# Photosynthetic rates of an aquatic macrophyte under interference from glitter particles

## Priority emerging pollutants in the hydrocycle: microplastics, nanomaterial, PFAs, and PPCPs: Emerging pollutants and managing wastewater and waste

UNESCO-IWRA ONLINE CONFERENCE
17-19 JANUARY 2023
3rd IN THE IWRA ONLINE CONFERENCE SERIES

## Introduction

Few studies consider glitter as a pollutant, although thousands of particles of this microplastic are potentially released into aquatic ecosystems[4]. Due to its direct contact with aquatic biota, there is a lack of possible effects of glitter on diverse ecological processes. This study aimed to evaluate the decrease in photosynthetic activities caused by the glitter potential underwater light reflection, considering the metallic composition of the glittering surface.

## Materials and Methods

About 400 apical fragments of *Egeria densa* were distributed in 100 replicates in 4 treatments: concentration of 0.04 g/L of glitter in the presence and absence of light, and without the microparticles with and without light. Photosynthesis was measured indirectly by the concentration of dissolved oxygen in the water over two hours. The classical method by Gaardner & Gran[1], the light and dark flasks method[3] and the equation described by Littler & Arnold[2] were applied to analyze net photosynthesis. In addition, the intensity of light inside the flask at the control treatment and 0.04 g/L of glitter treatment was also analyzed to verify a potential reflection of light by the glitter particles. Since the normality of experimental data was not confirmed, the non-parametric Kruskal-Wallis test was applied, and a p-value < 0.05 was considered statistically significant.

Figure 1: Apical fragment with glitter.

## Results and Discussion

The net photosynthesis rates (equivalent to the gross photosynthetic rate minus respiration) of the control treatment were 35% higher ($p < 0.0001$) than the net photosynthesis from the glitter treatment. The average light intensity of the treatment without glitter (3376.5 μmol $m^2$ $s^{-1}$ PAR) was 15% higher than the treatment with glitter (2881.49 μmol $m^2$ $s^{-1}$ PAR).

Table 1: Rates of net photosynthesis ($P_N$ in mg O2 $g^{-1}$ DM $h^{-1}$) of the treatments without and with glitter.

| Treatments | Average (mg O2 $g^{-1}$ DM $h^{-1}$) | Standard deviation (mg O2 $g^{-1}$ DM $h^{-1}$) | Minimum (mg O2 $g^{-1}$ DM $h^{-1}$) | Maximum (mg O2 $g^{-1}$ DM $h^{-1}$) |
|---|---|---|---|---|
| Without glitter | 7.60 | 0.47 | 0.28 | 22.54 |
| With glitter | 4.97 | 0.25 | 1.29 | 18.76 |

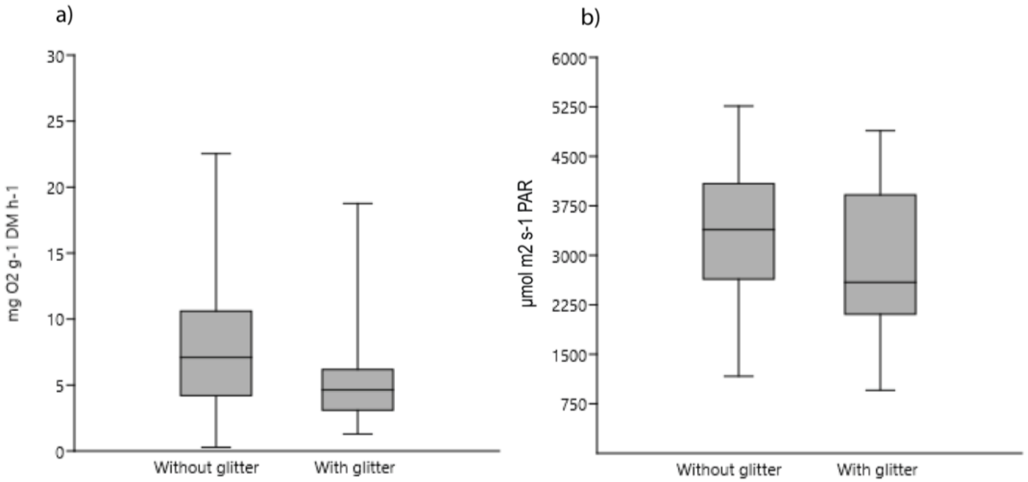


Figure 2: a) Box diagram of the rates of net photosynthesis ($P_N$ in mg O2 $g^{-1}$ DM $h^{-1}$) between the treatments without and with glitter; b) Box diagram of light intensity (μmol $m^2$ $s^{-1}$ PAR) in the presence and absence of glitter.

The interference of glitter on photosynthetic rates can be explained by: (i) the glitter metal surface reflected the radiation energy; and (ii) the glitter particle deposition both on the bottom of the water body and resuspended, therefore may exhibit the behavior of a suspended particle, reducing the penetration of light. The atypical values registered may have been influenced by the different *Egeria densa* phenological stages.

## Conclusion

Regarding the reduced primary productivity of *Egeria densa* in the presence of glitter, these particles interfere with underwater radiation and light absorption necessary for photosynthetic processes by reflecting light due to the high reflectance of their metal coating. This research was a pioneer in analyzing the interference of glitter in the photosynthetic rates of a submerged aquatic macrophyte. Investigations of these particles are essential to understand their effects on ecological processes and aquatic ecosystem services to develop public policies that restrict consumption and mitigate the possible environmental consequences of glitter presence in ecosystems.

## References

Gaarder T. & Gran,H. H. (1927) Investigations of the production of plankton in the oslo fjord. *Rapp, Proc. Verb., Cons. Perm. Internat. Explor. Mer.* **42**, 1–48. [1]
Littler M. M. & Arnold K. E. (1985) Electrodes and chemicals. In: *Handbook of phycological methods (Ecological field methods: macroalgae)* (eds M. M. Littler & D. S. Littler) pp. 349-375. Cambridge University Press, Cambridge. [2]
Pitcher G. C., Probyn T. A. & Du Randt A. (2022) Changes in water column oxygen, estimates of productivity and the development of anoxia in a major embayment of the southern Benguela eastern boundary upwelling system. *J. Mar. Syst.* **227**, 103694. [3]
Raju S., Carbery M., Kuttykattil A., Senthirajah K., Lundmark A., Rogers Z., Scb S., Evans, G. & Palanisami T. (2020) Improved methodology to determine the fate and transport of microplastic in a secondary waste water treatment plant. *Water. Res.* **173**(12), 115549. [4]

Luana Lume Yoshida[1*], Irineu Bianchini Jr[1]. and Marcela Bianchessi da Cunha-Santino[1]
[1] Laboratory of Bioassays and Mathematical Modeling, Department of Hydrobiology, Universidade Federal de São Carlos
* e-mail:luana.yoshida65@gmail.com