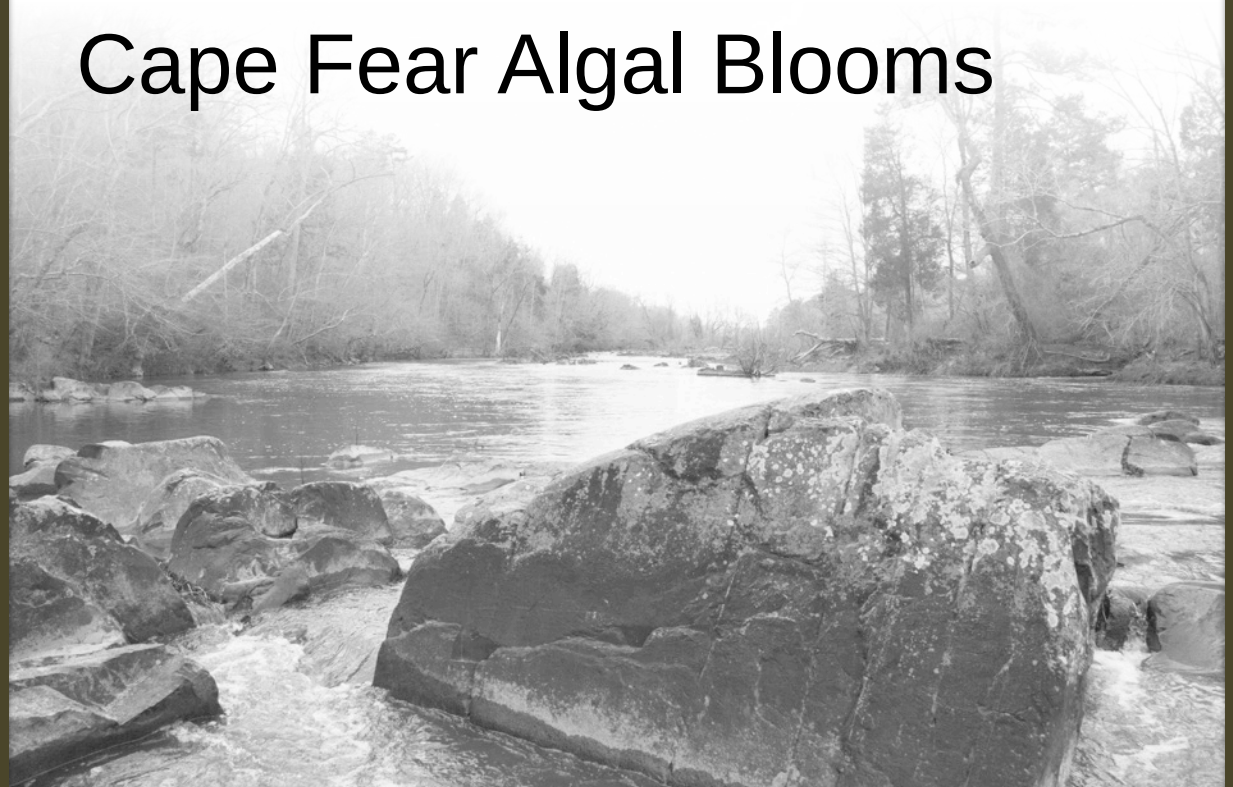
Evidence for Nutrient Factors in Cape Fear Algal Blooms



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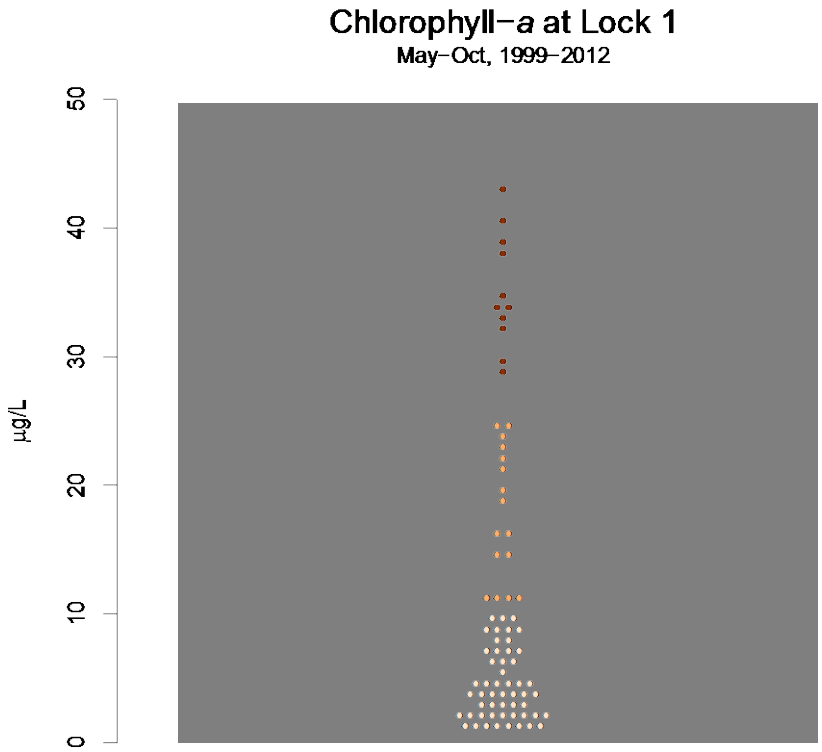
UNC Biostatistics

Cape Fear River Partnership Meeting

Outline

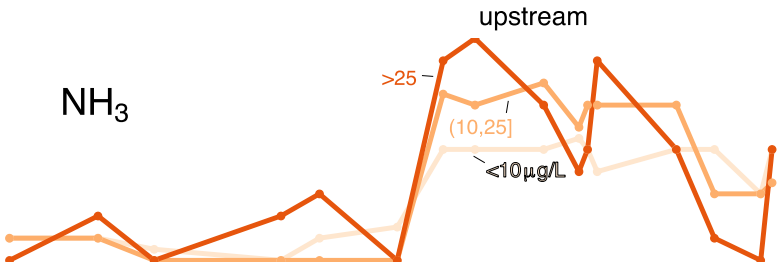
- Chlorophyll-*a* at Lock 1
- Nutrient patterns above Lock 1
- Causal Question
- Preliminary Results

Chlorophyll at Lock 1

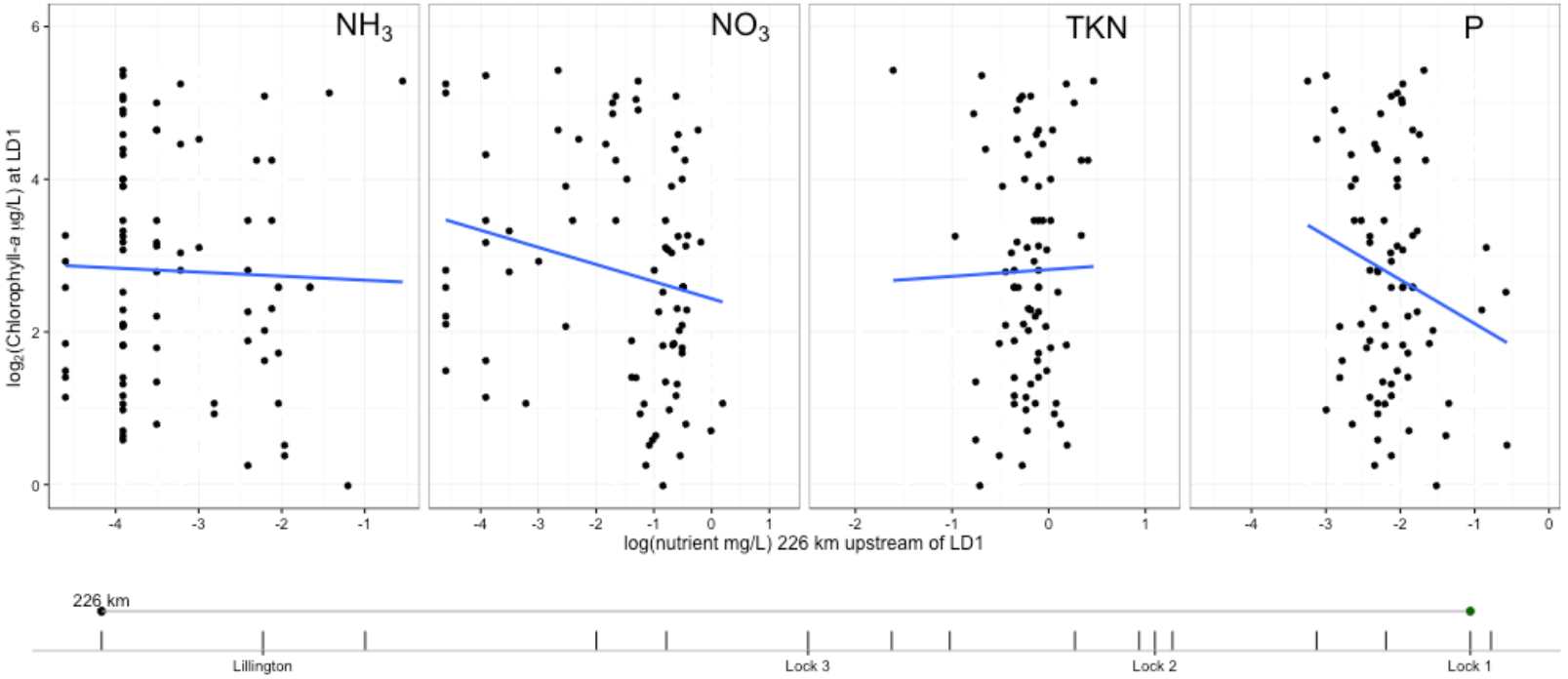


Nutrient patterns above Lock 1

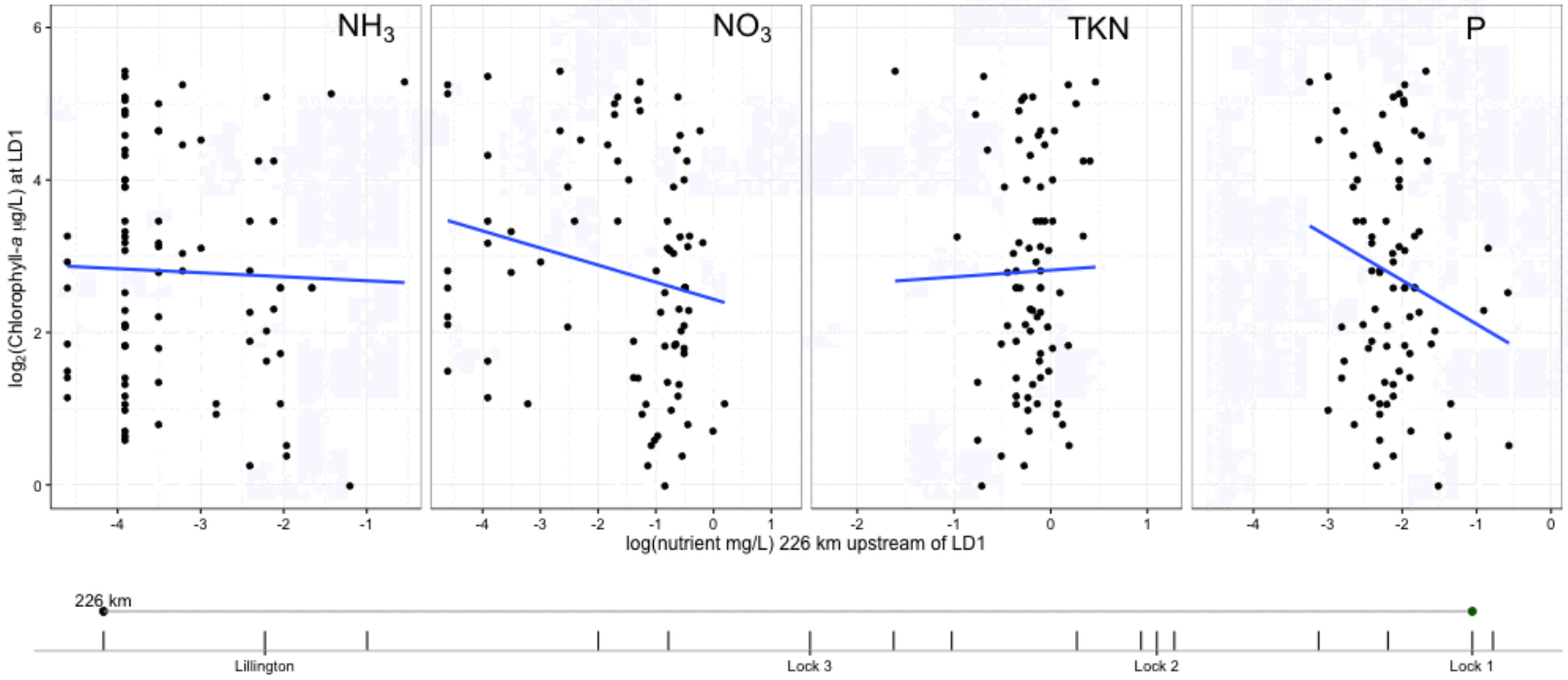
- Uptick in NH3, NO3, P after Lock 3.
- Maybe: more NH3, N03, P → more chlorophyll



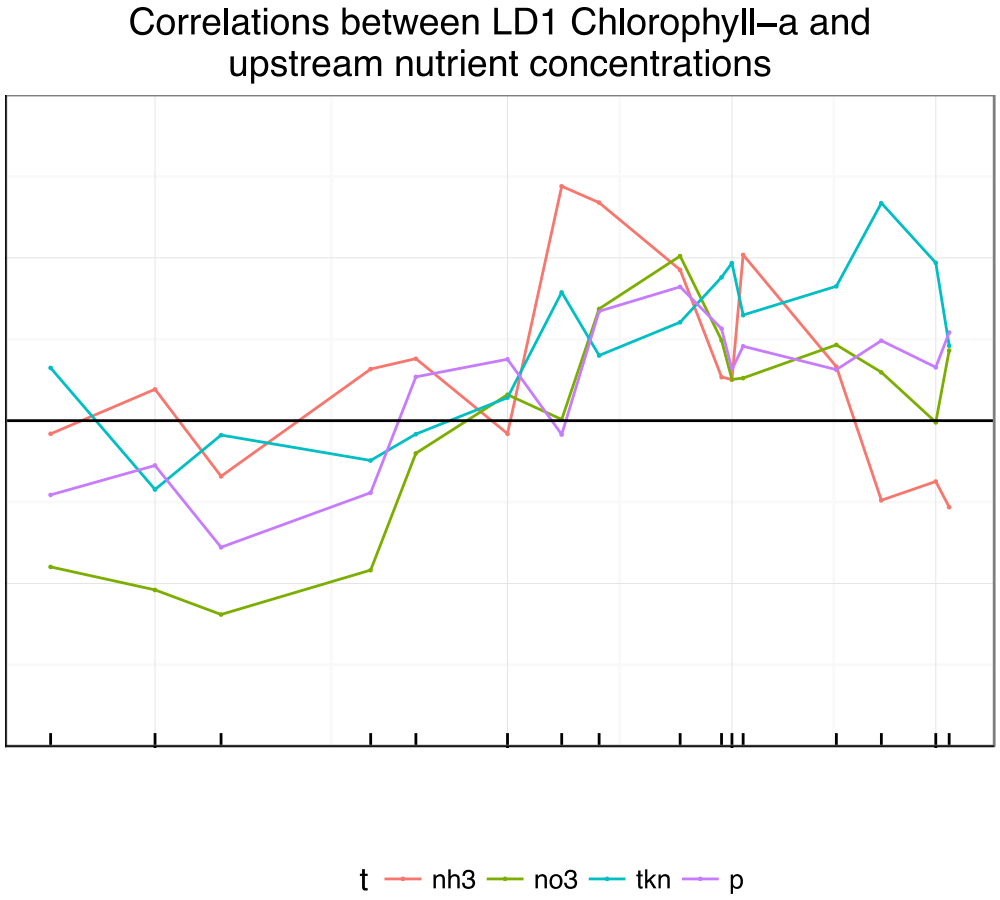
Relationship between Lock 1 Chlorophyll and upstream nutrients



Relationship between Lock 1 Chlorophyll and upstream nutrients



Correlation may increase after Lock 3

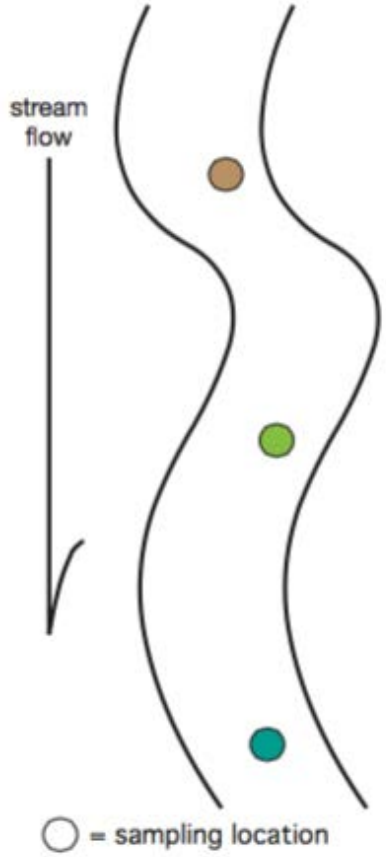


Causal Question

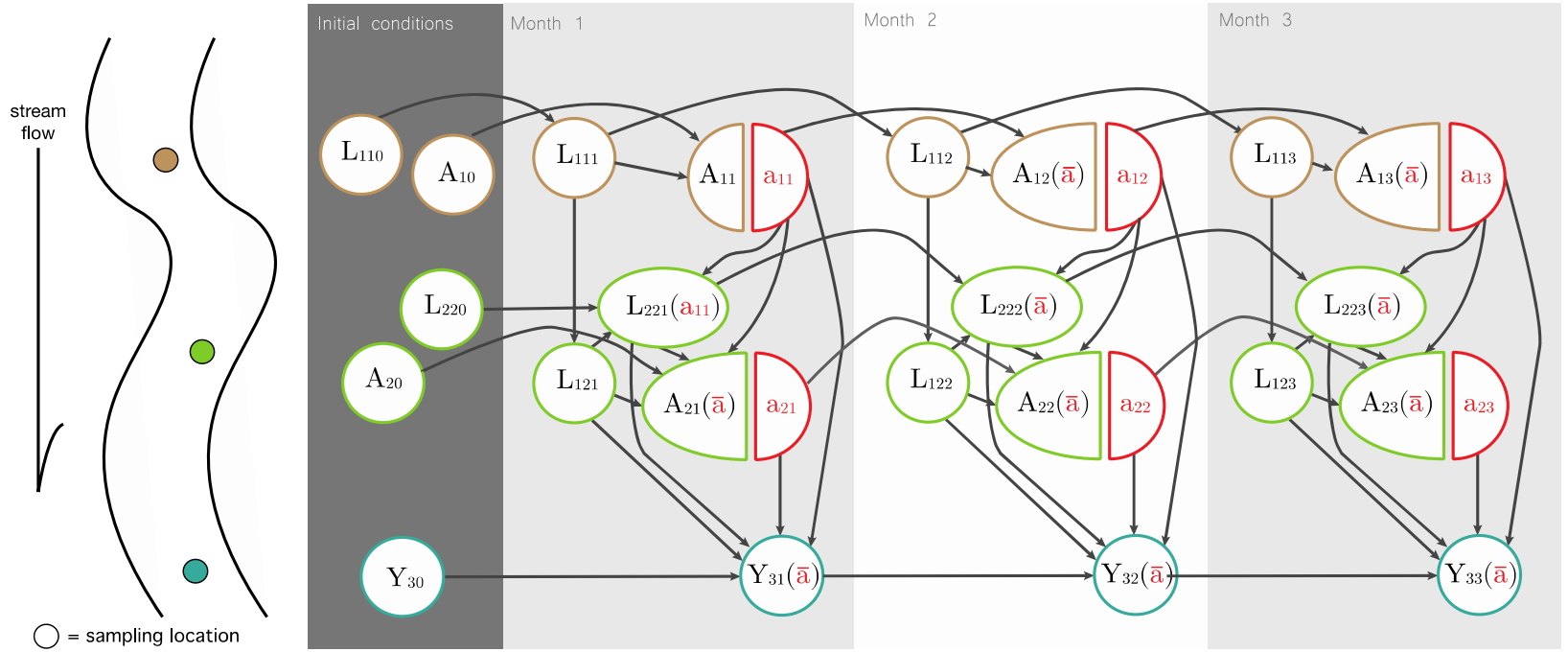
What if…

We had an intervention that could set a nutrient level to X at an upstream location.

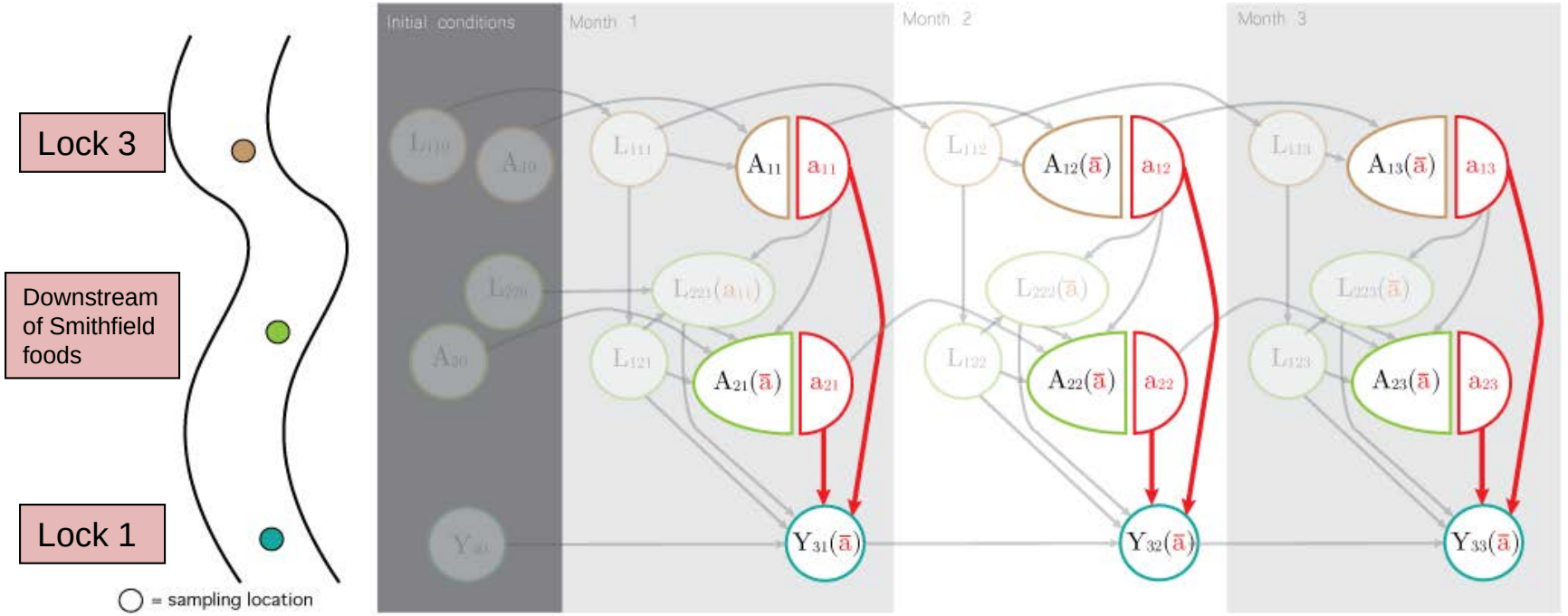
What effect would this have, on average, on downstream chlorophyll?



Causal Question (Mathematically)



Causal Question (Mathematically)



Statistical Issues & Limitations

- time- and space- varying confounding
- small sample size
- methods complicated
- methods not (yet) implemented in software

Preliminary Results: Interpretation

Average causal effect of NO_3 > 1mg/L at Tar Heel on chlorophyll-*a* concentration at Lock 1:

1.88 (95% CI: 0.47, 3.3)

Setting NO_3 at the sampling location 86km upstream (near Smithfield Foods) from below 1mg/L to above 1mg/L is expected to increase, on average, chlorophyll-*a* concentrations at Lock and Dam 1 by 3.5 times ($1.88^2 \approx 3.5$).

Good news

- surveillance data is useful beyond just monitoring
- *may* be some measureable effects with important policy and scientific implications

Limitations

- unable to make direct link to toxic blooms
- monthly sampling scheme does not give complete picture

Recommendations

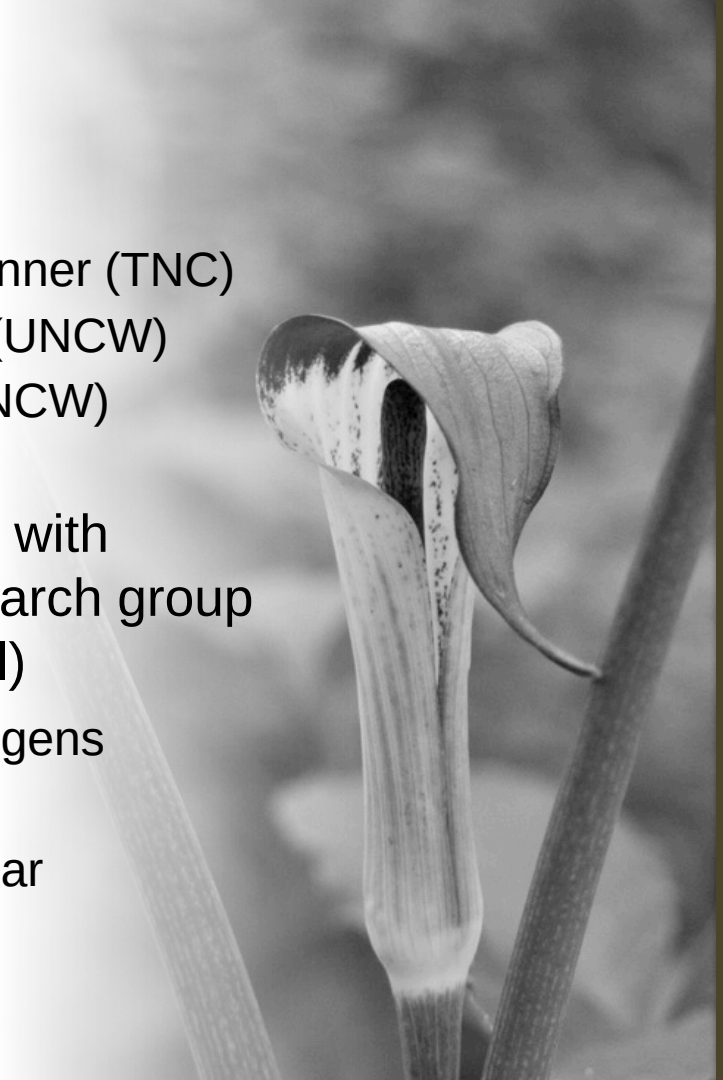
- measure the outcome(s) of interest – perhaps banking genetic samples
- augment regular surveillance with short-term, intensive sampling during bloom and non-bloom periods

Thank you

- Dr. Rebecca Benner (TNC)
- Dr. Mike Mallin (UNCW)
- Madi Polera (UNCW)

Causal inference with interference research group (UNC-Chapel Hill)

- Dr. Michael Hudgens
- Brian Barkley
- Sujatro Chakladar



Questions?

Extra slides

	Cutpoint (e.g NH_3 < 0.1 vs ≥ 0.1) Causal effect estimate (log_2 scale) 95% confidence interval		
NH_3	0.1 0.14 (-1.44, 1.71)	0.2 -0.15 (-1.75, 1.45)	0.3 -0.65 (-2.81, 1.52)
NO_3	0.8 1.34 (0.4, 2.29)	1.0 1.88 (0.47, 3.3)	1.1 0.33 (-1.11, 1.77)
TKN	0.65 -0.29 (-1.21, 0.63)	0.75 0.74 (-0.08, 1.57)	0.85 0.71 (-0.21, 1.63)
P	0.1 0.29 (-2.48, 3.06)	0.2 -0.12 (-1.42, 1.17)	

confidence intervals based on t distribution with 14 degrees of freedom (13 for P).