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Editorial
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A Downstream Strategy to Counteract the Effects of Eutrophication in Lagoon Environments

Mauro Lenzi*

Lagoon Ecology and Aquaculture Laboratory (LEALab), Italy

***Corresponding author:** Mauro Lenzi, Lagoon Ecology and Aquaculture Laboratory (LEALab), Orbetello, Italy, Email: lealab1@gmail.com

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Editorial

Here I want to focus on the environmental management of coastal shallow water, eutrophic areas, such as lagoons, estuaries and brackish lakes. It is now about fifty years that, everywhere in the world, these coastal areas are strongly eutrophic or hypertrophic. They are subject to microorganisms and/or macroalgal blooms, and, periodically, to dystrophic crises, which destroy the benthos communities and can penalize the fishing and tourism economies with die-off of commercial fish species, and stench.

Eutrophication produces accumulation of organic matter in the sediment and it is precisely this organic load that triggers summer hypoxia/anoxia, releases of hydrogen sulphide, die-off of benthic organisms, etc. To avoid all this, we should reduce coastal eutrophication, acting upstream of the system, as logic would like.

Perhaps I will be pessimistic, but I don't see how the global industrial economy, intensive farming and the increase in the human population, which are the causes of coastal eutrophication, can stop or just slow down, at least not by choice, if you think that the sensitivity of many great nations of the world is not even shaken by global warming, even after the already very evident repercussions of this phenomenon on our life.

In essence, the more we go forward with the population growth, the more the problems cannot be resolved at the origin. So, I think we must now tackle the eutrophication problem with a downstream strategy, how we will be forced to do it for many other problems that we will encounter as we proceed in our uncontrolled development.
Such a strategy means trying to directly counteract the worst effects of eutrophication, which occur in cascades and clusters.

Various systems can be adopted in a downstream strategy to counteract the effects of eutrophication, in estuarine and lagoon environments, and in particular in non-tidal lagoons:

- Increasing the hydrodynamics of the basin through the use of pumps that increase the exchange of water, or intervening on the morphology of the basin itself [1]. This is not always effective for all basins, much depends on their extent, height of the water column, and morphology.
- Collecting macroalgae and moving them away from the system. In theory, it could be a correct practice, but to have significant effects, it would be necessary to collect very high quantities, at least 20% of the major standing crop [2]. Therefore the practice becomes very expensive, especially if we consider that the opportunistic Chlorophyceae (which are the ones that most develop in shallow lagoon environments) are not, at the moment, industrially usable, at least in the western world [3-5].
- Increasing primary consumers. Also this is a solution that can be practiced in small environments, besides it

is not easy to find large quantities of juvenile stages of organisms that occupy low trophic levels and that have commercial importance [6].

- Increasing the buffering capacity of the sediments and blocking chemically the reducing sulfate bacteria [7-11], and references contained therein]. This solution is still experimental, but promises good results. Certainly, it could be used in relatively small environments, but it is not excluded in the future may be feasible even in larger areas, having iron and manganese oxides powders and coal ash and other alkalizing substances.
- Inducing forcibly the mineralization of organic matter in the first centimeters of the sediment. This solution consists essentially of the resuspension of soft sediment layer with a high organic load [12]. It has been adopted in two lagoons of the South Tuscany (Italy, West coast) [2,13]. This is a relatively inexpensive solution, requiring a boat or several boats, in relation to the extension of the lagoon, and a device able to send a jet of air or an air-water emulsion, towards the bottom, creating disturbance and resuspension of the first centimeters of sediment. Operation that must be repeated with a relatively high frequency, variable depending on the nature of the sediments and quantity and quality the organic load [14].

Sediment resuspension in the water column is a controversial phenomenon: depending on the aspect taken into account, it can have negative or positive consequences for the marine environment. The consequences can be very different between one ecosystem and another, and in relation to different environmental conditions at the beginning. There is a rich literature on the various aspects and contradictory consequences of sedimentary resuspension, but mostly a single event is studied. In the case of a single, isolated event or low frequency events (like a strong wind or an anthropic intervention), relatively negative consequences are often found, such as the re-circulation of previously sunk nutrients [15,16] or contaminants [17,18], or lowering of dissolved oxygen and pH [19]. But the environmental consequences for events that occur at relatively high frequencies can be very different [14,20,21]. The most significant effects are the mineralization of labile organic matter, which is easily attacked by bacteria and otherwise would support anaerobic processes [22,23], the subtraction of orthophosphates by the oxy-hydroxides of iron and manganese, due to the new sediment oxidation conditions, therefore a tendency to phosphorus-limitation for algal vegetation, the increase in nitrification and denitrification processes, therefore a tendency to reduce eutrophication by nitrogen [24-27]. A reduction in the organic load lowers the activity of reducing sulphate bacteria and, consequently, where there was the risk, it reduces mercury methylation [28-30]. Many advantages have been found in the use of this practice in poor renewal of water, hypertrophic shallow water environments [2,13,31,32], and benefits can also be observed for accidental natural series of events, such as high frequencies of strong wind [33,34].

References

1. Lenzi M (1992) Experiences for management of Orbetello Lagoon : eutrophication and fishing. Science of the Total Environment S3: 1189-1198.

2. Lenzi M, Leporatti Persiano M, Gennaro P, Rubegni F (2017) Artificial top layer sediment resuspension to counteract *Chaetomorpha linum* (Muller) Kutz blooms in a eutrophic lagoon. Threee year's full-scale experience. Journal of Aquaculture and Marine Biology 5(2): 00114.

3. Bastianoni S, Gaggi C, Nicolardi V, Bosco S, Coppola F, et al. (2008) Biofuel potential production from the Orbetello lagoon macroalgae: a comparison with sunflower feedstock. Biomass and Bioenergy 32(7): 619-628.

4. Migliore G, Alisi C, Sprocati AR, Massi E, Ciccoli R, et al. (2012) Anaerobic digestion of macroalgal biomass and sediments sources from the Orbetello lagoon, Italy. Biomass and Bioenergy 42: 69-77.

5. Schultz-Jensen N, Thygesen A, Leipold F, Thomsen ST, Roslander C, et al. (2013) Pretreatment of the macroalgae *Chaetomorpha linum* for the production of bioethanol-Comparison of five pretreatment technologies. Bioresource Technology 140: 36-42.

6. Lenzi M, Porrello S (2017) Non-tidal lagoon structure, dynamics and eutrophication management. Lambert Academic Publishing, pp: 1-60.

7. Kim KH, Hibino T, Yamamoto T, Hayakawa S, Mito Y, et al. (2014) Field experiments on remediation of coastal sediments using granulated coal ash. Marine Pollution Bulletin 83(1): 132–137.

8. Yamamoto T, Kim KH, Shirono K (2015) A pilot study on remediation of sediments enriched by oyster farming wastes using granulated coal ash. Marine Pollution Bulletin 90(1-2): 54-59.

9. Asaoka S, Okamura H, Akita Y, Nakano K, Nakamoto K, et al. (2014) Regeneration of manganese oxide as

adsorption sites for hydrogen sulfide on granulated coal ash. Chemical Engineering Journal 254: 531-537.

10. Asaoka S, Yamamoto T, Yamamoto H, Okamura H, Hino K, et al. (2015) Estimation of hydrogen sulfide removal efficiency with granulated coal ash applied to eutrophic marine sediment using a simplified simulation model. Marine Pollution Bulletin 94(1-2): 55-61.

11. Asaoka S, Okamura H, Kim K, Hatanaka Y, Nakamoto K, et al. (2017) Optimum reaction ratio of coal fly ash to blast furnace cement for effective removal of hydrogen sulfide. Chemosphere 168: 384-389.

12. Lenzi M (2010) Resuspension of Sediment as Method for Managing Shallow Eutrophic Lagoon. Journal of Ecology and the Natural Environment 2(11): 220-234.

13. Lenzi M, Birardi F, Calzolai R, Finoia MG, Marcone F, et al. (2010) Hypertrophic lagoon management by sediment disturbance. Marine Pollution Bulletin 61(4-6): 189-197.

14. Lenzi M, Renzi M (2011) Effects of artificial disturbance on quantity and biochemical composition of organic matter in sediments of a coastal lagoon. Knowledge and Management of Aquatic Ecosystems 402: 8.

15. Søndergaard M, Kristensen P, Jeppens E (1992) Phosphorus release from resuspended sediment in the shallow and wind-exposed Lake Arresoe, Denmark. Hydrobiologia 228(1): 91-99.

16. Wainright SC, Hopkinson JCS (1997) Effects of sediment resuspension on organic matter processing in coastal environments: a simulation model. Journal of Marine Systems 11(3-4): 353-368.

17. Hwang K-Y, Kim H-S, Hwang I (2011) Effect of Resuspension on the Release of Heavy Metals and Water Chemistry in Anoxic and Oxic Sediments. Clean- Soil, Air, Water 39(10): 908-915

18. Tomson MB, Thibodeaux LJ, Kan AT (2003) Fate of heavy metals and inorganic compounds during sediment Resuspension. Rice University, Houston, TX and Louisiana State University, Baton Rouge, LA.

19. Sloth NP, Riemann B, Nielsen LP, Blackburn TH (1996) Resilience of pelagic and benthic microbial communities to sediment resuspension in a coastal ecosystem, Knebel vig, Denmark. Estuarine Coastal Shelf Science 42(4): 405-415.

20. Widdicombe S, Austen MC (2001) The interaction between physical disturbance and organic enrichment: an important element in structuring benthic communities. Limnology and Oceanography 46(7): 1720-1733.

21. Stahlberg C, Bastviken D, Svensson BH, Rahm L (2006) Mineralisation of organic matter in coastal sediment at different frequency and duration of resuspension. Estuarine Coastal Shelf Science 70(1-2): 317-325.

22. Fanning KA, Carder KL, Betzer PR (1982) Sediment resuspension by coastal water: a potential mechanism for nutrient re-cycling on the ocean's margins. Deep-Sea Research 29(8): 953-965.

23. Wainright SC (1990) Sediment-to-water fluxes of particulate material and microbes by resuspension and their contribution to the planktonic food web. Marine Ecology Progress Series 62: 271-281.

24. Golterman HL (1995) The role of the iron hydroxide-phosphatesulphide system in the phosphate exchange between sediments and water. Hydrobiologia 297(1): 43-54.

25. Golterman HL (2001) Phosphate release from anoxic sediments or "what did Mortimer really write?". Hydrobiologia 450(1-3): 99-106.

26. Herbert RA, Nedwell DB (1990) Role of environmental factors in regulating nitrate respiration in intertidal sediments. In: Revsbech NP, Sorensen J, (Eds.), Denitrification in Soil and Sediment, Plenum Press, New York, pp: 77- 90.

27. Novicki BL, Requintina E, Van KD, Kelly JR (1997) Nitrogen losses through sediment denitrification in Boston Harbour and Massachusetts Bay. Estuaries 20(3): 626-639.

28. Compeau GC, Bartha R (1985) Sulfate-reducing bacteria: Principal methylators of mercury in anoxic estuarine sediment. Applied and Environmental Microbiology 50(2): 498-502.

29. King JK, Kostka JE, Frischer ME, Saunders FM, Jahnke RA (2001) A quantitative relationship that demonstrates mercury methylation rates in marine sediments are based on the community composition and activity of sulfate-reducing bacteria. Environmental Science and Technology 35(12): 2491-2496.

30. Benoit JM, Shull DH, Robinson P, Ucran LR (2006) Infaunal burrow densities and sediment monomethyl mercury distributions in Boston Harbor, Massachusetts. Marine Chemistry 102(1): 124-133

31. Martelloni T, Tomassetti P, Gennaro P, Vani D, Persia E, et al. (2016) Artificial soft sediment resuspension and high density opportunistic macroalgal mat fragmentation as method for increasing sedimento zoobenthic assemblage diversity in a eutrophic lagoon. Marine Pollution Bulletin 110(1): 212-220.

32. Sorce C, Persiano Leporatti M, Lenzi M (2017) Growth and physiological features of *Chaetomorpha linum* (Müller) Kütz in high density mats. Mar Pollution Bulletin 129(2): 772-781.

33. Rubegni F, Franchi E, Lenzi M (2013) Relationship between wind and sea grass meadows in a non-tidal eutrophic lagoon studied by a wave exposure model (WEMo). Marine Pollution Bulletin 70(1-2): 54-63.

34. Lenzi M, Persiano M, Gennaro P, Rubegni F (2016) Wind Mitigatin Action on Effects of Eutrophication in Coastal Eutrophic Water Bodies. International Journal of Marine Science and Ocean Technology 3(2): 14-20.