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Systematic Map
CEE 21-002

Limited direct evidence is available for the effects of decommissioning man-made structures on marine ecosystems globally

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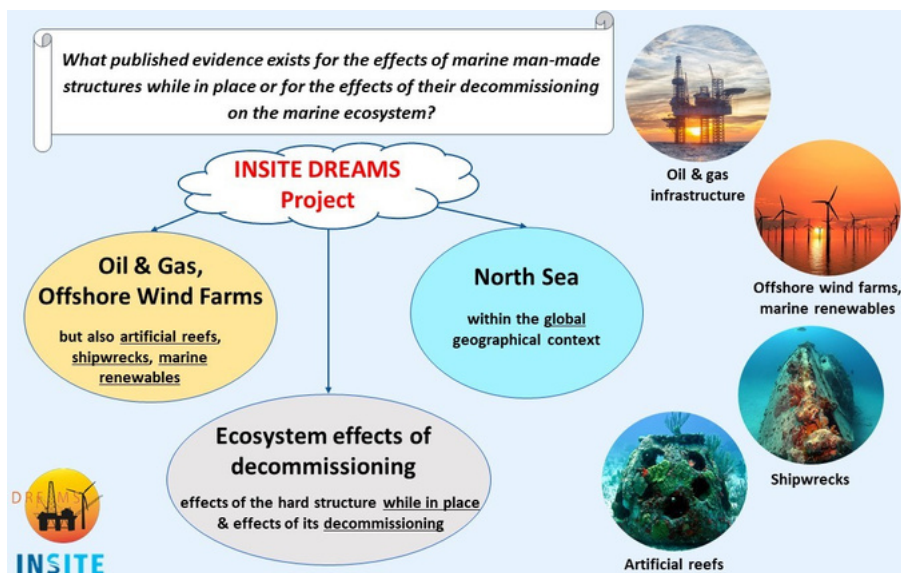


Diagram made by Anaëlle J. Lemasson

Why is this Evidence Synthesis Needed?

Many marine man-made structures (MMS) such as oil and gas (O&G) platforms or offshore wind farms (OWF) are nearing their 'end-of-life' and require decommissioning. Decommissioning is defined as the fate of a structure following cessation of operations and/or activities for which it was originally deployed. Limited understanding of MMS decommissioning effects on marine environments currently restricts the consideration of alternative management possibilities, often leaving complete removal as the only option in certain parts of the world.

This map examined the effects of the presence, any alteration, and any decommission of marine MMS, including O&G installations, OWF, marine renewable energy installations (MREI), shipwrecks, artificial reefs (AR), carbon capture and storage (CCS) facilities, and any other relevant and similar MMS (such as offshore research platforms). We considered all possible decommissioning options (including - but not limited to - reeving, topping, toppling, complete removal, partial removal, relocation, repurpose), and all possible marine ecosystem effects (from ecological effects to ecosystem service effects and social and economic effects where relevant and directly related to an ecosystem service (such as fisheries displacement)).

Only 57 studies published by the time this map was compiled provide direct evidence of the effects of decommissioning marine man-made structures (MMS). These mostly focus on oil and gas infrastructures and cover nine different decommissioning practices. There is, however, a substantial body of evidence relating to the presence of MMS, providing indirect evidence for what the effects of decommissioning might be.

This Collaboration for Environmental Evidence Systematic Map collates evidence of the effects man-made structures have on marine ecosystems and ecosystem services associated with their presence and/or decommissioning. The map identifies and describes evidence from studies of the effects of the presence of structures and the effects of decommissioning structures.

Main Findings

What studies are included?

A total of 979 unique articles published between 1973 and 2021 were deemed relevant. The vast majority of articles relates to the presence of MMS (942 articles), while very few (57 articles) consider decommissioning.

Overall, more than half of the articles consider AR, and about a quarter considers O&G, while shipwrecks and OWF were less studied.

Studies are distributed globally, but the majority focus on the United States, single countries within Europe, Australia, Brazil, China, and Israel; a few span multiple countries. Consequently, the bulk of the studies focus on the North Atlantic (incl. Gulf of Mexico, North Sea, and Mediterranean Sea) and North Pacific Oceans.

The majority of studies report on fish and invertebrates, and are disproportionately focused on biological and ecological impacts. Physicochemical, habitat, socio-cultural, economic, and functional outcomes have received less attention.

The number of decommissioning studies has increased since 2012 but remains noticeably low. Studies on decommissioning mostly focus on O&G infrastructures in the USA (Gulf of Mexico) and Northern Europe (North Sea), covering 9 different decommissioning options.

What are the Implications of the Review Findings?

Limited direct evidence is available to support the widespread acceptance that complete removal may not be the most beneficial decommissioning option, and that the repurposing of structures (for instance as artificial reefs or for other activities) for socio-economic or environmental benefits can be achieved. Indeed, only 15 articles considered the effects of fully removing structures, 16 articles considered toppling them, and 11 considered reefing them (toppling and reefing are two repurposing options consisting of leaving parts or all of the structures in the marine environment). Additionally, when considering potential decommissioning options, we should weight the potential benefits of any options against possible negative consequences, e.g. leaving structures in place might provide biodiversity benefits but also facilitate the spread of non-native species (66 articles mention non-native species).

Given that the success of any decommissioning option also depends on socio-economic factors, the apparent paucity of evidence relating to socio-economic aspects (7% of articles relates to social outcomes, 4% to economic outcomes) represents an added challenge to the management of MMS decommissioning. Finally, the marked increase in articles on MREIs and OWFs since 2000 reflects their relatively recent introduction to the environment, coinciding with the global drive toward the use of renewable energy sources. Yet their inevitable decommissioning will face similar considerations to that of O&G decommissioning.

We need urgent primary research to understand the direct effects of decommissioning MMS, and to help inform decision-making.



The 24,200-tonne topside of the Shell's Brent Delta oil and gas platform, located in the North-East coast of Shetland (UK) in the North Sea, was decommissioned and removed in April 2017. Photo by [Kevin Harris on Unsplash](#).

Synthesis Time Frame

The map authors searched for studies published at any time up to February 2021. This CEE Systematic Map was published in October 2022.

Full Citation

Lemasson, A.J., Somerfield, P.J., Schratzberger, M., McNeill, L., Nunes, J., Pascoe, C., Watson, S.C.L., Thompson, M., Couce, E., & Knights, A.M. (2022) Evidence for the effects of decommissioning man-made structures on marine ecosystems globally: a systematic map. *Environmental Evidence*, 11, 35. <https://doi.org/10.1186/s13750-022-00285-9>

Link to Publication

<https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-022-00285-9>

Funding

This map was undertaken within the agreed work of DREAMS, which is financed by the UK Natural Environment Research Council, Grants Nos. NE/T010843/1 and NE/T010835/1 awarded to the University of Plymouth and Plymouth Marine Laboratory (PML). Cefas were supported through its own strategic science investment fund (DP4000A).