Food web responses to low-level nutrient and 15N-tracer additions in the littoral zone of an oligotrophic dune lake

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ABSTRACT: We used natural abundance stable isotopes to establish the structure of the littoral zone food web of an oligotrophic, perched dune lake on Fraser Island, Australia. Mixing model analyses incorporating riparian vegetation, seston, and periphyton sources indicated that periphyton carbon was the most significant food resource for aquatic consumers, despite the abundance of allochthonous carbon sources. In order to examine the consequences of nutrient inputs from tourists visiting this remote lake, repeated additions of low levels of phosphate and ^{15}N-enriched ammonium nitrate were made to three littoral zone sites. Additions led to significant increases in periphyton chlorophyll *a* (Chl *a*) concentrations in enriched sites but had no measurable effect on phytoplankton Chl *a* concentrations. Periphyton collected 5 h after the first nutrient addition had substantially enriched $\delta^{15}N$ signatures, suggesting that periphyton rapidly assimilated the added nutrients (and ^{15}N-tracer). After 10 d of additions, all other primary food sources for consumers also became ^{15}N-enriched, indicating that ongoing nutrient inputs are likely to lead to increased primary production and detrital processing. Substantially enriched consumer $\delta^{15}N$ signatures were also measured, indicating that the added nutrients were assimilated and passed through multiple trophic levels. Our results indicate that ongoing low-level nutrient additions by tourists to oligotrophic lakes could lead to increased primary (periphyton) and secondary (consumer) production. However, increases in periphyton production and biomass accrual could eventually escape control by grazers, leading to adverse ecological and aesthetic effects.