Trophic plasticity in *Paracentrotus lividus*: herbivory, detritivory and omnivory as a function of resource availability and habitat features

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Abstract

Factors controlling herbivory pressure have a central importance in shaping the seascape. In the Mediterranean, the sea urchin *Paracentrotus lividus* is considered as a keystone herbivore in seagrass meadows and photophilic macroalgal communities on rocky substrates. Here, we explore the trophic ecology of sea urchins in a sheltered, shallow (1 m depth) habitat, constituted by a mosaic of seagrass (*Cymodocea nodosa*) mixed with *Caulerpa prolifera* and sandy patches. We assess the influence of high local availability of the pseudo-indigenous soft body bryozoan *Amathia verticillata* and the abundance of pen shells (*Pinna nobilis*) providing hard substrate and hides on the trophic plasticity of the sea urchin. To this end, an ensemble of food preference (Prado and Heck, 2011) and foraging experiments, stomach contents and stable isotope analyses (δ^{13}C and δ^{15}N) were conducted in the Alfacs Bay (Ebro Delta). Our results show that sea urchins strongly prefer *A. verticillata* over *C. nodosa* and *C. prolifera* (Figure 1, Table 1), confirmed by the high abundance of the bryozoan in stomach contents (ca. 44%) in August, coupled with green and decayed seagrass leaves (29.7 and 26.4% respectively). Stable isotope analyses, which better reflects a long-term feeding behavior, show that ca. 65% of the diet of *P. lividus* seems to be based on decayed seagrass leaves (Figure 2), followed by the bryozoan *A. verticillata* (only available in summer) and green seagrass leaves (21.7 and 13.3% respectively). The local availability of *P. nobilis* also provides a preferred habitat for sea urchins which showed limited foraging movements into the surrounding seagrass beds, particularly when *A. verticillata* was attached to the shells. The apparently high contribution of animal and detrital food to *P. lividus* diet is unprecedented, and suggests an opportunistic feeding behavior in sea urchins in those habitats.

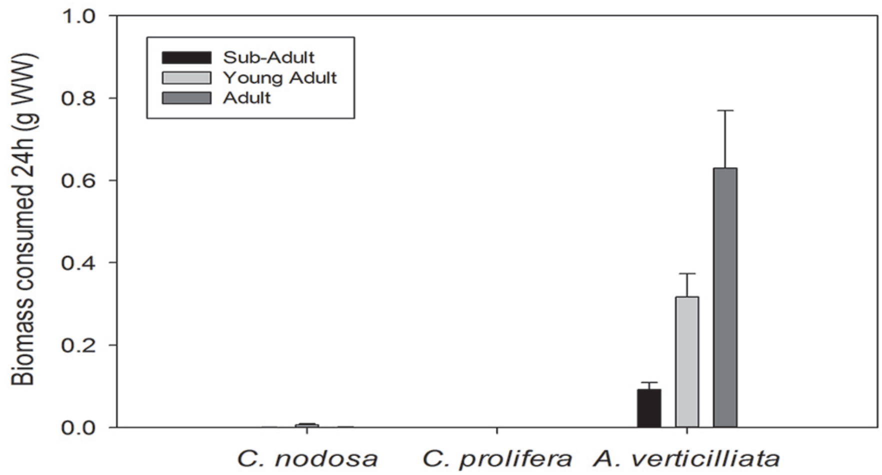

Figure 1: Biomass (g WW) of food items consumed in 24h-lasting experiments of food items *C. nodosa* (CN), *C. prolifera* (CP) and the bryozoan *A. verticillata* (AV)) by sea urchins size classes (Sub-Adults, Young Adults and Adults). Error bars are SE.

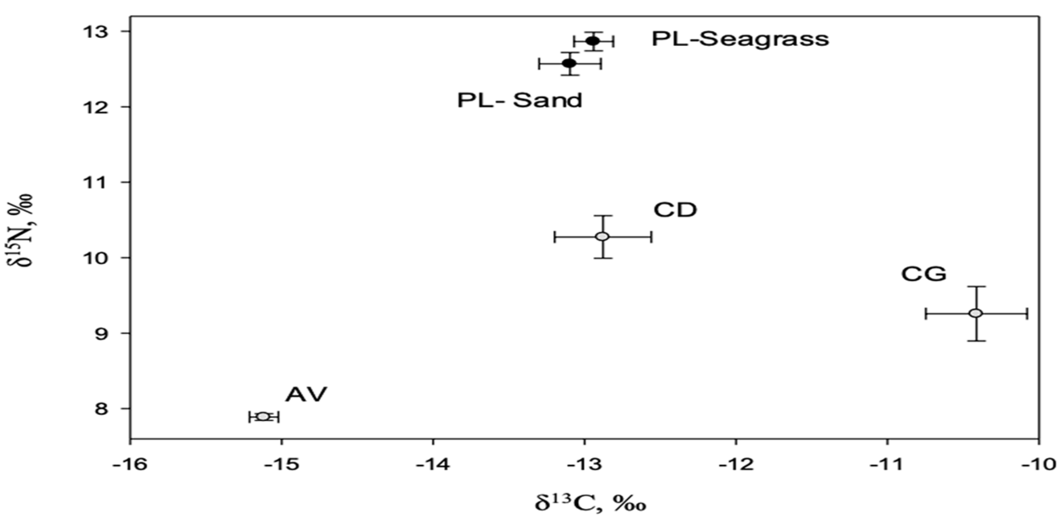

Figure 2: Stable isotope signatures (δ^{15}N and δ^{13}C) of *P. lividus* (PL) from *C. nodosa* (CN) and sand (S) habitats and food items including *A. verticillata* (AV), and green and detrital *C. nodosa* (G-CN and D-CN, respectively).

Table 1: Friedman's ANOVA X2 and Kendall's coefficient of concordance (W) for ranked consumption rates on offered food items including leaves of *C. nodosa* (CN), the bryozoan *A. verticillita* (AV) and the green algae *C. prolifera* (CP). In Wilcoxon matched pairs (WMP) post hoc comparisons, significant differences in consumption rates between pairs of diet items are indicated in bold.

Consumer (n=19, df= 2)	Friedman's ANOVA χ^2	Kendall'sW	*p*
Subadults	25.72	0.714	**0.000**
WMP post hoc:	AV> CN= CP		
Young adults	27.25	0.75	**0.000**
WMP post hoc	AV> CN= CP		
Adults	28.00	0.77	**0.000**
WMP post hoc:	AV> CN= CP		

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References

Prado, P., Heck, J.K., 2011. Seagrass selection by omnivorous and herbivorous consumers: determining factors. Marine Ecology Progress Series 429, 44–55. doi:https://doi.org/10.3354/meps09076.