



Supplementary Figure S1. Schematic representation of life support systems setup used in order to perform the experimental exposure of *Zostera noltii* to control, ocean warming and hypercapnic conditions. Temperature (18 °C and 22 °C); normocapnia (pH 8.0); hypercapnia (pH 7.6).

Supplementary Table S1. Seawater physicochemical parameters (temperature and pH) in all experimental setups. Salinity and temperature were measured daily and averaged per replicate aquarium over the whole experimental period. The combination of total alkalinity (A_T) and pH_T (pH total scale) was used to calculate carbonate system parameters [pCO_2 (carbon dioxide partial pressure), C_T (total inorganic carbon) and Ω Arg (aragonite saturation state)]. Values are represented as mean \pm standard deviation.

| Temperature | 18 °C | | | | | | 22 °C | | | | | |
|---|---------|---|--------|---------|---|--------|---------|---|--------|---------|---|-------|
| pH | 8.0 | | | 7.6 | | | 8.0 | | | 7.6 | | |
| <i>measured</i> | | | | | | | | | | | | |
| Temperature (°C) | 18.0 | ± | 0.2 | 18.1 | ± | 0.2 | 21.9 | ± | 0.2 | 22.0 | ± | 0.2 |
| Salinity | 35.2 | ± | 0.9 | 34.5 | ± | 0.8 | 35.1 | ± | 1.1 | 35.4 | ± | 0.8 |
| pH _T | 8.00 | ± | 0.03 | 7.61 | ± | 0.03 | 8.01 | ± | 0.04 | 7.61 | ± | 0.02 |
| A _T (μmol kg ⁻¹ SW) | 1204.76 | ± | 105.04 | 1121.74 | ± | 104.55 | 1210.45 | ± | 105.61 | 1122.65 | ± | 99.03 |
| <i>calculated</i> | | | | | | | | | | | | |
| pCO ₂ (ppm) | 221.15 | ± | 3.74 | 580.42 | ± | 48.61 | 219.10 | ± | 4.90 | 595.01 | ± | 44.37 |
| C _T (μmol kg ⁻¹ SW) | 1051.64 | ± | 87.16 | 1071.18 | ± | 99.92 | 1036.53 | ± | 85.60 | 1062.25 | ± | 95.03 |
| Ω Arg | 1.29 | ± | 0.20 | 0.55 | ± | 0.08 | 1.50 | ± | 0.20 | 0.63 | ± | 0.07 |

Supplementary Table S2. Summary of two-way ANOVA performed in order to assess the effects of temperature (T) and pH over *Zostera noltii* endpoints (i-vi), following a 30-day experimental exposure to conditions simulating present day and future climate change scenarios. i) shoot density; ii) photophysiological parameters [electron transport rate (ETR); maximum PSII quantum yield (F_v/F_m)]; iii) pigments; iv) total chlorophyll and total carotenoid; v) carotenoid/chlorophyll ratio and vi) De-epoxidation state (DES). Significant statistical values are marked in bold (see main manuscript for more details on α).

| | df | MS | F | p |
|--|-----|-----------------------|-------------------------|----------------|
| Shoot density ($\alpha = 0.05$) | | | | |
| T | 1 | 4556.25 | 63.83 | < 0.001 |
| pH | 1 | 0.25 | 3.50x10 ³ | 0.954 |
| T x pH | 1 | 121.00 | 1.69 | 0.217 |
| Error | 12 | 71.37 | | |
| Photophysiological parameters ($\alpha = 0.013$) | | | | |
| ETR | | | | |
| T | 1 | 2084.20 | 16.83 | < 0.001 |
| pH | 1 | 412.60 | 3.33 | 0.070 |
| T x pH | 1 | 957.60 | 7.73 | 0.006 |
| Error | 182 | 123.90 | | |
| F_v/F_m | | | | |
| T | 1 | 0.57 | 41.59 | < 0.001 |
| pH | 1 | 0.07 | 4.90 | 0.028 |
| T x pH | 1 | 1.00x10 ⁻⁵ | < 1.00x10 ⁻⁵ | 0.984 |
| Error | 153 | 0.01 | | |
| Pigments ($\alpha = 0.013$) | | | | |
| Chlorophyll a | | | | |
| T | 1 | 24621.00 | 6.66 | 0.011 |
| pH | 1 | 19286.00 | 5.22 | 0.024 |
| T x pH | 1 | 21951.00 | 5.94 | 0.016 |
| Error | 103 | 3694.00 | | |
| Chlorophyll b | | | | |
| T | 1 | 1199.70 | 1.94 | 0.166 |

| | | | | |
|--------------------------|-----|----------|-----------------------|---------|
| <i>pH</i> | 1 | 3233.50 | 5.23 | 0.024 |
| <i>T x pH</i> | 1 | 555.90 | 0.90 | 0.344 |
| <i>Error</i> | 104 | 617.60 | | |
| Total chlorophyll | | | | |
| <i>T</i> | 1 | 35062.00 | 4.79 | 0.031 |
| <i>pH</i> | 1 | 32569.00 | 4.45 | 0.037 |
| <i>T x pH</i> | 1 | 34689.00 | 4.74 | 0.032 |
| <i>Error</i> | 103 | 7321.00 | | |
| Pheophytin a | | | | |
| <i>T</i> | 1 | 9559.33 | 26.00 | < 0.001 |
| <i>pH</i> | 1 | 284.52 | 0.77 | 0.381 |
| <i>T x pH</i> | 1 | 2054.85 | 5.59 | 0.020 |
| <i>Error</i> | 99 | 367.69 | | |
| Pheophytin b | | | | |
| <i>T</i> | 1 | 2084.33 | 13.79 | < 0.001 |
| <i>pH</i> | 1 | 68.47 | 0.45 | 0.502 |
| <i>T x pH</i> | 1 | 1008.07 | 6.67 | 0.011 |
| <i>Error</i> | 102 | 151.11 | | |
| Auroxanthin | | | | |
| <i>T</i> | 1 | 10809.20 | 16.88 | < 0.001 |
| <i>pH</i> | 1 | 0.20 | 3.00x10 ⁻⁴ | 0.986 |
| <i>T x pH</i> | 1 | 4384.10 | 6.85 | 0.010 |
| <i>Error</i> | 102 | 640.20 | | |
| Antheraxanthin | | | | |
| <i>T</i> | 1 | 1297.06 | 25.06 | < 0.001 |
| <i>pH</i> | 1 | 501.82 | 9.70 | 0.002 |
| <i>T x pH</i> | 1 | 499.61 | 9.65 | 0.002 |
| <i>Error</i> | 103 | 51.75 | | |
| β-carotene | | | | |
| <i>T</i> | 1 | 843.04 | 9.54 | 0.002 |
| <i>pH</i> | 1 | 564.80 | 6.39 | 0.013 |
| <i>T x pH</i> | 1 | 135.22 | 1.53 | 0.219 |
| <i>Error</i> | 105 | 88.39 | | |
| Luteín | | | | |
| <i>T</i> | 1 | 353.50 | 5.16 | 0.025 |
| <i>pH</i> | 1 | 323.31 | 4.72 | 0.032 |
| <i>T x pH</i> | 1 | 113.17 | 1.65 | 0.201 |
| <i>Error</i> | 104 | 68.43 | | |
| Violaxanthin | | | | |
| <i>T</i> | 1 | 25.34 | 1.15 | 0.286 |
| <i>pH</i> | 1 | 205.81 | 9.33 | 0.003 |
| <i>T x pH</i> | 1 | 19.60 | 0.89 | 0.348 |
| <i>Error</i> | 102 | 22.07 | | |
| Zeaxanthin | | | | |

| | | | | |
|---------------|-----|--------|------|--------------|
| <i>T</i> | 1 | 363.70 | 3.71 | 0.057 |
| <i>pH</i> | 1 | 662.09 | 6.76 | 0.011 |
| <i>T x pH</i> | 1 | 109.10 | 1.11 | 0.294 |
| <i>Error</i> | 104 | 97.99 | | |

Total carotenoid

| | | | | |
|---------------|-----|----------|-------|-------------------|
| <i>T</i> | 1 | 32097.00 | 13.45 | < 0.001 |
| <i>pH</i> | 1 | 14599.00 | 6.12 | 0.015 |
| <i>T x pH</i> | 1 | 17497.00 | 7.33 | 0.008 |
| <i>Error</i> | 103 | 2386.00 | | |

Carotenoid/Chlorophyll ratio

| | | | | |
|---------------|-----|------|------|--------------|
| <i>T</i> | 1 | 1.50 | 9.20 | 0.003 |
| <i>pH</i> | 1 | 0.01 | 0.06 | 0.799 |
| <i>T x pH</i> | 1 | 1.39 | 8.53 | 0.004 |
| <i>Error</i> | 103 | 0.16 | | |

DES

| | | | | |
|---------------|-----|-----------------------|------|--------------|
| <i>T</i> | 1 | 0.046 | 7.03 | 0.009 |
| <i>pH</i> | 1 | 7.29x10 ⁻³ | 1.11 | 0.294 |
| <i>T x pH</i> | 1 | 0.03 | 4.00 | 0.048 |
| <i>Error</i> | 104 | 6.55x10 ⁻³ | | |
