

# Red List of Ecosystem assessment series

Produced by JNCC and NatureScot, supported by Natural Resources Wales, Natural England, and Northern Ireland Environment Agency.

This resource is one in a series/number of Ecosystem Red List assessments developed to accompany the UK Biodiversity Indicator '[Red List of Ecosystems](#)'. The assessments are available at: <https://jncc.gov.uk/resources/7b922dfc-708b-4c8c-9e6a-e2040447fb39>.

Resilient ecosystems are crucial for preventing biodiversity loss and species extinction. Maintaining healthy ecosystems safeguards the essential services they provide, which are fundamental to human well-being and a thriving economy. However, pressures and threats such as deforestation, overfishing, or climate change, can disturb the balance of ecosystems and threaten their health and functioning. Assessing the level of threat facing ecosystems is important in helping us understand the current status of the environment, and on a practical level, assessments can be used to help prioritise conservation funding decisions and where to take conservation management action on the ground.

The 'Red List of Ecosystems' (RLE) is a global assessment approach set out by the International Union on Conservation of Nature (IUCN). The approach includes consideration of a series of criteria, including change in geographic distribution through time; whether the ecosystem distribution is geographically restricted; evidence for any environmental degradation; and disruption to biotic processes or interactions. We have not carried out the quantitative analyses of the probability of ecosystem collapse necessary to assess criterion E as we do not have the data needed to carry out such analyses consistently. The IUCN methodology is widely used as a robust approach to assessing the status of ecosystems. Further details of the criteria used in these assessments are available on the [IUCN portal](#).

This assessment series sets out the RLE assessment conclusions for ecosystems found in the UK, alongside the details of how the assessment was made, including for each IUCN component criterion. The assessments have been peer-reviewed, and source data is referenced. Once complete, the series will cover the full range of natural and seminatural habitats that occur in the UK, throughout marine, terrestrial and freshwater environments.

Assessments are conducted according to the [Global Ecosystem Typology Level 3](#) (Ecosystem Functional Groups). This enables the assessments to feed into the Kunming-Montreal [Global Biodiversity Framework](#) (GBF) headline indicator A.1 Red List of Ecosystems. This indicator, which has been incorporated into the UK Biodiversity Indicator suite, is designed to measure progress against [Goal A](#) ('Protect and restore') and [Target 1](#) ('Plan and manage all areas to reduce biodiversity loss') of the GBF.

Any gridded maps are derived from public sector information licensed under the Open Government Licence v3.0. Coastline boundary is derived from the Oil and Gas Authority's and Lloyds Register SNS Regional Geological Maps (Open Source).

## M2.1 Epipelagic ocean waters

### 1. Key facts

**Ecosystem description:** Epipelagic ocean waters are defined the uppermost layer that is penetrated by sufficient light to support photosynthesis, covering water depths from the surface to 200m depth. This habitat provides for a complex trophic network, from the high biomass of phytoplankton such as diatoms, zooplankton such as copepods (resident and vertical migrants), through to fish, cephalopods, marine mammals, and seabirds.



Image credits: (Left to right) Phytoplankton © Plymouth Marine Laboratory; Sandeels, East of Cape Wrath © Lisa Kamphausen/ NatureScot; Guillemot, near Kinlochbervie © Lisa Kamphausen/ NatureScot

**Overall assessment conclusion:** Vulnerable (VU) based on criteria C2b and D2b.

**Date assessment published:** 02.12.2025

**Assessor:** Eunice Pinn (NatureScot)

**Reviewers:** Mike Best (EA), Abigail McQuatters-Gollop (University of Plymouth), Paul Tett (SAMS).

#### **Corresponding habitat classifications:**

The following habitats were considered in the production of this assessment:

**EUNIS codes:** [MH](#)

**UK Marine Habitat Classification:** no relevant biotope codes

### 2. Assessment against IUCN criteria

#### **Criterion A: Reduction in geographic distribution**

Criterion A considers reduction in geographic distribution over ANY of the defined time periods for criteria A1, A2a, A2b or A3. For details of time periods and criteria see [IUCN Red List of Ecosystems Criteria Summary Sheet 2.2\\_EN.pdf](#)

The geographic distribution of the UK's epipelagic ocean waters is equivalent to the UK's Exclusive Economic Zone (EEZ, up to 200 nautical miles from baseline): 730,102 km<sup>2</sup>. 63% of this area occurs within Scottish waters, 32% in English waters, 4% in Welsh waters and 1% in Northern Irish waters. This geographic distribution will not change unless there is a change in the legal definition of the EEZ.

**Least concern (LC)** – The geographic distribution of epipelagic waters is defined by the limits of the EEZ and is unchanging.

## **Criterion B: Restricted geographic distribution**

Criterion B considers restricted geographic distribution indicated by ANY of the time periods for criteria B1, B2 or B3. For details of time periods and criteria see [IUCN Red List of Ecosystems Criteria Summary Sheet 2.2 EN.pdf](#).

The geographic distribution of epipelagic ocean waters cannot be fragmented or noticeably restricted.

**Not Assessed (NA)** – This aspect of the assessment is not relevant.

## **Criterion C: Environmental degradation**

Criterion C considers environmental degradation over ANY of the time periods for criteria C1, C2a, C2b or C3. For details of time periods and criteria see [IUCN Red List of Ecosystems Criteria Summary Sheet 2.2 EN.pdf](#).

Human activities with the potential to directly affect pelagic habitats in UK waters include agriculture, waste treatment, dredging, shipping, fisheries, aquaculture, energy generation, and offshore extraction of oil and gas, many of which contribute to human-induced climate change, nutrient and chemical inputs (van Beusekom et al., 2009; OSPAR, 2017a, 2017b; McQuatters-Gollop and Holland, 2025). For example, fisheries activities can have an impact via direct effects such as targeting planktivorous forage fish (e.g. herring and sprat) as well as indirect effects via the suspension of sediments which effects water column transparency and therefore influences planktonic productivity (Tett et al., 2024).

Changes in planktonic communities are linked to upward trends in sea temperature and ocean acidification (Holland et al., 2023a; McQuatters-Gollop and Holland, 2025). Warming, increased stratification and changes in pH have led to widespread declines in key phytoplankton and their crustacean grazers, particular those species providing a key food resource for fish (Holland et al., 2023b). Elevated sea surface temperatures enhance stratification, causing greater summer nutrient-depletion, and shifting the foundation of pelagic food webs towards a less desirable state. The epipelagic ecosystem is moving from one dominated by diatoms and crustacean grazers to one where communities are dominated by much smaller planktonic cells, resulting in longer food chains and less efficient transfer to fish and other predators (Schmidt et al., 2020; McQuatters-Gollop et al., 2022, 2024). This has potential consequences for food webs and commercial fisheries over the long term.

**C2b Vulnerable (VU)** – significant changes in the planktonic communities of UK waters have already been recorded and are expected to have future impacts within the food webs and consequences for fisheries.

## **Criterion D. Disruption of biotic processes or interactions**

Criterion D considers Disruption of biotic processes or interactions over ANY of the time periods for criteria D1, D2a, D2b or D3. For details of time periods and criteria see [IUCN Red List of Ecosystems Criteria Summary Sheet 2.2 EN.pdf](#)

There have been important changes in biomass, balance of organisms, and diversity of plankton since the 1960s, in part driven by nutrient inputs but also climate change (e.g. OSPAR, 2017a, 2017b; Louchart et al., 2023a, 2023b). It is difficult to determine what the direct implications of these changes will be for pelagic habitats and the associated trophic relationships and food web dynamics in UK waters. The pelagic communities of UK waters

are considered to be in a “not good” status (OSPAR, 2023; McQuatters-Gollop and Holland, 2025; Thorpe, 2025).

**D2b Vulnerable (VU)** – there have been changes in the planktonic communities of UK waters over the last 50 years with the current condition considered to be ‘not good’.

### Conservation measures in place

The health of the epipelagic ecosystem can be defined by planktonic biodiversity as plankton form the base of the marine food web and, consequently, support food provision (Capuzzo et al., 2018; McQuatters-Gollop et al., 2024).

Climate change remains the most significant factor affecting the health of plankton communities in UK waters. Targets have been defined to reduce the UK’s contribution to climate change, but widespread international response will also be necessary (Defra, 2024; McQuatters-Gollop and Holland, 2025).

### Overall assessment conclusion

**Epipelagic ocean waters in the UK are assessed as being Vulnerable (VU) based on criteria C2b and D2b.**

## 3. Literature references

Capuzzo, E., Lynam, C.P., Barry, J., Stephens, D., Forster, R.M., Greenwood, N., McQuatters-Gollop, A., Silva, T., van Leeuwen, S.M., Engelhard, G.H., (2018). A decline in primary production in the North Sea over 25 years, associated with reductions in zooplankton abundance and fish stock recruitment. *Global Change Biology*, 24, e352-e364.

Department of Agriculture, Environment and rural Affairs (DAERA) (2024). Marine strategy part three: 2025 UK programme of measures. Available at: [https://assets.publishing.service.gov.uk/media/67990f039a6dc0352ab341e1/Marine\\_strategy\\_part\\_three\\_-\\_2025\\_UK\\_programme\\_of\\_measures.pdf](https://assets.publishing.service.gov.uk/media/67990f039a6dc0352ab341e1/Marine_strategy_part_three_-_2025_UK_programme_of_measures.pdf)

Holland, M., Louchart, A., Artigas, L. F. and McQuatters-Gollop, A., (2023a). ‘Changes in Phytoplankton and Zooplankton Communities’. In: OSPAR, 2023: *The 2023 Quality Status Report for the Northeast Atlantic*. OSPAR Commission, London. Available at: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/changes-plankton-communities/>

Holland, M. M., A. Louchart, L. F. Artigas, C. Ostle, A. Atkinson, I. Rombouts, C. A. Graves, M. Devlin, B. Heyden, M. Machairopoulou, E. Bresnan, J. Schilder, H. H. Jakobsen, H. Lloyd-Hartley, P. Tett, M. Best, E. Goberville and A. McQuatters-Gollop (2023b). Major declines in NE Atlantic plankton contrast with more stable populations in the rapidly warming North Sea. *Science of The Total Environment*, 898, 165505. Available at: <https://doi.org/10.1016/j.scitotenv.2023.165505>

Louchart, A., Holland, M., McQuatters-Gollop, A. and Artigas, L. F., (2023a). ‘Changes in Phytoplankton Biomass and Zooplankton Abundance’. In: OSPAR, 2023: *The 2023 Quality Status Report for the Northeast Atlantic*. OSPAR Commission, London. Available at: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/changes-plankton-biomass-abundance>

Louchart, A., Holland, M., McQuatters-Gollop, A. and Artigas, L. F., (2023b). 'Changes in plankton diversity'. In: OSPAR, 2023: *The 2023 Quality Status Report for the Northeast Atlantic*. OSPAR Commission, London. Available at: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/changes-plankton-diversity/>

McQuatters-Gollop, A., L. Guérin, N. L. Arroyo, A. Aubert, L. F. Artigas, J. Bedford, E. Corcoran, V. Dierschke, S. A. M. Elliott, S. C. V. Geelhoed, A. Gilles, J. M. González-Irusta, J. Haelters, M. Johansen, F. C. P. Lynam, N. Niquil, B. Meakins, I. Mitchell, B. Padegimas, R. Pesch, I. Preciado, I. Rombouts, G. Safi, P. Schmitt, U. Schückel, A. Serrano, P. Stebbing, A and C. Vina-Herbon (2022). Assessing the state of marine biodiversity in the Northeast Atlantic. *Ecological Indicators*, 141, 109148. Available at: <https://doi.org/10.1016/j.ecolind.2022.109148>

McQuatters-Gollop A. and Holland, M., (2025). *Pelagic habitats*. Available at: <https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/pelagic-habitats/>

McQuatters-Gollop, A., R. F. Stern, A. Atkinson, M. Best, E. Bresnan, V. Creach, M. Devlin, M. Holland, C. Ostle, K. Schmidt, L. Sheppard, G. Tarran, E. M. S. Woodward and P. Tett (2024). The silent majority: pico- and nanoplankton as ecosystem health indicators for marine policy. *Ecological Indicators*, 159, 111650. Available at: <https://doi.org/10.1016/j.ecolind.2024.111650>

OSPAR (2017a). *Changes in Phytoplankton Biomass and Zooplankton Abundance*. Intermediate Assessment 2017. Available at: <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/plankton-biomass/>

OSPAR (2017b). *Changes in Phytoplankton and Zooplankton Communities*. Intermediate Assessment. Available at: <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/changes-phytoplankton-and-zooplankton-communities/>

OSPAR (2023). 'Pelagic Habitats Thematic Assessment'. In: OSPAR, 2023: *Quality Status Report 2023*. OSPAR Commission, London. Available at: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/thematic-assessments/pelagic-habitats/>

Schmidt, K., Birchill, A. J., Atkinson, A., Brewin, R. J., Clark, J. R., Hickman, A. E., Johns, D. G., Lohan, M. C., Milne, A., & Pardo, S., (2020). Increasing picocyanobacteria success in shelf waters contributes to long-term food web degradation. *Global Change Biology*, 26(10), 5574-5587.

Tett, P., Englehard, G.H., Painting, S., Thompson, M., Johns, D. & Holland, M. (2024). Plankton and fish(eries) in pelagic habitats around the UK. PIT-PAF project report part B.

Thorpe, R., (2025). *Food webs*. Available at: <https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/food-webs/>

Van Beusekom, J. E., Loebel, M., & Martens, P., (2009). Distant riverine nutrient supply and local temperature drive the long-term phytoplankton development in a temperate coastal basin. *Journal of Sea Research*, 61(1-2), pp. 26-33.