Marine Management Organisation

Identification of areas of aquaculture potential in English waters [MMO1184]

Aim

The objective of this project and associated collaborative work with the Crown Estate is to delineate strategic areas of potential for aquaculture development in English waters. This project supported that objective by 1) identifying the spatial extent viable for growth of current and emerging species of importance to aquaculture in English waters and, 2) identifying the current technical constraints of aquaculture techniques used for culture of species of interest to further refine suitable areas.

Introduction and methodology

Aquaculture has the potential to be one of the fastest growing English maritime sectors. The Marine Management Organisation (MMO) has developed models that identify strategic areas of potential aquaculture development through an understanding of the environmental constraints in which aquaculture species may be grown, the technical constraints that reflect the limits of technology and technique use in aquaculture, and planning constraints from the wide range of activities occurring in the marine environment. Initial methods were developed for application to the East and South marine plan areas [as project MMO1040]. With the progression of marine planning to all English waters, the MMO expanded model coverage to all UK seas and incorporated new data and modelling approaches.

Fourteen species were considered encompassing fish, crustaceans, shellfish and seaweeds. Viable areas for growing species were determined using a Geographic Information System (GIS) based approach. Environmental variables (sea surface temperature, salinity, light climate, total oxidized nitrogen, dissolved oxygen and chlorophyll concentration) were classified into optimal, suboptimal and unsuitable ranges for each of the species investigated based on published literature. Comparison of these threshold levels with spatial data provided a suitability map showing the sites where the species can survive or thrive. In addition, technical constraints on the different culture techniques were extracted from the published literature including current speed, peak wave height, bottom substrate and bathymetry.

Results

Literature reviews identifying optimal, suboptimal and unsuitable conditions for growth of the focal species and the associated suitability layers (figure 1) were the primary outputs of this project.

The kelps *S. latissima* and *L. digitata*, sea trout, lobster, oysters (*Crassostrea gigas* and *Ostrea edulis*) and blue mussel appeared the most suitable species for aquaculture, based on their environmental ranges for optimal and

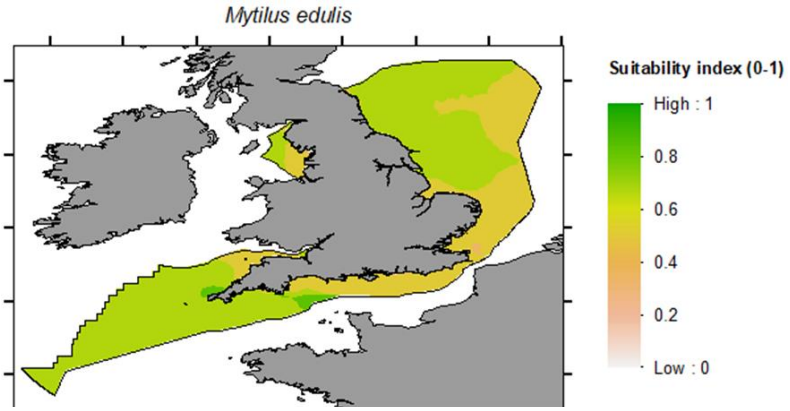

Figure 1: Suitability model output for blue mussel growth in the English waters drawing on minimum and maximum sea surface temperature and salinity, and chlorophyll and dissolved oxygen concentrations.

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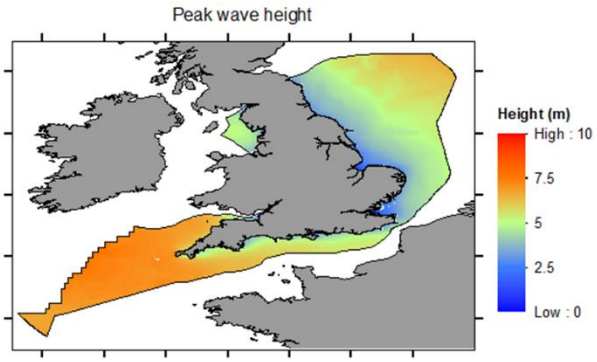

Figure 2: Peak wave height data to inform on technical feasibility of culture techniques e.g., floating cages.

sub-optimal growth. In contrast, farming of *Alaria esculenta* (seaweed) and Atlantic cod appeared to be limited by one or more of the suites of environmental factors e.g., maximum sea surface temperatures occurring in summer exceeding limits sub-optimal for culturing.

The project also collated data layers on current speed, peak wave height (Figure 2), bottom substrate and bathymetry.

Current speed was frequently being identified as a significant technical (and biological) constraint on culture.

Conclusions and recommendations

This report is complemented with a set of spatial data layers representing the aquaculture suitability maps and the technical constraints imposed by the aquacultures systems used. It is envisaged that these outputs will be combined with other information such as other uses of the marine area to identify the most suitable locations for aquaculture (i.e. optimizing the farm yield, while reducing potential conflicts with other uses or activities of the coast).

The report recommends the use of strategic site information and the consideration of proximity to potential sources of contamination (e.g., discharges from industry or treatment plants). Such water quality data was not available at the scale of this project but would be more relevant in refining ultimate aquaculture site selection.

The review encountered challenges in 1) identifying environmental conditions viable for culturing some species, particularly seaweeds, 2) spatial gaps in empirical data for some environmental layers e.g., dissolved oxygen and in consideration of relevant technical constraints to culture methods.

MMO comments

The MMO expects to draw together the suitability maps that show where aquaculture species could viably grow, with the technical constrains information to identify which culture techniques can be feasible where, with further data from the marine planning process that accounts for other activities and services in the marine environment e.g., international maritime vessel routeing, surface and sub-sea infrastructure etc. Collectively environmental viability, technical constraints and planning constraints will identify areas of strategic aquaculture potential in England.

Further information

Please direct any correspondence to the Evidence Team (evidence@marinemanagement.org.uk)