Chemicals: Assessment of Risks to Ecosystem Services (CARES). Where are we now and where are we going?

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Fibre
Fuel
Food
Water

Recreation
Inspiration
Nature conservation

Climate regulation
Soil retention
Flood attenuation
Water purification
Pest & disease control

ECOSYSTEM SERVICES

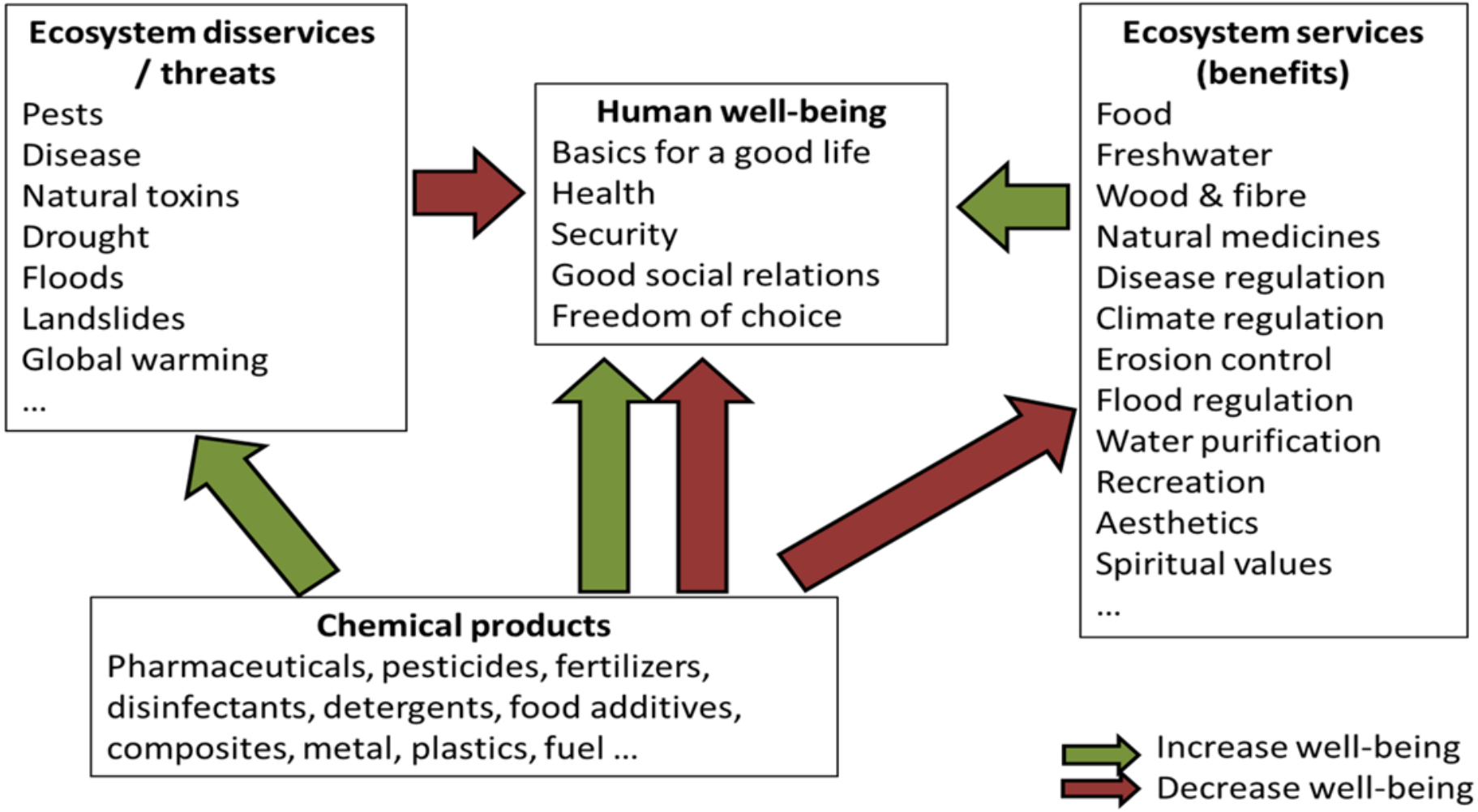
Direct and indirect contributions of ecosystems to human well-being*

NATURAL CAPITAL

Stocks of natural resources: rocks & minerals, soil , air, water, biodiversity

**Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.*2010, Brussels: Earthscan

Synthetic chemicals may increase or decrease human well-being



ES-based approaches for landscape scale RA and RM

- Is risk assessment environmentally relevant?
- Can we make regulatory protection goals more specific? Protection goals should indicate what to protect, where to protect it and over what time period
- Identifying specific protection goals for different uses of the landscape could be based on the services and benefits we want from ecosystems



Chemicals: **A**ssessment of **R**isks to **E**cosystem **S**ervices (**CARES**)

Aim: To facilitate engagement of the chemical industry, academia and regulators to help develop and evaluate the ecosystem service approach in guiding risk assessment schemes for any type of xenobiotic chemical.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Academia
Chemical Industry
EU and MS Regulatory Authorities
39 workshop participants
European Commission
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ENERPRISE
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efsa
European Food Safety Authority
Ministry of Infrastructure and the Environment
Environment Agency
National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

Clear advantages of using an ES approach, but also some challenges

Advantages	Challenges
Relevance	Anthropocentric
Transparency	Complexity
Integration	Tools
Communication	

(Maltby et al. 2017. *Science of the Total Environment* https://doi.org/10.1016/j.scitotenv.2017.10.094)

- Presumption that ecosystem service approaches provide better basis for environmental decision making.
- Actual realized benefit have not been systematically or rigorously evaluated.

(van Wensem et al 2017 *Integrated Environmental Assessment and Management* 13:41-51)

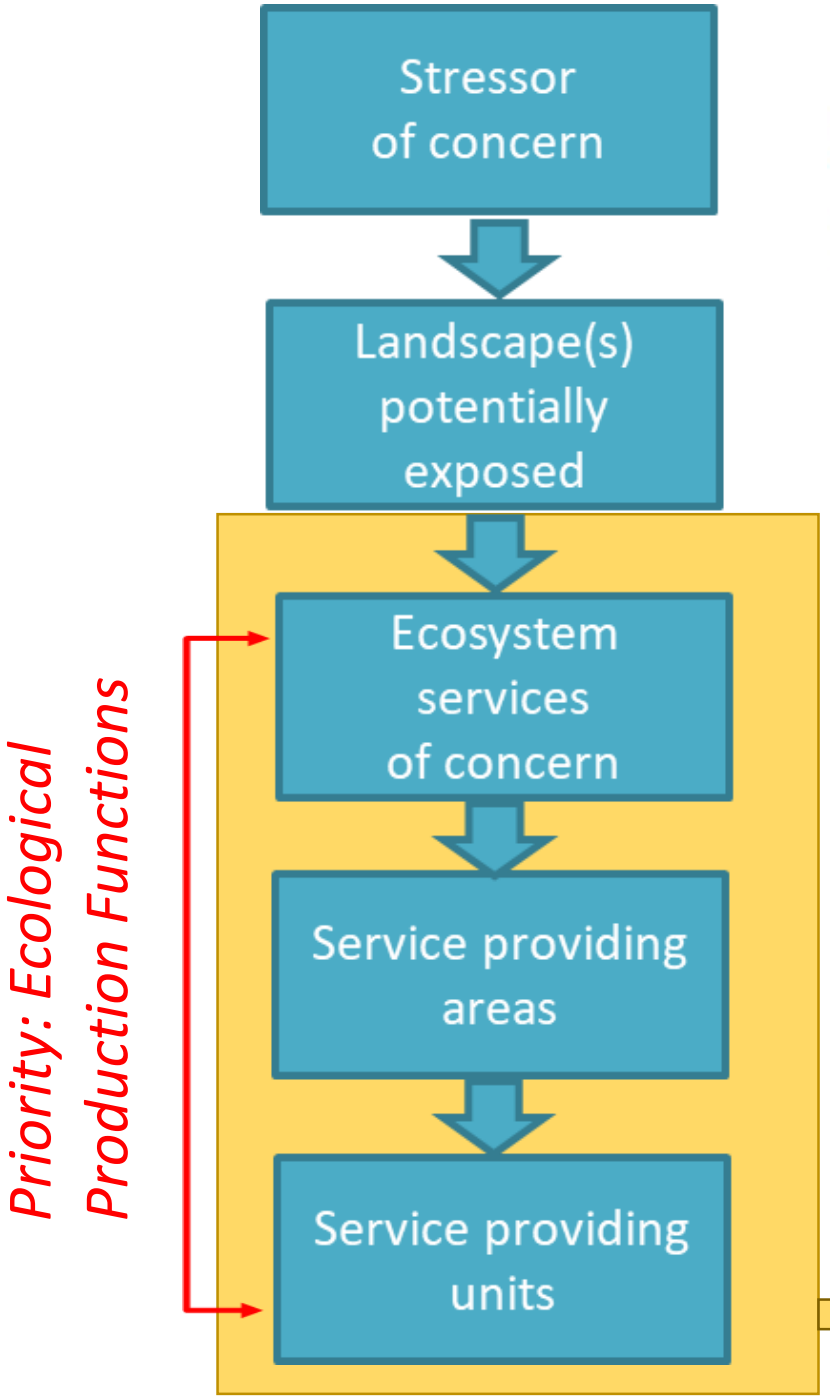
Assessing risk within an ecosystem services framework

- 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 stressor exposure and key service provider attributes?
- What are the interactions (synergies, trade-offs) between ecosystem services?

(Maltby, 2013 *Environmental Toxicology & Chemistry* 32: 974-983)

Research needs for prospective and retrospective RA

Research need	Prospective (%)	Retrospective (%)
Scenarios – develop and agree	81	10
EPF / mechanistic models	57	57
Guidance to link endpoints to ES (top down + bottom up)	33	48
Framework for decision making for risk assessors / risk managers	29	38
Calibration of tiered approach/evaluation of conventional tests	24	0
Landscape mapping	14	14
Illustrative case studies	14	14
Modelling of populations and landscapes	10	5
Risk assessors to offer options to RMs	10	10
Reference values for key ES	5	43
How do we measure/predict resilience and recovery?	5	14
Risk reduction/optimise	0	0
How to identify/engage stakeholders	0	0
Awareness – do not reinvent the wheel	0	0



GUIDANCE

EFSA Journal

ADOPTED: 21 April 2016

doi: 10.2903/j.efsa.2016.4499

Guidance to develop specific protection goals options for environmental risk assessment at EFSA, in relation to biodiversity and ecosystem services

EFSA Scientific Committee

Science of the Total Environment 580 (2017) 1222–1236

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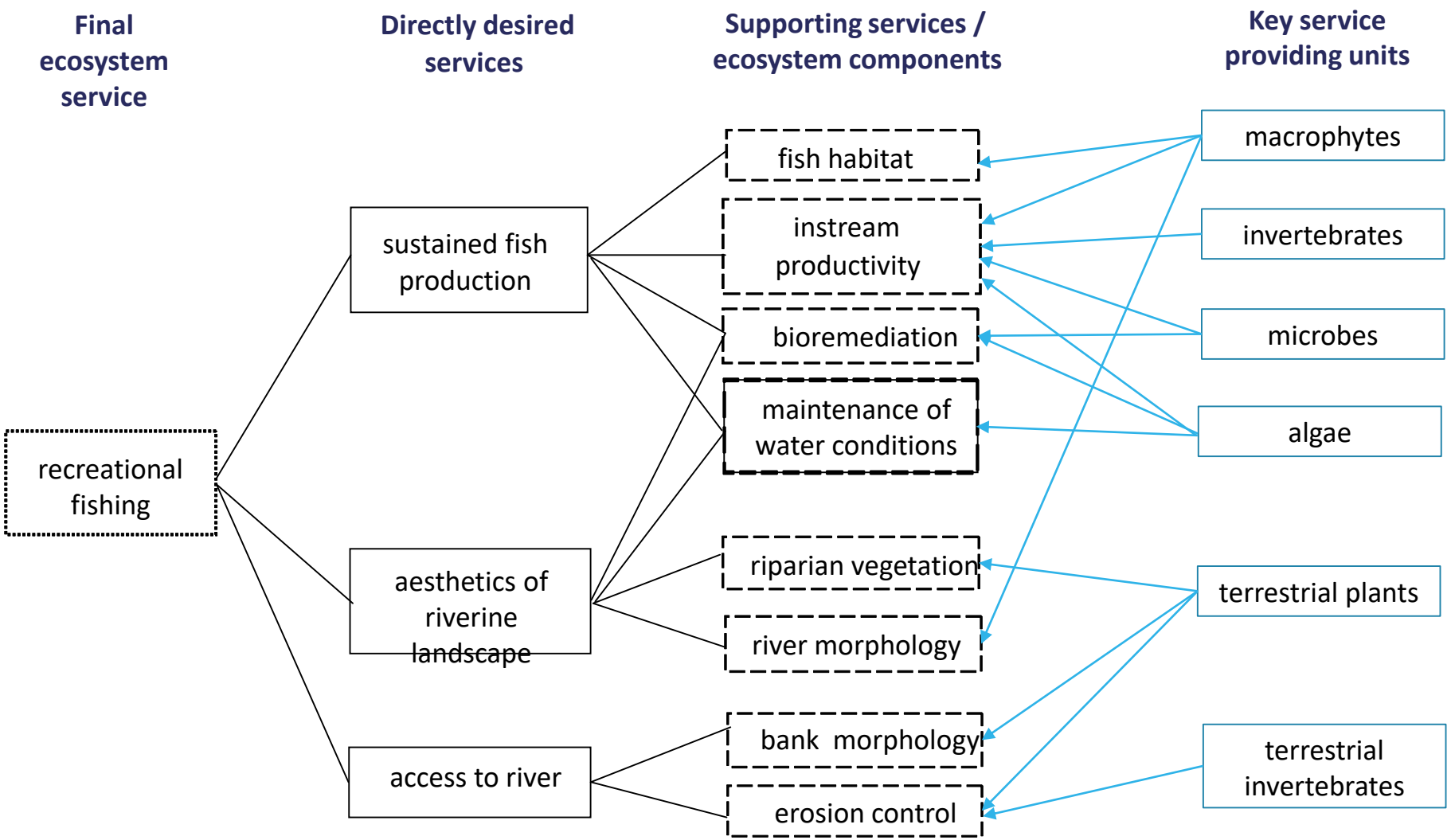
ELSEVIER

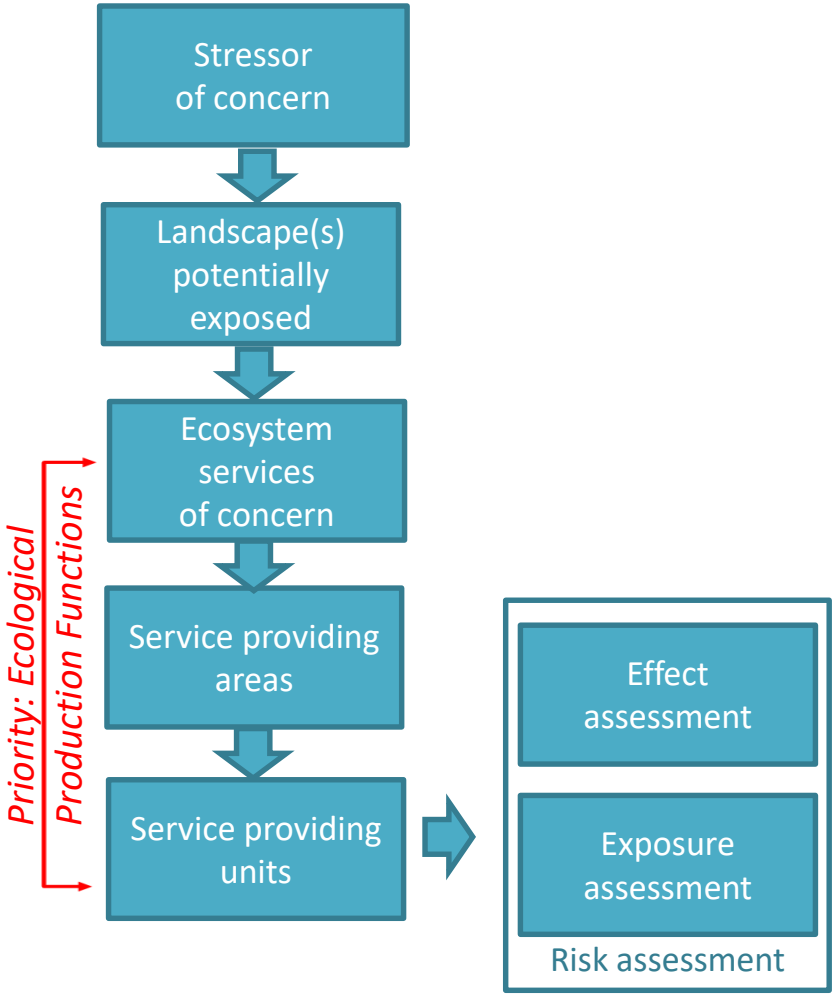
Is an ecosystem services-based approach developed for setting specific protection goals for plant protection products applicable to other chemicals?

Lorraine Maltby [a,*], Mathew Jackson [b], Graham Whale [b], A. Ross Brown [c], Mick Hamer [d], Andreas Solga [e], Patrick Kabouw [f], Richard Woods [g], Stuart Marshall [h]

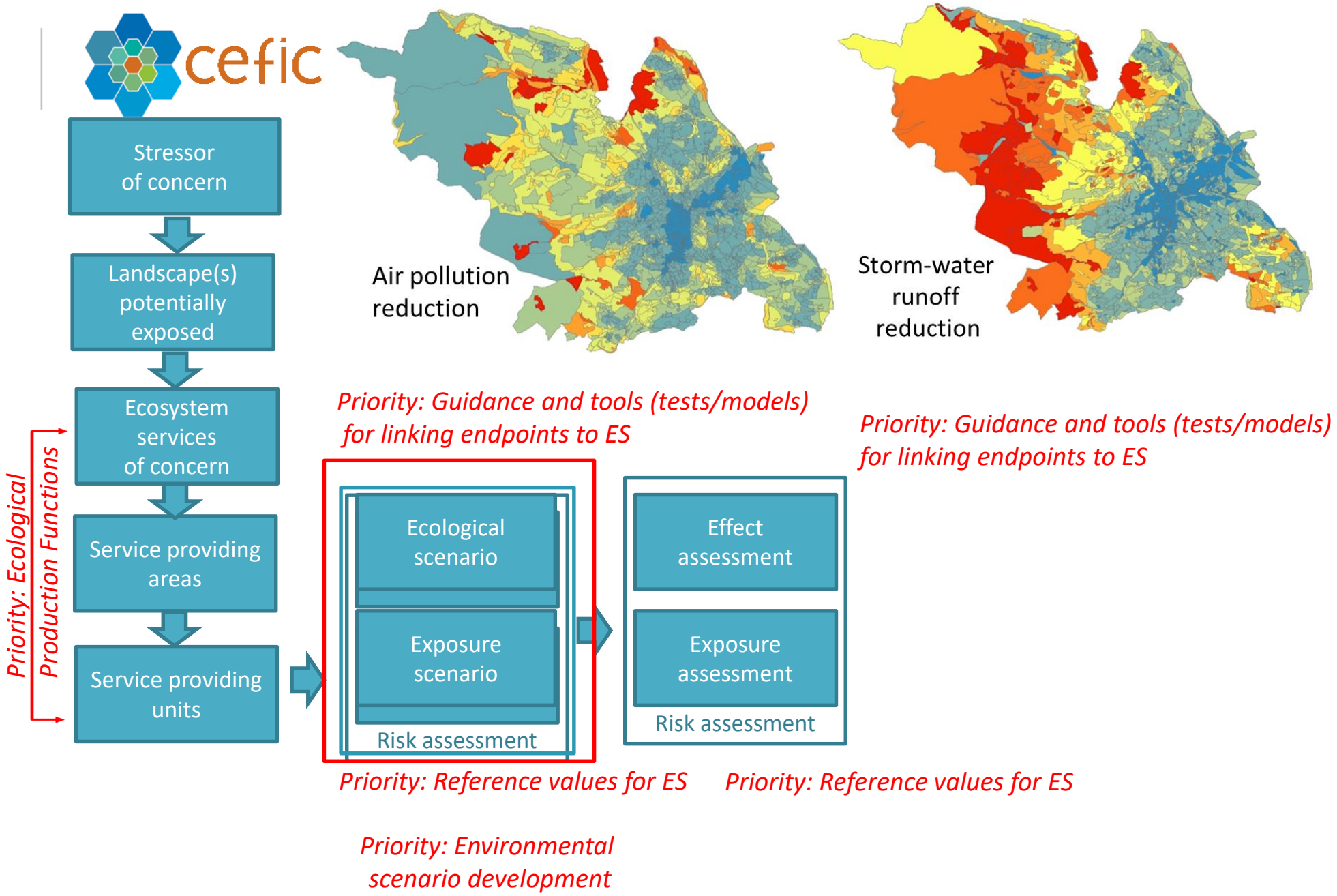
SPECIFIC PROTECTION GOAL

Ecological production function for recreational fishing

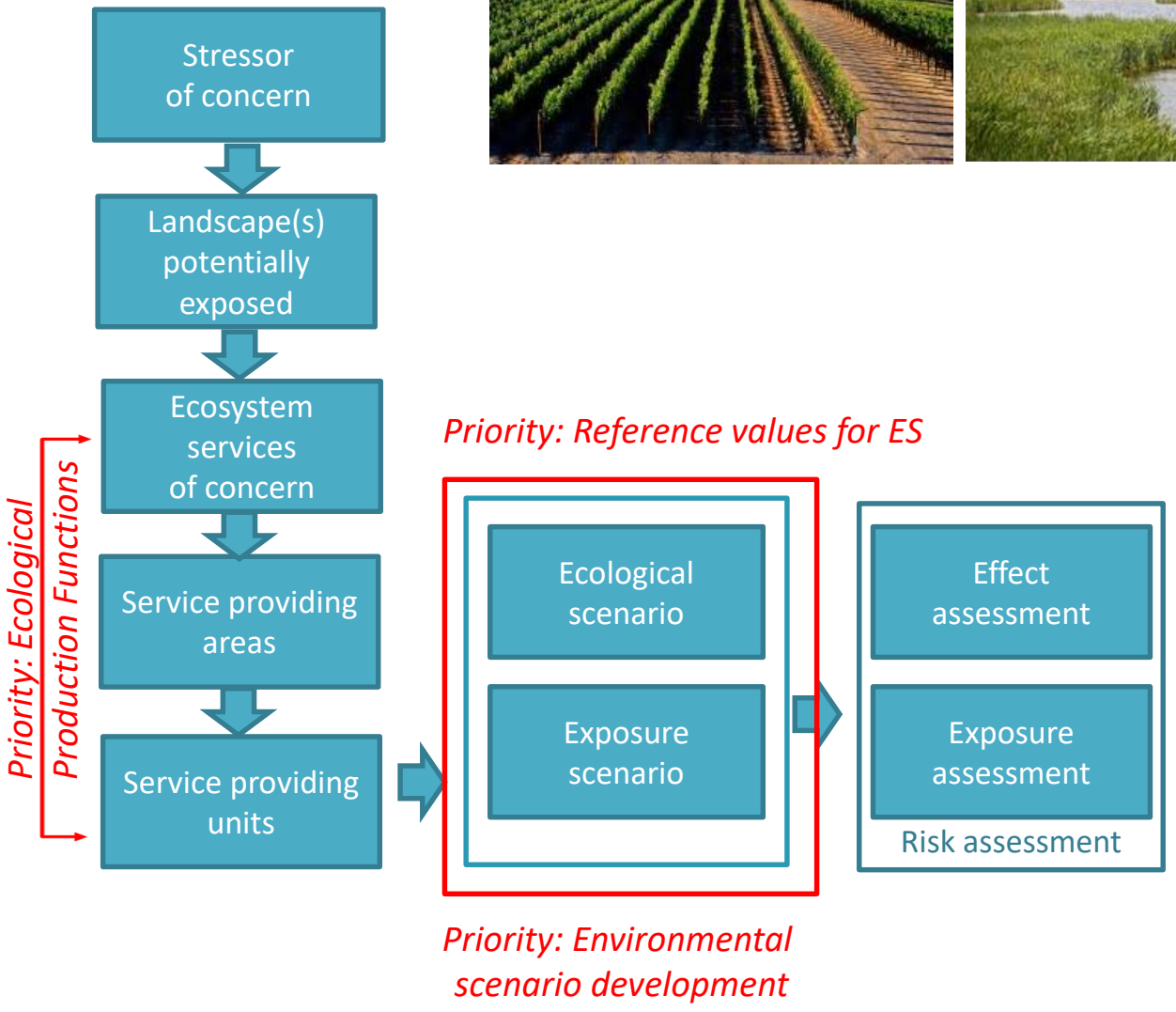



Stressor of concern
Landscape(s) potentially exposed
Ecosystem services of concern
Service providing areas
Service providing units
Priority: Ecological Production Functions
Effect assessment
Exposure assessment
Risk assessment

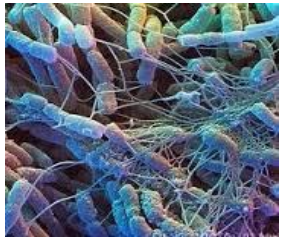
(Holt et al, 2015 *Ecosystem Services* 16: 33)






Stressor of concern
Landscape(s) potentially exposed
Ecosystem services of concern
Service providing areas
Service providing units
Priority: Ecological Production Functions
Priority: Reference values for ES
Ecological scenario
Exposure scenario
Effect assessment
Exposure assessment
Risk assessment
Priority: Environmental scenario development

Guidance and tools (tests/methods) for linking endpoints to ES



Ecosystem services		Taxa used in standard tests															
		Microbes	Algae	Plants	Nematodes	Annelids	Rotifers	Echinoderms	Molluscs	Insects	Collembolans	Mites	Crustaceans	Mammals	Birds	Amphibians	Fish
Provisioning	Cultivated crops			■													
	Reared animals and their outputs								▒	■				▒	■		
	Wild plants, algae and their outputs	▒	▒	■													
	Wild animals and their outputs							■	■	■			▒	▒	■	▒	■
	Plants and algae from in-situ aquaculture		▒	▒													
	Animals from in-situ aquaculture							■	■				▒				■
	Fibres and materials for use or processing		▒	■				▒	▒	▒				▒	▒		
	Materials for agricultural use		▒	■										▒			
	Genetic material for industrial processes	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
	Plant-based energy resources		■	■													
	Animal-based energy resources													▒	▒		
	Animal-based energy													▒			

■ (potentially) relevant test species and endpoint

▒ (potentially) relevant taxonomic group and endpoint

(Maltby et al. 2017. https://doi.org/10.1016/j.scitotenv.2017.10.094)

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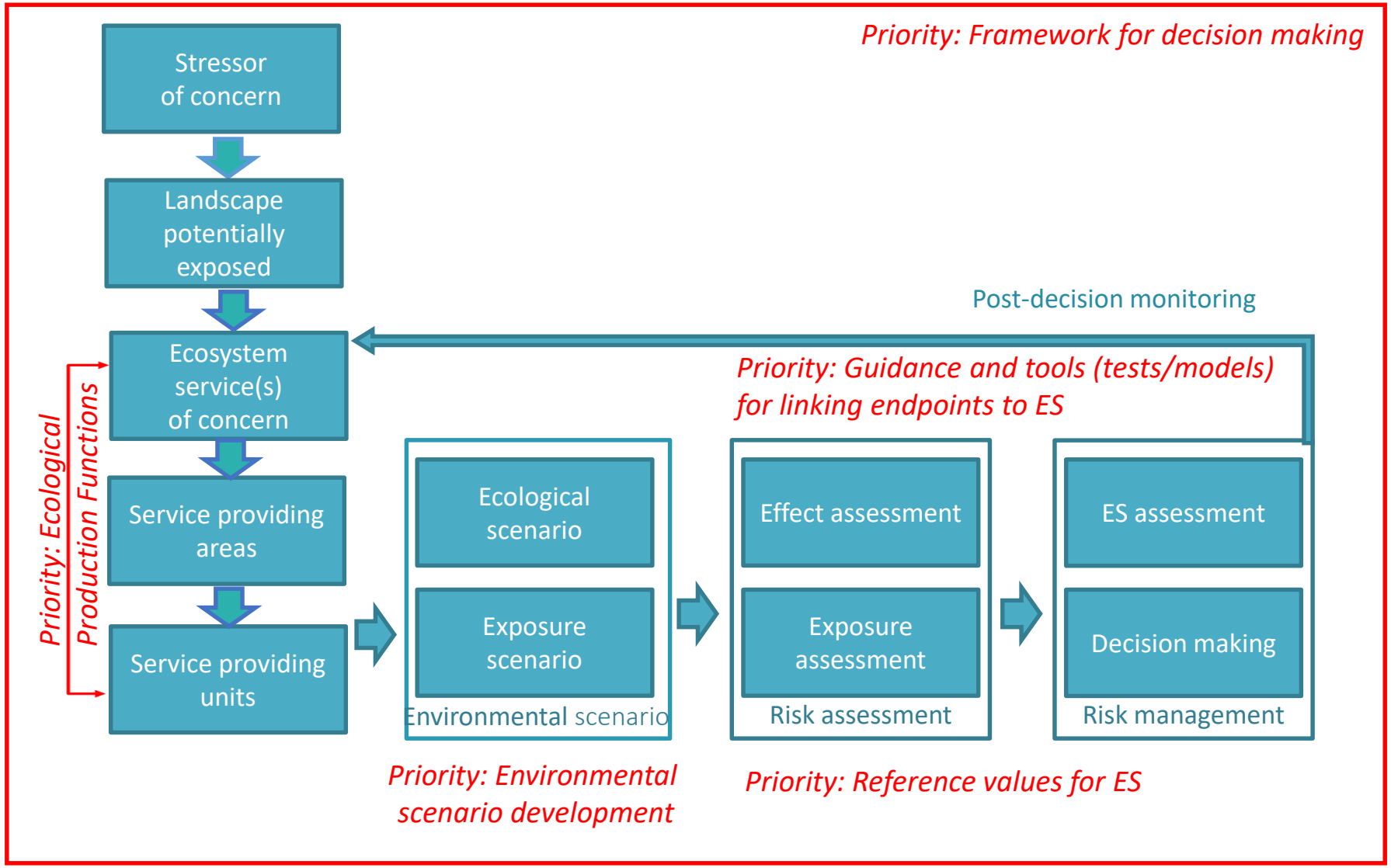
		Microbes	Algae	Plants	Nematodes	Annelids	Rotifers	Echinoderms	Molluscs	Insects	Collembolans	Mites	Crustaceans	Mammals	Birds	Amphibians	Fish
Regulation & maintenance	Bioremediation	■	■	■		▒											
	Filtration/sequestration/storage/accumulation	▒	▒	▒	▒	■	▒	▒	■	■	▒	▒	■	▒	▒	▒	■
	Stabilisation & erosion control		▒	■													
	Hydrological cycle, water flow maintenance			▒		▒											
	Flood protection		▒	■													
	Storm protection			▒													
	Ventilation & transpiration			▒													
	Pollination & seed dispersal									▒			▒	▒	▒		
	Maintaining nursery populations & habitats			▒													
	Pest control				▒					▒		■		▒	▒	▒	▒
	Disease control				▒	▒						▒					
	Weathering processes	▒				▒											
	Decomposition & fixing	■			■	■				■	■	▒	▒				
	Chemical condition of freshwater	▒	▒	▒													
	Chemical condition of salt waters	▒	▒														
	Global climate regulation of GHG		▒	▒													
	Micro/regional climate regulation			▒													

■ (potentially) relevant test species and endpoint

▒ (potentially) relevant taxonomic group and endpoint

(Maltby et al. 2017. https://doi.org/10.1016/j.scitotenv.2017.10.094)


Priority: Framework for decision making
Stressor of concern
Landscape potentially exposed
Ecosystem service(s) of concern
Service providing areas
Service providing units
Priority: Ecological Production Functions
Post-decision monitoring
Priority: Guidance and tools (tests/models) for linking endpoints to ES
Ecological scenario
Exposure scenario
Environmental scenario
Effect assessment
Exposure assessment
Risk assessment
ES assessment
Decision making
Risk management
Priority: Environmental scenario development
Priority: Reference values for ES

Conclusions

- The CARES project was co-produced by experts from the European chemical industry, EU and MS regulatory authorities, academia and environmental consultancies.
- Clear advantages of an ES approach to chemical risk assessment and risk management were identified.
- Development work necessary for the implementation of an ES approach was prioritized:
  - environmental scenarios,
  - models (EPFs) to link measurement and assessment endpoints,
  - guidance on the use and interpretation of tools and test methods
  - integrated decision-making framework for risk assessors and risk managers.
- The need for a ‘proof of concept’ study to assess the feasibility of evaluating the impact chemical exposure on ES delivery using current knowledge, was highlighted.

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THANK YOU!