Bioavailability of organic phosphorus across a riverine nutrient gradient

Eleanor B. Mackay[1], Mitzi De Ville[1], Chris Yates[2], Alun Owen[2], Miles Marshall[3], Nathan Callaghan[3] and Stephen C. Maberly[1].

1. Introduction

The increased loading of organic matter to freshwaters is a growing concern. Organic nutrients exported from catchments or produced *in situ* may contribute to the enrichment of rivers and lakes resulting in nuisance algal growth. However, the role of organic rather than inorganic phosphorus in promoting algal productivity has received little attention to date and few studies have considered the relative bioavailability of different organic phosphorus compounds across gradients of productivity.

This study presents some preliminary results to the following questions:

1. Are organic phosphorus compounds being utilised by river algae?
2. Does this vary according to location?
3. Does this utilisation change over time?

2. Methods

1. Samples of water and attached algae are collected once every two months from six sites along a nutrient gradient in two UK rivers (Fig 1).

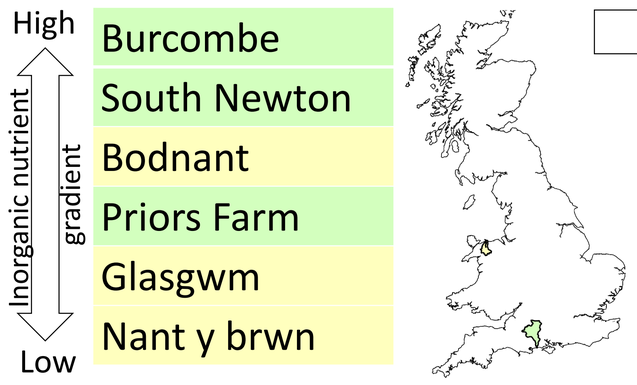
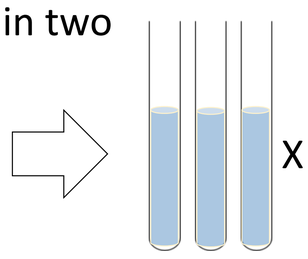


Figure 1. Location and nutrient status of Conwy (yellow) and Hampshire Avon (green) catchments

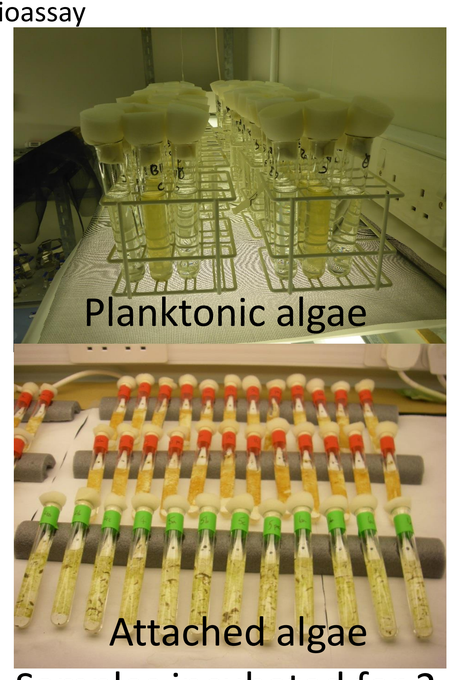


2. Triplicate samples are given 1 of 7 treatments (Table 1)

Table 1. Treatments used in the bioassay

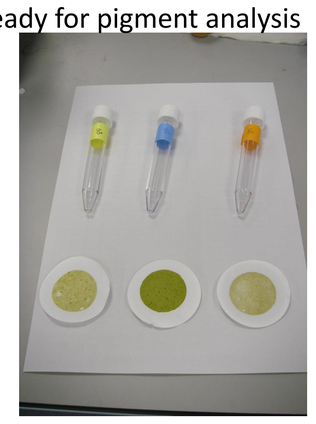
Treatment
1. Control
2. + Inorganic phosphorus
3. + Inorganic phosphorus and nitrogen
4. + Glucose 6-phosphate
5. + Phytic acid
6. + Methylumbelliferyl phosphate
7. + Methyl phosphonate

Figure 2. Experimental set up for algal bioassay



3. Samples incubated for 2 weeks at 20˚C with 18/6 hour light/dark cycle (Fig. 2)

Figure 3. Filtered algal samples ready for pigment analysis



4. Samples analysed for chlorophyll *a* pigment as a proxy for biomass (Fig. 3)

3. Preliminary Results

Q1 Is organic P being used?

Yes, for planktonic algae: Organic P treatments 4, 5 and 6 are significantly different to the control (Fig. 4a).
No evidence for attached algae (Fig. 4b)

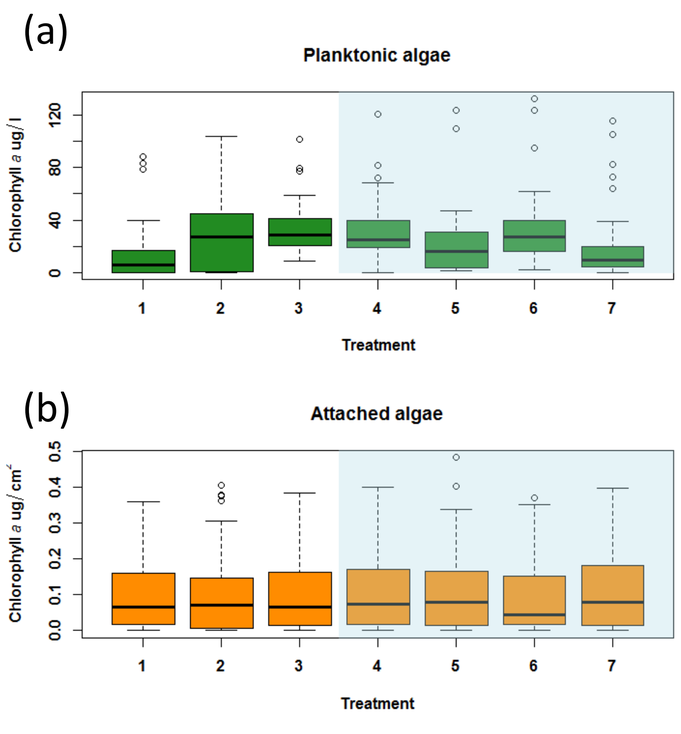


Figure 4. Chlorophyll *a* response of a) planktonic and b) attached algae. Blue shaded area are organic P treatments.

Q2 Does location matter?

Yes, the growth response to organic phosphorus treatment varies according to site (Fig. 5). High nutrient sites show less response relative to the control than poor nutrient sites

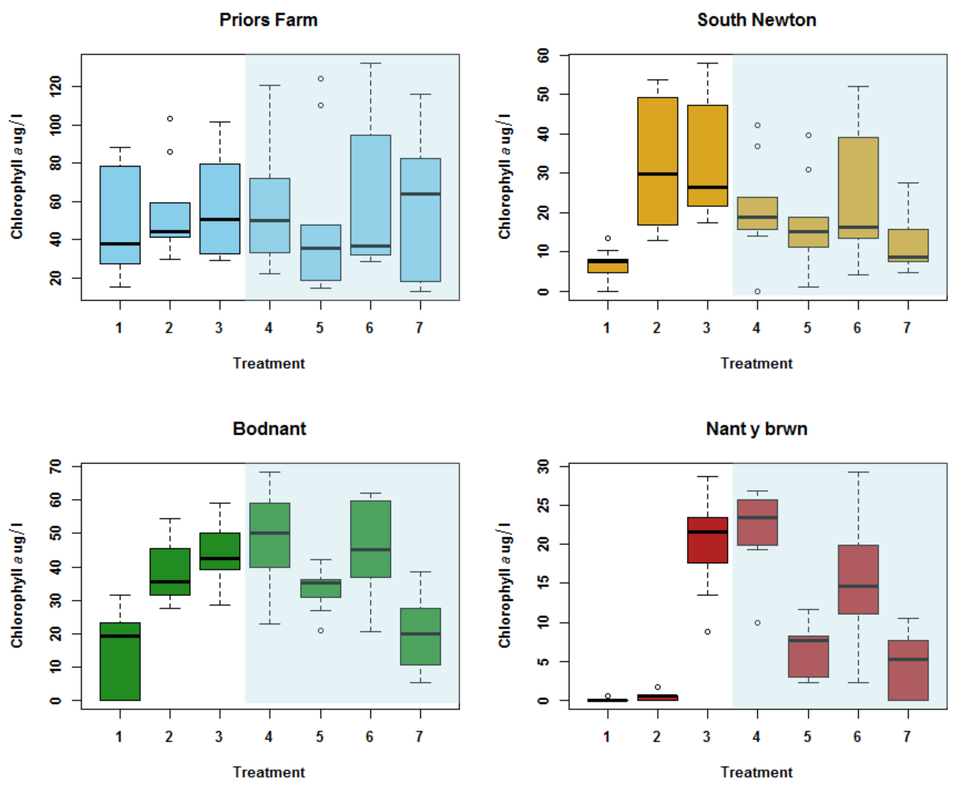


Figure 5. Chlorophyll *a* response of planktonic algae at four sites. Blue shaded area are organic P treatments.

Q3 Does time of year matter?

Yes, at the Bodnant site, the response to treatments varies significantly over time, particularly for treatments 4 and 6 (Fig. 6)

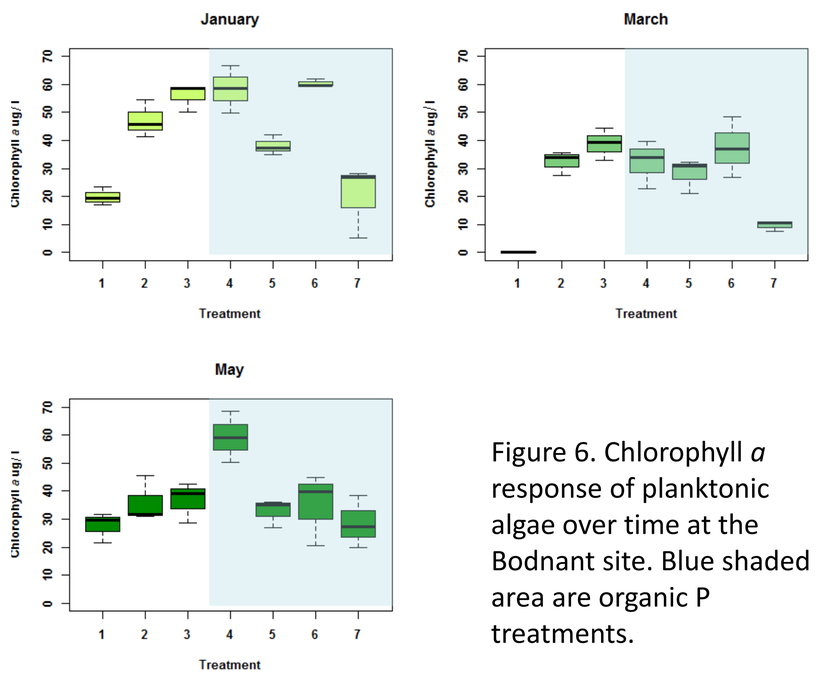


Figure 6. Chlorophyll *a* response of planktonic algae over time at the Bodnant site. Blue shaded area are organic P treatments.

4. Summary and next steps

- Some algal forms are showing clear use of organic phosphorus compounds
- This appears to vary along the nutrient gradient and by season (winter and spring)
- Next step 1: Examine the role of compositional changes using chlorophyll *b, c*, and *d*
- Next step 2: Extend the work to higher plants, rooted and unrooted
- Next step 3: Examine the role of concentration in bioavailability

Email: ellcka@ceh.ac.uk 1. Lake Ecosystems Group, CEH, Lancaster, LA1 4AP
2. School of Geographical Sciences, University of Bristol, BS8 1SS
3. CEH, Environment Centre Wales, LL57 2UW,

Project partners

Characterising the nature, origins and ecological significance of Dissolved Organic MAtter IN freshwater Ecosystems:
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