The effects of cultural eutrophication on the coupling between pelagic primary producers and benthic consumers

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ABSTRACT: We investigated the effects of cultural eutrophication on the coupling between pelagic primary producers and benthic consumers in Lake Tahoe. Spatial and temporal changes in zoobenthos energetics were documented by measuring >40 yr of change in pelagic primary production through 14C incubations, reduction in clarity by Secchi and light measurements, and sedimentation rates. Effects on zoobenthic primary consumers (oligochaete and chironomid) and an obligate benthic secondary consumer (*Catostomus tahoensis*) were determined by comparing $\delta^{13}C$ values of historical and contemporary samples. A model that considers primary production (benthic or pelagic) contributions and their respective $\delta^{13}C$ signals was used to examine the factors contributing to zoobenthic energy shifts. Spatially, zoobenthos exhibited a strong positive relationship between lake depth and pelagic isotopic signals. For depths at which ambient 1% light levels have shifted with time (50-85 m), pelagic primary producer and zoobenthic consumer coupling was positive. Historically, zoobenthos from this depth zone obtained 27% of their energy from phytoplankton sources. After 43 yr of eutrophication, they obtained 62% from pelagic sources. A simple model indicated that increased pelagic production and resultant export of matter combined with the loss of benthic primary production contributed to the change in zoobenthos energetics. This change was passed on to higher consumers, with the benthic fish Tahoe sucker (*Catostomus tahoensis*) now deriving ~21% of its energy from pelagic primary production sources. This study demonstrates how lake eutrophication increases the coupling between pelagic and benthic habitats.