Trade-offs in integrated ecosystem-based management in the North Sea aimed at achieving Biodiversity Strategy targets

Gerjan Piet, WMR
EBM in the North Sea: Trade-offs

1. The full implementation of the EU nature legislation;
2. Better protection and restoration of ecosystems and the services they provide, and greater use of green infrastructure;
4. Better management of EU fish stocks and more sustainable fisheries;
6. A greater EU contribution to averting global biodiversity loss.

2050 VISION

Nature ↔ Food ↔ Energy

The EU Biodiversity Strategy to 2020

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Social–Ecological System: Linkage Framework

Provisioning:
- Raw materials from Biomass
- Nutrition from biomass

Regulation and Maintenance:
- Maintaining Atmospheric Composition & Climate regulation
- Lifecycle & Habitat maintenance
- Pest & Disease Control
- Soil Formation & Composition
- Mediation of Waste & Mass flows

Cultural:
- Intellectual Representative
- Physical Experiential
- Spiritual Emblematic
- Spiritual Symbolic

Human activities

Pressures

Ecosystem components

Ecosystem services

Selective extraction of species
Input of organic matter
Marine Litter
Injury by
Noise
derging
Underwater noise

Fish-Demersal
Sublittoral Sediment
Marine Mammals
Birds
Cumulative effects: Integrated perspective

Human activities & Pressures

Ecosystem components

- Fish & Cephalopods
- Mammals
- Habitats: Coastal
- Habitats: Inlets Transitional
- Birds
- Reptiles
- Habitats: Shelf
- Habitats: Coastal Terrestrial
- Habitats: Oceanic
Integrated EBM toward different societal goals

- Sustainable food supply
- Healthy ecosystem
- Clean energy

CS1 North sea

Reduction (% of total impact risk)

- Fish & Cephalopods
- Mammals
- Birds
- Coastal
- Shelf
Summary and Conclusions

This represents a first attempt of a more integrated, ecosystem-based approach which considers diverse (and potentially conflicting) societal goals, includes several sectors, and considers their impacts on the entire ecological system (but not the social system).

Analyses confirm that applying an integrated perspective in EBM may help balance the achievement of different societal goals.

A risk-based approach showed the main threats to a healthy marine ecosystem and the most effective management measures to mitigate those threats.

This provided the basis for more quantitative approaches aimed at specific threats but can forecast scenarios in the detail required by decision-makers.
Case Study 2 – Practice and Lessons Learnt
Intercontinental Biosphere Reserve of the Mediterranean – Andalucía - Morocco
Where: In between 2 seas & 2 countries
AQUACROSS Assessment Framework to develop and design a multi-purpose Green and Blue Infrastructure.

Identifying stakeholder objectives: synergies, conflicts, and opportunities for improvement;

Green and Blue Infrastructure design based on spatial conservation prioritisation of biodiversity features and ecosystem services;

Identifying the best spatial allocation for an ecosystem-based management plan for the restoration of degraded ecosystems;

Co-creation with local stakeholders: two rounds of workshops held in Tarifa (Spain, northern section) and Tangier (Morocco, southern section).
How: Linkage matrix framework

Socio-ecological system – D-P-S-E-EFs/Ess assessment

[Diagram showing a network of socio-ecological factors and their linkages.]

- **Provisioning:**
  - Seafood: wild animals
  - Drinking and non-drinking water
  - Raw Materials
  - Agricultural Materials

- **Regulation and Maintenance:**
  - Lifecycle maintenance
  - Hábitat protection
  - Water condition
  - Climate regulation
  - Erosion control
  - Water retention
  - Water purification and waste regulation

- **Cultural:**
  - Recreation & Leisure
  - Cognitive, Heritage, Sacred
  - Aesthetic, Symbolic

[Links to various socio-ecological aspects such as fishing, shipping, urban dwellings, shore recreational activities, disturbance of species, etc.]

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How: Ecosystem-based management: Green and Blue Infrastructures (GBI)

Approach for the design of the Green and Blue Infrastructure

Engage the stakeholders

Data collection and processing; Spatial planning analysis (Marxan with Zones)

GBI best solution

Baseline scenario

Baseline scenario

Available

Core

Conservation

Sustainable use

Core

Conservation

Sustainable use

Core

Conservation

Sustainable use

Available

Restoration

EBM scenario

EBM scenario

Available

Restoration

Available

Restoration

Available

Restoration

Baseline scenario

Baseline scenario

Baseline scenario

Baseline scenario

Baseline scenario

Baseline scenario

Baseline scenario

Baseline scenario
Efficient allocation of ecosystem-based restoration measures can be explicitly included in an optimal spatial planning design of a GBI. GBI multi-zoning approach accounts for potential trade-offs, and maximize co-benefits, between ecosystem services and biodiversity. Restoration areas improve the connectivity across GBI while meeting the target 2 of the EU biodiversity 2020. GBI successfully achieves a transboundary spatial planning across different aquatic ecosystems.
Thank you

Muchas gracias

شكرا

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Intergovernmental Oceanographic Commission of UNESCO

The AQUACROSS project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 642317.
Case Study 3– Practice and Lessons Learnt

Danube River Basin

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

Danube River Basin District
Map 1: Overview

- **Basin:**
  - 19 countries
  - 800,000km²

- **Danube:**
  - 2,800km
  - 10 countries
  - 27 large and >300 small tributaries

ICPDR, 2016
What: River-floodplain systems

Hotspot of
- Biodiversity and
- Ecosystem services

Threatened by multiple human activities:
- construction of hydropower plants,
- expansion of agricultural use,
- large-scale river regulation measures related to flood protection and navigation

River floodplain restoration to:
- Conserve biodiversity
- Achieve “good status”
- Flood protection
- Pollution reduction
- Climate adaptation
- Recreation
How: AQUACROSS Assessment Framework

Selected sites within our EBM scenario were evaluated against a Baseline scenario.
The ecosystem-based management approach is more cost-effective than the baseline scenario.
the ecosystem-based management approach is considering the multifunctionality of river-floodplain systems - biodiversity, ecosystem service and multiple human activities.

Therefore, it fosters integrated conservation and restoration planning across multiple policies by creating the opportunity to pursue different policy objectives simultaneously.

The approach may also foster transboundary coordination and cooperation as it considers the whole navigable main stem of the River Danube on ecosystem scale independent from jurisdictional, administrative and political boundaries.
Thank you!
Case Study 4: Management of Invasive Species in Lough Erne County Fermanagh

Dr. Tim O’Higgins

Brussels 9/10/2018
In 2014, in order to meet its obligations under Aichi Target 5 of the Convention on Biodiversity, the European Union introduced its regulation on Invasive Alien Species (EC, 2014). Under the directive a suite of Invasive Alien Species (IAS) of union concern has been drawn up. Where these species are widespread members state are obliged to put in place effective management measures.
Fuzzy Cognitive Mapping (FCM)

Stakeholder workshop

Mental models

Visualisation

Qualitative dynamic FCM
Ecosystem Based Management Measures

Direct Stakeholder input

Identified through FCM

Cost (€): €0.5-2m

Nutrient reduction measures

Increased clearance

Reduced light

Increased Summer Lake Levels

154ft

151ft

1.2m (4ft)

Current Summer Lake Levels

PERCENTAGE REDUCTION IN PHOSPHORUS LEVELS

30% reductions target

70% reductions target
Case Study 5: Improving integrated management of Natura 2000 sites in the Ria de Aveiro Natura 2000 site, from catchment to coast, Portugal

Ana Lillebø, Heliana Teixeira, António Nogueira

Brussels 9/10/2018
The social-ecological system
Main Challenge

Mitigate negative unintended impacts on biodiversity in a Natura 2000 freshwater–marine continuum

In 2018/2019, two management interventions will be implemented:

i) a dredging programme to enable hydrodynamic equilibrium and navigability in the lagoon

ii) the extension of a floodbank to disable surface saltwater intrusion into Baixo Vouga Lagunar agricultural area.

Both measures are:
Acceptable – political
Feasible – financial incentives
Institutional fitness check – governance
Understand the social-ecological system

- Policy instruments

- Casual links and vulnerability assessment

Component-Ecosystem Services vulnerability assessment with AquaLinksTool and the major concern identified by stakeholders

- Spatial Multicriteria Analysis

Stakeholders participatory process on Ecosystem Services valuation
Scenario development workflow

**Input**
- Stakeholder meeting
  - Identification of management actions to be implemented

**Research**
- Previous projects data sets and information
  - LAGOONS FP7
  - ADAPT-MED FP7 ERA-NET
  - MARSH–C–LEVEL CNRS/INEE OHMI
  - LTER–RAVE FCT
  - PORBIOTA FCT

- Data collection
  - Current state characterization (Reports, Institutions, scientific publications, databases)

- Selection of indicators

**Output**
- Narratives: baseline and prospective scenarios
  - 2 spatial scales:
    - Natura 2000 freshwater–marine continuum territory
    - Baixo Vouga lagunar (low-lying territory at the confluence of the river Vouga with Ria de Aveiro coastal lagoon)

- Stakeholder workshop I
  - Validation of the base line scenarios:
    - Natura 2000 freshwater–marine continuum
    - Baixo Vouga lagunar
    - Spatial Multicriteria Analysis

- Stakeholder workshop II
  - Public discussion on mitigation measures and trade-offs

- Base line scenarios
  - Natura 2000 realms
  - Baixo Vouga lagunar

- Baixo Vouga lagunar
  - Model simulations on provisioning of ES

- Natura 2000 realms
  - Model simulations on provisioning of ES
  - Causal links and provisioning of ES vulnerability assessment

- Management scenario with possible mitigation measures
Ecosystem Based Management co-developed solutions

Overall policy instruments applicable to water-dependent Natura 2000 sites

- Harmonised WFD and HD monitoring programmes

Case study specific policy plans and programmes

- Development of the Vouga estuary management plan

- Engage local users and landowners in the restoration actions

- Restoration of tidal wetlands, namely saltmarshes and seagrasses

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Case Study 6: Eutrophication in Lake Ringsjön and Rönne å catchment, Sweden

Understanding opportunities and measures for managing aquatic, co-produced ecosystem services

Romina Martin and Maja Schlüter 10/10/18
A eutrophic freshwater catchment

**Rönne å catchment** in Southern Sweden

- Transitioning from agricultural to multi-functional landscape

**Lake Ringsjön**

- Received nutrients from agriculture and insufficient sewage treatment
- Restoration ongoing
- Freshwater services and biodiversity increase with clear water state
Local water governance in Sweden

River Basin Management Plans
Programme of Measures

Water authority

Water councils

General public

Municipalities

County administrative board

County’s measures to achieve Environmental Quality Objectives

Action plan

How fast can good water quality be restored collaboratively?

• Local environmental goals
• Comprehensive plans
Scenario development process

Input
- Literature
- Stakeholder workshops & interviews
- Key interactions on aquatic ESS co-production
- Narratives: forms of collaboration

Research
- Stylized simulation model
- ESS valuation
- Lake restoration success with biomanipulation
- Restoration over time with multiple ESS
- Restoration over space with collaboration

Output
- Explorative analysis of ESS interactions over time
- Public seminar/discussion on collaborative management of aquatic ESS
- ESS valuation
Insight: Ecosystem services are co-produced

Explicit consideration of

- Time lags and feedbacks
- Trade-offs among ecosystem services
- Cross-boundary coalitions for measure implementation

Pushing modelling frontiers

- Complex social-ecological interactions
- Reinforcing over time
- Intertwined over space and actors

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Ways to improve local water governance

- **Resilience thinking:** Feedbacks and social-ecological interactions have long-term consequences.

- Ecosystem service **trade-offs and synergies** need strategic foresight.

- Water councils are well equipped for **stewarding freshwaters** through forming strong alliances.
The AQUACROSS project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 642317.

CS 7 Biodiversity management for rivers in the Swiss Plateau

Nele Schuwirth, Mathias Kuemmerlen, Peter Vermeiren, Peter Reichert
Swiss Plateau
Causes for biodiversity loss

Human Activities

- Input of Nutrients & Micropollutants
- Channelization
- Habitat loss
- Transportation
- Invasive species
- Waste and storm water disposal
- Agriculture
- Drinking water production
- Flood protection

- Fragmentation
- Hydropeaking
- Hydropower production
- Alteration of sediment regime
- Recreation
Swiss policy: restoration of 25% of the rivers currently in a bad morphological state over the next 80 years (ca. 4000km), supported with 40 Mio CHF/year

cantons have to deliver a strategic planning for the next 20 years, to be updated every 12 years for spatial prioritization of measures

rough federal guidance for strategic planning mainly based on hydromorphological assessment and infrastructure

(formal) coordination between river restoration and other river management policies currently lacking (e.g. upgrading wastewater treatment plants to remove micropollutants)

in the past, river restoration measures often did not show biological success, mainly due to lacking coordination and limited recolonization potential
Aims

develop methods for the spatial & temporal prioritization of management measures based on currently available data that allows
• a better coordination across sectors,
• a joint evaluation of a portfolio of measures,
• to stimulate planning processes in practice

1. Propose integrative and spatially explicit criteria to evaluate the ecological state of catchments
2. Search for combinations of measures that maximise the ecological state while considering budget and other constraints
Reach scale assessment

ecological state based on morphology and water quality
Catchment scale assessment

considers spatial arrangement of reaches in good or bad ecological state and barriers to fish migration

<table>
<thead>
<tr>
<th>before restoration</th>
<th>after restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good ecological state of the catchment</td>
<td>Good ecological state of river reaches</td>
</tr>
<tr>
<td>Resilience supporting habitats</td>
<td>Resilience supporting habitats</td>
</tr>
<tr>
<td>Low network fragmentation</td>
<td>Low network fragmentation</td>
</tr>
<tr>
<td>Near-natural habitat diversity</td>
<td>Near-natural fish migration potential</td>
</tr>
<tr>
<td>Good mean state of reaches</td>
<td>Many reaches in good state</td>
</tr>
<tr>
<td>Many reaches in good state</td>
<td>Many reachable headwaters: trout</td>
</tr>
<tr>
<td>Many reachable headwaters: trout</td>
<td>Many reachable headwaters: other fish</td>
</tr>
<tr>
<td>Many reachable upstream habitats: trout</td>
<td>Many reachable upstream habitats: other fish</td>
</tr>
<tr>
<td>Resilience supporting habitats: ecological state</td>
<td>Resilience supporting habitats: trout</td>
</tr>
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</tr>
<tr>
<td>Low fragmentation: other fish</td>
<td>Low fragmentation: other fish</td>
</tr>
</tbody>
</table>

Colors:
- High: blue
- Good: green
- Moderate: yellow
- Poor: red
- Bad: red

10/10/2018
Event: Aquacross Final Conference
Authors: Nele Schuwirth, Mathias Kuemmerlen, Peter Vermeiren, Peter Reichert
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Case Study 8: Faial–Pico Channel, Azores

Ecosystem-based solutions to solve sectoral conflicts on the path to sustainable development in the Azores

Hugh McDonald, Ben Boteler, Holger Gerdes, Helene Hoffman, Keighley McFarland, Lina Röschel, and AQUACROSS Consortium

10/10/2018

The AQUACROSS project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 642317.
Overall Aim: support effective and equitable Marine Protected Areas

- Marine Protected Areas: a key tool to protect biodiversity

but...

- scientists question efficacy and equity of existing Marine Protected Areas
Rich in marine biodiversity, valued by:
• Fishers (commercial and recreational)
• Tourists
• Others

But, despite protected area designation – biodiversity declining!

Local aim: collaborate with local stakeholders and policymakers to apply the AQUACROSS Assessment Framework to understand the Channel, and identify actions to efficiently and equitably ensure the Channel’s long-run sustainability
What was done?

- Analyse local **policy** and **stakeholder** objectives
- Characterise the **socio-ecological system**
- Develop baseline **scenario**
- Identify and evaluate **Ecosystem-Based Management Plan**

**Co-creation with local stakeholders** - recreational and commercial fishers, diving operators, NGOs, scientists, local policy reps, and others – including two day-long workshops.
Results: Ecosystem–based management plan

EBM Plan:
1. Increased scientific monitoring
2. Stakeholder Advisory Group
3. Integrated, coordinated Channel management
4. Simplify/increase communication and enforcement fishing and biodiversity regulations
5. Share costs through a sustainability tax or diving fee.

Evaluation: relative to baseline, EBM Plan will
- support increased protection of biodiversity
- Support sustainability of social system and adaptive management (stakeholder engagement, knowledge, coordination
Stakeholder engagement and participation supports **effective and equitable management of Marine Protected Areas and ecosystem-based management**.

They can help:
- identify challenges and priorities,
- co-create innovative solutions,
- offer low-cost knowledge and expertise,
- support ongoing monitoring, enforcement, and evaluation.

Learn more: https://aquacross.eu/casestudies
To learn more:

- [aquacross.eu/casestudies](http://aquacross.eu/casestudies)
  - 30 page Case Study Report
  - 3 page summary for local stakeholders

- Posters – in the Case Study Gallery

- Networking drinks – film