LIGHT LIMITATION OF *POSIDONIA OCEANICA* (L.) DELILE GROWTH AT DIFFERENT DEPTHS

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Although several factors could be responsible for seagrass distribution and production patterns, light plays a major role in both growth rates and depth distribution (BUIA *et al.*, 1992; DUARTE, 1990). Reduction of light resources, due to environmental quality deterioration, contributes to the regression phenomena which make *Posidonia oceanica*, endemic of the Mediterranean Sea, an endangered species. The wide depth distribution shown by *Posidonia* translates into a variety of irradiance environment. The relationships between the light regime, production features and allocation of carbon has been approached in the case of other seagrass species such as *Zostera marina* (ZIMMERMANN *et al.*, 1991), *Thalassia testudinum* (FOURQUREAN and ZIEMAN, 1991) and others (POLLARD & GREENWAY, 1993). The objectives of the present research were to highlight :

- the role of photoperiod and available irradiance levels in explaining leaf growth patterns at different depths and light regimes,
- the role of belowground metabolic demand in the whole-plant carbon balance.

Two stands located at 5 m and 22 m respectively along a depth gradient at Lacco Ameno (Ischia, Gulf of Naples) were chosen. They are characterized by different structure (e.g. shoot density, Leaf Area Index) and growth patterns (BUIA *et al.*, 1992). Photosynthetic features were estimated measuring oxygen evolution through Clark-type electrodes of leaf tissues of different ages. Respiration by leaves and belowground tissues (roots and rhizomes) were estimated by the same methods. By knowing the leaf standing stock, these parameters were referred for each stand to the unit area (square meter). *In situ* PAR irradiance was periodically measured by a quanta meter and the average attenuation coefficient of local water column was calculated. By knowing the irradiance at which saturation of photosynthesis is achieved (Ik), the *in situ* maximum noon irradiance (Im) and the photoperiod, the daily period of saturating irradiance (Hsat) was assessed (DENNISON & ALBERTE, 1985). Hcomp, i.e. the daily period of irradiance above compensation light (Ic), was also estimated.

Stands at 5 m and 22 m showed variations in Pmax (maximum photosynthesis) mainly related to different leaf ages found in the different seasons (ranges are between 0.72 and 1.5 mgC/gdw/h at 5 m, and between 0.72 and 1.04 mgC/gdw/h at 22 m). However, in both stands low Ik ranging from 40 to 65 uE/m^2/sec were found, ensuring an optimal exploitation of light energy available. Belowground respiration is generally one order of magnitude lower than shoot respiration (0.05 vs 0.3 mgC/gdw/h, on the average). Hsat ranged from 14.4 hours (May) to 9.6 (November) at 5 m, and from 7.4 (May) to 4.9 hours (November) at 22 m (Fig.1). By combining production rates and respiration rates with the Hsat periods in the four seasons, a carbon balance was obtained for the unit area of the two stands. At 5 m, the maximum was achieved in May with 4.3 gC/m^2/day whereas the minimum occurred in January (0.6). At 22 m, a maximum was also achieved in May (0.2 gC/m^2/day) while in winter negative values were found (- 0.03 in Jan. and - 0.27 in Nov.). When Hcomp was taken into consideration, balance values at 22 m in winter were substantially raised (0.04 gC/m^2/h in Jan., - 0.14 gC/m^2/h in Nov.) (Fig.1).

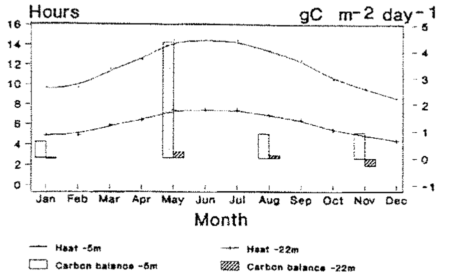

Figure 1. Carbon budget for *Posidonia*

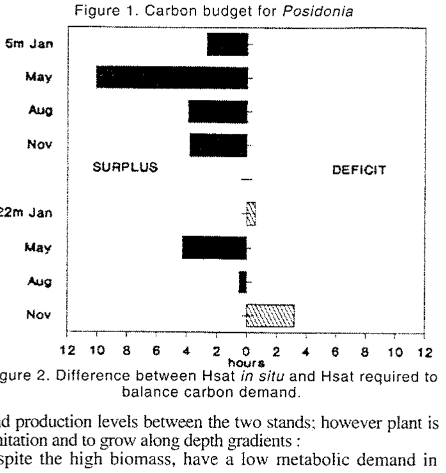

Figure 2. Difference between Hsat *in situ* and Hsat required to balance carbon demand.

The Hsat required to balance carbon demand, estimated by respiratory demand of the whole plant, as referred to the entire biomass, was largely reached and exceeded at 5 m in all four seasons, whereas at 22 m a deficit occurred in winter (Fig. 2). Light limitation seems to largely account for differences in growth patterns and production levels between the two stands; however plant is adapted to overcome this limitation and to grow along depth gradients :

- belowground tissues, despite the high biomass, have a low metabolic demand in comparison to the shoots;
- surplus production with respect to shoot growth, occurring in spring-summer, can be stored in the belowground tissues (PIRC, 1985) and can compensate for the depression of production due to biotic and abiotic factors.

As a result, although the plant has acquired adaptation to life at low irradiance, light limitation could be a factor for the rising of depth limit of *P. oceanica* contributing to the regression of its beds and consequently to the reduction of the high biodiversity which characterizes such systems. The role of *Posidonia oceanica* as a "biomass storer" through accumulation of belowground tissue is crucial in the coastal systems of the Mediterranean Sea making the species one of the most important structural component of complex ecosystems.

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