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Effects of short-term low irradiance on health status and biomechanics of *Zostera marina*

Davide Vettori (1), Anne Lise Middelboe (2), and Stephen Rice (3)

(1) Geography and Environment, Loughborough University, Loughborough, United Kingdom (d.vettori@lboro.ac.uk), (2) DHI A/S, Hørsholm, Denmark (ami@dhigroup.com), (3) School of Social Sciences, Loughborough University, Loughborough, United Kingdom (S.Rice@lboro.ac.uk)

Marine dredging activities may increase turbidity of the water and thereby potentially impact the health status of benthic vegetation. The Fehmarn Belt Fixed Link is a planned tunnel that will connect Denmark and Germany providing a direct railway and road link between the two countries. The tunnel construction will require intense dredging activities that will increase the concentration of suspended particles in the water and reduce underwater light availability. It is anticipated that this may impact the benthic macrophyte *Zostera marina*, which is a key seagrass species in the benthic communities of the Fehmarn Belt (FEMA, 2013). Here we investigated the effects of short-term low irradiance conditions on the health status and biomechanical properties of *Z. marina* via laboratory experiments. Ninety (90) plants were collected from Rødsand Lagoon, next to the Fehmarn Belt, Denmark in April 2018 and arrived at Loughborough University, UK within 36 hours of collection. They were distributed in two mesocosms consisting of 1000 l aerated tanks filled with saltwater. A control mesocosm was designed to replicate the natural environmental conditions (salinity, temperature, irradiance); the treatment mesocosm was designed to reproduce the highest reduction of irradiance due to dredging activities. 110 μmol m^{-2} s^{-1} was used to represent 70% of the natural irradiance (e.g. predicted maximum reduction in Rødsand Lagoon, FEMA, 2013). The health status, morphology and flexural rigidity of five plants from each mesocosm were investigated daily for nine days. Seagrass health status was assessed by chlorophyll fluorescence, specifically by measuring the maximum quantum yield of photosystem II (F_v/F_m) on the second youngest leaf. The flexural rigidity and bending Young's modulus of leaves was measured with cantilever tests conducted using a Peirce's testing apparatus (Henry, 2014). Results indicate that F_v/F_m was not significantly affected by the low irradiance to which plants were exposed, likely because the level of irradiance was well above the light compensation points for leaves of *Z. marina* reported in the literature (22 μmol m^{-2} s^{-1}). We did not report any significant effect of low irradiance on mass density, flexural rigidity or bending Young's modulus of seagrass leaves. Our results indicate that a short-term reduction of irradiance above the compensation point does not affect the health status of *Z. marina* nor induces variation in the biomechanical properties of its blades. Considering that longer periods of exposure to reduced light or periods that occur at different points of the growing cycle can have different effects, these findings can provide guidance for the planning of dredging activities so that environmental impact on seagrass is minimized.

FEMA (2013). Fehmarnbelt Fixed Link EIA. Marine Fauna and Flora – Impact Assessment Benthic Flora of the Fehmarnbelt Area. Report No. E2TR0021 - Volume I. Available from: https://vvmdocumentation.femern.com/

Henry, P. Y. T. (2014). Bending properties of a macroalga: Adaptation of Peirce's cantilever test for in situ measurements of Laminaria digitata (Laminariaceae). American journal of botany, 101(6), 1050-1055.