

Experiences in developing assessments from the supply side:

How to capture the influence of ecosystem state on  
capacity to support ecosystem services

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## Provisioning Services



## Regulation & Maintenance Services



## Cultural Services





# Ecosystem Capacity

Integrity of the ecosystem underpins ecosystem service supply



Coral bleaching impacting leisure and recreation

Thailand closes dive sites over coral bleaching crisis

In a rare move to shun tourism profits for environmental protection, 10 popular dive sites have been shut down in a bid to slow a coral bleaching crisis

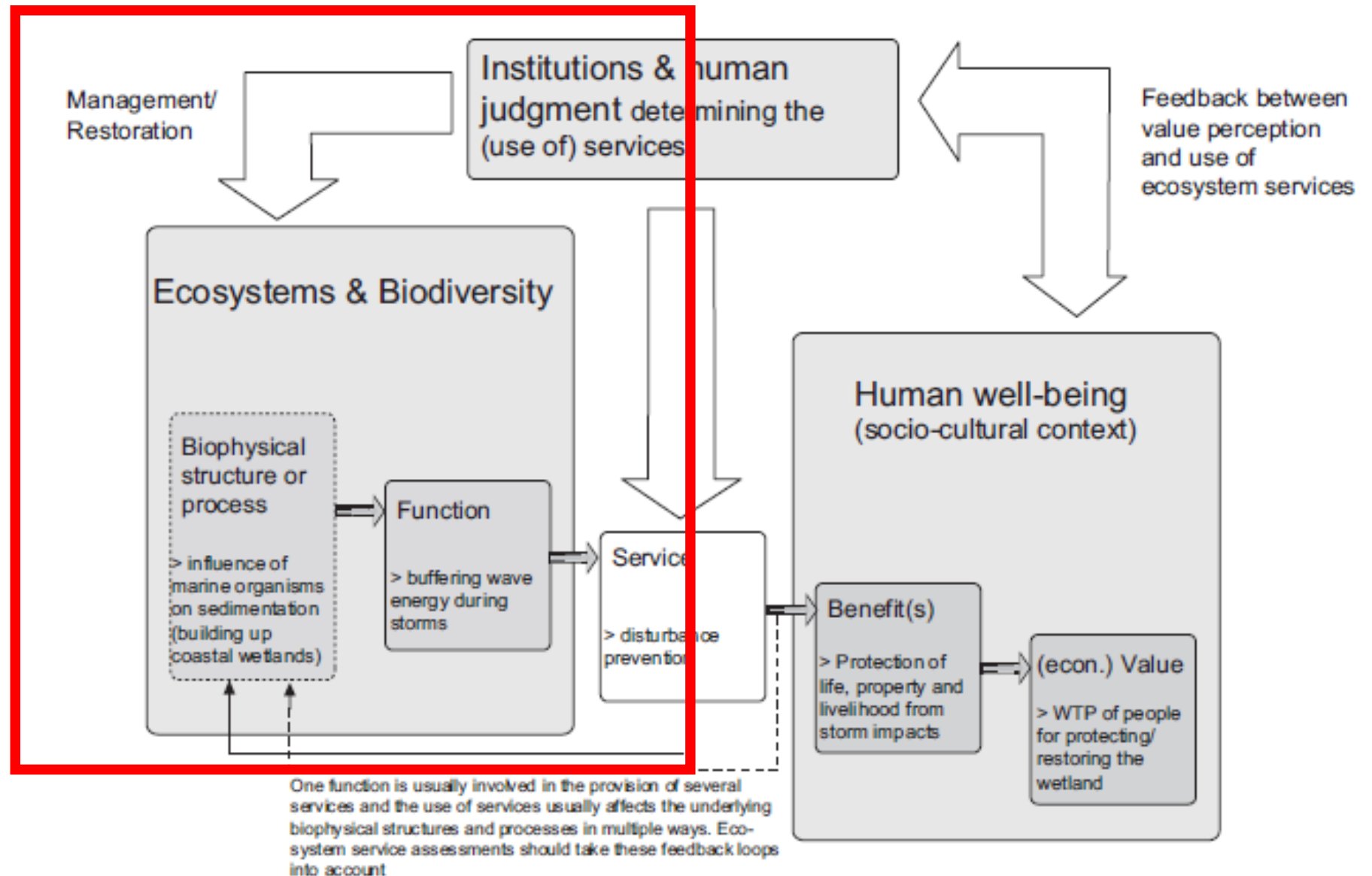
Picture: HANDOUT/Reuters via The Guardian

Headline: [www.theguardian.com](http://www.theguardian.com) Accessed 27/5/16

Focus on the supply side

Understanding how state of ecosystem affects capacity to supply ESs

Then can better advise management for sustainability of ES supply



Taken from Bohnke-Henrichs et al. (2013)

# A supply side assessment based on ES capacity

## What does this mean and why should we care?

- **Capacity** reflects the potential of the ecosystem to supply ecosystem services (ESs), based on its current (or future) state
- Taking **a supply side perspective** means that the ESs considered are not only those given value in the current system
- ESs are **key to adaptation and building societal resilience** to threats such as climate change (Munang et al., 2013; Allison and Bassett, 2015). Thus, even where ecosystem services are not currently in demand, the ecosystems capacity to supply them is often crucial to long term sustainability.

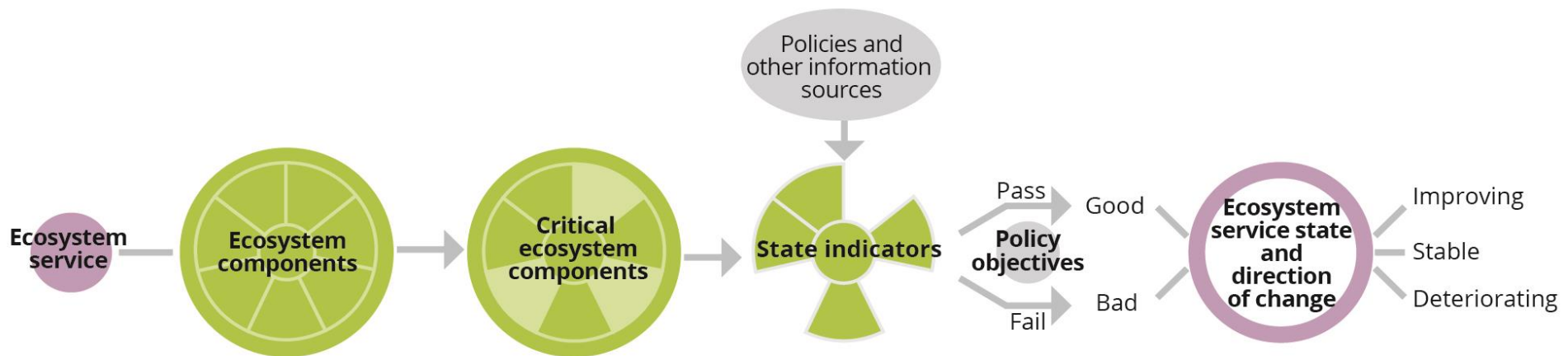
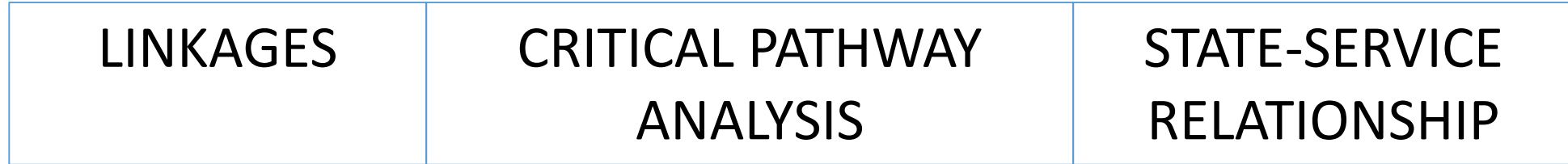




**How does change in ecosystem state affect capacity to supply ecosystem services?**

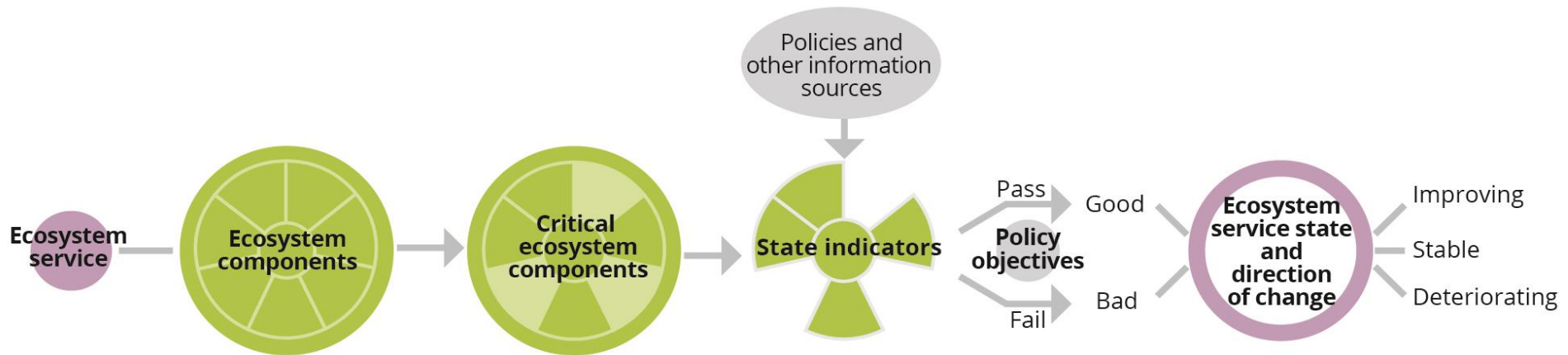
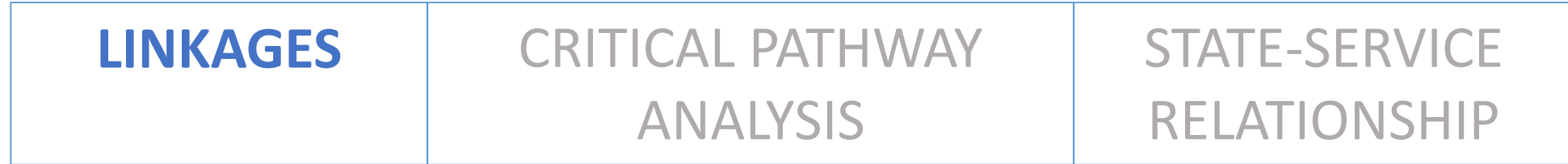


# MECSA Approach Framework Overview



Culhane et al. in the State of Europe's Seas (EEA, 2015)

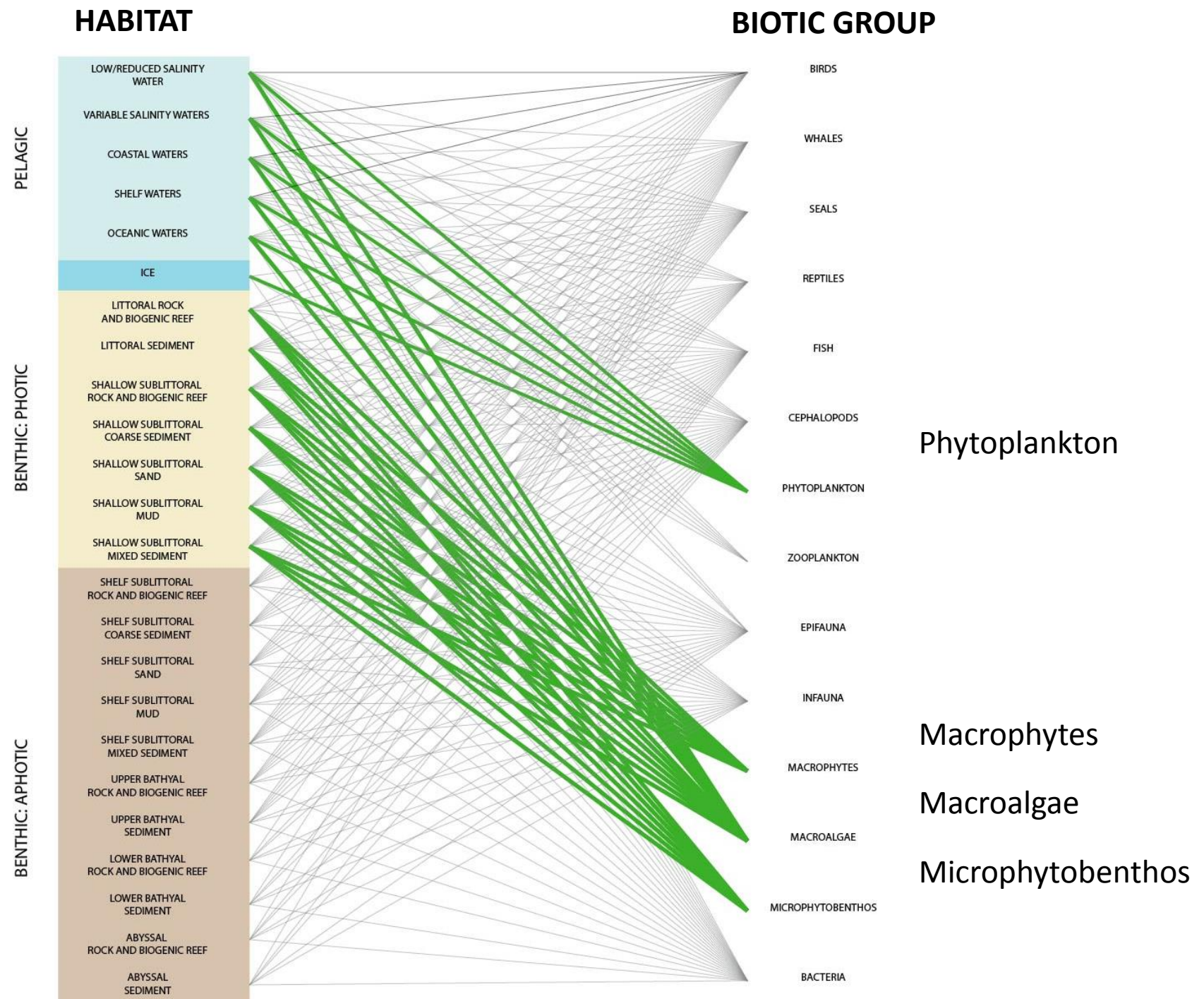
# Assessment Framework Overview



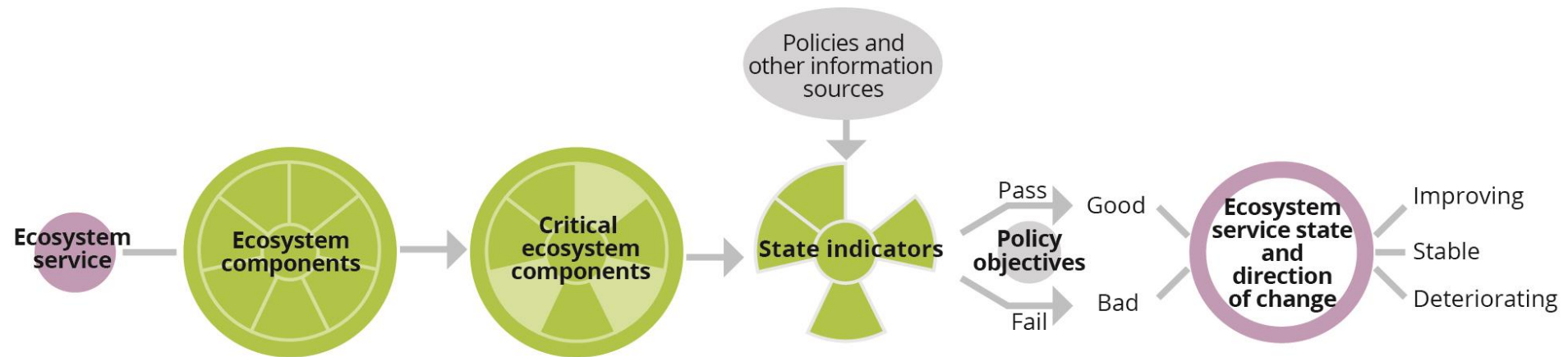
Culhane et al. in the State of Europe's Seas (EEA, 2015)



# Service: Waste nutrient removal



# Assessment Framework Overview



Culhane et al. in the State of Europe's Seas (EEA, 2015)

# Critical Pathway Analysis

- Criteria for relative contribution:
  - Rate of primary productivity of group
  - Spatial extent



- A3.1: Atlantic and Mediterranean high energy infralittoral rock
- A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
- A3.31: Silted kelp on low energy infralittoral rock with full salinity
- A4.11: Very tide-swept faunal communities on circalittoral rock or A4.13: Mixed faunal turf communities on circalittoral rock
- A4.12: Sponge communities on deep circalittoral rock
- A4.27: Faunal communities on deep moderate energy circalittoral rock
- A4.2: Atlantic and Mediterranean moderate energy circalittoral rock
- A4.31: Brachiopod and ascidian communities on circalittoral rock
- A4.33: Faunal communities on deep low energy circalittoral rock
- A5.13: Infralittoral coarse sediment
- A5.14: Circalittoral coarse sediment
- A5.15: Deep circalittoral coarse sediment
- A5.23: Infralittoral fine sand or A5.24: Infralittoral muddy sand
- A5.25: Circalittoral fine sand or A5.26: Circalittoral muddy sand
- A5.27: Deep circalittoral sand
- A5.33: Infralittoral sandy mud
- A5.34: Infralittoral fine mud
- A5.34: Infralittoral fine mud or A5.33: Infralittoral sandy mud
- A5.35: Circalittoral sandy mud
- A5.36: Circalittoral fine mud
- A5.36: Circalittoral fine mud or A5.35: Circalittoral sandy mud
- A5.37: Deep circalittoral mud
- A5.43: Infralittoral mixed sediments
- A5.44: Circalittoral mixed sediments
- A5.45: Deep circalittoral mixed sediments
- A6.11: Deep-sea bedrock
- A6.2: Deep-sea mixed substrata
- A6.3: Deep-sea sand or A6.4: Deep-sea muddy sand
- A6.5: Deep-sea mud
- Deep-sea coarse sediment
- Infralittoral Seabed
- Circalittoral Seabed
- Deep Circalittoral Seabed
- Deep-sea Seabed
- AtlantoArctic Deep-sea Seabed



Map copyright JNCC. EMODnet Seabed Habitats: [www.emodnet-seabedhabitats.eu](http://www.emodnet-seabedhabitats.eu), webGIS: [www.emodnet-seabedhabitats.eu/webgis](http://www.emodnet-seabedhabitats.eu/webgis).

Eg. Relative contributions of ECs to waste nutrient removal (quantitative, but proxy)

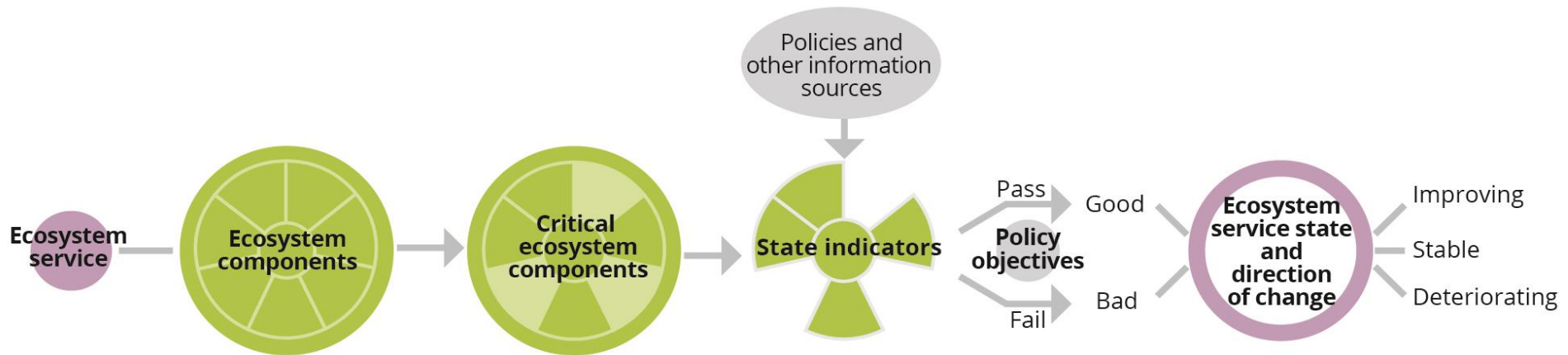
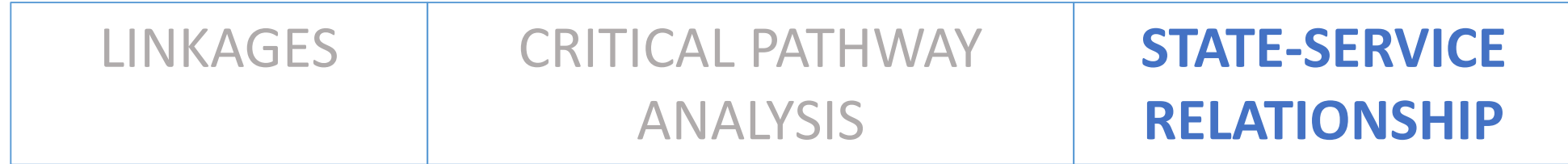
Table 5.6 Primary production of biotope types and contribution of each biotope type to total primary production in the Irish Sea. Taken from Table AIII.4

Broadscale Habitat (dominant primary producer)	Primary Productivity of Biotope Type ( $\text{kg m}^{-2} \text{yr}^{-1}$ dry weight)	Contribution to primary productivity in the Irish Sea ( $10^6 \text{ kg yr}^{-1}$ dry weight) <sup>A</sup>
EUNIS A1.1 (Fucoid)	0.19	3.22
EUNIS A1.2 (Fucoid)	0.75	81.03
EUNIS A1.3 (Fucoid)	1.50	116.40
EUNIS A3.1 (Kelp)	7.50	4307.30
EUNIS A3.2 (Kelp)	11.25	2518.13
EUNIS A3.3 (Kelp)	7.50	6.04
EUNIS A2.5 (Saltmarsh Macrophytes)	0.48	148.03
Water Column: Irish Sea (Phytoplankton)	0.19	19665.50
<b>Irish Sea Total Primary Productivity</b>		<b>26845.65</b>
<b>Macroalgae Proportional Contribution</b>		<b>26%</b>
<b>Macrophyte Proportional Contribution</b>		<b>&lt;1%</b>
<b>Phytoplankton Proportional Contribution</b>		<b>73%</b>

<sup>A</sup>Productivity was estimated based on primary productivity of the biotope type and the area of each biotope

Culhane et al. (2015) for the EEA, State of European Seas

# Assessment Framework Overview

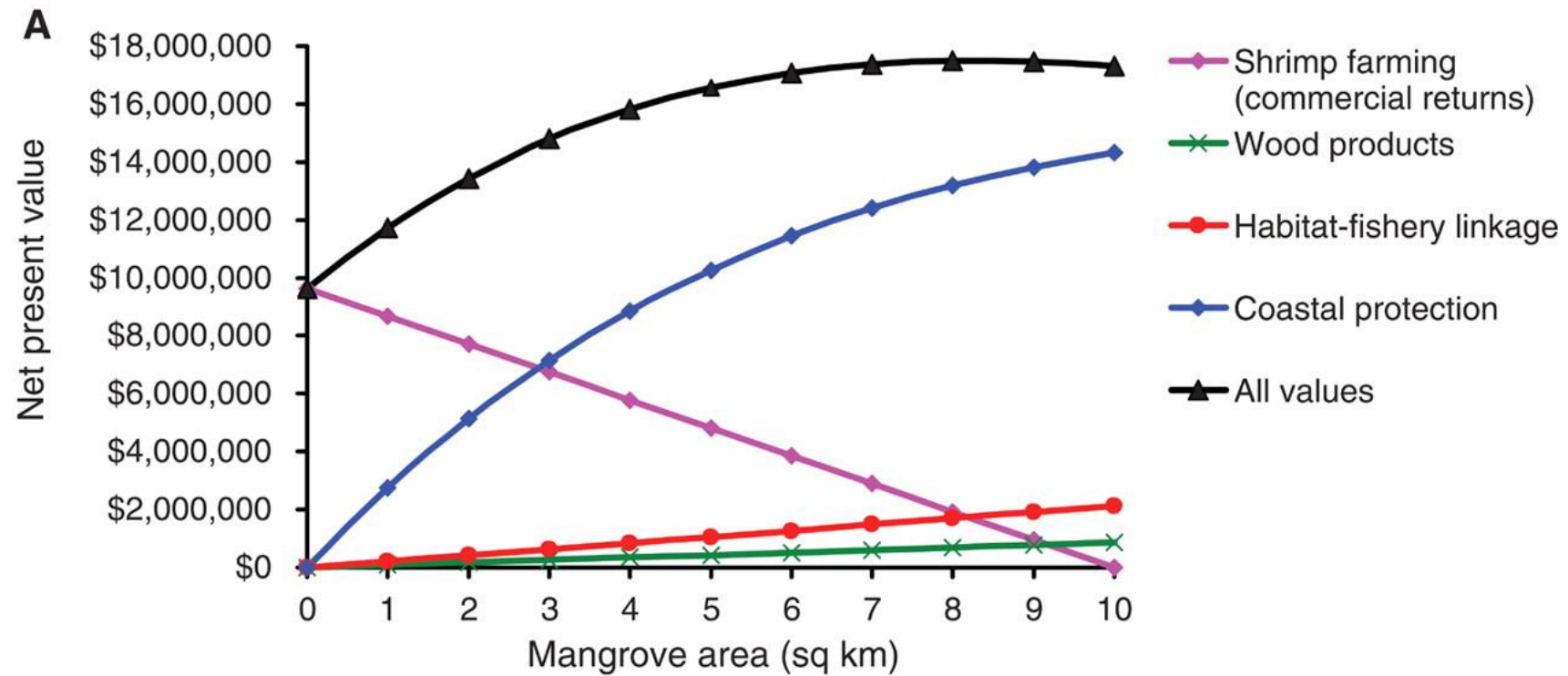


Culhane et al. in the State of Europe's Seas (EEA, 2015)



# State-service relationship

Comparison of various mangrove services at coastal landscape level (10 km<sup>2</sup>), Thailand



Edward B. Barbier et al. Science 2008;319:321-323



# Waste nutrient removal

- Increasing nutrients leads to increasing phytoplankton concentration and increasing service
- But...at some point, eutrophication makes service unsustainable

## Identifying indicators of state

- Which metrics are relevant (critical ecosystem components + nature of relationship between component and ES)
- Which indicators are available? Use of existing data (pros and cons)
- Example of information sources: WFD, MSFD, Habitat's Directive
- **Waste nutrient removal:** phytoplankton concentration, nutrient concentration and impacts on benthos



# Assessment Outcome: North East Atlantic

Capacity of the ecosystem to supply a service:  
based on state of critical ecosystem components

Ecosystem Service	Critical Component(s)	Assessment: Capacity and Trend
Waste Removal/Storage: Nutrients	Phytoplankton in all pelagic habitats	Good Capacity Stable Trend
Whale Watching	Whale species relevant for whale watching	Good Capacity Unable to Assess Trend
Seafood: wild commercial fish (North Sea) (Piet et al., IMARES)	Fish (>0.1% catch)	Moderate Capacity Increasing Trend

Any questions...?