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Wrack algae of exposed sandy beaches: effect on the nutrient supply to the coastal environment

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INTRODUCTION

The transfer of nutrients and organic matter across ecosystems can greatly influence food web processes and dynamics (Polis *et al*. 1997).

Sandy beaches are open ecosystems located between marine and terrestrial environments characterized by low primary productivity (McLachlan & Brown 2006). Research about the role of stranded algae on the ecology of sandy beaches has shown their importance as a food resource and refuge for the macrofauna (e.g. Lastra *et al.* 2008).

Due to the high permeability of the sandy sediment, beaches act as a biochemical reactors, in which organic matter that enters on the pore space is trapped enough to be mineralized (Anschutz *et al*. 2009).

In this work, we quantify the time variability of the stranded wrack and the nutrient supply to the coast in six exposed sandy beaches with the goal of better understanding the influence of wrack on the ecosystem functioning.

MATERIAL AND METHODS

Each beach was sampled monthly between October 2007 and November 2008. Field sampling was carried out during spring low tides. Six transects were established on each beach extending from the base of the dune to the lowest swash level. Cover, specific composition and biomass of wrack were calculated along each transect. Specific composition and biomass were estimated collecting all the wrack present within a 1 m wide strip of beach centred in each transect (Lastra *et al*. 2008). Wrack was transported to the laboratory where the species composition was determined to the lowest taxonomic level possible, dried (60ºC during 48h) and weighed. Mean values were calculated averaging data from the six transects.

To assess the nutrient release from the stranded wrack we collected interstitial water samples on transects 1, 3 and 5 at the beginning of the effluent line and sea water samples on the swash zone. Samples were taken in triplicate. The nutrients analysed were: nitrogen in nitrate, nitrite and ammonium form and phosphorus in phosphate form.

RESULTS

The quantity of stranded algae differed along the year and between localities. In most of cases the greatest algae inputs were recorded during the summer and at the beginning of the autumn. The biomass of wrack algae was lower in the most exposed beaches to wave action (Fig. 1).

Results show a positive correlation between the nutrient concentration in the interstitial water and the biomass of stranded wrack (Fig. 2).

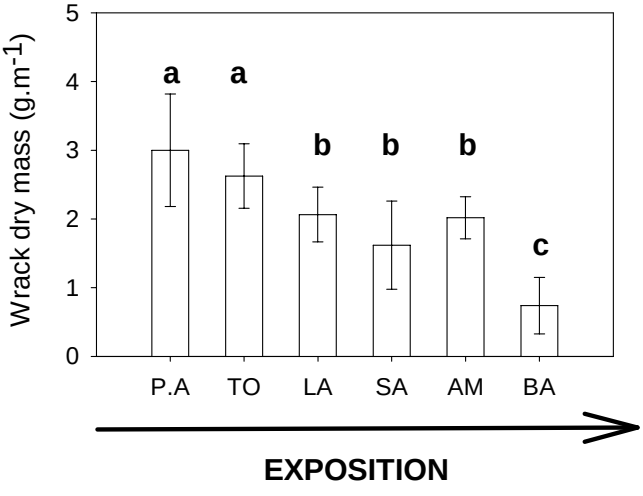

Figure 1: Mean biomass (g dry weight m-1) of stranded algae in each beach over time. Playa de Abra (P.A), Toralla (TO), Ladeira (LA), Samil (SA), America (AM) and Balieiros (BA). Errors bars represent standard deviation (n=12). Data has been transformed with a $Log_{10}(x+1)$. Letters (a, b, c) represent significant differences in a one-way ANOVA ($F = 23.64$, $p<0.001$, $df = 5, 66$).

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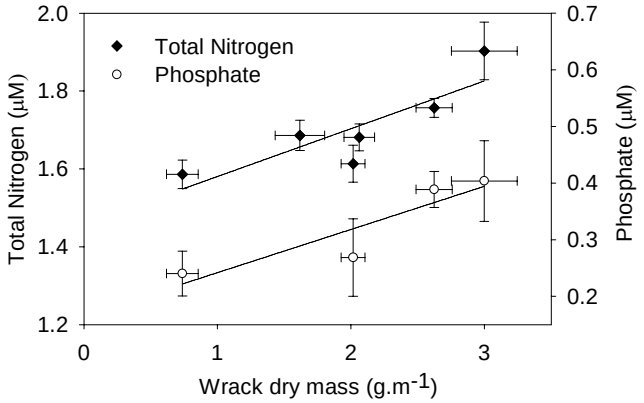

Figure 2: Annual correlation between total nitrogen and phosphate content (µM) in the interstitial water and mean biomass (g dry weight m^{-1}) of stranded wrack. Errors bars represent standard errors. Data have been transformed with a $Log_{10}(x+1)$.

Lineal regression between wrack and nutrient concentration were done over time to assess the nutrient released along the year. Best correlations were observed after summer, September for Total Nitrogen (R^2=0.960; p=0.0006) and October for Phosphate (R^2=0.673; p=0.045).

CONCLUSION

Wave exposition had a negative influence in the amount of stranded algae in the studied beaches.

Months with higher air temperatures registered the highest inputs of stranded algae. That coincidence may accelerate the decomposition process and increase the nutrient release. Differences in the chemical links between phosphorus and nitrogen with carbon involve a higher stability of phosphates, which need more time to be released.

The increase in nutrient supply related with larger amounts of stranded wrack proves the important role of the drifting algae in the nutrient cycle.

Beaches act as a recipient habitat, receiving inputs of wrack macroalgaes from the adjacent coastal ecosystems; once these inputs are processes (through decomposition, consumption and interaction with the fauna) beaches operate as donor habitats realising nutrients to the adjacent coast.

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