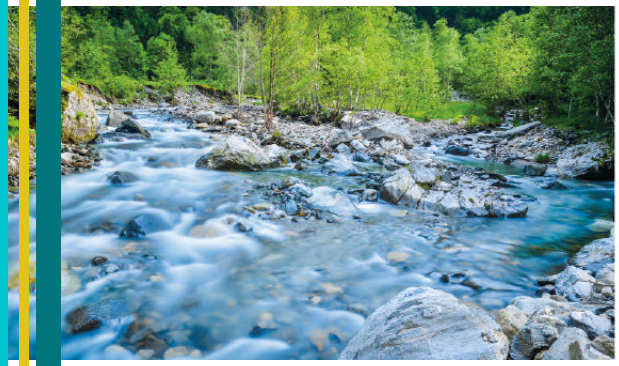
T2a - Integrating biodiversity and ecosystem services in ecosystem-based management of aquatic systems



AquaLinks tool – a versatile tool to address causal links involving activities, pressures, biodiversity, ecosystem functions and services in aquatic ecosystems

António J A Nogueira, Heliana Teixeira, Ana I. Lillebø, Florian Pletterbauer, Daniel Trauner, Leonie Robinson, Fiona Culhane, Thomas Hein, Martin Pusch, Gabriela Costea, Helena Hudek, GerJan Piet, Ana L. Barbosa, Juan Arevalo-Torres, Alejandro Iglesias-Campos, Andrea Funk, Tim O'Higgins, Romina Martin, Peter Reichert, Mathias Kuemmerlen, Hugh McDonald, Gonzalo Delacámara, Carlos M. Gomez, Ben Boteler, Manuel Lago

The AQUACROSS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 642317.

ESP Conference, San Sebástian, 2018

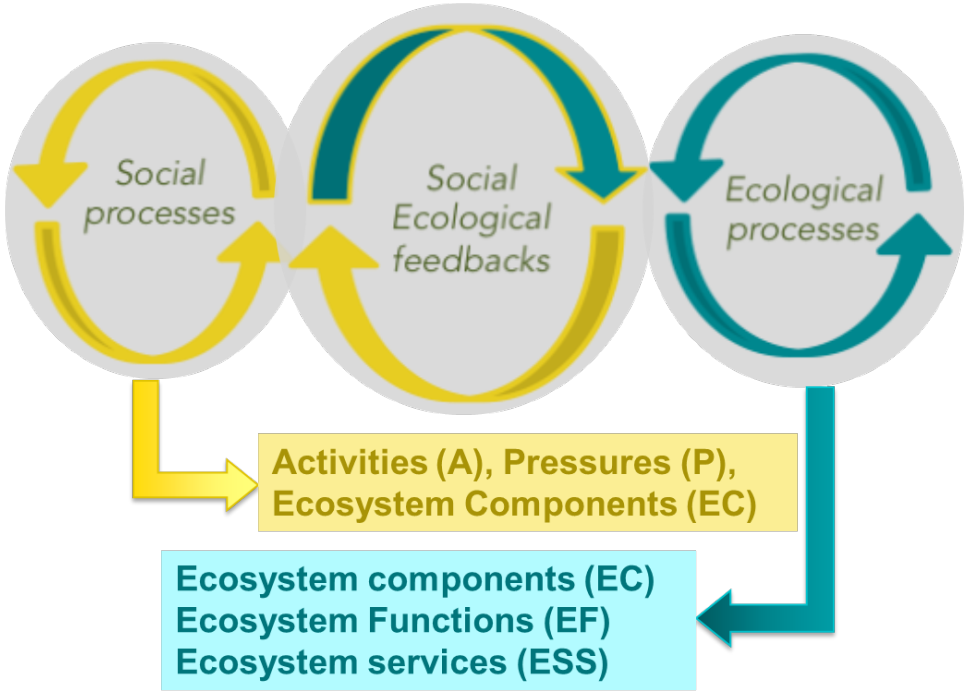
Messages

- Ecosystem Based Management needs a holistic thinking – the linkage framework allows to **comprehensively describe complex social-ecological systems** by including all relevant parts from human activities to ecosystem services

- The understanding of aquatic ecosystems across Europe is fragemented; by disciplines, policies, stakeholder views….; a **common terminology** is needed to establish a common understanding, to break up 'silo mentality', finally facilitating the implementation of Ecosystem Based Management of water bodies

AQUACROSS Background

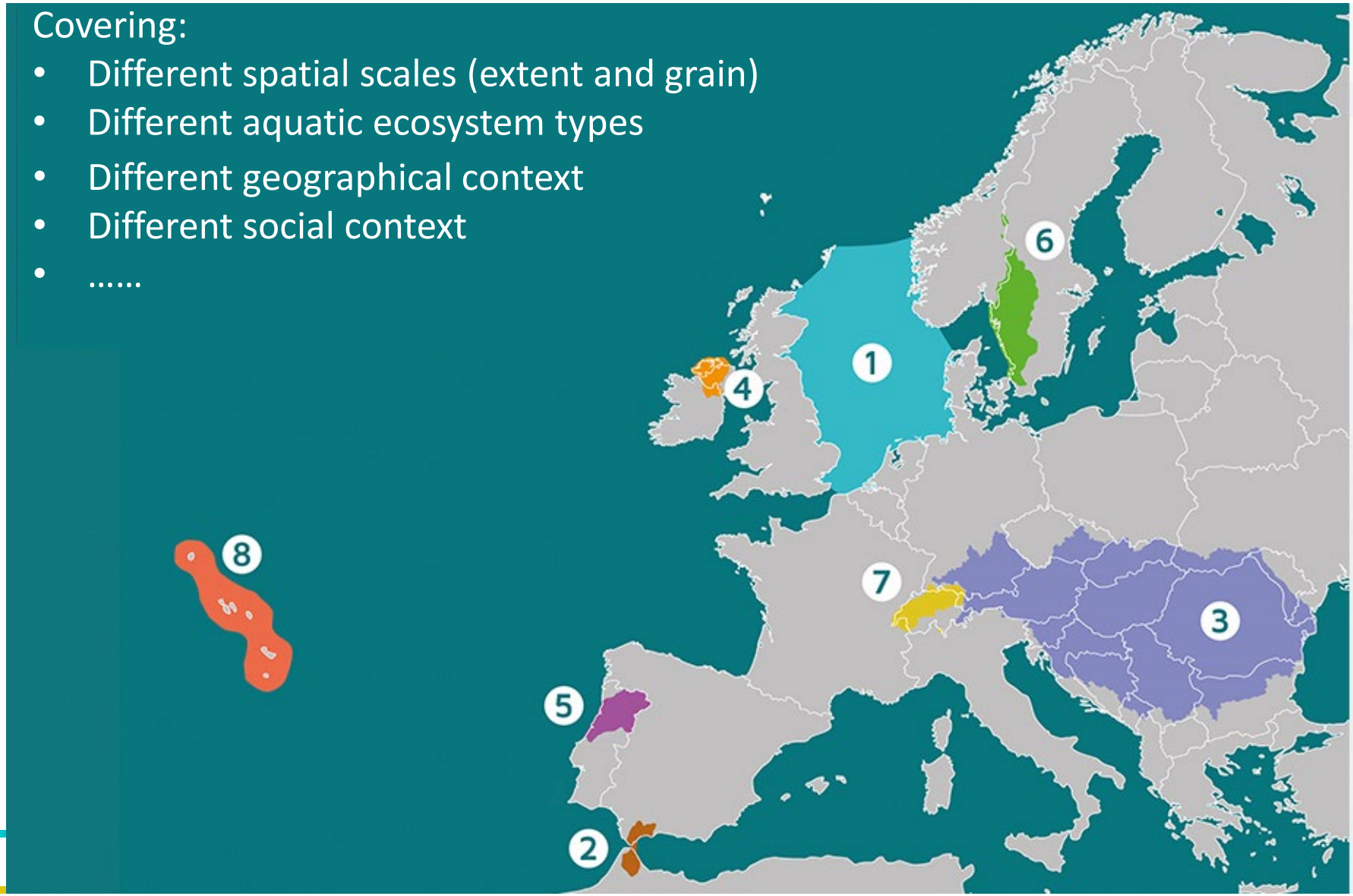
- WP4: Drivers of change and pressures on aquatic ecosystems
- WP5: Causalities between biodiversity, ecosystem functions and services



AQUACROSS Case Studies

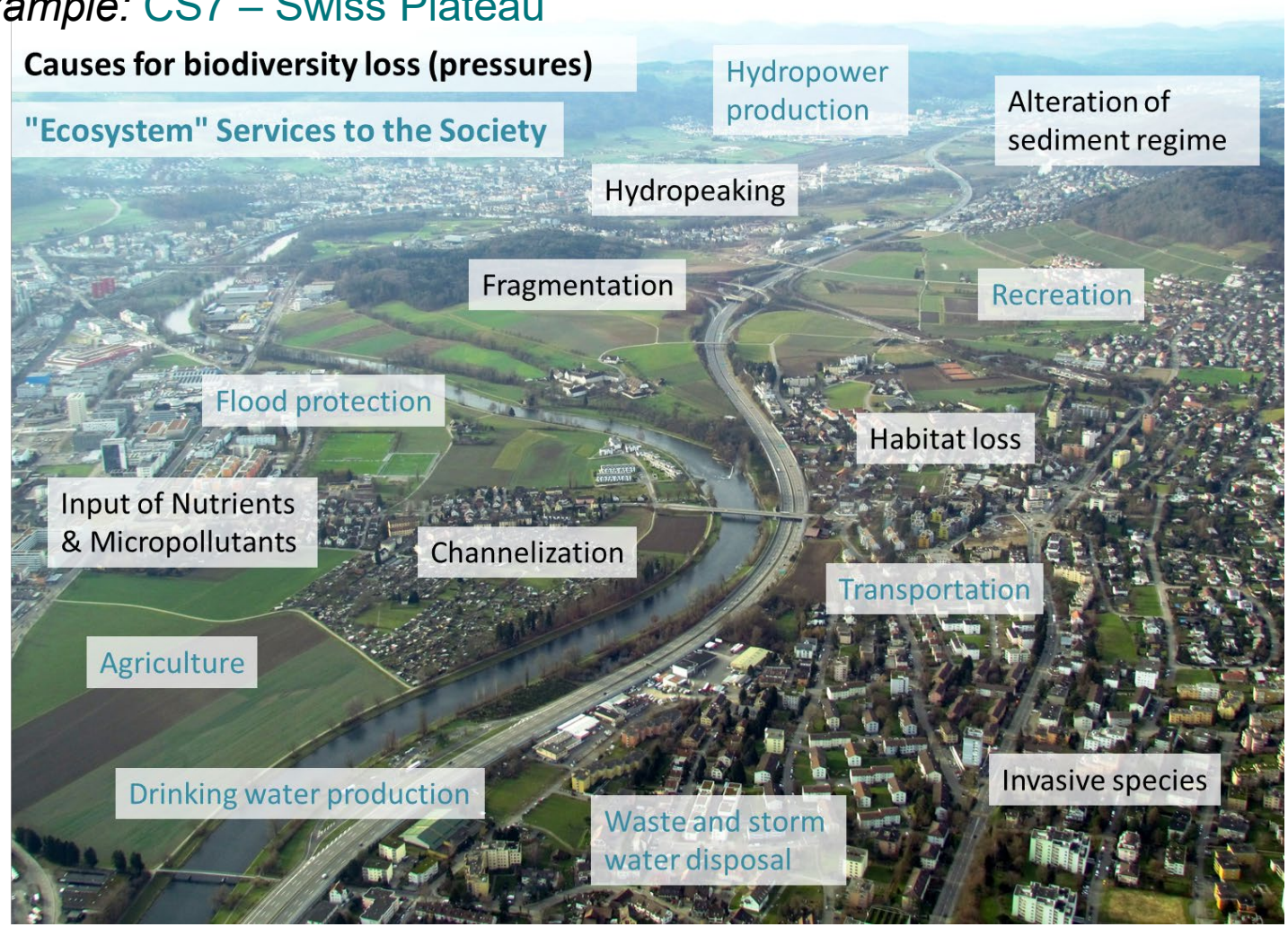
Covering:

- Different spatial scales (extent and grain)
- Different aquatic ecosystem types
- Different geographical context
- Different social context
- ……



Complex Social-Ecological Systems

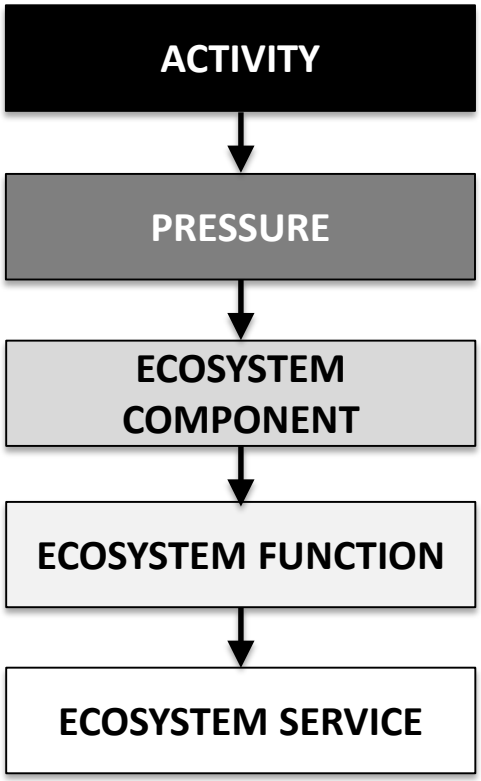
Example: CS7 – Swiss Plateau

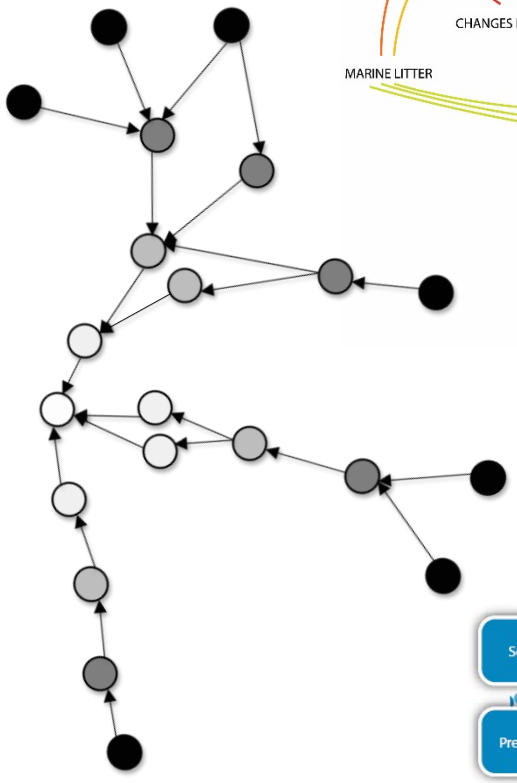


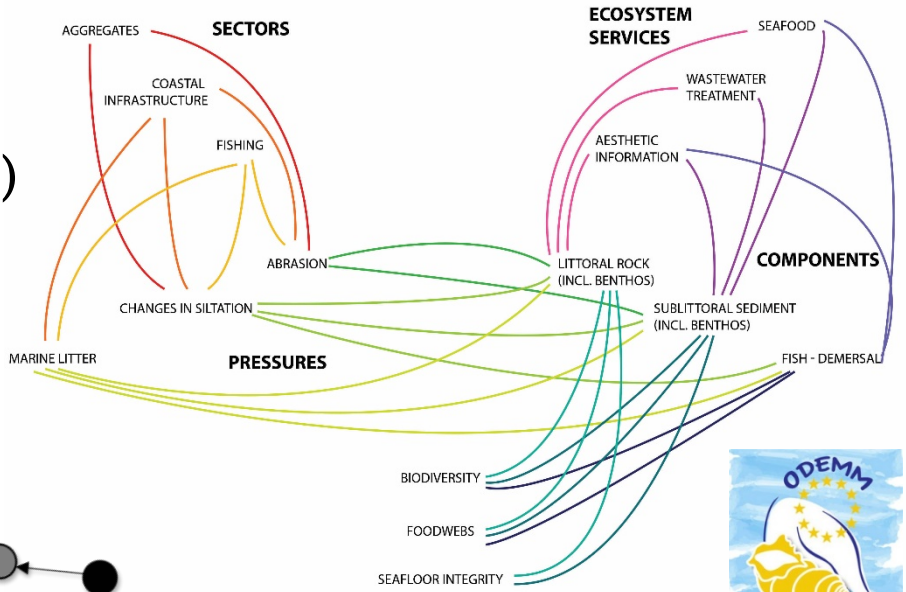
The linkage framework approach

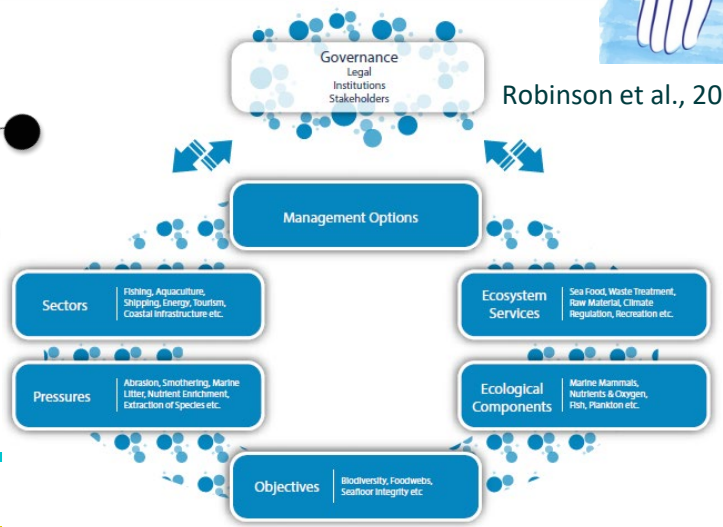
Comparable to a 'DPSIR network approach'

Forming multiple impact (A–P–EC) and supply chains (EC–EF–ESS)









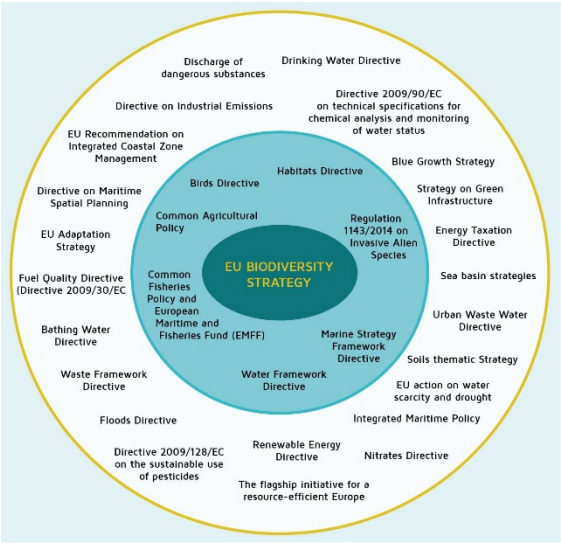
Robinson et al., 2014

Author: António J A Nogueira et al. (antonio.nogueira@ua.pt)

Common typologies across aquatic ecosystems

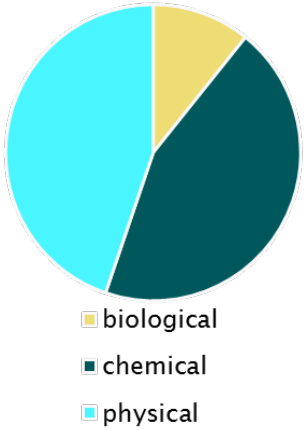
- Systematic alignment of nomenclatures and definitions (WFD, MSFD, HD) →link back to the different policies

- 12 broad activity types classified into 45 specific primary activities → possible linkage to NACE economic activities (social processes)



- 5 pressure categories classified into 31 single pressures

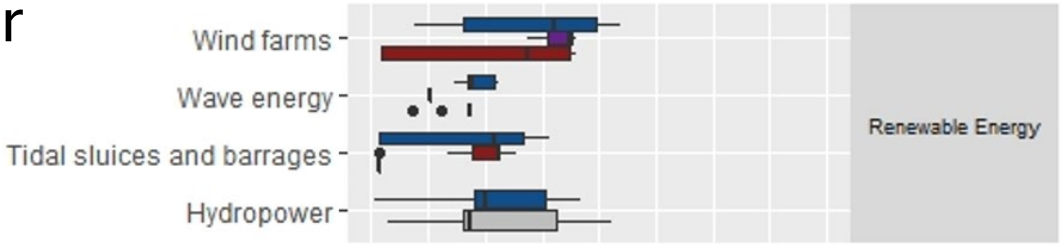
- **23,188 activity–pressure chains** based on 45 primary activities and 31 pressures covering 70 ecosystem components in **15 realms of 4 aquatic domains** for all case studies



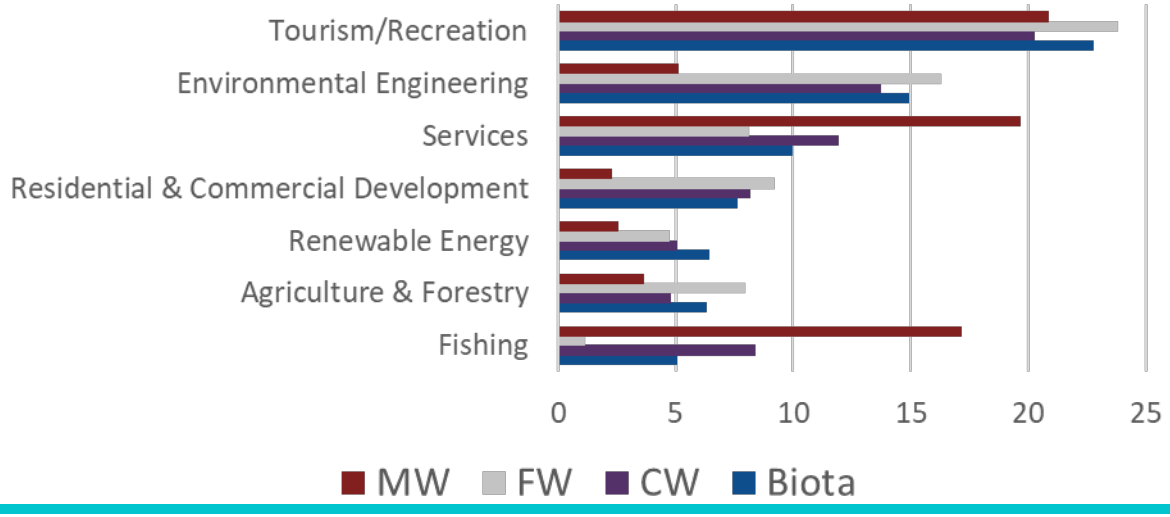
Pressure categories based on Stendera et al. 2012. Drivers and stressors of freshwater biodiversity patterns across different ecosystems and scales: A review. Hydrobiologia 696(1)

Outcomes

- Activities related to (renewable) energy production introduce high risk to aquatic ecosystems – windfarms vs. hydropower

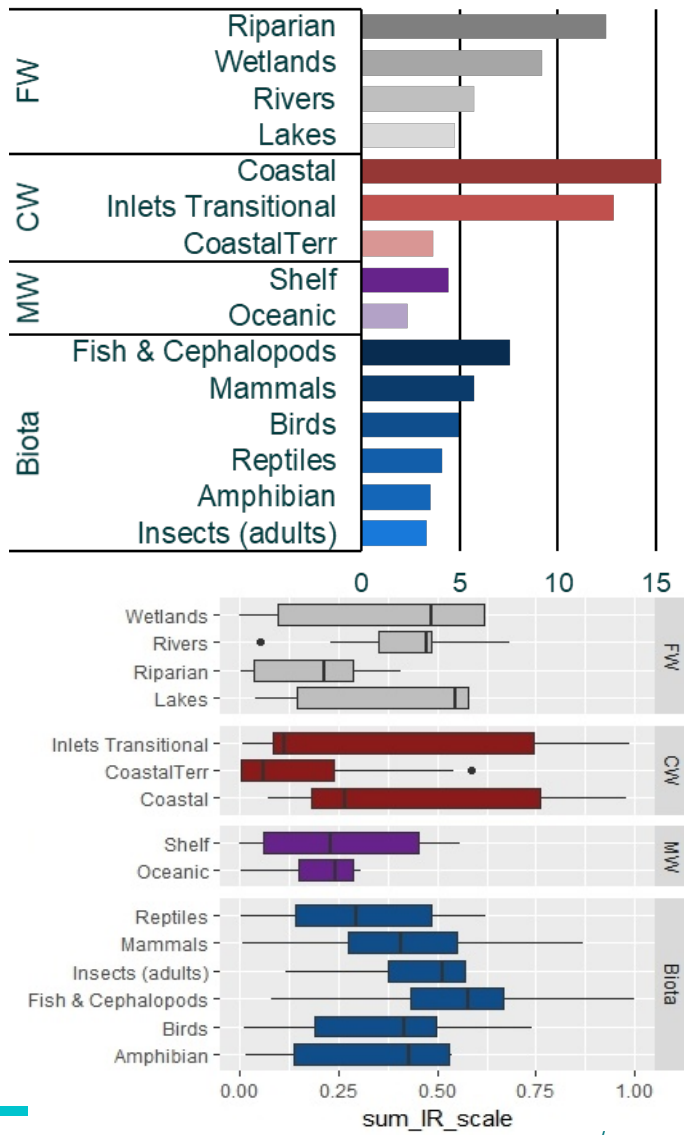


- Tourism activities were highly connected across aquatic ecosystems (having a lot of potential impacts)



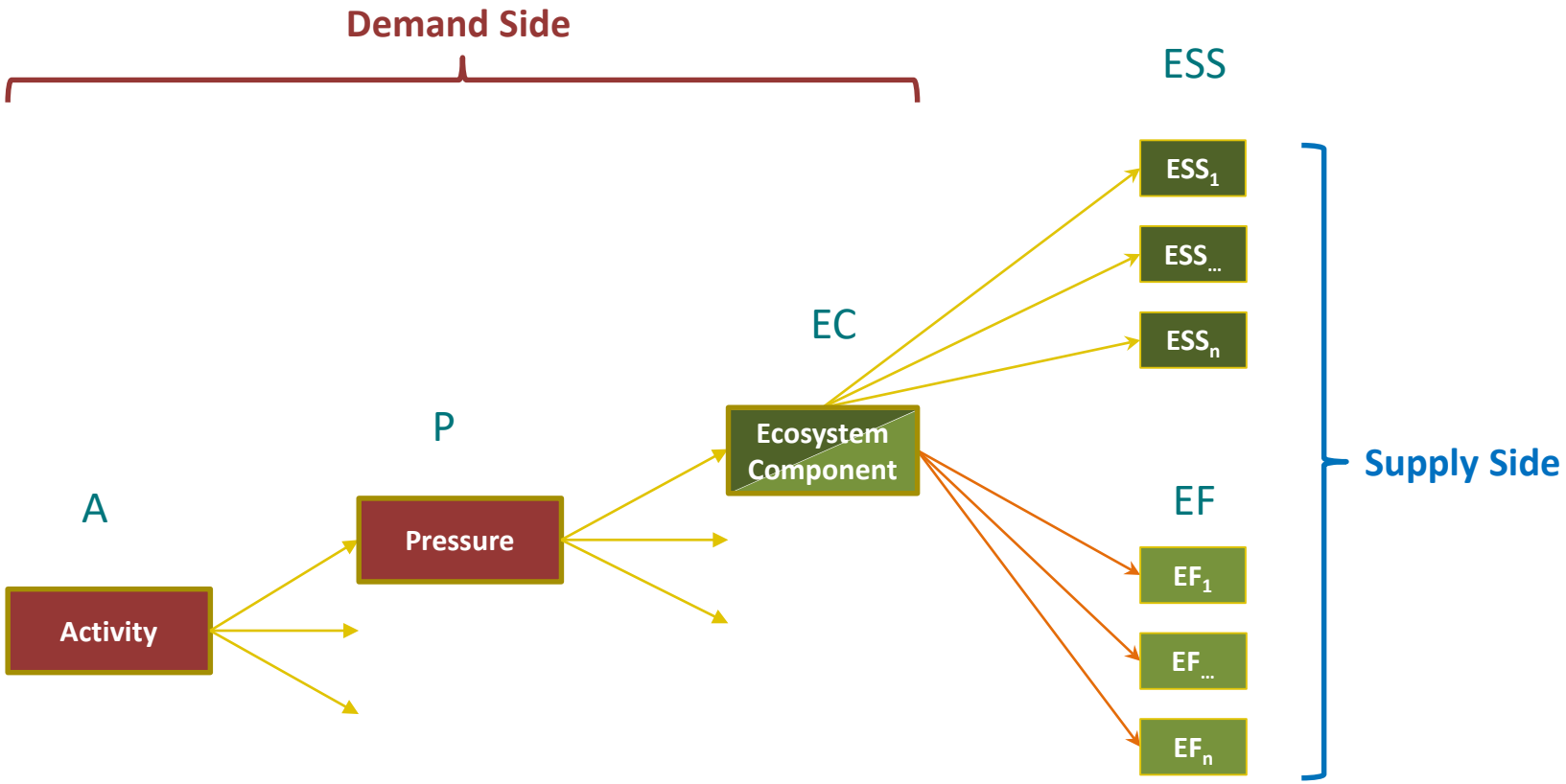
Outcomes

- Physical and chemical pressures introduce the greatest risk to aquatic ecosystems
- Ecotones (i.e. coastal, transitional, riparian habitats) are at high risk due to high connectance to activities
- Rivers and Lakes have the highest risk to ecosystem service supply
- Importance to consider spatial separation of activity location and pressure impact



AQUALINKS TOOL

AquaLinks tool linkage chains



AquaLinks tool and EBM

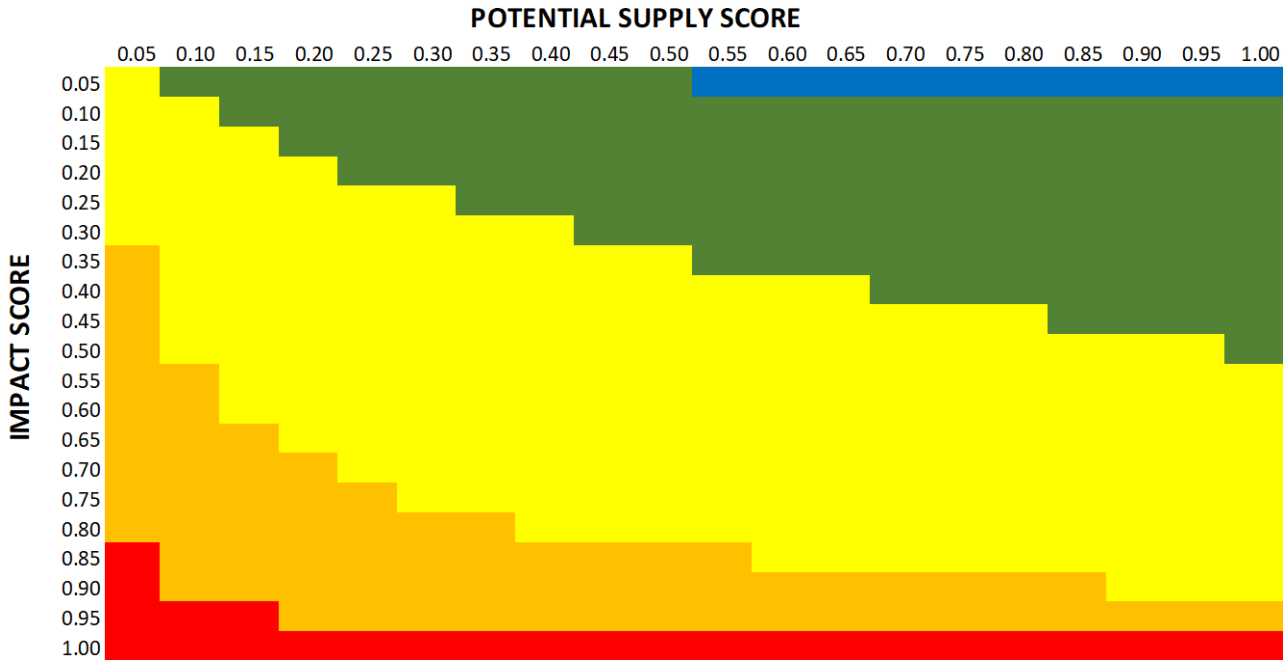
AquaLinks tool addresses explicitly five out of fifteen key principles:

- consider ecosystem connections:
- APPROPRIATE SPATIAL & TEMPORAL SCALES
- adaptive management
- USE OF SCIENTIFIC KNOWLEDGE
- integrated management
- stakeholder involvement
- account for dynamic nature of ecosystems
- ECOLOGICAL INTEGRITY & BIODIVERSITY
- sustainability
- RECOGNISE COUPLED SOCIAL–ECOLOGICAL SYSTEMS
- decisions reflect societal choice
- distinct boundaries
- interdisciplinarity
- appropriate monitoring
- ACKNOWLEDGE UNCERTAINTY

AquaLinks tool description

- **WHAT FOR**: assess the vulnerability associated with linkage chains of
  - activities–pressures–ecosystem components–ecosystem services (A–P–EC–ESS)
  - activities–pressures–ecosystem components–ecosystem functions (A–P–EC–EF)
- **HOW**: for each linkage chain an **impact score** and a **supply score are calculated to derive** a vulnerability quotient
- **SOURCE**: scores are derived from the **knowledge base produced within AQUACROSS** with contributions and expertise from case-studies

Vulnerability Quotient (VQ) Patterns



VULNERABILITY

low pressure
good conservation
large coverage/representativeness

high pressure
poor conservation
reduced coverage/representativeness

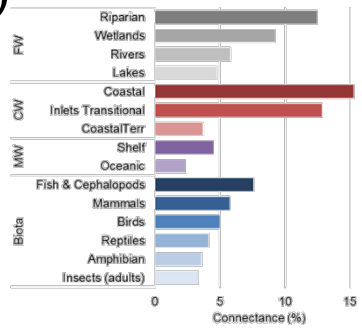
AquaLinks tool

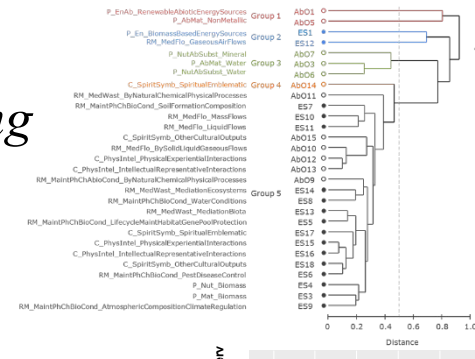
Highlights

- Europe's **surface waters** are affected by **multiple stressors**, with high relevance for **sustainable water management**
- The **ecological status of surface waters** relates to **ecosystem service provision**, but profound **empirical proof is still scarce** and highly **case-specific**
- A **common terminology** is needed for a **common understanding across aquatic realms** and to break up **'silo mentality'**
- **Ecosystem service supply** is **underpinned** by the **integrity of the ecosystem**
- The **linkage framework** allows a **comprehensive description** of complex **social-ecological systems** by including all relevant parts **from human activities to ecosystem services**
- Assessing the **ecosystem component vulnerability** with **AquaLinks** tool provides an **relevant contribution** to an **effective management of ecosystems**

Detailed sources

- Deliverables 4.1, 5.1, 4.2, 5.2 and the case study reports and their executive summaries (http://aquacross.eu)
- Detailed analyses of the linkage framework will be published in VSI of **STOTEN**

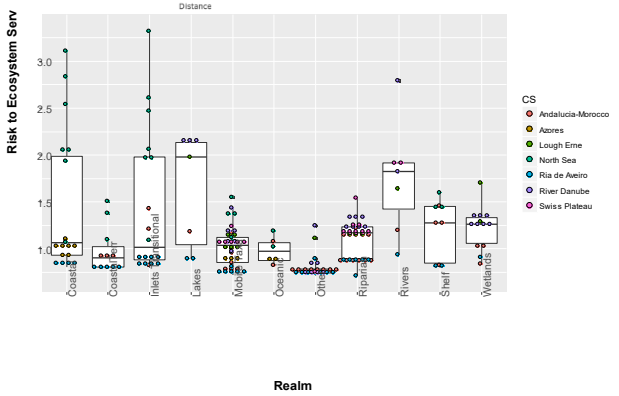




A-P-EC: Borgwardt et al. (subm.) *Exploring variability in environmental impact risk from human activities across aquatic ecosystems*

Eco-EF-ESS: Teixeira et al. (subm.) *Flow linkages from biodiversity to ecosystem services supply: integrating across aquatic ecosystems*

A-P-EC-EF-ESS: Culhane et al. (subm.) *Risk to the supply of ecosystem services across aquatic realms*




thank you!

Habitat Red List Conservation Score (RLS)

Red List Status	Score
Critically Endangered (CR)	1.000
Endangered (EN)	0.631
Vulnerable (VU)	0.398
Near Threatened (NT)	0.251
Least Concern (LC)	0.158
Data Deficient (DD) / Not Assessed / No Status	0.100

Assessment of Impact (A–P–EC)

- **Exposure Score (ES): 0..1**

$$ES = \frac{Disp_S + Per_S + Ext_S + Freq_S}{4}$$

Dispersal Score ($Disp_S$)
Persistence Score (Per_S)
Extent Score (Ext_S)
Frequency Score ($Freq_S$)

- **Consequence Score (CS): 0..1**

$$CS = Sev_S$$

Severity Score (Sev_s)

- **Impact Score – Euclidean distance (IS): 0..1**

$$IS = \frac{\sqrt{ES^2 + CS^2}}{\sqrt{2}} = \sqrt{\frac{ES^2 + CS^2}{2}}$$

Assessment of Supply (EC–ESS/EF)

Potential to Supply Services (PS)

$$PS = \left(\frac{NS}{TS}\right) \times \left(\frac{AS}{2}\right)$$

Number of Services/Functions linked to an EC in a Section (NS)
Total Number of Services/Functions in the Section (TS)
Average Score for Services/Functions linked to an Ec in a Section (AS)

Supply Score (SS)

$$Supply\ Score = \left(PS + (1 - PS) \times \left(RLS + (1 - RLS) \times \left(\frac{RC + R}{2}\right)\right)\right)$$

Relative coverage of EC (RC) – Mid range of percent cover (relative to Realm Area)
Representativeness (R) – Percent of EC Area relative to the CS area
Habitat Red List Conservation Score (RLS) (log scale between 0.1 and 1)