P09-09

Species-Specific Responses of *Daphnia* to Environmentally Relevant Cyanobacterial Exposures

Pinto I. (ivofilipemp@fc.up.pt)[1,2,3,4], Azevedo L. (lazevedo@icbas.up.pt)[1,3,5], Antunes S.C. (scantunes@fc.up.pt)[2,4]

[1] Instituto de Ciências Biomédicas Abel Salazar da Universidade do Porto, Porto, Portugal; [2] Centro Interdisciplinar de Investigação Marinha e Ambiental, University of Porto, Matosinhos, Portugal; [3] Unidade Multidisciplinar de Investigação Biomédica, Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Porto, Portugal; [4] Faculdade de Ciências da Universidade do Porto, Porto, Portugal; [5] Laboratory for Integrative and Translational Research in Population Health, Porto, Portugal



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Introduction







Lentic freshwater aquatic ecosystems management is one of the biggest challenges for the 21st century

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Water quality degradation is mainly due to the proliferation of Cyanobacteria

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Cyanobacteria are prokaryotes organisms, able to perform oxygenic photosynthesis

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They promote the **oxygen depletion**, **toxin/metabolites production**, **and disruptions to aquatic food webs**

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Zooplanktonic organisms are the main target *taxa* – primary consumer – affected by these blooms

AIM

To assess whether prior environmental exposure modulate the sensitivity and physiological responses of *Daphnia* to cyanobacterial stress?

H0	H1	H2
No significant effects are observed	*Daphnia* spp. showed significant effects	*Daphnia* spp. from different environmental context exhibited different responses

Methodology

1 *Daphnia* sp. reproduction assays (21 Days) [1]

Applied independently to:

Daphnia field species

- *Daphnia galeata*
  - recurrent bloom exposure
- *Daphnia middendorffiana*
  - bloom free environment

Cyanobacteria species

- *Aphanizomenon flos-aquae* (LEGE 231513)
- *Microcystis aeruginosa* (LEGE 231512)

Experimental design:

R. subcapitata baseline food supply at each culture medium change (48 h) - 1.5×10^5 cells/mL

+

Environmental cyanobacteria concentration gradient according to the public health risk [2]

T1	T2	T3	T4
0 cells/mL	1.9×10^4 cells/mL	7.5×10^4 cells/mL	1.5×10^5 cells/mL
(Control)	(Low)	(Moderate)	(High)



2 Endpoints

Life-history [3]

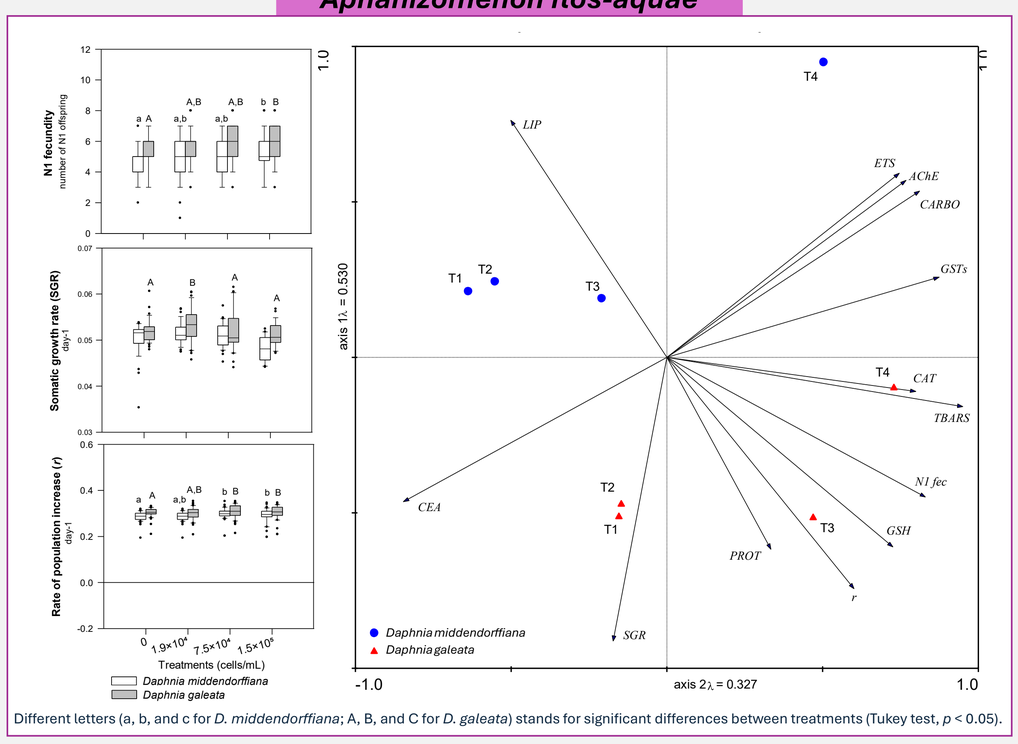
- Fecundity of the first brood
- Somatic growth rate
- Rate of population increase

Biomarkers [4,5]

- Oxidative stress (CAT and GSTs activities, GSH content, TBARS levels)
- Neurotransmission (AChE activity)
- Energy reserves (Carbohydrate, Lipid, and Protein contents, ETS activity, CEA)

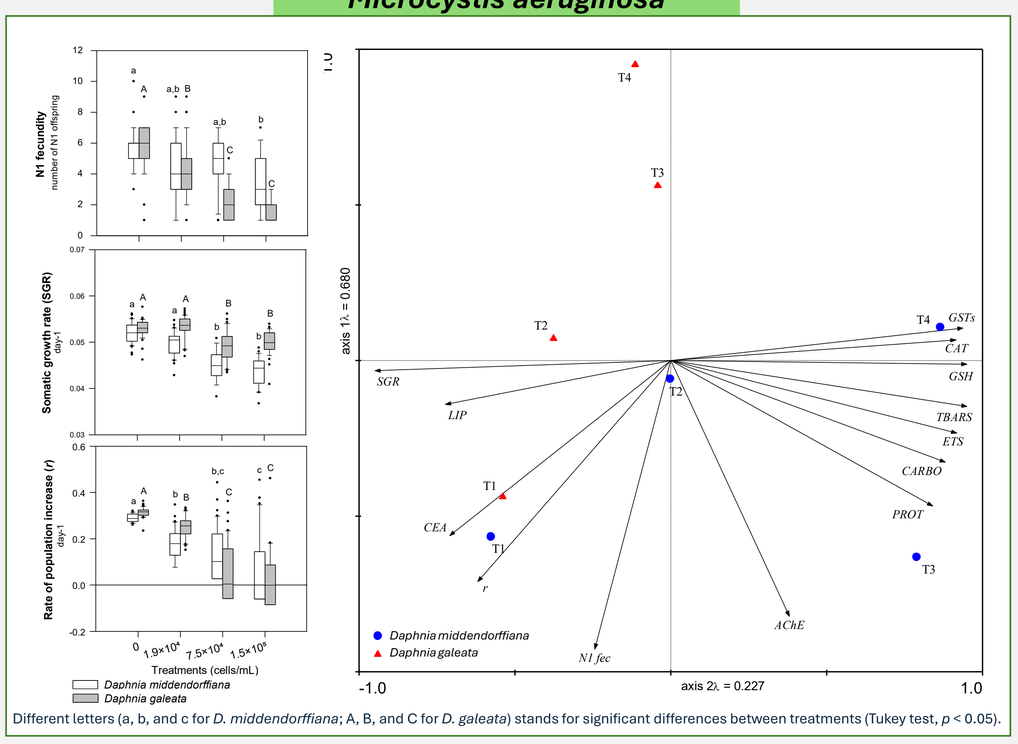
Results

Aphanizomenon flos-aquae



Different letters (a, b, and c for *D. middendorffiana*; A, B, and C for *D. galeata*) stands for significant differences between treatments (Tukey test, $p < 0.05$).

Microcystis aeruginosa



Different letters (a, b, and c for *D. middendorffiana*; A, B, and C for *D. galeata*) stands for significant differences between treatments (Tukey test, $p < 0.05$).

- **Similar life-history responses** were observed in both *Daphnia* species, characterized by **enhanced population growth rates regardless of the concentration tested**.
- Antioxidant responses indicate **physiological adjustment** to cyanobacterial exposure, with **oxidative damage** emerging mainly at the **higher concentration exposure**.
- Increased ETS activity and reduced cellular energy allocation at higher cell density indicate **greater energetic demands**.

D. galeata showed an **earlier physiological adjustment**, whereas *D. middendorffiana* exhibited a **delayed response**.

- Reduced fecundity, growth and rate of population increase indicate **impaired individual performance with consequences for population persistence;**
- **Activation of antioxidant defences** indicates **increasing physiological stress**, with lipid oxidative damage particularly evident in ***D. middendorffiana;***
- Contrasting energetic responses indicate **different resource-allocation strategies** between *Daphnia* species.

D. galeata showed an **earlier antioxidant response**, whereas *D. middendorffiana* initially relied on **metabolic/energetic adjustment**, followed by **antioxidant responses** at higher exposure.

FINAL CONSIDERATIONS

Both *Daphnia* life-history traits tended to **IMPROVE** with increasing *A. flos-aquae* concentration, possibly due to secondary metabolites, but with **NEGATIVE** effects at the biochemical level, indicative of physiological stress.

Life-history performance **DECLINED** in both *Daphnia* species with increasing *M. aeruginosa* concentrations, accompanied by **ADVERSE** biochemical effects.

H0 No significant effects are observed.

Not verified

H1 *Daphnia* spp. showed significant effects.

Responses differed among species and cyanobacterial exposure

H2 *Daphnia* spp. from different environmental context exhibited different responses.

D. galeata (recurrent bloom exposure) – earlier investment in antioxidant defences

D. middendorffiana (bloom free environment) – greater reliance on metabolic/energetic adjustment

Prior exposure to recurrent cyanobacterial blooms may enhance resilience through adaptive responses.

References

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