How we are using the Pooled Monitoring Initiative Research

Pooled Monitoring Program - Pools resources to support scientists who answer your key restoration questions and then provides those answers back to those that asked the question

Sadie Drescher, Vice President of Programs for Restoration
Chesapeake Bay Trust

Pooled Monitoring Initiative is a way to answer key restoration questions

Reason for the program:

- Stream restoration practices were stalled
- Funders, contractors, and regulators came together to figure out why this happened
- 2013 – Chesapeake Bay Trust, MDE, USACE, FWS, MD DNR, MDOT SHA, EPA, municipalities, practitioners, and others met to discuss this
- Realized there were very big, important questions that were valid
- Answers could not be found with site specific monitoring, permit monitoring, etc.
- Needed rigorous scientific efforts to start to tackle these questions

How the program started:

- MD DNR, US EPA CBPO, and the Trust pooled funding to offer first Restoration Research Award Program
- Request for Proposals (RFP) contained the top questions from earlier meeting/discussions

Pooled Monitoring Initiative - Science answers key restoration questions

- Desire to support the best, most cost-effective practices at the most optimal sites, but differences of opinion sometimes exist, and questions about the performance and function of some of these practices persist
- Funders pool resources to answer restoration questions posed by regulatory community & practitioners
  - **Partnerships and collaborations** – we are all a part of this effort!
- Increase power, objectiveness, and ability to know what works
- Bring science back to those that can use it for their work

Kelsey (UMD student) measuring groundwater for "Tree Trade-Offs in Stream Restoration Projects: Impact on Riparian Groundwater Quality" project (PI is Sujay Kaushal)

Final report here

Pooled Monitoring Initiative Provides Solutions

- Regulators prioritize their concerns with input from practitioners
- Funders "pool" resources
- Top restoration questions issued in the Restoration Research Request for Proposals (RFP) in FY15 administered by the Chesapeake Bay Trust
- Scientific teams research these questions and deliver answers back to the regulators
- RFP open to any organization – looking for best groups to answer your questions
- Results used in decisions, policy, practices, etc.

Claire Welty (UMBC) quantifying the cumulative effects of stream restoration and environmental site design on nitrate loads in nested urban watersheds using a high-frequency sensor network(Baltimore County, MD)

Restoration Research Award Program

- Supported 38 projects since FY 15 at >$7M
- Guided by the Pooled Monitoring Advisory Committee
- Uses scientific reviewers across the world to vet applications
- Runs all applications through a “management review”
- Projects are managed as contracts
- Questions are cycled off/on the RFP each year
- All awards, progress, and program products are online at: https://cbtrust.org/grants/restoration-research/

Keith Eshleman (UMCES) Plum Branch stormwater monitoring station (Ellicott City, Howard County, MD)

Tree trade-offs in stream restoration projects:

Impact on riparian groundwater quality

Sujay Kaushal, University of Maryland (PI)

Research Questions

- What is the impact of riparian tree removal during stream restoration and subsequent recovery (if any) on groundwater quality across restored, degraded, and forested reference sites in Maryland?
- Which type of broadly available data are best suited to predict both the nominal and cumulative impacts of riparian zones with various history of tree dynamics / disturbance on water quality at the watershed scale?

Slide info from 2021 forum presentation available here

How does removing trees affect groundwater quality?

Courtesy Gwen Sivirichi

Slide info from 2021 forum presentation available here

Experimental Design

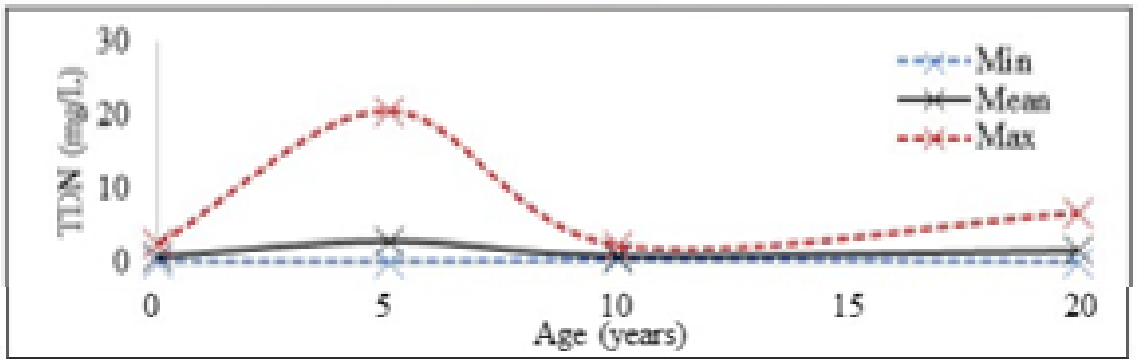
Chronosequence of sites 5- 20 years and uncut comparisons

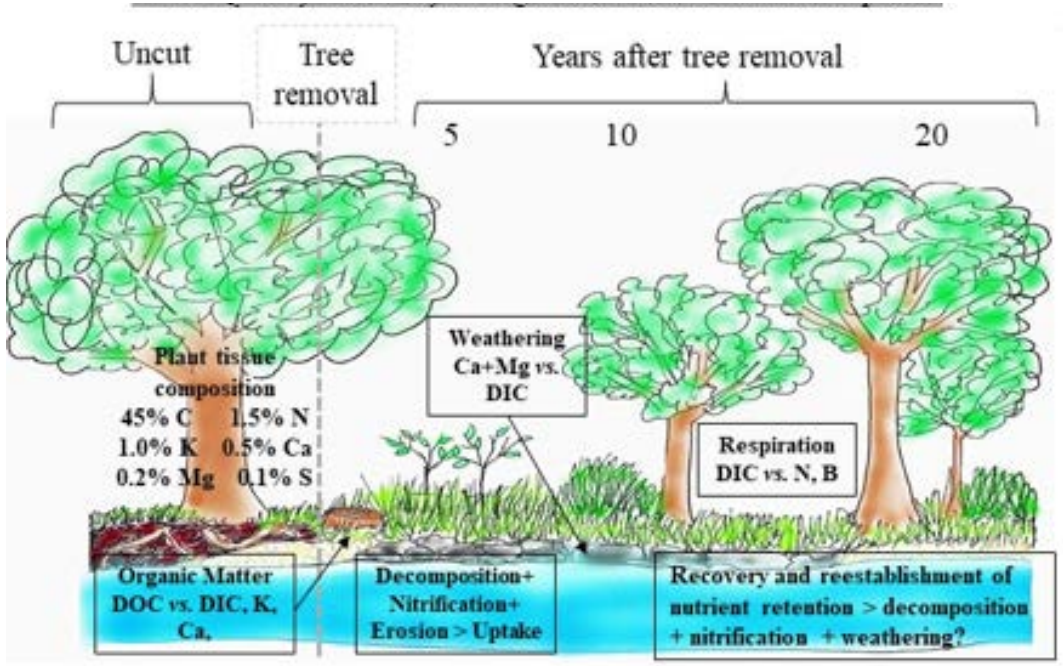
Wells installed in transects of 3

2021 forum presentation available here and final report here

Findings

Nutrient Concentration Ranges Along the Chronosequence





Restoration Question #9 under the Stability theme.

Improving the Success of Stream Restoration Practices

TESS WYNN THOMPSON, ASSOCIATE PROFESSOR, BIOLOGICAL SYSTEMS ENGINEERING

ERIC SMITH, PROFESSOR, STATISTICS

STUDENTS: REX GAMBLE, CORAL HENDRIXS, BILLY PARASZCZUK, BEN SMITH, U. SAMUEL WITHERS

Biological Systems Engineering

VIRGINIA TECH

Slide info from 2021 forum presentation available here

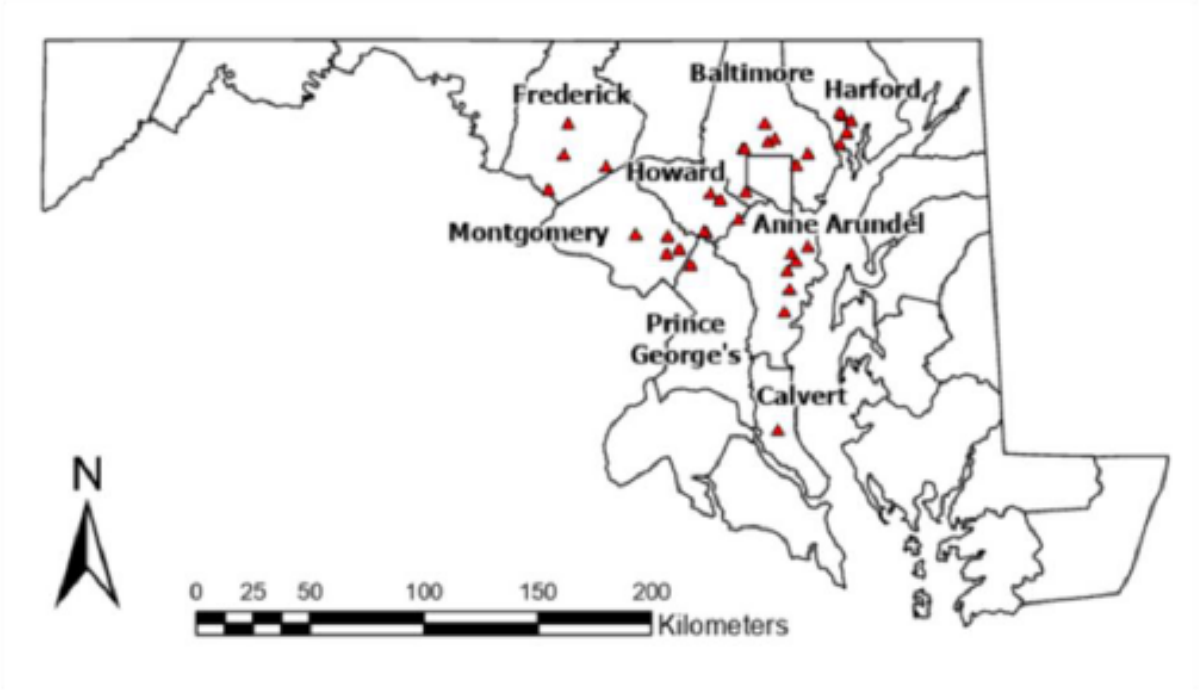
This research focused on 3 questions:

1. Linking stream restoration success with watershed and design characteristics
2. Design, project, and watershed factors that affect structure success
3. Comparison of 1-D and 2-D HEC-RAS modeling for stream restoration design

Slide info from 2021 forum presentation available here

The goal of Study 2 is to evaluate existing instream structures with the aim of informing structure design and siting

1. Structures were evaluated in the field
   - 38 Projects
   - 536 Structures
2. Watershed, project, and design characteristics correlated to structure assessment



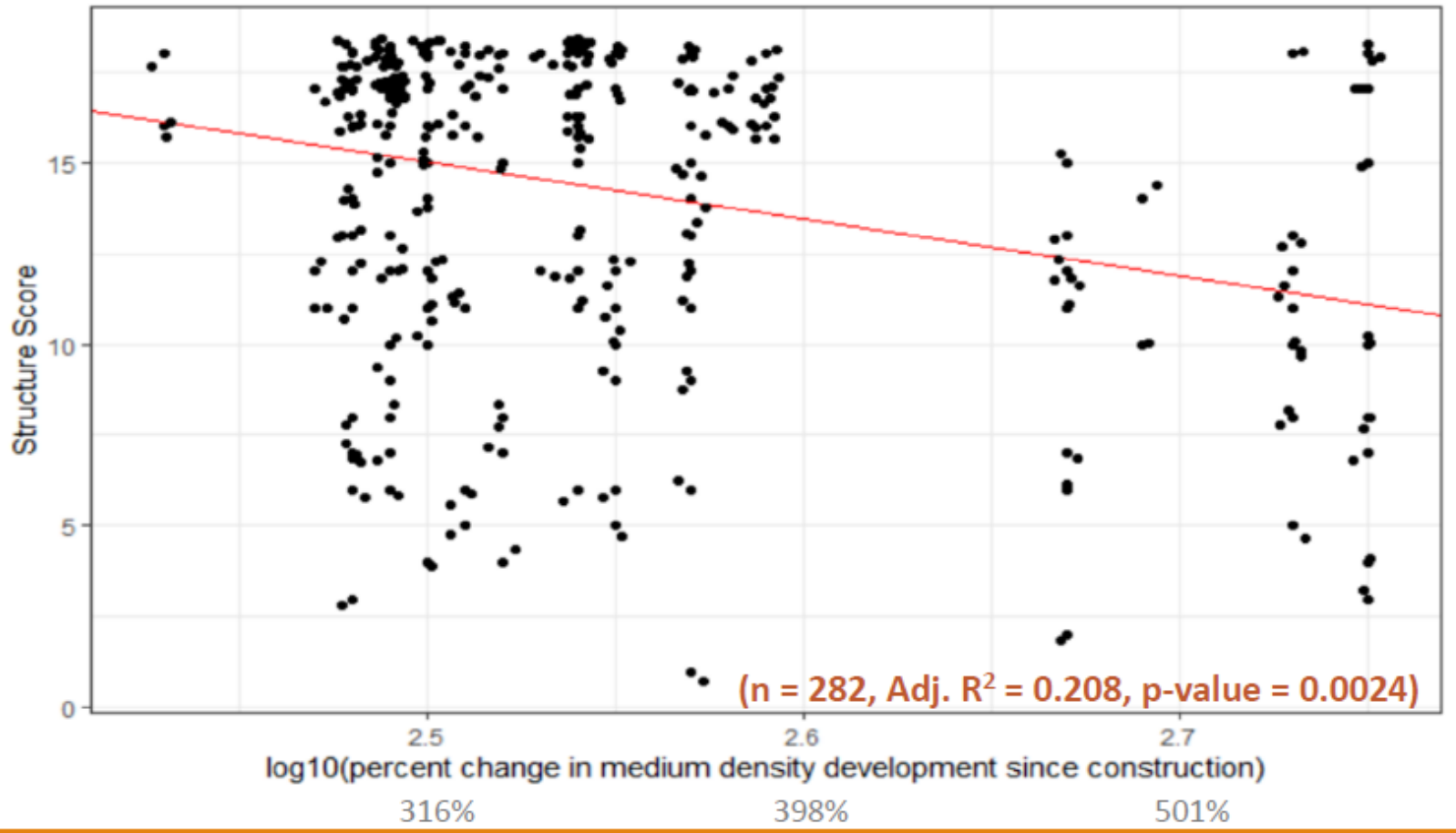
Slide info from 2021 forum presentation available here

What is structure success?

Attribute	1	2	3	4
Structure				
% remaining	0-25%	25-50%	50-75%	75-100%
material movement	significant	moderate	slight	none
Sediment				
unintended bank erosion or bed scour	significant	moderate	slight	none
unintended aggradation	significant	moderate	slight	none
Function				
serving intended purpose	no	partially	yes	

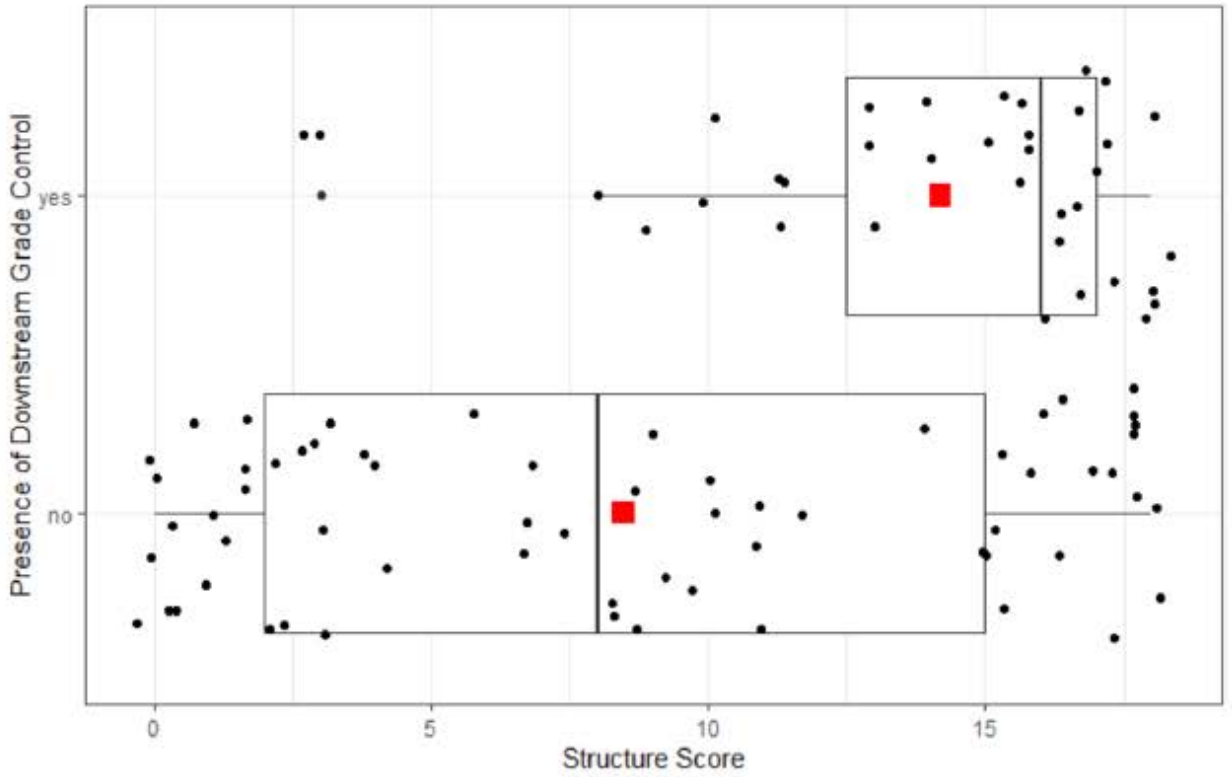
Slide info from 2021 forum presentation available here

Increased urbanization post-construction is negatively correlated with structure performance



Slide info from 2021 forum presentation available here

Constructed riffles with downstream grade control perform better.



Slide info from 2021 forum presentation available here and final report here

Determining the effects of legacy sediment removal & floodplain reconnection on ecosystem function & nutrient export

Vanessa B. Beauchamp
& Joel Moore
Towson University

Co-authors: Patrick Baltzer, Patrick McMahon, Melinda Marsh, Kyle Bucher, Ryan Casey, Chris Salice

Pooled Monitoring Forum
June 2021

Slide info from 2021 forum presentation available here

Likely outcomes & questions about Legacy Sediment Removal and Floodplain Reconnection

- Vegetation
  - Increased dominance of hydric vegetation
  - Change in community composition
  - Response to disturbance? Invasives?
- Water chemistry
  - Decrease in N, P and TSS due to increased overbank events and longer residence time
  - Relationship with drainage area? Impervious cover? Project length?

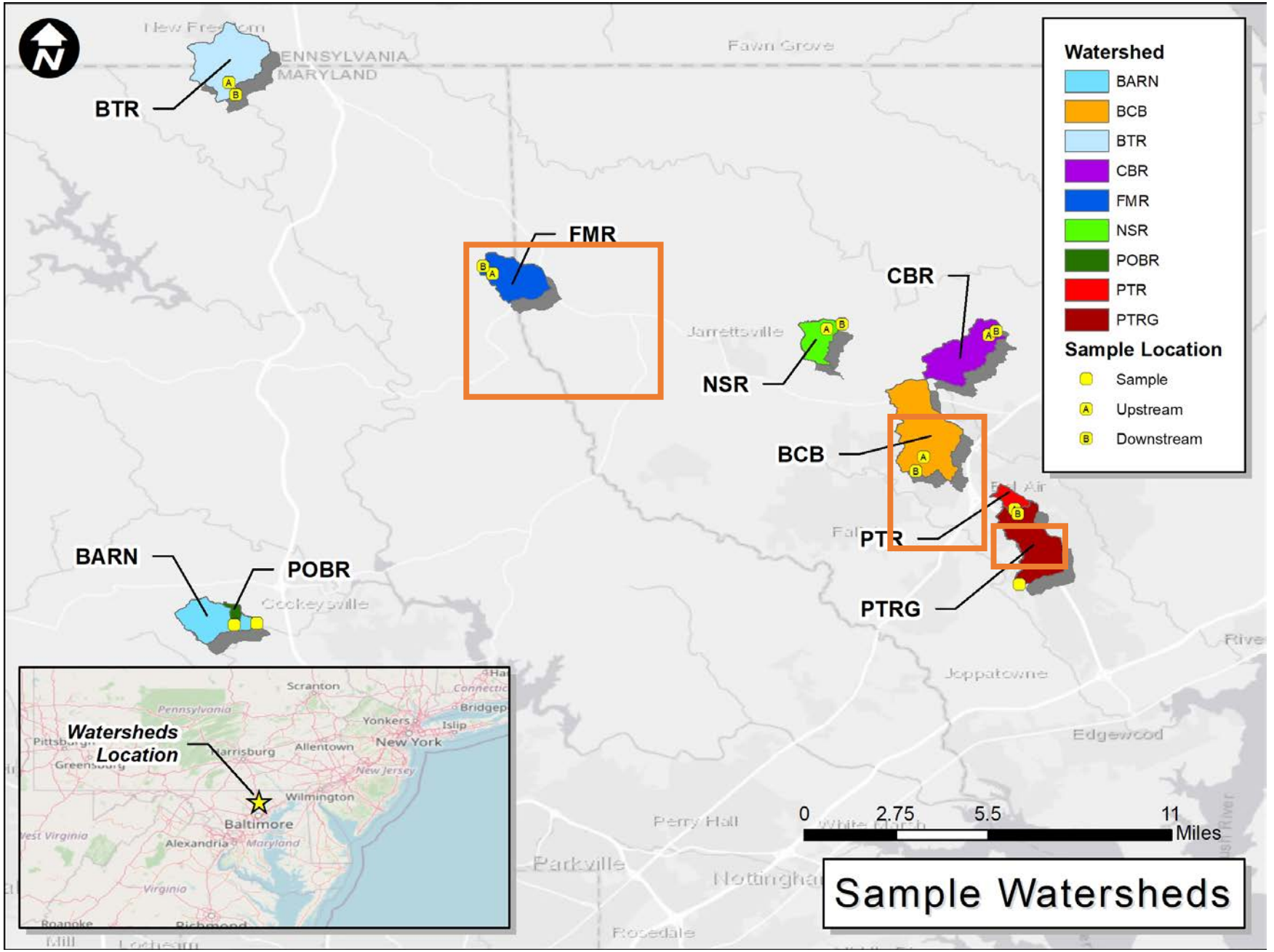
Slide info from 2021 forum presentation available here

Study sites

6 restored watersheds, 3 others

- 4 agricultural watersheds
  - 3 row crop
- 2 (sub)urban watersheds
  - + 1 larger scale watershed
- 2 (mostly) forested watersheds

- All <8.2 km^2
- Agricultural: 0 – 73%
- Impervious: 0 – 56%
- Restored length: 1240 – 5230 ft
- Restoration age: 1 – 5 years

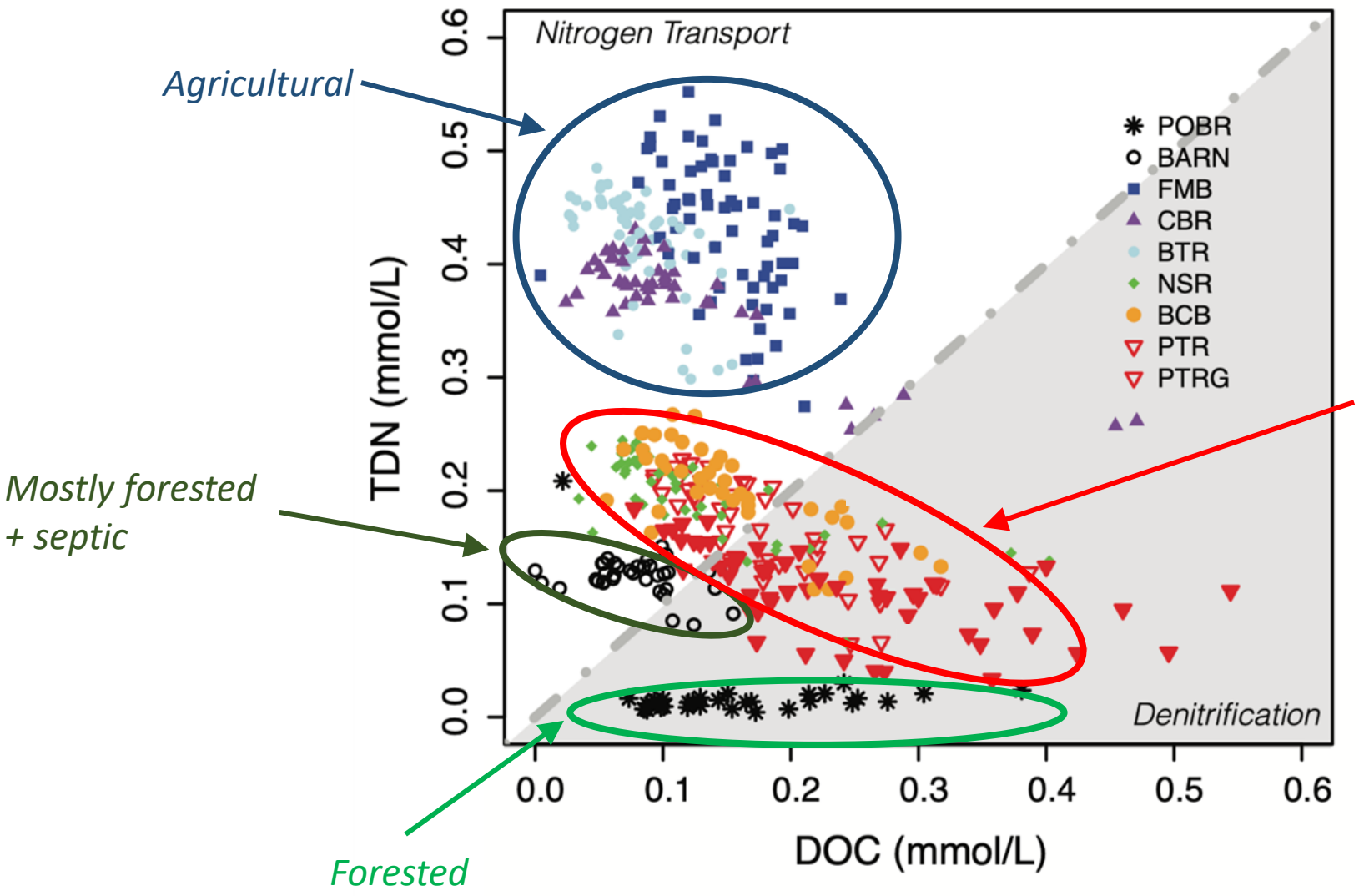


Slide info from 2021 forum presentation available here

First Mine Branch

Slide info from 2021 forum presentation available here

Carbon availability appears to be limiting denitrification



Similar dissolved organic carbon concentrations pre- & post-restoration

At Big Spring Run in PA, denitrification was not observed in groundwater (not even stream) until 5–6 years after restoration

Slide info from 2021 forum presentation available here

McMahon et al. (2021) *Environmental Research Letters*
https://iopscience.iop.org/article/10.1088/1748-9326/abe007

Summary - Water

- Weather (2018) made the study “interesting”
- Agricultural land use is the biggest driver of N concentrations
- Denitrification appears to be limited by carbon
- No significant difference in N after restoration
- During stormflow
  - Hints of slightly lower fluxes on downstream end
  - Of interest: storm N shifts with more ammonia & dissolved organic N (or NO_3^- decreases more than total dissolved N)

Slide info from 2021 forum presentation available here and final report here

Results

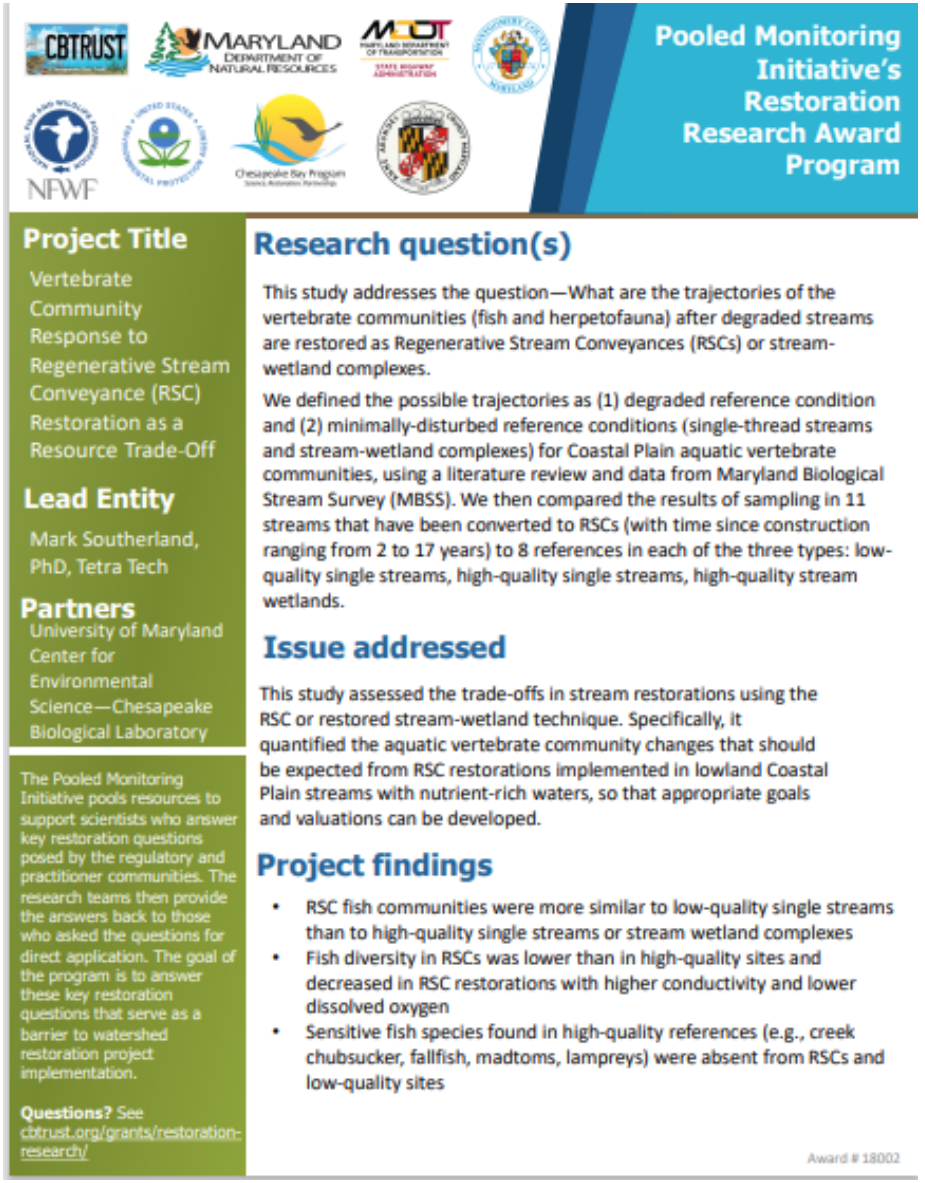
- Evaluating the effectiveness and sustainability of stream restoration designs: More TN, TP and TSS loads reduced in headwater streams for 10 streams monitored; stormflow more important in headwater streams and baseflow more important in lowland streams (forum ppt)
- Quantifying the ecological uplift and effectiveness of differing stream restoration approaches in Maryland - Urban stream restorations did not improve the benthics for ecological uplift (forum ppt)
- Optimizing sampling frequency and monitoring designs to assess BMP effectiveness - Statisticians ran scenarios to determine level of monitoring needed to really "see" restoration impact and we need 23 to 43 weeks of sampling to determine loads (forum ppt)
- Optimizing monitoring to realize BMP effectiveness – most monitoring programs are coarse and likely ineffective at evaluating the restoration program's success; developed decision support tool to help decide if monitoring will be worthwhile; evolution to hypothesis-driven monitoring recommended (forum ppt)

Results

- Climate impacts to restoration practices
  - Developed methods and Python code to update NOAA Atlas 14 Precipitation Intensity-Duration Frequency Curves for future climate conditions
  - Database of future IDF curves and 90th percentile events for all weathers stations in MD for 2055 and 2085
  - Analyzed potential effects on BMP performance, stream stability, and road culvert designs
  - Fact sheet and forum ppt
- Long-term impacts of living shorelines to SAV habitats – How does impacting SAV compare to benefit of creating intertidal wetland? When is SAV impact tolerable? How can indirect impacts on SAV loss be better predicted?
  - Living shorelines accreted sediment & SAV beds were not impacted by living shoreline
- Evaluating impacts of freshwater salinization on mobilization of nutrients and metals from stormwater best management practices –What are the concentration thresholds of road salt ions which can mobilize nutrients and metals to surface waters across varying stormwater BMPs? What are concentrations and loads of different road salt ions and associated metals/nutrients in nearby stream outfalls before, during, and after deicing events? – BMPs and stream restorations removing salts, but mobilization and salt ion impacts the “chemical cocktail” resulting (see final report)

Communicating results

- Pooled Monitoring forum each June
- Maryland Stream Restoration hosted Pooled Monitoring researchers
- Webinars to relay results to the Pooled Monitoring Advisory Committee throughout the year
- Peer to Peer information sharing
- Fact Sheets for completed projects
- And much more that I'm sure you are doing but I don't know about



Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Vertebrate Community Response to Regenerative Stream Conveyance (RSC) Restoration as a Resource Trade-Off

Lead Entity

Mark Southerland, PhD, Tetra Tech

Partners

University of Maryland Center for Environmental Science—Chesapeake Biological Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Research question(s)

This study addresses the question—What are the trajectories of the vertebrate communities (fish and herpetofauna) after degraded streams are restored as Regenerative Stream Conveyances (RSCs) or stream-wetland complexes.

We defined the possible trajectories as (1) degraded reference condition and (2) minimally-disturbed reference conditions (single-thread streams and stream-wetland complexes) for Coastal Plain aquatic vertebrate communities, using a literature review and data from Maryland Biological Stream Survey (MBSS). We then compared the results of sampling in 11 streams that have been converted to RSCs (with time since construction ranging from 2 to 17 years) to 8 references in each of the three types: low-quality single streams, high-quality single streams, high-quality stream wetlands.

Issue addressed

This study assessed the trade-offs in stream restorations using the RSC or restored stream-wetland technique. Specifically, it quantified the aquatic vertebrate community changes that should be expected from RSC restorations implemented in lowland Coastal Plain streams with nutrient-rich waters, so that appropriate goals and valuations can be developed.

Project findings

- RSC fish communities were more similar to low-quality single streams than to high-quality single streams or stream wetland complexes
- Fish diversity in RSCs was lower than in high-quality sites and decreased in RSC restorations with higher conductivity and lower dissolved oxygen
- Sensitive fish species found in high-quality references (e.g., creek chubsucker, fallfish, madtoms, lampreys) were absent from RSCs and low-quality sites

Award # 18002

https://cbtrust.org/wp-content/uploads/18002-Tetra-Tech-Fact-Sheet.pdf

Pooled Monitoring Initiative expansion will answer more of our questions

- Other states, organizations, City/Counties want to pool funds to answer their "burning" questions
- Maryland MS4 permit offers a Pooled Monitoring Program option
- What other ideas do you have for the Pooled Monitoring Initiative's use of information, questions to ask, sites to monitor, expansion, etc.?

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