Category II – Aquatic Ecosystems

Sources of Inorganic Nitrogen Utilized by Salt Marsh Macroalgae; Identification Using Stable Nitrogen Isotope Ratios

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Executive Summary:

Nutrient availability can control the rate of algal production in estuarine systems. Surface runoff entering estuaries from adjoining watersheds is frequently nutrient-enriched. Identifying the source of nitrogen used by macroalgae during bloom events is critical to determine the extent to which the ecology of coastal wetlands is coupled to land use in the watershed. Data from tracer studies, together with information on nutrient loading and variation in macroalgal biomass, may provide strong evidence for coupling between anthropogenic nitrogen inputs and blooms of macroalgae in coastal wetlands. A tracer may also provide evidence of the extent to which marsh food webs are influenced by anthropogenic nitrogen inputs.

The overall objective of this project is to investigate the potential of stable nitrogen isotope ratios to trace the utilization of fertilizer-derived nitrogen by salt marsh macroalgae. The stable nitrogen isotope ratio is a measure of the relative abundance of the two naturally occurring isotopes of nitrogen (^{14}N and ^{15}N). This study is being conducted in Carpinteria Salt Marsh, a component of the UC Natural Reserve System, and in the drainages entering the marsh.

To determine the stable nitrogen isotope ratios of nutrient sources in the watershed and relate these values to adjacent land use, water samples were collected from all significant sources of runoff entering two channelized creeks through side drains. Nutrient concentration and isotopic data were superimposed on land use maps, constructed as part of this project, to identify point source inputs. Nitrate nitrogen concentrations in the effluent varied with adjacent land use and were highest (up to 20,000 µM) adjacent to greenhouse development. The stable nitrogen isotope ratio ($\delta^{15}N$ value) of nitrate in this effluent was low (-4.7 to 0.5 ‰) and characteristic of fertilizer-derived nitrogen.

$\delta^{15}N$ values of nitrate-N in surface runoff entering the marsh varied among six drainages; low values (~2 ‰) in the two creeks were associated with point source inputs (greenhouses) while high values in smaller artificial drainages (up to 15 ‰) were not associated with point sources and may indicate the seepage of perched groundwater into channels. The similarity between the $\delta^{15}N$ values of nitrate and *Enteromorpha clathrata* from the upper reaches of marsh channels indicate that this macroalga is assimilating fertilizer-derived nitrogen.

To date, stable nitrogen isotope ratios appear useful in tracing the assimilation by marsh macroalgae of fertilizer nitrogen originating from greenhouse development. Stable nitrogen isotope ratios may also be useful in identifying contributions of nitrate from perched groundwater to surface runoff. Stable nitrogen isotope ratios of ammonium-N in marsh pore water are being determined and will be used in a simple mixing model to estimate the relative contribution of regenerated nitrogen versus fertilizer-derived nitrogen to macroalgal growth in restored portions of Carpinteria Salt Marsh that receive runoff from greenhouse agriculture.