RIVER EXPORT OF BIOAVAILABLE NUTRIENTS AND LABILE ORGANIC CARBON: EFFECTS ON ESTUARINE NUTRIENT STOICHIOMETRY AND BACTERIOPLANKTON NUTRIENT LIMITATION

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- **Resource stoichiometry from routinely analyzed nutrient fractions does not explain the nutrient regulation of bacterial metabolism in boreal river systems**
- **Variability in bioavailable P explains P limitation, while predictions based on total P or soluble reactive P fail**
- **The bioavailability of organic nutrients likely controls the ecosystem effects of nutrient loads to the Baltic Sea**

We measured total and bioavailable fractions of dissolved N, P, and organic C in 15 river systems in the Baltic Sea catchment (2012-2013). Total N and P pools were mainly organic. We found 10-fold higher C : N and 3-fold higher C : P ratios for the total nutrient fractions, compared with those of the bioavailable nutrient fractions. Mean bioavailability was 5% of organic C, while roughly half of total N, and a quarter of total P, was bioavailable.

Although classical resource C : N : P stoichiometry would suggest N limitation in several cases, our experiments showed that N had a systematically higher bioavailability and was never a limiting factor for bacterial respiration. The degree of P limitation of bacterial metabolism decreased with increasing concentrations of bioavailable P (Figure 1). Soluble reactive P or total P did not have any predictive value.

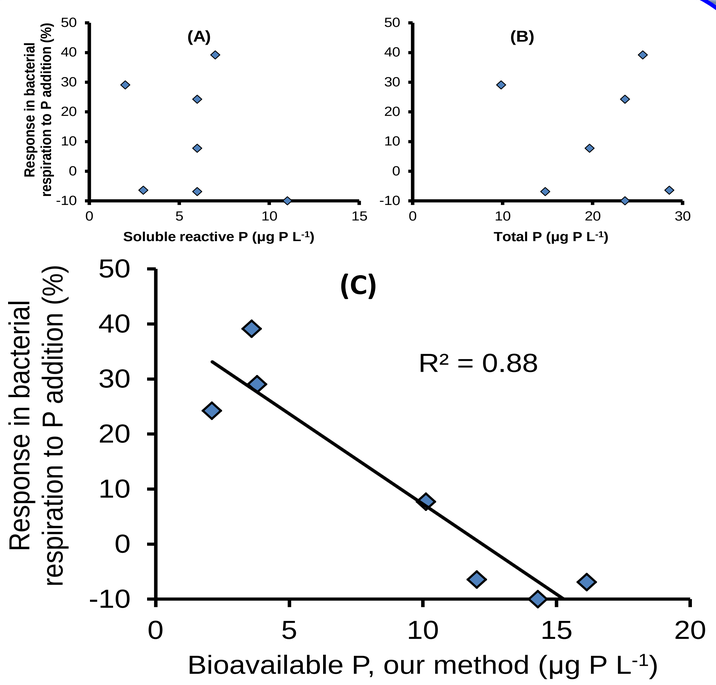
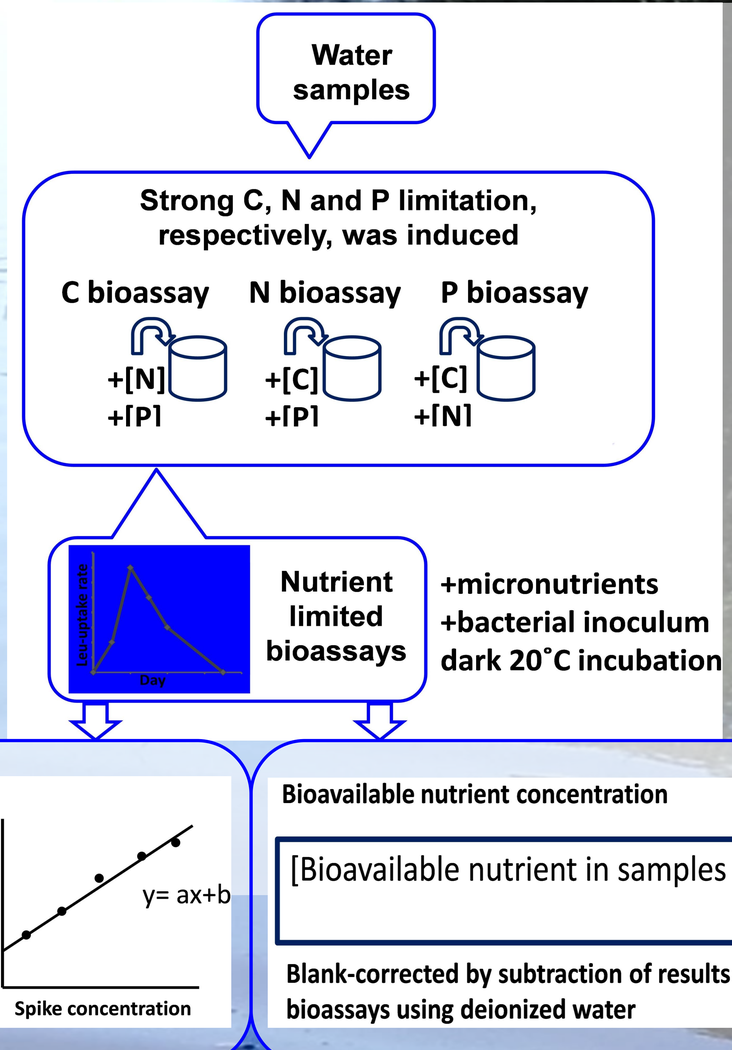


Figure 1. The relative relative effect of P additions (100 µg P L^{-1} as KH_2PO_4-P) on bacterial respiration (*in vitro* O_2 consumption rates) at seven selected Baltic Sea river mouths, plotted against (A) soluble reactive P, (B) total P and (C) bioavailable P.



Directions of future research

We are now analyzing our approach in relation to previously applied methods for assessing bioavailability of DOC (Del Giorgio and Davis 2003), N (Stepanauskas et al. 2000) and P (Jansson et al. 2012). Our methods yield DOC bioavailability values that are proportional to those inferred from O_2 consumption rates (R^2 = 0.74). However, they sometimes yield higher values of N and P bioavailability than previous methods. Yet, our methods seem to do a better job than these previous methods at predicting actual nutrient limitation of the ambient bacterial community.

In 2014, we plan to study how the bioavailability of the different nutrient pools responds to the increasing salinity gradients in the estuaries. Doing so, we aim at building an integrating understanding of how the nutrient pools that are exported from the northern part of the Baltic Sea catchment (mainly organic) contributes to the ongoing eutrophication of the Baltic Sea.

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Jansson, M., M. Berggren, H. Laudon, and A. Jonsson. 2012. Bioavailable phosphorus in humic headwater streams in boreal Sweden. Limnol. Oceanogr. **57:** 1161-1170.
Stepanauskas, R., H. Laudon, and N. O. G. Jørgensen. 2000. High DON bioavailability in boreal streams during a spring flood. Limnol. Oceanogr. **45:** 1298-1307.