Practical evidence from the implementation of EBM in the North Sea
EBM: a “wicked problem”
Ecosystem-Based Management

Phase I: Societal goals

Phase II: Scoping and Risk assessment
- Relevant components (e.g., human activities, pressures, ecosystem taxa) and an indication of status and impact
- Relevant components (actors, institutions, etc.) and an indication of how they drive the processes

Phase III: Planning of EBM
- Management measures (e.g., technical, MPAs) and policy instruments (regulatory, economic, awareness-raising)
- Evaluation of ecological (management measures) and social (policy instruments) components of the EBM plan

Phase IV: Implementation, Monitoring and Evaluation
Fully implement the Birds and Habitats Directives MSFD D1, D6

Maintain and restore ecosystems and their services

Help avert global biodiversity loss MSFD D1, D6

Ensure the sustainable use of fisheries resources CFP, MSFD D3

Structure of the EU 2020 Biodiversity Strategy

2050 VISION

2020 headline target
halt biodiversity loss – restore ecosystem services – global contribution

SIX TARGETS

1. Enhance implementation of nature legislation
2. Restore ecosystems establish Green Infrastructure
3. Sustainable agriculture and forestry
4. Sustainable fisheries
5. Combat Alien Invasive Species
6. Contribute to averting global biodiversity loss

Actions
Societal goals after stakeholder consultation

Nature

Sustainable food supply

Healthy marine ecosystem

Clean and renewable energy
Ecosystem-Based Management

- Phase I: Societal goals
  - Stakeholders

- Phase II: Scoping and Risk assessment
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- Phase IV: Implementation, Monitoring and Evaluation
  - Stakeholders
Socio-Ecological System

Ecological system

Ecosystem structure

Ecological processes

Flows of ecosystem services

Ecosystem functions

Benefits of ecosystem services

Human activities and their pressures

Social processes

Societal response

Human Drivers

Social system
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
Ecosystem-Based Management

Phase I: Societal goals

Phase II: Scoping and Risk assessment

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Phase IV: Implementation, Monitoring and Evaluation
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**
- Fisheries
- Renewables

**Pressures**
- Selective extraction of species
- Input of organic matter
- Marine Litter
- Death or injury by collision
- Abrasion
- Smothering
- Sealing
- Underwater noise

**Ecosystem components**
- Fish-Demersal
- Sublittoral Sediment
- Marine Mammals
- Birds

**Ecosystem services**
Social–Ecological System: Linkage Framework

**Fishing quota**

**Direct effect decreasing importance**

**Indirect effect**

**Human activities**

- Fishing
- Renewables

**Pressures**

- Selection of fishing
- Input of organic matter
- Marine Litter
- Death or injury by collision
- Abrasion
- Smothering
- Sealing
- Underwater noise

**Ecosystem components**

- Fish assemblage
- Sublittoral Sediment
- Marine Mammals
- Birds

**Ecosystem services**

- Programming:
  - 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
Social–Ecological System: Linkage Framework

Habitat credits
Pulse trawl

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
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Cultural:
- Intellectual Representative
- Physical Experiential
- Spiritual Emblematic
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Human activities

Pressures

Ecosystem components

Ecosystem services

Selective extraction of species
Input of organic matter
Marine Litter
Death or injury by collision
Abandonment
Smuggling
Underwater noise

Fish-Demersal
Structural Sediment
Marine Mammals
Birds

Direct effect decreasing importance
Indirect effect
Social–Ecological System: Linkage Framework

OWF planning

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

Fisheries
Recreables

Direct effect decreasing importance
Indirect effect

Selective extraction of species
Input of organic matter
Marine Litter
Death monopoly by
Abrasives
Smothering
Sealing
Underwater noise

Fish-Demersal
Sublittoral Sediment
Marine Mammals
Integrated EBM toward different societal goals

1.1 Less fishing effort. Catch = MSY
1.2 “choke species” Catch < MSY.
1.3 Habitat credits
1.4 Pulse trawl

2.1 MPAs
3.1 OWF Turbines < bird mortality
3.2 OWFs positioning < bird mortality
3.3 OWFs trawl ban
3.4 OWF hard substrate

Sustainable food supply
Healthy ecosystem
Clean energy

Management measure

Graph showing reduction (% of total impact risk)

- Fish & Cephalopods
- Mammals
- Birds
- Coastal
- Shelf
Anthropogenic scenarios

Scenario I
Slow Change

Scenario II
Pragmatic Sustainability

Scenario III
Rapid Development

Scenario IV
Sustainable Together

Future scenario
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Effectiveness protecting the seafloor: issues

Baseline

Alternative

Remove fishing

Reallocate to known fishing areas

Reallocate without prior knowledge

Baseline

Year


Surface abrasion 2009-2016

0 0.1 <= 0.2 0.2 <= 0.5 0.5 <= 1 1 <= 5 5 <= 10 10 <= 100 > 100 MPA Windfarms

Baseline

Graph of area fished

0.40 0.45 0.50 0.55 0.60

Marine Spatial Planning (MSP): Issues

Efficiency = % loss fishery

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Equity = % loss in revenue

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EBM main messages

≡ Integrated, Ecosystem–based
  • Activities–pressures with biggest impact
  • Ecosystem components mainly threatened
  • Appropriate level of detail

≡ Adaptive
  • Cyclical piecemeal process

≡ Knowledge base
  • Integrated risk–based approaches covering the full breadth of the social–ecological system
  • Detailed quantitative analysis of the main threats/issues
  • Coupled Social–Ecological System (including governance)
  • Trans–disciplinary