POTENTIAL FOR MARINE AQUACULTURE DEVELOPMENT IN AND AROUND MARINE PROTECTED AREAS (MPAS) IN ENGLAND

POLICY BRIEF

This briefing summarises the findings of a report submitted to Research England in September 2020.

Recommended citation

Brown AR, Daniels C, Jeffery K, Tyler CR (2020). Potential for marine aquaculture development in and around Marine Protected Areas (MPAs) in England. Policy Brief. 13pp.
https://www.exeter.ac.uk/research/saf/projects/strategypolicyregulation/

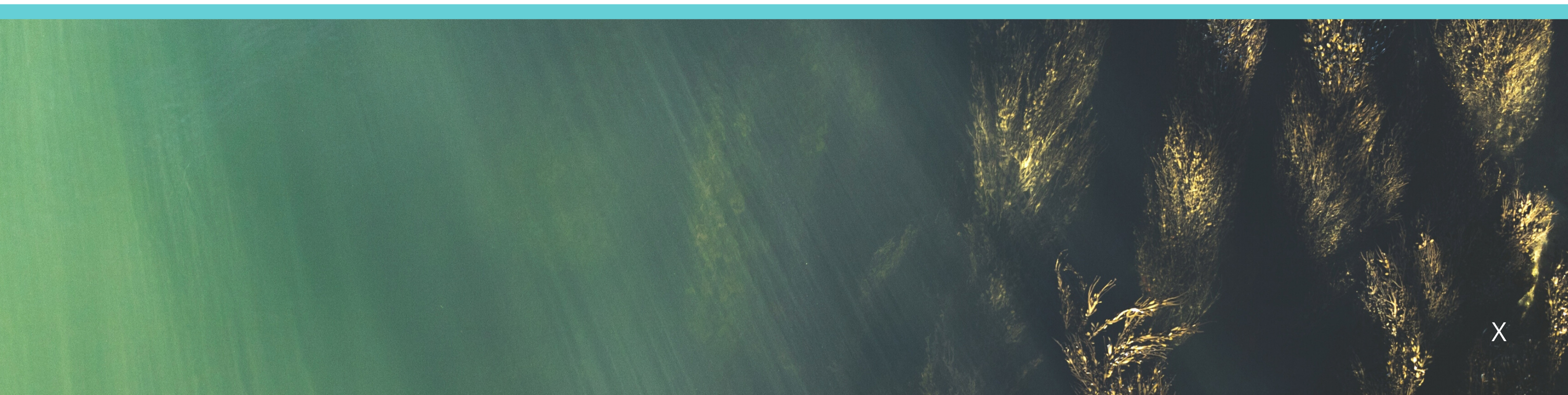
SUMMARY

- Food fish production from aquaculture (82 million tonnes, US$250 billion per year) now exceeds that from marine capture fisheries, many of which have reached maximum sustainable yields.
- Aquaculture is the fastest growing food production sector globally (currently >5% per year), but continued rapid growth is needed to meet rising global demands for human dietary protein.
- Marine aquaculture can contribute substantially to sustainable 'blue' growth in the EU and the UK.
- Marine aquaculture in England (predominantly shellfish) currently occupies less than 0.5% of the country's territorial coastal waters (12 nautical mile limit), compared with 50% occupied by Marine Protected Areas (MPAs) and with limited restriction of fishing activities (e.g. bottom trawls in MPAs).
- Around 50 (>70%) of existing marine aquaculture sites in England are located in MPAs, but licencing of new aquaculture sites within these areas currently adopts a highly precautionary approach.
- Evidence-based policy and decision support tools are urgently needed to support the sustainable management of marine resources and competing uses in England's coastal waters.
- Allocated Zones for Aquaculture are used widely in Europe to facilitate sustainable development and a similar approach could be implemented in England by adapting existing domestic policies and tools for fisheries management and conservation.

Summary of initial findings of a report on 'Evidence-based policy for mariculture development in and around Marine Protected Areas (MPAs) in England' (Brown et al., 2020).

GLOSSARY OF TERMS

AMA - Aquaculture Management Area
AZA - Allocated Zone for Aquaculture
AZE - Allowable Zone of Effect
CEFAS - Centre for Environment Fisheries and Aquaculture Science
Feature - defined habitats composed of distinctive biological or geological sub features
HRA - Habitats Regulations Assessment
IFCA - Inshore Fisheries Conservation Authority
MEA - Marine Economic Activity
MMO - Marine Management Organisation
MPA - Marine Protected Area
NE - Natural England
VME - Vulnerable Marine Ecosystem

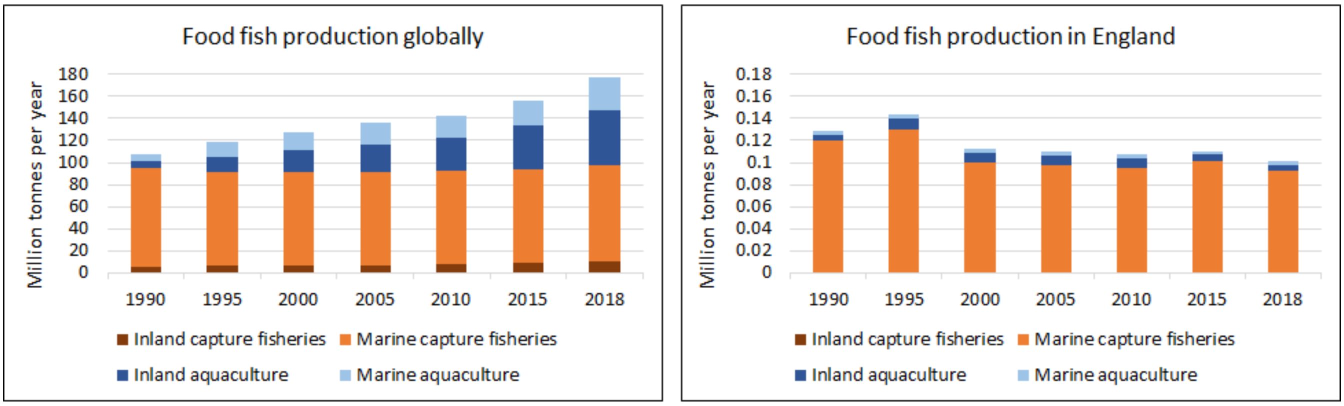


Sustainable growth and benefits of marine aquaculture including in England

Aquaculture offers considerable potential for sustainable growth in food production, unlike capture fisheries, many of which have reached maximum sustainable yields (**Figure 1**).

Figure 1: Trends in food fish production from aquaculture and capture fisheries

Aquaculture production has increased steadily on a global scale (but not in England) in the last three decades, while production from capture fisheries has plateaued. *Global data obtained from the UN Food and Agriculture Organisation; data for England obtained from CEFAS, MMO and SeaFish.*



Global food fish production from aquaculture (82 million tonnes, US$250 billion per year) now exceeds capture fisheries and production is projected to rise to 109 million tonnes, by 2030 (FAO, 2020). Especially strong growth is expected in marine aquaculture (FAO, 2020).

The UK currently generates less than 0.5% of annual global aquaculture production, mainly from Scottish sea salmon and shellfish (£900 million) (Seafish, 2016; Munro, 2019, 2020). English aquaculture currently generates only 8,000 tonnes (£30 million) of food fish per year, compared to English capture fisheries landings of 93,000 tonnes (£209 million) in 2018 (Figure 1). There is significant growth potential, particularly for marine shellfish (and seaweeds) in England, with a doubling in production projected over the next 20 years (Seafish, 2017). Greater economic growth is expected in the seafood value chain, including food processing, hospitality and tourism industries, benefiting local coastal communities in England in particular (SeaFish, 2017).

EVIDENCE

Human health benefits and significant reductions in national healthcare costs have been linked to the increased consumption of seafood, rich in proteins and micronutrients, including omega-3 fatty acids (UK Public Health Directorate, 2013; Seafish, 2017).

Numerous other important ecosystem services can be derived through the farming of filter feeding shellfish and seaweeds, in addition to food provisioning, including: nutrient regulation, habitat provisioning and enhancement of biodiversity and commercial fisheries (Le Gouvello et al., 2017; Smaal et al., 2018; IUCN, 2020). However, there are also potentially negative impacts of aquaculture on ecosystem services and net effects need to be better quantified, as they may vary considerably across different sites (Campbell et al., 2019; Van der Schatte et al., 2018).

> **Aquaculture can contribute to:**
>
> **Aichi Targets under the Convention on Biological Diversity**
> (6) - sustainable fisheries and
> (11) - marine biodiversity protection
>
> **UN Sustainable Development Goals:**
> (2) - food security
> (14) – oceans
>
> **(IUCN, 2020)**

Aichi Targets
Convention on Biological Diversity

SUSTAINABLE DEVELOPMENT GOALS

> **Current total landings of all wild-capture fisheries could be generated from mariculture in as little as 0.015% of the world's coastal oceans**
>
> **(Gentry et al, 2017).**

Sustainable development through marine spatial planning

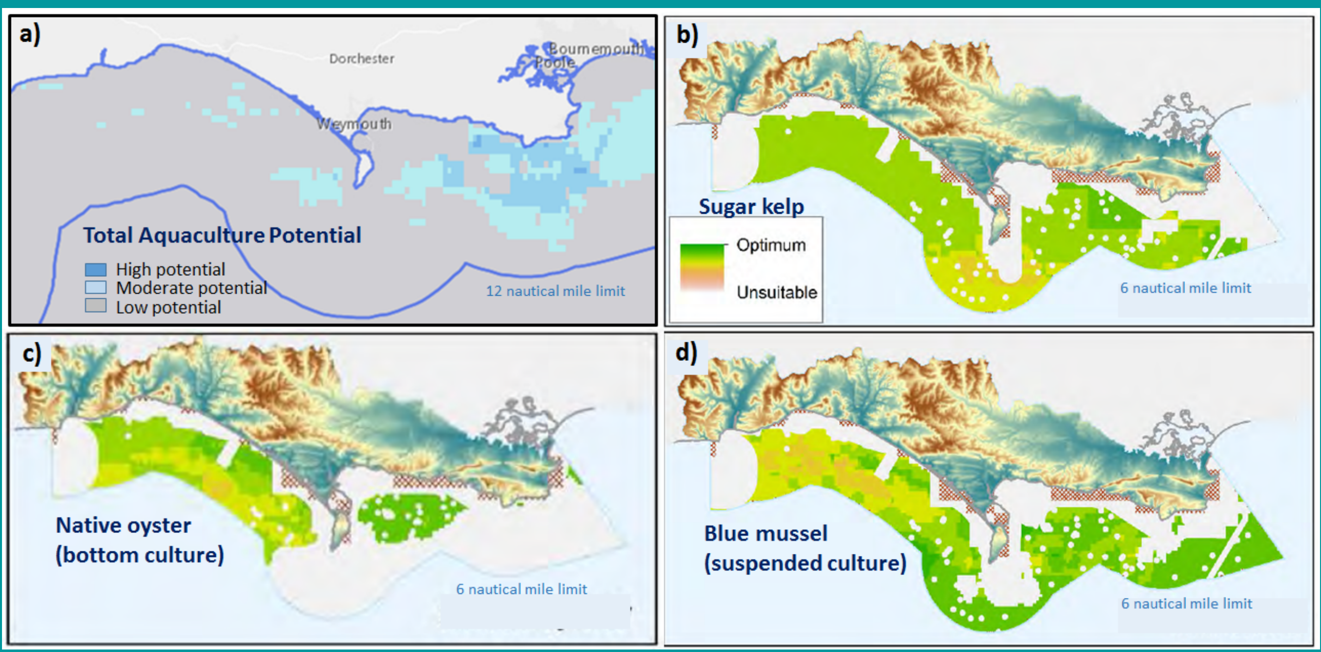
The Marine Management Organisation's (MMO's) 'Explore Marine Plans tool' is designed to identify possible sites for sustainable aquaculture development in England's coastal waters, taking into account planning constraints due to other Marine Economic Activities and Marine Protected Areas (MPAs). The tool is being further developed to include a broader range of environmental constraints, such as water quality, nutrient load and primary productivity. However, additional spatial resolution and specificity are needed for optimising the use of marine space by distinguishing areas that are suitable for different forms of aquaculture (**Case study 1, Figure 2**).

> **The UK Government's 25-year plan** aims to ensure "English inshore and offshore waters achieve good environmental status …. while allowing marine industries to thrive".
>
> **(DEFRA, 2019)**

Case study 1: Distinguishing areas that are suitable for specific forms of marine aquaculture

Figure 2: Marine aquaculture potential along the Dorset and East Devon coast

a) Total aquaculture potential according to the MMO. Specific aquaculture potential according to CEFAS (Kershaw et al., 2020) for **b)** sugar kelp (seaweed), **c)** native oyster, **d)** blue mussel



Realising opportunities for synergies between marine aquaculture development and nature conservation

Half (50%, 25,102 km2) of English inshore waters (out to the 12 nautical mile territorial limit) are designated for nature conservation within 154 MPAs, and (37%, 66,504 km2) of offshore waters contain 40 MPAs (JNCC, 2019). The majority of inshore waters are also open to fishing (MMO, 2018) and a range of other marine activities. This intense competition for marine space is recognised in the UK Multi-annual National Plan for the Development of Sustainable Aquaculture (DEFRA, 2015).

In order to resolve potential conflicts between marine activities in England's crowded coastal waters, there is a need to seek opportunities for synergies between marine uses, and to identify and understand possible trade-offs, to enable sustainable development alongside marine environmental protection and conservation.

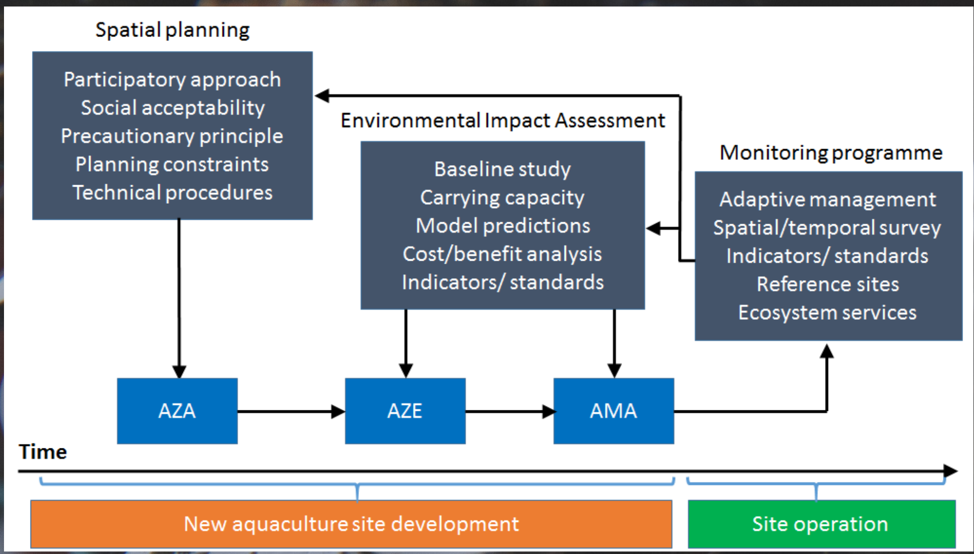
One approach is to refine and use tools for assessing the compatibility of habitat features with different aquaculture methods, building on generic pressure-feature sensitivity assessments underpinning Natural England's advice on operations.

Another approach being adopted widely in Europe is the establishment of Allocated Zones for Aquaculture 'AZAs' (**Figure 3**), where aquaculture development can be aligned with the objectives of other marine economic activities and also MPAs (Sanchez-Jerez et al., 2016; FAO, 2019). Marine policy making and decision support tools required for establishment of AZAs in England could be drawn from existing policy frameworks for fisheries management and conservation (DEFRA, 2012), fisheries byelaws, Regulating Orders and Several Orders (Seafish, 2016). (**Case study 2, Figure 4**)

EVIDENCE

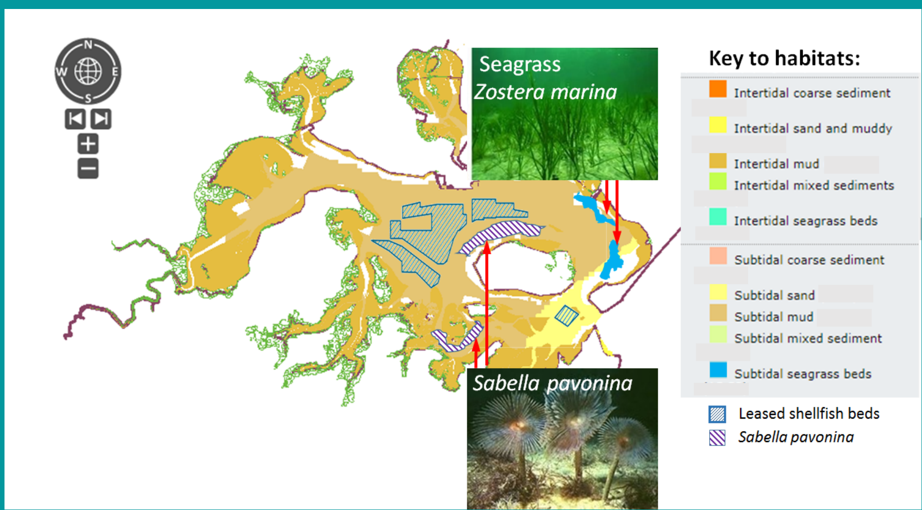
Figure 3: Ecosystem approach for sustainable development of marine aquaculture within AZAs

The ecosystem approach outlined below includes the definition of an Allocated Zone for Aquaculture (AZA), definition of an Allowable Zone of Effect (AZE) and an Aquaculture Management Area (AMA) (after Sanchez-Jerez et al., 2016).



Case study 2: Long-standing example of an Allocated Zone for Aquaculture (AZA) in Poole Harbour

Figure 4: Mapping of leased shellfish beds, habitat features, sub features

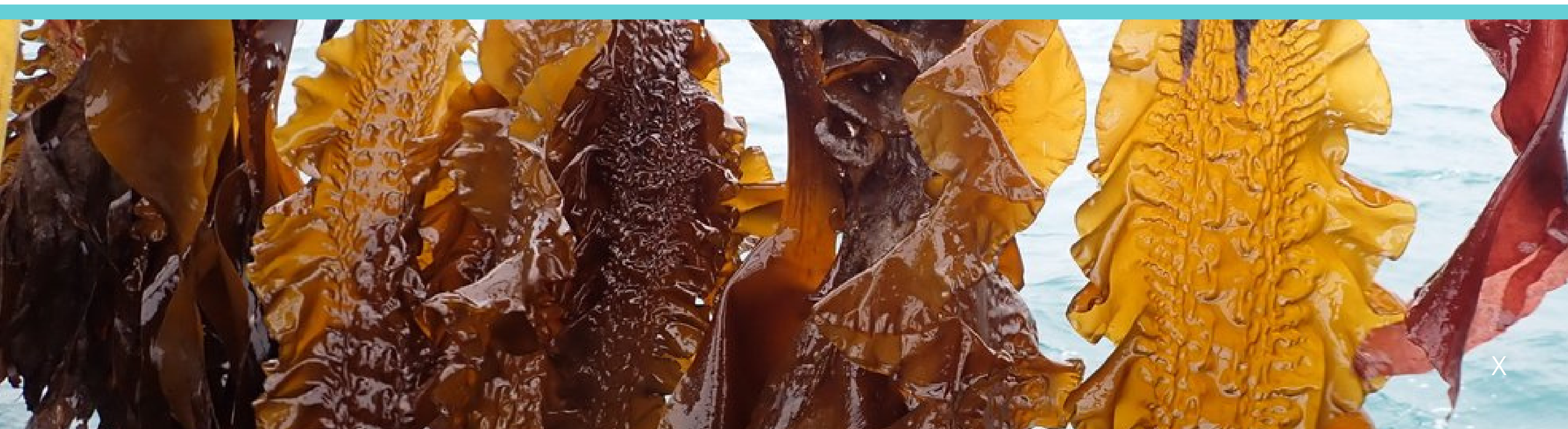


Poole Harbour is one of the largest coastal lagoons in Europe. It is an MPA (Special Protection Area and Ramsar site), which has supported a thriving shellfish aquaculture industry, managed via a Several Order since 1915 (Southern IFCA, 2020). Currently 24% of the Poole Harbour MPA is leased for bottom-culture of shellfish (blue mussels, Pacific oysters, edible cockles and Manilla clams). The leased area constitutes an AZA, located on sub-tidal mud, away from sensitive species and habitats, including seagrass beds (Zostera marina), peacock worms (Sabella pavonina) and internationally important populations of intertidal wading birds.

DISCUSSION

Alternative frameworks
for assessing the compatibility of different types of marine aquaculture in and around MPAs

Precautionary, feature-based approach
Marine aquaculture developments require screening to (determine the need for Environmental Impact Assessment) and Habitats Regulations Assessment (HRA, for European Marine Sites) to evidence that designated habitat features are maintained in a favourable condition. There are several short comings in this 'feature-based approach', including: (i) Lack of representation of species and habitats within the UK's MPA network, which are not included among designated habitat features; (ii) Practical limitations for accurately mapping the distribution and extent of many features; (iii) Lack of reliable indicators to assess changes in feature condition; (iv) Infrequent monitoring of feature condition e.g. every six years for Marine Conservation Zones (Ware and Downie, 2020). These practical (and economic) constraints lead to a reliance on wider published evidence of feature sensitivity to specific pressures from marine activities (Tyler-Walters, 2018). However, sensitivity assessments fail to account explicitly for duration or extent of pressures (CEFAS, 2012) and there are limited data for benchmarking specific pressures from marine aquaculture (Brown et al., 2020), including discerning when aspecific pressure leads to an adverse impact on a feature, and distinguishing this from other anthropogenic or natural background pressures (Möckel, 2017). Lack of site- and feature- specific evidence leads to application of the precautionary principle. For example, there is a tendency under the UK Habitats Regulations to afford the highest levels of conservation protection to all 'natural habitats' and 'habitats of species', at the expense of sustainable development (Solandt et al., 2020). For example, some habitats, such as reefs are recognised as being particularly vulnerable to towed fishing gear and marine plans generally consider reefs to be vulnerable marine ecosystems (VMEs). However, there is evidence that static fishing gears, which more closely resemble marine aquaculture activities, have limited impact on reefs (Rees et al., 2019). Furthermore, the feature-based approach to MPA management places little, or no, emphasis on assessing net impacts, including the positive impacts of marine aquaculture on biodiversity conservation within MPAs, or on other ecosystem services and dependent marine economic activities, including fishing.



DISCUSSION

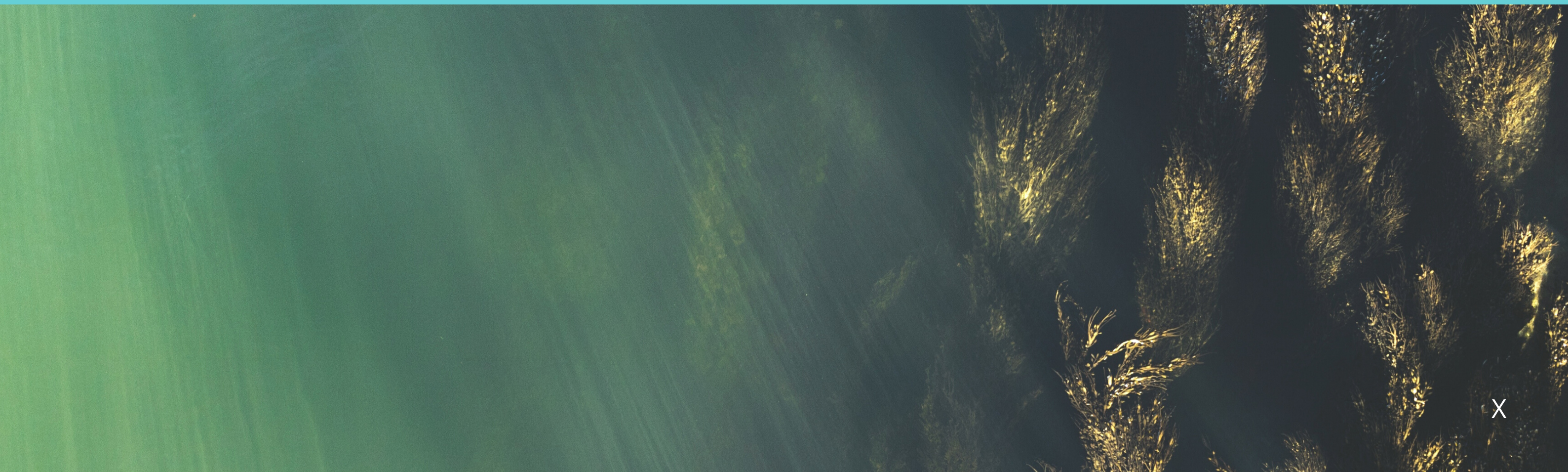
Participatory, ecosystem-based approach

An alternative approach to the feature-based approach is to protect whole ecosystems, which is advocated in UK Government's 25 year Environmental Plan (DEFRA, 2019). This 'whole site', 'ecosystem-based approach' seeks to preserve structure and function, and enable the repair and renewal of marine systems, and is more consistent with the sustainable development and use of marine resources (Solandt et al., 2020; Rees et al., 2020). This approach is embodied in DEFRA's 'revised approach' to the management of commercial fisheries in European Marine Sites in England (DEFRA, 2012) and JNCC's participatory approach to fisheries management in MPAs (JNCC, 2020). In addition to protecting the most vulnerable habitat features within a site from higher risk fishing activities (e.g. demersal trawling), adaptive risk management (based on ongoing monitoring and assessment) can be used to regulate fishing in habitat areas where evidence of negative impacts is lacking.

Adaptive risk management

Adaptive risk management takes into account: conservation feature condition and extent; sensitivity to the specified activity; spatial distribution and intensity of the activity; evidence on other background pressures; trends indicating whether features are progressing towards achieving their conservation objectives. This approach is integral to marine aquaculture management in AZAs (**Figure 3)** (Sanchez-Jerez et al., 2016; FAO, 2019).

Environmental monitoring is required to ensure the adaptive management and sustainable development of marine aquaculture, including within MPAs. Current levels/frequencies of habitat feature condition monitoring undertaken by JNCC and Natural England are limited. Additional regulatory-approved, industry-sponsored monitoring would support both marine aquaculture and MPA management.



RECOMMENDATIONS

Establishing Allocated Zones for Aquaculture (AZAs) in England's crowded coastal waters, including within **Marine Protected Areas (MPAs)** requires the refinement and use of a suite of tools. These tools include:

1) Habitat feature-based sensitivity matrices for prospective assessment of the suitability of different types of marine aquaculture:

- o Feature-specific risk assessment should be refined, building on Natural England's (generic) risk matrices and environmental monitoring data from existing sites quantifying aquaculture x MPA feature interactions.
- o General rules for the screening of proposed marine aquaculture developments should be established, based on learning gained from risk matrices and environmental monitoring data.

2) Adaptive risk management of ongoing aquaculture developments (pilot studies) and operations:

- o Marine aquaculture developments and site operations in and around MPAs should be informed by evidence gathered from ongoing monitoring of habitat features in relation to planned and implemented aquaculture activities.
- o Comparing evidence from monitoring of aquaculture sites and reference sites (e.g. HRA sites) will help elucidate trends in feature condition and impacts from other (background) pressures.

3) Tools quantifying ecosystem service benefits provided by different forms of marine aquaculture, including habitat provisioning, coastal protection, nutrient regulation, carbon sequestration.

4) General planning rules developed from the above tools – these should be applied within a transparent decision making framework for regulators and prospective marine aquaculture licensees (see Daniels et al., 2020; SeaFish, 2020).

AUTHORS

Dr Ross Brown is a Senior Research Fellow with 25 years of experience in industry, in environmental risk and impact assessment. He has more recently (over the last 6 years) developed a portfolio of projects in Sustainable Aquaculture Futures at the University of Exeter.

Dr Carly Daniels is a Research Fellow at the University of Exeter, with 15 years in marine conservation and aquaculture, working at the interface between industry and science. Carly has developed and managed projects in fisheries stock enhancement, mariculture and environmental monitoring.

Keith Jeffery is Group Manager of Statutory Aquatic Services within the Centre for Environment Fisheries and Aquaculture Science. He was previously responsible for statutory inspections of aquaculture production businesses with the Fish Health Inspectorate.

Professor Charles Tyler is an Environmental biologist in the College of Life and Environmental Sciences at the University of Exeter. He leads various (inter)national strategic research partnerships including with CEFAS. He is Co-Director of the centre for Sustainable Aquaculture Futures, GW4 Water Security Alliance, Aquaculture Research Hub UK.

ACKNOWLEDGEMENTS

The authors are very grateful to: **Roger Covey (Natural England)** and **Pia Bateman (Southern Inshore Fisheries Conservation Authority)** for their expert opinion and guidance, and for providing links to a range of conservation planning resources for MPAs and mariculture, which are referenced in this document.

Author affiliations:

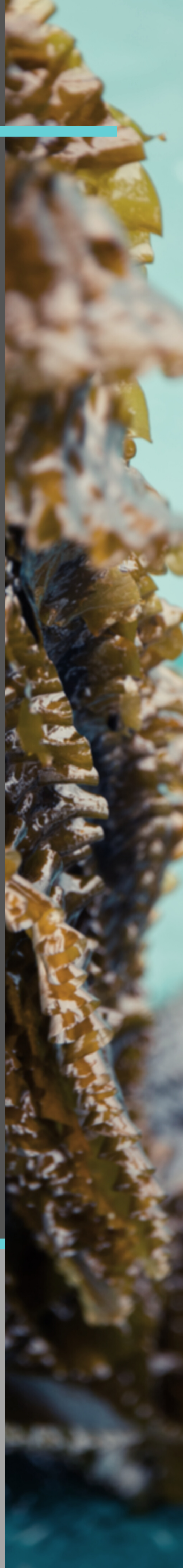
University of Exeter | Cefas | sweep | SAF

Work funded by:

UKRI Research England | UKRI Natural Environment Research Council

Published by:

Mindfully Wired Communications



REFERENCES

Brown et al. (2019). Assessing risks and mitigating impacts of harmful algal blooms on mariculture and marine fisheries. Reviews in Aquaculture 12(3):1663-1688.

Brown et al. (2020). Developing general rules to facilitate evidence-based policy for mariculture development in and around Marine Protected Areas (MPAs) in England. Report to Research England (Strategic Priorities Fund), 30pp. https://www.exeter.ac.uk/research/saf/projects/strategypolicyregulation/

Campbell et al. (2019) The environmental risks associated with the development of seaweed farming in Europe - Prioritizing key knowledge gaps. Frontiers in Marine Science 6:107.

CEFAS (2012). Fisheries in European Marine Sites: review of the matrix'. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/310814/cefas_matrix_review.pdf

CEFAS (2020). Aquaculture Mapping Project – Dorset and East Devon FLAG Area. Mapping areas of potential aquaculture within the Dorset and East Devon FLAG Area. Report C7731.

Daniels et al. (2020) Supporting Mariculture Development: Evidence for Informed Regulation. Policy Brief. 21pp. https://www.exeter.ac.uk/research/saf/projects/strategypolicyregulation/

DEFRA (2012). Revised approach to the management of commercial fisheries in European marine sites in England: https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

DEFRA (2015). United Kingdom multiannual national plan for the development of sustainable aquaculture.https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/480928/sustainable-aquaculture-manp-uk-2015.pdf

DEFRA (2019). HM Government: A Green Future: Our 25 Year Plan to Improve the Environment https://www.gov.uk/government/publications/25-year-environment-plan

FAO, Food and Agriculture Organisation (2019). Allocated Zones for Aquaculture: A guide for the establishment of coastal zones dedicated to aquaculture in the Mediterranean and the Black Sea. http://www.fao.org/3/ca7041en/CA7041EN.pdf

FAO, Food and Agriculture Organisation (2020). The State of the World Fisheries and Aquaculture 2012. http://www.fao.org/3/ca9229en/ca9229en.pdf

Gentry et al. (2017) Mapping the global potential for marine aquaculture. Nature Ecology and IUCN, International Union for the Conservation of Nature (2020). Aquaculture and Marine Protected Areas: Exploring Potential Opportunities and Synergies. URL (2020): https://www.iucn.org/sites/dev/files/content/documents/aquaculture_and_marine_protected_areas.pdf

Huntington and Cappell (2020). English Aquaculture Strategy. Draft. Produced by Poseidon Aquatic Resources Management Ltd.

JNCC, Joint Nature Conservation Committee (2019). UK Marine Protected Area network statistics. https://jncc.gov.uk/our-work/uk-marine-protected-area-network-statistics/

JNCC, Joint Nature Conservation Committee (2020). MPA Fisheries Management Toolkit. http://data.jncc.gov.uk/data/da4ae34c-d0f3-41df-b4fd-79df0a079647/MPA-Fisheries-Management-Toolkit-FINAL.pdf

Kershaw et al. (2020). Mapping of Areas of Potential Aquaculture within the Dorset and East Devon Fisheries Local Action Group (FLAG) area. Cefas Contract C7731, European Maritime and Fisheries Fund (EMFF) grant number ENG3016, pp. 1-187.

Le Gouvello et al. (2017). Aquaculture and marine protected areas: Potential opportunities and synergies. Aquatic Conservation: Mar Freshw Ecosyst. 27(S1):138–150.

MMO, Marine Management Organisation (2018). UK Sea Fisheries Statistics 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742793/UK_Sea_Fisheries_Statistics_2017.pdf

REFERENCES

MMO, Marine Management Organisation (2019). Identification of Areas of Aquaculture Potential in English Waters, A report produced for the Marine Management Organisation by Centre for Environment Fisheries and Aquaculture Science, MMO Project No: 1184, May 2019, 107 pp.

Möckel (2017). The assessment of significant effects on the integrity of "Natura 2000" sites under Article 6(2) and 6(3) of the Habitats Directive. Nature Conservation 23: 57-85.

Munro LA (2019). Marine Scotland Science: Scottish fish farm production survey 2018. 48 pp. https://www.gov.scot/publications/scottish-fish-farm-production-survey-2018/

Munro LA (2020). Marine Scotland Science: Scottish Shellfish Farm Production Survey 2019. 26 pp. https://www.gov.scot/publications/scottish-shellfish-farm-production-survey-2019/

Rees et al. (2018). The Lyme Bay experimental potting study: A collaborative programme to assess the ecological effects of increasing potting density in the Lyme Bay Marine Protected Area. A report to the Blue Marine Foundation and Defra, by the Marine Institute at the University of Plymouth.

Rees et al. (2020). Emerging themes to support ambitious UK marine biodiversity conservation. Marine Policy 117, 103864.

Sanchez-Jerez et al. (2016). Aquacultures struggle for space: The need for coastal spatial planning and the potential benefits of allocated zones for aquaculture (AZAs) to avoid conflict and promote sustainability. Aquaculture Environment Interactions, 8: 41–54.

SeaFish (2016). SR695 UK Shellfish Production and Several, Regulating and Hybrid Orders: The Contribution and Value of Orders in Relation to the Sector's Past Development and Future Growth. https://www.seafish.org/media/publications/FINAL_SRO_REPORT_-_AUGUST_2016_FINAL.pdf

SeaFish (2017). Sea Food 2040 – A strategic framework for England. https://seafish.org/media/Seafood%202040%20strategic%20framework.pdf

Smaal AC, Ferreira JG, Grant J, Petersen JK, Strand Ø (Ed.s) (2018). Goods and services of marine bivalves. Springer. https://doi.org/10.1007/978-3-319-96776-9.

Solandt et al. (2020). Managing marine protected areas in Europe: Moving from 'feature-based' to 'whole-site' management of sites. In Eds Humphreys J and Clarke RWE, Marine Protected Areas - Science, Policy and Management 2020, Pages 157-181, Publ. Elsevier, London.

Southern IFCA, Inshore Fisheries Conservation Authority (2020). Southern Inshore Fisheries and Conservation Authority Poole Harbour Several Order 2015 Management Plan (2020 revision).

Tyler-Walters et al. (2018). Marine Evidence-based Sensitivity Assessment (MarESA) – A Guide. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, pp. 91. https://www.marlin.ac.uk/publications

UK Public Health Directorate (2013). Nutrient analysis of fish and fish products, summary report. Prepared by the Food Composition and Diet Team, Public Health Directorate. URL https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/167921/Nutrient_analysis_of_fish_and_fish_products_-_Summary_Report.pdf

Van der Schatte et al. (2018). A global review of the ecosystem services provided by bivalve aquaculture. Reviews in Aquaculture, 1–23 DOI: 10.1111/raq.12301.

Visch et al. (2020). Environmental impact of kelp (Saccharina latissima) aquaculture. Marine Pollution Bulletin 155, 110962.

Ware and Downie (2020). Challenges of habitat mapping to inform marine protected area (MPA) designation and monitoring: An operational perspective. Marine Policy 111: 103717. https://doi.org/10.1016/j.marpol.2019.103717