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HABITATS EXPERT

Natural Capital and Ecosystem Assessment

Eutrophication monitoring recommendations for future assessments

HIGHLIGHTS

Image: Google Earth / Airbus, 2024



- Knowledge gaps around eutrophication monitoring and assessment were explored through literature, consultation and review
- 12 priority areas were identified under five main themes of DATA, ALIGNMNENT, INDICATORS, **ECOSYSTEM, and CLIMATE**
- DATA identifies priority areas linked to collection of high frequency and innovative data, increasing data confidence in monitoring impacts from land to sea
- ALIGNMENT explores the need to match our inshore to offshore processes
- INDICATORS and **ECOSYSTEM on developing** new ways to assess eutrophication
- CLIMATE considers interactions between climate changes within eutrophication

Our understanding of UK coastal and marine systems is changing, and our approach to eutrophication needs to consider changing baselines, cumulative pressures and new technology

Eutrophication has a substantial impact, limiting access to ecosystem services by acting as a pressure on biodiversity and the ecosystem. Even at relatively low levels, increased nutrient loads and changing nutrient proportions often lead to high phytoplankton biomass and species shifts that affect higher trophic level species.

With improving understanding, eutrophication assessments in the United Kingdom are changing — in multiple ways and in multiple directions. The shift from reporting under EU environmental directives to a nationally based marine strategy and/or natural capital approach is challenging but is a catalyst to rethink how we manage our environment.

Data collected with new technology and at high frequency has also shifted how we assess and manage marine environments. Future assessments need to consider data streams that can fully integrate novel and high frequency data into traditional monitoring, to develop a new understanding of the integrated functioning between our coastal and marine ecosystems.

Our future marine eutrophication work should be focused on developing improved assessments under OSPAR, the UK Marine Strategy and the Water Environment Regulations (Water Framework Directive), developing ecologically relevant assessment areas, which are not constrained by geographical boundaries; developing agreed assessment levels; and applying a harmonised assessment with a much stronger political and stakeholder alignment betweeen nearshore coastal and marine waters.

Future work needs to consider improved harmonisation from catchment to coast and the inclusion of new or improved indicators that tell us more about the ecosystem — and the services that mitigate or are impacted by eutrophication.

Advancements that move our reliance from common indicators (nutrients, chlorophyll, dissolved oxygen) to better estimates of community shifts such as nutrient imbalances, plankton lifeforms and ecosystem functioning would help develop capacity and confidence in data collected under our monitoring programs.

Knowledge gaps

One of our challenges has been responding to shifts in our understanding of eutrophication and enhancing confidence in national assessments through improved technology, modeling, mapping, better use of high-frequency data, and collaboration across the catchment-to-coast continuum — the pathway along which nutrients travel from their source to the sea. Knowledge gaps span five themes: DATA, ALIGNMENT, INDICATORS, ECOSYSTEM and CLIMATE, with 12 recommendations identified to improve eutrophication monitoring and assessment.



A changing perspective

Current eutrophication assessments were developed to meet UK and European directives' legal and technical requirements through a series of cross agency meetings and technical groups. These groups developed a set of tools: a winter nutrient indicator (assessing nutrients and turbidity); an impact indicator (a multi-metric assessment of phytoplankton biomass and abundance); and a dissolved oxygen indicator. These were shaped by our primary understanding of the impacts of high nutrients and available monitoring data. Our perspective has, and is, changing, with more awareness of an ecosystem approach, advances in data and technology, and emerging indicators that describe components of state not considered in the earlier assessments.

Activities that develop new assessment **indicators**



INDICATORS, ECOSYSTEM and CLIMATE

Traditionally eutrophication indicators have relied on nutrients, phytoplankton biomass (measured as chlorophyll), and dissolved oxygen (often green opportunistic macroalgae replaces phytoplankton in intertidal waters). These parameters are, and continue to be, highly relevant indicators when measuring the extent and impact of eutrophication issues. However, the use of these indicators can limit understanding of impacts, and there is an urgent need to expand, both in the improvement of our current indicators and development of new indicators.

As the world, and the multiple pressures on our marine environment, becomes ever more complex it is increasingly important to measure, monitor and assess the health of our marine environment. We still need traditional methods like discrete in-situ sampling but are developing novel ways to collect environmental data. Accessible, data-rich methods — such as autonomous moorings, modeling, and satellite data — will play a key role in UK water quality monitoring. Improved data and confidence will help reveal a fuller picture of the health of our seas and oceans.

Programs such as the incorporation of natural capital accounting or OneHealth are exploring better ways to encapsulate the full value of a functioning ecosystem. Improving stakeholder engagement with river trusts, conservation groups, farmers, water operators and community is required. Bringing conflicting voices to work together will offer the best way to implement these recommendations and continue to manage and protect our coastal resources. Activities connecting **ecosystem** (pelagic and eutrophication) indicators

ECOSYSTEM

Consider linkages between nutrient ratio imbalances and pelagic (plankton) community change indicators

Improve understanding of links between eutrophication and plankton community health

Activities connecting **climate** and eutrophication

CLIMATE

Consider the impacts of eutrophication on climate resilience. Embed the consequences of changing baselines into assessment

Conclusions and way forward

A new integrated approach will help reveal a fuller picture of our seas' and oceans' health. Integrated programs combining ecosystem, economic, and social criteria are exploring better ways to encapsulate the full value of functioning ecosystems. Novel data collection methods provide opportunities to understand highly variable processes influencing eutrophication's scale and extent. Improved understanding of complex connections between nutrients and the pelagic community helps clarify how nutrient imbalances impact trophic interactions, food webs, and other key indicators informing system susceptibility to eutrophication.

Enhancing stakeholder engagement with river trusts, conservation groups, farmers, water operators, and communities must be integral to eutrophication assessment. Bringing conflicting voices together will foster progress, evolving assessments to balance diverse needs while managing coastal and marine resources. Eutrophication can be addressed, despite its complex drivers, impacts, and uncertain mitigation timelines. Positive recovery stories emerge when nutrient inputs are reduced or eliminated. Solutions, though rarely simple, require long-term strategies, improved infrastructure, agricultural and aquaculture best practices, detailed monitoring, and partnerships among stakeholders, public users, and governments.