Draft – Effect of Atmospheric Heatwaves on Reflectance and Pigment Composition of Intertidal *Nanozostera noltei* – Draft

Simon Oiry[a,*], Bede Ffinian Rowe Davies[a], Philippe Rosa[a], Pierre Gernez[a], Laurent Barillé[a]

[a] *Institut des Substances et Organismes de la Mer, ISOMer, Nantes Université, UR 2160, F-44000 Nantes, France,*

Abstract

To be written

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1. Introduction

Intertidal seagrasses play a crucial role in the ecosystem by providing habitats and feeding grounds for various marine species, supporting rich marine biodiversity, and contributing significantly to primary production and carbon sequestration [1, 2]. These seagrasses are essential in maintaining the health of coastal ecosystems by stabilizing sediments, filtering water, and serving as indicators of environmental changes due to their sensitivity to water quality variations [3]. The interactions between seagrass meadows and their associated herbivores further enhance the delivery of ecosystem services, including coastal protection and fisheries support [4, 5, 6]. Understanding and preserving these ecosystems are vital for maintaining the biodiversity and productivity of coastal regions [7, 8].

Despite their crucial role in marine ecosystems, intertidal seagrasses face numerous threats that compromise their health and functionality. Coastal development and human activities are primary threats. These activities not only reduce the available habitat for seagrasses but also increase water turbidity, which limits light penetration and hampers photosynthesis [9]. Seagrasses are also threatened by nutrient enrichment from agricultural and urban runoff, which can lead to eutrophication. This condition promotes the overgrowth of algal blooms that

*Corresponding author
Email address: oirysimon@gmail.com (Simon Oiry)

compete with seagrasses for light and nutrients, further stressing these important plants [10] (Oiry et al. 2024). Pollution from industrial and municipal sources introduces harmful chemicals and heavy metals into coastal waters, posing toxic risks to seagrass health. These pollutants can affect the physiological processes of seagrasses, reducing their growth and survival rates [11] Additionally, invasive species can outcompete native seagrasses for resources, altering community structure and function [12].

Heatwaves, exacerbated by climate change, represent a significant and growing threat to seagrasses. These extreme temperature events can cause severe physiological stress, affecting growth, reproduction, and survival. Heatwaves can intensify the cumulative effects of other stressors such as overgrazing and seed burial, leading to compromised sexual recruitment [13].

Bibliography

[1] R. K. Unsworth, L. C. Cullen-Unsworth, B. L. Jones, R. J. Lilley, The planetary role of seagrass conservation, Science 377 (6606) (2022) 609–613.

[2] A. I. Sousa, J. F. da Silva, A. Azevedo, A. I. Lillebø, Blue carbon stock in zostera noltei meadows at ria de aveiro coastal lagoon (portugal) over a decade, Scientific reports 9 (1) (2019) 14387.

[3] M. L. Zoffoli, P. Gernez, L. Godet, S. Peters, S. Oiry, L. Barillé, Decadal increase in the ecological status of a north-atlantic intertidal seagrass meadow observed with multi-mission satellite time-series, Ecological Indicators 130 (2021) 108033.

[4] E. Jankowska, L. N. Michel, G. Lepoint, M. Włodarska-Kowalczuk, Stabilizing effects of seagrass meadows on coastal water benthic food webs, Journal of Experimental Marine Biology and Ecology 510 (2019) 54–63.

[5] M. L. Zoffoli, P. Gernez, S. Oiry, L. Godet, S. Dalloyau, B. F. R. Davies, L. Barillé, Remote sensing in seagrass ecology: coupled dynamics between migratory herbivorous birds and intertidal meadows observed by satellite during four decades, Remote Sensing in Ecology and Conservation 9 (3) (2023) 420–433.

[6] R. C. Gardner, C. Finlayson, Global wetland outlook: state of the world's wetlands and their services to people, in: Ramsar convention secretariat, 2018, pp. 2020–5.

[7] A. L. Scott, P. H. York, C. Duncan, P. I. Macreadie, R. M. Connolly, M. T. Ellis, J. C. Jarvis, K. I. Jinks, H. Marsh, M. A. Rasheed, The role of herbivory in structuring tropical seagrass ecosystem service delivery, Frontiers in Plant Science 9 (2018) 127.

[8] C. Ramesh, R. Mohanraju, Seagrass ecosystems of andaman and nicobar islands: Status and future perspective., Environmental & Earth Sciences Research Journal 7 (4) (2020).

[9] M. Waycott, C. M. Duarte, T. J. Carruthers, R. J. Orth, W. C. Dennison, S. Olyarnik, A. Calladine, J. W. Fourqurean, K. L. Heck Jr, A. R. Hughes, et al., Accelerating loss of seagrasses across the globe threatens coastal ecosystems, Proceedings of the national academy of sciences 106 (30) (2009) 12377–12381.

[10] E. Thomsen, L. S. Herbeck, I. G. Viana, T. C. Jennerjahn, Meadow trophic status regulates the nitrogen filter function of tropical seagrasses in seasonally eutrophic coastal waters, Limnology and Oceanography 68 (8) (2023) 1906–1919.

[11] K. Sevgi, S. Leblebici, Bitkilerde ağır metal stresine verilen fizyolojik ve moleküler yanıtlar, Journal of Anatolian Environmental and Animal Sciences 7 (4) (2022) 528–536.

[12] T. S. Simpson, T. Wernberg, J. I. McDonald, Distribution and localised effects of the invasive ascidian didemnum perlucidum (monniot 1983) in an urban estuary, PLoS One 11 (5) (2016) e0154201.

[13] L. Guerrero-Meseguer, A. Marín, C. Sanz-Lázaro, Heat wave intensity can vary the cumulative effects of multiple environmental stressors on posidonia oceanica seedlings, Marine Environmental Research 159 (2020) 105001.