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C. Facca, A. Bonometto*, R. Boscolo*, A. Sfriso

Dipartimento di Scienze Ambientali, Informatica e Statistica (DAIS), Università Ca' Foscari Venezia, Calle Larga Santa Marta, 2137 - 30123 Venezia, Italia.
facca@unive.it
*Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), 30015 Chioggia (VE), Italia.

PLANKTONIC AND BENTHIC MICROALGAE IN CHOKED AREAS OF THE VENICE LAGOON AND THEIR RELATIONSHIPS WITH WATER AND SEDIMENT PHYSICO-CHEMICAL PARAMETERS

MICROALGHE PLANCTONICHE E BENTONICHE IN AREE CONFINATE DELLA LAGUNA DI VENEZIA E LORO RELAZIONI CON I PARAMETRI CHIMICO-FISICI DI ACQUA E SEDIMENTO

Abstract - *Phytoplankton taxonomic composition and cell abundance were determined monthly in chocked area of Venice lagoon. Such data were compared with nutrient and chlorophyll concentrations in water and surface sediments in order to draw planktonic-benthic interaction. A significant contribute to diversity was recorded for the planktonic community but the abundance and seasonal trends were independent.*

Key-words: *chlorophylls, phytoplankton, sediments, water, Venice lagoon.*

Introduction - Water-sediment interactions are of primary importance to better understand shallow ecosystem processes and trophic levels. Brito *et al.* (2012) discussed which is the contribute of microphytobenthos (MPB) to phytoplankton (PPL) in few restricted sites of Venice lagoon. Despite the correlation between MPB and PPL, the seasonal and spatial variability of the two microalgal communities was found to be quite different (Facca *et al.*, 2002; Brito *et al.*, 2012). The present paper aims at deepening that study including choked zones and comparing microalgal occurrence with water and sediment physico-chemical conditions.

Materials and methods - In 2010, samples were collected monthly at 4 sites (Ca' Zane=CZ, Millecampi=ML, Teneri=TN, Palude della Rosa=PR) located in chocked and always submerged areas (depth: 0.5÷0.7 m msl). Temperature, Salinity (S), suspended solids, light transmission, chlorophyll *a* (Chl *a*), reactive phosphorus, dissolved inorganic nitrogen, PPL taxonomic composition and cell abundance were determined in water samples. Total nitrogen, total and inorganic carbon, total and inorganic phosphorus, grain size and density were measured in the surface sediments (top 5 cm). All methods are described in Facca *et al.*, 2002. Chl *a* was measured in the first cm of sediment on freeze-dried samples by means of spettrophotometric detection.

Results - The highest PPL cell abundance (annual mean 7×10^6 cells l^{-1}; peak value 23×10^6 cells l^{-1}) occurred at CZ, the only site in a euhaline choked water body. The other stations were located in polyhaline choked areas and they all had similar abundance (annual mean $\approx3\times10^6$ cells l^{-1}; peak value $\approx12\times10^6$ cells l^{-1}). The seasonal trends were characterized by a peak in July-August and a slight increase in late winter. At CZ, a prolonged nanoflagellate (spherical flagellated cells <5 µm) bloom ($>17\times10^6$ cells l^{-1}) started in July and lasted till the end of September. Nanoflagellates represented the dominant taxon at all sites and in all seasons, whereas diatoms hardly reached a maximum relative abundance (RA) >36% (Tab. 1). Despite of its low RA, diatom taxonomic composition let to verify how important was the contribute of benthic microalgae to PPL diversity. Most of these species were, in fact, typically benthonic, but some may be found equally in the water and in the surface sediments and just few were planktonic (Tab. 1). Dinoflagellates were negligible.

Tab. 1 - For each site, mean Relative Abundance (RA) of the main observed PPL groups is reported. In the column on the right, minimum and maximum RA was calculated by month.

Per ciascun sito sono riportate le medie delle abbondanze relative (RA) dei principali gruppi fitoplanctonici osservati. Nella colonna a destra sono indicati i massimi e i minimi delle RA calcolati su base mensile.

	ML	TN	PR	CZ	Temporal variations
Diatom RA (%)	15.4	23.3	14.3	9.0	8.2-36.1
Nanoflagellates RA (%)	70.3	67.2	79.7	83.7	53.2-84.5
Benthic species RA (%)	54.8	41.5	75.7	59.0	30.9-60.5
Planktonic species RA (%)	4.46	8.61	5.8	11.3	0-38.8
Planktonic/Benthic species RA (%)	29.3	45.2	13.6	25.6	3.9-52.5

Chl *a* in the water column varied between 0.40 and 6.51 μg l^{-1}, being the highest at CZ and in July. Chl *a* in the surface sediments was maximum during winter in all sites except for ML, where it peaked in summer. On the basis of sediment density and porosity, benthic Chl *a* varied between 0.55 and 17.60 μg ml^{-1} wet sediment, being the highest at CZ and 3 order of magnitude higher than PPL. Chl *a* in water was well correlated with PPL cell abundance and, in particular, with diatoms ($p<0.001$), whereas no correlation was recorded with Chl *a* in the surface sediments. PPL mainly depended on increasing temperature and light availability (p-value <0.05); benthic Chl *a* was negatively correlated (p-value <0.05) with water temperature, inorganic carbon and suspended solids and positively with oxygen saturation and inorganic phosphorus.

Conclusions - Phytoplankton was dominated by nanoflagellates, which occurrence has always been significant in Venice lagoon but at a minor extent (Bernardi Aubry *et al*., 2013). Reduction of phytoplankton cell size could be related to global warming (Peter and Sommer, 2012) but further investigations are needed. Benthic and planktonic Chl *a* concentrations and trends appeared to be independent, in chocked area as well as in restricted zones (Facca *et al*., 2002). Comparing the taxonomic list of benthic and planktonic microalgae, it was observed that most of the diatoms in the water column are typical of the benthic habitat. Therefore the main interaction are in term of community diversity. Temperature seasonal variations and light availability were the key factors influencing both microalgal assemblages, but PPL and MPB showed opposite relation with temperature, confirming previous observations (Facca *et al*., 2002). At CZ the less macrophyte coverage may explain the high Chl *a* values.

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