Human pressures are changing marine ecosystems. Information on the causes and impact of these pressures should be used to guide policy and conservation decisions. Collecting data on marine creatures such as microscopic plankton, which produce half the planet’s oxygen supply, can provide important indications of what is happening in the marine environment now. Plankton indicators are now included in the first UK-wide assessment of marine biodiversity and, also across the Northeast Atlantic, through the Oslo and Paris Conventions (OSPAR) Commission. With human activities causing changes in the marine environment, the most straightforward and immediate response is to influence human behaviour through policy. Policy makers need the right information to guide their work. It is crucial that scientists and policy makers communicate with each other to articulate what data needs to be collected and analysed to inform policies for conservation and environmental protection to safeguard the health of the oceans.

“Human pressures on the marine environment have caused problems such as overfishing, coral bleaching and pollution. They are also contributing to climate change. It is vital that we seek to understand people’s behaviour, engage with different publics and break down siloes to bring different groups, such as scientists and policy makers, together to solve these problems”.

Summary

PRESERVING THE PLANET’S LUNGS AND SECURING THE OXYGEN SUPPLY

The role of plankton in establishing broader pelagic ecosystem status

Dr Abigail McQuatters-Gollop, University of Plymouth
Key points

- The importance of integrating marine conservation and fisheries management into wider marine environmental management.
- Without baseline data and regular monitoring, it is impossible to detect or understand changes in the marine environment such as whether a change in a particular species matters. Observing changes in species, especially microscopic creatures such as plankton which are sensitive to environmental changes, can help predict changes that will affect humans.
- The importance of breaking down silos and ensuring there is liaison between scientists and policy makers to ensure that the correct data is available to provide the evidence on which policy makers can make informed policy decisions.
- Science can shape policy development and policy makers need to advise the scientists what they want; achieving this depends on building a relationship of trust, honest communication and a preparedness to listen.

Plankton produce 50 per cent of the earth's oxygen and are the base of marine foodwebs.

Context

The planet is in a biodiversity emergency. Every day, species and habitats are being lost. Humans depend on biodiversity to live. Whilst considerable strides have been taken in the past 20 years to protect and manage the planet’s biodiversity, more action is needed. Surprisingly, the negative impact of climate change on the marine environment continues to be under reported. The UN Sustainable Development Goal 14 to “conserve and sustainably use the oceans, seas and marine resources for sustainable development” requires managing marine ecosystems to provide the benefits derived from biodiversity. In order to manage our marine ecosystems sustainably, the state of marine biodiversity must first be assessed and understood to ensure more evidence-based decisions are made on how to manage the marine environment.

The pelagic zone

The pelagic zone is the ocean’s open water realm, inhabited by fish, mammals, and plankton. It makes up 98 per cent of the world ocean. Plankton are microscopic algae and animals. They produce 50 per cent of the earth’s oxygen and are the base of marine foodwebs. As the foundation of the marine pelagic ecosystem, plankton community indicators are representative of broader pelagic habitat status. The UK and OSPAR Northeast Atlantic Ocean Region Pelagic Habitats Expert Groups are chaired by Dr Abigail McQuatters-Gollop and comprise of national and international scientific experts. The expert groups are tasked with steering scientific research to meet policy needs, including biodiversity indicator development and assessment, and the assessment and reporting of pelagic biodiversity status to the European Commission and UK government.
The Issue

Plankton are microscopic creatures that exist everywhere in the marine environment. They support the entire planet. Every second human breath contains oxygen generated from plankton. If the rainforest is one of the planet’s lungs, the other lung is plankton. Plankton’s importance to our survival has often been overlooked. Whilst fish, birds, and whales have been closely monitored for decades, plankton have not been subject to this kind of monitoring. It is tempting to focus on the creatures that generate column inches in newspapers because their readership can relate to them most immediately but, sometimes, the most important information and indicators of environmental changes are to be found in the least likely creatures and places. In essence, the planet is supported by creatures that are invisible to the human eye. If they are threatened, the world’s oxygen supply, and all marine life, is threatened.

Too small to see, too important to ignore

Every second human breath contains oxygen generated from plankton. If the rainforest is one of the planet’s lungs; the other lung is plankton.

Addressing the issue

Identifying and understanding the effects of human activities on the marine environment must inform policy making to ensure the marine environment is managed sustainably. Dr McQuatters-Gollop chairs the UK’s Pelagic Habitats Expert Group. She also leads the development of plankton indicators for the first UK-wide assessment of marine biodiversity. These indicators, a direct response to policy makers’ needs, are used to monitor the health of the marine ecosystem through understanding how environmental changes influence plankton distribution and community composition. Dozens of plankton time-series are used to inform biodiversity indicators and deliver assessments on the health of pelagic habitats. The Expert Groups found that significant changes are occurring in plankton communities throughout both UK waters and the Northeast Atlantic, causing alterations in foodwebs that may impact fisheries and other critical ecosystem services such as oxygen production and carbon cycling.

Plankton communities can provide important indications of what is happening in the marine environment now

Plankton are particularly susceptible to changes in their environment, responding very quickly to a decline in water quality and changing temperatures. When developing marine policy and marine management, it is important to understand how organisms such as plankton, fish, or whales respond to human pressures such as climate change, overfishing, shipping and coastal development. Regionally coherent marine management approaches will promote sustainability and help the UK realise its high-level marine objective of having healthy, productive and biodiverse seas. It will also be important to retain a focus on efforts to deliver impact at a local level and, once demonstrated, explore how these can be scaled up and replicated in other environments.

With human activities causing changes in the marine environment, the most straightforward and immediate response is to influence human behaviour. Policy can help achieve this, but policy makers need the right information to be impactful. A key breakthrough has been encouraging policy makers and scientists to co-develop biodiversity indicators and assessments. Academics can act as a linchpin between the two, understanding policy makers’ needs and then working with scientists to ensure the right information is captured and then analysing that data to inform policy development and delivering it back into the policy cycle. Scientists need to continue working on the monitoring and interpretation of data to ensure that changes, and the reasons behind these changes, are better understood. Biodiversity can be protected by ensuring the right information is informing policy and that the scientific community is responding to policy makers’ needs. Breaking down siloes and bringing different groups of people together helps deliver solutions to this biodiversity crisis.

Significant changes are occurring in plankton communities throughout both UK waters and the Northeast Atlantic, causing alterations in foodwebs that may impact fisheries and other critical ecosystem services such as oxygen production and carbon cycling.

Range shift of calanus helgolandicus - a warmer temperate water indicator species

The Marine Strategy Framework Directive (MSFD) and the UK Marine Strategy (UKMS) have both benefitted from bringing discrete groups of scientists and stakeholders together. They take an ecosystem approach to managing Europe’s seas. The overarching objective is to achieve ‘Good Environmental Status’ (GES). Under the MSFD and UKMS, indicators of biodiversity state are used to assess the health of European and UK marine ecosystems and then determine the main drivers of change affecting these marine ecosystems. If the ecosystem state does not reflect GES, a programme of management measures, designed to manage direct human pressures on the marine environment, must then be implemented. Indicators of plankton biodiversity are used to assess the ‘pelagic habitat’ component of European and UK marine ecosystems as plankton are representative of broader pelagic ecosystem status. A suite of three plankton indicators recently developed for the MSFD and UK Marine Strategy capture aspects of pelagic diversity (OSPAR, 2017c), functioning (OSPAR, 2017a) and productivity (OSPAR, 2017b) in the Northeast Atlantic. The UK and OSPAR Pelagic Habitats Expert Groups are tasked with steering scientific research to meet policy needs, including indicator development and assessment and reporting of pelagic biodiversity status to the European Commission and the UK government.

Conclusion

This holistic, integrated approach has resulted in an increased understanding of how marine biodiversity is responding to climate change and human pressures. There are still information gaps that need filling, but significant progress has already been made working effectively across the science/policy interface in a holistic, integrated way that gives indications where future work needs to focus. Both the UK Marine Strategy and the MSFD are legal commitments. To ensure that the commitments are being met, it is necessary to monitor the environment. This data will then inform indicators which can then track progress towards policy goals.

Ultimately, marine conservation policy has to address climate change. Without a reduction in carbon outputs, climate change will continue. A greater understanding of the changes wrought by climate change is required. Influencing peoples’ behaviour will continue to be key to improving the environment but efforts need to be scaled up. Humans need to work out how to live in a way that does not continue to put biodiversity in jeopardy.
Dr Abigail McQuatters-Gollop, Associate Professor of Marine Conservation, is leading the integration of holistic marine policy and evidence to inform the effective management of the UK’s pelagic marine environment post-Brexit. Her expertise has been sought all over the world and she currently holds a prestigious NERC Knowledge Exchange Fellowship and was previously awarded an Invited Fellowship from the Japan Society for the Promotion of Science. She led the first regional pelagic habitat biodiversity assessment in the Northeast Atlantic Ocean and has been a key champion for bringing together the UK’s plankton scientists into a tight-knit, collaborative community, ensuring their science achieves the greatest impact.

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The University of Plymouth has a national and international track record in specific areas of data acquisition as well as the interpretation and visualisation of environmental data. It is currently working draw these strengths together to deliver the next generation of environmental monitoring and assessment. Building on research bases within environmental monitoring and fate, sensors, agri-tech, and biology we have formed a University-wide Sensors group, which is already forging new collaborations and gaining funding.

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Researcher biography

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