

Decommissioning Options for Oil & Gas Infrastructure - Potential Impacts on the Integrity of MPAs and the Provision of Ecosystem Services (DECOM-MPA) – Information Acquisition and Use

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Challenges for science & management:



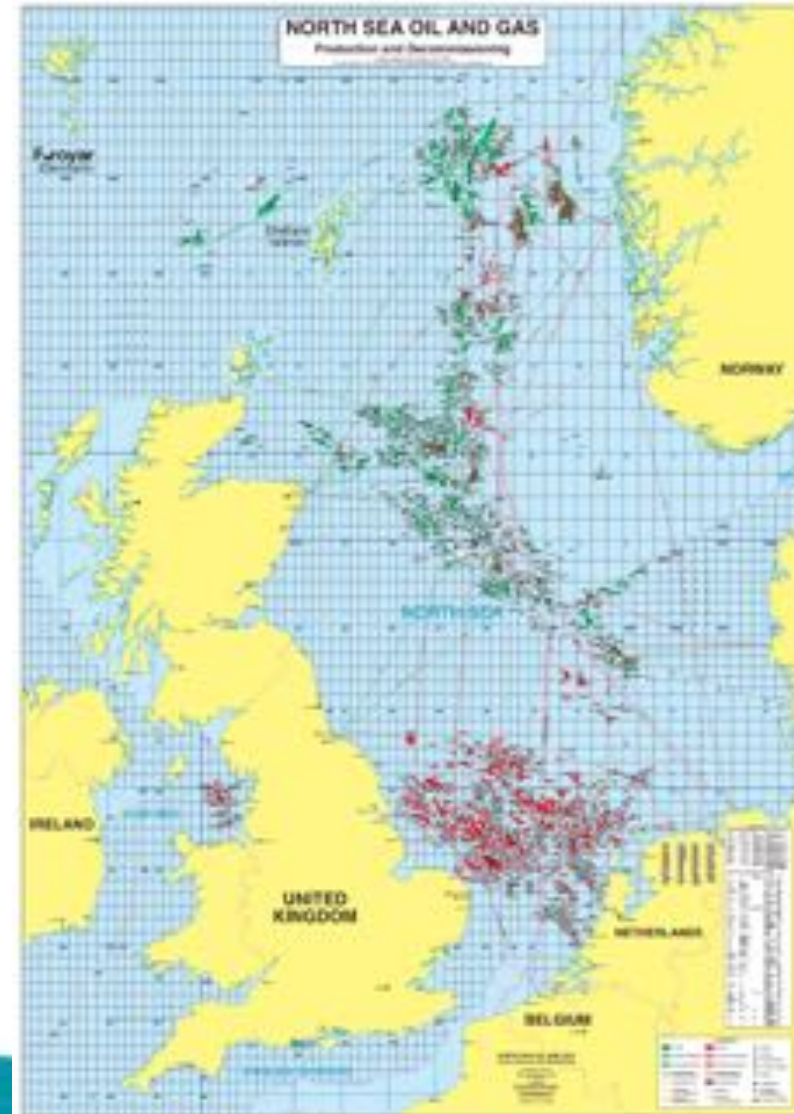
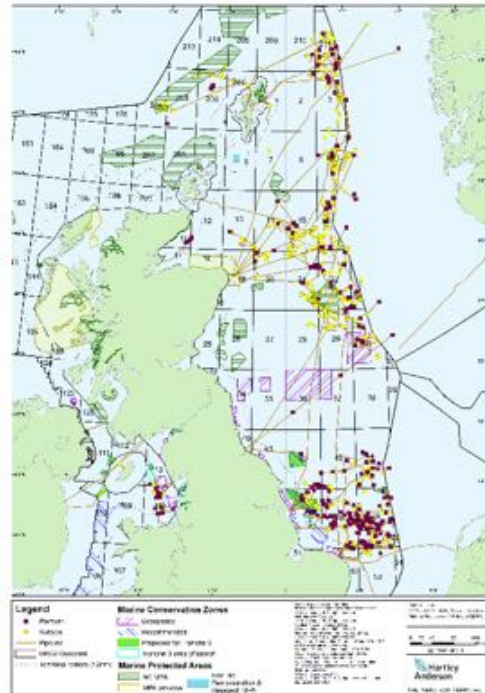
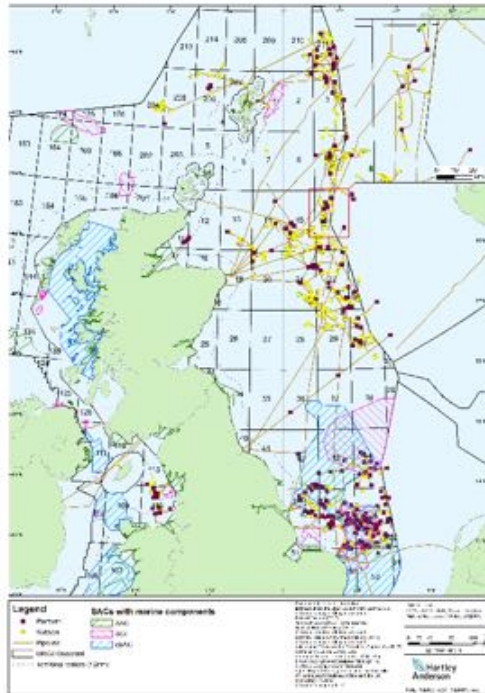
There is only one big idea in marine management: *how to maintain and protect ecological structure and functioning while at the same time allowing the system to produce ecosystem services from which we derive societal benefits.*

- 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

The UK and Marine Scotland vision: *“clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long-term needs of people and nature”.*

North Sea Oil and Gas Decommissioning and MPAs

- 50 years: >8,000 structures (platforms, pipelines and wells); most in the North Sea.
- Costing approximately £37 billion.
- Decommissioning operations within MPAs have further challenges.
- 13 UK MPAs have O&G platforms (or platforms and pipelines) within them.
- A further 33 UK MPAs have O&G pipelines in them.
- Robust scientific evidence and a defensible approach is required.



Oil and Gas – Innovation Programme



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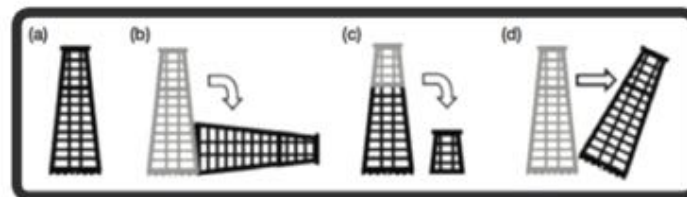




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Key Questions to be Addressed:

1. What oil and gas structures need to be decommissioned?
2. Are they located within/adjacent to an MPA?
3. What decommissioning options are available?
4. What are the potential environment impacts on interest features?
5. What are the potential impacts on ecosystem service provision?
6. What are the potential impacts on conservation objectives and site integrity?



Challenges – to determine:

- the loss and gain of habitats and surfaces
- the loss and gain of ecosystem services and societal goods and benefits
- the value of removing structures with and without damage
- the whole system energy and economic budgets
- the whole cycle environmental footprints at near and far scales
- how to ensure the protection of other uses and users
- the relevant baseline/reference condition (with or without structures)
- the harmonised implementation of Good Ecological Status (WFD), Good Environmental Status (MSFD) and Favourable Conservation Status (HD).

and

- what are the bottlenecks, showstoppers and train-wrecks?



AIMS & OBJECTIVES:

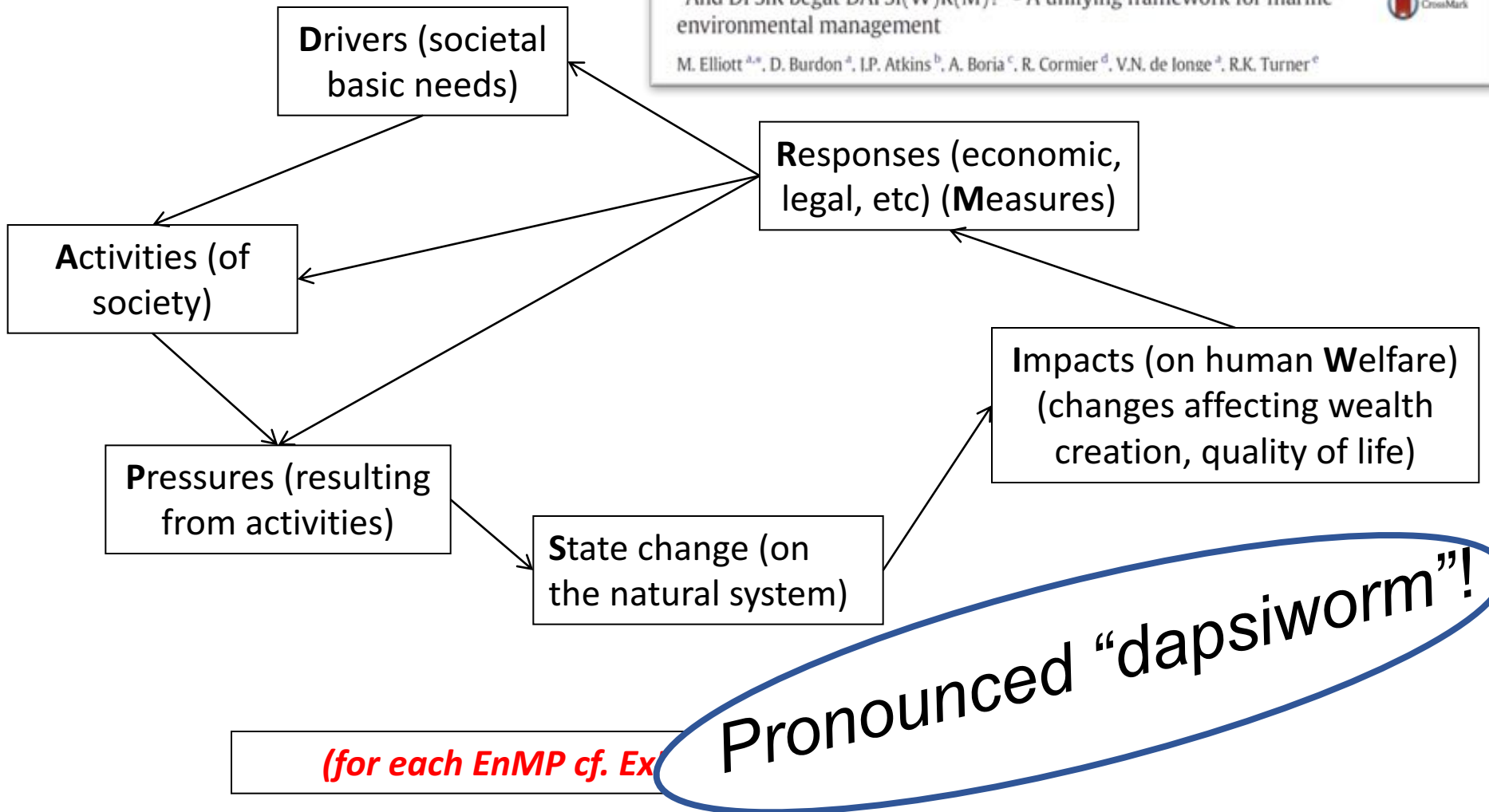
DECOM-MPA aims to develop a Decision Support Document and strengthen the evidence base to support decision making for decommissioning oil and gas infrastructure.

The project is:

1. **Developing a Decision Support Document (DSD);**
2. **Gathering and Assessing Best Available Scientific Evidence;**
3. **Engaging End-Users Throughout the Project;**
4. **Using Industry-Led Case Studies to Test the DSD; and**
5. **Disseminating Findings to a Wide Range of Stakeholders.**



DAPSI(W)R(M) framework





Drivers: (D)

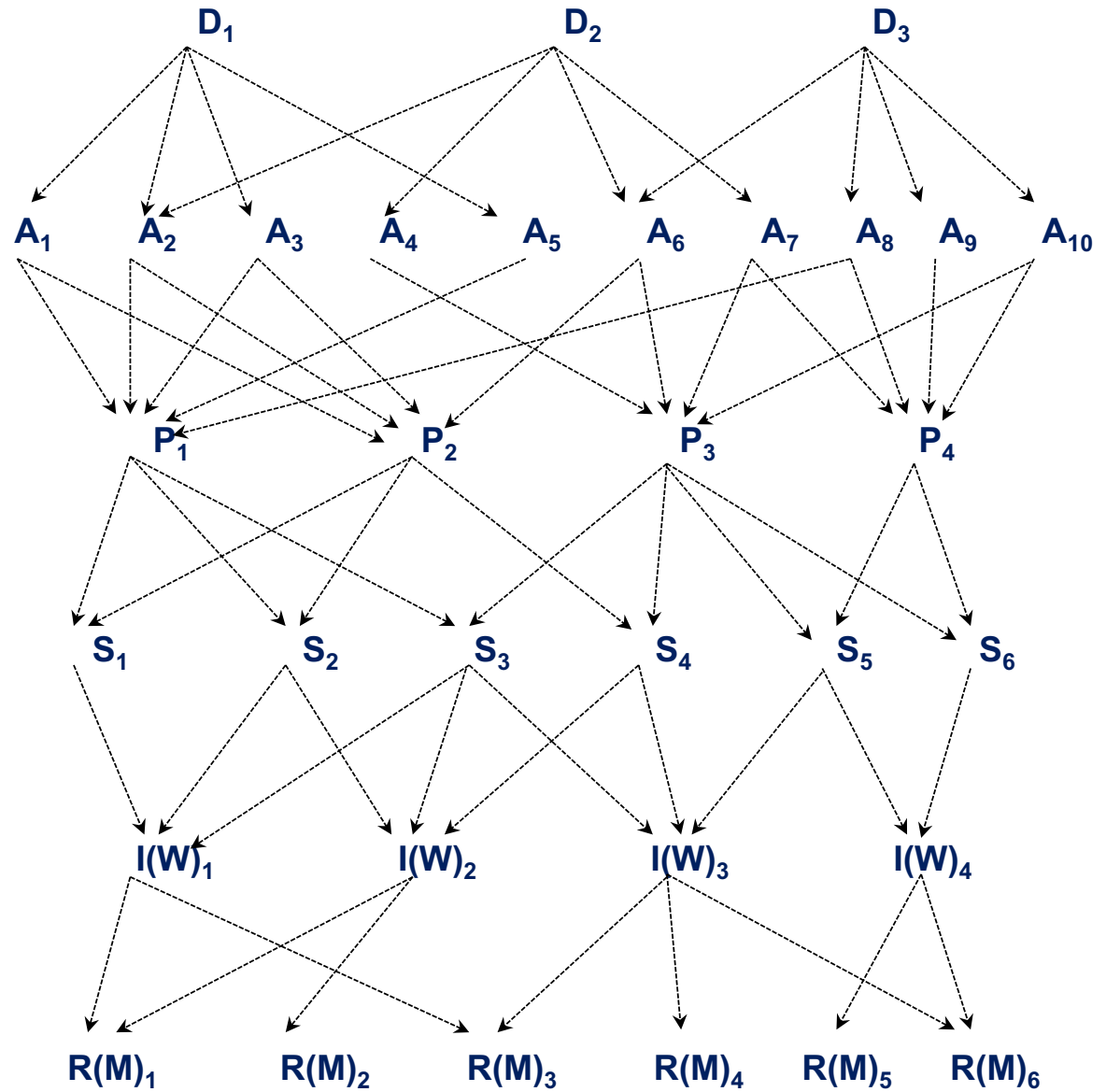
Activities: (A)

Pressures: (P)

State changes: (S)

Impacts (on Welfare): I(W)

Responses (as Measures): R(M)



COMPLEXITY – DATA NEEDED:

- **Infrastructure groups and types** (e.g. platform topside, platform jackets, platform wells, subsea wells, pipelines, subsea structures)
- **Objectives** (e.g. full removal, partial removal, plug/abandon)
- **Decommissioning methods** relating to specific infrastructure types (21)
- **Pressures** (short list of 28 identified from the full list of 40 pressures)
- >380 potential **Activity-Pressure** combinations
- **Features**; species, habitats, etc. (>100)
- **Sensitivity** (>100)
- Nearly 40,000 potential **Activity-Pressure-Sensitivity** pathways to consider

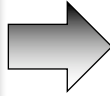
No.	Infrastructure	Objective	Method
1	Platform wells	Plug and abandon	Existing integrated facilities
2	Platform wells	Plug and abandon	“Rigless” modular units
3	Platform wells	Plug and abandon	Jack-up rig
4	Subsea wells	Plug and abandon	Jack-up rig
5	Subsea wells	Plug and abandon	Light well-intervention vessel
6	Platform topsides	Full removal	Piecemeal removal involving demolition in situ, and multiple smaller ships and possibly crane vessels
7	Platform topsides	Full removal	Reverse installation using an anchored HLV
8	Platform topsides	Full removal	Reverse installation using a DP HLV
9	Platform topsides	Full removal	Single lift using an anchored HLV
10	Platform topsides	Full removal	Single lift using a DP HLV
11	Platform jackets	Full removal	Multiple lifts using a shear-leg barge or smaller HLV
12	Platform jackets	Full removal	Single lift using an anchored HLV
13	Platform jackets	Full removal	Single lift using a DP HLV
14	Pipelines and umbilicals	Full removal	“cut and lift” of pipeline sections: most practical for large diameter, rigid and concrete coated pipelines, though applicable to any
15	Pipelines and umbilicals	Full removal	Reverse reel or reverse S-lay
16	Pipelines and umbilicals	Partial removal	“cut and lift” of individual sections [may involve various degrees of intervention, with removal of pipeline ends and remediation involving rock placement]
17	Pipelines and umbilicals	Leave in situ	Usually involves various degrees of intervention, with removal of pipeline ends and remediation involving rock placement
18	Pipelines and umbilicals	Leave in situ	Trench and bury
19	Drill cuttings	Leave in situ	Leave in place
20	Drill cuttings	Leave in situ	Leave in place but cover with gravel
21	Drill cuttings	Full removal	Remove cuttings (pump up to surface rig/vessel), dewater, and either reinject into bedrock waste well or transfer to shore for treatment/landfill



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Number	Pressures
1	Above water noise
2	Abrasion
3	Abrasion / disturbance
4	Barrier to species movement
5	Change in bathymetry
6	Change in siltation rate
7	Change in suspended solids
8	Collision risk
9	Contamination - transition elements and organo-metals
10	Contamination - HC and PAH
11	Contamination (transition elements and organo-metals)
12	Cuttings pressures
13	Drilling
14	Extraction
15	INNS
16	Light
17	Litter
18	Microbial pathogens
19	Penetration (subsurface)
20	Penetration (surface)
21	Physical change (to another seabed type)
22	Physical change (to another sediment type)
23	Physical loss
24	Physical loss of seabed type
25	Underwater noise
26	Vibration
27	Visual disturbance
28	Water flow

Ecosystem Services & Societal Goods & Benefits

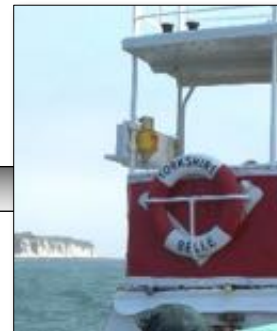
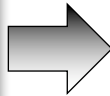


Marine Ecosystem
structure &
functioning

Ecosystem
Services

Input of Human
Capital

Societal Goods
& Benefits



Ecosystem services are the link between ecosystems and
the goods and benefits that they provide for society

Food to eat



**Regulate
our climate**



**Education &
research**



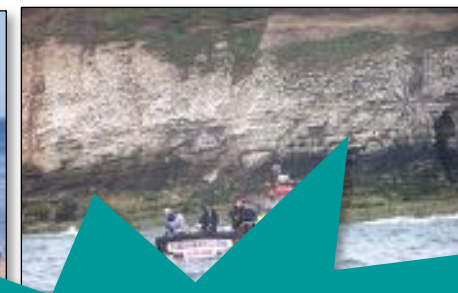
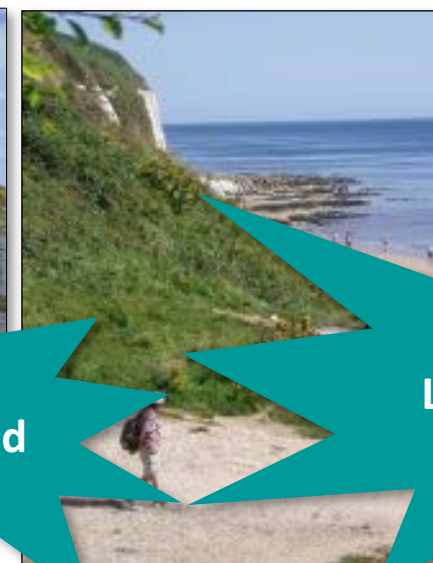
**Breakdown our
waste**



**Provide
natural flood
defence**



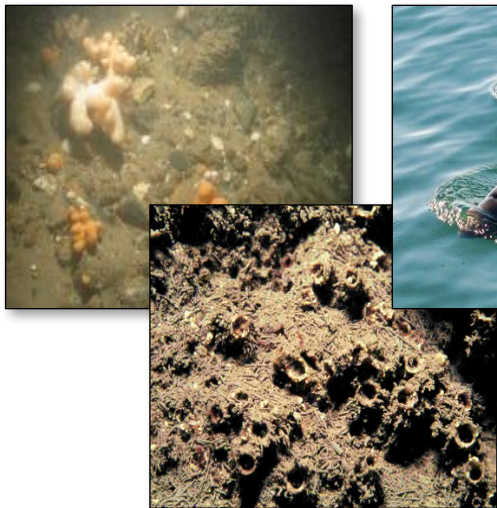
Leisure & recreation





Using the Matrix Approach:

Feature	EUNIS code	Feature	Intermediate services										Goods/Benefits															
Features			Intermediate Services										Goods/Benefits															
↓			↓										↓															
	EUNIS code and this column should only be used as a guide.		Primary production	Larval and gamete supply	Nutrient cycling	Water cycling	Formation of species habitat	Formation of physical barriers	Formation of seascape	Biological control	Natural hazard regulation	Waste breakdown and detoxification	Carbon sequestration	Food (wild, farmed)	Fish feed (wild, farmed, bait)	Fertiliser and biofuels	Ornaments and aquaria	Medicines and blue biotechnology	Healthy climate	Prevention of coastal erosion	Sea defence	Waste burial / removal / neutralisation	Tourism and nature watching	Spiritual and cultural well-being	Aesthetic benefits	Education and Research	Physical health benefits	Psychological health benefits
Existing Habitats protected under EU legislation																												
E,EU,W	A1.1	High energy intertidal rock																										
E,EU,W	A1.2	Moderate energy intertidal rock																										
E,EU,W	A1.3	Low energy intertidal rock																										
E,W	A2.2	Intertidal sand and muddy sand																										
E,W	A2.3	Intertidal mud																										
E,EU	A2.4	Intertidal mixed sediments																										
Assessment of Importance			Assessment of Confidence										Feature Type															
↓			↓										↓															
Scale of ecosystem service relative to other features			Confidence in evidence										Feature type[†]															
<div>#</div> Significant contribution			<div>3</div> UK-related, peer-reviewed literature										<div>S</div> Scottish MPA search feature															
<div>#</div> Moderate contribution			<div>2</div> Grey or overseas literature										<div>E</div> English MCZ feature															
<div>#</div> Low contribution			<div>1</div> Expert opinion or Obvious										<div>W</div> Welsh HP MCZ feature															
<div>#</div> No or negligible ESP			<div></div> Not assessed										<div>NI</div> Northern Ireland MCZ feature															
<div></div> Not assessed													<div>EU</div> EU Habitats Directive Annex 1 feature or sub-feature															



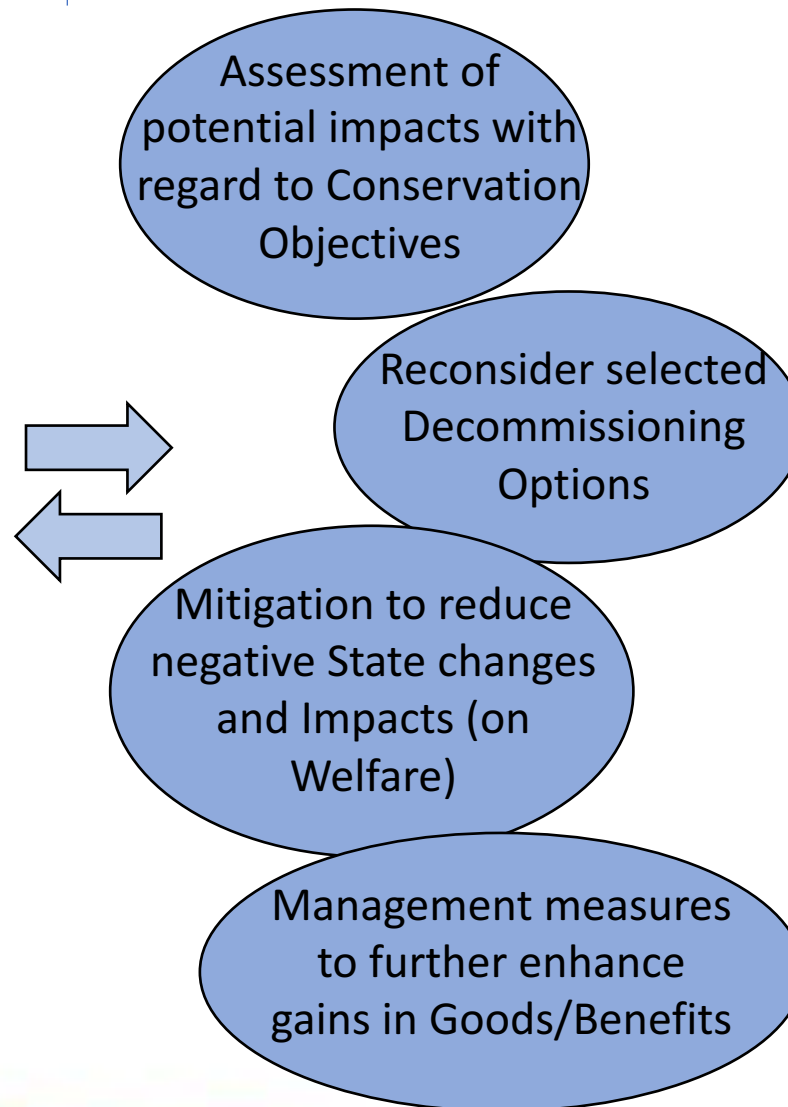
Trade-offs of ecosystem services

- To determine the potential effect (positive and/or negative) of 'rigs' and 'no rigs' within the NNSSR cSAC/SCI on the provision of ecosystem services and societal benefits.
- To use a simple scoring system (++, +, 0, -, --) to qualitatively assess potential change in ES provision with and without a rig in place.

Intermediate Ecosystem Services	Rigs	No Rigs	Comments
Primary production			
Larval and gamete supply			
Nutrient cycling			
Formation of species habitat			
Formation of physical barriers			
Formation of seascape			
Biological control			
Natural hazard regulation			
Waste breakdown and detoxification			
Carbon sequestration			
Final Ecosystem Services	Rigs	No Rigs	Comments
Fish and shellfish			
Algae and seaweed			
Ornamental materials			
Genetic resources			
Water supply			
Climate regulation			
Natural hazard protection			
Clean water and sediments			
Places and seascapes			
Goods/Benefits	Rigs	No Rigs	Comments
Food (wild, farmed)			
Fish feed (wild, farmed, bait)			
Fertiliser and biofuels			
Ornaments and aquaria			
Medicines and blue biotechnology			
Healthy climate			
Prevention of coastal erosion			
Sea defence			
Waste burial / removal/ neutralisation			
Tourism and nature watching			
Spiritual and cultural well-being			

Responses (as Measures)

Drivers
Activities
Pressures
State Changes
Impacts (on
human
Welfare)



10 Tenets

Ecologically sustainable
Technologically feasible
Economically viable
Socially desirable/tolerable
Legally permissible
Administratively achievable
Politically expedient
Ethically defensible (morally correct)
Culturally inclusive
Effectively communicable

Summary - DAPSI(W)R(M) Framework applied to Oil and Gas Decommissioning

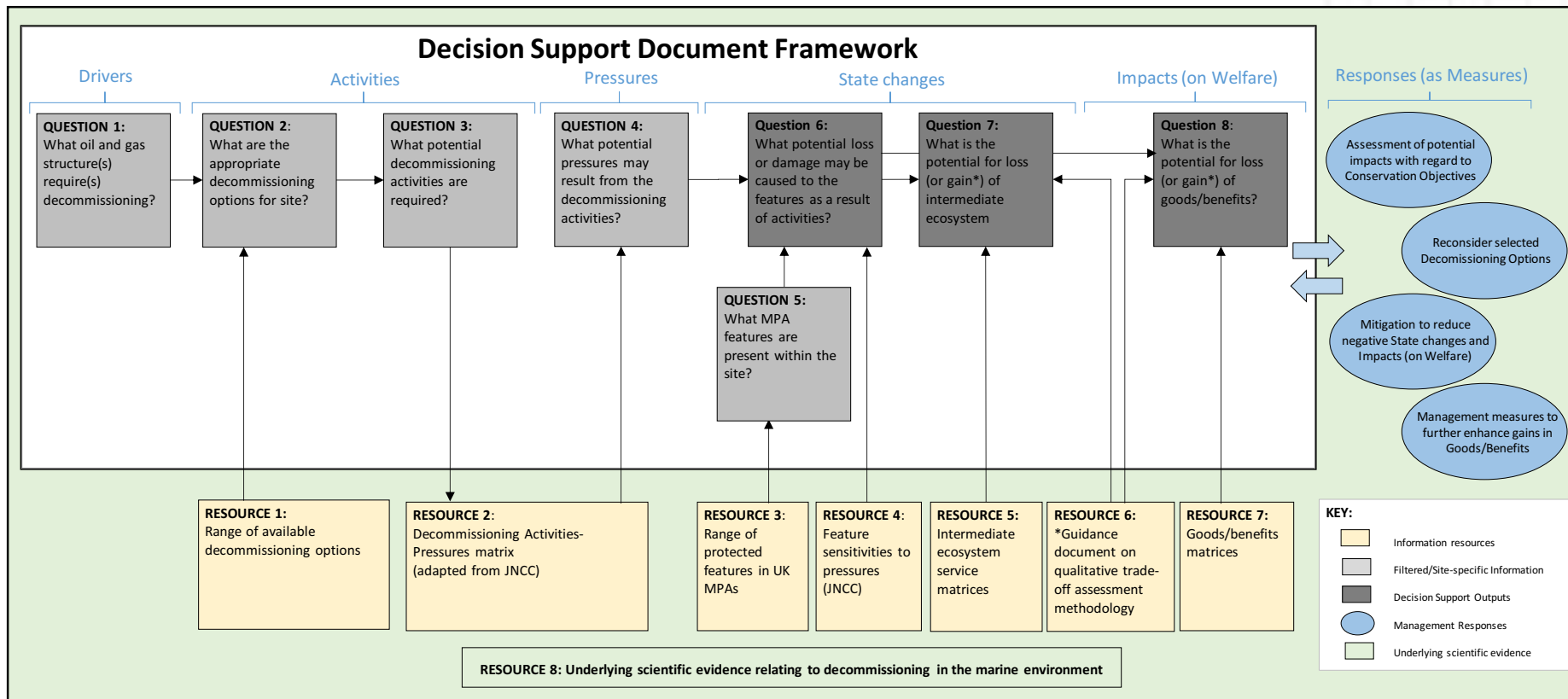
Element	Relevance to Decommissioning
Drivers	Legal and societal demand for clean, safe, productive, diverse and healthy environment
Activities	Appropriate decommissioning options and their associated activities e.g. removal of rigs
Pressures	Widescale pressure list: above-water noise, abrasion, siltation, collision risk, contamination by chemicals, litter, light, etc.
State changes	Potential biological loss, gain or damage to hydrodynamics, ecology, ecosystem services
Impact (on human Welfare)	Potential loss or gain of societal goods and benefits, commercial, recreational and cultural aspects
Responses (using management Measures)	Management measures to further enhance provision of ecosystem services; mitigation and/or compensation to minimise effects

Summary - Relevance of the 10-tenets of sustainable management to Oil and Gas

Tenet	Relevance to Oil, Gas and OWF decommissioning
Ecologically sustainable	Effects of loss or gain of habitats and surfaces; changes in ecological equilibrium; increase or removal of pressures
Technologically feasible	Are there the techniques and technologies for removal?
Economically viable	Costs/benefits/increase/decrease/legacy issues of energy/GHG/jobs/ecosystem services/societal goods and benefits in removal and recycling
Socially desirable/ tolerable	Societal views of remain/removal and company responsibility; repercussions for other societal users and uses
Legally permissible	Legal requirements to remove or allow retention; challenges to legal practice
Administratively achievable	National bodies to implement international regulations and decide removal and derogations
Politically expedient	Politics of austerity, environmental protection and Blue Growth
Ethically defensible (morally correct)	Ethics of leaving and/or decommissioning debts for future generations
Culturally inclusive	Influence on indigenous peoples' land and on high seas areas
Effectively communicable	Delivery of relevant and unbiased information

RATIONALISATION –THE WAY AHEAD

- Although nearly 40,000 *potential* impact pathways to consider, only a relatively small number are relevant to any given scenario
- Require a transparent, standardised methodology to filter down to the key Pressures
- What structure; what option; what method; what feature(s)?
- Easier to build agreement on component elements
- ‘Future-proofed’ approach (facilitating ‘plug-and-play’ adaptability, where blocks of information can be updated with no change to underlying process structure)



KEY:



Information resources



Filtered/Site-specific Information



Decision Support Outputs



Management Responses



Underlying scientific evidence



Drivers

QUESTION 1:

What oil and gas structure(s) require(s) decommissioning?

Activities

QUESTION 2:

What are the appropriate decommissioning options for site?

QUESTION 3:

What potential decommissioning activities are required?

Pressures

QUESTION 4:

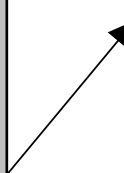
What potential pressures may result from the decommissioning activities?

RESOURCE 1:

Range of available decommissioning options

RESOURCE 2:

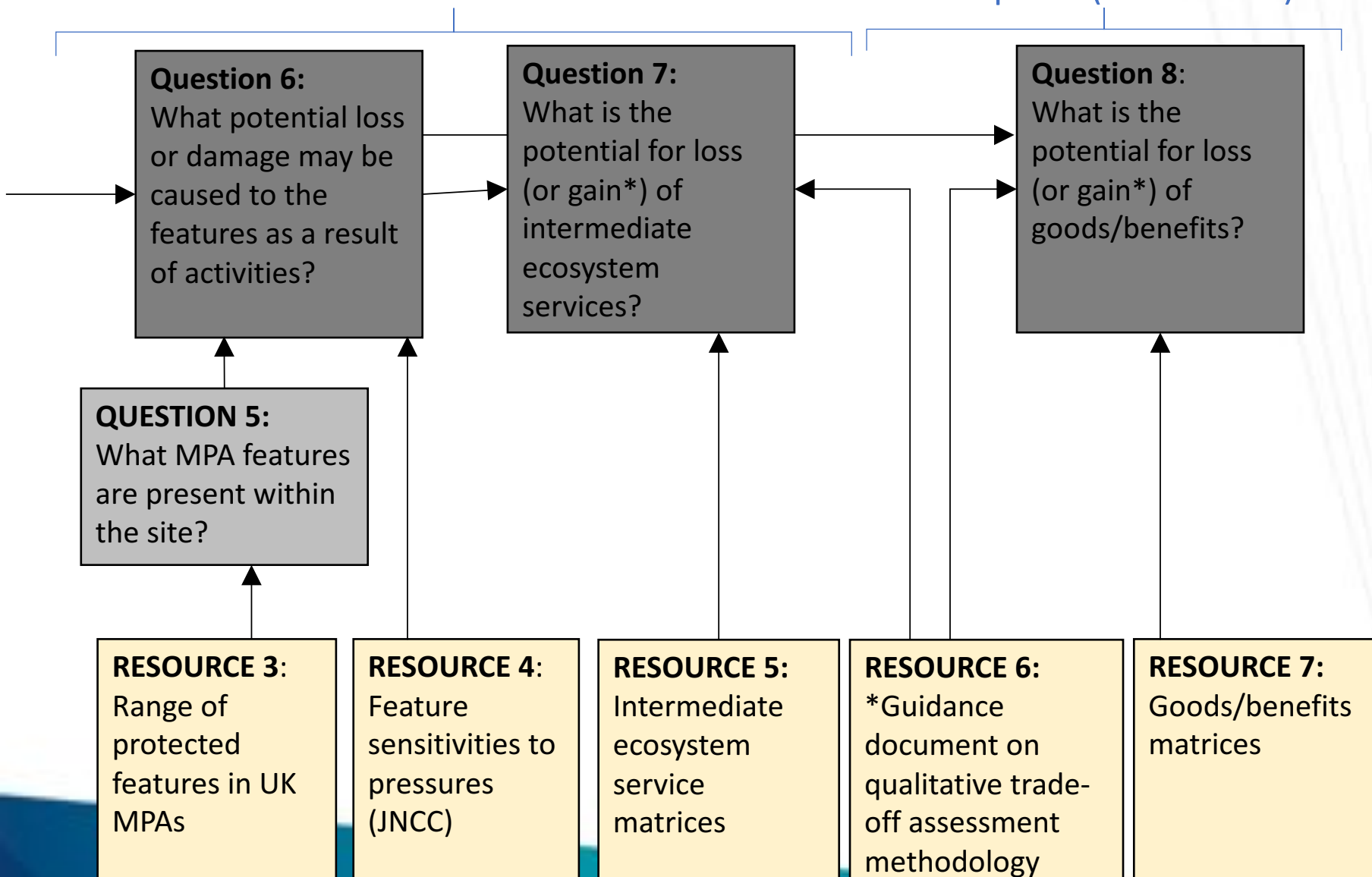
Decommissioning Activities-Pressures matrix
(adapted from JNCC)





State changes

Impacts (on Welfare)





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SPIDA – A user friendly interface

- SPIDA: Screening Potential Impacts of Decommissioning Activities
- Access database (c.f. PRISM, FEAST, etc.)
- Intuitive, easy to use front-end
- Underlying data tables easily updated
- Clear, standardised outputs





SPIDA: Screening Potential Impacts of Decommissioning Activities

1: Infrastructure selection

Select class of infrastructure: Platforms

Select specific infrastructure type: Platforms/topsides

2: Decommissioning objective

Select decommissioning objective: Full removal

3: Decommissioning method

Select decommissioning method:

[Click here to show pressures](#)

Decision Support Document (DSD)

What the DSD will do!

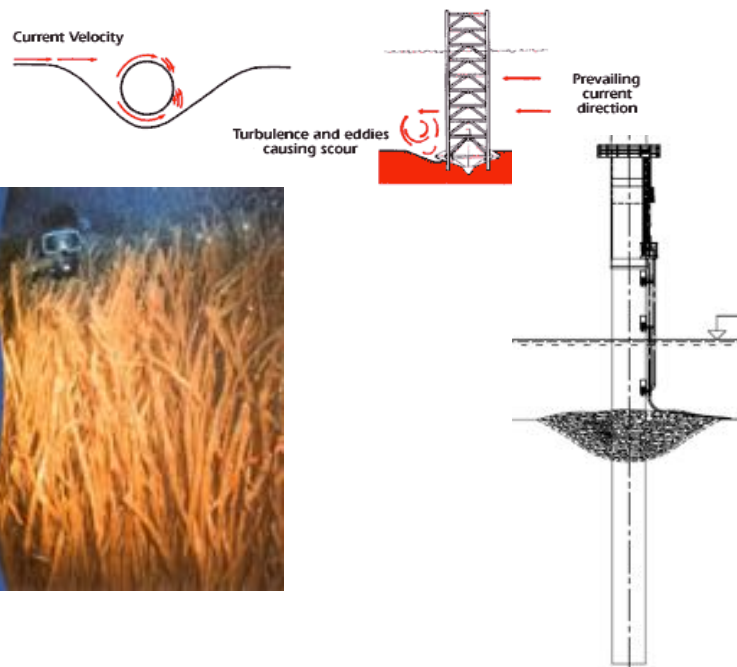
- ✓ Feed into EIA, CA, or Derogation Cases process
- ✓ Focus on environmental impacts
- ✓ Facilitate decision-making
- ✓ Transparent, defensible, more streamlined
- ✓ Provide flexibility to evolve
- ✓ Take an innovative natural capital approach
- ✓ Allow for review of existing evidence
- ✓ Link existing frameworks and tools
- ✓ Formalise/simplify current assessment methods

What the DSD will not do!

- ✗ Replace the EIA, CA, or Derogation Cases process
- ✗ Incorporate Safety, Societal, Technological and Economic aspects
- ✗ Make decisions – it is not a DSS!
- ✗ Generate new data or evidence
- ✗ Develop new tools

Summary - Influence of O&G decommissioning on MSFD

MSFD Descriptor	Relevance to Oil, Gas and OWF decommissioning
D01 biodiversity	Biodiversity/MPA change against uncertain baselines
D02 alien species	Surfaces for attachment and spread of NIS?
D03 foodwebs	Biomass and feeding area changes; reef-effect & loss;
D04 seafloor integrity	Disturbance through drill cuttings, cabling, tunnelling, scour-protection and surface structures;
D05 fishing	<i>De facto</i> no-take zones with structures vs. regaining fishing grounds after removal
D06 eutrophication	No changes, minimal response
D07 hydrography	Removal of impediments to flow, local changes in local hydrodynamics
D08 contamination in environment	Release of contaminants due to physical disturbance of from anoxic sediments (H ₂ S, CH ₄ etc)
D09 contamination in seafood	Uptake of any released contaminants but perhaps dispersion means non-detectable additional contamination
D10 litter	Remaining materials (pipelines, mattresses) regarded as 'litter' with eventual dispersion
D11 energy/noise	Noise, vibration (use of explosives) and energy use in removal



Energies **2010**, *3*, 1383–1422; doi:10.3390/en3071383

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Review

Coastal and Offshore Wind Energy Generation: Is It Environmentally Benign?

Jennifer C. Wilson ^{1,2,*}, Mike Elliott ¹, Nick D. Cutts ¹, Lucas Mander ¹, Vera Mendao ^{1,3}, Rafael Perez-Dominguez ¹ and Anna Phelps ¹

WIND ENERGY

Wind Energy, 2009; **12**:203–212

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Research
Article

The Habitat-creation Potential of Offshore Wind Farms

Jennifer C. Wilson* and Michael Elliott, Institute of Estuarine and Coastal Studies, University of Hull, HU6 7RX, UK

Marine Pollution Bulletin 90 (2015) 247–258

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journal homepage: www.elsevier.com/locate/marpolbul



Renewables-to-reefs? – Decommissioning options for the offshore wind power industry

Katie Smyth ^{a,*}, Nikki Christie ^b, Daryl Burdon ^a, Jonathan P. Atkins ^c, Richard Barnes ^b, Michael Elliott ^a





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