



## Lake metabolism: Relationships with dissolved organic carbon and phosphorus

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**ABSTRACT:** Recent literature has suggested that for many lakes and rivers, the respiratory breakdown of organic matter ( $R$ ) exceeds production of organic matter by photosynthesis (gross primary production [ $GPP$ ]) within the water body. This metabolic balance ( $GPP < R$ ; heterotrophy) implies that allochthonous organic matter supports a portion of the aquatic ecosystem's respiration. Evidence that many lakes are heterotrophic comes from diverse approaches, and debate remains over the circumstances in which heterotrophy exists. The methods used to estimate  $GPP$  and  $R$  and the limited extent of lake types studied, especially with respect to dissolved organic carbon (DOC) and total phosphorus (TP) concentrations, are two reasons for differing conclusions. We deployed  $O_2$  and  $CO_2$  sondes to measure diel gas dynamics in the surface waters of 25 lakes. From these data, we calculated  $GPP$ ,  $R$ , and net ecosystem production ( $NEP = GPP - R$ ). Over the broad range in TP and DOC among the lakes, diel  $CO_2$  and  $O_2$  changed on a near 1 : 1 molar ratio. Metabolism estimates from the two gases were comparable, except at high pH. Most lakes in our data set had negative NEP, but  $GPP$  and  $R$  appeared to be controlled by different factors. TP correlated strongly with  $GPP$ , whereas DOC correlated with  $R$ . At low DOC concentrations,  $GPP$  and  $R$  were nearly equal, but, at higher DOC,  $GPP$  and  $R$  uncoupled and lakes had negative NEP. Strong correlations between lake metabolism and landscape related variables suggest that allochthonous carbon influences lake metabolism.

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