Functional ecological traits in juvenile and adult thalli of canopy-forming brown macroalga *Gongolaria barbata* from a Transitional Water System

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Gongolaria barbata thrives the intertidal and subtidal habitats of the warm-temperate Mediterranean Sea, particularly vulnerable to environmental changes due to its geography and exposure to various stresses. Testing whether the functional ecological traits of *G.barbata* vary with age is essential for predicting the performance of the algae under different environmental variables. Juveniles and adult thalli were collected from the Venice Lagoon, Italy, and analyzed for dry matter content (TDMC), photosynthetic activity, pigment and protein content, and antioxidant capacity to evaluate if thallus age may drive the species responses to environmental changes. Juveniles exhibited elevated photosynthetic efficiency, as evidenced by higher quantum yield of PSII electron transport, electron transport rate, and Rubisco amount. Juveniles also displayed higher levels of polyphenols, flavonoids, and tannins, and a stronger antioxidant capacity compared to adults. In contrast, adults showed higher TDMC and pigment concentration as well as increased non-photochemical quenching. No significant difference was found in maximum PSII photochemical efficiency and D1 protein content between the two groups. These findings suggest a different trade-off between acquisition and conservation strategies employed by young and adult individuals of *G. barbata* population. Juveniles allocate more energy to photosynthesis and chemical defenses to mitigate the risks associated with environmental stresses. Adults adopt a more conservative strategy, reducing photosynthesis and promoting structural biomass to withstand prolonged exposure to environmental factors such as waves and currents. The study provides insights into the physiological cost associated with thalli growth and development, defense mechanisms, and overall primary production.