Ecological niche predicts photoprotection capacity of microphytobenthic diatoms inhabiting intertidal mudflats

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Despite being exposed to a highly fluctuating light climate, intertidal sediments belong to the most productive ecosystems on Earth. The main primary producers in this habitat are diatoms. They belong to two main functional groups: large motile diatoms (epipelon), which move freely in between sediment particles, and smaller diatoms which live in close association with individual sand grains (epipsammon). Within the epipsammon different growth forms can be distinguished. Non-motile forms live appressed to or stalked on sand grains. Other epipsammic species however are motile but only move within the sphere of individual sand grains. One of the main physiological mechanisms of photoprotection in diatoms is Non Photochemical Quenching (NPQ) which is associated with the xanthophyll cycle. In stressful light conditions the xanthophyll pigment diadinoxanthin is converted into diatoxanthin which safely dissipates excess energy as heat. It has been hypothesized that epipelic diatoms can migrate within a vertical light gradient to the most optimal light climate whereas epipsammic forms must be able to cope with a fluctuating light climate using mainly physiological mechanisms. NPQ would therefore be more performant in epipsammon than epipelon. We tested the ability of a selection of representatives of each growth form to perform NPQ during 5min high light exposure (full sunlight, 2000µmol photons m^{-2} s^{-1}) and measured NPQ. We observed that epipelic diatoms have a lower NPQ potential than epipsammic ones. Interestingly, small motile epipsammic growth forms, despite being phylogenetically more closely related to epipelic taxa than to other epipsammic forms, have an intermediate NPQ photoprotection capacity. This observation underscores the importance of growth form and not phylogenetic relatedness as the prime determinant shaping the physiological photoprotective capacity of benthic diatoms.