ORIES

Offshore Renewables Impacts and Ecosystem Services

Decision Support Tools

User Guide

ORIES tool developed by: Plymouth Marine Laboratory

Funders: UKERC (as funded by UKRI), Garfield Weston Foundation

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Contents

Acknowledgements

Glossary

Cultural Ecosystem Service	The benefits people gain from their interactions with different environmental spaces.[1]
Ecosystem Services (ES)	The direct and indirect contributions ecosystems (known as natural capital) provide for human wellbeing and quality of life.[1]
GIS	Graphical Information System.
Grey Literature	Multiple types of report or document, defined as: "information produced on all levels of government, academia, business and industry in electronic and print formats not controlled by commercial publishing" i.e. where publishing is not the primary activity of the producing body.[2]
Operational phase	The development phase of a wind farm; either construction, operation, or decommissioning. Operation includes post-construction.
Piece of evidence	A result from a scientific paper or grey literature report that links a cause (e.g. an <u>action</u> or <u>effect</u> arising from the construction, operation or decommissioning of an offshore wind farm or related infrastructure), and an observed impact on a species or community, physical process or cultural aspect of the marine environment.
Primary Literature	Literature published in peer-reviewed scientific journals, addresses specific research questions, is often (although not always) produced through research institutions and typically funded through research grants.
Provisioning ES	The products obtained from ecosystems.[1]
Regulating ES	The benefits obtained from the regulation of ecosystem processes.[1]
Supporting ES	Ecosystem services that are necessary for the production of all other ecosystem services[1,3]. These are referred to as ecosystem processes and functions in some ES classifications.

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[1] UK National Ecosystem Assessment: www.uknea.unep.wcmc.org.
[2] ICGL (1997). Third International Conference on Grey Literature 1997.
[3] Millenium Ecosystem Assessment: www.millenniumassessment.org

Background

Expansion of global offshore wind

The UK has set legally binding targets to reduce its greenhouse gas emissions and increase the use of renewable energy. Offshore wind capacity in UK waters is expected to grow five-fold by 2030, and potentially ten-fold by 2050. While the rapid expansion of offshore renewables is vital for addressing climate change, it also has the potential to cause considerable damage to marine habitats that support precious biodiversity (including fisheries) and store large volumes of carbon. Impacts of offshore wind on the marine environment need to be urgently evaluated to optimise outcomes for society, climate and biodiversity.

Ecosystem Services are defined as "the direct and indirect contributions that ecosystems provide for human wellbeing and quality of life", such as provision of food, raw materials for pharmaceuticals and opportunities for recreation. Furthermore, these services maintain our climate, transform waste products and support biodiversity.

There are tangible benefits to applying an **ecosystem services** framework:

- Translates complex ecological functions and processes into terms which are meaningful for non-experts, clarifying the resultant impacts of environmental change on human well-being
- Both positive and negative outcomes can be evaluated
- Enables cost/benefit analyses, and trade-off analyses
- It provides the foundation for monetary and non-monetary evaluation of natural capital and ecosystem services
- If monetized, allows impacts to be reported in a single metric, in language that can be understood by policy and decision makers

Our target audience is academics, industry and decision makers requiring the most up-to-date evidence. We developed a comprehensive database of available evidence for the environmental and socio-economic outcomes of OWF developments. The database is designed to help users find, access and utilise evidence for decision-making, expediting planning and enabling access to the latest and most appropriate information, for example to support the consenting process.

ORIES - Value to Users

- Provides central evidence base
- Easy access to evidence sources and summary data from reports
- Evaluation of evidence by subject, pressure, ecosystem service, development phase and type of literature
- Will be kept up-to-date with new evidence

The ORIES tool kit consists of two open-access, interactive, web-based tools

1. **Database tool** – applicable to global wind farms and of generic relevance
2. **Spatial visualisation tool** – applicable to UK wind farm case studies

The tools are not intended to question offshore energy production as a source of clean energy, but to provide state-of the-art scientific knowledge regarding environmental, biodiversity and ecosystem service consequences, with the aim of facilitating biodiversity and environmental net gain approaches in the marine environment.

Scope of the work

All current literature relates to fixed OWF structures which are located in fairly shallow water (> 15 miles from the coast). With the planned increase in capacity and the development of floating wind farms, structures will be sited further offshore and in water up to 700m depth (Diaz et al, 2022). Current evidence will not be adequate for the different habitats and communities impacted by floating turbines and priorities should lie in developing the evidence base for these types of installations.

Caveats and assumptions

If there is no data available for a specific subject/pressure, this does not indicate there are no positive or negative outcomes, but that the specific relationship has not been studied or there are no data publicly available.

Percentages displayed in the tool indicate the proportional response by direction (positive vs. negative) for each outcome (e.g. 50% negative outcome for Regulating ES, 21% no impact outcome for Regulating ES, etc). The percentage and colour-grading of the cells is not meant to represent the quantity of evidence or severity of the outcome. Therefore the percentages should always be interpreted alongside the total number of pieces of evidence available, to avoid over-inflating expected outcomes e.g. 100% may equal 1 or 2 pieces of evidence in certain cases.

The authors acknowledge that a measure of confidence in the data would be a useful addition to the tool and this will be addressed in future versions.

How to access and use the tools

ORIES Database tool

The ORIES database tool can be accessed via the following link from a Google Chrome browser: https://ories.pml.space/

There is a flash cover page with background information and acknowledgements. Scroll to the bottom of the page and click '**DISMISS**.

Filtering and downloading

The database can be filtered using the options in black drop-down boxes on the left side of the screen. All filters are optional.

After selecting filtering options, to view summary outcomes to the right of the screen, click the **FILTER** button, or click the **DOWNLOAD** button under the filter boxes (indicated by the red arrow in Figure 1) to download the database as a .csv file. If no filtering options are selected, the full database can be obtained by pressing the **DOWNLOAD** button. Before clicking the DOWNLOAD button, you can assign a filename in the text box.
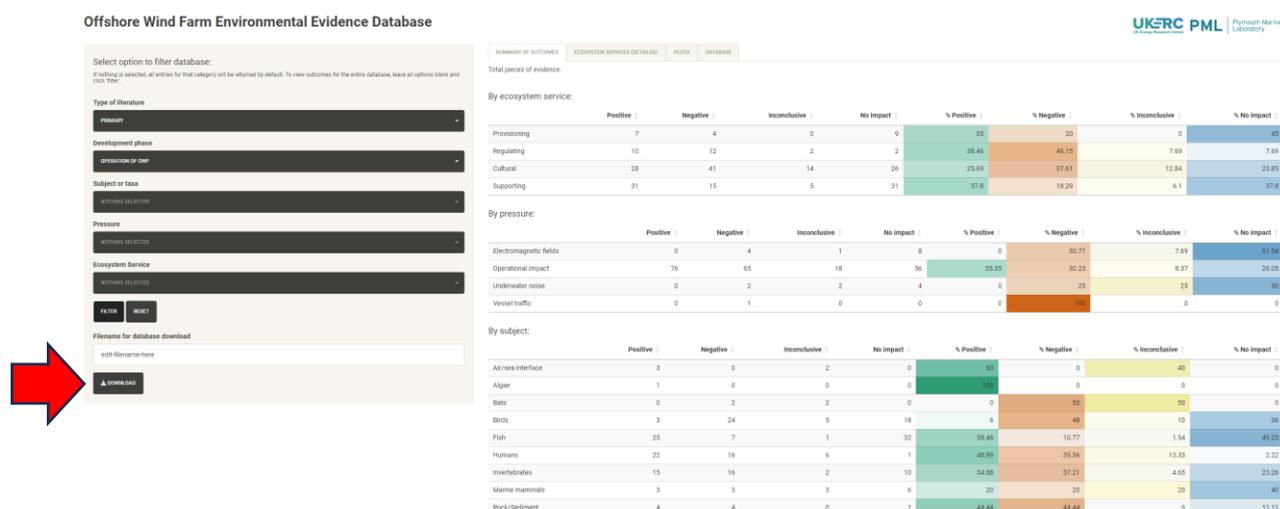
Figure 1: Screen shot of the filtering options (left side, black boxes) and output for the four main ecosystem services on the left side. Values are colour coded for positive (green), negative (red), inconclusive (yellow) and no impact (blue). Darker shading represents a higher proportion of evidence for the ecosystem service, pressure or subject in question, in relation to the direction of the outcome.

You can add a new filter to any current session, and hit the **FILTER** button to update results, or to start a completely new session hit the RESET button and this will clear all the filters.

> *TIP: Give the downloaded database a new filename based on the filtering options you have assigned.*

Outputs from the database tool

There are <u>four tabs</u> showing summary information on the right side of the screen.

SUMMARY OF OUTCOMES tab:

This provides three summary tables of the total pieces of evidence, based on the filtering applied to the dataset. The first table shows the total pieces of evidence available by ecosystem service (Figure 1). The percentages are shown for the direction of the reported outcomes (e.g. 9% positive, 63% negative, etc). The direction of outcomes are colour coded: green = positive, red = negative, yellow = inconclusive, blue = no impact. The darker the shading, the higher the percentage.

The second table shows the total pieces of evidence, and the percentages of outcome direction by eight different pressure categories assigned in the database (Figure X). There are eight categories including; underwater noise, electro-magnetic fields, vessel traffic, scour and cable protection removal, cable installation, and three general categories for construction, operational and decommissioning impacts.

The third table shows the total pieces of evidence, and the percentages of outcome direction by the twelve subject categories assigned in the database.

ECOSYSTEM SERVICES (DETAILED) tab:

The second tab shows the total pieces of evidence, and the percentages of outcome direction of ecosystem service outcomes categorised by more detailed categories, related to CICES v5 class (Figure 2). The direction of outcomes are colour coded: green = positive, red = negative, yellow = inconclusive, blue = no impact. The darker the shading, the higher the percentage.

Total pieces of evidence:

	Positive	Negative	Inconclusive	No impact	% Positive	% Negative	% Inconclusive	% No impact
aesthetic/visual interactions with seascape	3	7	2	0	25	58.33	16.67	0
biodiversity	27	13	3	30	36.99	17.81	4.11	41.1
biomass for the provision of materials	1	1	0	4	16.67	16.67	0	66.67
biomass for the provision of nutrition	4	2	0	5	36.36	18.18	0	45.45
carbon sequestration and storage	2	0	0	0	100	0	0	0
climate regulation	1	0	2	0	33.33	0	66.67	0
experiential, existence and bequest aspects of cultural services	6	27	8	25	9.09	40.91	12.12	37.88
habitat quality/condition	3	1	0	1	60	20	0	20
habitat quantity	0	1	0	0	0	100	0	0
life cycle maintenance – maintaining nursery habitats	1	0	0	1	50	0	0	50
mediation of flows - mass flows – mass stabilisation	0	3	0	0	0	100	0	0
nutrient cycling	1	0	2	0	33.33	0	66.67	0
pest and disease control	0	9	0	0	0	100	0	0
physical and experiential interactions with natural environment	3	1	1	1	50	16.67	16.67	16.67
provision of nutrition	2	1	0	0	66.67	33.33	0	0
public acceptance of offshore wind power project	16	5	3	0	66.67	20.83	12.5	0
regulation of extreme events (storm and flood)	3	0	0	0	100	0	0	0
regulation of physical, chemical, biological conditions	1	0	0	1	50	0	0	50
sense of place and identity	0	1	0	0	0	100	0	0
waste remediation	2	0	0	0	100	0	0	0

Figure 2: Tab showing the number of pieces of evidence for detailed ecosystem service outcomes based on the filtering criteria used. Values are colour coded for positive (green), negative (red), inconclusive (yellow) and no impact (blue). Darker shading represents a higher proportion of evidence for the ecosystem service, pressure or subject in question, in relation to the direction of the outcome.

Three sets of bar plots are displayed to help visualise patterns and trends in the data (Figure 3).

The first set of plots shows the total pieces of evidence, by direction of outcome and by ecosystem service category. If both primary and grey literature has been included in the database search, the bars are split to show outcomes by literature type. Grey literature outcomes are shaded in a darker colour than primary literature outcomes and the colour coding follows the same pattern for direction of outcomes described above.

The second set of plots shows the total pieces of evidence, by direction of outcome and by pressure.

The third set of plots shows the total pieces of evidence, by direction of outcome and by subject.
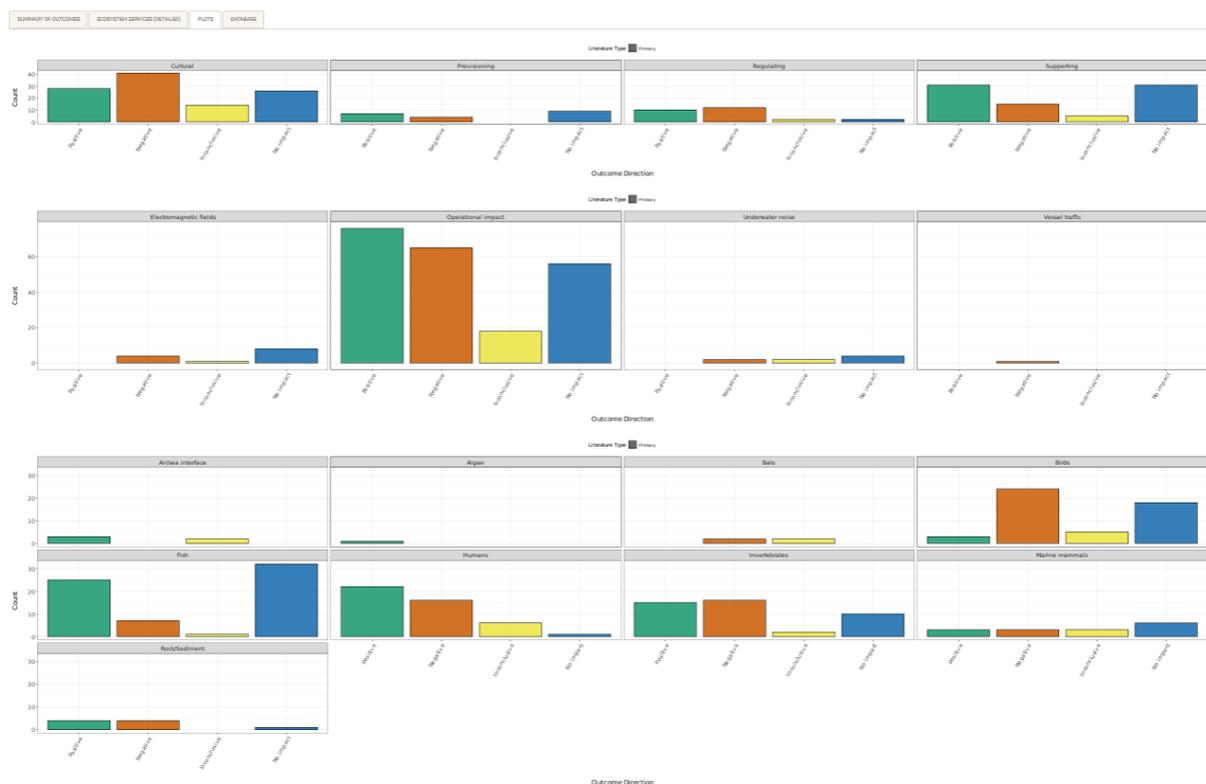

Figure 3: Histograms of the filtered data showing the number of pieces of evidence by ecosystem service (top), pressure (middle) and subject (bottom). Bars are colour coded for positive (green), negative (red), inconclusive (yellow) and no impact (blue).

TIP: The scale of each set of plots will differ and the numbers on the x-axis should be checked for reference and comparison.

DATABASE tab:

This tab provides a print out of the filtered database, although we <u>recommend the downloaded .csv file version of the database</u> is used for ease of viewing and further sorting/filtering (Figure 4).

Figure 4: Screen shot of the information provided in the database tab. This is for reference only and it is recommended the filtered database is downloaded as a .csv file, for inspection of the detail.

The downloaded database contains a number of columns with various detail about the extracted evidence, such as the full reference for the study, study type, date of publication, year(s) the study took place, geographic region, additional detail about the environmental outcome and the relevant indicator for UK Good Environmental Status (GES) or Sustainable Development Goal (SDG).

ORIES Spatial visualisation tool

The ORIES spatial visualisation tool can be accessed via the following link from an incognito browser: https://evendim.eofrom.space/

The data behind this tool is the same database as the previous tool, but using UK wind farms as case-studies where location-specific evidence exists.

Navigating to the spatial portal

On opening the web page you will see a map of the British Isles. You can zoom in and out of the map, view the full map extent, and drag the map around using your mouse or the buttons in the top right corner of the screen.
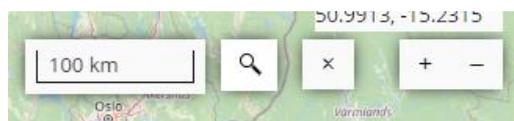
Wind farms are indicated by polygons on the map. Wind farms that don't have specific evidence in the database are shown in grey. Wind farms for which there is evidence are shown in a shade of purple, ranging from pale (few pieces of evidence) to dark purple (many pieces of evidence).

Selecting data for a wind farm

To bring up a table summarising environmental and ecosystem services evidence, click on a wind farm polygon. The table pop-up displays the name of the wind farm, the latitude and longitude of the site, and a summary of all pieces of evidence relating to the wind farm (Figure 5). The rows are colour coded according to the direction of the outcome. The full reference is given in the final column. To view all the evidence, scroll down the table.

Filtering and downloading

In the filter box on the left side of the screen, navigate to the 'Filter Pop-ups' tab to view filtering options. When you apply a filter it will apply to the data summary for any wind farm you click on until you clear the filters or select new filtering options. Filters can be re-set using the grey 'Reset filters' button, underneath the filtering options.

The wind farm specific evidence can be downloaded as a .csv file by clicking the 'Download data' button at the top of the table.
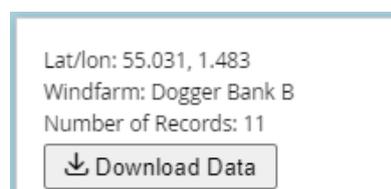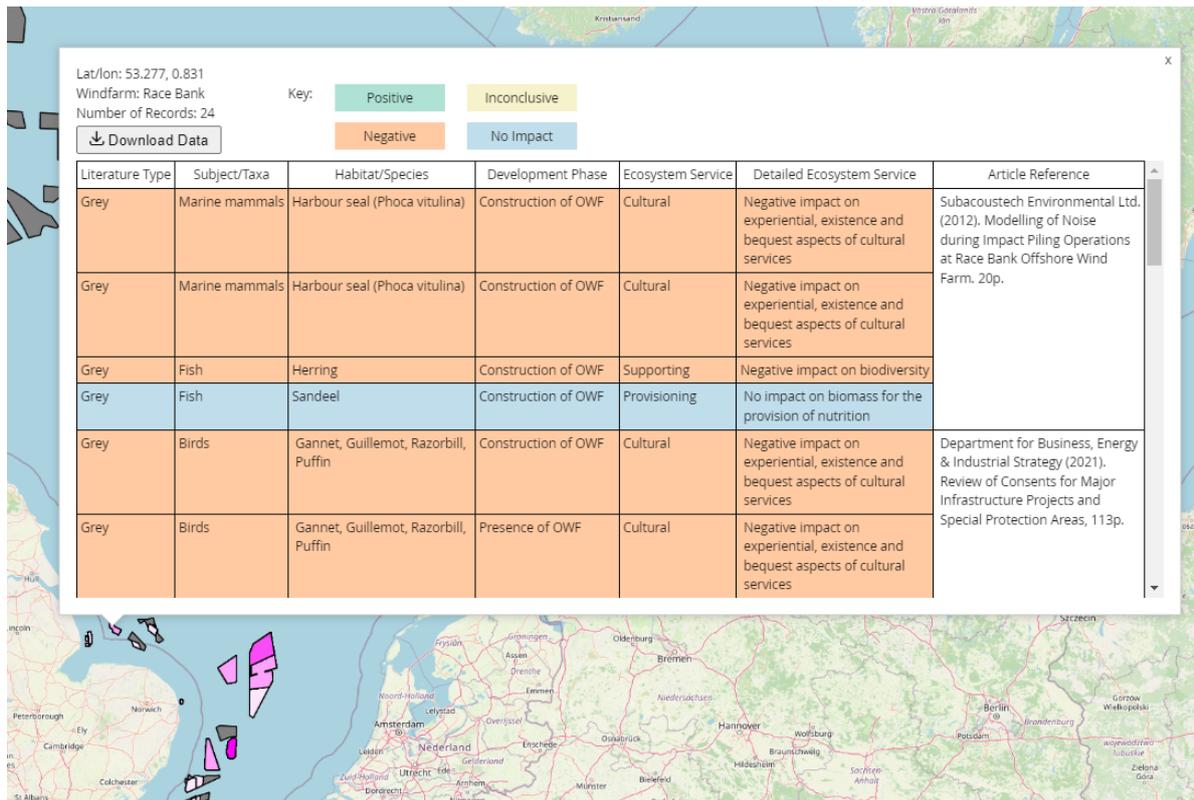
Figure 5: Screen shot of a pop-up table of summary evidence relating to a single wind farm.

Link to the ORIES database tool

The database tool can be opened by clicking the 'Database' button at the bottom of the filter box. This function can be used as a quick link to download the full database file to obtain all extracted data from the reports highlighted in the wind farm evidence summary boxes.

How the tool was developed

Systematic review process

A semi systematic review process was used to search and synthesise all global primary scientific literature in relation to the environmental and societal impacts of offshore wind farms (Watson et al., 2024, Figure 6, Table 1). A similar process was used to identify grey literature on the topic (Szostek et al., 2024), from the UK (including wind farms in adjacent waters) (Figure 7). This search was extensive but not exhaustive.
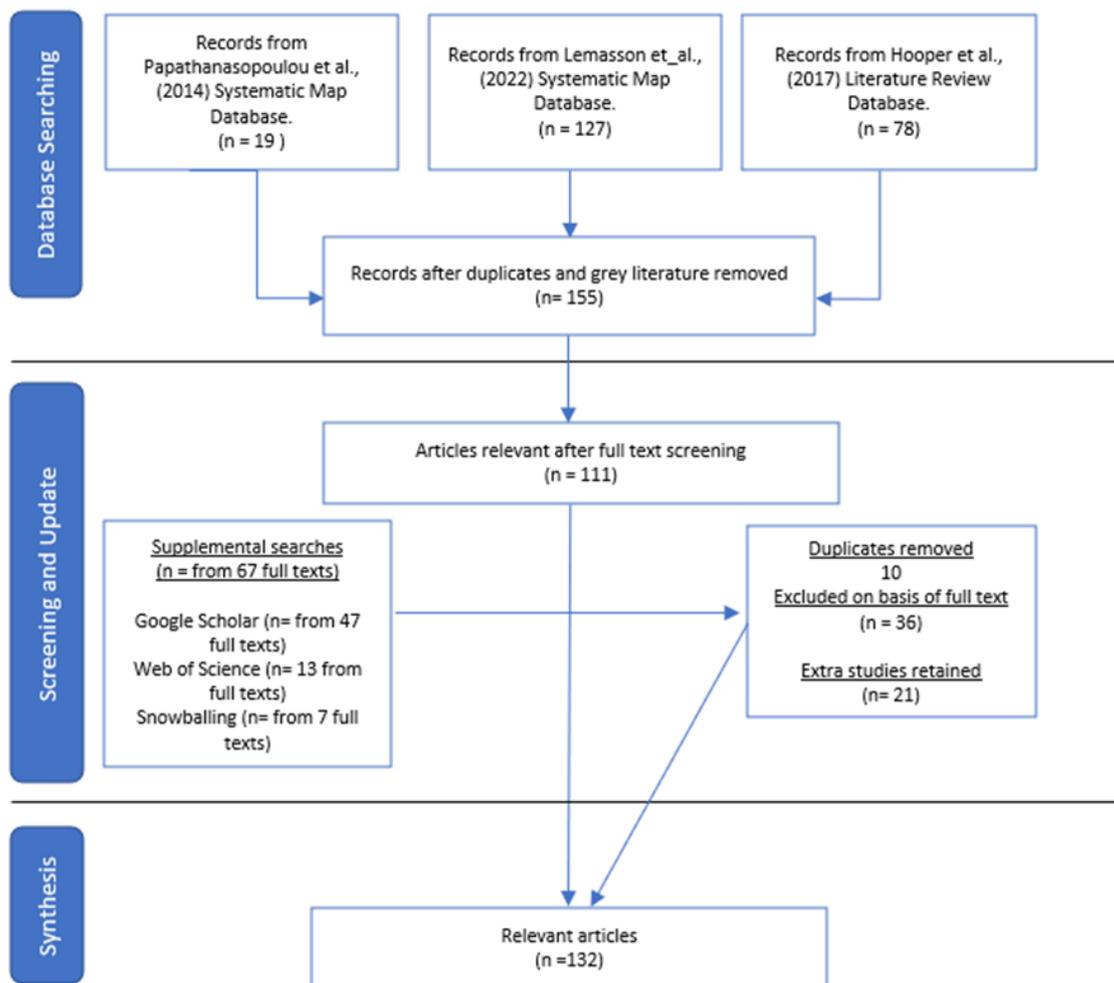
Figure 6: Schematic diagram of the procedure that led to the selection of primary literature used in the ORIES tool (Watson et al., 2024).

Table 1: Summary of primary and grey literature included in the database and tools, arising from the semi-systematic literature searches.

Primary Literature	Grey Literature
Date range: 2002-2021	**Date range:** 2012-2022
Global	**UK only**
Type of document: Research studies published in peer-reviewed scientific journals.	Type of document: Environmental statements, Environmental monitoring reports, modelling studies, non-technical summaries and others.
Inclusions: 132 documents met the inclusion criteria. 314 individual pieces of evidence were documented.	Inclusions: 56 documents met the inclusion criteria. 755 individual pieces of evidence were documented.

Database searches

Records from grey literature sources: Marine Data Exchange (423), Lemasson et al. 2021 (33), UKERC 2022 Conference (4), Enabling a Natural Capital Approach online portal (23), INSITE publications webpage (17), CEFAS data & publications webpage (34), DEFRA (328), JNCC resource hub (206), Marine Scotland (390), Natural Resources Wales (77), British Ecological Society (4), MEDIN publications (13), Natural England Access to Evidence database (220), PI project files (3)
n=1775

Screening

Records after inclusion/exclusion criteria applied
n=137

Records after title and abstract screening
n=76

Synthesis

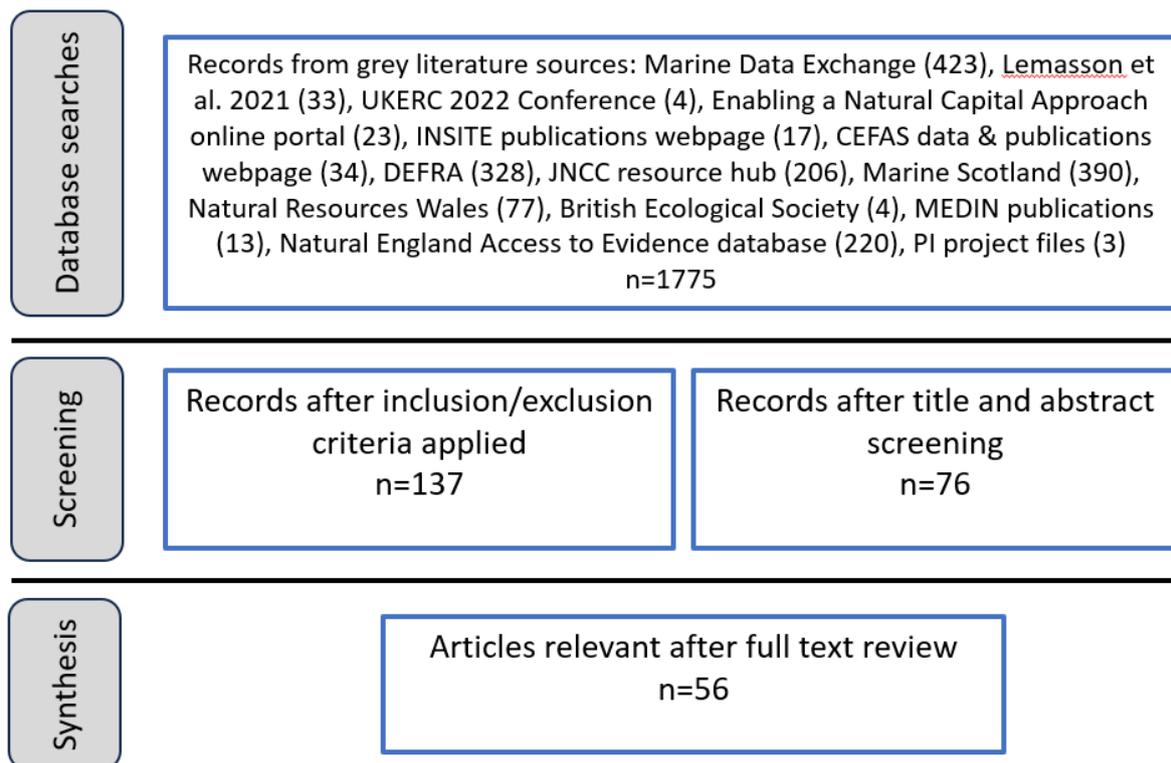Articles relevant after full text review
n=56

Figure 7: Schematic diagram of the procedure that led to the selection of grey literature used in the ORIES tool.

Database development

Data was extracted from each report/study in relation to: development phase, the subject of the outcome or impact, study design, study year, date of publication, site name and characteristics, impact or outcome (ecological, physical or cultural). Each reported outcome (whether positive, negative, or neutral) has been translated onto recognized ecosystem services frameworks – Common International Classification of Ecosystem Services (CICES) v 5.1 and the Millenium Ecosystem Assessment (MEA) (Papathanasopoulou *et al.,* 2014; 2015; Lemasson *et al.,* 2021; 2022). The final database is open access and available on the UKERC Energy Data Centre data catalogue, accessed at:

https://ukerc.rl.ac.uk/DC/cgi-bin/edc_search.pl?GoButton=Detail&WantComp=289

Interpreting the evidence

Pressures

Eight different pressures were categorised in the database (Table 2). A full description of all column headers, categories and explanations for the database is in appendix A1.

Table 2: Table of pressures categorised in the evidence database.

Pressure	Definition
Construction impact	An unspecified impact related to the construction phase of a wind farm
Operational impact	An unspecified impact related to the operational phase of a wind farm
Decommissioning impact	An unspecified impact related to the decommissioning phase of a wind farm
Underwater noise	Underwater sounds caused by human activities that can interfere with or obscure animals or natural processes
Electromagnetic fields (EMF)	Invisible areas of energy, often referred to as radiation, associated with the generation of electrical power
Vessel traffic	The movement of vessels in and around the area of the wind farm location
Scour & cable protection removal	The removal of scour prevention and cable protection upon decommissioning of offshore wind farms and potential impacts to marine habitats
Cable installation	Installation (laying) of underwater cables associated with offshore wind farms

Classification of Ecosystem Services

Each piece of evidence was categorised as per Watson et al. (2024) (S1).

Outcomes relating to species or community abundance were classified as the Supporting ES of biodiversity, except when in relation to commercial fish species (classified as Provisioning

ES), or abundance of charismatic marine megafauna (classified as the existence and bequest aspect of Cultural ES).

Outcomes relating to biomass or body size were classified as the Supporting ES of 'primary/secondary production'.

Outcomes relating to condition or community structure were classified under the Supporting ES of life-cycle maintenance.

Outcomes relating to habitat quality or condition were classified as the Supporting ES of 'Habitat'.

ES outcomes were also linked to the UK descriptors of Good Environmental Status (GES) (DEFRA, 2019), or the UN Sustainable Development Goals (SDG's) (United Nations, 2016).

Type of study

In primary literature the majority of evidence comes from empirical or observational studies, followed by social studies, modelling and a limited number of laboratory experiments and literature-based assessments (Szostek et al., 2024). In contrast, for grey literature, the majority of evidence comes from literature-based assessments (such as reviews, reports, consultation documents, environmental statements, HRAs), followed by empirical or observational studies, modelling and just two pieces of evidence from social studies. Although, the authors note that EIAs are based on mixed-methods assessments and may include data from empirical or modelling studies. In primary literature, empirical social studies (choice experiments, opinion surveys, questionnaires, interviews) provide data on socio-cultural outcomes. In grey literature, socio-cultural ES outcomes are established through literature-based assessments, working groups, scoping studies, visual impact assessments, archaeological/cultural assessment and socio-economic assessment.

Distribution of outcomes by Ecosystem Service and literature type

Although Cultural ES are the second most abundant positive outcome in primary literature, both types of literature report a proportionally high number of negative outcomes for Cultural ES, and grey literature is heavily weighted towards negative Cultural ES outcomes overall. This is linked to the focus in EIAs on high priority species such as birds and marine mammals (Szostek et al., 2024).

The significant quantity of evidence found in grey literature *c.f.* primary literature is attributed to grey literature often reporting synthesised outcomes for a suite of subjects and impacts, whereas PL tends to have a narrower research focus, on a single topic or taxa. Multiple reports are required for each wind farm development at various stages of the consenting, developing and operational stages. Most evidence is available for the operational phase of an OWF, around twice the amount available for the construction phase, with the construction phase lacking focus in PL. This could be due to the logistical complications of sampling during construction or suggests that closer links are required between scientists and industry to fill this gap. There is a significant data gap for decommissioning impacts of OWF, with no evidence available in primary literature (Lemasson et al., 2022; Watson et al., 2024).

Ecosystem service outcomes for the decommissioning phase reported in UK grey literature are mostly negative (78%). However, the outcomes are based on assumptions (that decommissioning outcomes are the same as for construction) and inference, made at baseline survey and pre-construction stages, rather than empirical evidence. Therefore, the reliability of the evidence should be considered speculative at best.

Interpreting positive and negative outcomes

In primary literature, where quantitative or statistical analysis was presented, the direction of outcome either positive or negative was reported. In grey literature, the direction of outcomes in EIAs are often summarised as either positive or negative, using terminology such as 'slight negative impact' or 'low to no significant impact', with no assessment of statistical significance, and little consideration for robust 'Before-After-Control-Impact' (BACI) experimental designs. Therefore, outcomes recorded as negative in the database might not reproduce significant impacts if tested empirically, but nevertheless, the direction of outcome was recorded in the database as per the text in the report.

The much higher proportion of negative ES outcomes reported in the grey literature compared to PL are likely due to a range of factors. Research studies in primary literature typically investigate specific pressure/subject relationships, evaluated according to the statistical significance of the results which can be of a positive or negative direction. Also, in many grey literature reports (e.g. EIAs and HRAs), only potential adverse effects are recorded in the final assessment, therefore omitting any positive outcomes that may occur as part of a development or activity.

Cumulative effects

The risk of cumulative adverse effects of OWF is poorly researched and assessment processes are underdeveloped (Willsteed et al., 2018). EIAs attempt to cover cumulative effects, although approaches are inconsistent. We do not attempt to qualitatively assess cumulative effects in the database, although they may be discussed in the corresponding literature.

Frequently asked questions

Q. Can I view outcomes by specific wind farms?

A. Yes – in the spatial visualisation tool, click on the wind farm you are interested in to bring up evidence relating to that wind farm. In the database tool, download the full database (without applying any filters) and in the .csv file, search or filter the [Structure ID-name] column.

Q. Can I find evidence for a specific time period?

A. Yes – download the full database as a .csv file and filter/sort the [Study year(s)] or [Date of Publication] columns.

Q. Is it possible to filter by species name?

A. The database tools do not have this feature, due to the complexity of the data and because some impacts are described for groups rather than single species. You can download the .csv file and use the Excel search function to search for evidence specific to a particular species, although the species name alone may not reveal all the relevant information, so this should be done with care.

Q. How do I cite the database?

A. Plymouth Marine Laboratory (2023). Database of evidence for the impact of Offshore Wind Farms on Marine Ecosystem Services. UKERC Energy Data Centre: Data Catalogue. DOI: 10.5286/ukerc.edc.000961.

Q. How do I cite the tools?

A. Plymouth Marine Laboratory (2023). ORIES database tool in R Shiny. Accessed at www.ories.pml.space

Plymouth Marine Laboratory (2023). ORIES Spatial Visualisation tool. Accessed at https://evendim.eofrom.space/

Q. Are the two tools linked?

A. The data behind both tools is the ORIES database (DOI: 10.5286/ukerc.edc.000961.). There is a link from the GIS tool to the Database tool, but currently searches and filters must be applied separately in each tool. Future developments will provide better linkages and functionality between the tools.

Q. How often will the database be updated and how will I know about updates?

A. The database will be updated on an annual basis. To be kept informed of updates please sign up for updates through the option in the database tool.

Appendix

A1: Table of column headers, categories and explanations in the database.

Variable	Response categories	Explanation
Type of literature	Peer-reviewed | Grey literature	The type of literature
Full reference	*Free text*	Full reference of the paper/report in Harvard style
Title	*Free text*	The title of the paper/report
Intervention - Level 1	Construction of OWF | Operation of OWF | Decommissioning of OWF	The operational stage of the wind farm that the evidence relates to
Population - level 1	Species/population | Community/assemblage | Abiotic | Human/Social	Categorical descriptor for the group or population (including any component of the marine ecosystem) that is impacted
Population - level 2	Fish | Fish and shellfish | Mammals | Birds | Invertebrates | Water Column | Habitat | Sediment | Human	Specific group that is impacted (includes biotic and abiotic). A new category of 'Habitat' was added for the grey literature to cover broader assessments on mixed biotic and abiotic receptors.
Population - level 3	*Free text*	Specific species/taxa or abiotic ecosystem component that is impacted
Outcome - level 1	Species or biological |Social or cultural |Economic |Ecological or community |Physical or Chemical	Categorical descriptor for the impact on the species, marine environment or ecosystem component
Outcome - level 2	*Twenty descriptive categories*	More specific descriptor for the impact on the species, marine environment or ecosystem component
Presence or mention of non-native or invasive species?	Yes | No or Unspecified	Studies searched for 'non-native', 'introduced' and 'alien'.
Presence or mention of commercial species?	Yes | No or Unspecified	Studies searched for 'commercial', 'economic' and 'value' in relation to fish or shellfish species

Study design - level 1	Empirical or observational study |Qualitative or quantitative social study |Modelling study |Laboratory experiment | Literature-based assessment	Categorical descriptor for the type of study
Study design - level 2	Site comparison study (reference site or comparable site) | No comparator | Interviews | Survey/Questionnaire | Before-after-control-impact study | Control-impact or Inside-outside study | Focus group/workshop/deliberative | Correlative only (no direct effects) | After only study (multiple time points/succession) | Participatory mapping | Scenarios comparisons (for modelling) | not specified	Categorical descriptor for the study design
Study year(s)	*e.g. 2010*	The year or years during which the study took place (not the year of publication), or 'unspecified' if no date was provided.
Date of publication	*e.g. 2017*	The date the study or report was published
Structure ID-name	*e.g. Thanet Offshore Wind farm*	The name given to the wind farm or study site. If not specified, or the study relates to multiple or generic sites, 'unspecified' is stated.
Structure type	*Free text*	Various descriptions of the type of structure included in the study
Structure age (at time of study)	*Numerical value or range of values*	The age of the structure at the time of the study. This is recorded as '0' years during construction, or the number of years post-construction.
Structure depth	*Numerical value*	The depth of the structure below the seabed (metres)
Subject	*Free text*	The species or ecosystem component being observed in the study
Geographical marine location - level 1	Atlantic | Pacific | NA	The global ocean region of the study

Geographical marine location - level 2	*e.g. North Sea*	The regional sea in which the study took place
Country	*e.g. Netherlands*	The country in which the study took place
Region	*Global | Laboratory | UK_Europe*	Distinction between studies in the UK and Europe, other global country or a laboratory based study
Pressure	Operation of windfarm | Construction of windfarm | Underwater noise | Electro-magnetic fields| Vessel traffic | Scour and cable protection removal | Decommissioning of windfarm | Cable installation	Categorical descriptor of the specific pressure from the offshore wind farm development that is causing the impact
Outcome	*Free text*	Summary of the outcome or response variable measured in the study, including whether positive or negative
ES impact	*e.g. Positive impact on biomass for the provision of nutrition*	The ecosystem service outcome class relating to the evidence, identified using the CICES class examples and MEA classifications. Includes the direction of the outcome (Positive, Negative, Inconclusive or No impact).
ES group	*e.g. Positive impact on provisioning services*	The ecosystem service outcome group relating to the evidence, identified by mapping class results up the hierarchical levels of CICES and MEA. Includes the direction of the outcome (Positive, Negative, Inconclusive or No impact).
Classification system used	CICES | MEA | Hooper et al., 2020 | Ryfield et al., 2019	The Ecosystem Services Classification system used
Notes	*Free text*	Additional information about the study

References

Lemasson AJ, Knights AM, Thompson M, Lessin G, Beaumont N, Pascoe C, et al. Evidence for the effects of decommissioning man-made structures on marine ecosystems globally: a systematic map protocol. Environ Evid. 2021;10:4. https:// doi. org/ 10. 1186/ s13750- 021-00218-y.

Lemasson, A.J., Somerfield, P.J., Schratzberger, M., McNeill, C.L., Nunes, J., Pascoe, C., Watson, S.C.L., Thompson, M.S.A., Couce, E., Knights, A.M., 2022. Evidence for the effects of decommissioning man-made structures on marine ecosystems globally: a systematic map. Environ. Evid. 11 (1), 1–29.

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