Some potential issues with long-term stoichiometric approaches

Walter Dodds 2018 LTER ASM

Example 1. Hard to get even 24 hours of detailed stoichiometric information

- Uptake of N, P and C as a function of light 6 times over a year
- Compared to nutrient bioassays

- Dodds WK, Priscu JC. 1989. Ammonium, Nitrate, Phosphate, and Inorganic Carbon Uptake in an Oligotrophic Lake - Seasonal-Variations among Light Response Variables. Journal of Phycology 25:699-705.
- Dodds WK, Priscu JC. 1990. A Comparison of Methods for Assessment of Nutrient Deficiency of Phytoplankton in a Large Oligotrophic Lake. Canadian Journal of Fisheries and Aquatic Sciences 47:2328-2338.

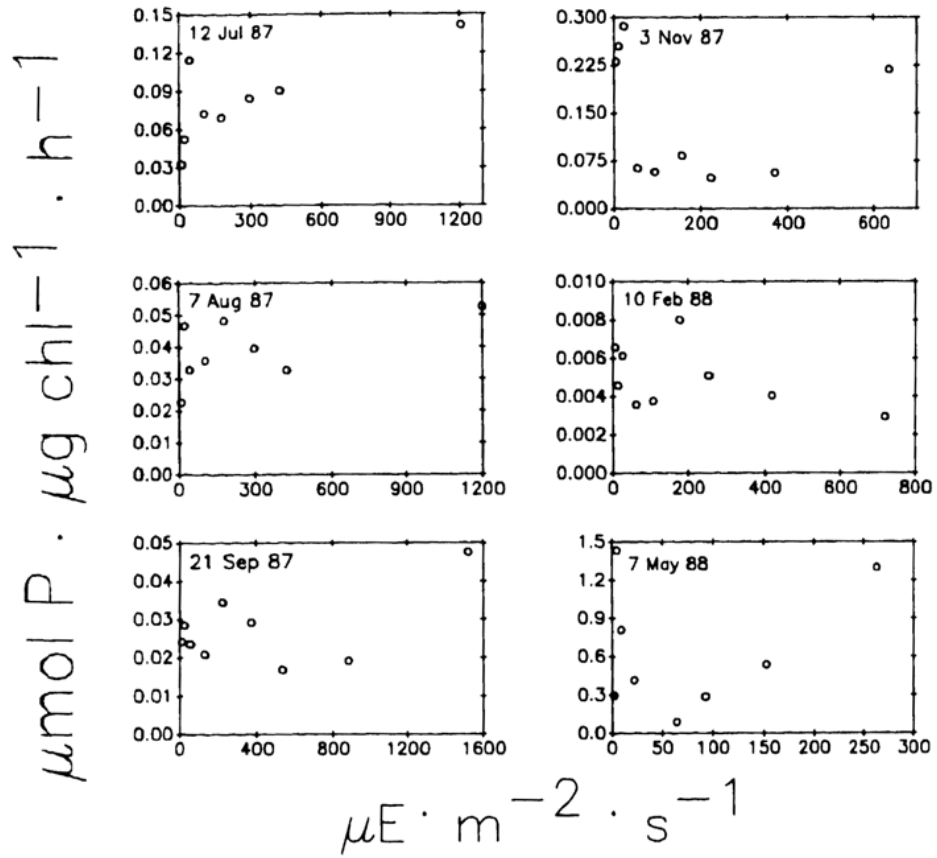


FIG. 1. Seasonal relationship of PO_4^{3-} uptake to PPFD in Flathead Lake.

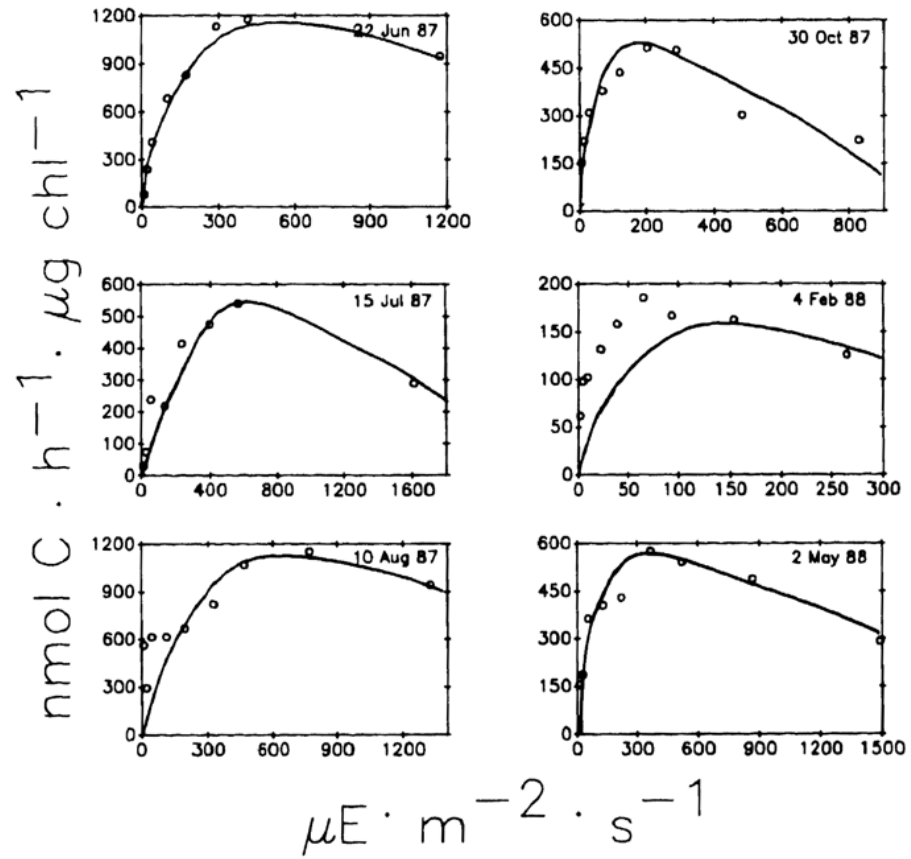


FIG. 2. Seasonal relationship of CO_2 uptake to PPFD in Flathead Lake. See text for a description of the model used to fit the curves to the data.

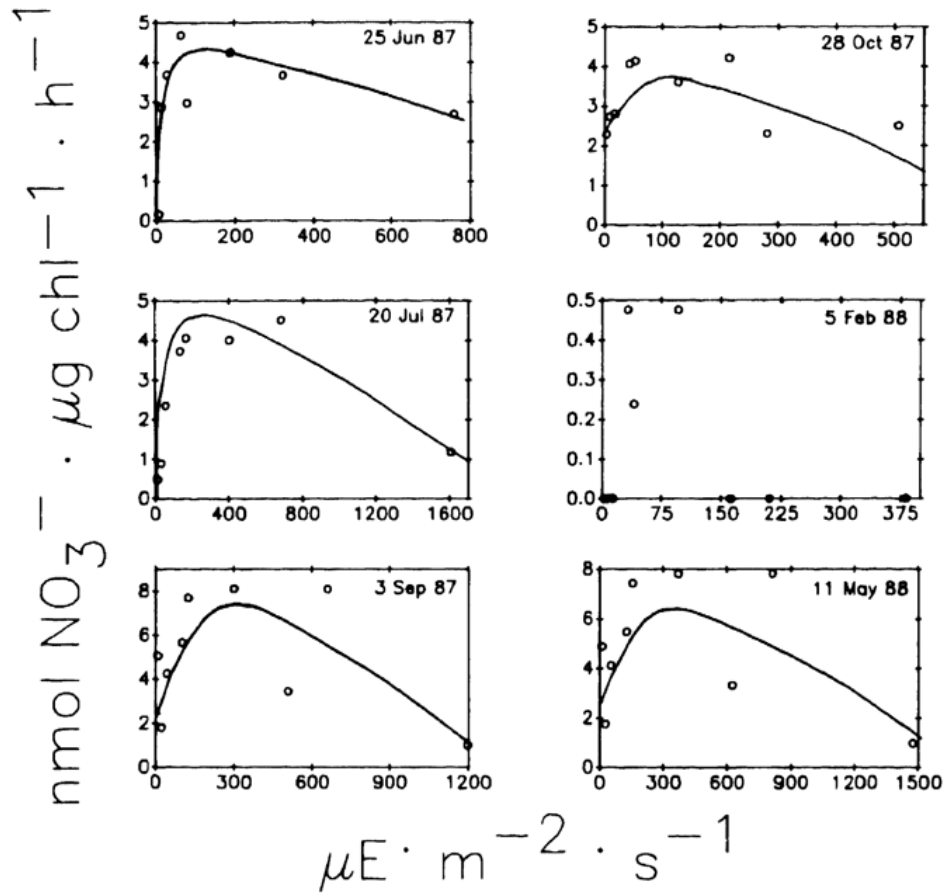


FIG. 3. Seasonal relationship of $^{15}NO_3^-$ uptake to PPFD in Flathead Lake.

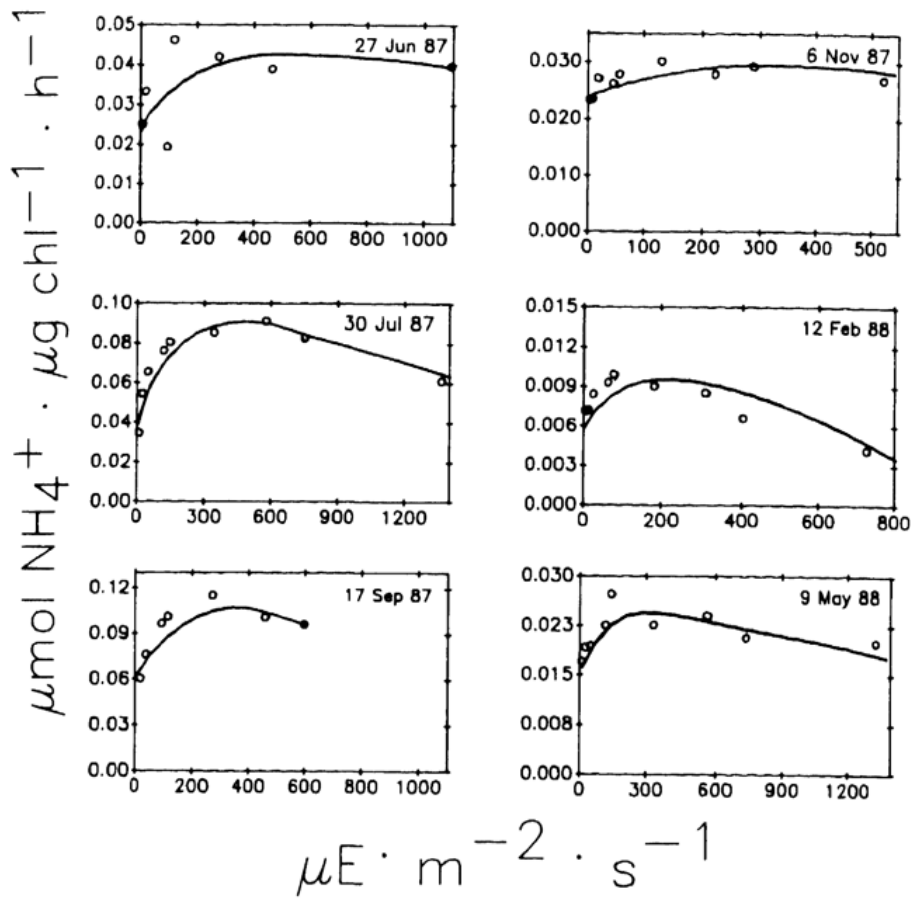


FIG. 4. Seasonal relationship of $^{15}NH_4^+$ uptake to PPFD in Flathead Lake.

Stoichiometry of C:N:P uptake ratios (molar), bioassay and standing stocks Flathead lake

Date			
10 August 1987	Noon	Midnight	24 h integrated
Surface	3125:20:1	0:12:1	1480:17:1
5m	2500:27:1	0:12:1	1260:19:1
Bioassay			N+P
Nutrient ratio			N+P
12 February 1988			
Surface	476:2.5:1	0:2.3:1	165:2.3:1
5m	667:3.5:1	0:2.3:1	182:2.6:1
Bioassay			Neither
Nutrient ratio			N or P

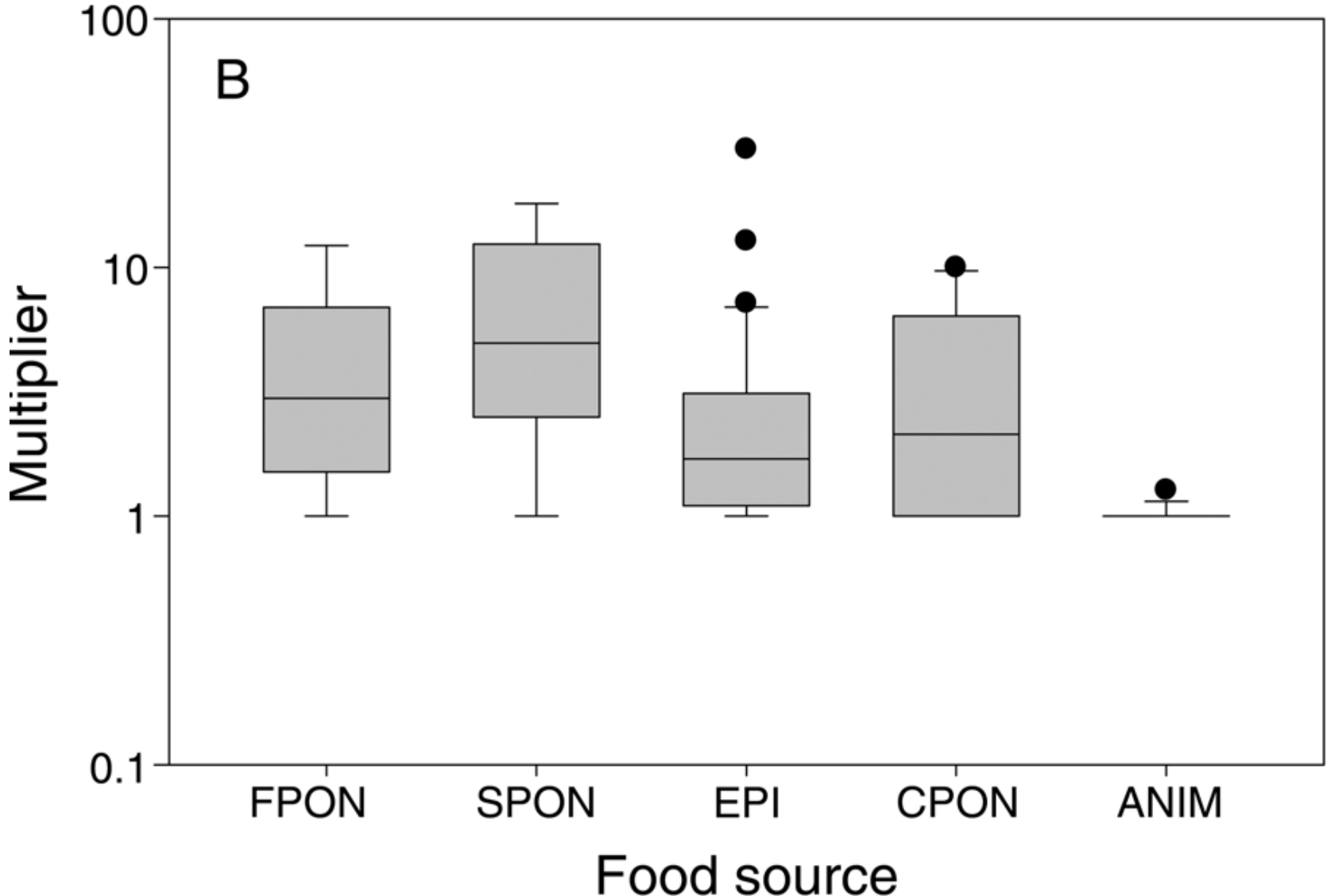
Example 2. What we measure as nutrient content of primary uptake compartments might be irrelevant to actual biologically available nutrients

- Analyzed 21 whole-stream long term 15N uptake experiments (LINX I style)

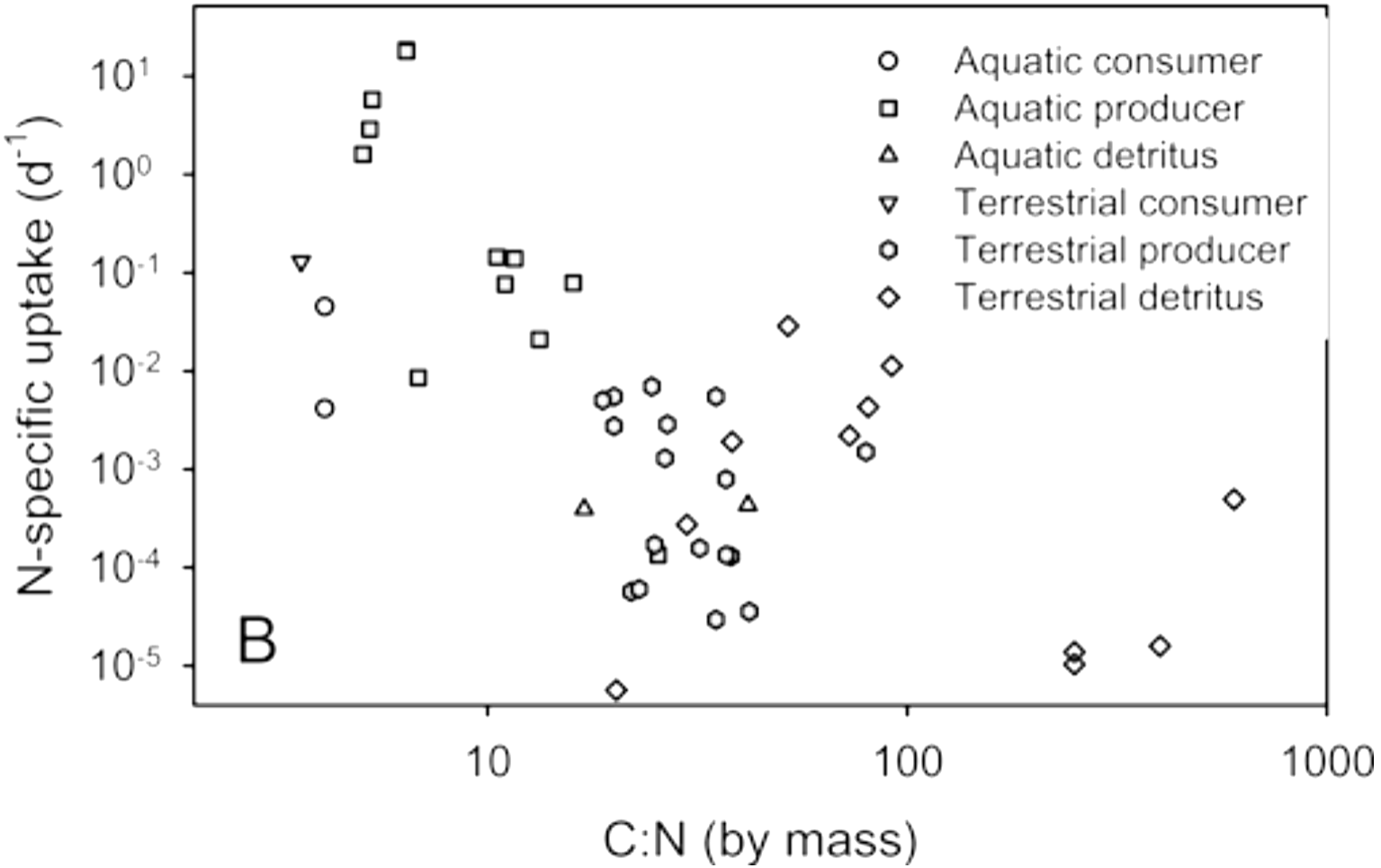
- Uptake rates of animals did not logically match with measured isotope labeling of epilithon, leaves, filamentous algae, fine benthic organic material

- Dodds WK, et al. 2014. You are not always what we think you eat: selective assimilation across multiple whole-stream isotopic tracer studies. Ecology 95:2757-2767.
- Dodds WK, et al. 2004. Carbon and nitrogen stoichiometry and nitrogen cycling rates in streams. Oecologia 140:458-467.

½ or more of the N was not actively cycling into food web



Slower N turnover in more C rich materials, but shows stoichiometry is important

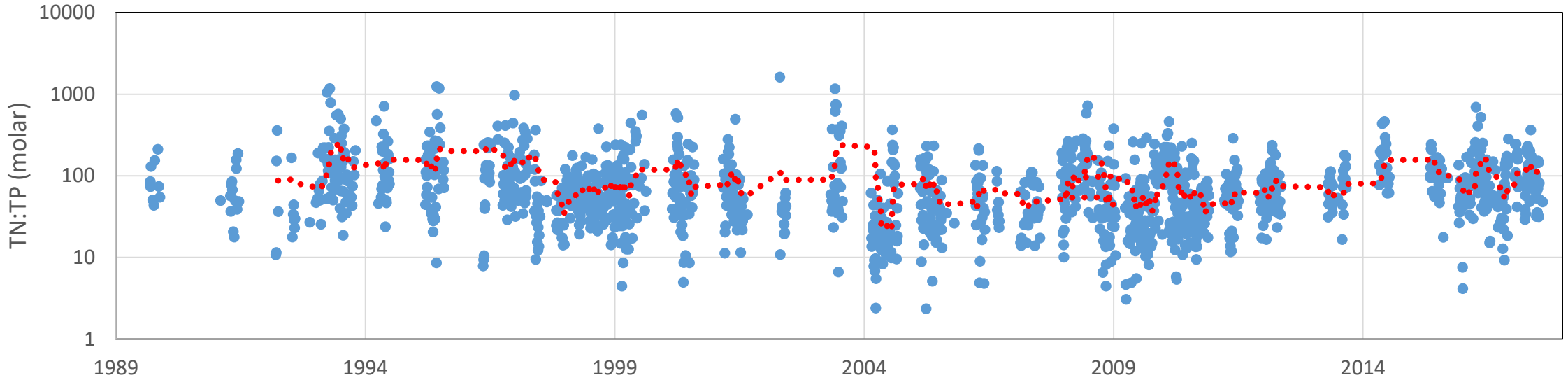


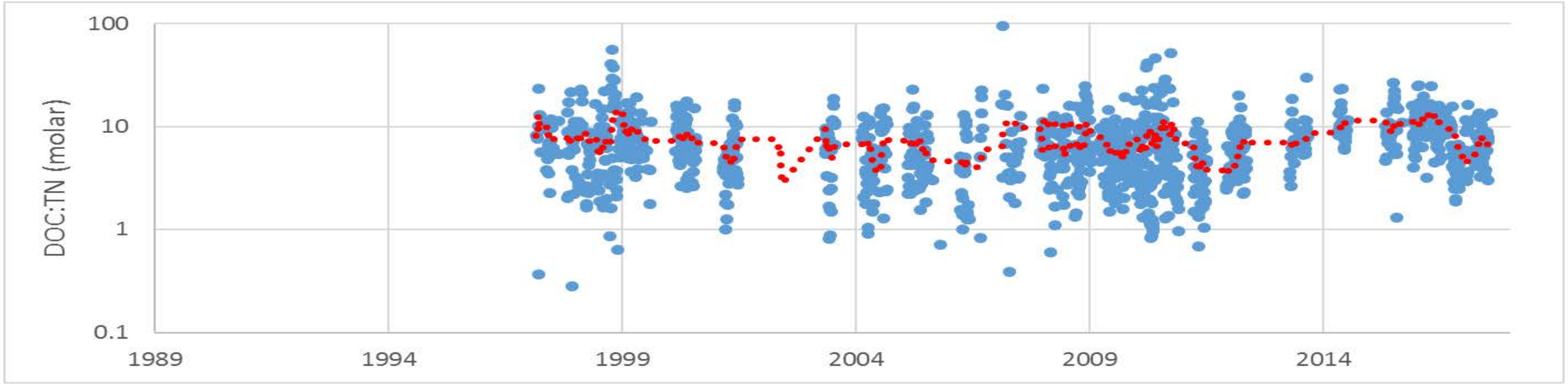
Example 3. People insist on using SRP:DIN ratios to indicate nutrient limitation

- It doesn’t work!
- Standing stocks of small pools do not indicate flux rates
- SRP assay is an indeterminate chemical fraction

- Dodds WK. 2003. Misuse of inorganic N and soluble reactive P concentrations to indicate nutrient status of surface waters. Journal of the North American Benthological Society 22:171-181.

Example 4: Ecosystems are messy and variable (Kings Creek N4D)





Should we look at long term nutrient stoichiometry patterns?

- Yes
- Don’t expect to get answers without lots of data or huge changes
- Lots of methodological challanges