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Autochthonous versus allochthonous carbon sources of bacteria: Results from whole-lake ^{13}C addition experiments

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Abstract

Organic substrates for pelagic bacteria are derived from dissolved organic carbon (DOC) in the water column. DOC is a heterogeneous mixture of molecules, some of which are imported from the watershed (allochthonous DOC) and others that are produced by autotrophs within the system (autochthonous DOC). We examined the importance of autochthonous versus allochthonous DOC in supporting the growth of pelagic bacteria by manipulating the ^{13}C content of autochthonous sources in a whole-lake experiment. $NaH^{13}CO_3$ was added daily to two small forested lakes for a period of 42 d, thereby strongly labeling autochthonous primary production. To obtain bacterial carbon isotopes, bacteria were regrown in vitro in particle-free lake water and in situ in dialysis tubes; little difference was found between the two methods. The contribution of autochthonous versus allochthonous carbon to the bacterial biomass was estimated by applying a two-member mixing model using a ^{13}C of $-28‰$ as the allochthonous end member. The autochthonous end member, which varied over time, was estimated indirectly by several approaches. The bacterial biomass consisted of 35–70% allochthonous carbon. This result confirms the often-stated hypothesis that autochthonous carbon alone does not support bacterial production. On the other hand, autochthonous DOC was preferentially utilized relative to terrestrial DOC. On the basis of ^{13}C measurements, only 13% of the DOC standing stock was of recent autochthonous origin, but it supported 30–65% of bacterial production.