The value of biodiversity – natural and social science perspectives

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Challenges for estuarine/marine science & management:

There is only one big idea: how to maintain and protect ecological structure and functioning while at the same time allowing the system to produce ecosystem services from which we derive societal benefits.

- Recovery/coping with historical legacy
- Endangered coastal and marine ecosystem functions
- Legal & administrative framework
- Economic prosperity and delivery of societal benefits
- Coping with climate change & moving baselines

In other words: “to look after the natural stuff and deliver the human stuff”
Change & degradation of the natural state (S)

Ecosystem Structure & Biodiversity

Ecosystem Functioning (supported, regulated)

Ecosystem Services (regulating and provisioning)

Change & decrease in output from the natural state into human welfare (S, I(W))

Socio-economic & cultural goods & benefits (regulated, provisions)

Activities (A)

Drivers (basic human needs, wants & values) (D)

Endo- & exogenic pressures (P)

Physico-chemical environmental conditions

Governance (policies, politics, legislation, administration) (R(M))

Adaptive, spatial & temporal management & planning (R(M))

Active and passive maintenance & restoration (including eco- & geo-engineering, nature-based solutions and other societal actions) (R(M))

Enhancement by active & passive restoration (including eco- & geo-engineering, nature-based solutions and other societal actions) (R(M))

Responses using a programme of management measures (incorporating the 10-tenets) (R(M))

Inputting complementary capital & assets (human, social & built capital: skills, energy, money, time, knowledge &/or sentience)
Oil and gas and offshore wind infrastructure operation and decommissioning
Offshore wind farms  Oil & Gas  Infrastructure  Artificial reefs  Wrecks

exploration/planning  construction  operation  decommissioning  presence

C1 Interference/distortion biological migrations
hydrographic/oceanographic processes
influence on biological connectivity
food-web dynamics

C2 Base support for biota key species structure
functioning
creation of new habitat
habitat extension
habitat removal

C3 Habitat modification surface area
surface complexity
siting/distance with respect to populations

C4 Introduction of materials physical structure
particulate
energy

C5 Role for Non-Indigenous Species movement
physical dissolved
chemical

To determine cause, presence, size, consequences and response:
Activity-footprint
Pressures-footprint
Effects-footprint
Management responses-footprint

on human system
on natural system

Type and adequacy of information:
conceptual
quality
spatial
local to global
deterministic, empirical
quantity
temporal
short to long term

(Child & Birchenough, Mar Poll Bull 2022)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Vessel movements</td>
<td>✓</td>
</tr>
<tr>
<td>Embedment Anchoring</td>
<td>-</td>
</tr>
<tr>
<td>Suction Anchoring</td>
<td>✓</td>
</tr>
<tr>
<td>Survey sampling</td>
<td>-</td>
</tr>
<tr>
<td>Overtrawl survey</td>
<td>✓</td>
</tr>
<tr>
<td>Making safe</td>
<td>-</td>
</tr>
<tr>
<td>Rig placement</td>
<td>-</td>
</tr>
<tr>
<td>Rig removal</td>
<td>-</td>
</tr>
<tr>
<td>Detachment of top side</td>
<td>✓</td>
</tr>
<tr>
<td>Digging out infrastructure (excavation around jacket footings, pipeline sections, risers etc)</td>
<td>-</td>
</tr>
<tr>
<td>Placement of stabilisation material</td>
<td>-</td>
</tr>
<tr>
<td>Removal of the infrastructure (cutting / explosives)</td>
<td>✓</td>
</tr>
<tr>
<td>Removal of the infrastructure (pipelines, jacket footings (non-derogation), risers, mattresses) (impact on seabed)</td>
<td>✓</td>
</tr>
<tr>
<td>Rejection of cuttings</td>
<td>✓</td>
</tr>
<tr>
<td>Concrete Gravity Based Structure (remaining in place)</td>
<td>-</td>
</tr>
<tr>
<td>Footings (derogation) (remaining in place)</td>
<td>-</td>
</tr>
<tr>
<td>Buried mattresses (remaining buried)</td>
<td>-</td>
</tr>
<tr>
<td>Pipeline trenched and buried (remaining as buried)</td>
<td>-</td>
</tr>
<tr>
<td>Pipeline rock dump</td>
<td>-</td>
</tr>
<tr>
<td>Pipeline open trench (remaining open)</td>
<td>-</td>
</tr>
<tr>
<td>Cutting a trench (trenching a surface pipeline)</td>
<td>✓</td>
</tr>
<tr>
<td>Seabed preparation (corridor for pipeline)</td>
<td>-</td>
</tr>
<tr>
<td>Drill cuttings (undisturbed)</td>
<td>-</td>
</tr>
<tr>
<td>Drill cuttings (disturbed)</td>
<td>-</td>
</tr>
</tbody>
</table>
State changes to the natural system reflected by changes in the marine ecosystem, intermediate and final ecosystem services (left hand side), and Impacts (on human Welfare) reflected by changes to the provision of Societal goods and benefits (right hand side) (Elliott et al., 2017, modified and expanded from Turner et al., 2015).
The estuarine, coastal and marine environments can be valued in a continuum covering three terms: ecological valuation, socio-ecological valuation and socio-economic valuation.
Ecosystem services are the link between ecosystems and the goods and benefits that they provide for society.

(* Human complementary assets – time, money, skills, energy required to obtain the goods and benefits, being sentient)
Ecological valuation – at genetic, species, community, habitat and ecosystem levels of biological organisation

‘Ecological value’ can be defined as: ‘the intrinsic value of biodiversity, without reference to anthropogenic use; it is measured in non-monetary terms’.

*1 – if this is in societal terms then this refers to anthropogenic valuation; *2 – if this relates to activities or anthropogenic pressures then it is societal valuation.
Socio-ecological valuation

• Socio-ecological valuation relates to the development of ecosystem services from those biological levels of organisation and based on supporting and regulating aspects of ecosystems.
• In turn these give the provisioning services which in turn can deliver societal goods and benefits, including cultural benefits.
• That socio-ecological valuation then ensures that individual and societal welfare and wellbeing can be measured and safeguarded.
Socio-economic Valuation

• Socio-economical valuation relates to the societal and national macro-economics,
• including the employment related to the environment, the economic aspects related to public health and public safety,
• and the protection of people and coastal assets from both endogenic managed pressures and exogenic managed pressures such as climate change.
• The types of valuation can be made in
  • monetary/non-monetary,
  • material/non-material and
  • tangible/non-tangible terms
  • and constitute both natural and human capital.
Total Economic Value

- Economic values are measured in **monetary terms** (£, $, €).

- Total Economic Value comprises both **use and non-use values**.

- Economic values can be captured through the **Willingness to Pay (WTP)** for goods and services or their **Willingness to Accept (WTA)** compensation for a disservice.
Natural Capital: “The elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions”.

Ecosystem Services: “Functions and products from nature that can be turned into benefits with varying degrees of human input”.

Benefits: “Changes in human welfare (or well-being) that result from the use or consumption of goods, or from the knowledge that something exists”.

Understanding the links between natural capital, ecosystem services and benefits is a fundamental part of applying an ecosystem approach to management.

- Provides a means of integrating the natural and societal aspects.

- Makes system complexity understandable to policymakers and stakeholders and therefore provides a valuable tool for the Abu Dhabi workshops.
Indicators can be used to identify the behaviour, state and trajectory of natural capital, ecosystem services and societal benefits.

Indicators of stocks and flows can be used to track natural changes over time or changes as a result of Activities, Pressures and Responses (as Management measures).

Therefore indicators can be used for monitoring and management purposes.
Natural Capital Accounting

• Governments attempt to **value the Natural Capital** and generate sets of national natural capital accounts similar to traditional National Income Accounts.

• This requires putting **monetary values** on the natural capital stock by, for example, valuing the range of flows of benefits that natural capital offers at present and into the future.

• **The UN SEEA guidelines enable monitoring of**: pressures exerted by the economy on the environment, in terms of abstraction of natural resources and emissions; impacts in terms of changes in environmental condition, and how the economy responds in terms of expenditure on environmental protection and resource management.

https://seea.un.org/
Use of quantitative matrices to link biodiversity and habitats to ecosystem services and societal goods and benefits (such as the Matrix Approach)

Main aims:

To give:

- The matrix analysis tool which links the natural environmental assets and components being protected to the pressures and the ecosystem services and societal goods and benefits produced;
- The examples of the matrix approach for both highly mobile species (such as birds) and sedentary habitats and species features;
- The data required and limitations of the methods for the Matrix Approach and its implementation across the environments.
The Matrix Approach

- **Structured desk-based assessment** with peer-reviewed outputs (Potts et al., 2014).

- Assess the **relative importance** of natural capital assets (e.g. habitats and species) in delivering ecosystem services and benefits.

- Provides a **confidence score** for each cell within the matrix.

- Can be used to **inform trade-offs** of Responses (using management Measures).
Should we value nature?

Controversy on the value of nature

Ecologist advocated biocentric perspectives based on intrinsic ecological values

Complementarity?

Values affecting decisions far beyond markets

Economist adopt anthropocentric perspectives that focus on instrumental values

Utilitarian perspective based on cost-benefits rationality

Moral motivation (extended rationality?) conferring rights to nature?

“I suppose I’ll be the one to mention the elephant in the room.”

“How come it’s always the old, bald-headed guy with glasses in cartoons?”

Horizon Europe Project – MARBEFES - Objectives:

• Develop and use a set of tools for ecological and economic (financial and non-financial) valuation of marine biodiversity and its services and societal goods and benefits for implementing in the Broad Belt Transect areas.

• Characterise the benefits and co-benefits humans derive from coastal and marine ecosystem services for policy and decision making.

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Thanks for listening!

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