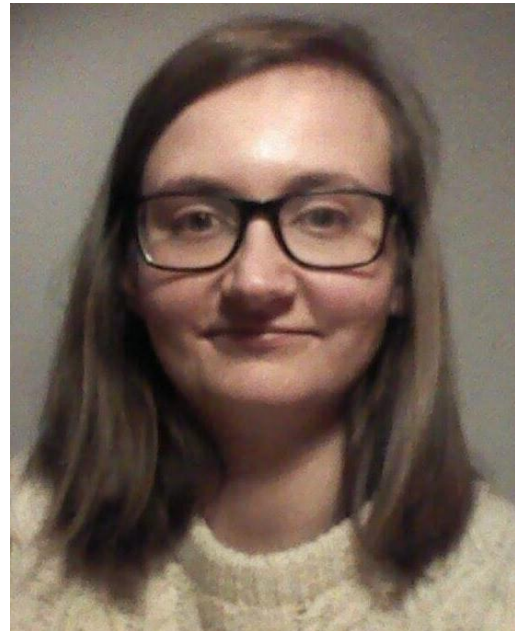


Offshore Windfarm Impact on Pelagic Primary Production in the Southern North Sea

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Expansion of Offshore Windfarms in the Southern North Sea

- EU offshore wind electricity over the next 15 years to increase over 40 fold, with the construction of offshore windfarms focused in the North Sea
- Offshore wind turbines provide shallow hard substrate suitable for biofouling, dominated by the filter feeder *Mytilus edulis*
- *Mytilus edulis* abundance and distribution may influence plankton biomass by altering the particle and nutrient fluxes between the water column and sediment

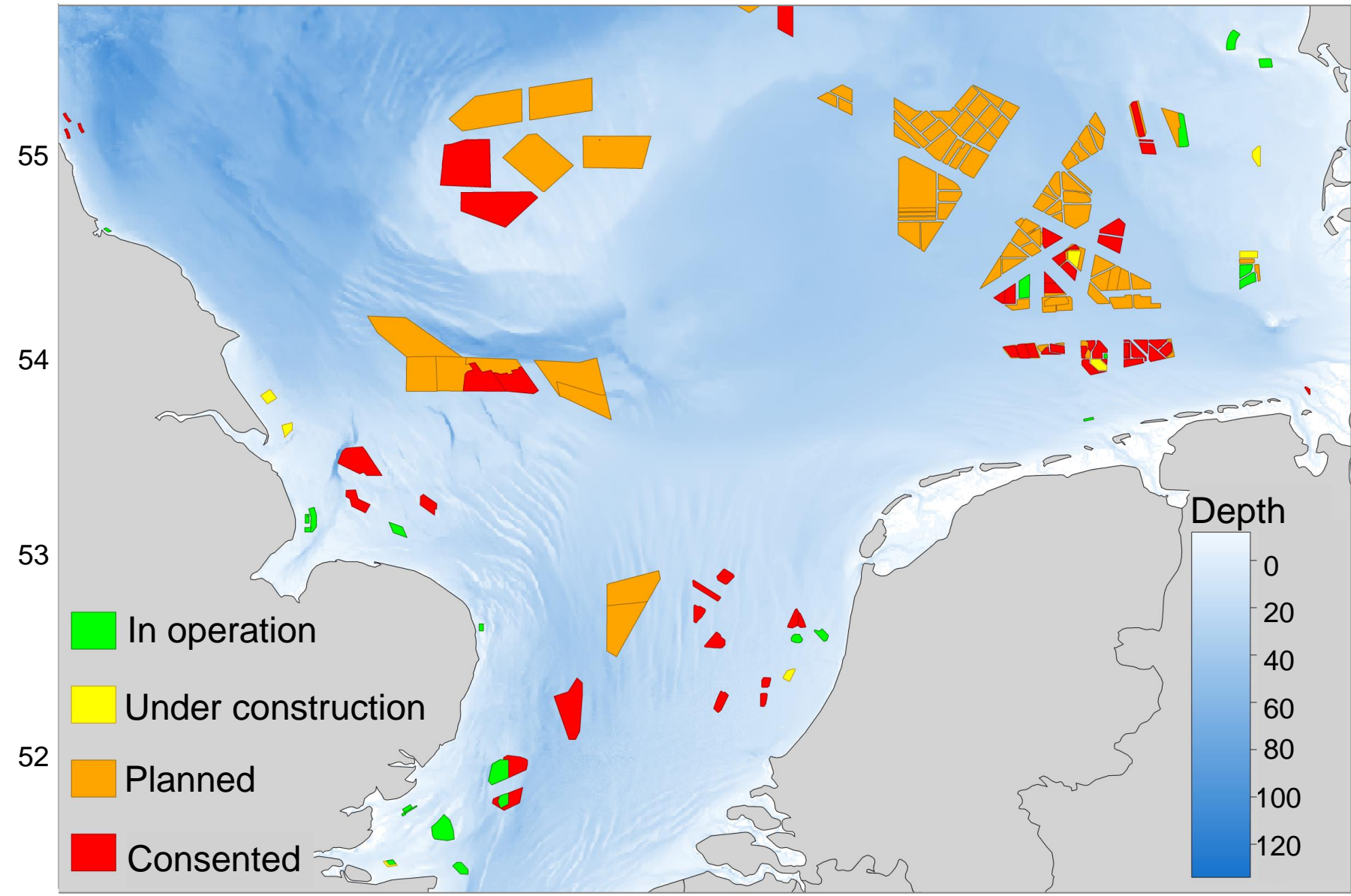


Figure 1: Location, distribution and status of windfarms in the southern North Sea as of June 2015. The average depth of offshore windfarms is 34.66m.

What is the potential impact of future offshore windfarm construction on pelagic primary production in the southern North Sea?

The Ecosystem Impact

Mytilus edulis

- Overall increase in *Mytilus edulis* abundance of 4.5% or $1.4 \cdot 10^{11}$ individuals
- 7.1% increase in *Mytilus edulis* abundance in depths deeper than 10m, *Mytilus edulis*' natural depth limit

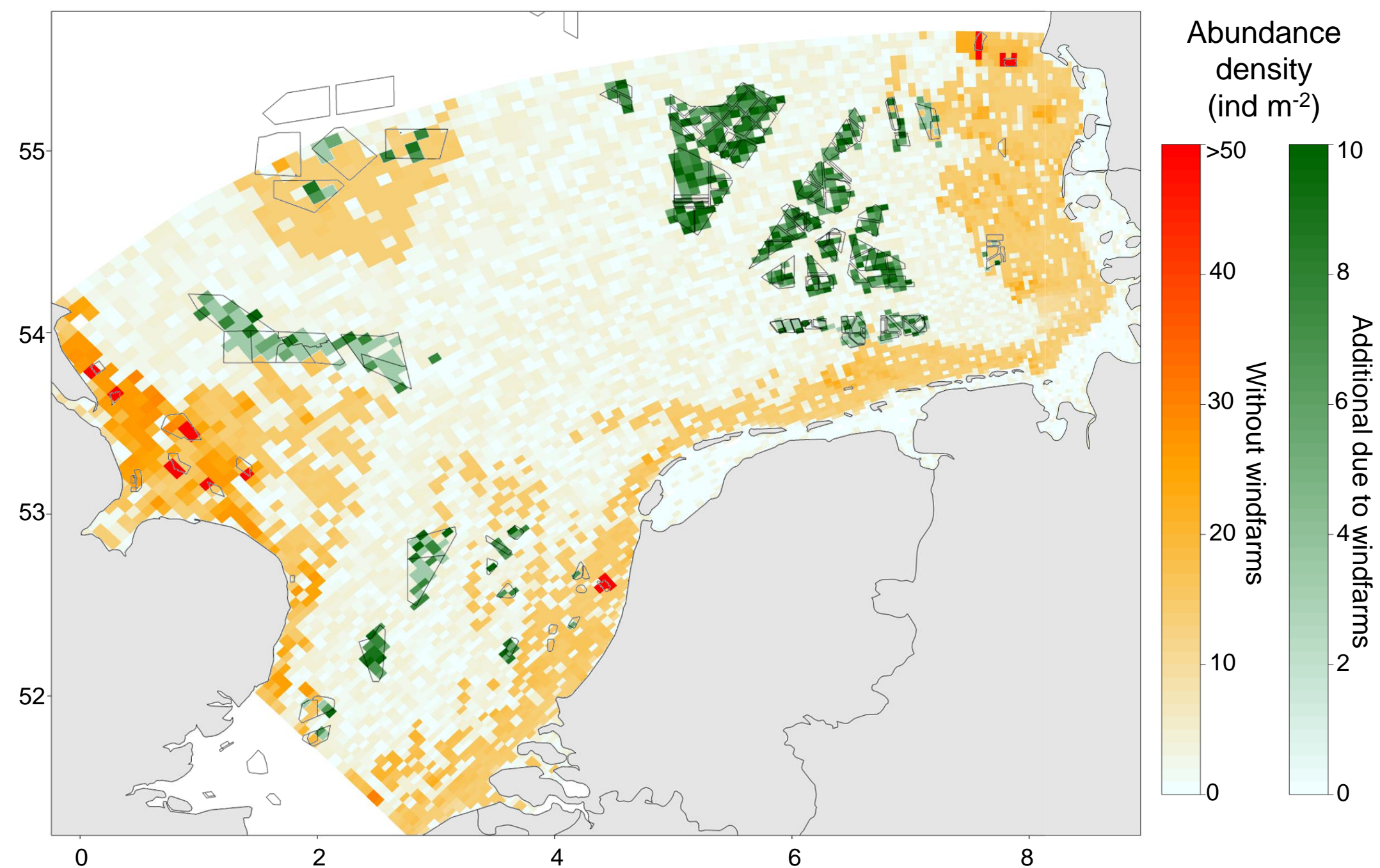


Figure 2: Abundance and distribution of *Mytilus edulis* in the southern North Sea, without windfarms and the predicted increase due to windfarms.

Phytoplankton biomass

- Reduce phytoplankton biomass by up to 25% per 7 month growing period

Method

Mytilus edulis abundance and distribution

- Within 10m, abundance density changes linearly with sediment type and depth
- Outside its depth limit, abundance density ranges between 0 and 5 ind m^{-2}
- *Mytilus edulis* are assumed to be concentrated in the upper 2.5m (Krone *et al.* 2013) at windfarms
- Assume 6 turbines km^{-2} and 2.5m turbine radius

Filtration due to *Mytilus edulis*

- Phytoplankton loss due to *Mytilus edulis* is calculated using reported filtration rates (i.e. Bayne *et al.* 1993) and model derived current velocities

Modular Coupling System for Shelves and Coasts (mossco.de)

The spatially variable effect at the scale of the southern North Sea ecosystem was estimated using the modular system MOSSCO, including:

- physical (GETM)
- biological (MAECS)
- hydrodynamical and ecosystem models

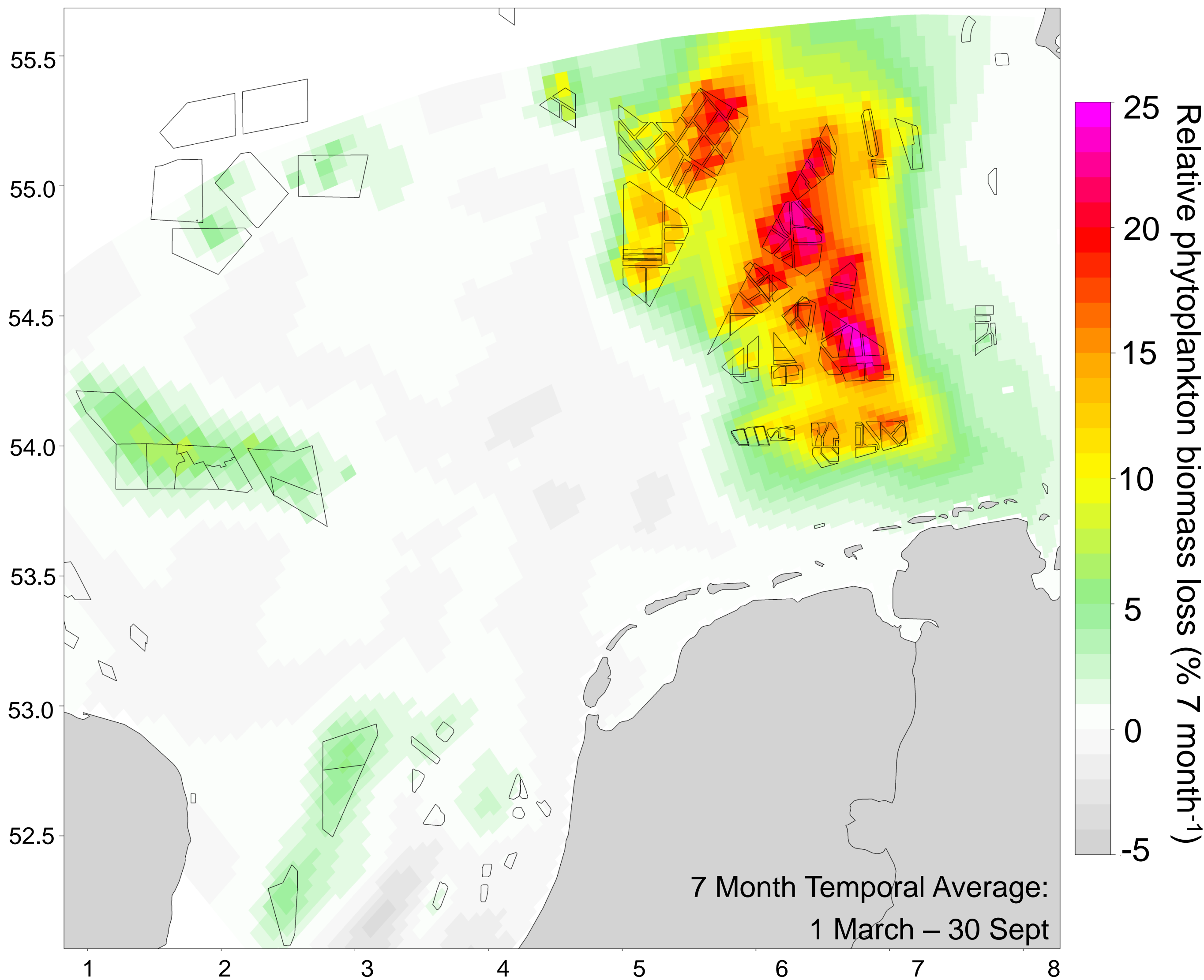


Figure 3: Relative loss of phytoplankton biomass as a result of offshore windfarm construction. There is a strong local effect as well as a less intense regional effect.

References

Bayne *et al.* 1993, J. Mar. Biol. Assoc. U. K. 73, 813-829.
Krone *et al.* 2013, Mar Environ Res 85, 1-12.

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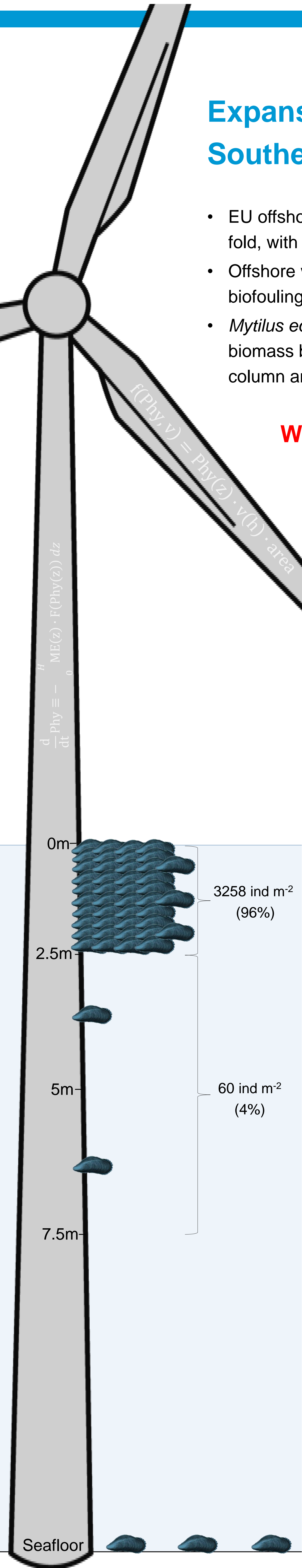


Figure 4: Vertical distribution of *Mytilus edulis* at offshore wind turbines (Krone *et al.* 2008)

