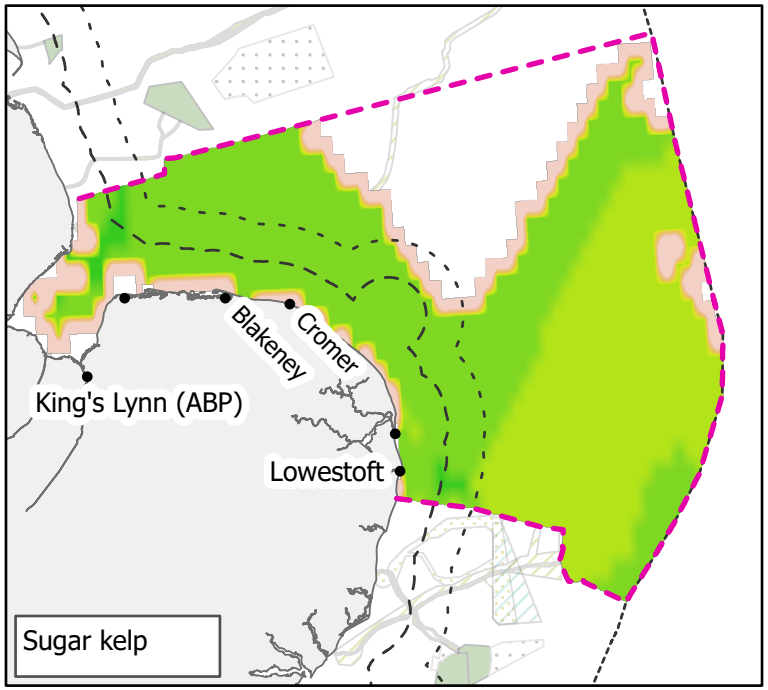

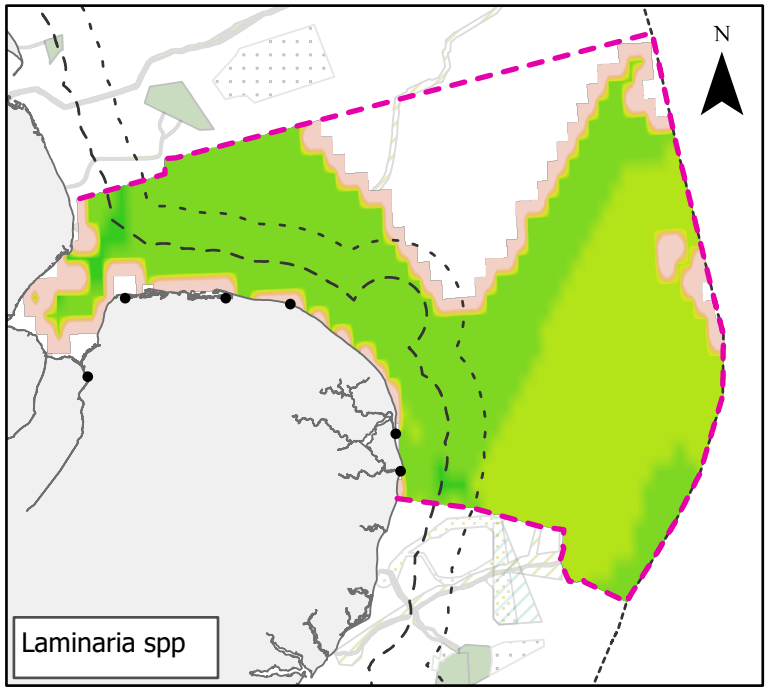

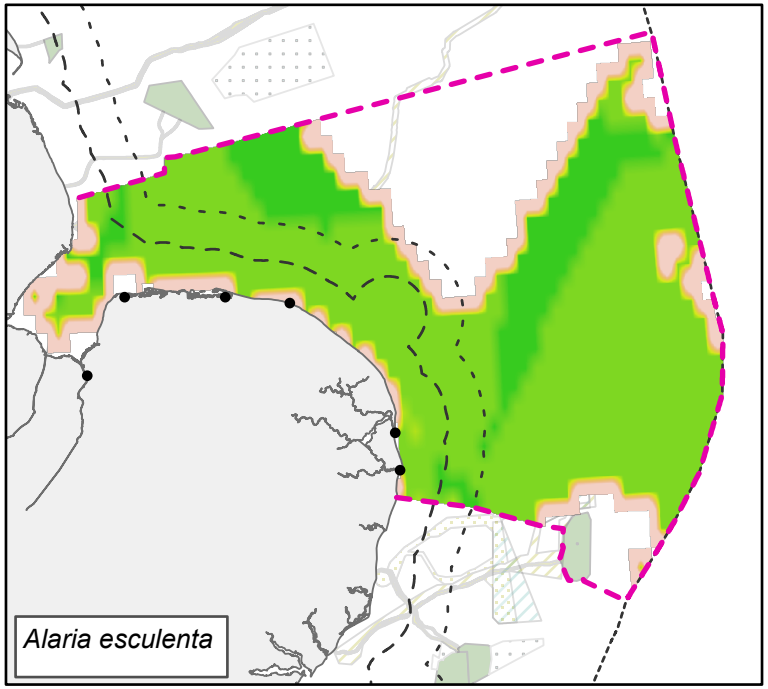

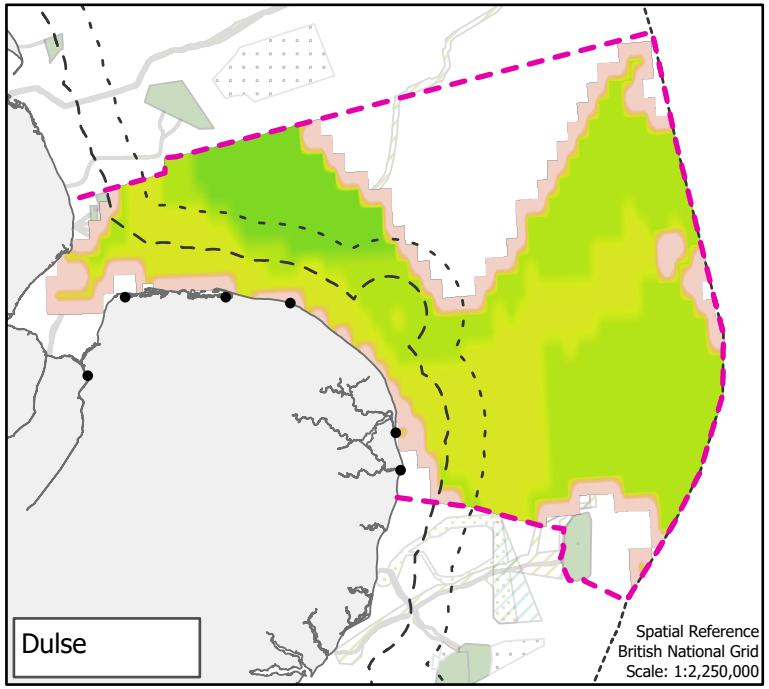

Seaweed in East Anglia

Maps showing the environmental suitability of seaweed aquaculture cultivation in the Seaweed in East Anglia study area.

Suitability was assessed on environmental variables assuming June harvesting and October seeding for the period of 2019 to 2022.

Suitability for Aquaculture

- Optimal
- Suboptimal

Offshore Wind Farms

- Operational
- Consented/In planning

OWF Cables

- Active/In operation
- Consented
- In Planning
- SEA Area of Interest Boundary
- EEZ
- 12 nm
- 6 nm
- Ports

Cefas

0 25 50 100 km

30/01/2024

Supplementary Information for the Seaweed in East Anglia Project Maps

This document outlines additional metadata concerning the spatial data presented in the Seaweed in East Anglia (SEA) project maps.

All maps were generated in ArcGIS Pro 2.9.0 using the coordinate reference system WGS84 (EPSG 4326). Sourced data layers were clipped to the SEA area of interest unless otherwise specified.

1. Spatial Data Layers Used

Details of the spatial data used in Seaweed in East Anglia project maps is provided in Table 1.

Category	Data Layer	Source	Accessed
Current seaweed aquaculture	Norfolk Seaweed Limited	Site footprint taken from KML file in marine licence application MLA/2020/00475 (https://www.gov.uk/check-marine-licence-register)	26/01/2024
Offshore Wind Farms	Operational OWF Future OWF	WindSiteAgreements_EnglandWalesAndNI_TheCrownEstate shapefile downloaded from The Crown Estate open data portal (https://opendata-thecrownestate.opendata.arcgis.com/datasets/).	12/05/2023
	OWF Cables OWF Cables (Future)	WindCableAgreements_EnglandWalesAndNI_TheCrownEstate shapefile downloaded from The Crown Estate open data portal (https://opendata-thecrownestate.opendata.arcgis.com/datasets/).	
Marine Protected Areas	Offshore MPAs Ramsar sites	c20230705_OffshoreMPAs_WGS84 and Ramsar_EnglandPolygon shapefiles downloaded from the JNCC resource hub (JNCC Resource Hub)	07/01/2024
Other Marine Uses	Recreational fishing	Data was taken from the ENGLAND_SHORE_POLYS_ID shapefile from the Catchwise project (Cefas Data Portal - View)	09/05/2023
	Transportation	Ships Routeing Measures (IMO_Routeing_Measures_Areas.shp) downloaded from UK Hydrographic Office Marine Data Portal (Marine data sets - Access and download data from UKHO (admiralty.co.uk))	08/01/2024
	Historic wreck sites	Wrecks_and_Obstructions_Shapefile downloaded from UK Hydrographic Office Marine Data Portal (Marine data sets - Access and download data from UKHO (admiralty.co.uk))	
	Military Range	Data from the UKHO Licensing_Fast_track_Military_practice_areas available via ArcGIS Map Service (https://tiles.arcgis.com/tiles/JJzESW51TqeY9uat/arcgis/rest/services/Licensing_Fast_track_Military_practice_areas/MapServer)	25/01/2024
Seaweed Aquaculture Suitability		See Section 2 below.	
Background	SEA Area of Interest	Polygon derived from the “United Kingdom” and “UKHO EEZ” features.	NA
	Territorial limits UKHO EEZ UKHO 12nm limit UKHO 6nm limit	UK Hydrographic Office Maritime Limits and Boundaries shapefile downloaded from UK Hydrographic Office Marine Data Portal (Marine data sets - Access and download data from UKHO (admiralty.co.uk)). UK EEZ, 12nm, and 6nm features were extracted from the shapefile.	10/04/2023
	Ports	Port locations from the Department for Transport UK Ports shapefile delivered via ArcGIS Map Service https://services.arcgis.com/JJzESW51TqeY9uat/arcgis/rest/services/UK_Ports/FeatureServer	25/01/2024
	United Kingdom	The outline of the UK was derived from the OS Merdian 2 Coastline which represents the mean high-water limit.	13/04/2022

Table 1. Source of spatial data layers used in the Seaweed in East Anglia project maps.

2. Generation of the seaweed aquaculture suitability data layers.

The seaweed aquaculture suitability layers represent areas that have the best range of environmental conditions for seaweed growth under open ocean farming conditions. Please note that these data layers represent a guide to areas that have potential for seaweed farming. Assessment of local site environmental variables is recommended. For more details and environmental thresholds used, please see Capuzzo and MacMillan (2024).

Suitability was assessed by classification of the environmental variables (see Table 2) as either unsuitable (growth unlikely), suboptimal (limited growth) or optimal (ideal growth conditions) and overlaying the classified layers to generate a suitability score of 0 (one or more environmental variables were unsuitable), or a value between 1 (all environmental variables were suboptimal for growth) and 2 (all environmental variables were optimal for growth). All processing was performed in R (version 4.1.2) using the native resolution of the source data layers. Final data layers were resampled to a c-square grid with a resolution of 0.05° using ArcGIS Pro to ensure alignment and consistency of gridded data. For mapping, the suitability gridded data was sampled to a higher resolution (100m x 100m) using a bilinear function in ArcGIS Pro 2.9.0.

Environmental Variable	Data Source	Resolution	Accessed
Maximum water temperature Minimum water temperature	The sea surface temperature data was obtained from the Global Ocean OSTIA Sea Surface Temperature and Sea Ice Analysis dataset (SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001) downloaded from https://marine.copernicus.eu/access-data/myocean-viewer). The annual 95th percentile was used as the maximum water temperature and the 5th percentile as the minimum water temperature. [Unit °C].	0.05° x 0.05°	21/09/2023
Minimum water salinity	Salinity data was taken from the Atlantic - European North West Shelf - Ocean Physics Analysis and Forecast dataset (NORTHWESTSHELF_ANALYSIS_FORECAST_PHY_004_013) downloaded from https://marine.copernicus.eu/access-data/myocean-viewer. [Unit psu].	0.03° x 0.01°	29/11/2023
Light penetration	The diffuse attenuation coefficient for blue/green light (Kd_{490nm}) was obtained from NASA Global Ocean Color. Data was converted to Kd_{PAR} using the equations in Saulquin et al 2013. The mean light penetration depth to 10% of PAR radiation was used. [Unit = m].	0.04° x 0.04°	30/11/2023
Winter nutrient concentration	Nutrient data from the Atlantic- European North West Shelf- Ocean Biogeochemistry Reanalysis (NWSHELF_MULTIYEAR_BGC_004_011) was used (https://marine.copernicus.eu/access-data/myocean-viewer) to extract total oxidised nitrogen concentrations between 01/11/2019 to 31/12/2022. [Unit mmol per m^3].	0.11° x 0.07°	29/11/2023
Peak wave height	Significant wave height was taken from the Atlantic - European North West Shelf - Ocean Physics Analysis and Forecast dataset (NORTHWESTSHELF_ANALYSIS_FORECAST_PHY_004_013) downloaded from https://marine.copernicus.eu/access-data/myocean-viewer. The peak wave height was taken as 1.8 times the significant wave height. The annual 97.5th percentile was taken as the maximum peak wave height. [Unit m].	0.03° x 0.01°	29/11/2023
Current speed	The easterly and northerly current velocities was taken from the Atlantic - European North West Shelf - Ocean Physics Analysis and Forecast dataset (NORTHWESTSHELF_ANALYSIS_FORECAST_PHY_004_013) downloaded from https://marine.copernicus.eu/access-data/myocean-viewer. The water current was resolved from the x and y velocities and the annual mean current speed was used. [Unit m per s].	0.03° x 0.01°	29/11/2023
Substrate Site Exposure	The bottom substrate [Substrate] and site exposure [Energy] were extracted from the UKSeaMap2018 geodatabase (https://hub.jncc.gov.uk/assets/202874e5-0446-4ba7-8323-24462077561e) and gridded onto 0.05° c-squares using ArcGIS Pro. [Unit category].	0.05° x 0.05°	09/12/2022
SPIM	The monthly average non-algal Suspended Inorganic Particulate Matter (SPIM) concentration on the UK shelf waters (https://doi.org/10.14466/CefasDataHub.31) was used to calculate the maximum annual SPIM concentration. [Unit g per m^3].	0.015° x 0.01°	29/11/2023

Table 2. Source of environmental data used to assess seaweed aquaculture suitable for the SEA project.

Capuzzo, E. and MacMillan, I. (2024). Review of species and farming methods. Seaweed in East Anglia (SEA) project, Cefas project code C8594, funded by Norfolk investment Framework.

Saulquin B., Hamdi A., Gohin F., Populus J., Mangin A. and d'Andon O.F. (2013) "Estimation of the diffuse attenuation coefficient KdPAR using MERIS and application to seabed habitat mapping", *Remote Sensing of Environment*,**128**, 224-233 (https://doi.org/10.1016/j.rse.2012.10.002).