Application of deuterium tracer techniques to food-web analysis of seagrass meadows

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Coastal benthic ecosystems are fueled by multiple basal resources of both autochthonous and allochthonous origins. For seagrass beds, major basal resources include live and dead seagrasses, attached microalgae, microphytobenthos, suspended and sinking organic matter derived from plankton, and terrestrial and mangrove-derived organic matters depending on location. The turnover rate and the conversion efficiency through trophic transfer are vastly different between different basal resources. Stability and resilience of an ecosystem have been considered to depend on the range and diversity of such dynamic properties associated with respective basal resources. However, conventional tools for trophic analysis, such as stable isotope mapping and gut content inspection, are not necessarily useful for evaluating time scales of trophic transfer. In this study, for evaluating trophic transfer and turnover rates in experimental mesocosms, a deuterium (^{2}H)-based pulse-and-chase experiment combined with carbon (C) and nitrogen (N) stable isotope mapping was developed and applied to the macrobenthic community of seagrass meadows. At first, primary producers such as seagrasses and epiphytic microalgae were labeled with ^{2}H through a short-term incubation in $^{2}H_2O$-enriched seawater under natural light conditions. Then, the labeled primary producers were washed and transferred to a mesocosm with running or static natural seawater and incubated further with macrobenthic consumers such as crustaceans, molluscs, echinoderms, annelids, and juvenile fish for 2 –10 days. After incubation, primary producers and consumers were collected, freeze-dried, and analyzed for hydrogen, C, and N isotopic ratios. Trophic transfer rate was evaluated by comparing the ^{2}H enrichment between the primary producers and the consumers. Because ^{2}H enrichment did not disturb natural abundance of C and N isotopes, the trophic position of each consumer could be assessed by conventional C-N isotope ratio mapping. A preliminary experiment was also performed in which primary producers were labeled with multiple tracers of ^{2}H, ^{13}C, and ^{15}N, to compare uptake and translocation processes within the seagrass and trophic transfer to consumers between these elements. In this presentation, we introduce backgrounds, methodology, and some technical precautions of this method with some examples of application to the epibenthic food web in subtropical seagrass meadows (*Thalassia hemprichii* and *Syringodium isoetifolium*) and experimental acidification mesocosms of a temperate seagrass *Zostera marina* and associated macrobenthos.

Keywords: Food web analysis, Pulse-chase experiment, Stable isotope mapping, Coastal benthic ecosystem, Ecosystem functioning, mesocosms

