RIVER ECOSYSTEMS IN A CHANGING ARCTIC: USING RETROSPECTIVE AND EXPERIMENTAL APPROACHES TO UNDERSTANDING FUTURE CHANGE

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Abstract:
Accelerated rates of warming in arctic environments are expected to have substantial effects on arctic river ecosystems. This dissertation uses observational and experimental approaches to understand potential responses of an arctic river ecosystem to climate change at population, community, and ecosystem levels. Research focused on two study reaches of the upper Kuparuk River located on Alaska's North Slope, an un-manipulated reference reach and an experimentally phosphorus enriched reach (+P). Chapter 2 addresses gaps in our understanding of the patterns and drivers of primary productivity, showing high levels of primary production during cold, and historically under-sampled shoulder seasons. Seasonal patterns in primary production were significantly and negatively related to grazing invertebrates. A 31-year record revealed that chlorophyll biomass was significantly related to the discharge regime of the previous summer, a "legacy effect" that demonstrates how bedfast ice that encases streambed sediments each winter protects epilithon from the high flows that characterize spring discharge. Chapter 3 investigates potential roles of grazing insects in mediating primary productivity. *Acentrella lapponica*, a dominant grazing mayfly, was associated with significant declines of summer chlorophyll over a 12 year period that were contrasted with increases in shoulder-season chlorophyll. An unexpected increase from univoltinism to bivoltinism for *Orthocladius rivulorum* under nutrient enriched conditions, coupled with this species ability to enhance primary productivity via "farming", resulted in substantial increases in total algal availability. Invertebrate life cycle phenology, thus, may play a substantial role in river ecosystem responses to climate change in the Arctic. Chapter 4 shows that annual community productivity tracked closely with epilithic chlorophyll, as mediated by the "legacy effect" of the previous year's discharge. Finally, Chapter five presents the results of an analysis of Arctic-LTER monitoring data and demonstrates changes in discharge-corrected concentrations of nitrate (+) and DOC (-) and significant declines in phosphorus supply. Isotopic composition of aquatic invertebrates indicate increasingly negative carbon source that is likely due to the effects of thawing permafrost and potentially attributed to increases in methane-derived carbon. These data point to the importance of hydrology, resource availability, and biotic interactions as important drivers of arctic river responses to climate warming.