

Impact case study (REF3)

Institution: University of Plymouth		
Unit of Assessment: UoA7		
Title of case study: Implementing an ecosystem approach for marine conservation policy		
Period when the underpinning research was undertaken: 2010 - 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Abigail McQuatters-Gollop	Role(s) (e.g. job title): Associate Professor of Marine Conservation	Period(s) employed by submitting HEI: 2015- present
Period when the claimed impact occurred: August 2013 – November 2020		
Is this case study continued from a case study submitted in 2014? N		
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>Marine ecological systems are responding to human pressures such as climate change, fishing, and nutrient loading leading to deterioration. Therefore, an active approach to marine management is required to conserve marine biodiversity. Plankton are robust indicators of environmental change and can be used to support marine policies which protect human health and inform conservation efforts for fish and seabirds. McQuatters-Gollop led the development of new plankton indicators which contributed to the first ever regional marine biodiversity assessment in Europe. Her research influenced UK Fisheries policy and the EU Marine Strategy Framework Directive (MSFD) and resulted in policy changes across Europe through OSPAR. These indicators now inform the regional implementation of management measures for the achievement of Good Environmental Status in the North East Atlantic</p>		
<p>2. Underpinning research (indicative maximum 500 words)</p> <p>The development of scientifically robust indicators that can track changes in pelagic habitats is a critical but novel field, which is evolving quickly to fill the needs of UK and EU policymakers. Pelagic habitats are found in the ocean water column and cover 90% of the world's seas. Plankton, microscopic algae and animals, are ubiquitous throughout pelagic habitats and their close links to their environment and high diversity mean that they can be used as robust indicators of environmental change. The EU Marine Strategy Framework Directive (MSFD) is the first large-scale mechanism to holistically manage marine biodiversity through the setting of biodiversity indicators and legally required plankton indicators to track progress towards Good Environmental Status (GES). However, the type of indicators which should be used was undefined and unconnected to policy goals and therefore unfit for purpose. In addition, no description of GES existed for plankton.</p> <p>In response to this, McQuatters-Gollop developed three plankton biodiversity indicators revealing important information about changes in plankton species composition, functioning, and production linked to wider changes in pelagic habitats [3.1 & 3.2]. Though critical for marine management and policy, biodiversity indicators are only useful if they are both scientifically robust and fulfil policy objectives. These three plankton indicators were therefore co-developed between scientists and policy makers at the UK (Defra) and OSPAR (the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the North-East Atlantic) levels. This was the first time that the pelagic plankton community had been assessed at North-East Atlantic and UK-wide scales, and the assessments formed the foundation</p>		

of both the UK's 2020 Marine Strategy Assessment and the 2017 OSPAR Intermediate Assessment for pelagic habitat biodiversity and food webs.

Such assessments depend on setting biodiversity targets. This is not straightforward, however, as often the links between direct human disturbances and plankton responses may not be clear due to environmental and climate change. In order to resolve this challenge, a clear articulation of GES for pelagic habitats was developed by McQuatters-Gollop and is now in use in UK and OSPAR MSFD assessments, providing the foundation for environmental target setting for the implementations of the MSFD and the UK Marine Strategy [3.3].

In addition to the operational role of pelagic indicators, McQuatters-Gollop showed that plankton indicators can also serve a surveillance role where information on plankton change can provide evidence critical for understanding variations higher up in the food web (higher trophic levels) e.g. fish, seabirds, or seabed habitats [3.4]. Subsequently, McQuatters-Gollop investigated links between multiple trophic levels in the North Sea and demonstrated that change in plankton communities resonates upward through the food web, causing alterations to fish populations [3.5]. From a policy perspective, understanding of the role of plankton as surveillance indicators and the manifestation of links to higher trophic levels are required evidence to determine if UK and EU waters are in GES. The knowledge of these links addressed the key policy challenge of separating the drivers of change in higher trophic levels (birds, non-commercial fish) in MSFD assessments, underpinning the assessment of food webs in the UK and OSPAR areas. This evidence [3.1-3.5] provided information to policy makers about if and where to enact management measures such as sewage treatment and changes to farming practices. The results also showed that climate change is driving the changes in plankton indicators [3.6]. This analysis was reported in the OSPAR Intermediate Assessment 2017 and the UK Marine Strategy assessment in 2020.

3. References to the research (indicative maximum of six references)

- 3.1 **McQuatters-Gollop, A.**, Atkinson, A., Aubert, A., Bedford, J., Best, M., Bresnan, E., Cook, K., Devlin, M., Gowen, R., Johns, D.G., Machairopoulou, M., Mellor, A., Ostle, C., Scherer, C. and Tett, P., (2019). Plankton lifeforms as a biodiversity indicator for regional-scale assessment of pelagic habitats for policy Ecological Indicators, 101: 913-925.
- 3.2 Rombouts, I., Simon, N., Aubert, A., Cariou, T., Feunteun, E., Guérin, L., Hoebeke, M., **McQuatters-Gollop, A.**, Rigaut-Jalabert, F. and Artigas, L.F., (2019). Changes in marine phytoplankton diversity: Assessment under the Marine Strategy Framework Directive. Ecological Indicators, 102: 265-277.
- 3.3 Dickey-Collas, M., **McQuatters-Gollop, A.**, Bresnan, E., Kraberg, A.C., Manderson, J.P., Nash, R.D.M., Otto, S.A., Sell, A.F., Twedde, J.F. and Trenkel, V.M., (2017). Pelagic habitat: exploring the concept of good environmental status. ICES Journal of Marine Science, 74: 2333-2341.
- 3.4 Bedford, J., Johns, D., Greenstreet, S. and **McQuatters-Gollop, A.**, (2018). Plankton as prevailing conditions: a surveillance role for plankton indicators within the Marine Strategy Framework Directive. Marine Policy 89:109-115.
- 3.5 Capuzzo, E., Lynam, C.P., Barry, J., Stephens, D., Forster, R.M., Greenwood, N., **McQuatters-Gollop, A.**, Silva, T., Sonja M. van Leeuwen and Engelhard, G.H., (2017). 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.
- 3.6 Bedford, J., Ostle, C., Johns, D.G., Atkinson, A., Best, M., Bresnan, E., Machairopoulou, M., Graves, C.A., Devlin, M., Milligan, A., Pitois, S., Mellor, A., Tett, P. and **McQuatters-Gollop, A.**, (2020). Lifeform indicators reveal large-scale shifts in plankton across the North-West European shelf. Global Change Biology.

Grants

Abigail McQuatters-Gollop. Knowledge Exchange Fellowship: Interpreting and targeting NERC-funded research outputs to inform and influence marine policy. NERC. 2013-2017. £110,269.

Abigail McQuatters-Gollop. Knowledge Exchange Fellowship: Plankton science for supporting the implementation of marine ecosystem-based management and conservation. NERC. 2018-2020. £70,000.

Abigail McQuatters-Gollop. ICEGRAPH: Increasing Confidence in Evaluating GES for Regional Assessments of Pelagic Habitats. MMO/EMFF. 2019. £190,000.

4. Details of the impact (indicative maximum 750 words)

At the base of the marine food web and closely linked to their immediate environment, plankton are increasingly needed as indicators to support marine policy, inform conservation efforts for higher trophic organisms such as fish and seabirds, and protect human health. McQuatters-Gollop's research has informed national and international policy through the novel use of plankton indicators to provide evidence for policy decision making. Europe, including the UK, has and continues to implement ecosystem-based management (EBM) of its seas. McQuatters-Gollop's research has resulted in the Marine Strategy Framework Directive (MSFD) being instrumental in delivering EBM and requiring European marine habitats and species to achieve Good Environmental Status (GES) for their biodiversity and food webs, which will protect the resource base upon which marine-related economic and social activities depend.

Influencing policy to achieve GES

McQuatters-Gollop's research has aided the articulation of a policy vision of GES under the MSFD for pelagic habitats, which is the foundation of the environmental target development for pelagic habitats. This novel work has led to the development and policy uptake of pelagic habitat biodiversity indicators in close collaboration with Defra (UK) and the OSPAR Commission.

Plankton monitoring is essential for collecting data which highlights environmental change. As plankton communities change due to climate change or other direct anthropogenic pressures, composition of other marine food web components such as seabirds or commercial fish can be affected. McQuatters-Gollop's three new plankton biodiversity indicators identified statistically significant changes in plankton communities throughout UK and North East (NE) Atlantic. The operationalisation of these environmental indicators and targets was critical to enable monitoring of changes in marine biodiversity. McQuatters-Gollop's development of these innovative biodiversity indicators and targets in close collaboration with international policy makers (13 EU Member States, Iceland, and Norway) through OSPAR's Pelagic Habitats Expert Group (chaired by McQuatters-Gollop since 2011) expedited this [5.1]. These indicators now inform the regional implementation of management measures for the achievement of GES in the North East Atlantic [5.3]. This has led to the knowledge that plankton are experiencing profound region-wide changes in abundance and distribution suggesting alterations to the marine food web. Many of these changes have been linked to increasing sea surface temperature changes - a key manifestation of climate change. Emily Corcoran, Deputy Secretary, OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic stated that McQuatters-Gollop's *'contribution to this process [was] valuable for achieving regional coherence in the implementation of the Directive through the provision of advice to OSPAR.'* [5.2]

Assessing pelagic habitats against environmental targets for GES

McQuatters-Gollop developed and led the first ever assessment of the status of the UK and OSPAR's pelagic habitats against environmental targets representing GES [5.4]. She chaired and represented the UK in the pelagic group of OSPAR COBAM and at the national (UK) level chairing (for Defra) the pelagic expert group in the Healthy and Biologically Diverse Seas Evidence Group (HBDSEG), which facilitated the delivery of eco-system based assessments and management of the UK's marine environment. In late 2019, McQuatters-Gollop's leadership on HBDSEG enabled the draft assessments to go out for public consultation in the UK [5.5]. This was pivotal in the development of marine conservation policy and

ensured that the UK had the added benefit of a consistent approach across these two groups in the development and implementation of indicators and targets for pelagic habitats under the MSFD at both UK and EU levels. McQuatters-Gollop's understanding, interpretation and ongoing contributions within the OSPAR MSFD processes allowed the UK to take a leading international role in the MSFD and enabled the development of scientifically robust targets which have enabled the first ever assessment of pelagic biodiversity for UK and NE Atlantic (OSPAR) waters. Dominic Pattison, Defra stated that, *'Your advice has allowed us to progress development of robust indicators and targets which stand up to scrutiny and challenge and beyond this for use in consideration against wider UK marine policies'* [5.6].

An ecosystem approach and UK Fisheries Policy

McQuatters-Gollop's research directly influenced recommendations on post-Brexit marine management. She was an advisor to MPs and Ministers on sustainability and on fisheries policy and facilitated the uptake of the ecosystem approach by contributing scientific expertise to the UK Fisheries Management POSTnote [5.7]. She also provided evidence in Parliament as an expert witness for the House of Commons Environmental Audit Committee Sustainable Seas Inquiry [5.8] and the Environment, Farming and Rural Affairs Committee Fisheries Bill Inquiry [5.9]. The evidence in Parliament was considered when refining the sustainability aspects of the fisheries bill (now the UK Fisheries Act 2020). Underpinning everything in the Act is a commitment to sustainability, ensuring healthy seas for future generations of fishermen. Dr Charlotte Marshall, Defra said *'McQuatters-Gollop's research has made a significant contribution to the development of marine conservation policy in the UK.'* [5.10]

5. Sources to corroborate the impact (indicative maximum of 10 references)

- 5.1 UK MSFD Assessment for pelagic habitats biodiversity indicators
<https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/pelagic-habitats/>
- 5.2 Corroborating letter from OSPAR (LoS Emily Corcoran OSPAR.pdf)
- 5.3 Marine Strategy Part 3 Programme of Measures
- 5.4 OSPAR 2017 Intermediate Assessment: I led the following sections:
 - a) McQuatters-Gollop, A., Artigas, F., Aubert, A., Budria, A., Johansen, M., Ostle, C. and Rombouts, I., (2017). PH1/FW5: Changes in phytoplankton and zooplankton communities. In: OSPAR (Editor), OSPAR Intermediate Assessment 2017. OSPAR, London, UK, pp. 2. <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/changes-phytoplankton-and-zooplankton-communities/>
 - b) Aubert, A., Artigas, F., A., Budria, A., Johansen, M., Ostle, C., and Rombouts, I., and McQuatters-Gollop, A., (2017). PH2: Plankton biomass and/or abundance. In: OSPAR (Editor), OSPAR Intermediate Assessment 2017. OSPAR, London, UK, pp. 2. <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/plankton-biomass/>
 - c) Rombouts, I., Budria, A., Aubert, A., Artigas, F., Johansen, M., Ostle, C., and McQuatters-Gollop, A., (2017). PH3: Changes in biodiversity index(s). In: OSPAR (Editor), OSPAR Intermediate Assessment 2017. OSPAR, London, UK, pp. 2. <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/pilot-assessment-changes-plankton/>
- 5.5 Draft UK monitoring options proposal and evaluation of evidence presented at HBDSEG March 2018
- 5.6 Corroborating letter from Defra (LoS Dominic Pattinson Defra.pdf)
- 5.7 Program and materials from The Science of Managing UK Fisheries, Westminster, Feb 2018
b) UK Fisheries Management. POSTnote. POST-PN-0572, 2018.
<https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0572>
- 5.8 Creagh, M., and the Environmental Audit Committee, (2019). Sustainable Seas. Fourteenth Report of Session 2017-19. Environmental Audit Committee, House of Commons, UK Parliament, London, 66 p.

5.9 Parish, N., and the Environment, Food, and Rural Affairs Committee, (2019). Beyond the Common Fisheries Policy: Scrutiny of the Fisheries Bill. Environment, Food, and Rural Affairs Committee, House of Commons, UK Parliament, London, 38 pp.

5.10 Defra testimonial