



THERMAL TOLERANCE OF NATIVE AND EXOTIC MACROPHYTES UNDER HEATWAVES SCENARIOS

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Climate extremes are increasingly threatening the thermal tolerance of species in freshwater ecosystems worldwide, with temperate regions experiencing more intense and prolonged heatwaves. This study assessed the thermal limits of aquatic macrophytes - the native *Myriophyllum verticillatum* and the exotic *Egeria densa* - under warming scenarios to infer their heatwave resistance. Species were collected from the Neiva and Minho rivers, northern Portugal and acclimatized for 48 hours. We then used 50 apical fragments (6 cm) arranged in native/exotic pairs and placed them in mesocosms maintained in a water bath. These were subjected to a gradual temperature increase (16–54 °C) using a ramping protocol, for 3, 6, 12, 24 and 48 hours. Physiological responses to ramping temperature were assessed by maximum quantum yield of photosystem II (F_v/F_m) and analyzed using segmented and linear regression models to determine the temperature breakpoint and Critical Thermal Maximum (CT_{max}). Both species showed a decline in F_v/F_m at an average thermal *breakpoint* of 40–42 °C, regardless of exposure duration. However, they exhibited different CT_{max} : at 3h (native ~54 °C; exotic ~ 52 °C), 6h (both species ~ 49°C), 12h (native ~ 54 °C; exotic ~49 °C), 24h (both species ~ 45 °C), and 48 h (native ~ 46 °C; exotic ~ 44 °C). Overall, both macrophytes exhibited high resistance to heatwaves, but *M. verticillatum* demonstrated higher critical limits than the exotic species, highlighting its potential for adaptation, resistance, and competitive ability via phenotypic plasticity. Although this elevated tolerance is maintained, it can affect other physiological mechanisms, ultimately impacting plant fitness and, more broadly, river primary productivity. Despite the greater tolerance of native species, both exhibited decreased tolerance as thermal exposure increased, indicating cumulative stress effects. This pattern is particularly concerning for native populations, given projections of increasingly prolonged and intense heatwaves in the future.

Palavras-chave: *climate change; extreme climate; phenotypic plasticity; temperate river*