Environmental Indicators: Ectoenzyme Activity in Different Size Communities
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ABSTRACT

Extracellular enzyme ("ectoenzyme") activities of aquatic microorganisms have been found to be effective determinants in evaluating nutrient deficiency. When a nutrient becomes limiting, it causes certain extracellular enzymes ("ectoenzymes") to be synthesized, which are capable of hydrolyzing specific substrates. Two of these enzymes are alkaline phosphatase, synthesized when phosphorus is limiting, and aminopeptidase, synthesized when nitrogen is limiting. This project examined phosphatase and peptidase activity overall and in what size fractions they each occur in the Gulf of Mexico during July 2004. During this period, alkaline phosphatase activity was found to be highest in the Mississippi River mouth. Alkaline phosphatase activities were found in both bacterial (<2 μm) and algal (10-2 μm) size fractions. Aminopeptidase activity occurred equally in all size fractions. The Mississippi River is one of the world's top ten rivers in sediment delivery, and freshwater discharge. Increased nitrogen loading to the Gulf of Mexico causes surface plume become phosphorus-limited during the high flow season. The first response in the microbial community to environmental change is ectoenzyme activity. Ectoenzymes can be produced by many microorganisms, such as bacteria, protozoa, and heterotrophic nanoflagellates. However, most activity is associated with heterotrophic bacteria and is generally found in bacterial size fractions (0.2-2 μm). Alkaline phosphatase has been associated with both algae and bacteria and is most often found in both bacterial (<2 μm) and algal (10-2 μm) size fractions. The Mississippi River mouth is the starting point for a large number of microorganisms. The Mississippi River is one of the world's top ten rivers in sediment delivery, and freshwater discharge. Increased nitrogen loading to the Gulf of Mexico causes surface plume become phosphorus-limited during the high flow season. The first response in the microbial community to environmental change is ectoenzyme activity. Ectoenzymes can be produced by many microorganisms, such as bacteria, protozoa, and heterotrophic nanoflagellates. However, most activity is associated with heterotrophic bacteria and is generally found in bacterial size fractions (0.2-2 μm). Alkaline phosphatase has been associated with both algae and bacteria and is most often found in both bacterial (<2 μm) and algal (10-2 μm) size fractions.

METHODS
The contour map of aminopeptidase shows the highest activities at the Mississippi River mouth. This is assumed to occur because the low salinity in this region, and the increased nitrogen loading from the high flow rate of the Mississippi River, a substantial increase in biomass. Alkaline phosphatase activities are also highest in this region, providing evidence for phosphorus limitation. The size fractionation data shows that peptidase activity was somewhat equally distributed among the three size fractions. This does not explain why peptidase activities were found to occur equally. Phosphatase activity was highest in the <2 μm size fraction. This fraction is where bacteria are found and so bacteria seem to be the most phosphorus-limited. Ppad data suggests that in July, the system begins to move away from a phosphorus-limited environment to a nitrogen-limited environment. We propose that the decreasing nitrogen caused by the decreasing flow rate causes the population reduction of larger organisms. There is still enough nitrogen for the smaller organisms (i.e., cyanobacteria, which are prominent in the region in July) to survive. Therefore, phosphatase activities increase in the smaller size fractions.

RESULTS

**Aminopeptidase Activity (μM L⁻¹ hr⁻¹)**

**Phosphatase Activity (μM L⁻¹ hr⁻¹)**

**CONCLUSION**

The contour map of aminopeptidase shows the highest activities at the Mississippi River mouth. This is assumed to occur because the low salinity in this region, and the increased nitrogen loading from the high flow rate of the Mississippi River, a substantial increase in biomass. Alkaline phosphatase activities are also highest in this region, providing evidence for phosphorus limitation. The size fractionation data shows that peptidase activity was somewhat equally distributed among the three size fractions. This does not explain why peptidase activities were found to occur equally. Phosphatase activity was highest in the <2 μm size fraction. This fraction is where bacteria are found and so bacteria seem to be the most phosphorus-limited. Ppad data suggests that in July, the system begins to move away from a phosphorus-limited environment to a nitrogen-limited environment. We propose that the decreasing nitrogen caused by the decreasing flow rate causes the population reduction of larger organisms. There is still enough nitrogen for the smaller organisms (i.e., cyanobacteria, which are prominent in the region in July) to survive. Therefore, phosphatase activities increase in the smaller size fractions.

**Works Cited**


