Ecosystem services and chemical risk assessment: ECETOC Task Force

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Robust and efficient environmental risk assessment procedures require clear protection goals specifying what to protect, where to protect it and over what time period.

Assessing chemical risk within an ecosystem services framework

- What portfolio of services are required from a particular landscape and by whom?
- Which ecological components provide the services demanded and how are they related to service provision?
- What is the relationship between chemical exposure and key service provider attributes?
- What are the interactions (synergies, trade-offs) between ecosystem services?

(Maltby, 2013 *Environmental Toxicology & Chemistry*, 32: 974)

European Food Safety Authority

EFSA Journal 2010;8(10):1821

SCIENTIFIC OPINION

Scientific Opinion on the development of specific protection goal options for environmental risk assessment of pesticides, in particular in relation to the revision of the Guidance Documents on Aquatic and Terrestrial Ecotoxicology (SANCO/3268/2001 and SANCO/10329/2002)[1]

*"the **entities** that need to be protected, the **attributes and/or functions** of those entities, as well as the **magnitude, temporal and spatial scales of effects** on these attributes and/or functions that can be tolerated without impacting the general protection goal and the required degree of certainty with which the protection goal defined should be achieved."*

ECETOC Task Force: Chemical Risk Assessment – Ecosystem Services

- Investigate the wider applicability of the risk assessment paradigm developed by EFSA.
- Develop a framework for the chemical industry applicable to all sectors.
- Use case studies to demonstrate how the framework would be applied.
- Recommendations on how risk assessments schemes need to be evolved.

Task Force members

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ExxonMobil

Case studies

- Oil refinery: Exposure of aquatic habitats, including wetlands to the chemicals present in waste water from a single refinery in an estuarine location.
- Oil dispersants: Exposure from the use of dispersants in ocean and estuarine/transitional environments, not including the impact of spilt oil.
- Down-the-drain chemicals: Continuous exposure of a wide range of ecosystems to a complex mixture of chemicals from the disposal of consumer products/pharmaceuticals via household waste systems into the municipal waste water treatment/disposal infrastructure.
- Persistent organic pollutants: Potential impacts to POP-type chemicals in remote (pristine) areas, e.g. high altitude alpine and arctic regions.

Step 1: Habitats & services

Habitat type
Urban
Cropland
Grassland
Woodland and forest
Heathland and shrub
Sparsely or unvegetated land
Inland wetlands
Rivers and lakes
Marine inlets and transitional waters
Coastal areas
Shelf
Open ocean

12 x 23 matrix

MA category	Ecosystem service
Provisioning services	Food
	Fibre and fuel
	Genetic resources
	Biochemical / natural medicines
	Ornamental resources
	Fresh water
Regulatory services	Pollination
	Pest & disease regulation
	Climate regulation
	Air quality regulation
	Water regulation
	Erosion regulation
	Natural hazard regulation
	Water purification / soil remediation / waste treatment
Cultural services	Spiritual and religious values
	Education and inspiration
	Recreation and ecotourism
	Cultural diversity and heritage
	Aesthetic values
	Sense of place
Supporting services	Primary production, photosynthesis
	Soil formation and retention

Step 2: Relative importance

Ecosystem service		Terrestrial				
		Urban	Cropland	Grassland	Woodland and forest	Heathland and shrub
EUNIS habitat code		**J**	**I**	**E**	**G**	**F**
Provisioning services	Food	++	+++	++	+	++
	Fibre and fuel	++	+++	++	+++	++
	Genetic resources	++	++	+++	+++	+++
	Biochemical / natural medicines	?	++	+	++	++
	Ornamental resources	+	+	+	+	+
	Fresh water	++	++	+	+++	+++
	Pollination	++	+++	+++	++	+++
	Pest and disease regulation	++	+++	+	++	+
	Climate regulation	+++	+++	++	+++	++

Step 3: Potential impact

Ecosystem service	Freshwater Wetlands	Rivers and Lakes	Coastal wetlands	Inlets and transitional waters	Coastal	Shelf
Food						
Fibre and fuel						
Genetic resources						
Biochemical / natural medicines						
Ornamental resources						
Fresh water						
Pollination						
Pest & disease regulation						
Climate regulation						
Air quality regulation						
Water regulation						
Erosion regulation						
Natural hazard regulation						
Water purification / soil remediation / waste treatment						

Severe impact

Moderate impact

Low/no impact

Step 4: Prioritization

Ecosystem service	Wetlands	Rivers & lakes	Inlets and transitional waters	Coastal	Shelf
Food	++	++	++	++	++
Fibre and fuel	++	+	++	+	+
Genetic resources	+++	+++	+++	+++	+++
Biochemical / natural medicines	+	+	++	+	+
Ornamental resources	+	+	+	+	
Fresh water	+++	+++			
Pollination	++	+	++		
Pest & disease regulation	++	++	+	++	++
Climate regulation	+++	++	++	+++	+++
Air quality regulation	+	++	+	+++	+++
Water regulation	+++	+++	+++	+	
Erosion regulation	++	++	+	++	
Natural hazard regulation	++	++	+++	+++	++
Water purification / soil remediation / waste treatment	+++	+++	+++	++	++

Ecosystem service	Freshwater Wetlands	Rivers and Lakes	Coastal wetlands	Inlets and transitional waters	Coastal	Shelf
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Fibre and fuel						
Genetic resources						
Biochemical / natural medicines						
Ornamental resources						
Fresh water						
Pollination						
Pest & disease regulation						
Climate regulation						
Air quality regulation						
Water regulation						
Erosion regulation						
Natural hazard regulation						
Water purification / soil remediation / waste treatment						

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Pest & disease regulation						
Climate regulation						
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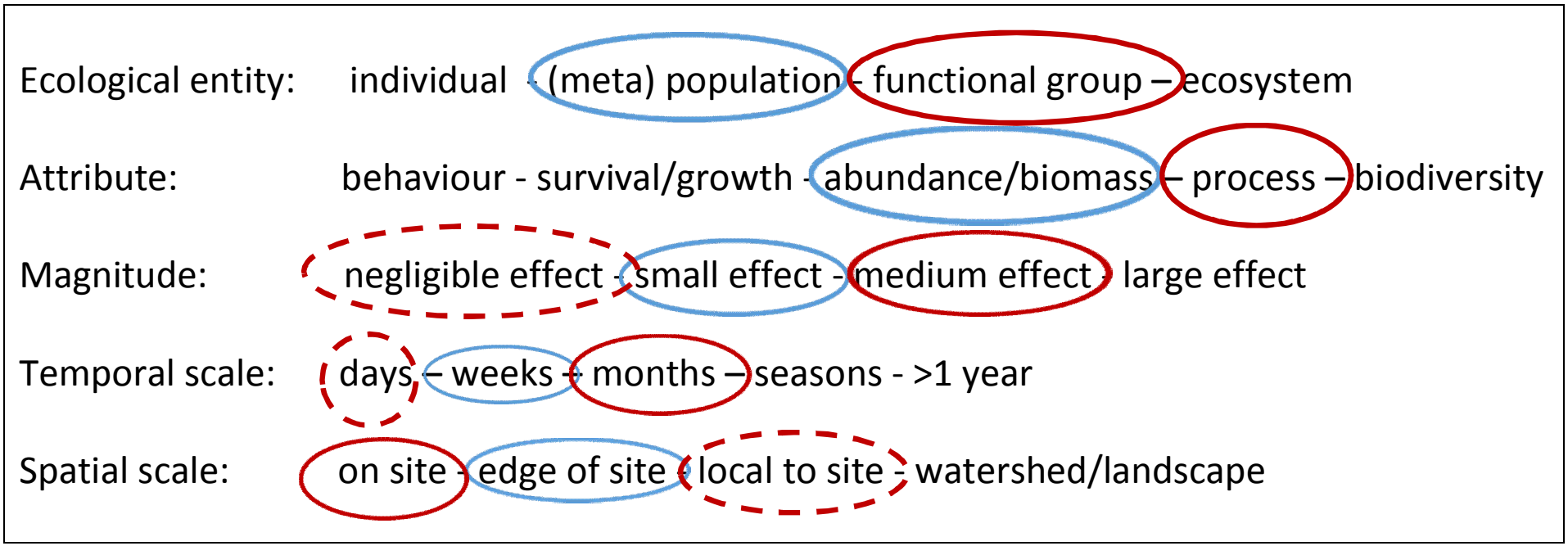
Water regulation						
Erosion regulation						
Natural hazard regulation						
Water purification / soil remediation / waste treatment						

Step 5: Specific Protection Goals

Genetic resources – aquatic invertebrates

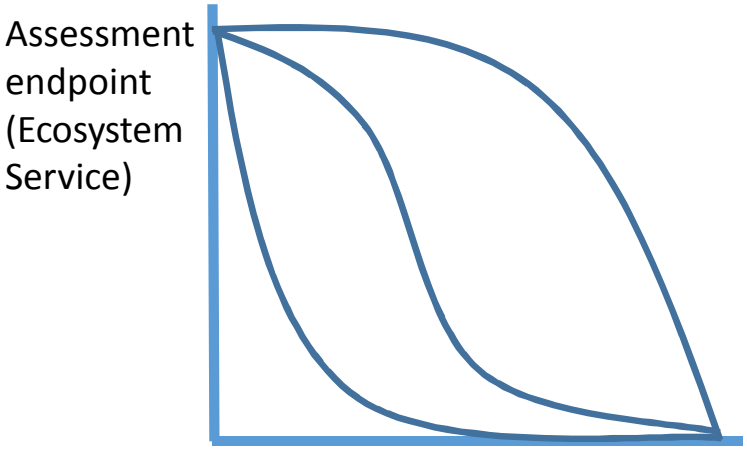
Water purification / soil remediation / waste treatment - microbes



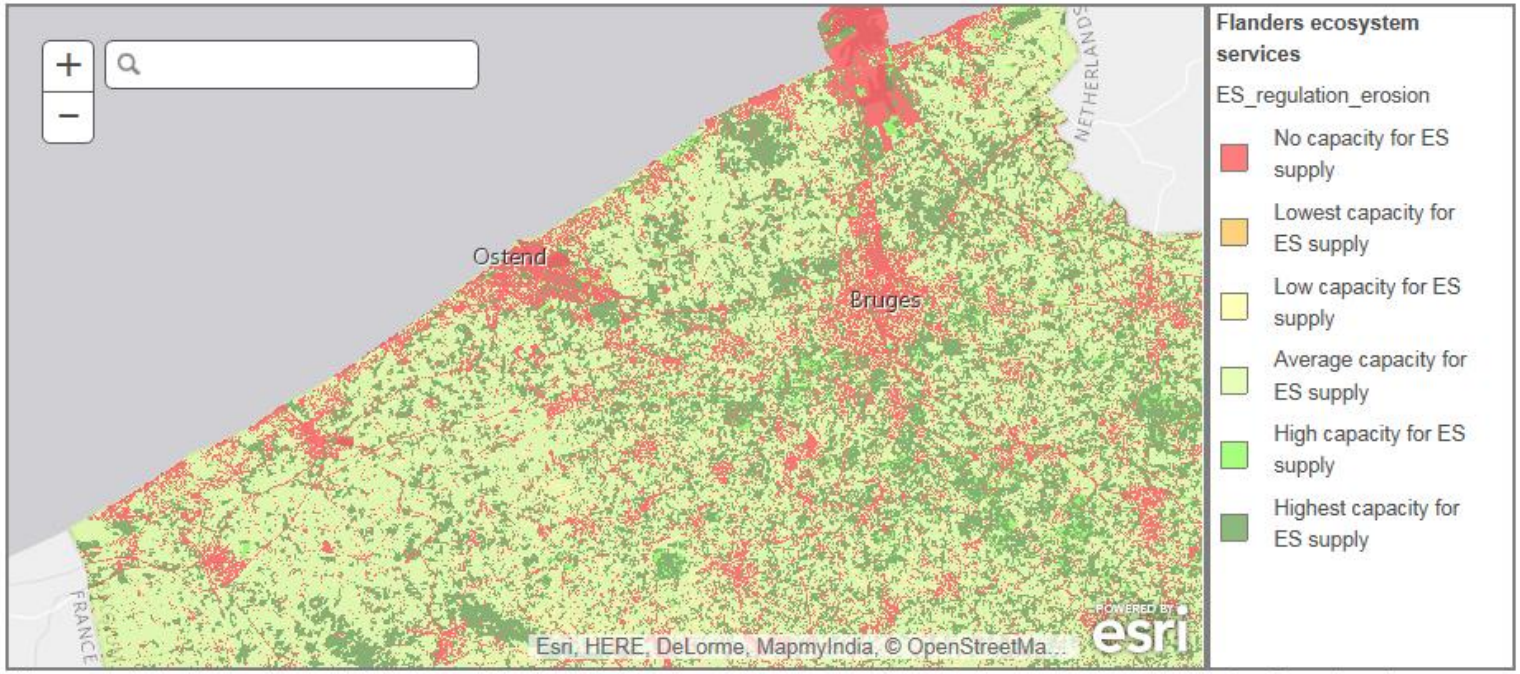
Next steps

Generating and interpreting ERA data.

- Linking standard test data to ecosystem services
  - Bees → pollination, fish → food, earthworms → soil structure
- Calculating thresholds and relationships
  - Ecological production functions (models)
- Developing scenarios that enable interactions between services to be explored.
  - Ecological/management scenarios and ecosystem service bundles



MAES Digital Atlas



This case study has been elaborated in the frame of the MESEU (Mapping of Ecosystems and their Services in the EU and its Member States) service contract for the European Commission

Conclusions

- Ecosystem services are particularly suited to identifying spatially explicit or scenario based specific protection goals
- ‘EFSA’ framework can be generalised to apply to all chemicals
- Identifying key service providing units and specific protection goals could help target prospective and retrospective risk assessment
- Risk assessment methodology requires development to accommodate assessment of specific protection goals.
- Opportunities to build on on-going activities in ecosystem service mapping to inform risk assessment, risk management and compensation options.
- Valuation of ecosystem services is required for assessing trade-offs.