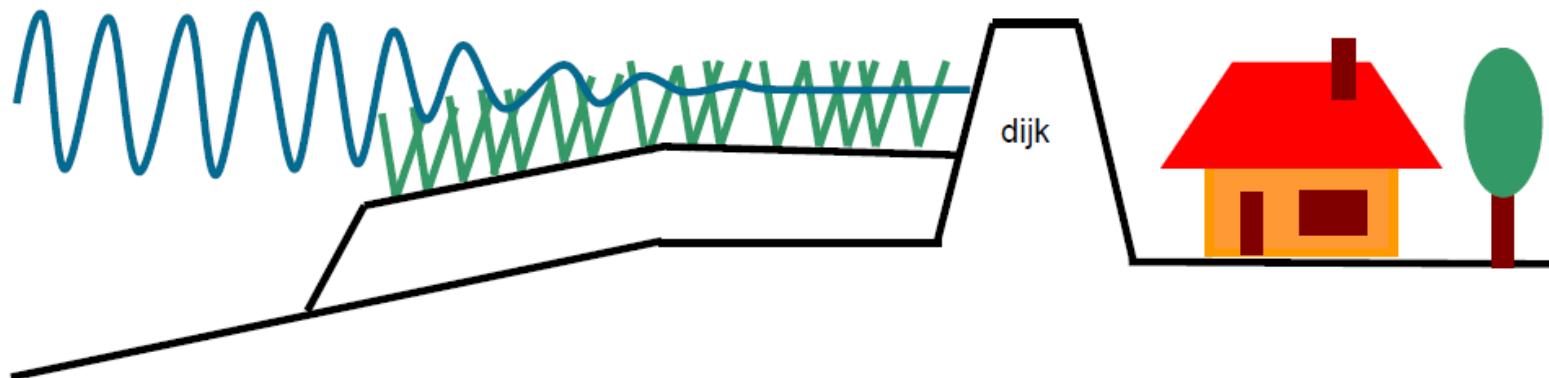




Low tide



high tide



Coastal vegetation (salt marshes, mangroves in (sub)tropical regions) tempers wave energy.

....such as erosion protection and flood protection.



Grote nete 17 september 1998

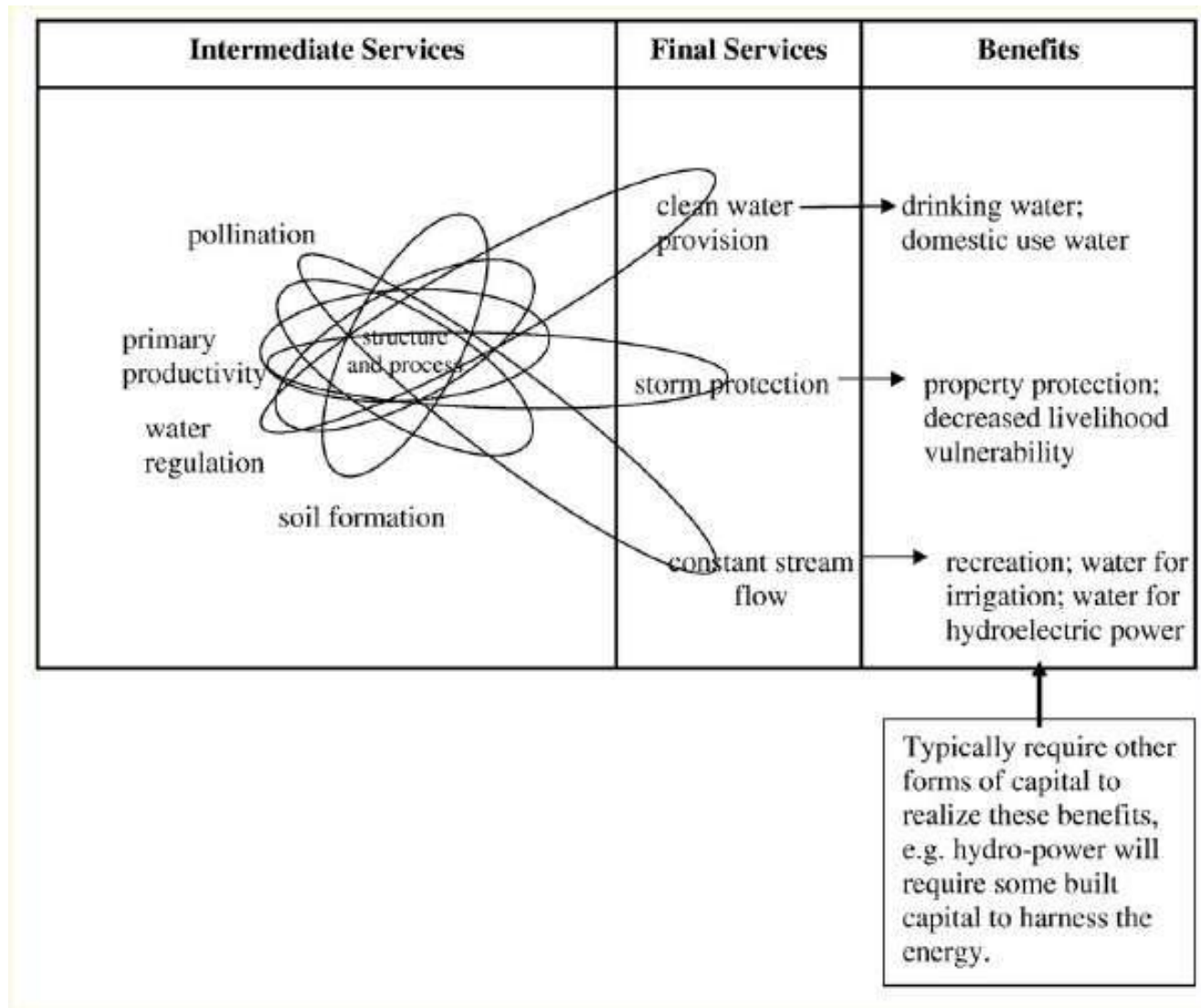
Foto: aminor

Cultural services.

Ecosystem Assessment	<h2>Cultural Services</h2> <p>Non-material benefits obtained from ecosystems</p> <ul style="list-style-type: none">Spiritual and Religious ValuesKnowledge SystemsEducational values	
Millennium	<ul style="list-style-type: none">InspirationAesthetic ValuesSocial RelationsSense of PlaceRecreation and Ecotourism	  

Photo credits (top to bottom): W. Reid, Mary Frost, Stefan Widstrand, unknown.

Conclusion: ecosystem services provide benefits for mankind.



Benefit areas.

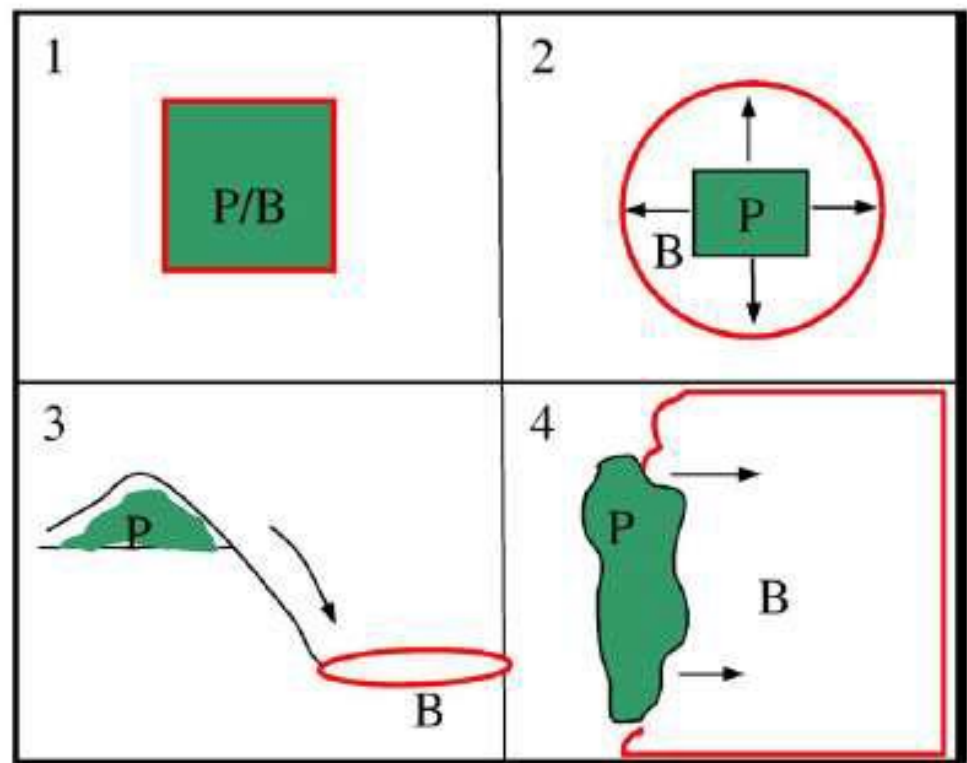
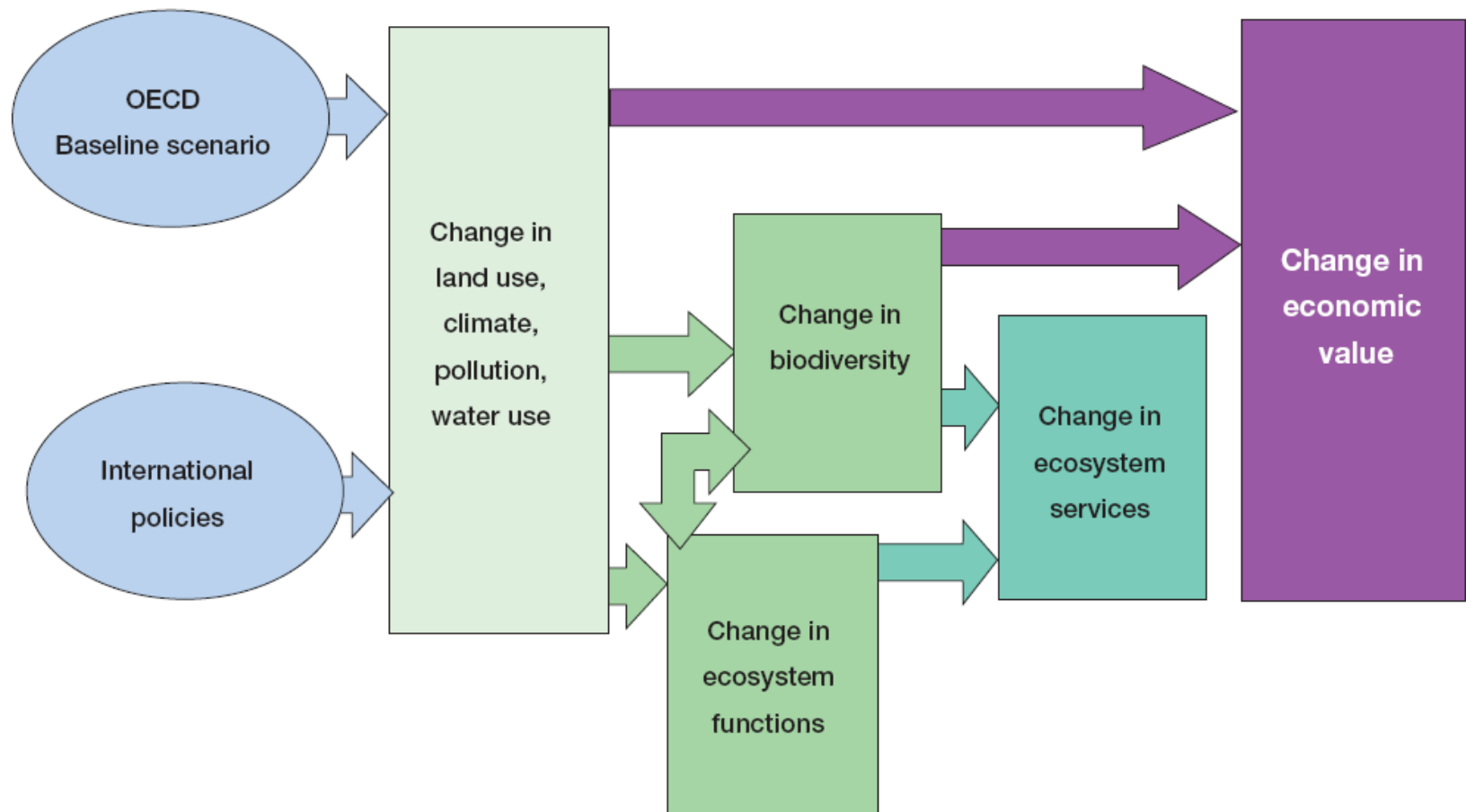
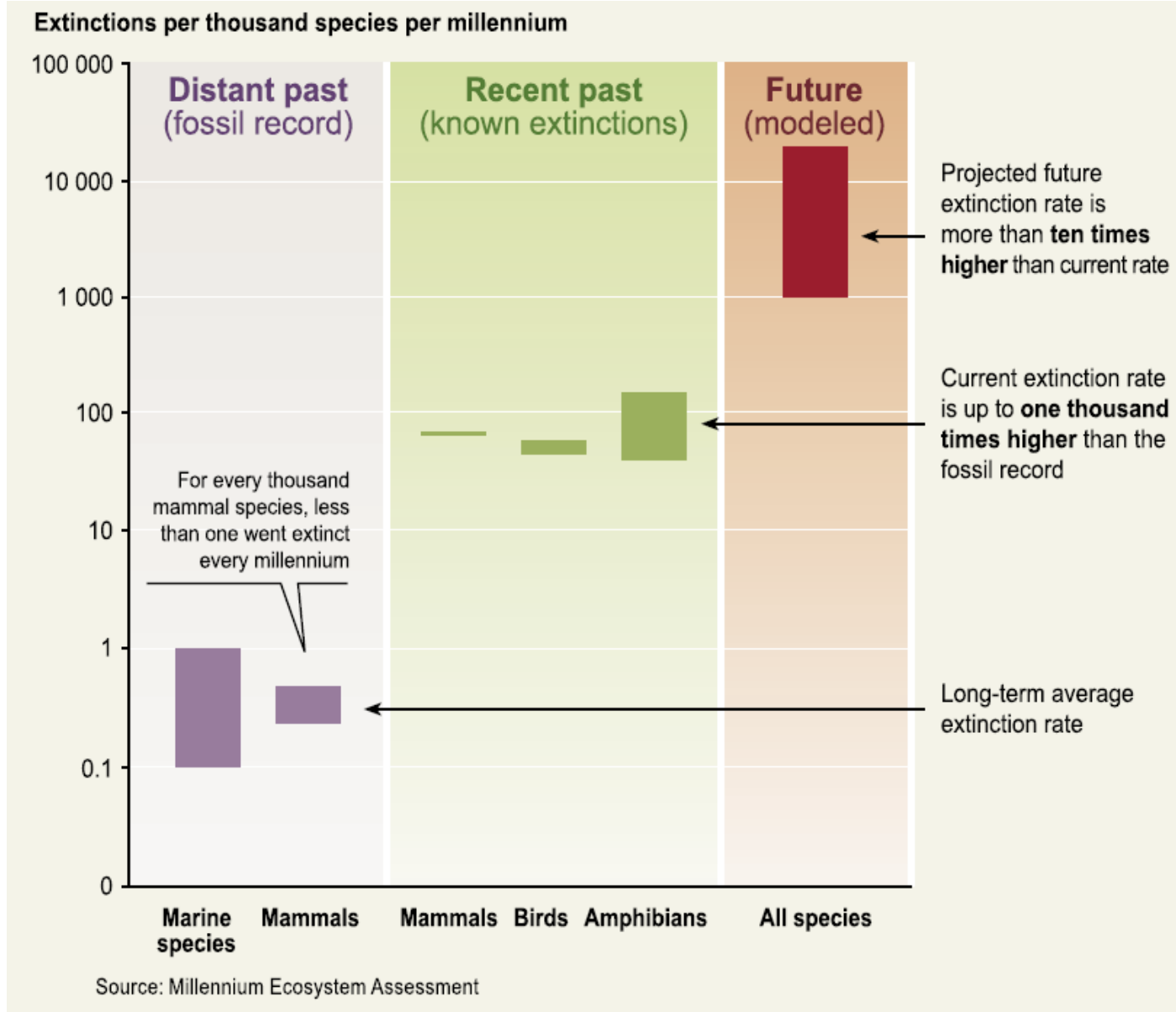


Fig. 5–Possible spatial relationships between service production areas (P) and service benefit areas (B). In panel 1, both the service provision and benefit occur at the same location (e.g. soil formation, provision of raw materials). In panel 2 the service is provided omni-directionally and benefits the surrounding landscape (e.g. pollination, carbon sequestration). Panels 3 and 4 demonstrate services that have specific directional benefits. In panel 3, down slope units benefit from services provided in uphill areas, for example water regulation services provided by forested slopes. In panel 4, the service provision unit could be coastal wetlands providing storm and flood protection to a coastline.



Extinctions



Cities and biodiversity

- The full text of Cities and Biodiversity Outlook is available online at www.cbd.int/en/subnational/partners-and-initiatives/cbo.
- Cities and Biodiversity Outlook was supported by the Government of Japan through the Japan Biodiversity Fund, by the European Union and several national research councils in Europe through BiodivERsA, and by SIDA through The Resilience and Development Program—SwedBio.

Cities and Biodiversity Outlook

Action and Policy A Global Assessment of the Links between Urbanization, Biodiversity, and Ecosystem Services



Convention on
Biological Diversity

Stockholm Resilience Centre
Research for Governance of Societal-Ecological Systems



ICLEI
Local
Governments
for Sustainability

Ten key messages

Ten Key Messages

1
Urbanization is both a challenge and an opportunity to manage ecosystem services globally.

2
Rich biodiversity can exist in cities.

3
Biodiversity and ecosystem services are critical natural capital.

4
Maintaining functioning urban ecosystems can significantly enhance human health and well-being.

5
Urban ecosystem services and biodiversity can help contribute to climate-change mitigation and adaptation.

6
Increasing the biodiversity of urban food systems can enhance food and nutrition security.

7
Ecosystem services must be integrated in urban policy and planning.

8
Successful management of biodiversity and ecosystem services must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement.

9
Cities offer unique opportunities for learning and education about a resilient and sustainable future.

10
Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.

Tropical and subtropical wildlife versus urban blue-green fingers

- Of course there is a need for more research to look carefully whether blue-green wedges close to dwellings in tropical and subtropical regions always are safe in terms of wildlife.
- One can imagine citizens in south Asia, Africa or south America being anxious living too close to dangerous wildlife.
- The European situation is quite different, for dangerous animals for example are rarely living close to cities.
- Further social and biological research on this topic is urgently needed.

Conclusion: towards an ecopolis

- Ecosystem services have urgently to be taken into account in urban and rural planning.
- This course '*environmental sustainability*' aimed to awake architects and planners to implement ecology in their designing of dwellings, city quarters, cities and rural areas and provided tools and guidelines for the urgent transition towards an **ecopolis**.

Erik ROMBAUT, 2015.
