MODULE 2.

Improving measurement and assessment for better governance and wise use

Objectives of Module 2

- To **explain why it is important to measure** the ES provided by wetlands
- To **present the main categories of indicators** that are available to measure and value wetlands' ES , in order to contribute to their wise management
- To explain the **uses, advantages and limitation of monetary valuation**
- To give **some examples** to illustrate these points
- To **practice** the choice of methodologies

The Economics of Ecosystems & Biodiversity

Indicators and methodologies

For more information: Chapter 3 of the TEEB W&W report

By Daniela Russi
Senior Policy Analyst, Institute for European Environmental Policy, IEEP

and Patrick ten Brink
Senior Fellow | Head of Brussels office & Environmental Economics Programme

Why it is important to measure the ES provided by wetlands?

- To **understand, appreciate** and **demonstrate** the ES we obtain from wetlands, and promote their protection/restoration
- To **discuss trade-offs** between alternative policies (e.g. provisioning versus regulating/supporting ES)
- To **improve wetland management**, prioritise interventions, monitor results

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How to measure the ES provided by wetlands?

1) **Qualitative, non-numerical indicators**, can be used to describe the ES that are not easily translated into quantitative information

This can help make them visible and promote their conservation

Examples:

- Changes in the beauty of a landscape
- Impacts on security and wellbeing
- Impacts on cultural and spiritual values

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Stoeng Treng Ramsar site, Cambodia

- Qualitative and quantitative indicators used to estimate the importance of protected wetlands to local communities
- Benefits were identified through a resource flow diagram, demonstrating the flow of benefits from the wetland to the beneficiaries
- They were rated according to their importance on a scale of 1–5 using focus group discussions

Identified benefits	*Quantified importance*
Resource: fishing	5
Water: washing	5
Water: cooking and drinking	5 for each benefit
Water: transportation	4
Fibre: construction (sand and rock)	3
Fibre: fuel wood	3
Biodiversity resources: aquatic animals	2
Biodiversity resources: water birds	2
Biodiversity resources: reptiles	2
Biodiversity resources: traditional medicines	2
Water: irrigation	2
Resource: floodplain rice	1
Recreation: swimming	1
Other: dolphins	1

Source: Kettunen and ten Brink (ed.) (2013), based on Chong, J. (2005)

2) <u>Quantitative indicators</u> use physical/numerical units of measurement. Examples:

- <u>Provisioning ES</u>:
  - ***Freshwater abstraction*** *in a watershed (m^3/year)*
  - ***Crop production*** *(tonnes/year)*
- <u>Regulating ES</u>:
  - **Carbon sequestered** in peatlands (tonne/ha per year)
  - **Removal of nutrients** by wetlands (tonnes/year or %)
- <u>Cultural ES</u>:
  - Changes in the **number of residents** (n.)
  - **Number of visitors** to sites per year

Nitrification in salt marshes

- Nitrogen plays a key role in determining the presence of the different species in most coastal areas and is often a **limiting factor** for primary production
- The excess influx of nutrients like nitrogen and phosphorus (mainly caused by runoff of inorganic fertilisers, manure and detergents) results in **eutrophication**
- Piehlert and Smyth (2011) demonstrated that salt marshes and temperate shallow-water estuarine ecosystems (e.g. submerged aquatic vegetation and oyster reefs) present significant rates of **bacterial nitrogen removal** (natural denitrification)
- The nitrogen removal function of these habitats provides an important contribution to the estuarine ecosystems

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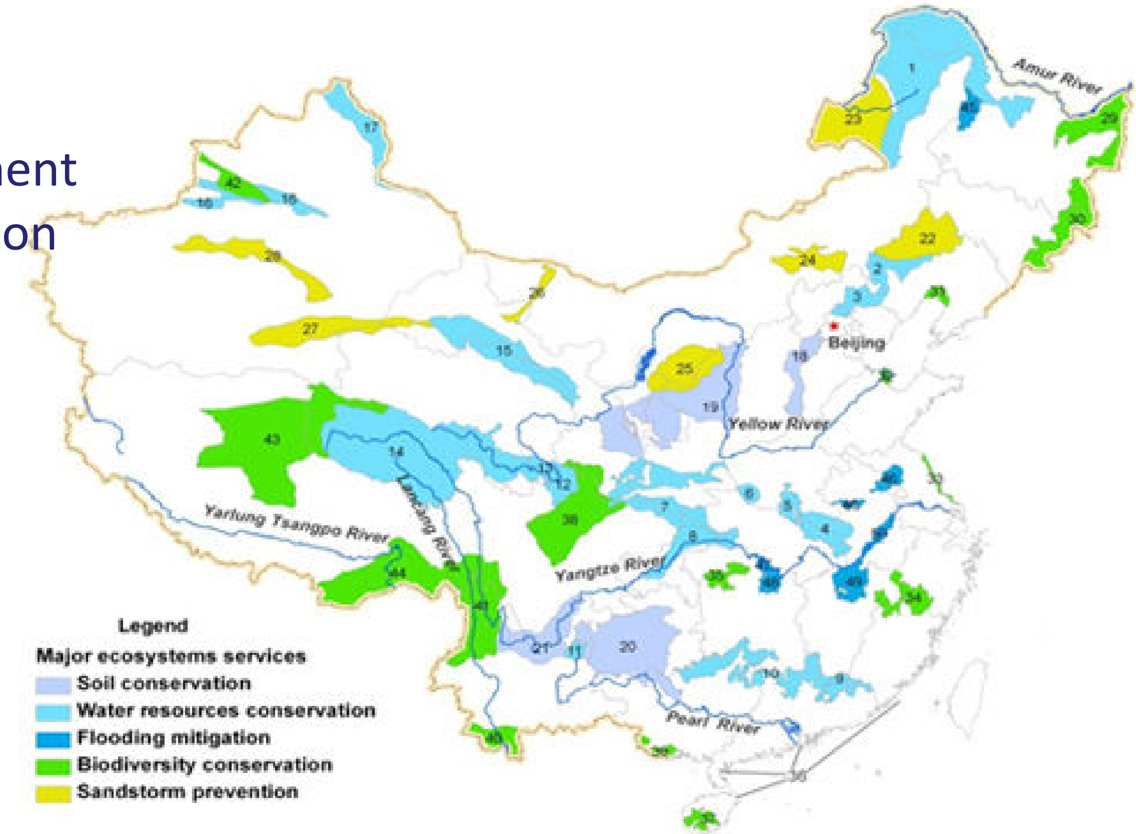
3) **Geospatial mapping** allows the quantitative data to be linked with geographical information (e.g. which community benefits from clean water provision from a given wetland)

It can also be used to model the outcomes of alternative land and water management decisions on specific wetland sites

Yangtze River in China

- InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a software package that models ES on the basis of biophysical and economic ‘production functions’
- InVEST was used in Baoxing County to assist local government to determine Ecological Function Conservation Areas (EFCA), in the Land Use Master Plan
- Sediment retention, water retention and carbon models were used to estimate and map the annual average delivery of the ES



Source: TEEBcase by Yukuan et al. (2010)

3) **Monetary valuation**, which uses monetary unit of measurements:

- Methodologies based on **markets**
- Methodologies based on **revealed preferences**
- Methodologies based on **stated preferences**

Direct market valuation approaches

- Assessment based on **market prices** (e.g. using the price of timber or food or carbon credits in the market)
- Methodologies based on the estimated **cost** of
  - **avoided damage** (e.g. for ecosystem services like flood or storm prevention)
  - **replacement** of ES (e.g. the cost of mechanical water depuration to replace natural depuration provided by healthy ecosystems)
  - **mitigation** (e.g. based on the cost of preventive expenditures to avoid flooding, which could have been avoided by natural infrastructure like mangroves)
  - **restoration costs** (e.g. the costs related to restore a degraded ecosystem)
- **Production functions** or **factor income**, which estimate the effect of ecosystem services on production or income (e.g. increased income of fishermen due to improved water quality and therefore of available fish)

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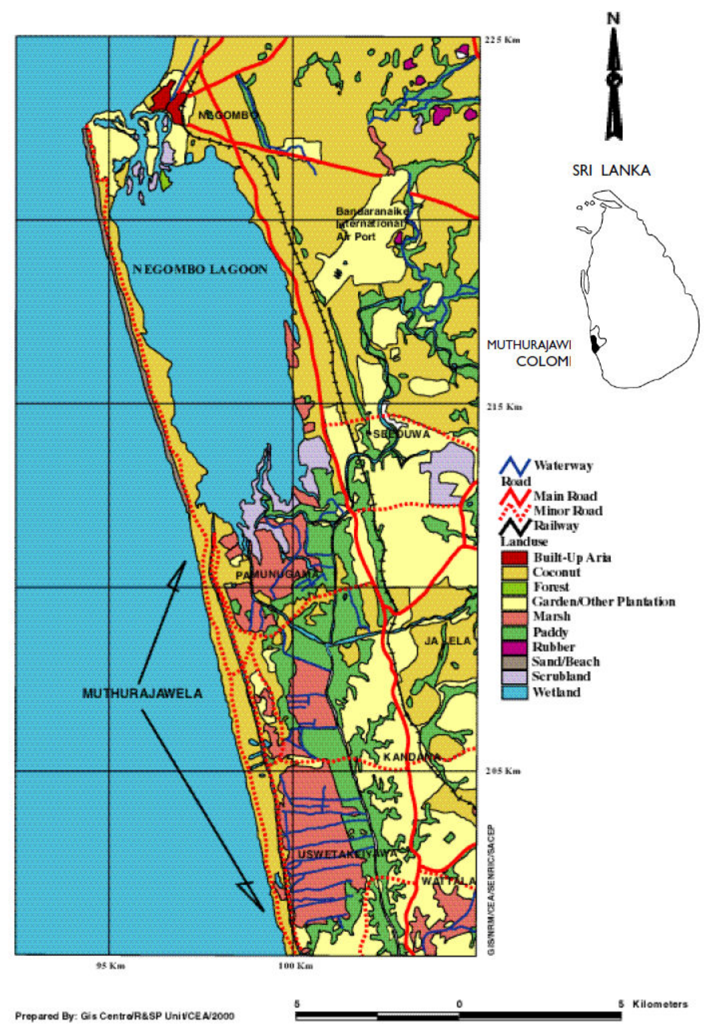
Muthurajawela Wetland Sanctuary (Sri Lanka)

- The flood attenuation ES of this Ramsar site were valued using the replacement cost approach
- The valuation used the cost of an hypothetical artificial drainage system supported by a pumping station, which would be needed to replace the flood attenuation ES
- The economic value of flood attenuation ES was estimated at around US$5.4 M/yr (US$1,700/ha per yr), including construction and maintenance costs



Source: Emerton (2003a), Emerton and Kekulandala (2003)

slide by Sabrina Dekker

Methodologies based on revealed preferences

- **Travel Cost method**, which estimates the value of a protected area through the amount of time and money people spend to visit (direct costs + opportunity costs)
- **Hedonic Pricing method**, which use changes in property prices due to changes in the surrounding environment as an indicator of landscape value

The Hanauma Bay Nature Preserve (Hawaii)

- The Travel Cost methodology was used to estimate value of the area, including:
    - costs of transportation
    - costs related to the travel time
    - the local expenditures
- The result was a value of $97M

- The valuation study was an important input for the subsequent setting of reef damage penalties, as it served as a measure to determine the possible loss from degradation

Source: TEEBcase by Beukering an d Cesar (2010)

Methodologies based on stated preferences:

- **Contingent Valuation,** which is based on asking people's
  - **Willingness to pay (WTP)** for improved environmental protection

  or

  - **Willingness to accept (WTA)** compensation for a reduction in the environmental quality

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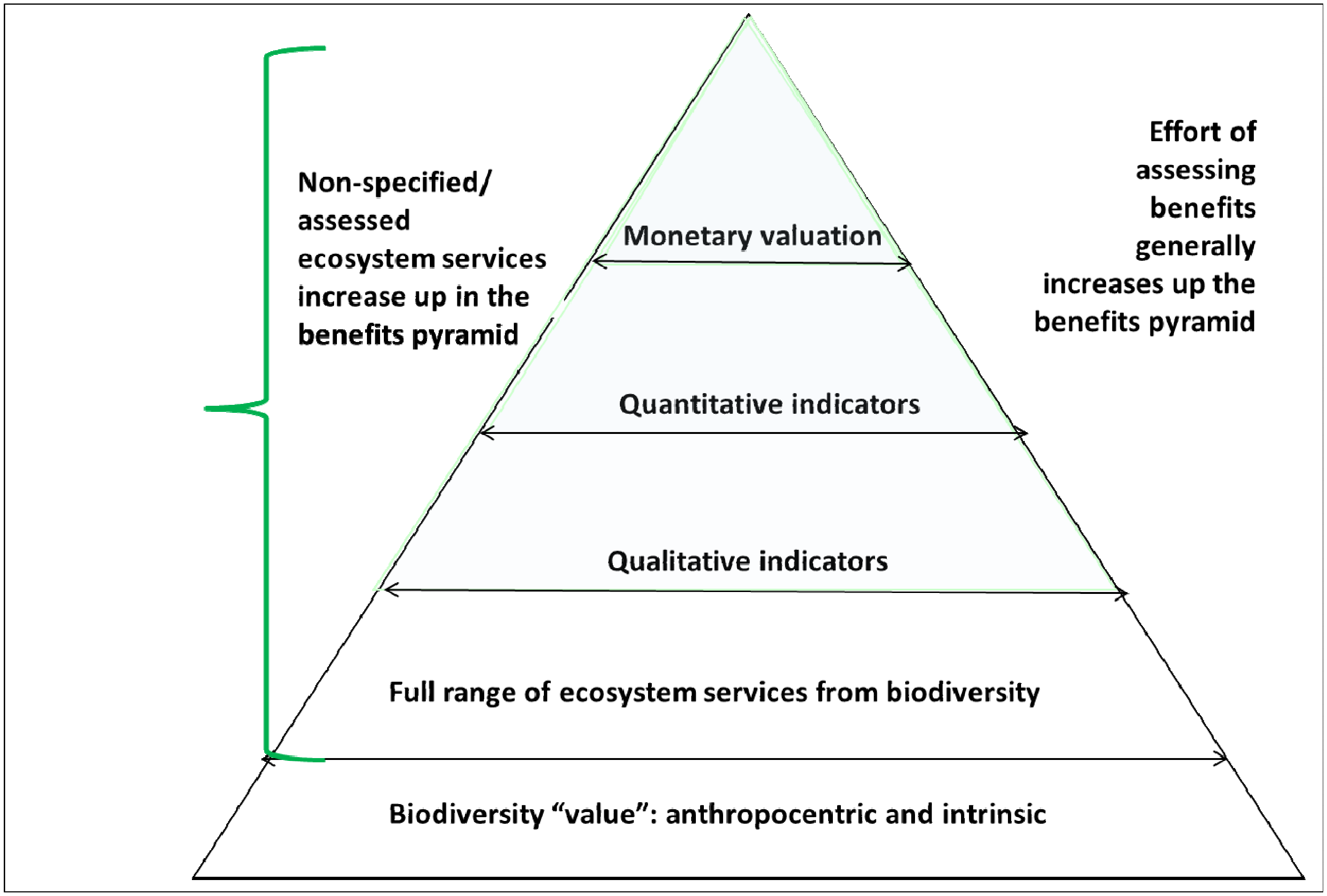
Scheldt estuary, Belgium and the Netherlands

- Comparison between dikes and flood plains vs. storm surge barrier for flood protection
- Contingent valuation to assess the recreational benefits of creating new floodplains
- Based on these results, an integrated management plan was approved, consisting of restoration of approximately 2,500 ha of intertidal and 3,000 ha of non-tidal areas, reinforcement of dikes, and dredging to improve the fairway to Antwerp


Picture: http://www.sigmaplan.be

Different kinds of indicators of ecosystem services

Qualitative, quantitative and monetary assessments can be used and combined, depending on the objectives, available information, available budget



slide by Patrick ten Brink (adapted)

CAVEATS

- Monetary valuation can represent only a subset of the values of nature (incommensurability)
- The results need to be interpreted with caution:
  - *Scientific uncertainty -> need for many assumptions*
  - *Lack of data*
  - *Local specificities/ changing conditions over time*
  - *Stated/revealed preference methods assume knowledge on the ES (-> cultural ES more visible than regulating/supporting ES)*

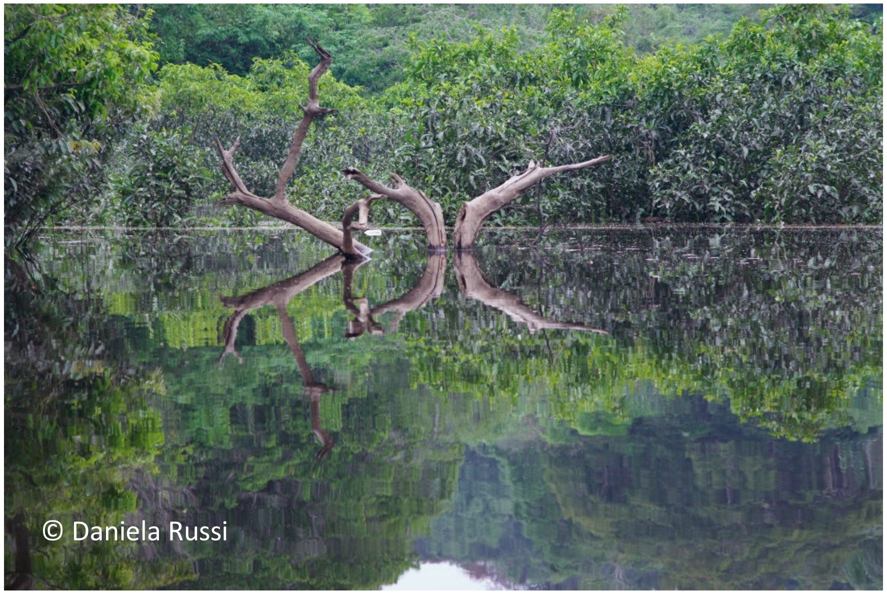
- In some cases, monetary valuation can even be counterproductive (see e.g. discussion on commodification of nature, crowding-out)

The role of monetary valuation

- Monetary valuation can give a contribution in showing (part of) the economic consequences of nature degradation

- It can act as a counterweight to the pressures towards degradation (often economic)

- It can be used as a policy tool to promote conservation with social actors with no interest in nature conservation per se



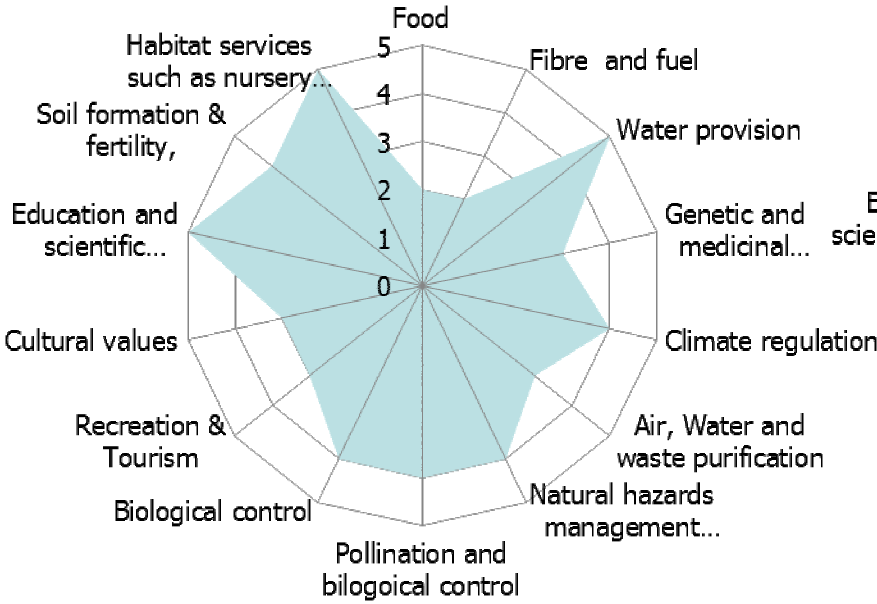
Discussing trade-offs

- Many provisioning ES (e.g. food, timber) have a market price and are more visible and often favoured over other ES

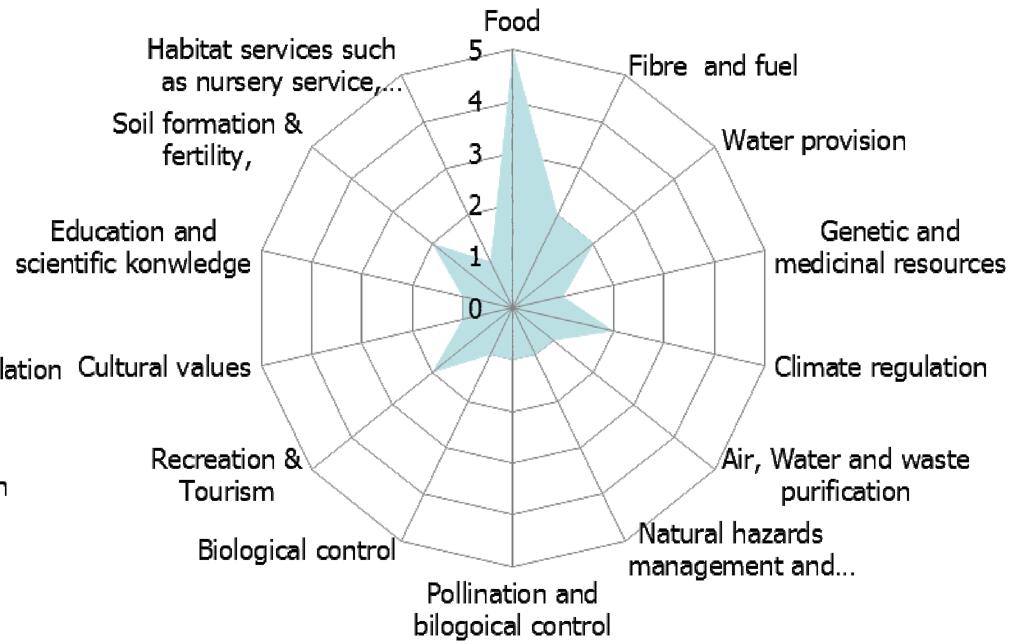
- The calculation of the economic value of non-provisioning ES (e.g. water purification, waste water treatment, erosion control) may contribute to the arguments for their conservation, wise use and restoration

Trade-offs across land use options (illustrative)

Extensive agriculture



Intensive agriculture



Source: ten Brink (2013) EU FP7 OPERAS project

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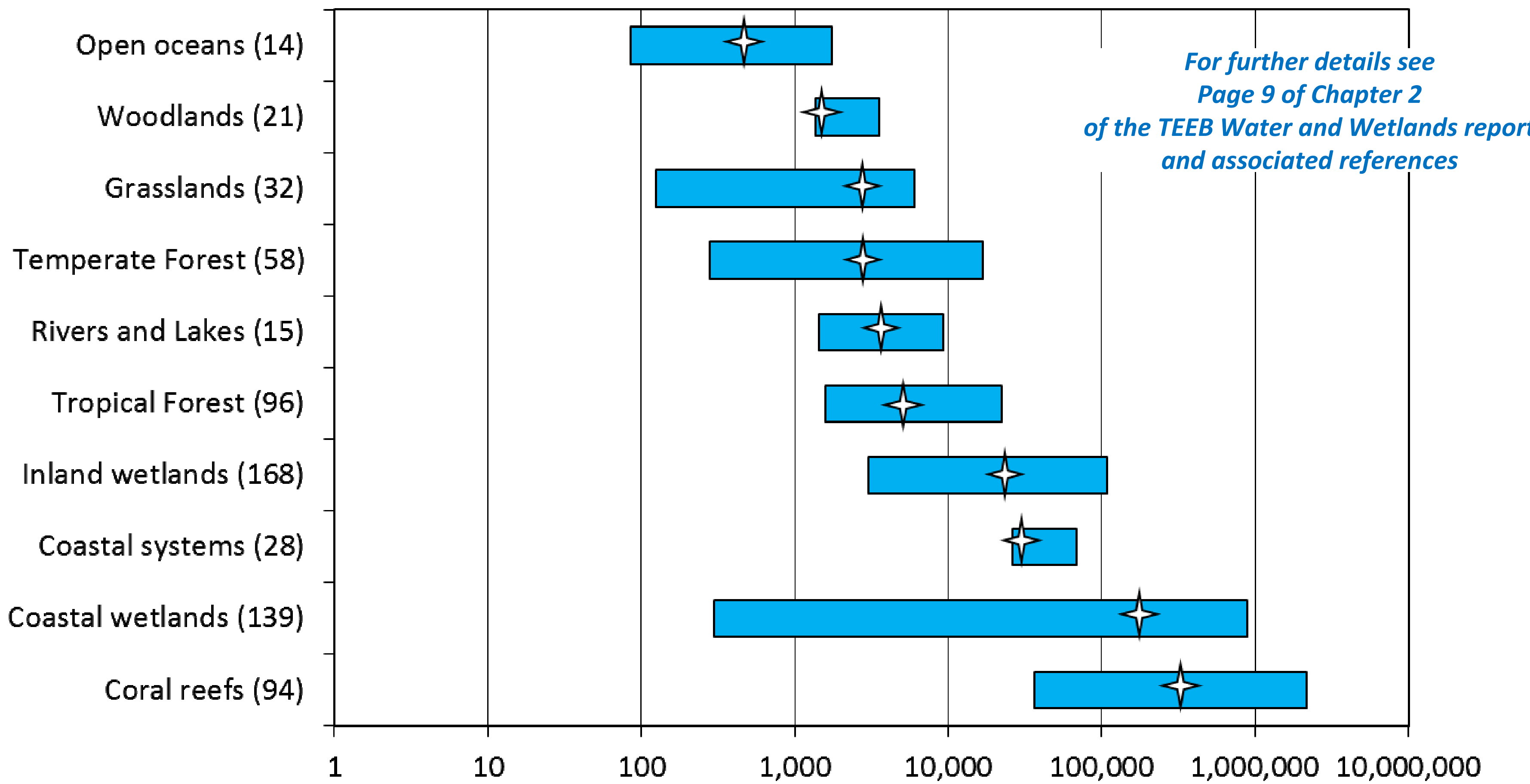
Values of Ecosystem Services



Sources: de Groot et al 2012 building on TEEB 2010

Values of both coastal and inland wetland ecosystem services are typically higher than for other ecosystem types

	Coral reefs		Mangroves & tidal marshes		Coastal systems (habitat complexes e.g. shallow seas, rocky shores & estuaries)		Inland vegetated wetlands (floodplains, swamps/marshes and peatlands)		Freshwater lakes & rivers		
Ecosystem services	Relative ecosystem service importance	No. of valuation studies	Relative ecosystem service importance	No. of valuation studies	Relative ecosystem service importance	No. of valuation studies	Relative ecosystem service importance	No. of valuation studies	Relative ecosystem service importance	No. of valuation studies	TOTAL
Provisioning											
Food	•	22 ☺	●	12 😐	•	14 ☺	●	16 ☺	●	3 ☹	67
(Fresh) water supply	n/a	n/a	·	3 😐	·	1 ☹	●	6 ☹	●	2 ☹	12
Raw materials	·	6 😐	●	18 ☺	•	5 😐	•	12 ☺	•	1 ☹	42
Genetic resources	·	1 ☹	·	0 ☹	·	0 ☹	·	1 ☹	·	0 ☹	2
Medicinal resources	·	0 ☹	·	2 😐	·	0 ☹	·	1 ☹	·	0 ☹	3
Ornamental resources	•	5 😐	·	0 ☹	·	0 ☹	·	1 ☹	·	0 ☹	6
Regulating											
Influence on air quality	·	0 ☹	·	1 ☹	·	0 ☹	·	0 ☹	·	0 ☹	1
Climate regulation	•	1 ☹	•	6 ☺	•	0 ☹	•	5 😐	•	1 ☹	13
Moderation of extreme events	●	13 ☺	●	13 ☺	•	1 ☹	●	7 ☹	●	0 ☹☹	34
Regulation of water flows	n/a	n/a	·	0 ☹	·	0 ☹	●	4 ☹	●	0 ☹☹	4
Waste treatment/ water purification	·	2 😐	●	4 ☹	•	0 ☹	•	9 😐	•	2 ☹	17
Erosion prevention	·	1 ☹	●	3 ☹	•	0 ☹	•	1 ☹	·	0 ☹	5
Nutrient cycling/ maintenance of soil fertility	•	0 ☹	●	1 ☹☹	•	4 😐	●	5 ☹	•	1 ☹☹	11
Pollination	n/a	n/a	·	0 ☹	·	0 ☹	·	1 ☹	·	0 ☹	1
Biological control	·	2 😐	●	0 ☹☹	•	1 ☹	•	1 ☹	•	0 ☹	4
Habitat											
Lifecycle maintenance (a.k.a. biodiversity)	•	0 ☹	•	33 ☺	•	2 ☹	●	2 ☹	●	0 ☹☹	37
Gene pool protection	?	8 😐	?	5 😐	?	1 ☹	?	7 😐	?	1 ☹	22
Cultural											
Aesthetic information	●	12 ☺	•	0 ☹	•	1 ☹	•	2 😐	•	0 ☹	15
Recreation/ tourism opportunities	●	31 ☺	•	13 ☺	•	7 😐	•	9 ☺	●	5 ☹	65
Inspiration for culture, art & design	●	0 ☹☹	•	0 ☹	•	0 ☹	●	2 ☹	●	0 ☹☹	2
Spiritual experience	●	0 ☹☹	•	0 ☹	•	0 ☹	●	0 ☹☹	●	0 ☹☹	0
Cognitive information (education & science)	·	0 ☹	·	0 ☹	·	1 ☹	●	0 ☹☹	●	0 ☹☹	1

Sources: TEEB (2010); de Groot et al. (2010); MA (2005b); Danone Fund for Nature (2010).

For further details see Annex II (page 62 to 71) of the TEEB Water and Wetlands report

Practical Exercise Questions – Module 2

- Brainstorm the main beneficiaries of the ecosystem services provided by the wetland. Choose two beneficiaries - What ecosystem services they benefit from? How are they likely to suffer the impacts of (positive and negative) changes to the wetland ecosystems?
- How can the ecosystem services provided by the wetland be measured? Would you use qualitative, quantitative or monetary indicators?

Beneficiaries of the ES	ES they benefit from	Impacts suffered from a change in the ES provided by the wetland	How can ES be measured