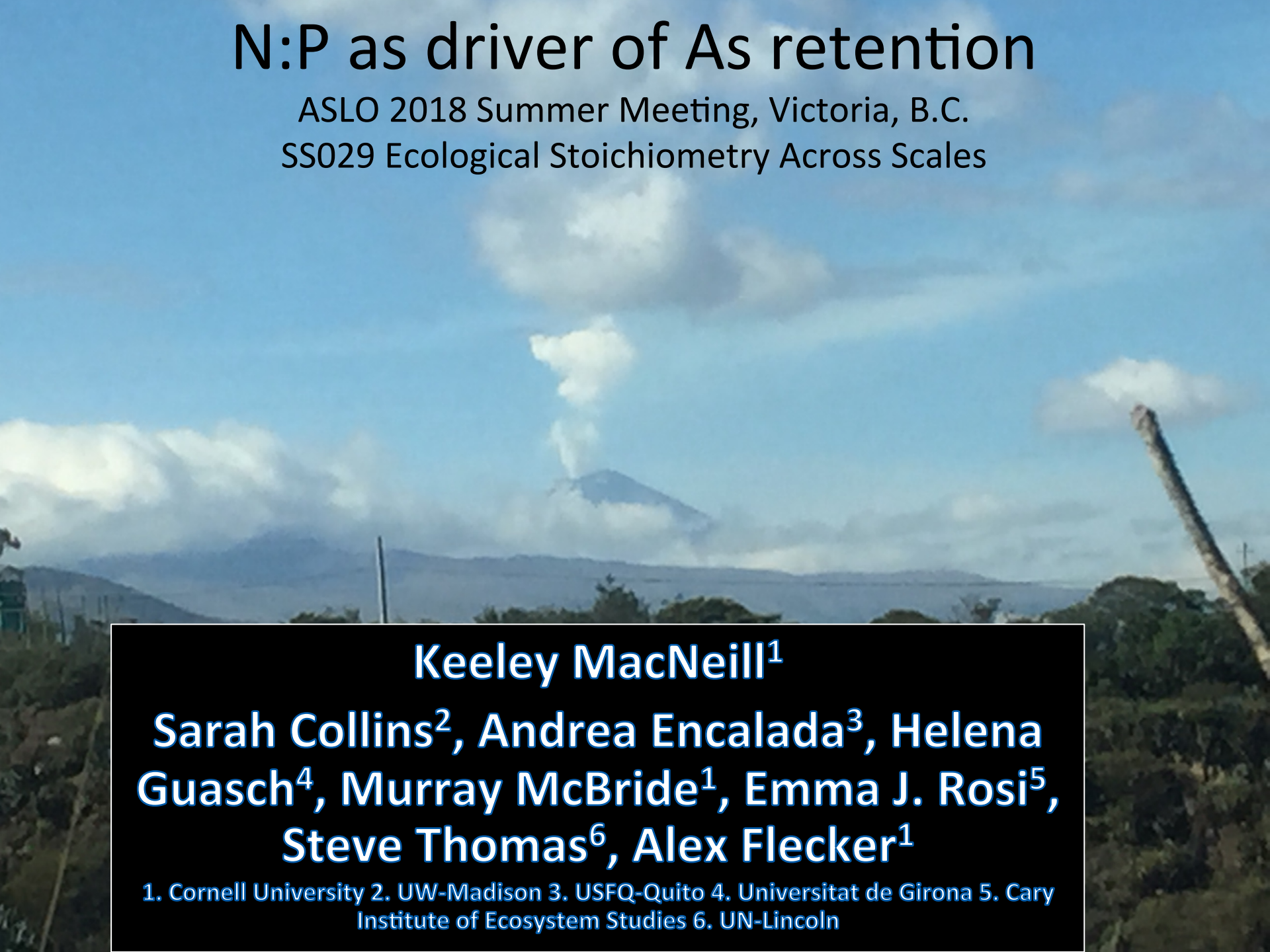
N:P as driver of As retention

ASLO 2018 Summer Meeting, Victoria, B.C.
SS029 Ecological Stoichiometry Across Scales



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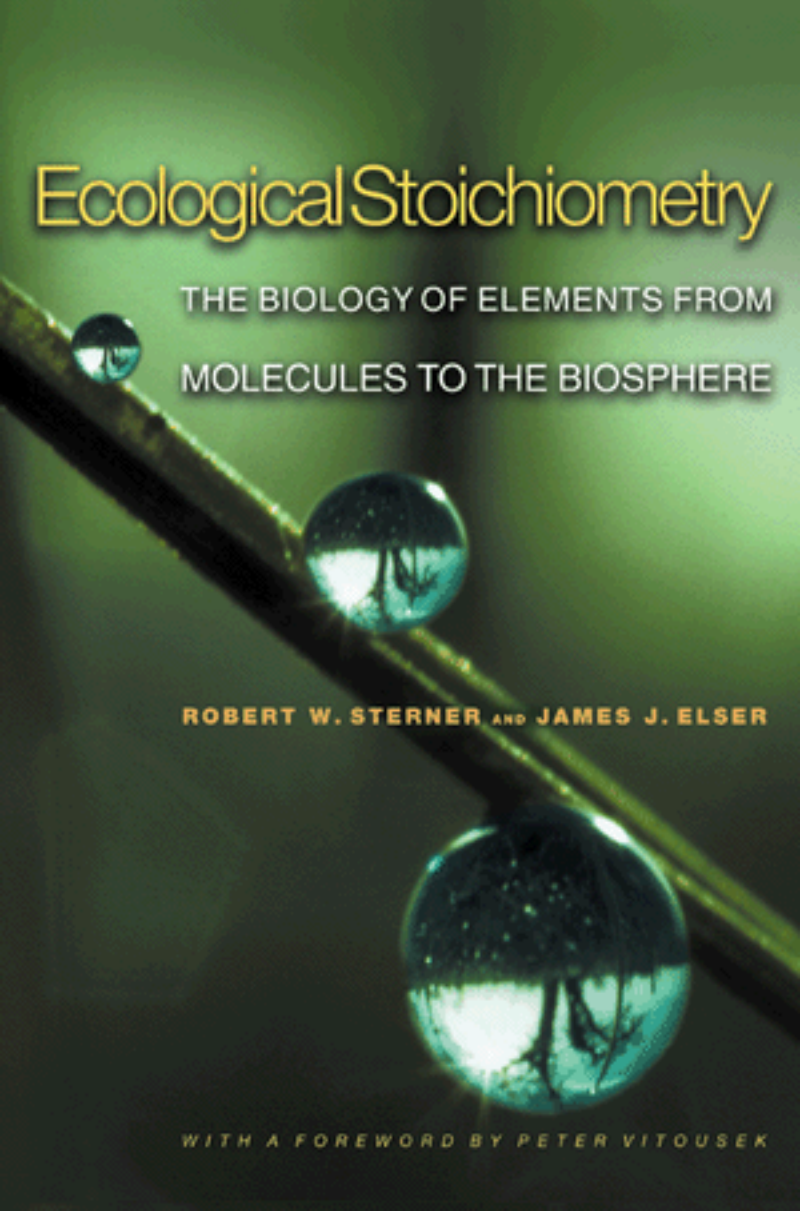
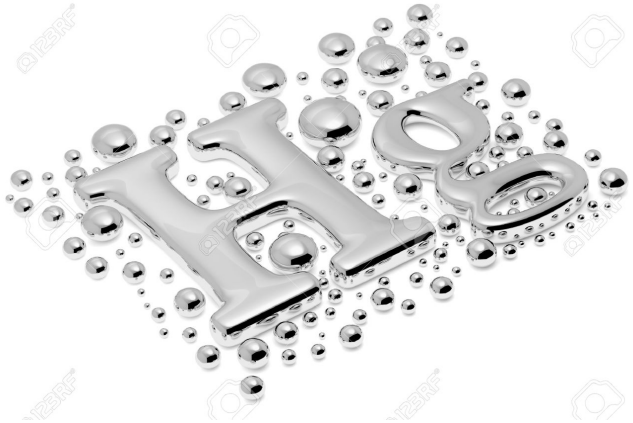
1. Cornell University 2. UW-Madison 3. USFQ-Quito 4. Universitat de Girona 5. Cary Institute of Ecosystem Studies 6. UN-Lincoln


Ecological Stoichiometry
THE BIOLOGY OF ELEMENTS FROM MOLECULES TO THE BIOSPHERE
ROBERT W. STERNER AND JAMES J. ELSER
WITH A FOREWORD BY PETER VITOUSEK

C N P As

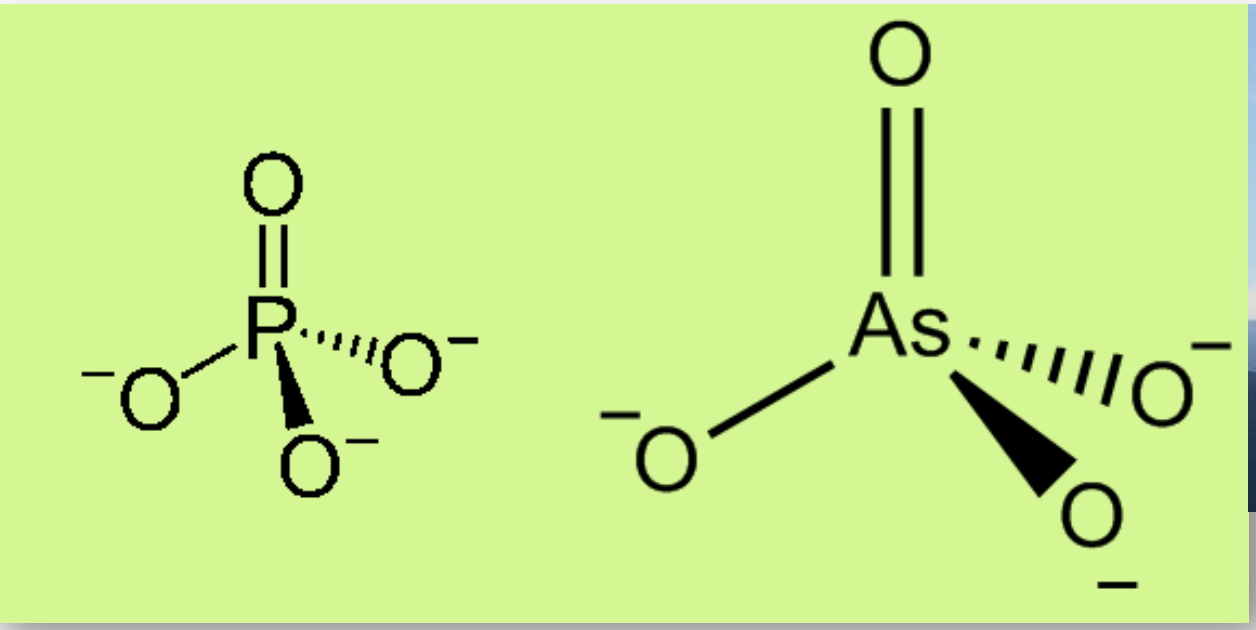


Beijer & Jernelov 1978
Bjerregaard et al 2011
Walters et al 2015

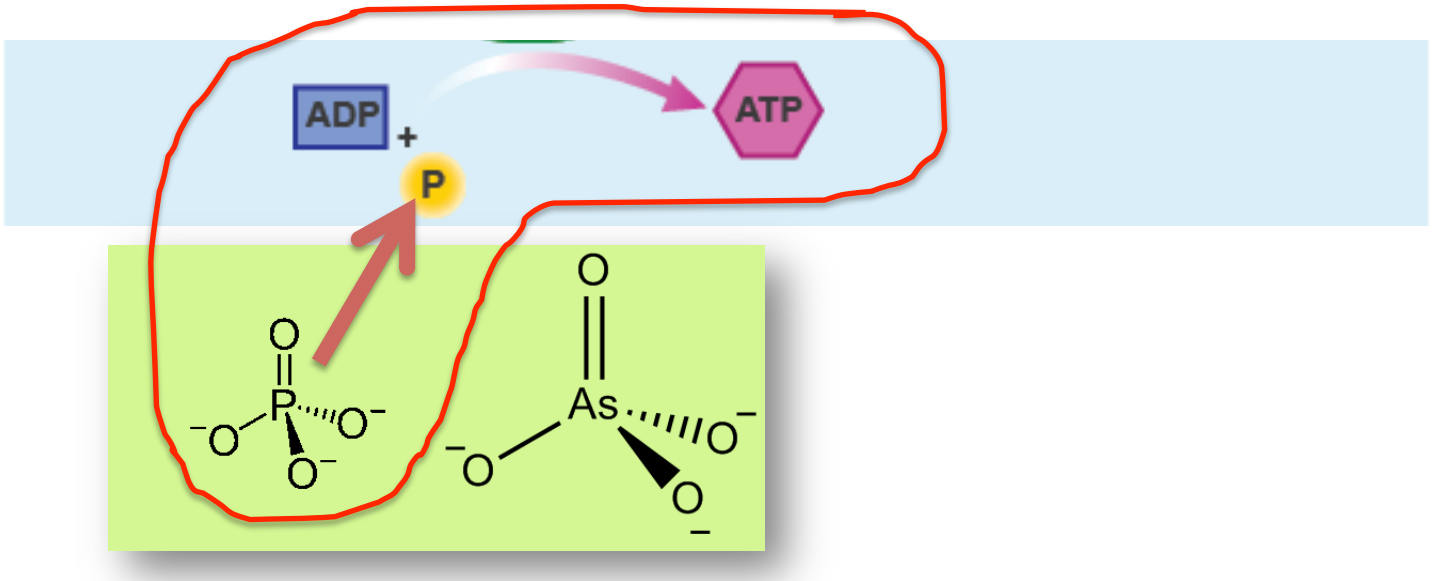
Hg illustration: alexeysmirnov
Se illustration: Calcium metals

Arsenic

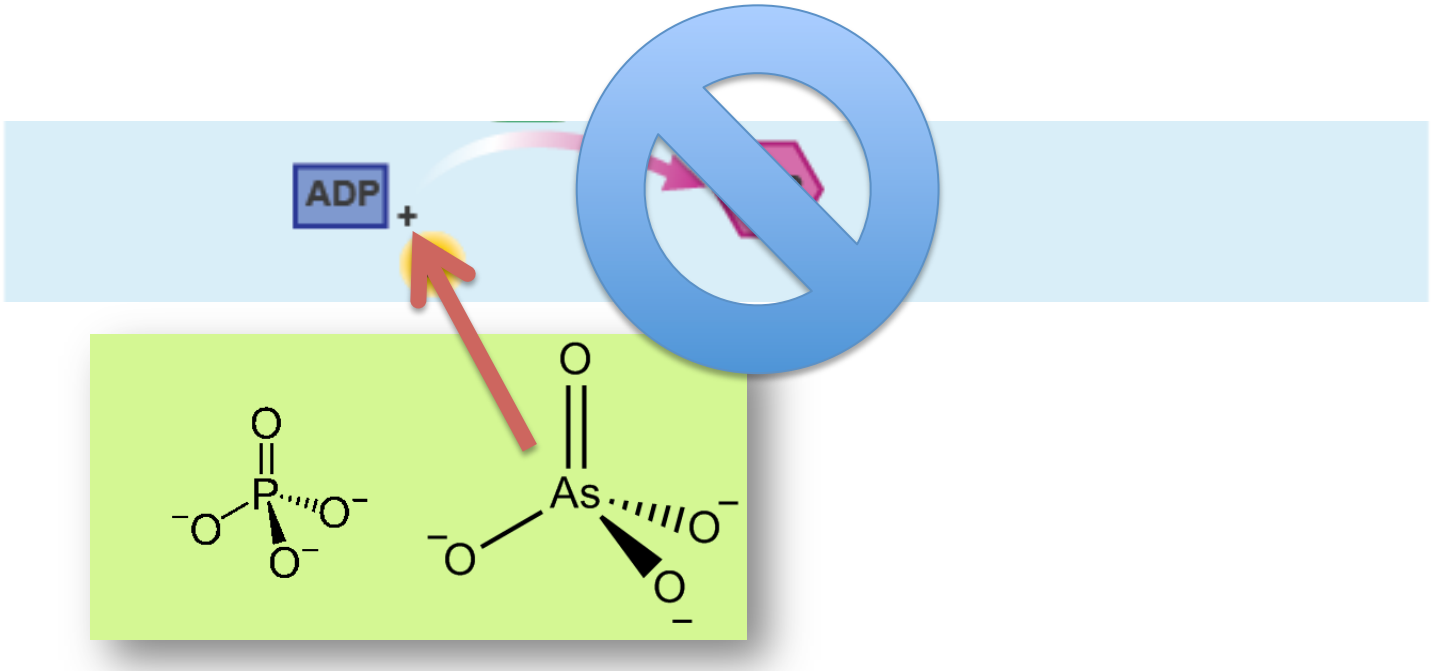
- Important human health implications
  - Naujokas et al 2013, Ravenscroft et al 2009, lots of others
- Directly linked to P, indirectly to N
  - Finnegan & Chen 2012, Barringer et al 2012,



Phosphorylation: ADP + PO_4^- = ATP

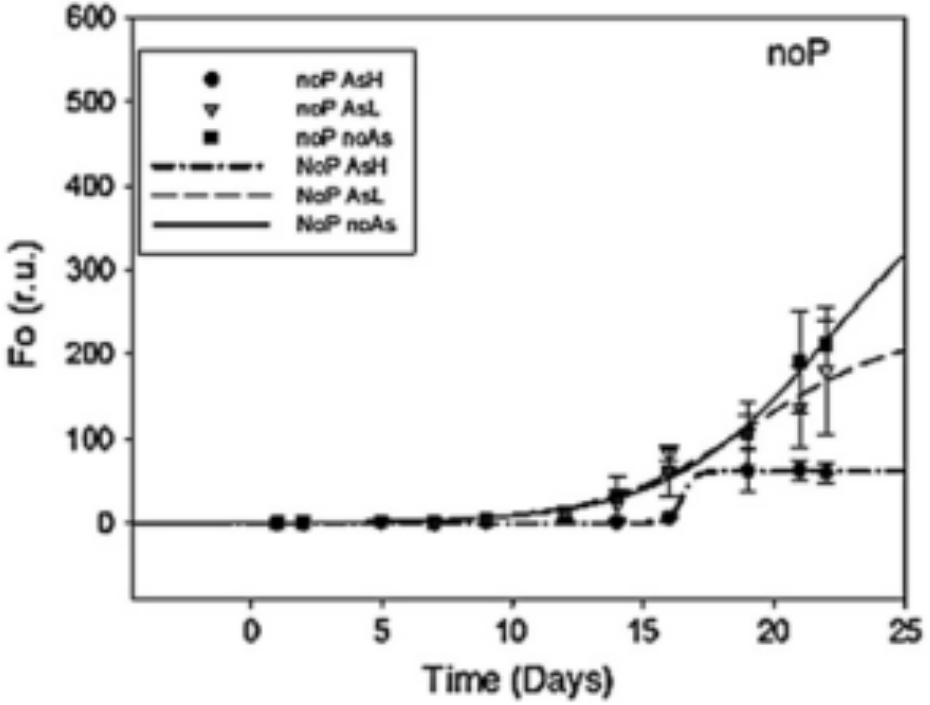


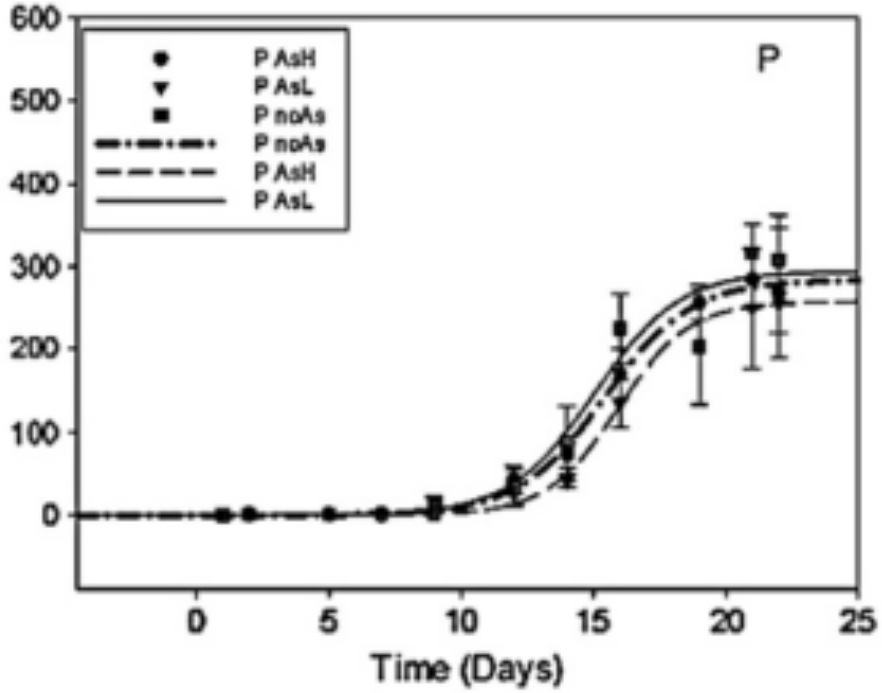
Phosphorylation is decoupled by AsO_4^-



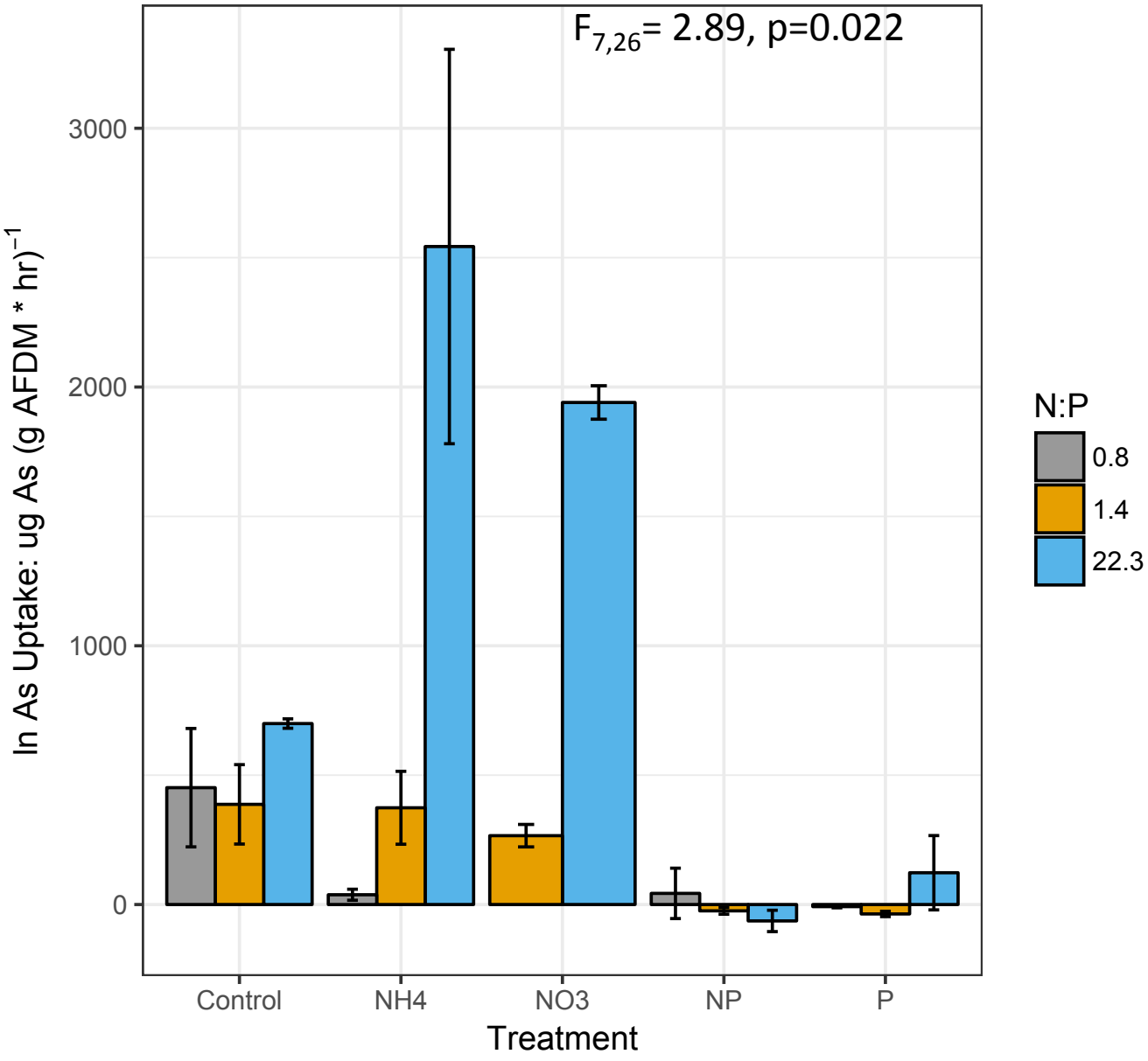
No As effects at high P
As hinders algal growth at low P

Rodriguez Castro et al 2015





N:P drives As uptake

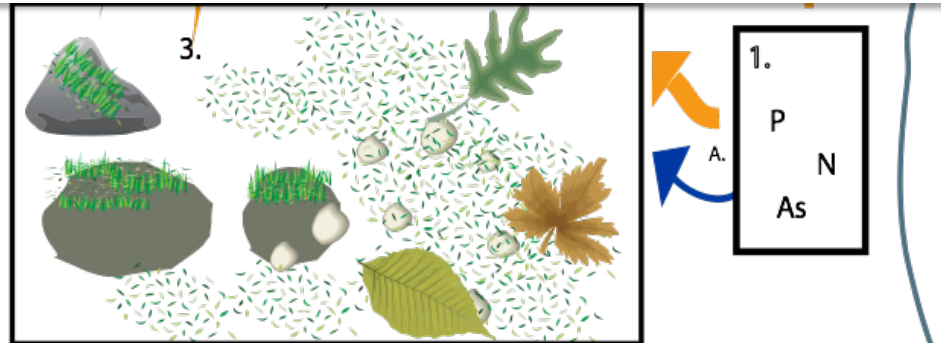


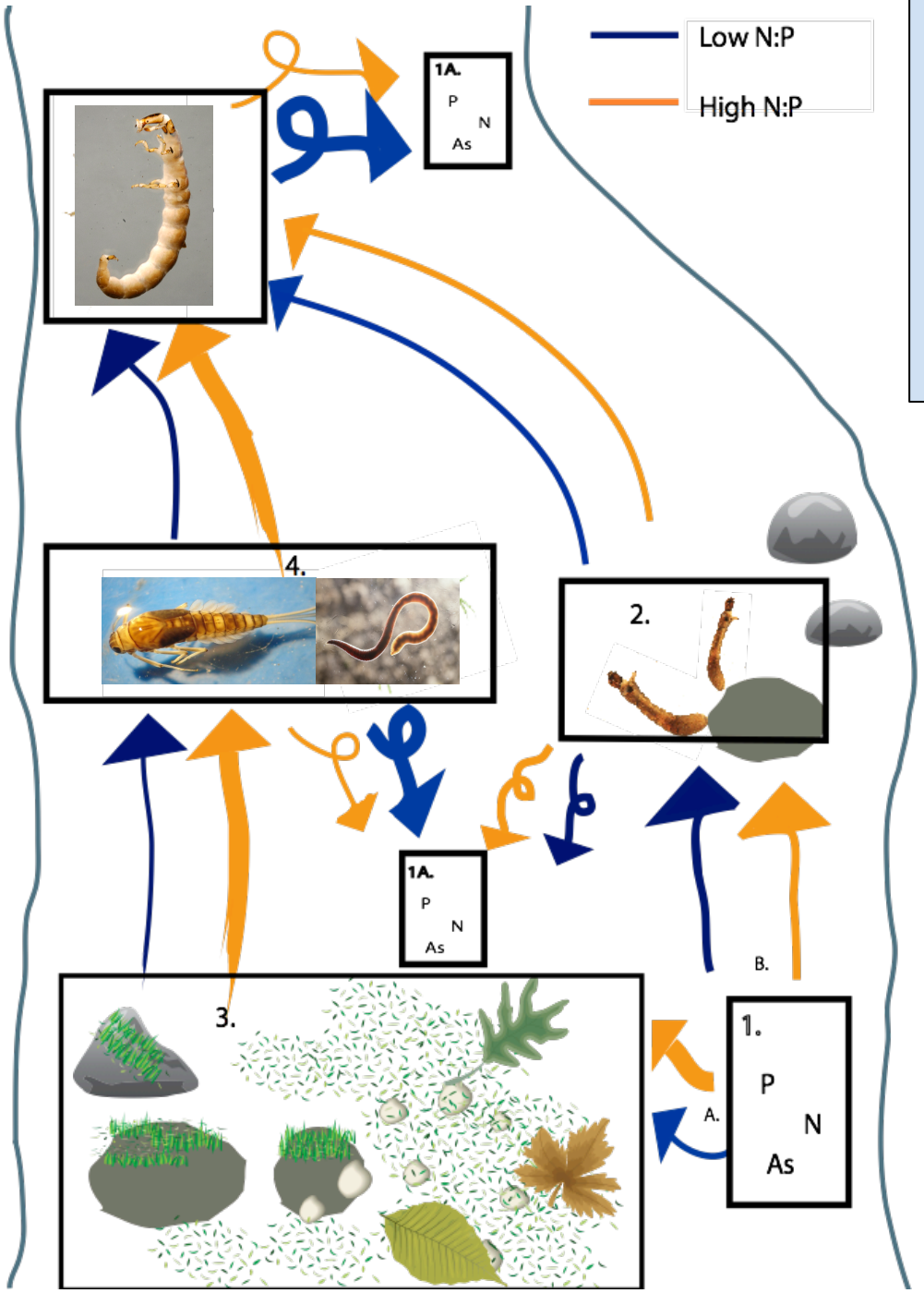
MacNeill et al, in prep

Low N:P

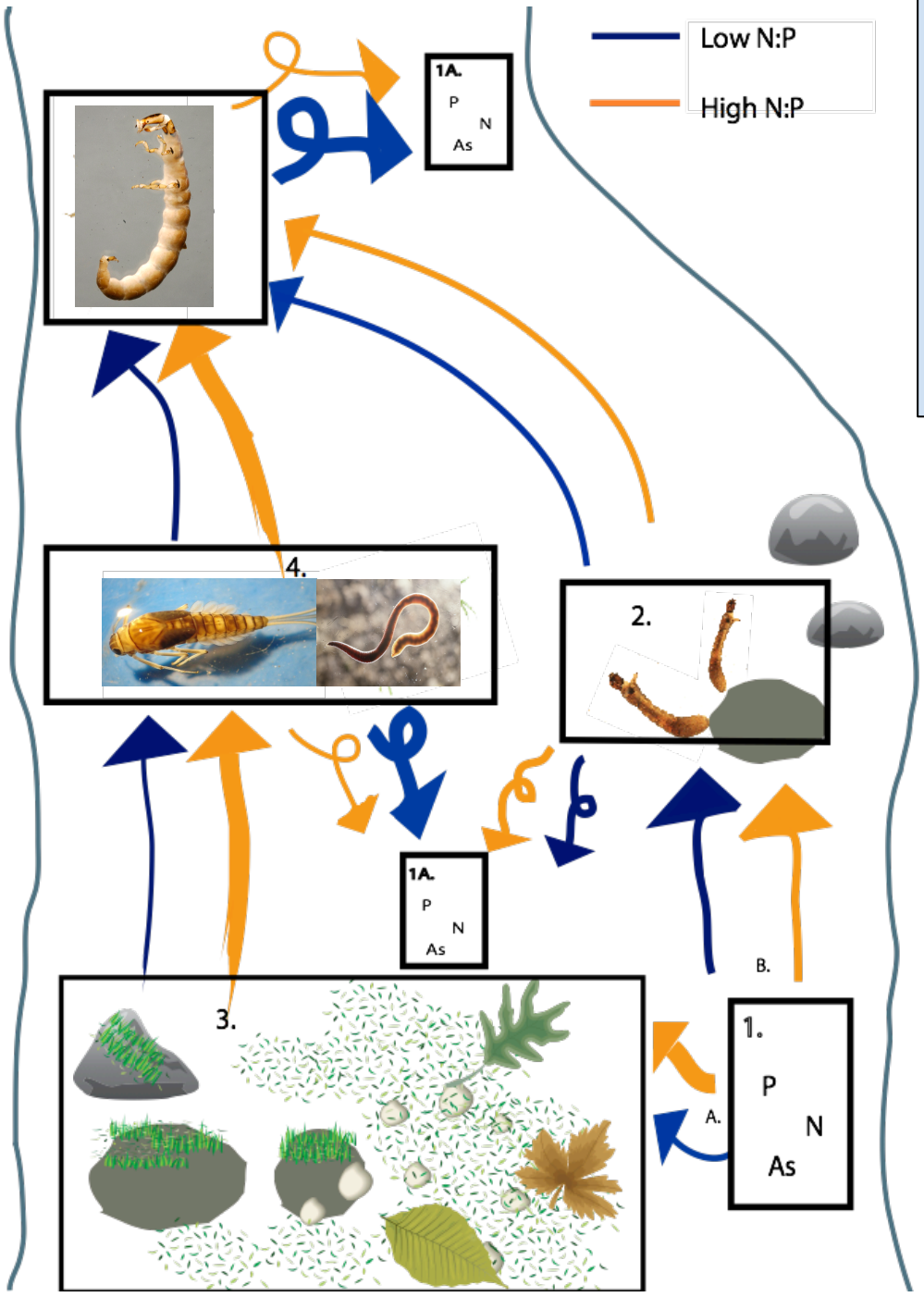
High N:P

Test if the $N:P_{water}$ controls the amount of As retained in basal resources.





Test if the relative As, N, and P concentrations in +As streams alter invert P and As excretion, thereby influencing invert As retention



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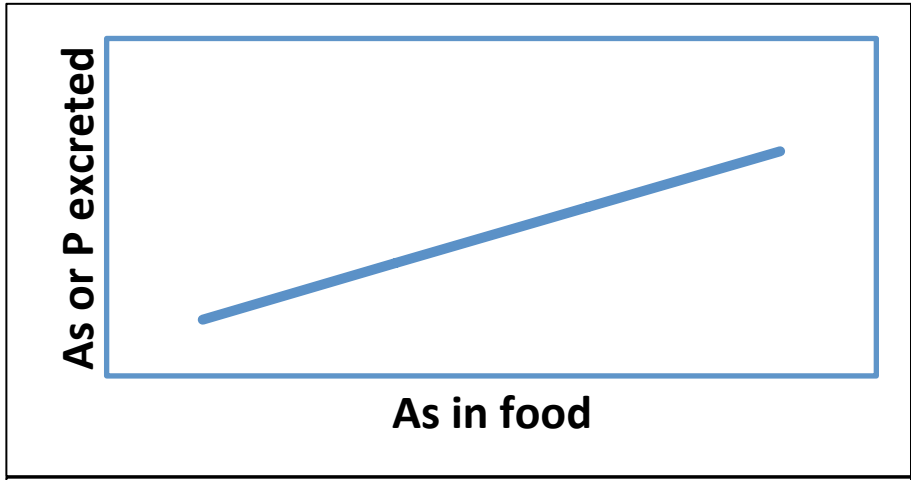
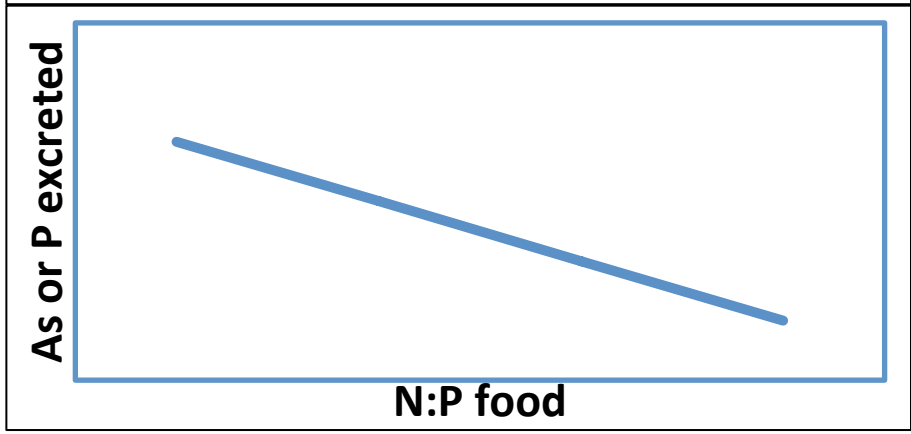
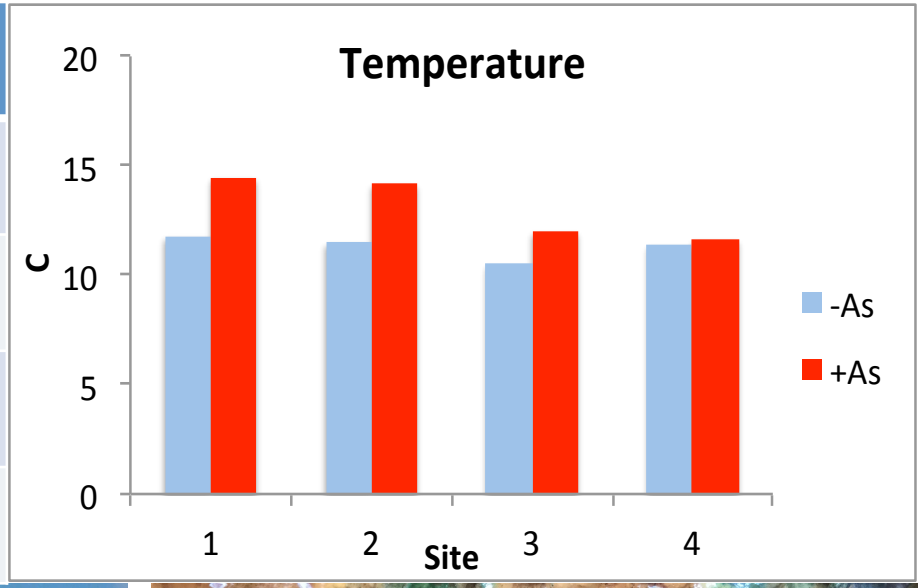
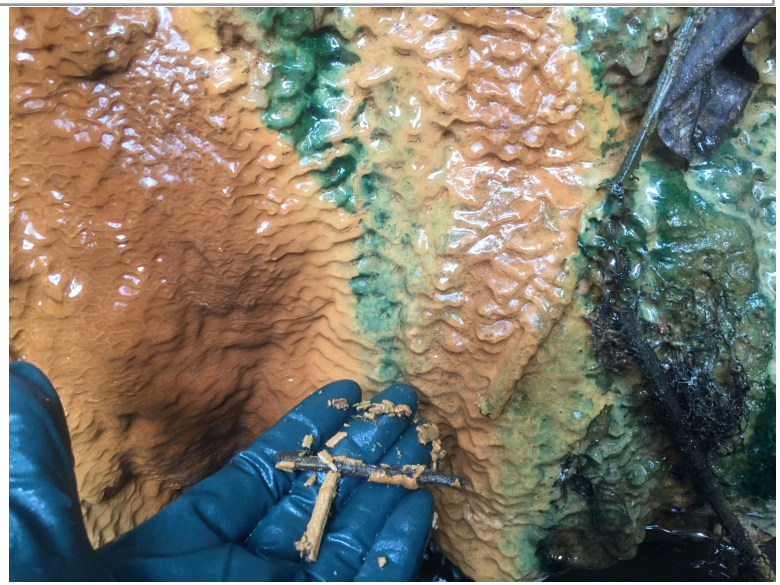




The System

	ppb
NH_4^+	3 - 71
TP	1 - 19
NH_4^+:P	1 – 15 (molar)
As	0 - 323





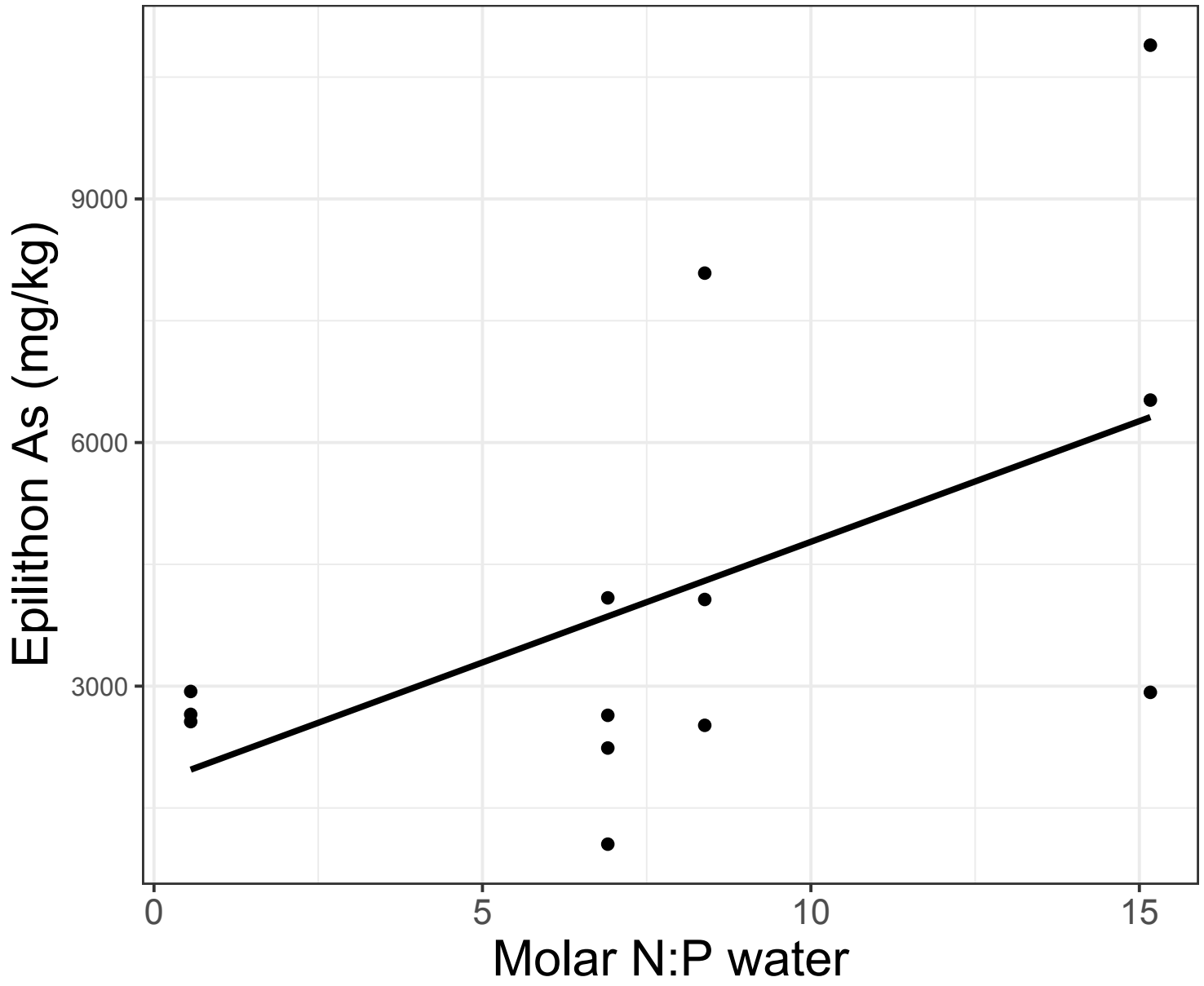
Methods

- As & P concentration of:
  - Basal resources
  - Invert body
  - Invert excretion

Measured NH_4^+ on Turner Designs Aquafluor Handheld Fluorometer

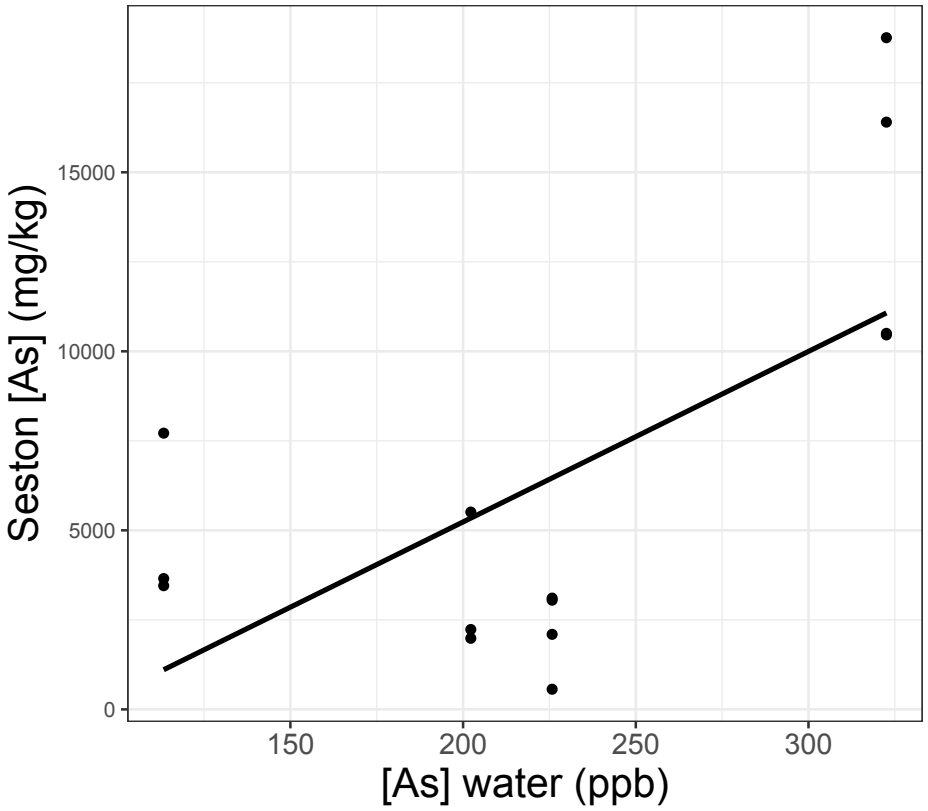
Objective 1: Water N:P => Basal Resource [As]?

Adj R2 = 0.25 Intercept = 1800 Slope = 300 P = 0.048

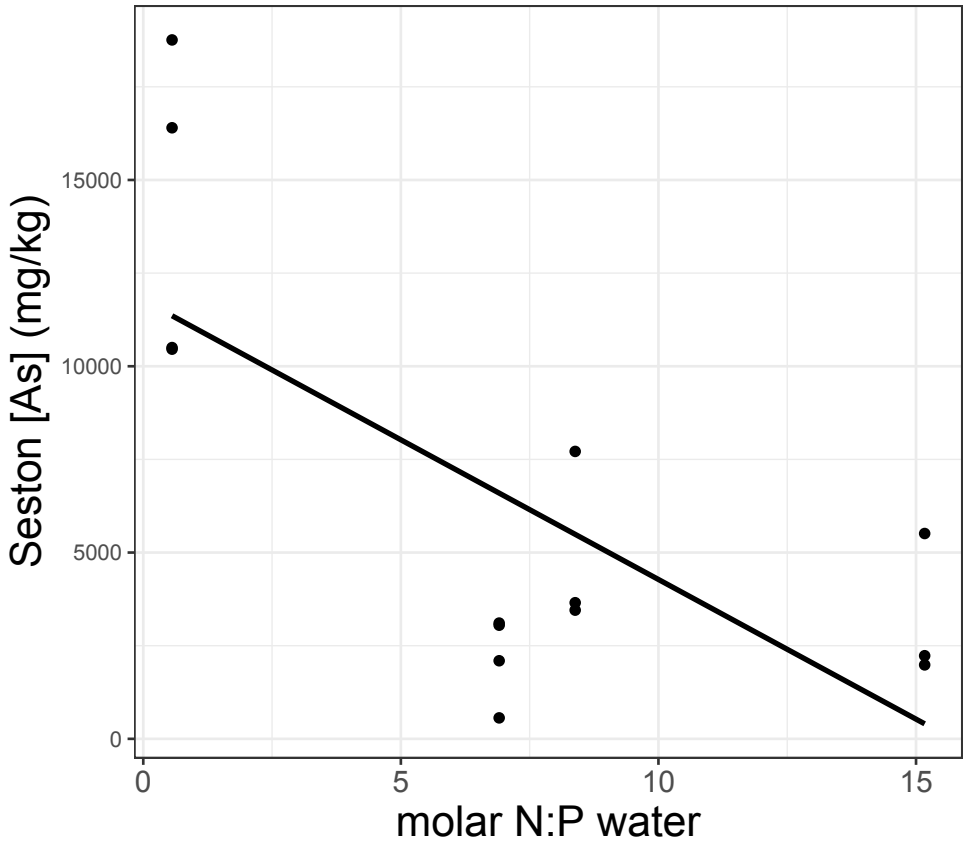


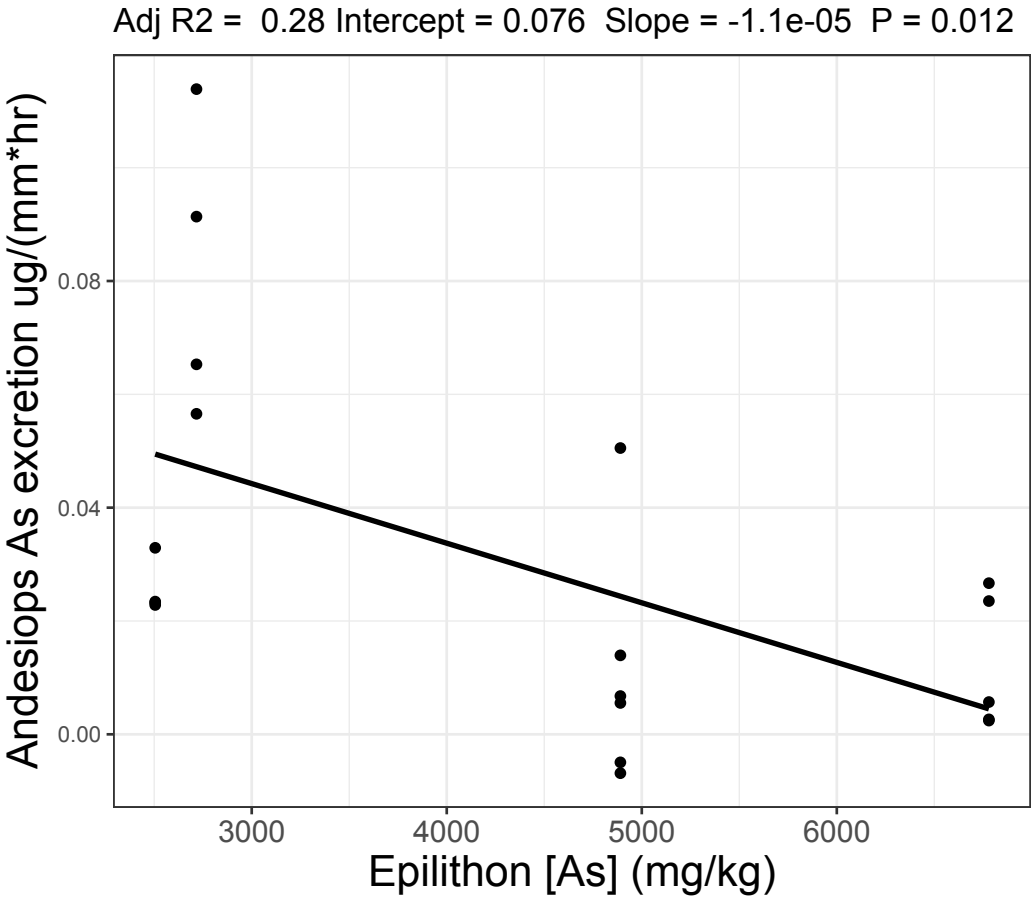
Objective 1: Water N:P => Basal Resource [As]?

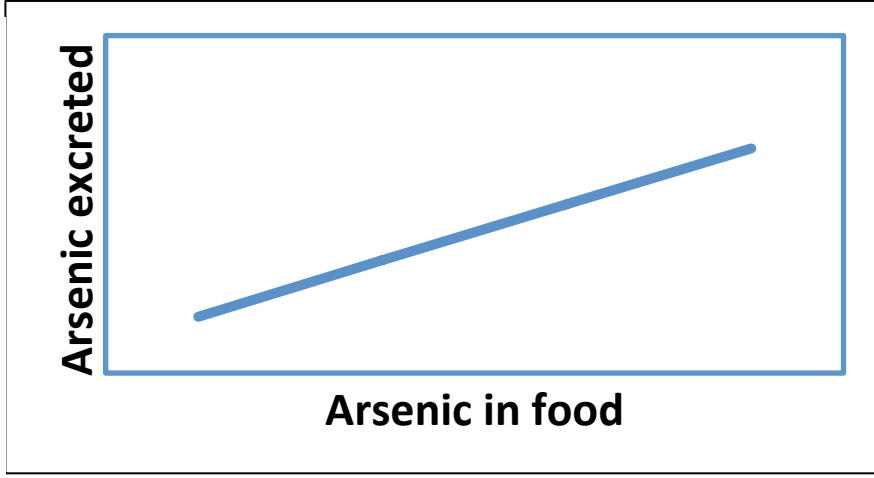
Adj R2 = 0.37 Intercept = -4300 Slope = 48 P = 0.012



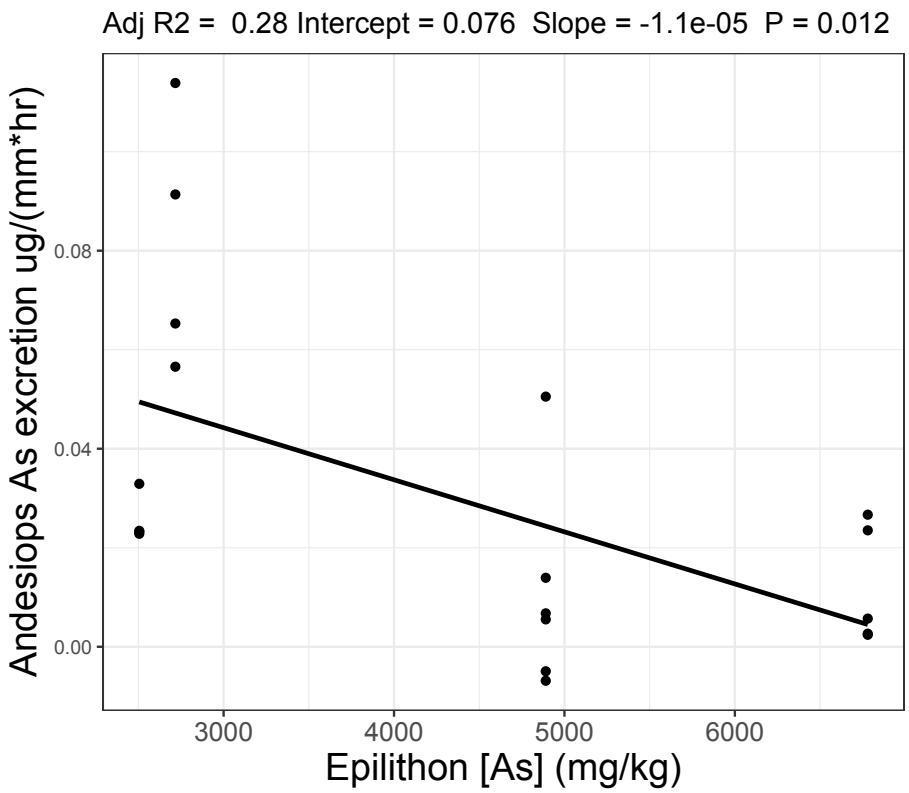
Adj R2 = 0.46 Intercept = 12000 Slope = -750 P = 0.004



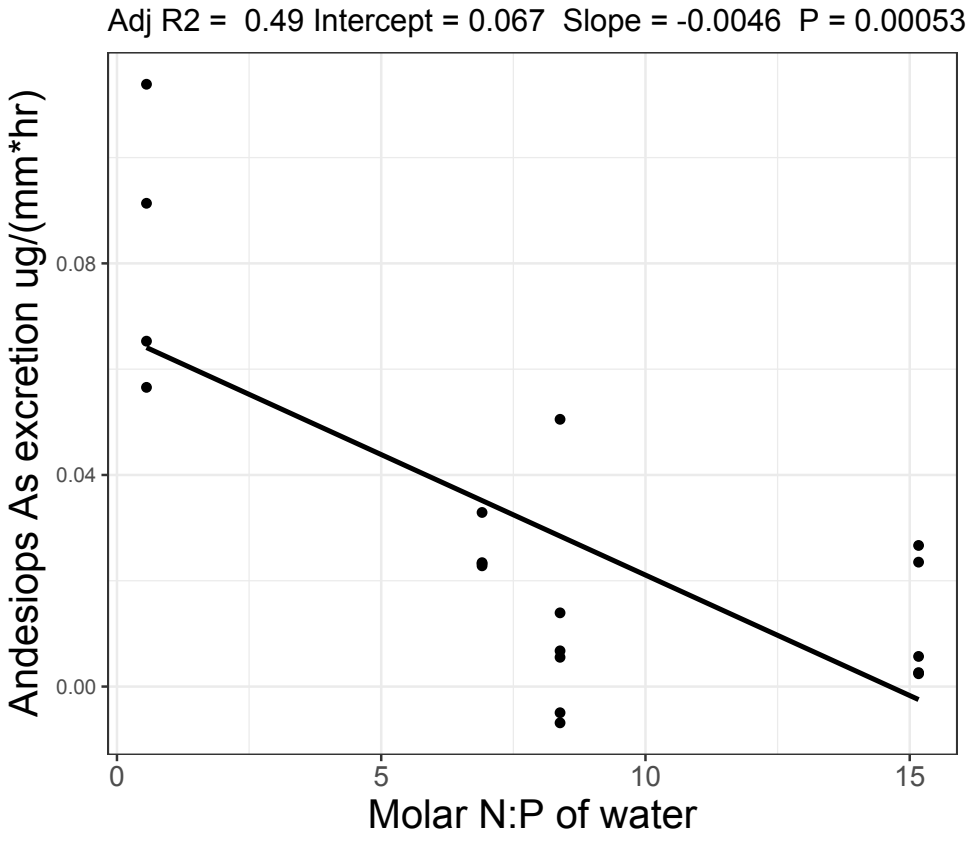




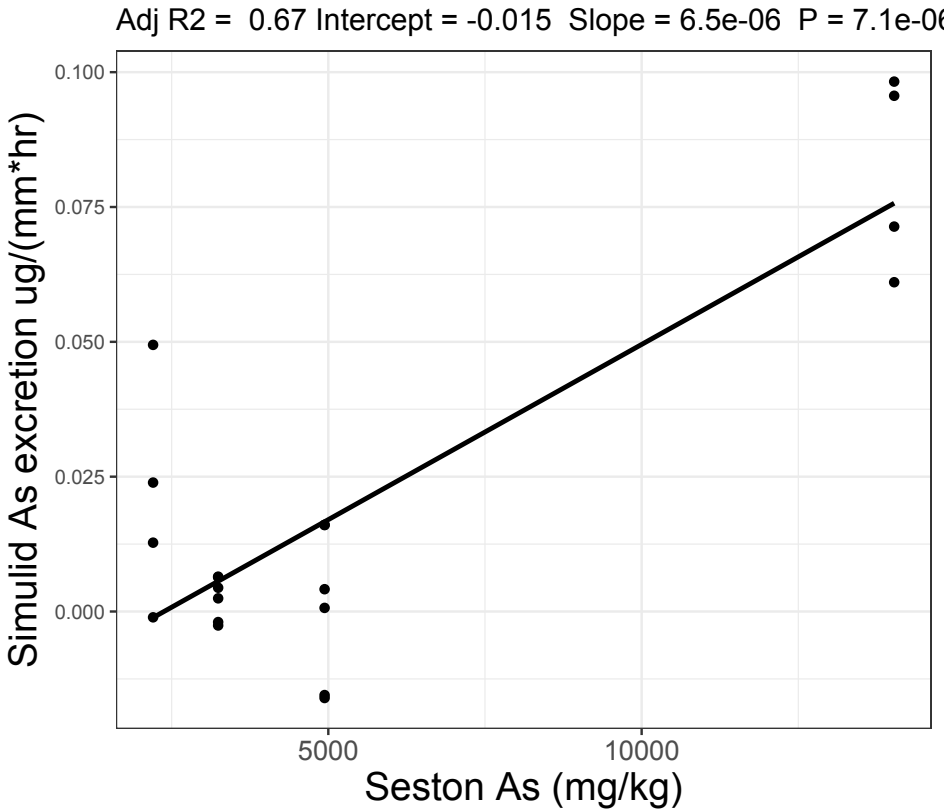
As in food kind of drives As excretion (grazers), but not in a direction that makes sense

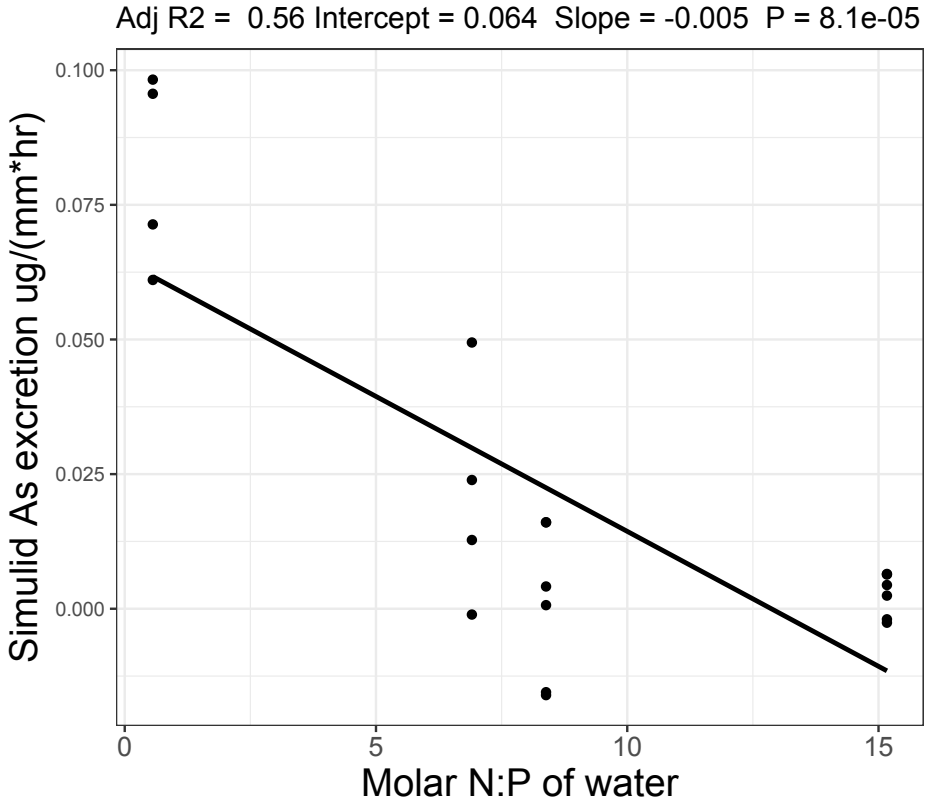


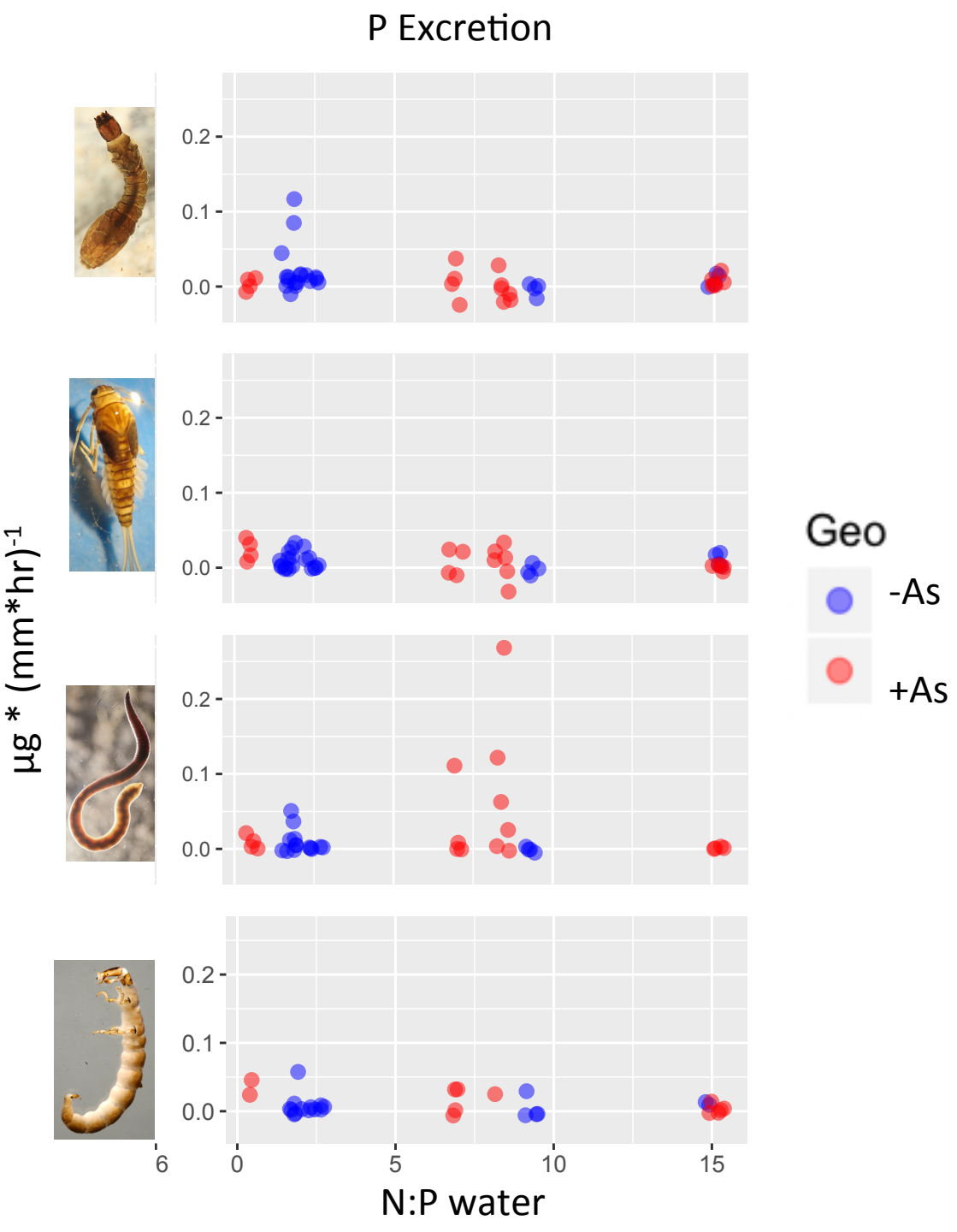
N:P drives As excretion in grazers!

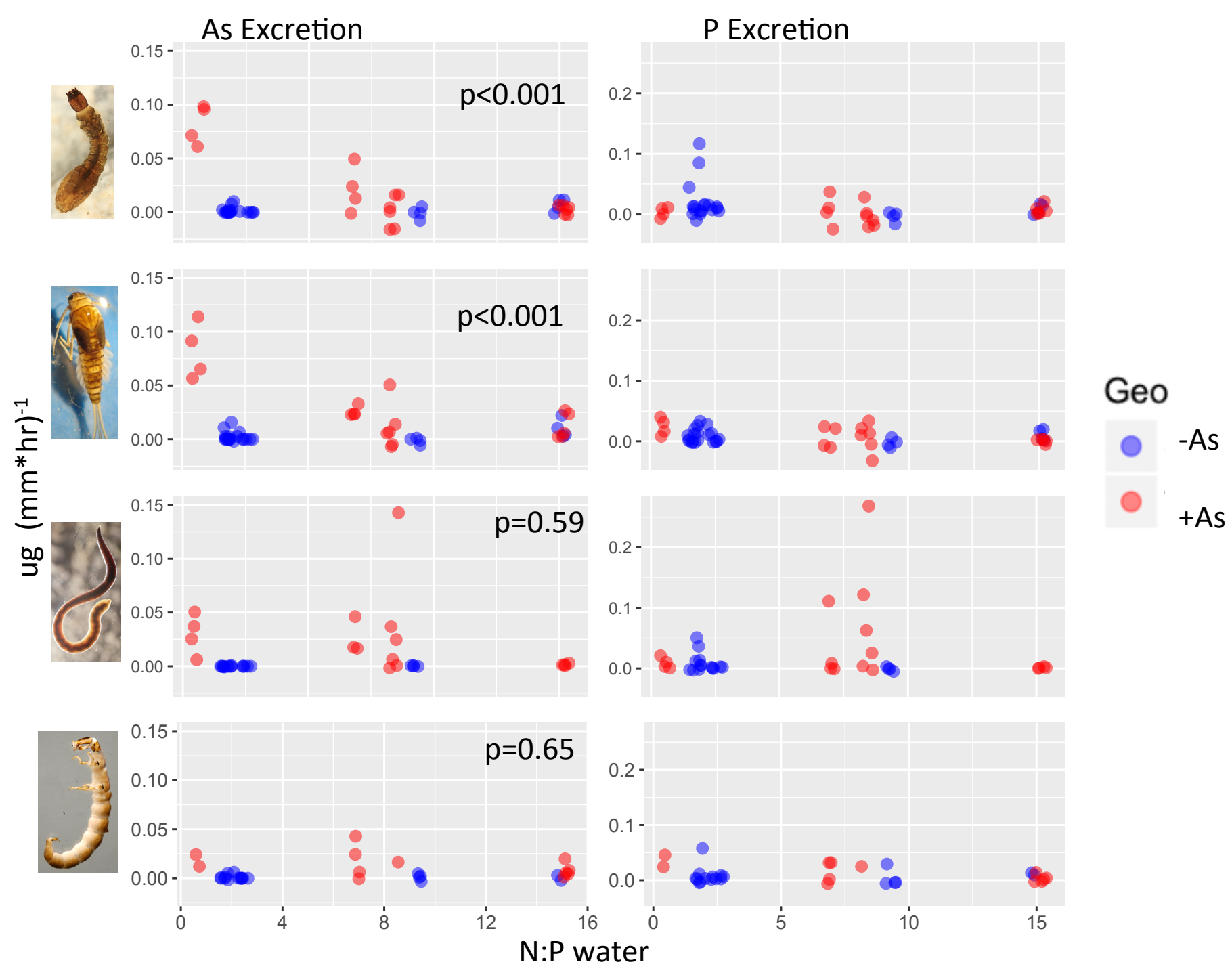


N:P might drive As excretion in filterers






P Excretion
µg * (mm*hr)-1
0.2
0.1
0.0
6
0
5
10
15
N:P water
Geo
-As
+As


As Excretion
P Excretion
p<0.001
p<0.001
p=0.59
p=0.65
ug (mm*hr)-1
N:P water
Geo
-As
+As

Arsenic

- Important human health implications
  - Naujokas et al 2013, Ravenscroft et al 2009, lots of others
- Directly linked to P and C, indirectly to N
  - Finnegan & Chen 2012, Barringer et al 2012, Castro et al 2015

Photos: NIH, USGS

Thanks!

klm324@cornell.edu

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- Laboratorio de Andrea Encalada, USFQ
- Oyacachi Community

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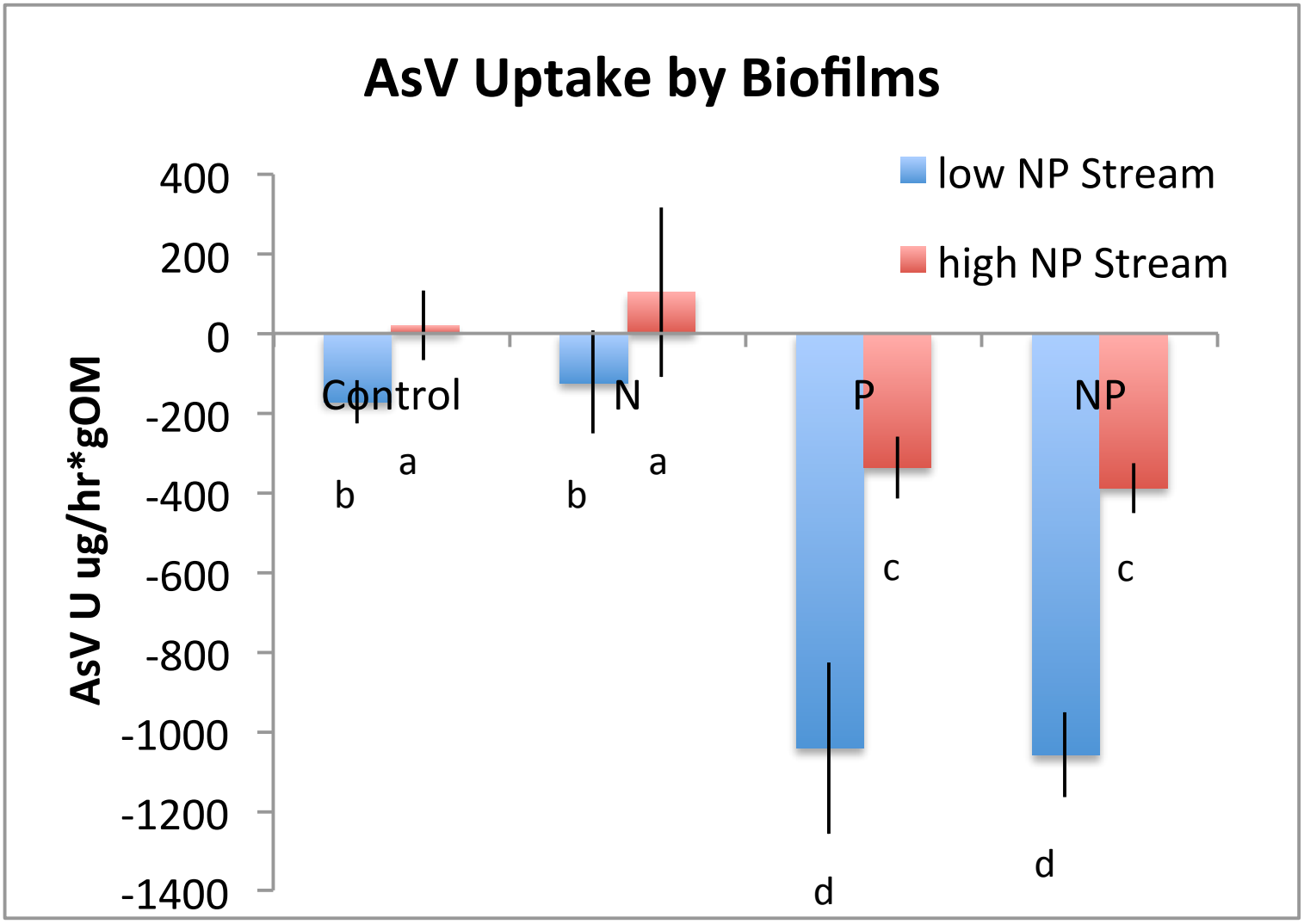
- Einaudi Center
- Lewis & Clark Fund
- Explorer's Club
- Evotrac Project, NSF DEB-1045960

N:P drives As uptake



High N:P v low N:P p=0.0003

MacNeill et al, in prep