Interactions of climate and land use in controlling nitrogen fluxes through the Oyster River watershed in 2013 (and 2014)

Wil Wollheim, Gopal Mulukutla, Richard Carey, Chris Cook

Department of Natural Resources and Environment
&
Water Systems Analysis Group
University of New Hampshire

University of New Hampshire

New Hampshire Agricultural Experiment Station

Sea Grant New Hampshire

New Hampshire EPSCoR

ECOSYSTEMS + SOCIETY

Acknowledgements

- UNH Facilities and Town of Durham (Dave Cedarholm, Paul Chamberlin, Jim Dombrosk)
- VHB (Bill Arcieri)
- UNH Agriculture Experiment Station
- NH SeaGrant
- NSF-EPSCoR Ecosystems and Society
- Oyster River Watershed Association
- McDowell Lab

Goal

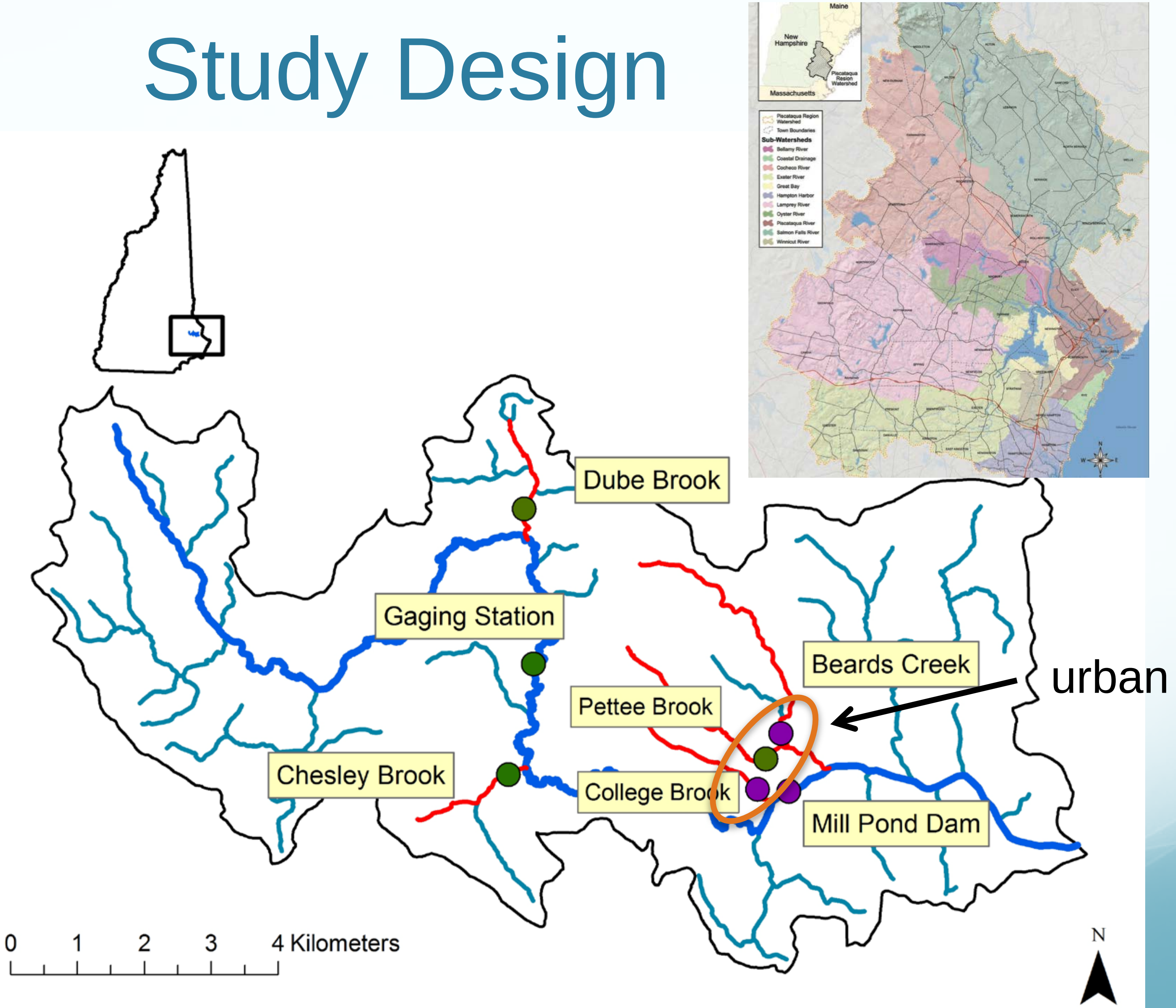
- **Quantify the amount and temporal variation of N <u>fluxes</u> from Oyster River and various sub-watersheds using continuous and high frequency *in situ* measurements in order to establish a baseline of non-point export flux patterns.**

1) Determine accuracy of existing non-point N loads based on infrequent grab sampling (accounting for storm events and short term variability)

2) Understand timing of exports among land uses and identify potential management priorities.

3) Develop baseline flux estimates to assess future improvements

Study Design



Study Design

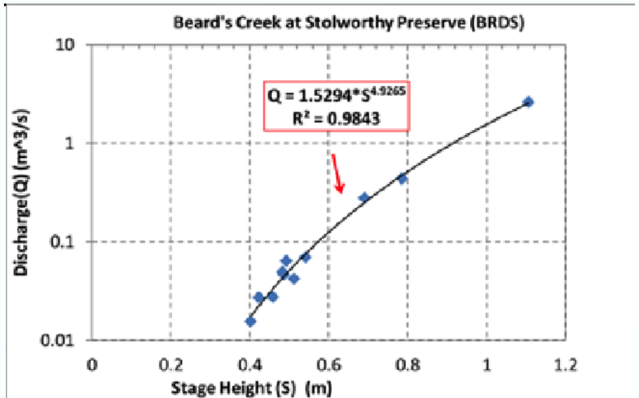
- Temporally intensive, measurement intensive (3 sites)
  - Satlantic SUNA for nitrate
  - Turner C6 or YSI for fDOM (DOC/DON), Turbidity (PON)
  - Hydrolab or YSI Sondes (D.O., Conductivity, pH), Stage
- Temporally intensive (4 sites)
  - Stage, water temperature, and conductivity
- Grab sampling – weekly or biweekly

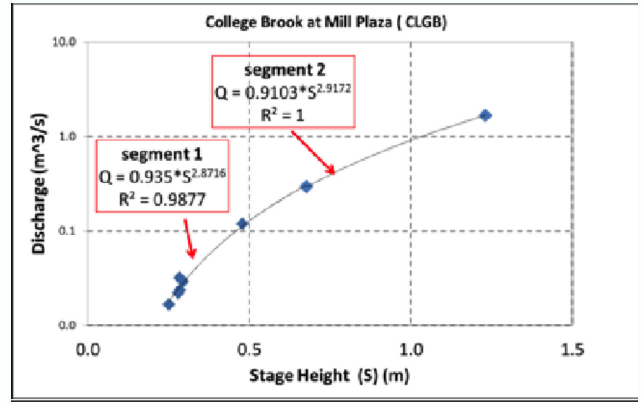
Oyster R. @ Mill Pond

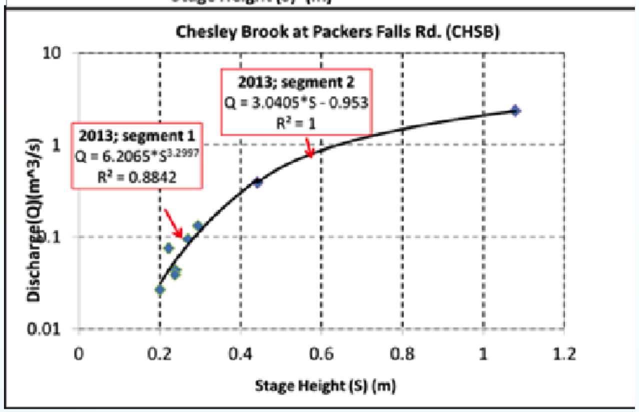
College Br. @ Mill Plaza

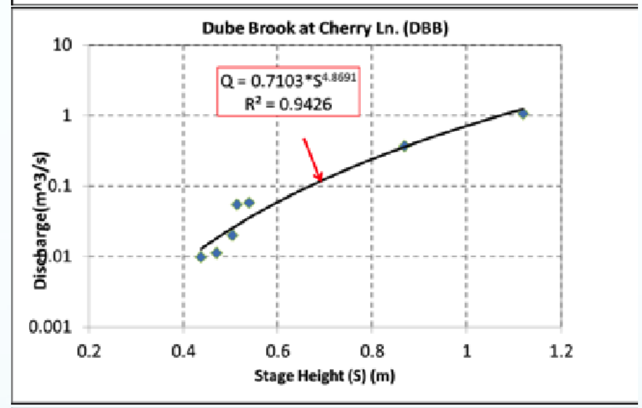
Beards Cr. @ Stolworthy

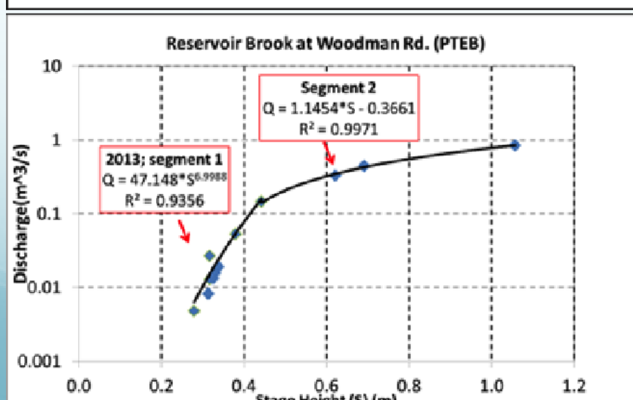
Improved Discharge Rating Curves

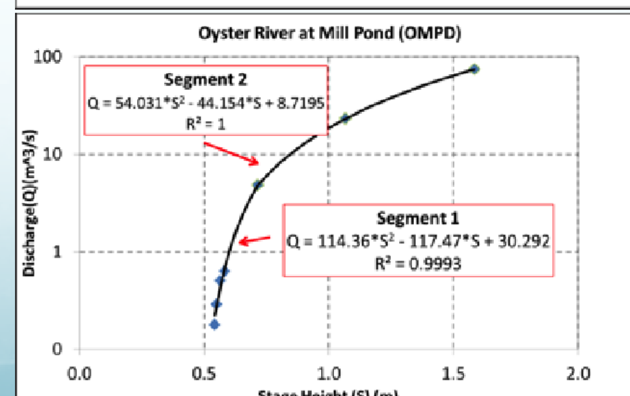




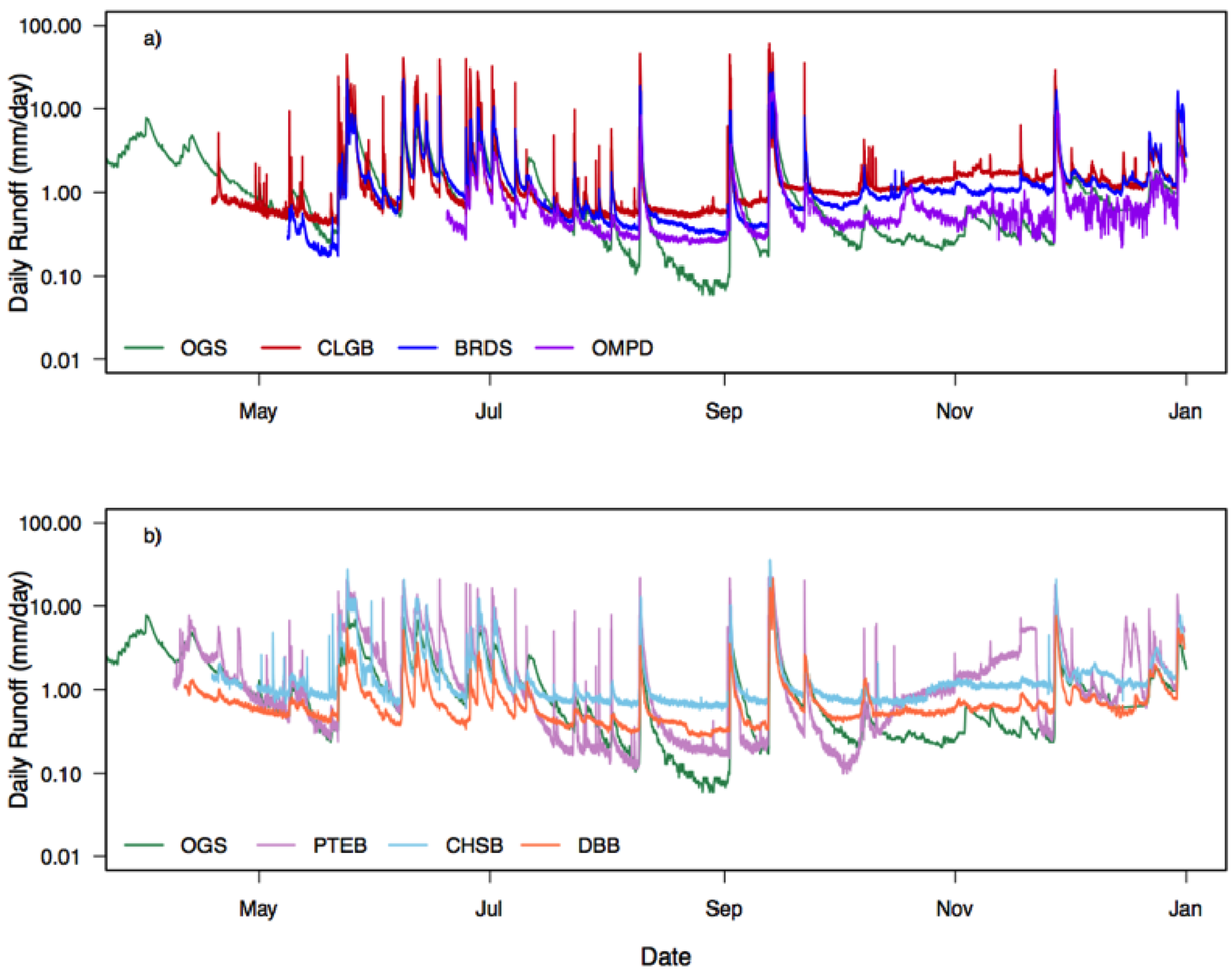




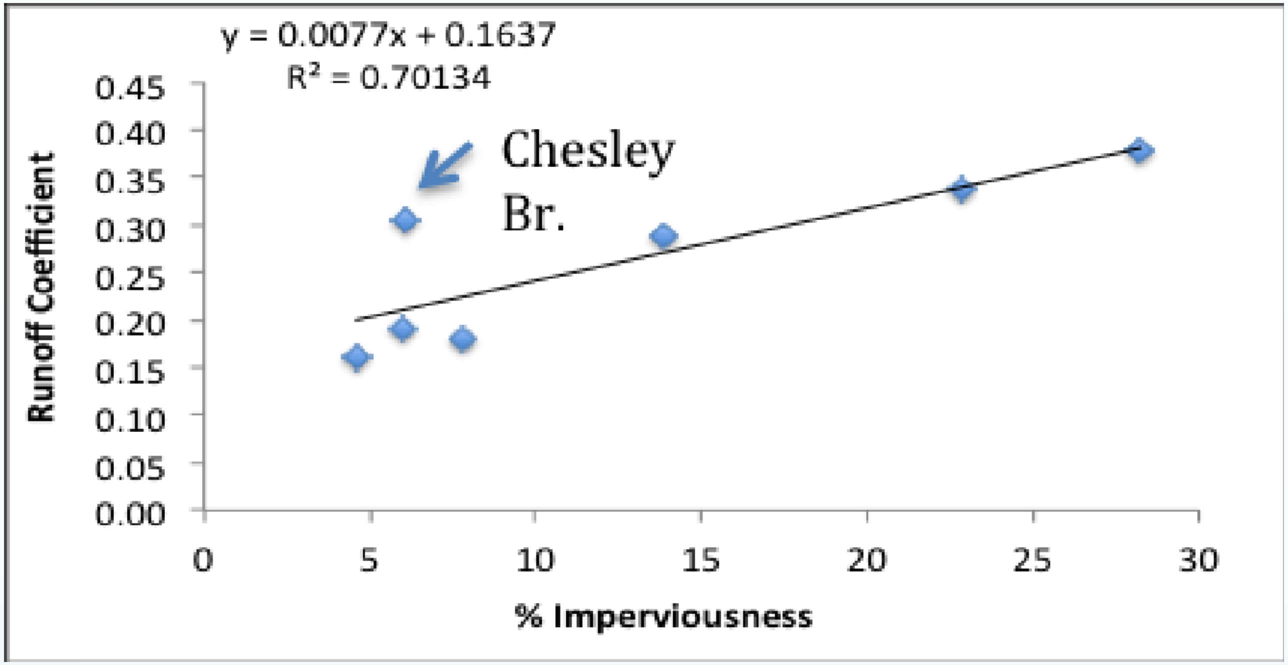




Annual Hydrographs (2013)

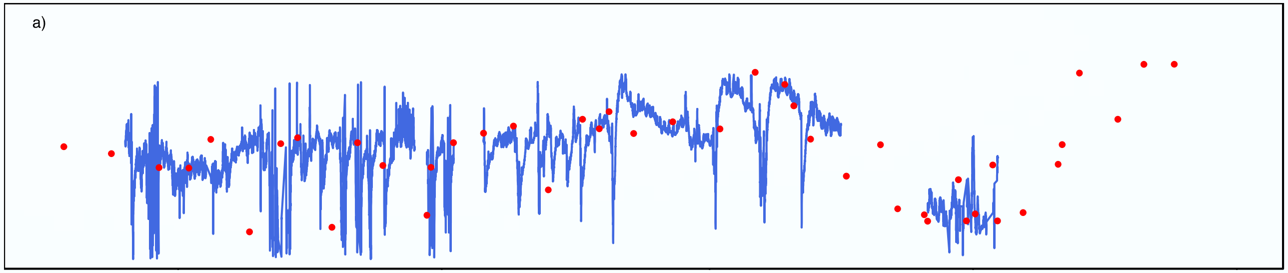


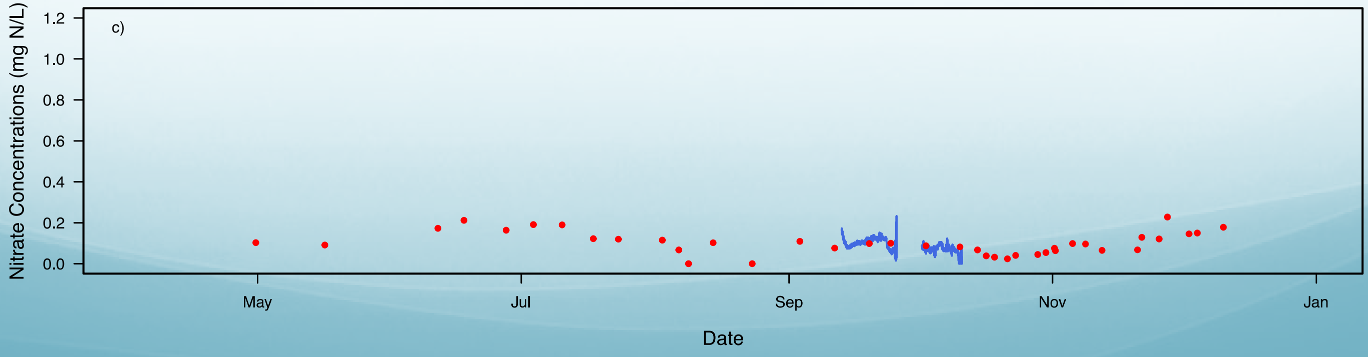
Seasonal Runoff Coefficients
(June to December 2013)



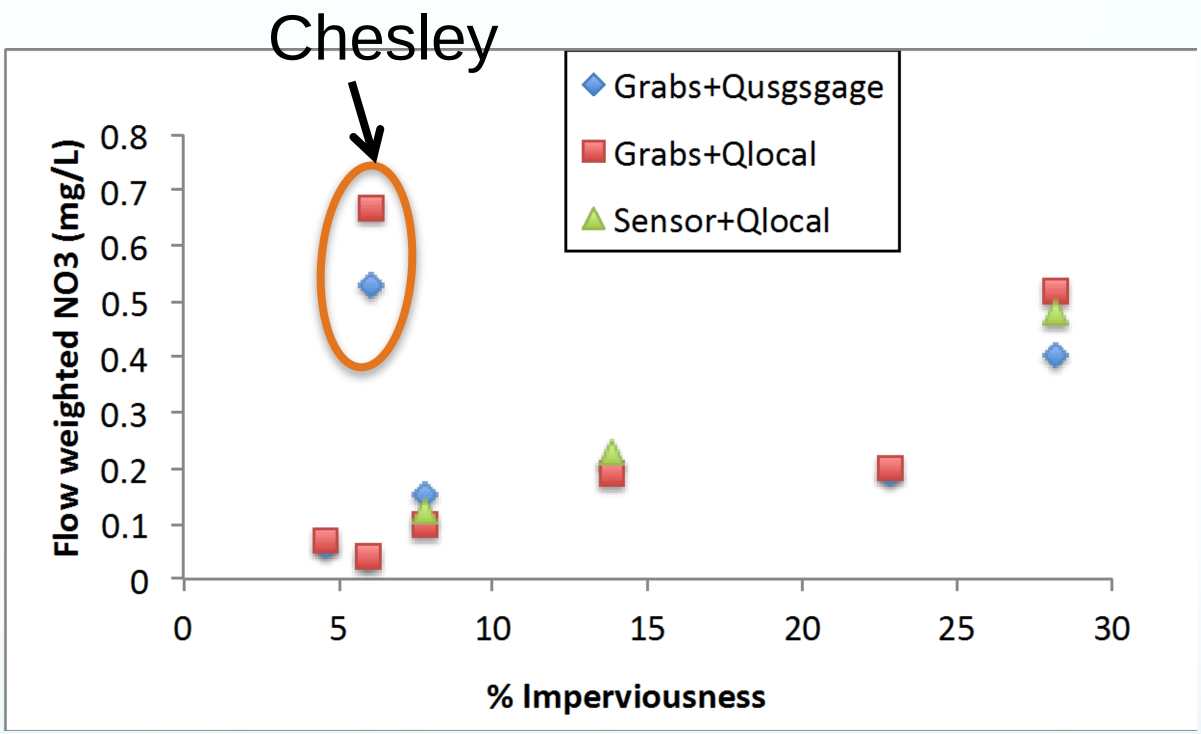
Runoff coefficient = Σ runoff / Σ precipitation

Nitrate Nutrographs





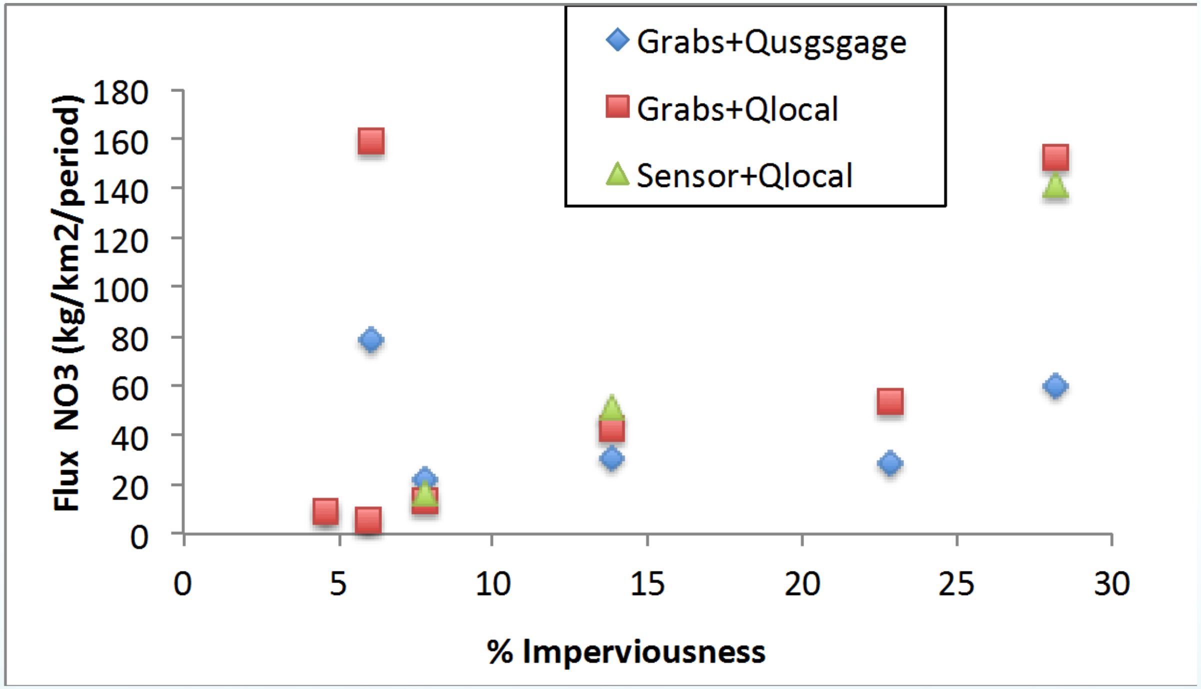
Mean Export Concentrations
(June – December 2013)



Three approaches:

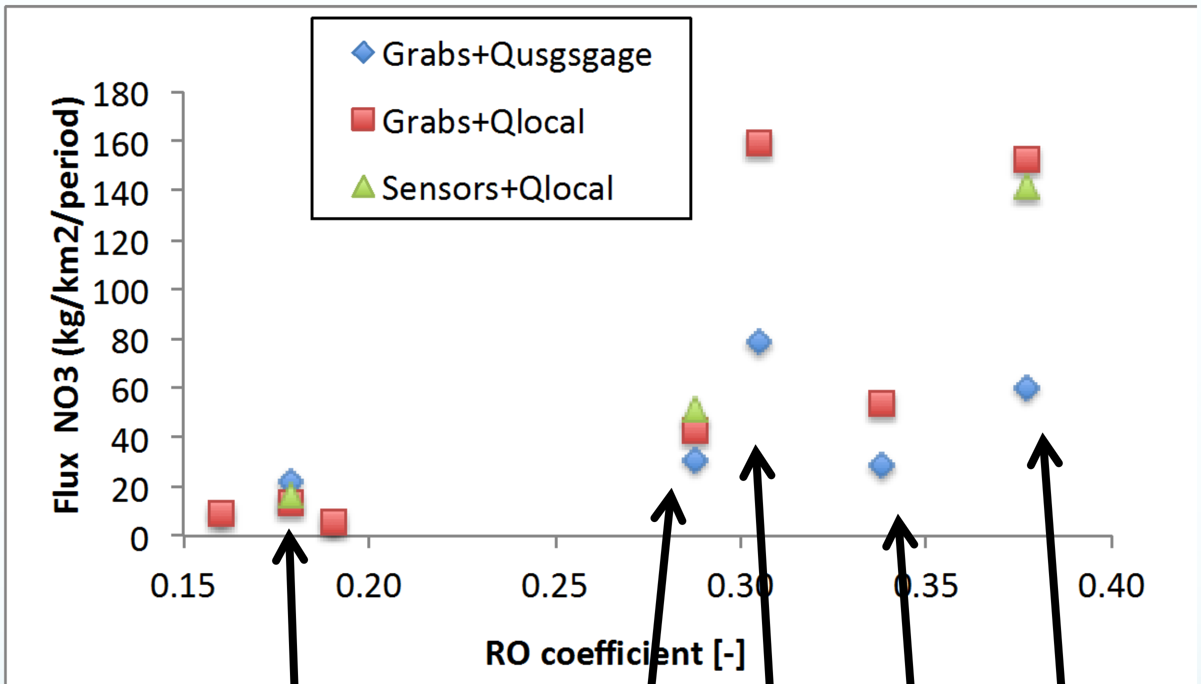
- Weekly grabs with USGS discharge (area weighted)
- Weekly grabs with locally measured discharge
- In situ sensors with locally measured discharge

Mean Export Flux
(June – December 2013)



- Critical to use flow from the measurement location in human dominated catchments

Mean Export Flux vs. ROcoeff
(June – December 2013)



Oyster, Mill Pond

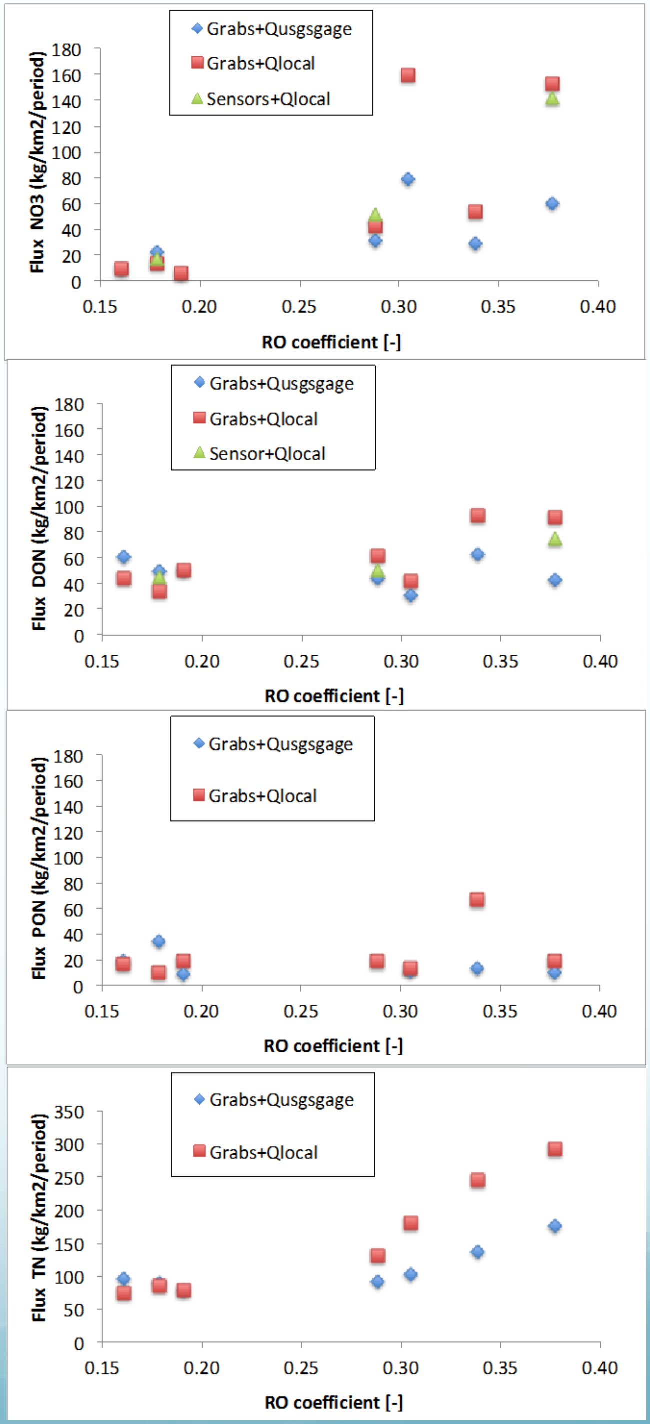
Beards Cr.

Chesley Br.

Pettee Br.

College Br.

Flux: All N Forms



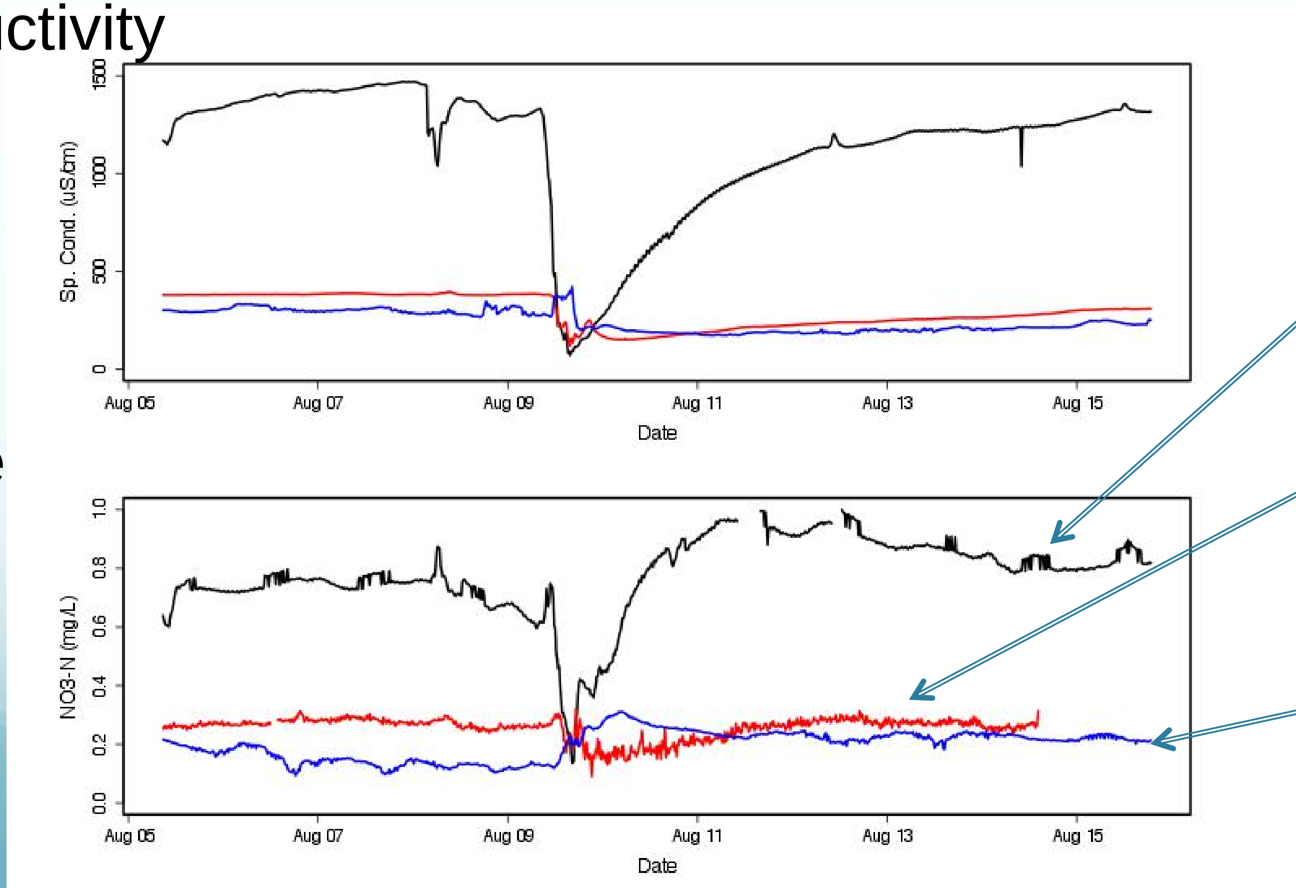
Total Nitrogen

Role of sensors?

- UNDERSTANDING:
  - High resolution to detect and eventually understand storm event scale responses
  - Why are the relationships between flux and imperviousness what they are?
  - Short time scale sources
  - Whether management/mitigation activities work

Conductivity

Nitrate



urban

suburban

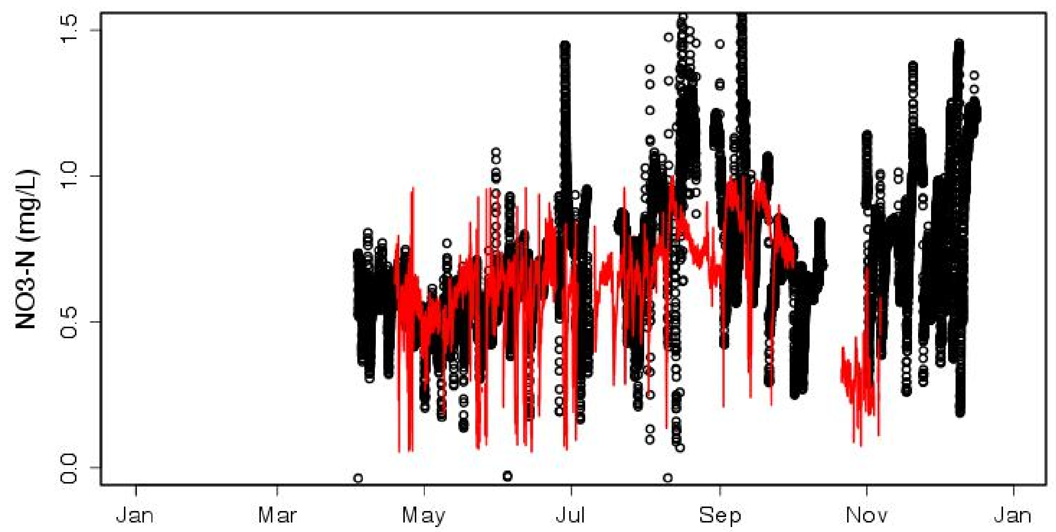
Integrated watershed

Conclusions

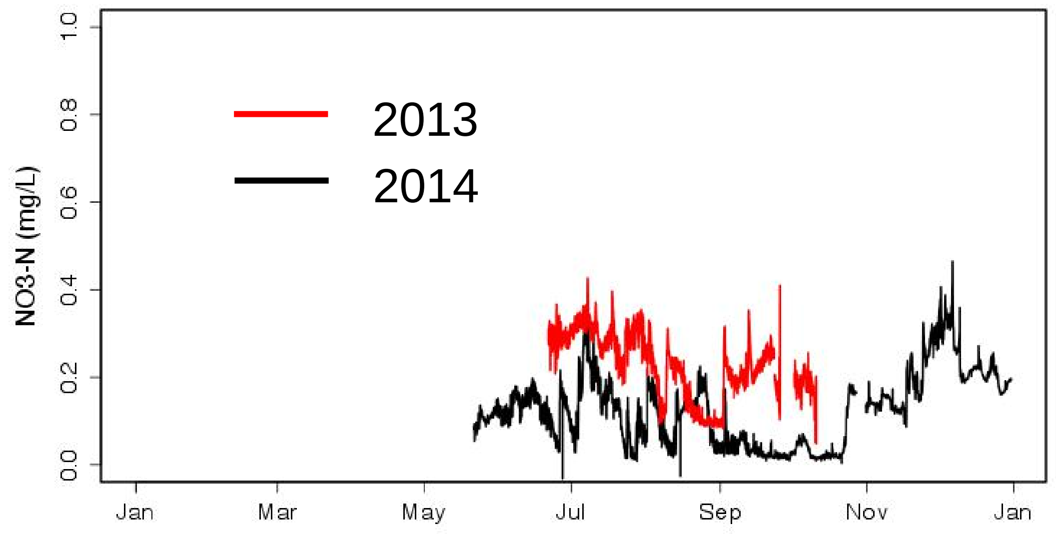
- Local discharges critical to quantify export fluxes.
  - Challenges for developing local rating curves
- Runoff coefficients drive exports
  - Related to impervious surface cover (but not always)
  - Chesley appears to be an outlier
- Form of N exported varies among watersheds, but TN flux driven mostly by runoff coefficient.
  - Threshold response?
- Sensors will be useful understanding storm event scale responses
  - Also source attribution (Richard Carey talk)
- Compare to 2014 data.
  - Evaluate interannual variability.

Comparison of 2013 and 2014

College Br.



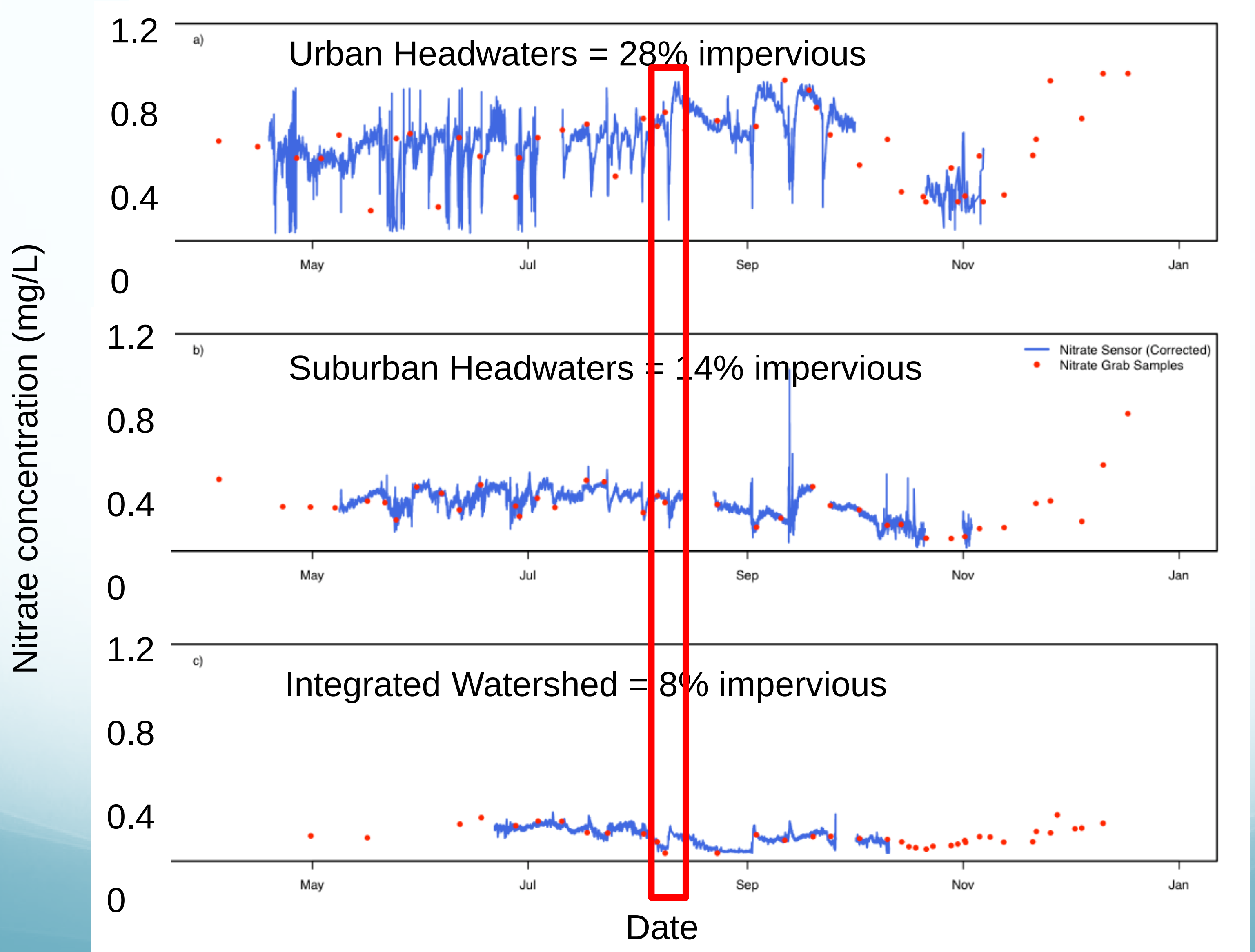
Oyster at Mill Pond




Questions?

Land use/storm interactions

Nitrate Time Series Oyster River : Land Use and Storm Interactions



Ongoing Work

- Sensor deployment for all of 2014
  - Chesley Br. instead of Beards Cr.
  - Added Upper College Br. and Moore Field (west).
- Synthesizing results for 2014
  - <u>Annual</u> Fluxes!
- Analysis of storm event controls of N export across scale
  - Effect of land use
  - Led by Chris Cook (Masters Student)
- Storm event source determination
  - Led by Richard Carey (earlier talk today)