Westport Aquaculture Siting Prioritization

Study Region

Aquaculture siting occurred within 20 miles of Westport, Massachusetts. To identify potential locations, the study region was constrained to areas within federal waters that had depths between 20 and 40 meters. A hexagonal grid with 10-acre cells covered all areas that met these three criteria.

Data components

All data were transformed to the coordinate reference system of NAD83 / UTM 18N ([EPSG:26918](https://epsg.io/26918)) to ensure they can get analyzed together. Datasets often covered areas larger than the study area. For these datasets, only data within the study region were kept. A value of 0 was allocated to any dataset that was classified as a constraint. Suitability datasets received either a discrete scores for all areas located within the study region, while other datasets with continuous values were rescaled to have scores between 0 and 1.

Constraints

*Bathymetry*

Aquaculture siting had to get limited to water depths between 20 and 40 meters. NOAA maintains a data portal to identify and download all potential bathymetry datasets for the United States. This analysis relied on the Continuously Updated Digital Elevation Model (CUDEM) for constructing the bathymetry datasets to limit the study region. These bathymetry datasets have multiple resolutions, and two different resolutions were required for covering the entire region as no one resolution could cover all the area. Three bathymetric-topographic tiles from the [1/9-arc second](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/) (~3 m) and [1/3-arc second](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_third_Topobathy_2014_8580/) (~10m) tiles covered the study region. The tiles for the ninth-arc second were from 2018 and cover the blocks [41x50 north and 71x00 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/rima/ncei19_n41x50_w071x00_2018v1.tif), [41x50 north and 71x25 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/rima/ncei19_n41x50_w071x25_2018v1.tif), and [41x50 north and 71x50 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/rima/ncei19_n41x50_w071x50_2018v1.tif). Tiles for the third-arc second data were from 2021 and cover the blocks to the south: [41x25 north and 71x00 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_third_Topobathy_2014_8580/MA_NH_ME/ncei13_n41x25_w071x00_2021v1.tif), [41x25 north and 71x25 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_third_Topobathy_2014_8580/MA_NH_ME/ncei13_n41x25_w071x25_2021v1.tif), and [41x25 north and 71x50 west](https://chs.coast.noaa.gov/htdata/raster2/elevation/NCEI_third_Topobathy_2014_8580/MA_NH_ME/ncei13_n41x25_w071x50_2021v1.tif). Tiles for the third-arc second data got disaggregated to match the resolution of the ninth-arc second data. After mosaicking the six tiles together, any bathymetric value below 40 meters or above 20 meters was given an NA value.

*Federal waters*

Areas defined as federal waters came from the [Coastal Zone Management Act dataset](https://marinecadastre.gov/downloads/data/mc/CoastalZoneManagementAct.zip) hosted on Marine Cadastre. In the dataset, federal waters get labeled as “federal consistency.”

*Westport distance*

Massachusetts GIS provides [administrative boundary data](https://s3.us-east-1.amazonaws.com/download.massgis.digital.mass.gov/gdbs/townssurvey_gdb.zip) for the state’s towns. The boundary for Westport got a 20-mile buffer to determine which federal waters would overlap within this constraint.

*Unexploded ordnance (locations and areas)*

Two types of [unexploded ordnance locations](https://marinecadastre.gov/downloads/data/mc/UnexplodedOrdnance.zip) got classified as constraints. Those types, JATO racks and unexploded depth bombs, had 500-meter setbacks applied to them to ensure safety of the aquaculture sites.

*Danger zones and restricted areas*

Any areas designated as [danger zones or restricted zones](https://marinecadastre.gov/downloads/data/mc/DangerZoneRestrictedArea.zip) were not viable options for aquaculture and became constraints. Both danger zones and restricted areas get [defined](https://www.ecfr.gov/current/title-33/chapter-II/part-334/section-334.2) within the Code of Federal Regulations. According to the regulations, a danger zone can get closed to the public fully or when needed. These areas get used for a variety of uses, including, but not limited to: target practice, bombing, and rocket firing or other especially hazardous operations. Restricted areas, as defined within the CFR, get closed for the security of government operations or protect the public from the government’s use of that area.

*Environmental sensors and buoys*

The Northeast Ocean Data portal [hosted](https://www.northeastoceandata.org/files/metadata/Themes/PhysicalOceanography.zip) geographic locations for environmental sensors that encompass the network in the Northeast Regional Association of Coastal Ocean Observing Systems ([NERACOOS](https://neracoos.org/index.html)). To minimize the effect of aquaculture on the sensors, no aquaculture can get sited within 500 meters of a sensor.

*Wastewater locations*

[Wasterwater data](https://marinecadastre.gov/downloads/data/mc/WastewaterOutfall.zip) are comprised by three datasets: (1) facility locations, (2) outfall pipes, and (3) outfall discharge points. These data summarize geographic data for public treatment works that can affect the United States coastlines and waters. All the locations got a 500-meter setback. Even with the setback distance applied, the publicly available wastewater discharge data as of January 2024, were not located within the study region.

*Ocean disposal sites*

The publicly available data for current and past [ocean disposal sites](https://marinecadastre.gov/downloads/data/mc/OceanDisposalSite.zip) do not contain any locations that exist within the study region.

*Aids to navigation*

Navigational aids help vessels and crew avoid dangerous obstructions and chart a safe course. Types of aids include lights, signals, buoys, and beacons. A 500-meter setback got applied to the [aids to navigation](https://marinecadastre.gov/downloads/data/mc/AtoN.zip) so that vessels do not pass through the aquaculture site nor a aquaculture site gets placed where a key navigational aid is currently located making passage for a vessel less safe.

*Wrecks and obstructions*

The wrecks and obstructions datasets came together from two sources: NOAA’s [Automated Wreck and Obstruction Information System](https://www.nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html) (AWOIS) and NOAA’s [Electronic Navigational Charts](https://www.nauticalcharts.noaa.gov/charts/noaa-enc.html) (ENC). The AWOIS database stopped getting updated in 2016. While the ENC gets updated weekly, wrecks may have been last updated at a similar time as those data in the AWOIS database. Aquaculture sites were constrained to areas beyond a 152.4-meter setback of any [wreck and obstruction](https://marinecadastre.gov/downloads/data/mc/WreckObstruction.zip) site.

*Shipping fairways*

To eliminate disruption to shipping and by shipping on the aquaculture sites, all [shipping fairways](http://encdirect.noaa.gov/theme_layers/data/shipping_lanes/shippinglanes.zip) got classified as no-go areas for the siting analysis. All shipping theme classifications were considered to be equally off limits. For instance, precautionary areas, particularly sensitive sea areas, and traffic lanes were all classified as prohibited areas even though they have different regulations for what can and cannot occur in those waters by shipping activity. These shipping lanes are only for federal waters (3 nautical miles – 200 nautical miles for the study region).

National Security

*Military operating areas*

Marine Cadastre worked with the United States Navy to create the [military operating areas](https://marinecadastre.gov/downloads/data/mc/MilitaryCollection.zip) where training exercises and tests get run. Another dataset exists on Marine Cadastre, but [those data](https://marinecadastre-noaa.hub.arcgis.com/datasets/noaa::military-operating-area-boundary/about) were deprecated on 9 February 2024.

*Special use airspace*

No areas designated as [special use airspace](https://marinecadastre.gov/downloads/data/mc/MilitarySpecialUseAirspace.zip) overlap with the study region.

Industry

*Automatic identification system (AIS)*

[Automatic identification system](https://services.northeastoceandata.org/downloads/AIS/AIS2022_Annual.zip) data for all of 2022 were analyzed for the study region. Count data were summarized at the annual level for cargo, fishing, other, passenger, pleasure craft and sailing, tanker, and tug-tow vessels. These count data were rescaled using an adapted [z-shaped membership function](https://www.mathworks.com/help/fuzzy/zmf.html).

Fisheries

*Vessel monitoring system (all)*

*Vessel monitoring system (< 4-5 knots)*

*Vessel trip reporting (charter / party)*

*Cod spawning protection areas*

*Known cod spawning areas*

Rasters

Convert from raster to polygons

Overlapping values

Z-shaped membership function

A new maximum is calculated by adding 1/1000th of the current maximum value to the maximum value so that no z-value gets a 0. This avoids the continuous data getting misclassified as constraints.

Geometric mean