



Essential Environmental Concepts for the Offshore Wind Energy Sector in Europe

Discussion Paper

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16 environmental concepts relevant to offshore wind

- Conservation
- Critical habitat
- Ecological opportunity
- Ecological risk
- Ecosystem approach
- Ecosystem restoration
- Ecosystem services
- Good Environmental Status
- Mitigation hierarchy
- Nature-based solutions
- Nature-inclusive design
- Nature positive
- Precautionary principle
- Pressures and impacts
- Seascapes approach
- Sustainability

Summary of linkages between key concepts

Ecosystem restoration, mitigation hierarchy & Nature Positive

Ecosystem approach & cumulative impacts

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Conservation		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2 Critical habitat	✓								✓							✓
3 Ecological opportunity	✓					✓					✓					
4 Ecological risk	✓															
5 Ecosystem approach	✓					✓	✓	✓	✓	✓			✓	✓	✓	✓
6 Ecosystem restoration	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
7 Ecosystem services	✓				✓	✓			✓	✓		✓			✓	
8 Status	✓				✓	✓							✓	✓		✓
9 Nature-based solutions	✓	✓				✓	✓	✓				✓	✓	✓		✓
11 Nature-inclusive design	✓		✓							✓						✓
12 Nature positive	✓					✓	✓		✓					✓		✓
13 Precautionary principle	✓				✓			✓						✓		✓
14 Pressures and impacts	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓		✓	✓
15 Seascapes approach	✓				✓	✓								✓		✓
16 Sustainability	✓	✓							✓	✓	✓	✓	✓	✓	✓	

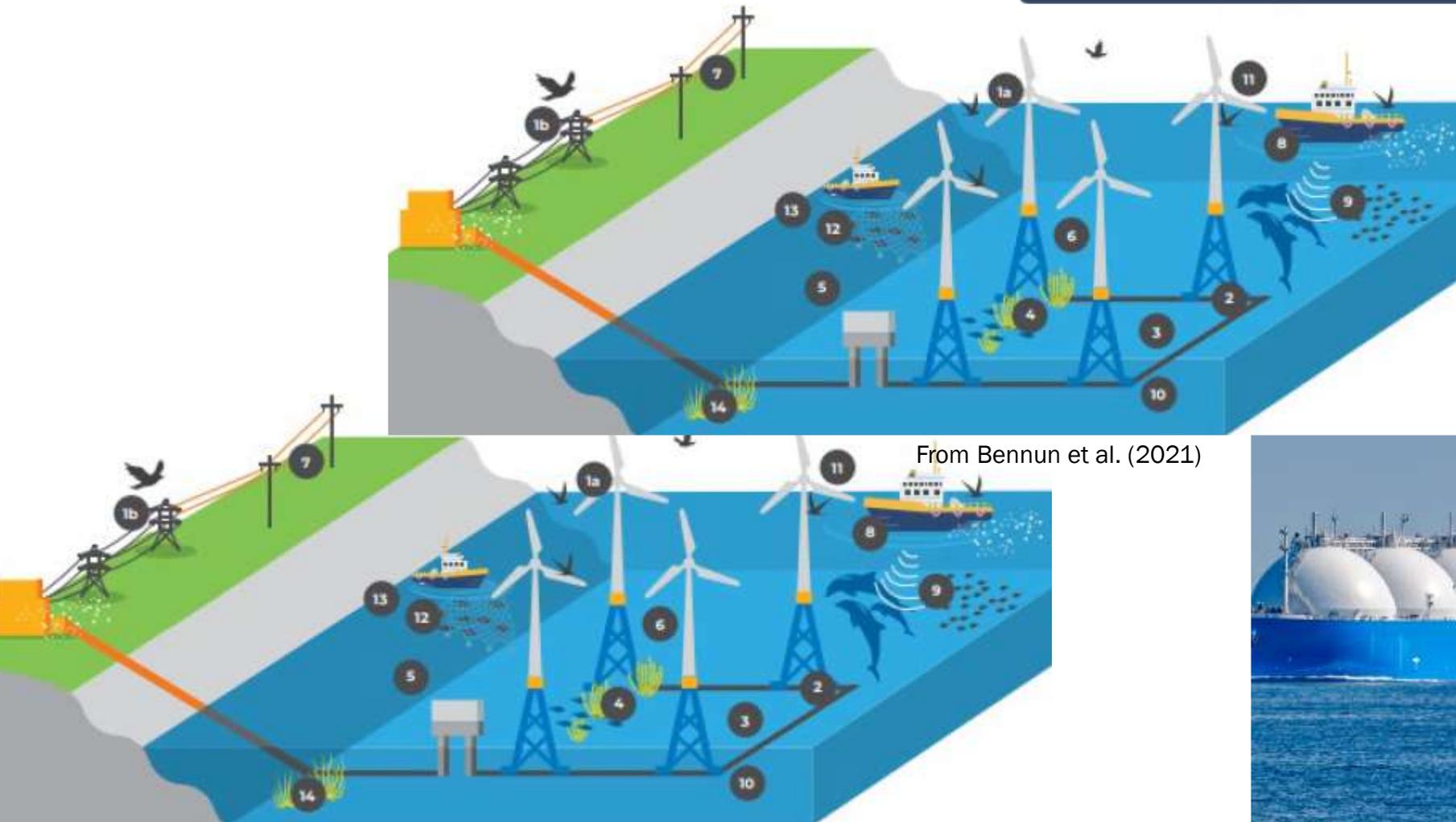
Precautionary principle

Nature-based Solutions and Nature-inclusive Design

Closely related concepts

Cumulative impacts

- Environmental effects caused by combined action of past, current and future activities (EU)



From Bennun et al. (2021)



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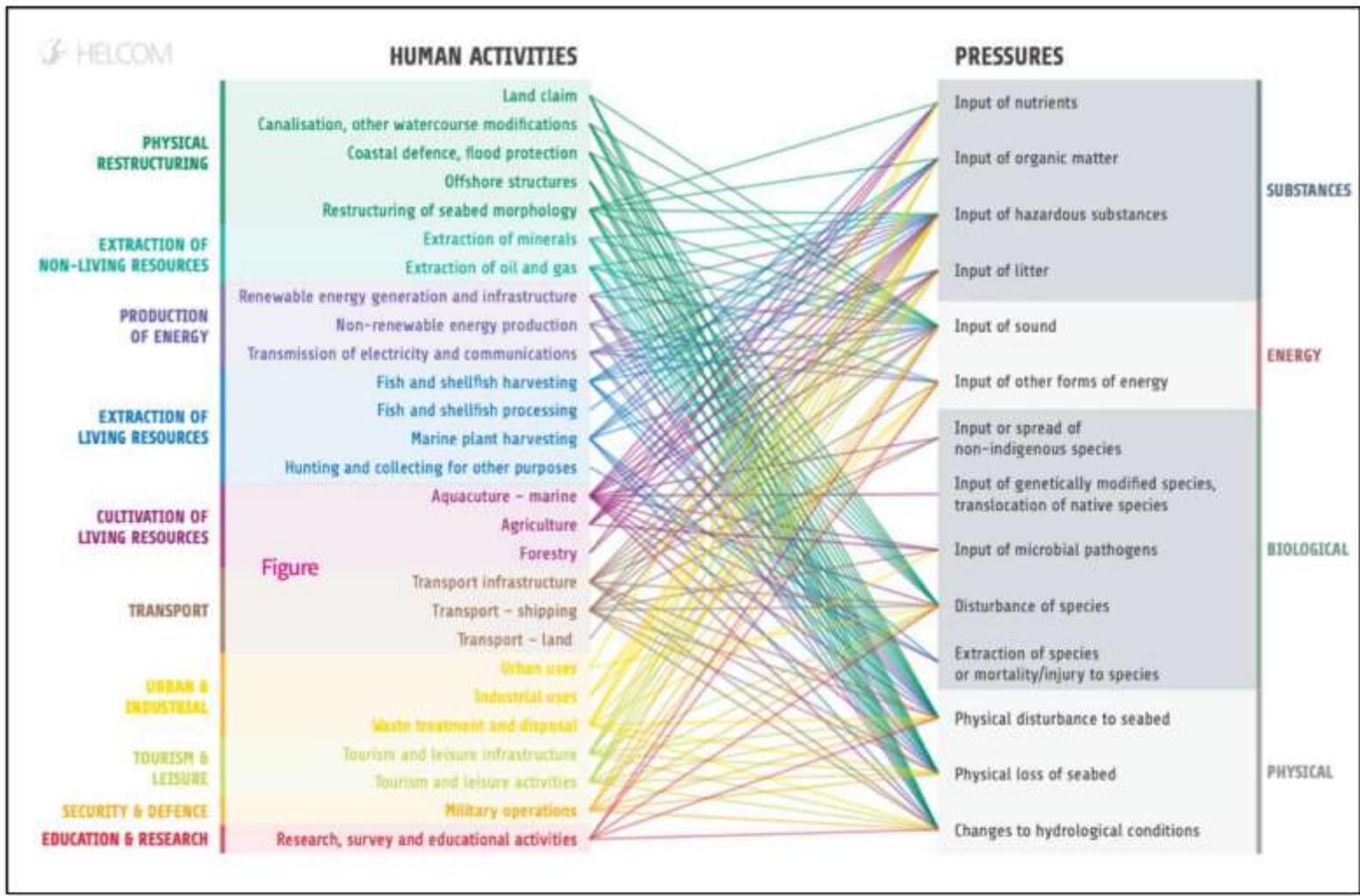


Figure 4. Links between human activities and marine pressures (HELCOM, 2018). Multiple pressures will lead to cumulative impacts.

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Closely related concepts

Cumulative impacts

- Environmental effects caused by combined action of past, current and future activities (EC)
- 93% of Europe's marine area faces multiple pressures and the combined effect of multiple pressures on marine species and habitats reduces the overall resilience of marine ecosystems
- The assessment of the cumulative effects from human activities at sea and on land is therefore a requirement of the EU's Marine Strategy Framework Directive
- Methods are available for assessing cumulative impacts, but more studies and data sharing are needed to better understand these impacts

Ecosystem (or ecosystem-based) approach

- Integrated management of land, water & living resources that promotes conservation and sustainable use (CBD)
- EBA is a key requirement of maritime spatial planning as per the European Maritime Spatial Planning Directive (EU, 2014) & considers the cumulative impacts of different sectors

Closely related concepts

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Ecosystem (or ecosystem-based) approach

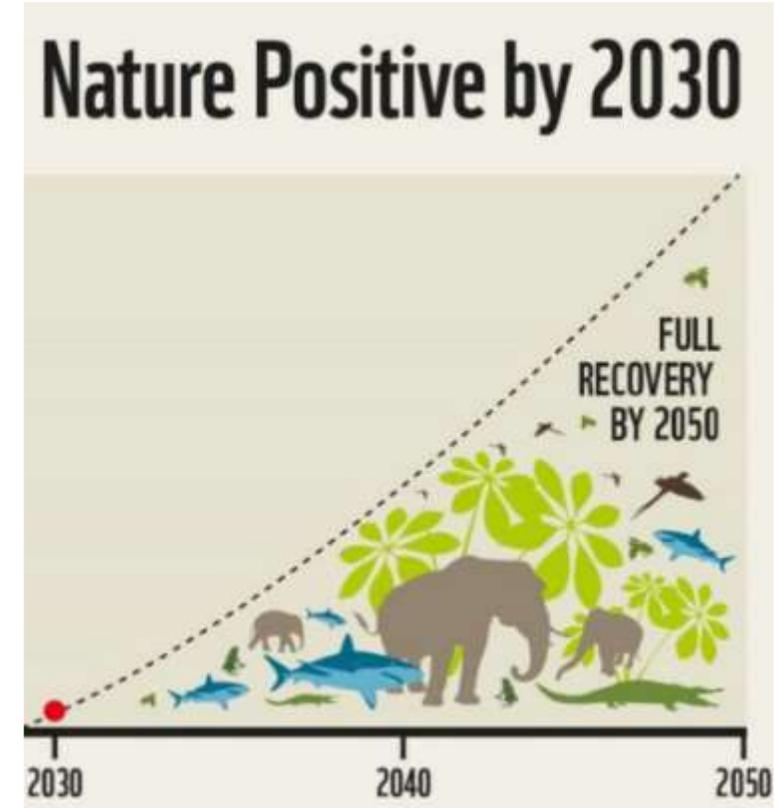
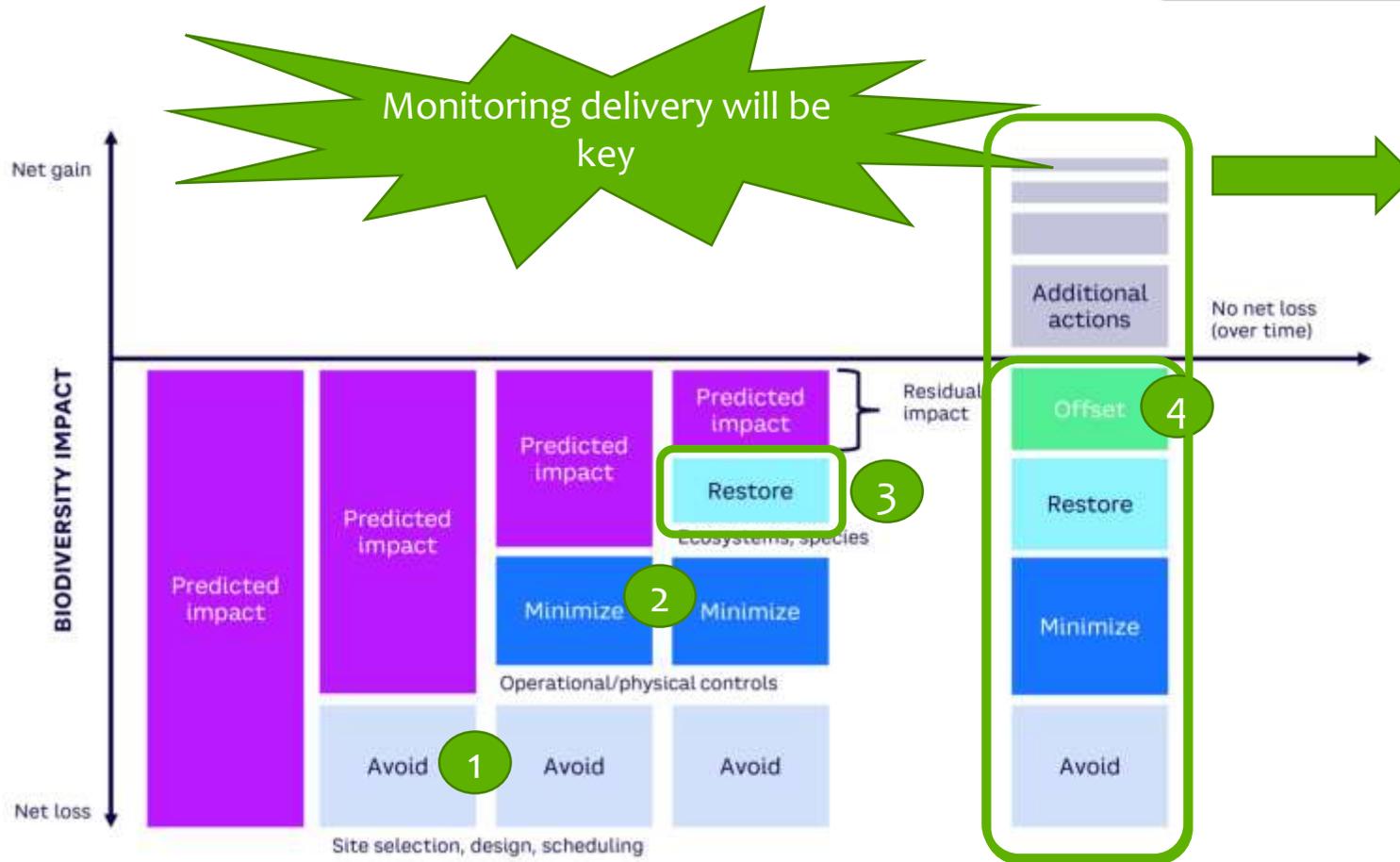
- BUT a review of 12 case studies showed several features of EA were rarely included in spatial plans:
 - standardisation of human pressures
 - frameworks to assess ecosystem services
 - implementation of precautionary and adaptive management approaches
- Discussions continue on definitions and implementation of the EA and how it relates to ecosystem services

Understanding!
Standardised approaches!

Ecosystem restoration, mitigation hierarchy & Nature Positive

Ecosystem restoration	
Nature Positive	
Mitigation hierarchy	

Ecosystem restoration, mitigation hierarchy & Nature Positive



Ecosystem restoration

- Marine restoration is relatively new and lessons need to be learned from experiences restoring terrestrial ecosystems
- Defining and predicting ecological success in marine ecosystem restoration is a consistent challenge
- Success depends primarily on the ecosystem, site selection, and techniques applied
- Effort involved varies between habitat types (coral reefs and seagrass beds take longer than others)
- Conservation is preferred: better to protect nature than try to restore it later!

NEW: Proposed EU Nature Restoration Law



Photos © PJ Stephenson

Mitigation hierarchy

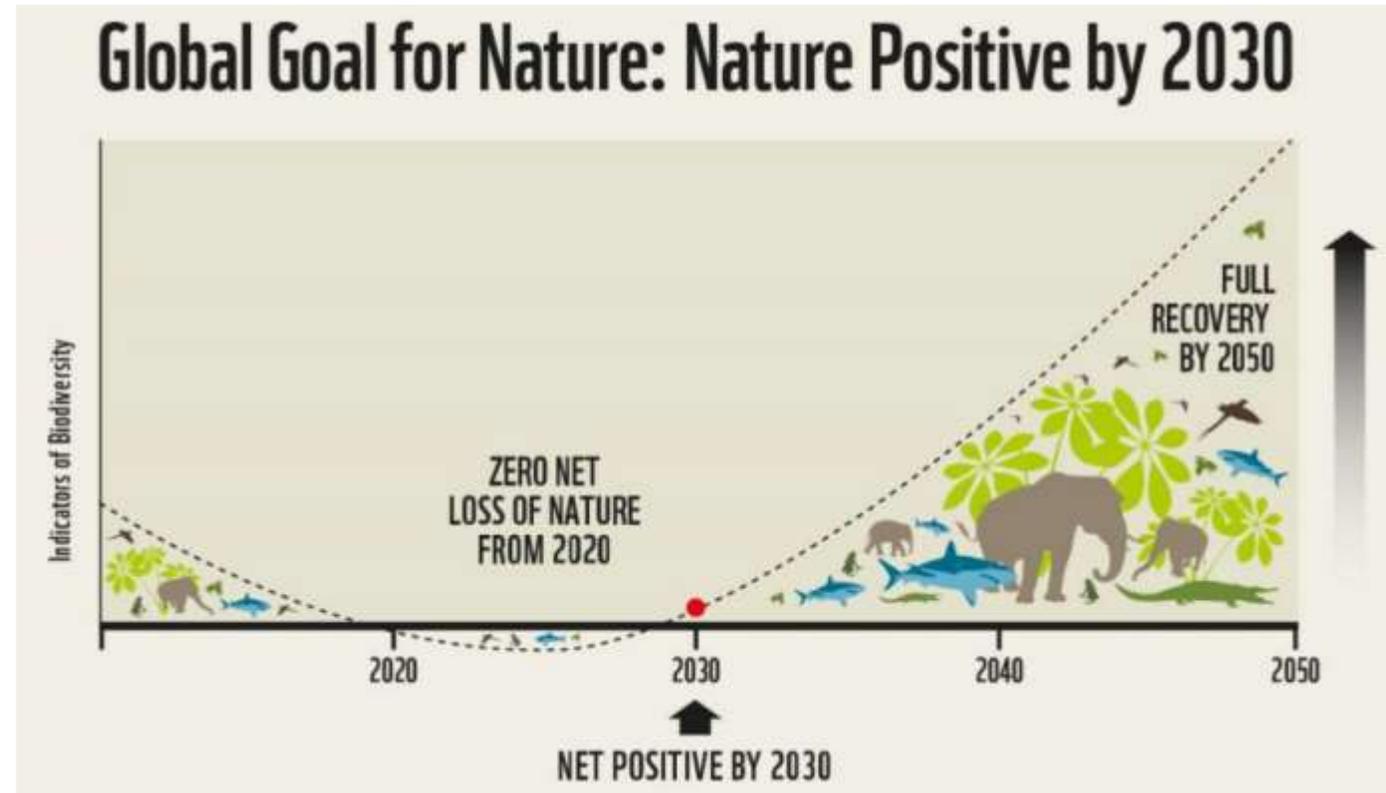
- Most commonly used on land but increasing discussion of its use in marine ecosystems
- Useful framework to plan biodiversity actions around wind farms
- Restoration will be key in offshore wind farms close to important natural habitats; may also be applied in some countries as part of decommissioning



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Nature Positive

- “A rallying term, a beacon, to guide and to transform action across all sectors of society, including business”
 - World Business Council for Sustainable Development
- A move towards net gain ambitions, rather than no net loss, is gaining momentum
- The degree to which European countries in general, and the offshore wind sector in particular, decide to aim collectively for net gain will influence the extent to which Nature Positive is embraced



From Locke et al. (2021)

Closely related concepts

Nature-based Solutions

- Actions to protect, sustainably manage and restore ecosystems... to provide both human well-being and biodiversity benefits

Nature-inclusive Design

- Options integrated in, or added to, the design of human structures to enhance ecological functioning



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Nature-based Solutions

- IUCN has produced a standard for NbS and guidelines on applying the standard
- Examples of marine NbS:
 - climate change risk mitigation initiatives e.g. beach nourishment, reef and mangrove revivals
 - creation of reef substrate on offshore wind farm foundations to enhance settlement of organisms while reducing scouring
- Challenges:
 - the term is often used loosely (not according to IUCN definitions)
 - what is 'nature' or 'natural'?
 - implementation requires a good understanding of ecosystem processes, engagement of diverse actors & the integration of a broad set of societal issues



© IUCN

Nature-inclusive Design

- For offshore wind, NID refers to nature-inclusive construction, linked to:
 - wind turbine foundations
 - offshore substations
 - scour protection layers
 - cable protection measures
 - (e.g. using substrates that encourage settlement or shelter of sealife)
- Challenges include:
 - risk of structural failure, biofouling or invasive alien species
 - confusion between NID and restoration in Maritime Spatial Planning
 - (NID is about improving human structures added to the sea; restoration is about recovering damaged natural ecosystems)
- So how does NID differ from NbS?
 - NID is essentially a type of NbS
 - BUT only if applied according to the Standard (e.g., addresses a societal challenge, results in net gain).



Precautionary principle (or approach)

- The precautionary principle or approach helps decision-making when the possibility of harm has not been established scientifically
- To deliver global biodiversity targets, decision-making needs to be based on sound science and the precautionary approach (CBD)
- The EU Marine Strategy Framework Directive states that measures to maintain Good Environment Status “should be devised on the basis of the precautionary principle...”
- The lack of understanding of many offshore wind pressures and cumulative impacts makes the precautionary principle even more important
- But when pressures and cumulative impacts are better understood, we will be able to reduce use of the precautionary principle



Trends and actions needed

- Common definitions need to be developed for each concept in the offshore wind energy context and the inter-linkages between concepts more thoroughly mapped and described
- Most concepts were developed on land and some are newer than others, so many will require more testing, especially nature-inclusive design and nature positive
- More research and data collection are required for several concepts, especially cumulative impacts, ecological risk, ecosystem restoration, good environmental status, and nature positive



Photos © PJ Stephenson

Trends and actions needed

- How different stakeholders view and use different concepts within national Exclusive Economic Zones will vary
- But finding ways of extending the use of the concepts to the high seas would be beneficial.
- In conclusion, all 16 key concepts should be considered to some degree in maritime spatial planning going forward
- Important next steps include:
 - harmonising definitions and terminology
 - providing examples of the key concepts in action in the offshore wind energy sector and monitoring their impacts on biodiversity



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