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Isotopic Insights into Inorganic and Organic Nitrogen Dynamics: A Pathway to Restoration in a Semi-Arid Estuary

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Stakeholder concerns over water quality issues along the Texas Gulf of Mexico Coast have driven my research group's collaborative efforts to identify root causes and support effective watershed mitigation plans. This presentation highlights our long-term research in Baffin Bay, TX, USA where eutrophication and intermittent harmful algal blooms have been linked to nitrogen inputs. Our primary approach involves using stable isotope techniques to trace the sources and transformations of dissolved inorganic and organic nitrogen across groundwater, pore water, and surface water. Our findings indicate that high nitrate concentrations in surficial wells stem from on-site sewage facilities (OSSFs), elevated ammonium in pore water results from dissimilatory nitrate reduction to ammonium and remineralization, and persistent dissolved organic nitrogen in surface waters is driven by long residence times and allochthonous inputs. The isotopic evidence and observed low inflow coupled with collaborative groundwater discharge studies, suggest groundwater as the primary delivery mechanism of nitrogen to the Bay. Our findings have played a pivotal role in informing watershed management plans and guiding a new multi-decade "Bringing Baffin Back" restoration initiative. Continuous monitoring of changes in nitrogen concentrations and isotopic composition remains a central focus of future work, enabling us to evaluate the efficacy of restoration efforts over time.