Estimation of the annual primary production of stream epilithic biofilms based on photosynthesis-irradiance relations

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With 2 figures and 5 tables in the text

Abstract: The main objective of this study was to estimate annual primary production in two undisturbed streams: La Solana (LS) and Riera Major (RM). Using hourly values of irradiance, community-specific photosynthesis irradiance relations (P-I) measured in the laboratory were used to estimate areal net and gross primary production over an annual cycle. The model (referred to as P-I model), showed good agreement ($r^2 = 0.53$ and $r^2 = 0.62$, $p<0.001$ for LS and RM, respectively) between estimated values and those measured in the field. The P-I model was also applied to estimate annual primary production after nutrient enrichment. Annual primary production was $50 \text{gC m}^{-2} \text{y}^{-1}$ for RM and $157 \text{gC m}^{-2} \text{y}^{-1}$ for LS before nutrient addition, but increased to $440 \text{gC m}^{-2} \text{y}^{-1}$ after nutrient addition. Light conversion efficiency (Ef) was higher for RM (0.25%) than for LS (0.16%) and it was significantly enhanced after nutrient additions (0.55%). A comparison between the annual primary production values obtained in this study with those from other lotic systems in different climatic zones indicated that stream order, nutrient concentration and light availability are probably more important than climate type in determining annual values of primary production in fluvial systems.

Introduction

Epilithic biofilms may account for the greatest part of primary production in low order streams (NAIMAN 1983), and influence nutrient dynamics, bacterial activity, invertebrate composition and other structural and functional aspects (MEYER et al. 1988, LOCK 1992, LAMBERTI et al. 1989, DUDGEON & CHAN 1992). Although studies of epilithic productivity are abundant, relatively few investigations have quantified annual primary production (e.g. ODUM 1957, McCONNEL & SIGLER 1959, HALL 1972). The most common approach uses