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

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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 fluxes 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
Improved Discharge Rating Curves

Beard's Creek at Stolworthy Preserve (BRDS)

Discharge (Q) (m³/s) vs. Stage Height (S) (m)

Segment 2
Q = 3.529*5^0.922
R² = 0.9843

Chesley Brook at Packers Falls Rd. (CHSB)

Discharge (Q) (m³/s) vs. Stage Height (S) (m)

2013; segment 2
Q = 6.2065*5^0.8842
R² = 0.9884

Dube Brook at Cherry Ln. (DBB)

Discharge (Q) (m³/s) vs. Stage Height (S) (m)

Q = 0.7103*5^0.8991
R² = 0.9426

Reservoir Brook at Woodman Rd. (PTEB)

Discharge (Q) (m³/s) vs. Stage Height (S) (m)

2013; segment 1
Q = 1.1454*5^0.3661
R² = 0.9951

Oyster River at Mill Pond (OMPND)

Discharge (Q) (m³/s) vs. Stage Height (S) (m)

Segment 2
Q = 54.031*5^2 - 44.154*5 + 8.7195
R² = 1

Segment 1
Q = 114.36*5^2 - 117.47*5 + 30.292
R² = 0.9993
Annual Hydrographs (2013)
Seasonal Runoff Coefficients
(June to December 2013)

Runoff coefficient = $\Sigma \text{runoff} / \Sigma \text{precipitation}$
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)

![Graph showing Mean Export Flux vs. ROcoeff for different locations.
Oyster, Mill Pond, Chesley Br., Beards Cr., 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

- **Urban Headwaters** = 28% impervious
- **Suburban Headwaters** = 14% impervious
- **Integrated Watershed** = 8% impervious
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
  - Annual 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)