Spring 2020

Impacts of human recreation on nutrient availability and periphyton abundance on the Niobrara River

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UNL Undergraduate Creative Activities and Research Experience at Nebraska (UCARE)

Introduction

Thousands of tourists travel to the Niobrara River each summer to partake in recreational activities ranging from camping to leisurely floating down the river. A portion of the river near Valentine, NE is the most highly trafficked stretch. The following question was asked as we began our project; **Do human recreational activities have a direct impact on the river ecosystem**

To answer this question we chose a stretch of the Niobrara River that saw a range of human activity and divided it into three sections (Figure 1). Within each of these zones, sites were chosen to collect data on nutrient concentrations (nitrate (NO_3^-), ammonium (NH_4^+), and phosphorus (SRP)), periphyton abundance on the river bed and periphyton abundance in the water column. Periphyton is a collection of diatoms, algae, cyanobacteria, and other organisms found in water. Data collection followed the APHA *Standard Methods for the Examination of Water and Wastewater* and *Methods in Stream Ecology.*

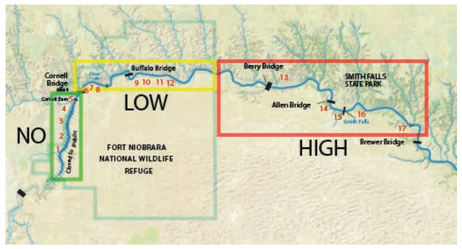

Figure 1: A map of collections sites divided into three impact zones: "NO", "LOW", and "HIGH". The NO impact zone was on a designated stretch of the river where there was no public access. The LOW and HIGH impact zones both allowed public access but the LOW impact zone had alcohol restrictions, inherently limiting summer recreation.

Does nutrient availability vary through the year?

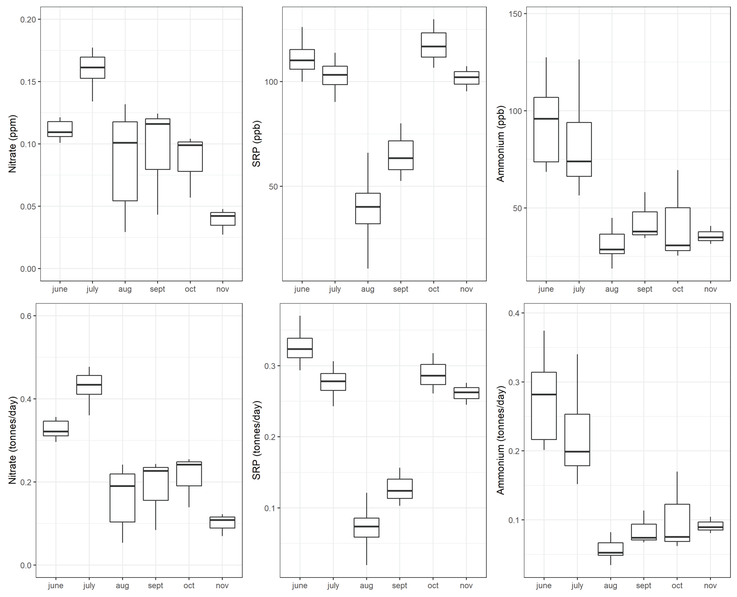

Figure 2: Graphs showing the concentrations and daily loads of nitrate, ammonium and soluble reactive phosphorus (SRP) measured over summer and fall months of 2019. Across all three of the measured nutrients there is a significant decrease in concentration and daily load in August. SRP rebounds significantly after August to return to levels seen in the early summer whereas both of the nitrogen compounds only see a slight increase over following August and remain at lower levels. The decrease seen across all three measured nutrients could be attributed to a spike in biological activity which in turn lowers the nutrient availability. This hypothesis does not seem to be supported by figures 3-5, indicating that there is a significant nutrient sink other than periphyton. The difference between SRP and the two nitrogen compounds is interesting and may indicate that phosphorus availability is generally higher than that of nitrogen (i.e. nitrogen is more limiting than phosphorus). This hypothesis will require further analysis to confirm or reject.

Is periphyton growth affected by human recreation?

Figure 3: A graph showing epilithic (growing on rock) periphyton abundance through the course of the summer as represented by Chlorophyll-*a* concentration (µgcm^{-2}). There is no significant trend among the three impact zones. Even more surprising there is little to no trend throughout the months. However, epilithic periphyton was consistently higher than that found in epipsammic regions (Figure 4).

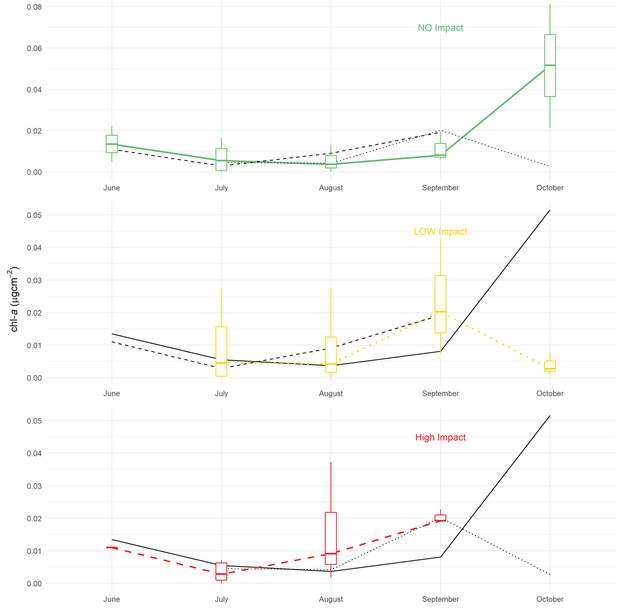

Figure 4: A graph showing epipsammic (growing in/on sand) periphyton abundance through the course of the summer as represented by Chlorophyll-*a* concentration (µgcm^{-2}). Again, there is no difference between the three impact zones but we see a more pronounced trend as we move farther into the summer. It is interesting to note that in the NO impact zone, October shows a large increase in periphyton whereas in both the LOW and NO impact zones a slight decrease is apparent.

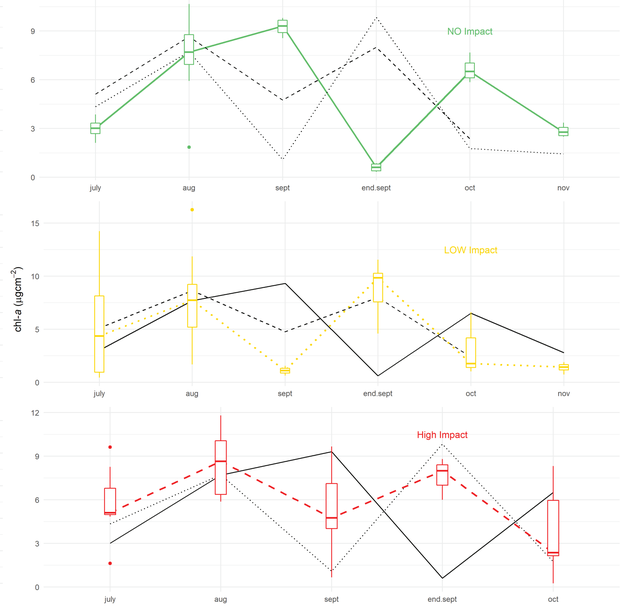

Figure 5: A graph showing periphyton growth on the control cups from nutrient diffusing substrata (NDS) through the course of the summer as represented by Chlorophyll-*a* concentration (µgcm^{-2}). NDS were set out at each site to investigate nutrient limitation. Upon analysis there were no significant trends seen with nutrient limitation. The control cups (those with no nutrient amendment) were plotted to represent the periphyton abundance in the water column. Again, no trend is seen between any of the impact zones and no noticeable trend is found across time.

Conclusion

Based on our results there is no significant human impact on nutrient availability or periphyton growth. As with most aquatic ecosystems there appears to be a significant seasonal pattern to nutrient availability. However, there does not seem to be a mirrored response in the periphyton growth indicating another sink for these nutrients. Much more data will need to be collected in the coming years to verify the results presented here.

A small caveat

2019 brought major flooding at the end of the spring and persisted through the entire summer and well into the fall. Water levels on the Niobrara were consistently higher than the historical averages and altered the physical nature of the system. On a typical year during the late summer months the water becomes incredibly clear and the water levels in some reaches of the river can drop below two feet. During the time that we sampled the river, there was never a day where we could see the stream bed. Less light penetration to the bottom may have impacted the epilithic and epipsammic growth of periphyton. More water means that the water will move quicker than usual and normal growth patterns may have been disrupted (sandy areas being washed out, rocks turning over, etc.). More water also means that any potential nutrient additions as a result of recreation may not have been as prominent as a typical year. Continued research in the coming years will be necessary to determine to what extent flooding has impacted the data in regards to the research question.

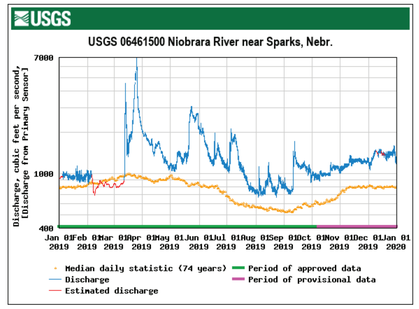

Figure 7: A graph showing the monthly discharge on the Niobrara River in 2019 in comparison to the historic averages. The 2019 data (seen in blue) remains above the historic averages (seen in orange) after a spike at the end of March.

Figure 8: Kayla, Matthew and Jessica studying a periphyton covered rock in unusually turbid, fast moving water.

Contact us!

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Special thanks to Cabela's and the UNL Undergraduate Creative Activities and Research Experience at Nebraska (UCARE) and the Cabela's Apprenticeship program for fuding this project. The Cabela's Apprenticeship program is a collaborative effort among Cabela's, Nebraska Game and Parks Commission, and University of Nebraska-Lincoln to provide tangible, experiential opportunities for undergraduate and graduate students committed to conserving fish, wildlife, and wild places. The UCARE program is supported by generous gifts from the Pepsi Quasi Endowment and Union Bank & Trust.