Seagrass fitness under ocean warming and acidification

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BACKGROUND

- **Dwarf eelgrass (*Zostera noltei*) has a wide geographical distribution, covering coastal areas of Atlantic marine environments, from Norway to Mauritania, including the Mediterranean and adjacent seas;**
- **Seagrasses play an essential ecological role as foundations species, ecosystem builders and nursery grounds within marine habitats;**
- **Worldwide decline of seagrass populations and their inability to quickly relocate makes seagrasses critically vulnerable to a changing environment**

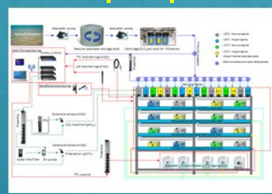
OBJECTIVES

- **Investigate the expected effects of future ocean acidification and warming on fundamental biological processes of *Zostera noltei***

METHODS

Seagrass collection, acclimation and exp. exposure

- **30 days -> 30 days**
- **Control (18°C - pH 8.0)**
- **Hypercapnia (18°C - pH 7.6)**
- **Warming (22°C - pH 8.0)**
- **Warming/hypercapnia (22°C - pH 7.6)**

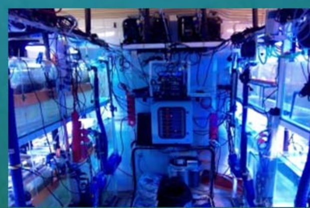


Shoot density and leaves color frequency

- **Shoot density** - *number of shoots per area (shoots.cm^{-2})*
- **leaves color**
  | 100% green | 75% green/25% brown | 50% green/50% brown | 100% brown |

Photobiology

- **Pulse amplitude modulation (PAM) fluorometry**



Gauss peak spectra pigment analysis

- **Gauss-Peak Spectra method (Küpper *et al.*, 2007)**
- **Dual beam spectrophotometer (350 nm - 750 nm)**

RESULTS

Fig. 1

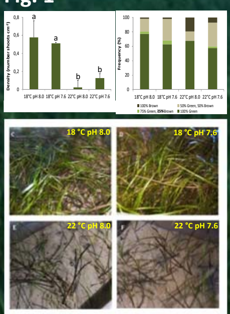


Fig. 2

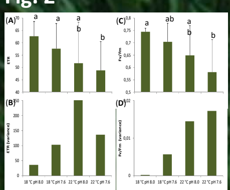


Fig. 3

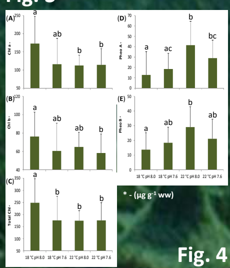


Fig. 4

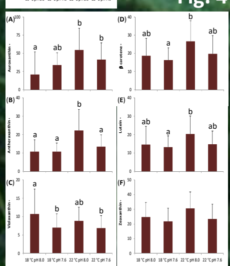
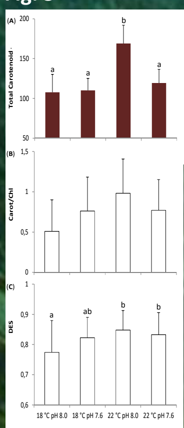


Fig. 5



- **Shoot density was severely affected under warming condition (Fig. 1)**
- **Higher frequency of brownish colored leaves (seagrass die-off) was observed under warming condition, in opposition to control scenario (Fig. 1)**
- **Electron transport rates (ETR), maximum PSII quantum yield (F_v/F_m), chlorophyll and violoxanthin content were significantly higher under control conditions, opposing to warming/hypercapnic conditions (Fig. 2-4)**
- **Warming prompted the highest ETR and F_v/F_m variability, as well as total carotenoid content (Fig. 2, 5)**
- **Total carotenoids were significantly higher under warming and normocapnic scenario and lower, including De-epoxidation state (DES), under control conditions (Fig. 4, 5)**
- **Positive correlations between photosynthetic related pigments, leave coloration, shoot frequency and ETR variability.**

CONCLUSIONS

***Zostera noltei* exhibited down-regulated acclimation potential to future projected warming conditions**

We show that high CO_2 environment was unable to significantly counteract the deleterious effects posed by increasing temperature