

Microbes vs Nutrients: Understanding Nutrient Pollution in Streams

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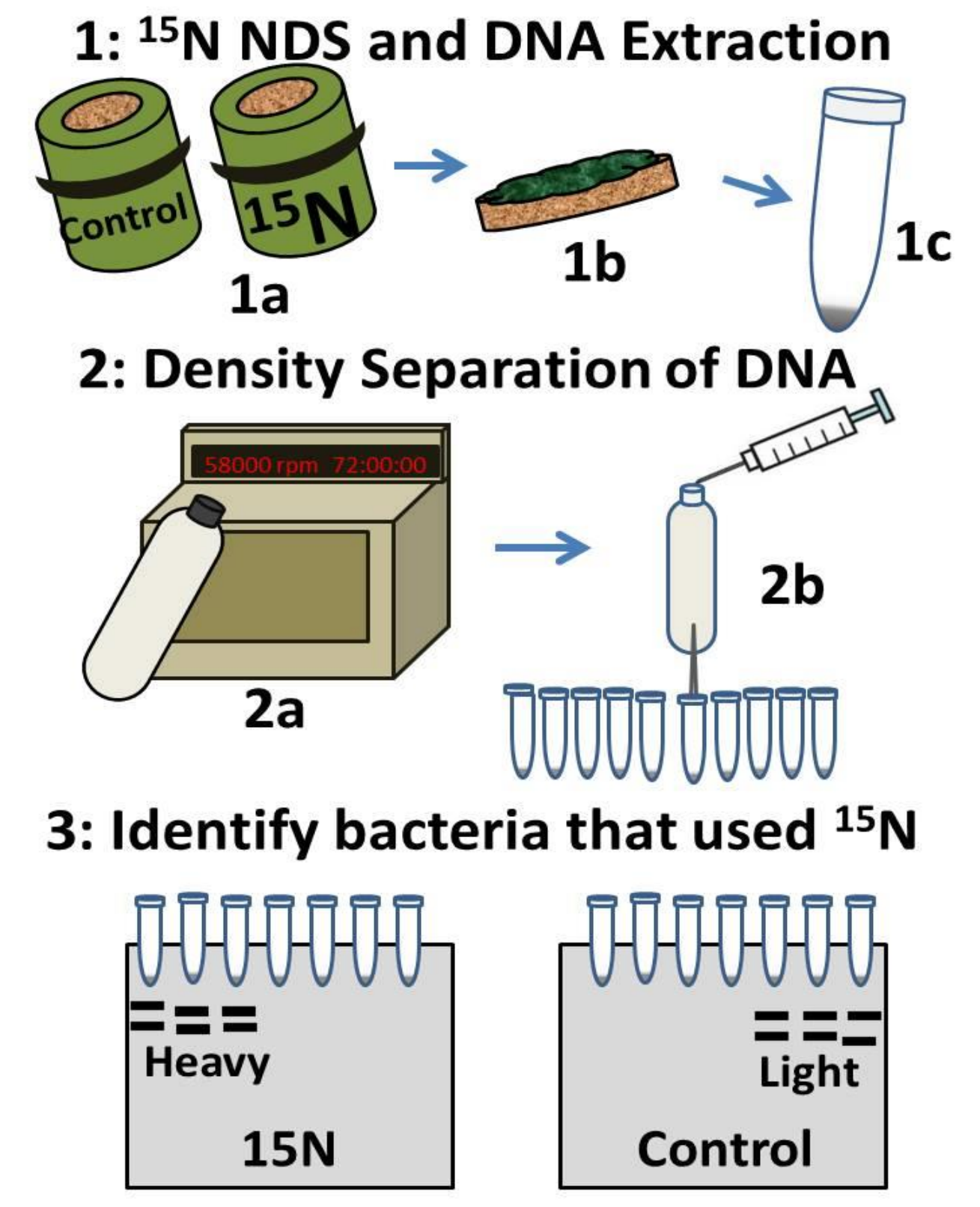
Problem

Nitrogen and phosphorus are important nutrients for bacterial and algal growth. However, human inputs of these nutrients can cause eutrophication, negatively impacting aquatic ecosystems. Understanding the effects of nutrient pollution can help us protect water resources. We asked: How do excess nutrients affect the structure and function of stream biofilms?



Algal growth in a manmade pond in Providence, UT

Bacterial Nitrogen Preferences



Nutrient diffusing substrates (NDS) were used to expose stream biofilms to ¹⁵N-nitrate, ¹⁵N-ammonium, and ¹⁵N-organic nitrogen (glycine) (1a). We extracted DNA from the biofilms (1b;1c), and separated the DNA by density using ultracentrifugation (2a; 2b). Changes in DNA density were used to identify the bacteria that used the ¹⁵N substrates (3). This will help understand which types of bacteria are influenced by eutrophication.

Biofilm Nutrient Limitation

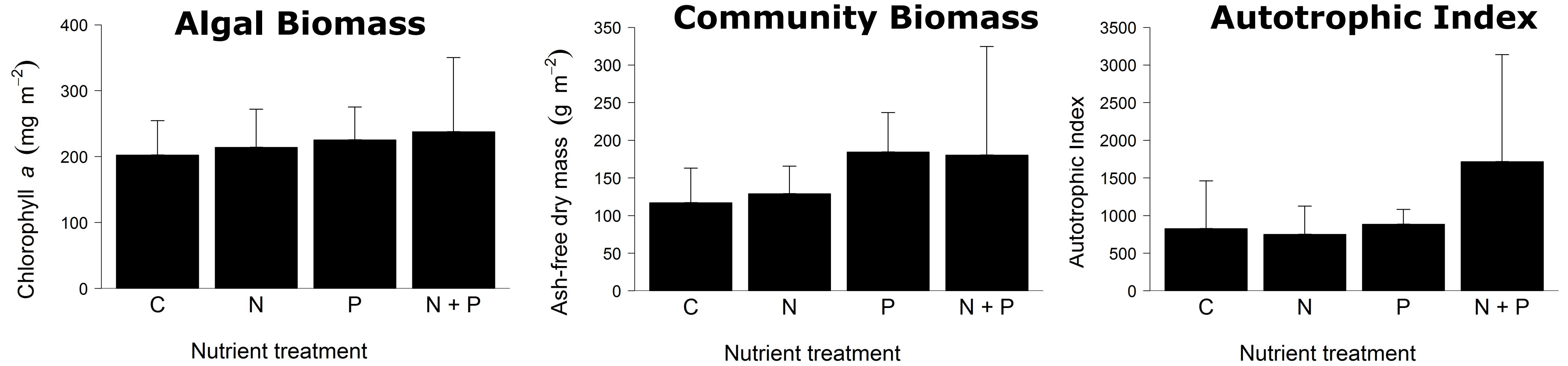
We deployed nutrient diffusing substrates (NDS) that contained nitrogen and phosphorus in the Middle Provo River. These mimic high nutrient loads in streams. We measured how nutrients influence biofilm growth to assess which nutrient was limiting.



Nutrient diffusing substrates with biofilm growth

Results

Nutrients did not affect algal biomass (chlorophyll), community biomass (ash-free dry mass) or the relative abundance of autotrophs in biofilms (autotrophic index), indicating that neither nitrogen or phosphorus (alone or in combination) were limiting to biofilms.



Responses of biofilm biomass to treatments in nutrient diffusing substrates: Control (C), nitrogen (N), phosphorus (P), and nitrogen and phosphorus in combination (N + P)

We think that nutrients were not limiting biofilms in the Middle Provo River because existing nutrient pollution may have alleviated any limitation. We hope that the analysis of the ¹⁵N NDS samples will help us understand how different forms of nitrogen influence the bacterial community.



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