Marine Management Organisation

Identification of strategic areas of sustainable aquaculture production in English waters: Final Report

(MMO1184)

...ambitious for our seas and coasts

MMO1184: Identification of strategic areas of sustainable aquaculture production in English waters: Final report (updated 2021)

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When referencing this publication, please cite as:

MMO (2021). Identification of areas of aquaculture potential in English waters: Modelling methods, Marine Management Organisation, MMO Project No: 1184, May 2021, 22 pp.

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1 Introduction

1.1 Aquaculture in England

English aquaculture production has significant growth potential and may provide multiple benefits, particularly the potential to contribute to domestic food production in the UK, thereby increasing food security in a way which is carbon efficient and benefits local economies. Aquaculture may directly and indirectly provide a source of employment, particularly in coastal peripheral towns and ports, as well as contribute to the diversification of the fishing sector. Biological benefits also include restocking species to conserve and recover marine biodiversity, with some cultured species providing indirect benefits through ecosystem services.

However, a lack of availability of new production sites is a key limiting factor for growth in the English aquaculture sector. Due to this, developers are not informed of optimal sites for aquaculture production, and it is not clear which areas should be protected by policy for future aquaculture production. This evidence project aims to remove this barrier by identifying sites that are the most suitable for aquaculture, and ensuring their existence is taken into account in marine license decisions.

1.2 Policy background

The UK Marine Policy Statement (MPS) sets out policy objectives for aquaculture from a planning perspective. These include:

- to take advantage of the opportunities that climate change may bring to certain marine areas, for example, …aquaculture of acceptable and commercially desirable species (MPS section 2.6.7.9)
- embrace the significant opportunities for co-existence of aquaculture and other marine activities (MPS section 3.9.6)
- seek information on possible future aquaculture operations in areas not previously used, assessing the suitability of those areas for development (MPS section 3.9.7)

The vision of Seafood 2040: A Strategic Framework for England is that by 2040, a sustainable aquaculture sector will have seen significant growth, thriving within a safe regulatory framework. As part of this, the original Seafood 2040 recommendations included the investigating the potential of establishing priority aquaculture/coastal development zones. This forms one of the key actions to fulfil the strategies' Priority 2: Grow a sustainable aquaculture sector.

The English Aquaculture Strategy identifies the marine plans as one of the major policy drivers for future aquaculture growth. As stated in the strategy; "*Marine Plans and their more detailed local interpretation will be the primary mechanism for identifying areas for potential sustainable growth in marine aquaculture production*" (p.18).

The Marine Management Organisation (MMO) has previously undertaken development of spatial models to delineate potential areas for aquaculture development. The first approach to developing spatial models for aquaculture was developed as part of MMO1040 'Spatial trends in aquaculture potential in the South and East inshore and offshore marine plan areas'. This project followed a regional approach and was instigated during the development of the South Marine Plans, also supporting the East Marine Plans.

1.3 Marine Planning in England

The Marine and Coastal Access Act 2009 established the legal basis for marine planning in the UK. Section 58(1) states that authorisation and enforcement decisions must be taken "*in accordance with the appropriate marine policy documents*". In England, the MMO is responsible for preparing marine plans, as guided by the UK Marine Policy Statement.

Marine plans aim to ensure that the right activities occur in the right place, at the right time and in the right way, placing sustainable development at the centre of all decisions to deliver the UK vision for "*clean, healthy, safe, productive and biologically diverse oceans and seas*" (p.3).

There are 11 plan areas in England, covered by 6 individual marine plans. The East Marine Plans were adopted in April 2014, the South Marine Plans in July 2018, and the North East, North West, South East and South West Marine Plans in June 2021. England now has a complete and integrated marine planning framework to guide the usage, development, protection, and enhancement our marine environment.

Each marine plan contains aquaculture policies, written to respond to unique issues, challenges and opportunities raised by regional stakeholders during the respective planning processes. The plan drafting process occasionally identifies gaps in the MMO evidence base, where new evidence is needed to ensure policies can be implemented. In these cases, a new evidence project will be commissioned to facilitate the provision of data.

1.4 MMO1184 Evidence Activity

The development of policy AQ-1 in the North East, North West, South East and South West Marine Plans raised a new evidence commission in response to one of the evidence gaps identified. The subsequent evidence report defines areas in which applicants should consider the potential for future aquaculture, referred to as "strategic areas of sustainable aquaculture production". The data is based on:

i) environmental conditions that influence or limit species' growth (biological constraints)
ii) physical conditions prohibitive to establishing aquaculture infrastructure or operations (technical constraints)

iii) other uses of the marine area that either exclude or otherwise reduce the suitability of an area for aquaculture (planning constraints)
iv) other considerations such as distance from shore.

The MMO commissioned the Centre for Environment, Fisheries and Aquaculture Science (Cefas) to inform on needs i) and ii). The resulting Cefas report titled "Identification of areas of aquaculture potential in English waters" (MMO 1184) is hereafter referred to as the commissioned report.

The MMO undertook internal work) to address iii) and iv) and integrate them with the outputs from the commissioned report to produce this report. The result is a single body of work that identifies strategic areas of sustainable aquaculture production.

1.5 This Methods report

This report, first published in 2019, updated in 2021 and published in 2023, describes the sequence of steps followed in the modelling process to generate the strategic areas. It summarises methods from the commissioned report to assist readers in understanding the full process but does not repeat detailed methods, such as the sources and treatment of environmental datasets reported there. Those interested in how the biological components of the model were developed and the process by which the technical layers were defined should refer to the commissioned report.

This report is structured as follows:

- Section 2 summaries the outputs (biological and technical constraints) of the commissioned report, placing them in the context of the wider modelling work
- Section 3 describes how planning constraints were considered in the model
- Section 4 describes the approach to modelling including the software, tools used and the construction of the models
- Section 5 defines the caveats associated with model development, the intentions of model refinement, and how the commissioned report outputs should be used to aid marine plan implementation.

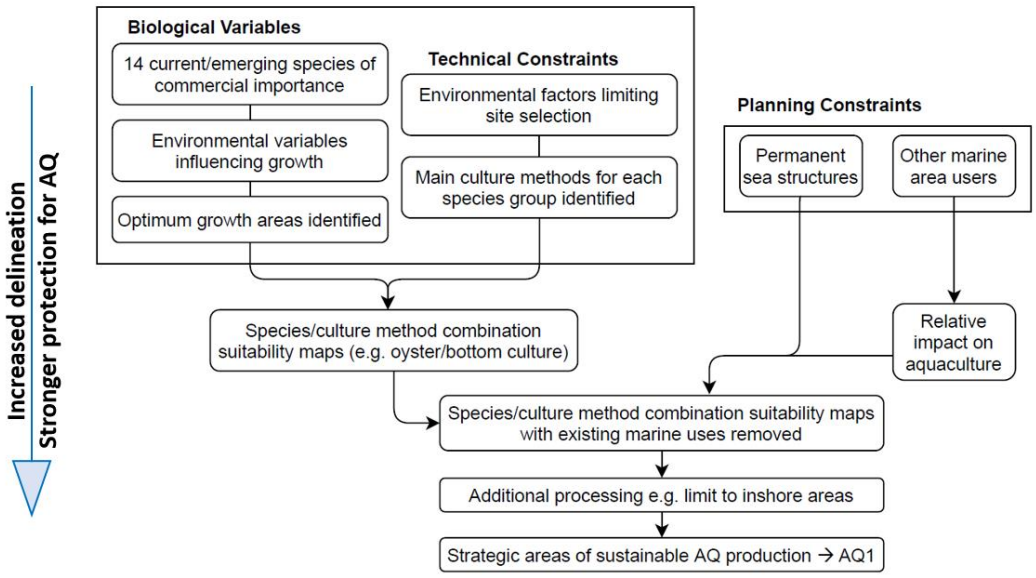
2 Biological and Technical Variables

2.1 Overview

The MMO commissioned Cefas to undertake an aquaculture mapping study to identify areas viable for growth of species in the English marine area. The work also identified technical constraints for site identification based on aquaculture infrastructure. The commissioned report is available on the gov.uk project page (Identification of areas of aquaculture potential in English waters (MMO1184)).

Figure 1 shows a flow chart that illustrates the full methodology described in this report. The box around the biological and technical variables highlights the elements of the data that were produced by Cefas in the commissioned report.

Figure 1: Complete methodology flowchart



2.2 Biological Constraint Layers

All identification, collation, manipulation and analysis of biological constraint data was conducted within the commissioned report. In summary, 14 species were selected for study:

seaweed

- Dulse (*Palmaria palmata*)
- Oarweed (*Laminaria digitata*)
- Sugar kelp (*Saccharina latissimi*)
- Winged kelp (*Alaria esculenta*)

finfish

- Atlantic cod (*Gadus morhua*)
- Atlantic salmon (*Salmo salar*)
- Rainbow trout (*Oncorhynchus mykiss*)
- Sea trout (*Salmon trutta)*

crustaceans

- European lobster (*Homarus gammarus*)

bivalve molluscs

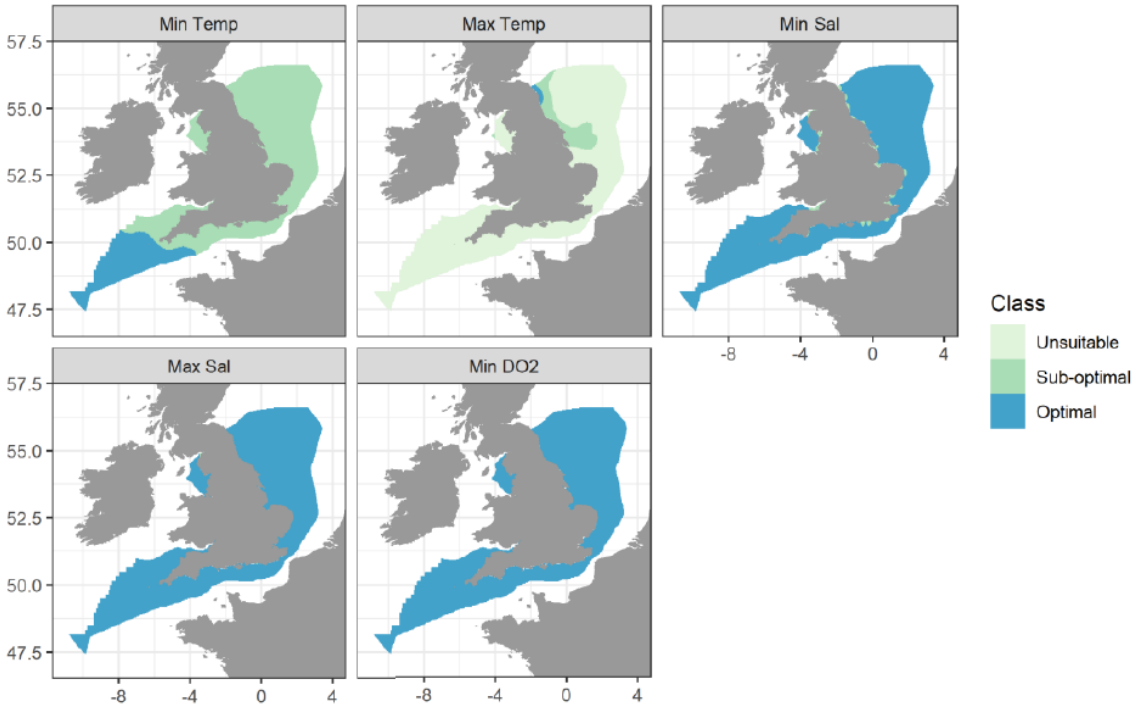
- Blue mussel (*Mytilus edulis*)
- King scallop (*Pecten maximus*)
- Manila clam (*Ruditapes philippinarum*)
- Native oyster (*Ostrea edulis*)
- Pacific oyster (*Crassostrea gigas*).

Datasets were obtained for key environmental layers that informed species distribution models:

- chlorophyll concentration
- light penetration depth
- minimum dissolved oxygen
- salinity (minimum and maximum)
- sea surface temperature (minimum and maximum)
- total oxidised nitrogen.

Environmental variables were classified in optimal, suboptimal and unsuitable ranges for each of the species investigated, based on published literature thresholds. This was conducted across the whole English marine area, where data was available (Figure 2) below. Not all environmental variables were relevant for all species.

Figure 2: Environmental constraints defined for Atlantic cod (*Gadus morhua*)



Comparison of threshold values with separately mapped data of each variable across the English marine area provided suitability maps showing areas where each species can survive or thrive according to each variable. Layers for each individual variable were combined and normalised based on the total number of variables. This

process implicitly weights each environmental variable as equally important to biological suitability and cannot account for combination effects.

This process produced 14 raster data layers showing suitability for growth, one for each species assessed. The continuous data layers were on a floating-point scale of 0 (less suitable; only sub-optimal conditions) to 1 (more suitable; all variables optimal). Areas non-viable for any one of the relevant environmental variables were excluded from the suitability maps.

The above outputs were converted by the MMO to vector layers based off suitability scores and became inputs into later modelling.

2.3 Technical Outputs

2.3.1 Outputs of the commissioned report

Table 1 lists which of the common culture types for aquaculture of different species were considered in this report.

Table 1: Species and culture combinations considered in the report

	Aquaculture Methods					
Species	Bottom culture	Bottom-secured (trestle/poles)	Rope/textile (suspended)	Bags/lantern nets (suspended)	Sea Based Container Culture	Cages
Sugar kelp			✓			
Oarweed			✓			
Winged kelp			✓			
Dulse			✓			
Atlantic Salmon						✓
Rainbow trout						✓
Sea trout						✓
Atlantic cod						✓
European Lobster	✓				✓	
Pacific oyster	✓	✓				
Flat oyster	✓	✓				
Blue mussel	✓		✓	✓		
Manila clam	✓					
King scallop	✓	✓	✓	✓		

The range of environmental and physical variables that presented technical constraints to the culture types were identified via a literature review in the commissioned report. These variables act on the ability to either deploy aquaculture

infrastructure or to undertake and maintain culture activity. Such environmental or physical variables can also influence species' biological distribution; for example, water current is necessary for water exchange around seaweed, but too much will overcome attachment. However, the physical variables above generally act as constraints on infrastructure before becoming biologically constraining.

The technical constraints identified were:

- bathymetry
- bottom substrate
- current speed
- peak wave height.

Raster data layers were used to map each of the constraints across the English marine area were. Threshold values of optimal, sub-optimal or unsuitable ranges (or classifications in the case of bottom substrate) of the constraints were included in table format within the commissioned report.

Conversion of variable data layers to suitability layers was conducted by the MMO. The rationale was to allow iterative modelling on technical constraints, to be undertaken in-house, based on stakeholder engagement and to allow for the introduction of new or improving technologies over time that might change the technical constraints and thus require the models to be re-run.

2.3.2 Preparation of species/culture type suitability layers

All modelling was conducted in ArcMap 10.2.2 and ArcPro 2.4. All data used and produced was projected in the ETRS 1989 geographic coordinate reference system with UTM Zone 30N.

All floating raster outputs from the commissioned report were converted to regular rasters, and then finally to vectors.

Vectors for the technical constraints were processed using definition queries with the aim of only displaying areas where conditions were optimal for each individual species/culture type combination, for example blue mussels/bottom culture, as per Table 1. Optimal extents were initially defined separately for each species for bathymetry, current speed, peak wave height and substrate type, based on the threshold values provided in the commissioned report. The intersect tool was then used to produce layers showing only areas where optimal conditions of all technical constraints overlapped. It should be noted that the optimal thresholds used sometimes only applied to a single species (current speed requirements were unique to sugar kelp), whereas others were common to a whole species group (peak wave height and bathymetry requirements were common to all suspended seaweed aquaculture).

The biological constraint vectors (as produced in section 2.2) were clipped using the newly produced optimal layers, therefore excluding technically suboptimal and unsuitable areas (Figure 1).

Distance offshore was used to constrain all data. Whist not strictly a technical constraint, distance offshore is a proxy for several economic considerations including fuel price, transit times, fish stock and price fluctuation, which can act as limiting factors to locating aquaculture developments. To ensure the outputs of this work adequately reflect the needs of the current, predominantly inshore status of the English aquaculture industry, the map outputs were limited to the inshore marine plan areas only, using the clip tool.

3 Planning Constraints

3.1 Definition of constraint types

The third component of the model considers other uses of the marine area, termed 'planning constraints'. Consideration of planning constraints was not in scope of the commissioned report. This section outlines the process undertaken by the MMO to identify and incorporate consideration of other activities in the marine area that may constrain the siting of an aquaculture development.

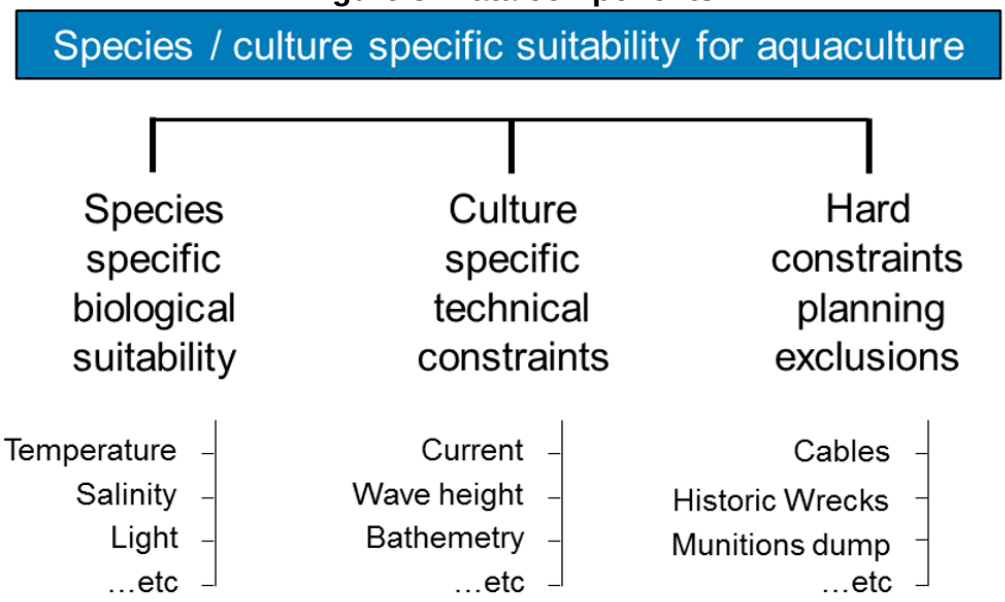
Planning constraints can be defined as either hard or soft constraints. Hard constraints exclude aquaculture from an area completely, for example in areas of fixed infrastructure for energy production, cables, or designated disposal sites. Soft constraints reduce the suitability of a particular location for aquaculture, such as International Maritime Organization (IMO) ship routes (shipping lanes), marine protected areas or areas of high recreational, commercial, or fishing vessel activity, where there may be greater competition for space.

Datasets for planning constraints fell into three categories based on the geometry type that dictated whether pre-processing of the data was required:

- point and line features e.g., wrecks, cables
- polygons e.g., Marine Protected Areas (MPAs)
- continuous datasets, e.g., Automatic Identification System (AIS).

Figure 3 demonstrates how planning constraints were considered alongside the existing biological and technical constraints in the construction of the final outputs.

Figure 3: Data components



3.2 Processing of constraints data

All data types were processed to the point that they could be treated as 'presence or absence' data. All datasets used, their sources and any treatment applied are described in Table 2.

3.2.1 Point and line features

Spatial data presented as point or line does not have a spatial footprint. Feature dependant buffers were applied around such datasets to create polygons. The extent of buffers applied depended on the dataset in question and the requirements of the relevant sector, such as accepted exclusion zones. The International Cable Protection Committee (ICPC) recommends that cables are given a buffer of 500m on either side, while a buffer of 500m is also used around offshore platforms, wind farms, cables and pipes in accordance with common practice and legislation. Buffers around (non-military) shipwrecks were based on the approach used by Cefas when producing resources for the Dorset aquaculture map of a 500m radius. Data sourced from the Oil and Gas Authority (OGA) was also processed to remove features that were either defunct, inactive or otherwise not current constraints to aquaculture development. This was informed by consulting guidance for applications for suspension of inactive wells.

3.2.2 Polygon data

Polygon data required minimal processing, this is again highlighted where relevant in Table 2, with details around buffers as described in section 3.2.1.

3.2.3 Continuous data

Data layers describing activity intensity included AIS data for commercial shipping. The same method used to produce the high density navigation routes layer as displayed on the MMO Explore Marine Plans webpage was used to map AIS data, with areas of high intensity activity or visibility considered less suitable for aquaculture, and areas of lower intensity, more suitable.

3.3 Application of constraint data

All polygons produced were combined and flattened using the merge tool to create a single presence or absence layer, which spatially represented planning constraints to aquaculture. Using the clip tool, the extent covered by this layer was removed from each of the species/culture type layers (Figure 1), ensuring that spatial constraints to aquaculture were fully accounted for in the data. Through exclusion of planning constraints from the aquaculture areas, the likelihood of future conflicts between marine users is reduced.

4 Model Building

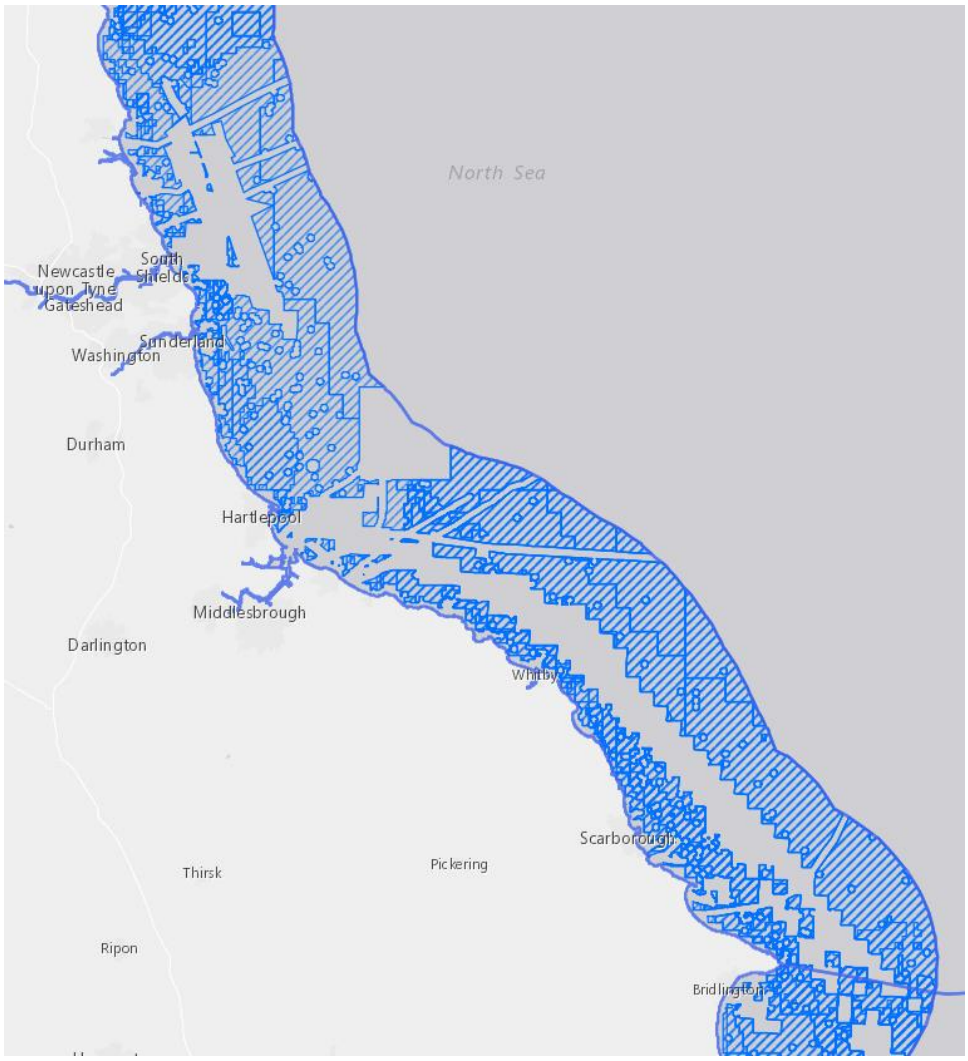
4.1 Final Aquaculture Suitability Layer

To produce the final strategic layer for use in policy AQ-1, all contributing species/culture combination files were merged.

The final list of outputs produced by this work include a single layer representing the strategic areas of sustainable aquaculture production, and a series of separate layers detailing areas where production of certain individual species, cultured via select methods (Table 1) can thrive.

Error! Reference source not found. shows a section of the final strategic layer, taken from the north east inshore marine plan area, with the full data displayed on the MMO Explore Marine Plans digital service.

Figure 4: Strategic areas of sustainable aquaculture production in the north east inshore marine plan area



5 Caveats, considerations and further actions

5.1 Caveats and cautions

This work identifies strategic areas for sustainable aquaculture production, with models returning outputs at 0.01 degrees. The resolution of input data varied given the diverse nature of datasets such as biological suitability, with a loss of precision when data was aggregated.

Important variables that influence site selection (such as water quality) were not considered as they are relevant at a finer spatial resolution than that used in this work. It would therefore be inappropriate to base any site level assessments solely on the outputs of this work.

Some soft planning constraints (Section 3.1), such as recreational and fishing activity were not excluded from the final strategic areas. While datasets can be identified to spatially represent these considerations (e.g., recreational boating areas), these activities do not necessarily exclude aquaculture from an area, and their inclusion in this work may preclude the possibility for future coexistence and sharing of space with aquaculture. The marine licensing process allows for consideration of such activities on an individual case-by-case basis.

Not all environmental variables are derived from observational data. To generate full spatial coverage of environmental variables, direct and indirect observational data was used, and, in some cases, this required further interpolation or the use of modelled data.

Data layers were treated independently of each other. This is particularly notable in biological layers where parameters classed as viable across a single variable may become non-viable in interaction with other variables. For example, temperature and dissolved oxygen tend to be inversely related with warmer temperature waters holding less oxygen. Increasing temperature also increases the biological demand for oxygen in the cultured species, thus both supply and demand pressures on dissolved oxygen may interact to reduce upper temperature tolerances.

There are biases towards including certain variables because data was available versus those for which data was poor, for example close inshore environmental data or water quality offshore or non-licensable activities distributions.

5.2 Further development, engagement and review

Models were based on the best available data at the time of publishing. The marine plan policies, which are informed by this work have a 3-year monitoring and reporting cycle, at the end of which, the need to amend policies may be considered. At present the marine plans reference strategic areas of sustainable aquaculture production in a way that enables outputs to be improved or changed independently from the plan review process, if a need is identified.

6 Implementation through marine plans

The outputs of the above modelling work support the implementation of aquaculture policies in the English marine area. The method follows an approach of identifying all optimal areas for species growth, then using various constraints to narrow these down, increasing spatial delineation to remove conflicts and identify the most strategic areas, and strengthening the protection for these through the implementation of marine plan policies in the decision-making process.

6.1 Iterative product development

A first draft of the strategic areas of sustainable aquaculture production and the associated layers was produced for publication with the draft consultation for the North East, North West, South East and South West Marine Plans, which ran between January and April 2020. Following the consultation, stakeholder feedback and additional communications with Cefas on the models were reviewed and used to refine the outputs published in April 2021. The work detailed in this report reflects the method used in producing the published layers.

6.2 Plan Implementation

The strategic areas of sustainable aquaculture production should be used to inform the implementation of policy AQ-1 in North East Marine Plans, North West Marine Plans, South East Marine Plans and South West Marine Plans. The policy requires that within existing or potential strategic areas of sustainable aquaculture production, all developers seeking to obtain a marine licence demonstrate consideration of, and compatibility with aquaculture. The data produced in this report fulfils the “potential” aspect of the policy; the wording of which applies within these areas only (i.e., not across the wider marine area). By following the wording of the AQ-1 policies, opportunities for future aquaculture are provided a degree of protection within these identified strategic areas. Through this, marine plans provide appropriate support for the aquaculture industry.

In addition to the strategic layer, individual species/culture type layers (Section 2.3.2) are also provided. Whereas the strategic layer is comprised only of optimal areas, these species layers also include suboptimal areas. These were excluded from the process of producing the strategic areas due to the much larger extent they cover. Species/culture type layers may however be of interest to potential developers, so are provided separately. It should be noted that these layers are only provided as additional information, and do not provide any weighting or influence under the aquaculture policies.

Although the marine plans provide support for aquaculture within the identified strategic areas, aquaculture developers are not obligated to locate their developments within either these. The project outputs can be used to inform site

selection based on the detailed considerations in this report, though the primary purpose remains in supporting the implementation of AQ-1.

The outputs of this report are intended to compliment and potentially inform more local investigations into aquaculture site selection; these are covered in the next section of this report.

6.3 Complimentary localised mapping approaches

The English Aquaculture Strategy identified the marine plans as one of the major policy drivers for future aquaculture growth:

> "*Marine Plans and their more detailed local interpretation will be the primary mechanism for identifying areas for potential sustainable growth in marine aquaculture production – this will enable more focused investigation and the most suitable location(s) for a particular species and/or culture method to be identified.*" (p.8)

As stated in section 5.1, the methods in this report have followed a relatively broad-scale approach, excluding more detailed localised data considerations that could not be accurately represented at this scale. Section 6.2 outlines how the data responds to the AQ-1 policy, ultimately in line with Section 58(1) of the Marine and Coastal Access Act 2009, directly informing the marine plan documents under which authorisation and enforcement decisions are made.

In addition to obtaining a marine license, there are many localised considerations to account for when obtaining the necessary permissions for an aquaculture development. To help understand these and to aid the local siting of aquaculture developments, a complimentary mapping project has been undertaken by Cefas in the Dorset and East Devon FLAG (Fisheries Local Action Group) area. The subsequent mapped outputs and report can be accessed using Dorset Council's Aquaculture Map. The data can be used by developers in the Dorset area to aid localised site selection, as it takes variables such as water quality into account. The MMO modelling described in this report and the local FLAG modelling are complimentary; fulfilling similar but subtlety different functions, and at different scales, and should be used together as part of the wider process of locating aquaculture developments.

6.4 Relation to previous evidence projects

The area of study covers the entire English marine area. This includes the east and south marine plan areas, for which strategic areas of sustainable aquaculture production[1] were defined in a previous evidence project (MMO1040). MMO1040

[1] Areas were referred to as "identified areas of potential sustainable aquaculture production" in the South Marine Plan and as "sustainable aquaculture development sites" in the East Marine Plans.

followed a similar process of spatial modelling as undertaken in this report (MMO1184), but this report updates and expands the previous models including:

- expanding the model to consider the entire English marine area
- expanding the data used in the models to improve outcomes
- providing both a single layer for use in policy implementation, and a breakdown according to individual species/culture types
- using recent data to improve timeliness of models
- utilising stakeholder feedback obtained during the marine plan consultation working at a species (rather than taxon group) resolution.

MMO1184 completely supersedes MMO1040, which will no longer be presented on the MMO Explore Marine Plans digital service. However, MMO1040 data will still be available on the Defra Data Services Platform to support transparency for legacy decision making. MMO1184 data will become applicable across all plan areas.

Table 2: Constraints represented as presence/absence data

Sector	Dataset	Originator	Updated	Source*	Treatment
AGG	Aggregate application areas	TCE	16/08/17	[internal] MMO.Aggregate_App_Areas_GB_TCE	
AGG	Offshore Minerals Aggregates Site Agreements	TCE	06/01/21	https://opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-minerals-aggregates-site-agreements-england-wales-ni-the-crown-estate?geometry=-1.389%2C51.309%2C3.838%2C51.906	Production Agreement Area & Exploration and Option Area
CAB	Cables	KIS_ORCA	20/12/18	[internal] Thinned Renewable Installations - Sea Fish Industry Authority (KIS-ORCA)	"STATUS" = 'Active' OR "STATUS" = 'ACTIVE' OR "STATUS" = 'INACTIVE' OR "STATUS" = 'PROPOSED' OR "STATUS" = 'UNDER CONSTRUCTION' Buffer 500m
CAB, OG	Offshore Installations (cables & pipelines)	UKHO	20/12/18	[internal] SO_OffshoreInstallations_line	Cable duplicates removed Buffer 500m
DD	UK Disposal Site Layer	Cefas	19/09/20	http://data.cefas.co.uk/#/View/407	
DEF, HER	Military Protected Wrecks	MOD	19/03/10	[internal] protected_wrecks_MOD	Buffer 500m
DEF	Munitions Disposal Sites	MOD	06/03/11	[internal] Munitions_Disposal_Disused	Buffer 1000m

DEF	Munitions dumping grounds	UKHO	05/01/15	[internal] ActivityAndLicence_A_UKHO	
HER	Protected Wreck Sites and War Graves in England	HE	16/01/15	[internal] protected_wreck_sites_HE	
HER	Shipwrecks and Obstructions	HE	11/12/20	https://datahub.admiralty.co.uk/portal/apps/sites/#/marine-data-portal/items/a46e1c0d912d459fbaf723c347ee9b78	Buffer 500m
OG	Oil & gas safety zones	CDA	01/07/15	[internal] Safety_Zones_Oil_Gas_CDA	
OG	Pipelines	UKHO	15/03/21	https://data-ogauthority.opendata.arcgis.com/datasets/pipelines-etrs89	"STATUS" = 'ACTIVE' OR "STATUS" = 'PRECOMMISSION' OR "STATUS" = 'PROPOSED' OR "STATUS" = 'NOT IN USE' Buffer 500m
OG	Subsurface Infrastructure	OGA	15/03/21	https://data-ogauthority.opendata.arcgis.com/datasets/surface-infrastructure-etrs89	"STATUS" = 'ACTIVE' OR "STATUS" = 'PRECOMMISSION' OR "STATUS" = 'PROPOSED' OR "STATUS" = 'NOT IN USE' Buffer 500m

OG	Surface Infrastructure	OGA	15/03/21	https://data-ogauthority.opendata.arcgis.com/datasets/subsurface-infrastructure-etrs89	Buffer 500m No abandoned infrastructure in English EEZ
OG	Oil and gas wells	OGA	15/03/21	https://data-ogauthority.opendata.arcgis.com/datasets/offshore-wells-etrs89	"ORIGINSTAT" = 'Present' AND "WELLOPSTAT" <> 'Suspended' Or "COMPLESTAT" = 'Plugged' Buffer 500m
PS	High Density Navigation Routes	MCA	2015	[internal] AIS	Top 10% of ship density definition query
PS	Traffic Separation	UKHO	05/01/15	[internal] Transportation and Routes (Polygon) (UKHO)	
REN	Offshore Installations (OWF cable areas)	UKHO	20/12/18	[internal] SO_OffshoreInstallations_polygon	
REN	Offshore Tidal Stream Site Agreements	TCE	12/05/20	https://opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-tidal-stream-site-agreements-england-wales-ni-the-crown-estate?geometry=-45.498%2C48.068%2C38.130%2C57.342	
REN	Offshore Wave Cable Agreements	TCE	12/05/20	https://opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-wave-cable-agreements-england-wales-ni-the-crown-estate?geometry=-5.992%2C50.197%2C-5.066%2C50.351	

REN	Offshore Wave Site Agreements	TCE	12/05/20	https://opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-wave-site-agreements-england-wales-ni-the-crown-estate?geometry=-12.861%2C49.164%2C1.960%2C51.615	
REN	Offshore Wind Site Agreements	TCE	13/01/21	https://opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-wind-site-agreements-england-wales-ni-the-crown-estate	
n/a	Nuclear Powerstations	BE	19/04/06	[internal] Nuclear_Power_Stations_GB	Buffer 500m

* sources include either names of internal datasets or URLs for data sourced externally