Management promoting recovery of coralarine red algae impacted by Samarco's mud

Samara Dumont Fadigas[1]*, Daniela Gadens Zanetti[2], Paulo Antunes Horta Jr.[1]

[1]Laboratório de Ficologia. Universidade Federal de Santa Catarina. Florianópolis, Brazil

[1]Laboratório de Oceanografia Química. Universidade Federal de Santa Catarina. Florianópolis, Brazil

*Corresponding Author: sdfadigas@gmail.com

Considered the worst environmental disaster in the history of Brazil, Fundão dam rupture, belonging to Samarco mining company in Bento Rodrigues district, municipality of Mariana, Minas Gerais, caused spill of millions cubic meters of iron ore tailings generating numerous social, economic and environmental impacts (1) (figure 1a,b) and opened space for discussion on consequences of such impacts specially in marine environment.

Figure 1: Impacts of iron ore dam rupture: (a) burial of Doce River fauna; (b) plume that reached an extension of approximately 20km, reaching three areas of environmental preservation.

The impacts caused by rupture of iron ore dams are numerous (2) (3) (4), but especially, burial and shading of benthic organisms caused by sedimentation (5), mainly calcareous algae.

In this work, we investigated, through experimentation (figure 2), effects and impacts of burial and recovery on physiology of calcareous algae (figure 3a,b), using as parameter productivity (figure 4) comparing with analysis of photosynthetic yield (figure 5).

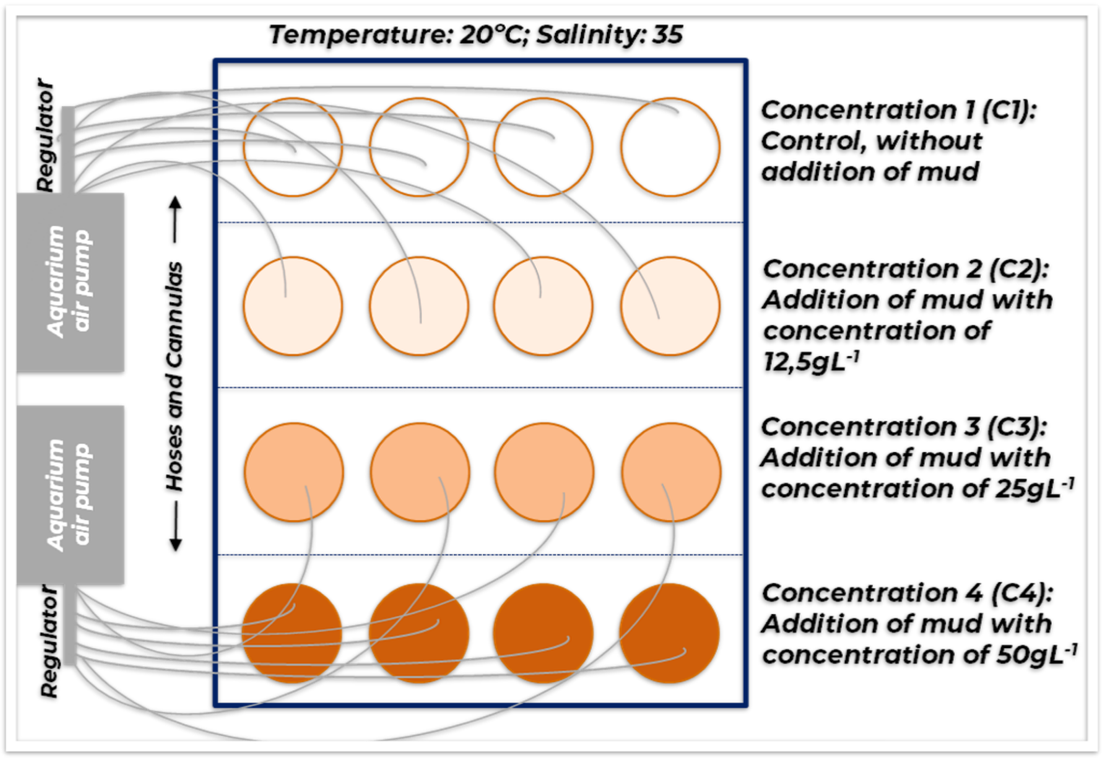


Figure 2: A 14-day mesocosm experiment was carried out with an experimental design consisting of 4 treatments with different concentrations of mud (C1, C2, C3 and C4). Sixteen samples of *Lithophyllum margaritae* were used in a room with 12h photoperiod with fluorescent lamps at 210 umol photons m^2s^{-1}. During first 7 days of experimente, rhodoliths were submitted to treatment with different concentrations of mud in each sample. On 7th day, samples were washed and mud was removed and then, 7 day recovery period was started.

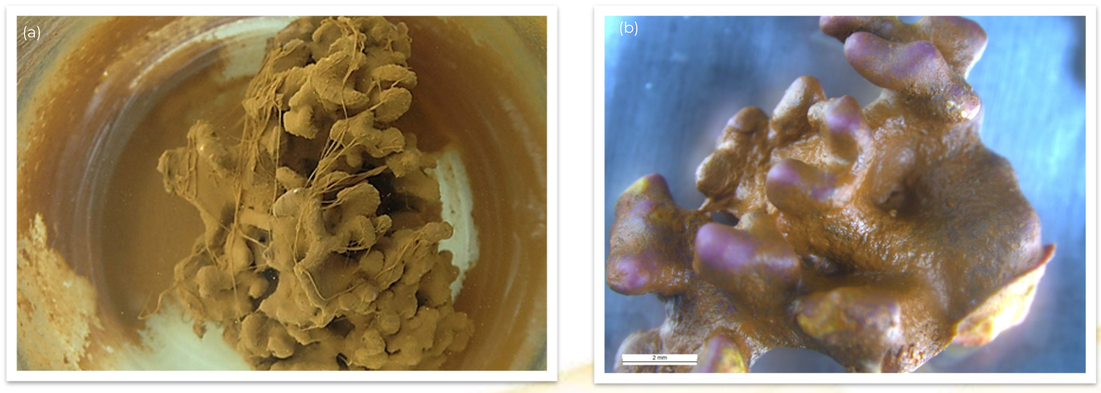
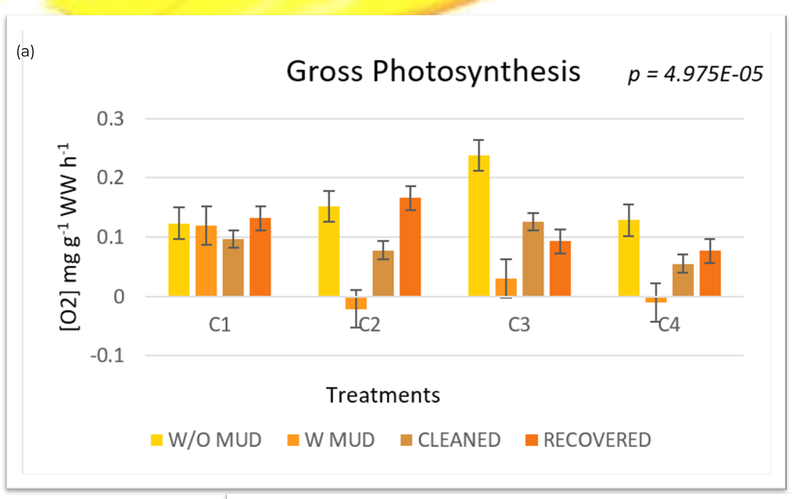


Figure 3: (a) Sample of rhodolith after 24 h of exposure to lowest concentration of mud (12.5 gL^{-1}) presented practically all surface covered with mud; (b) Fragment of rhodolith practically all covered by fine sediment. It is observed that even after removal of sample from aqueous environment, mud still remains impregnated in fragment parts.



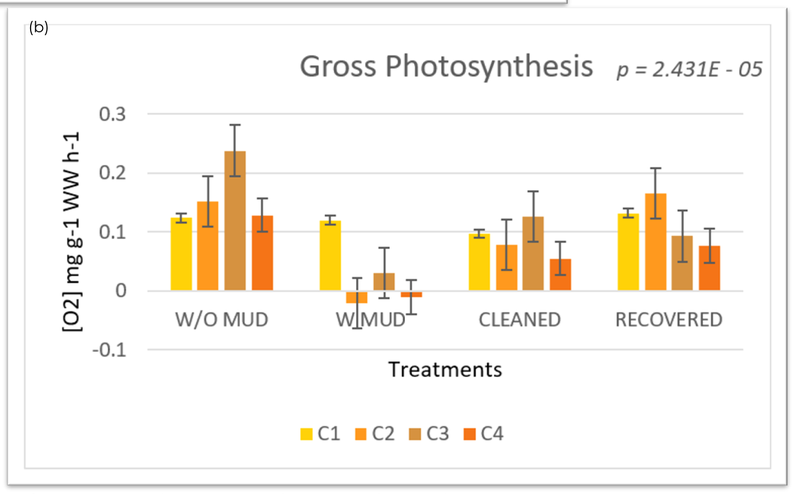


Figure 4: (a) Mean of gross photosynthesis data between concentrations among different treatments. Graph shows significant difference between means of samples that present mud concentrations and control samples (C1); (b) Mean of gross photosynthesis data between treatments (without mud, with mud, cleaned and recovered) between different mud concentrations. Graph shows significant difference between means of treatments with mud and other treatments.

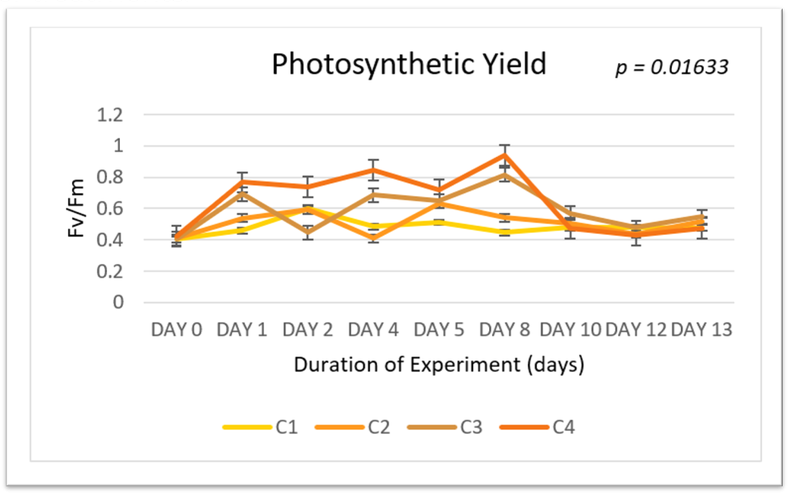


Figure 5: Mean of PSII quantum yields (Fv / Fm) over experiment days at different mud concentrations. Differences between values of Fv/Fm are only perceptible in treatment period with mud (day 1 to day 8).

According to the results it is possible to notice that there was a change in rhodolith physiology when exposed to mud, regardless of the concentration, through productivity and photosynthetic yield data.

Calcareous algae can withstand extremely low irradiance levels however, burial by a thin layer of long-term sediment can cause high levels of stress and can even being lethal, due to the anoxicity in the environment generated by the accumulation of the sediment.

The key issue for CCA survival and health recovery under impacts such as toxic mud burial is promoting sediment remobilization, through waves and currents, prevent sediment anoxia.

References:

(1)ESCOBAR, Herton. Mud tsunami wreaks ecological havoc in Brazil. 2015.

(2)HATJE, Vanessa et al. The environmental impacts of one of the largest tailing dam failures worldwide. Scientific reports, v. 7, n. 1, p. 10706, 2017.

(3)WURSTER, Maria-Theresia et al. Sedimentological downstream effects of dam failure and the role of sediment connectivity: a case study from the Bohemian Massif, Austria. In: EGU General Assembly Conference Abstracts. 2017. p. 13159.

(4)SERFAS, Daniel Henry. Assessing the impacts of dams on nutrient and sediment loading in the Kalamazoo River using the Soil and Water Assessment Tool (SWAT). 2012.

(5)GOMES, L.E. et al. The impacts of the Samarco mine tailing spill on the Rio Doce estuary, Eastern Brazil. Marine pollution bulletin, v. 120, n. 1-2, p. 28-36, 2017.

Acknowledgments:

CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico · CAPES · Universidade Federal de Santa Catarina · LAFIC Laboratório de Ficologia

The São Paulo School of Advanced Science on Ocean Interdisciplinary Research and Governance

USP · IO Instituto Oceanográfico · ie] · IAI Inter-American Institute for Global Change Research · FAPESP