

## Assessment of Marine-Derived Nutrients in the Copper River Delta, Alaska, Using Natural Abundance of the Stable Isotopes of Nitrogen, Sulfur, and Carbon

Thomas C. Kline, Jr., Carol Ann Woody, Mary Anne Bishop, Sean P. Powers, and E. Eric Knudsen

**ABSTRACT** We performed nitrogen, sulfur, and carbon stable isotope analysis (SIA) on maturing and juvenile anadromous sockeye and coho salmon, and periphyton in two Copper River delta watersheds of Alaska to trace salmon-derived nutrients during 2003–2004. Maturing salmon were isotopically enriched relative to alternate freshwater N, S, and C sources as expected, with differences consistent with species trophic level differences, and minor system, sex, and year-to-year differences, enabling use of SIA to trace these salmon-derived nutrients. Periphyton naturally colonized, incubated, and collected using Wildco Periphyton Samplers in and near spawning sites was  $^{34}\text{S}$ - and  $^{15}\text{N}$ -enriched, as expected, and at all freshwater sites was  $^{13}\text{C}$ -depleted. At nonspawning and coho-only sites, periphyton  $^{34}\text{S}$  and  $^{15}\text{N}$  was generally low. However,  $^{34}\text{S}$  was low enough at some sites to be suggestive of sulfate reduction, complicating the use of S isotopes. Juvenile salmon SIA ranged in values consistent with using production derived from re-mineralization as well as direct utilization, but only by a minority fraction of coho salmon. Dependency on salmon-derived nutrients ranged from relatively high to relatively low, suggesting a space-limited system. No one particular isotope was found to be superior for determining the relative importance of salmon-derived nutrients.