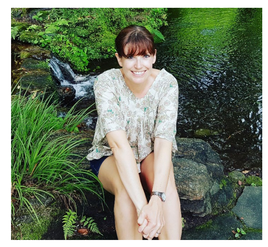
Assessing the State of Plankton Biodiversity in the Northeast Atlantic



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NEA PANACEA — North East Atlantic project on biodiversity and eutrophication assessment integration and creation of effective measures

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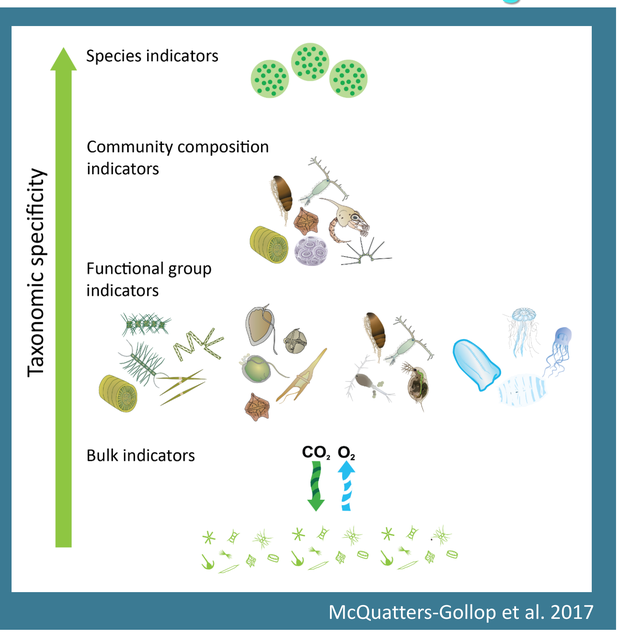
Why plankton?

- Plankton communities are the key biological feature of pelagic habitats
- Plankton comprise the base of the marine food web and are sensitive to changes in their environment, making them good indicators



McQuatters-Gollop et al. 2017

Aim: Assess the state of plankton biodiversity in the Northeast Atlantic

- OSPAR biodiversity assessments assist Contracting Parties with their EU Marine Strategy Framework Directive reporting obligation of assessing Good Environmental Status for marine biodiversity
- Three plankton indicators were included in the previous OSPAR Intermediate Assessment 2017, but lack of understanding of pressure-state relationships, novelty of work, and resource limitations meant change in indicators was simply detected, but Environmental Status could not be determined
- For the OSPAR Quality Status Report 2023, the challenges above had to be overcome to determine the Environmental Status of each indicator to meet policy objectives

Northeast Atlantic plankton indicators

Plankton time-series inform indicators

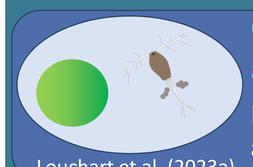
In situ plankton abundance, in situ chlorophyll, and satellite chlorophyll a datasets populate indicators

Changes in Phytoplankton and Zooplankton Communities

Holland et al. (2023)

Abundance of plankton taxa grouped by functional traits into eight lifeforms

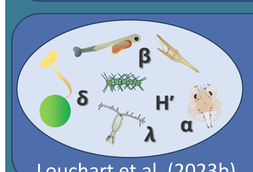
Changes in Phytoplankton Biomass and Zooplankton Abundance



Louchart et al. (2023a)

Phytoplankton biomass and copepod abundance

Changes in Plankton Diversity



Louchart et al. (2023b)

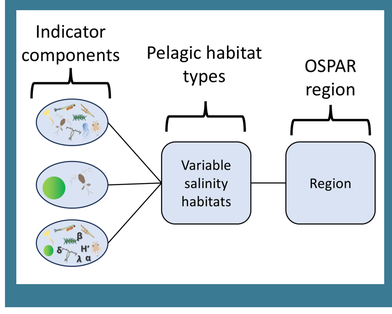
Indices of zooplankton and phytoplankton community composition (richness), species turnover, and dominance.

Determining status

- No assessment thresholds exist for pelagic habitats indicators
- An adapted version of McQuatters-Gollop et al. (2022) semi-quantitative assessment method was applied (right)
- Status was assessed by considering net trend, spatial-temporal confidence, spatial representativeness, strength of link to environmental pressures

Not Good Environmental Status	Indicator value is below assessment threshold, **or** change in indicator represents a declining state, **or** indicator change is linked to increasing impact of anthropogenic pressures (including climate change), **or** indicator shows no change, but state is considered unsatisfactory
Unknown Status	No assessment threshold **and/or** unclear if change represents declining or improving state, **or** indicator shows no change but uncertain if state represented is satisfactory
Good Environmental Status	Indicator value is above assessment threshold, **or** indicator represents improving state, **or** indicator shows no change, but state is satisfactory
Unassessed	Indicator was not assessed in a region due to lack of data, lack of expert resource, or lack of policy support.

McQuatters-Gollop et al. (2022)



- Each indicator component, within each indicator, within each pelagic habitat type was assessed separately for each OSPAR region
- More detail can be found in the Pelagic Habitats QSR –QR code at bottom right

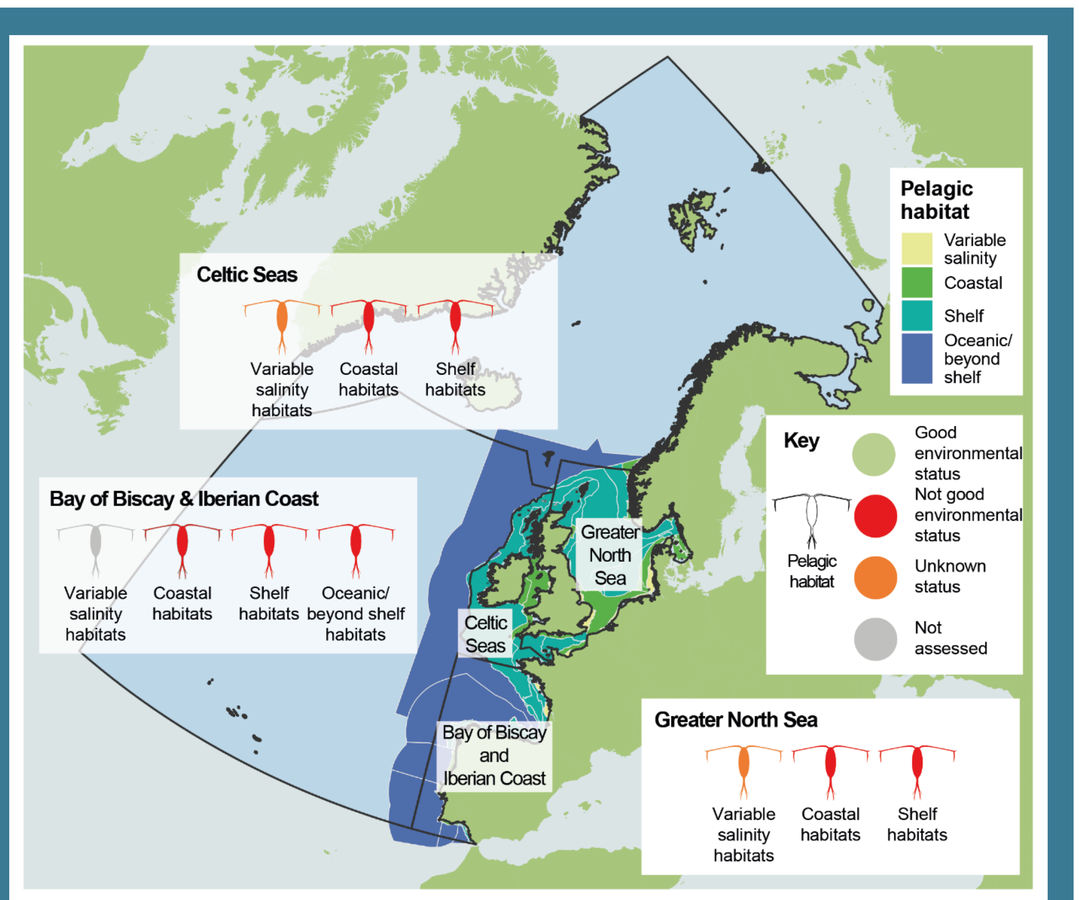
Integration across indicators

- Indicators were integrated across each habitat, per region
- Habitat status in a region was first determined by indicator majority status
- Region status was then determined by habitat majority status

Region	Habitat	Changes in Phytoplankton and Zooplankton Communities	Changes in Phytoplankton Biomass and Zooplankton Abundance	Changes in Plankton Diversity	Habitat status	Region status
Greater North Sea	Variable salinity	Uncertain	Uncertain	Not Good	Uncertain	Not Good
	Coastal	Uncertain	Not Good	Not Good	Not Good	
	Shelf	Not Good	Not Good	Uncertain	Not Good	
Celtic Seas	Variable salinity	Uncertain	Uncertain	Not assessed due to data limitations	Uncertain	Not Good
	Coastal	Not Good	Not Good	Not Good	Not Good	
	Shelf	Not Good	Not Good	Uncertain	Not Good	
Bay of Biscay and Iberian Coast	Variable salinity	Not assessed due to data limitations	Not assessed due to data limitations	Not assessed due to data limitations	Not assessed due to data limitations	Not Good
	Coastal	Uncertain	Not Good	Not Good	Not Good	
	Shelf	Not Good	Not Good	Uncertain	Not Good	
	Oceanic	Not Good	Not Good	Uncertain	Not Good	

Northeast Atlantic pelagic habitats are not in Good Environmental Status

- The Greater North Sea, Celtic Seas, and Bay of Biscay & Iberian Coast regions all failed to achieve Good Environmental Status for pelagic habitats
- Out of ten habitat-region combinations assessed, seven were found to be in Not Good status, two were Uncertain due to inconsistent trends, and one could not be assessed due to data limitations. No habitat-region combination met the criteria for Good Environmental Status.
- Across the Northeast Atlantic, phytoplankton and zooplankton communities have undergone significant changes, with general trends showing decreasing abundance and biomass, particularly in shelf and offshore habitats
- Sea surface temperature (SST) rise, nutrient input changes, and shifts in the nitrogen-to-phosphorus ratio were the most important pressures driving alterations in plankton communities
- Some plankton lifeforms, such as meroplankton and larval fish, showed increasing trends in specific regions, while diatoms, dinoflagellates, copepods, and holoplankton generally declined, indicating potential ecosystem imbalances



Conclusions

- Without substantial reductions in anthropogenic pressures, particularly through climate change mitigation and improved nutrient management, the continued degradation of pelagic habitats will compromise ecosystem resilience and the ability to achieve Good Environmental Status in the future.
- The observed plankton changes are likely already affecting higher trophic levels and ecosystem services, including carbon sequestration, nutrient cycling, and fishery productivity, with potential long-term consequences for biodiversity conservation and fisheries.

References:

Holland, M., et al., (2023). PH1/FW5 Changes in phytoplankton and zooplankton communities, in: OSPAR Commission (Ed.), The 2023 Quality Status Report for the Northeast Atlantic. OSPAR, London. • Louchart, A., et al., (2023a). PH2 Change in phytoplankton biomass and zooplankton abundance, in: OSPAR Commission (Ed.), The 2023 Quality Status Report for the Northeast Atlantic. OSPAR, London. • Louchart, A., et al., (2023b). PH3 Changes in Plankton Diversity, in: OSPAR Commission (Ed.), The 2023 Quality Status Report for the Northeast Atlantic. OSPAR, London. • McQuatters-Gollop, A., et al., (2022). Assessing the state of marine biodiversity in the Northeast Atlantic. Ecological Indicators 141, 109148. • McQuatters-Gollop, A., et al., (2017). From microscope to management: the critical value of plankton taxonomy to marine policy and biodiversity conservation. Marine Policy 83, 1-10.