Project/Activity Number: NE-1938

Project/Activity Title: Carbon Dynamics and Hydromorphology in Depressional Wetland Systems

Period Covered: December 2020 to December 2021

Date of This Report: February 4, 2022

Annual Meeting Date: January 10, 2022

Annual Meeting Participants: Marty Rabenhorst, Mark Stolt, John Galbraith, Patrick Drohan, Bruce Vasilas, Karen Vaughan, Judy Turk, Colby Moorberg, Jim Thompson.

Agenda

1) Review of what we have said we would do in the proposal.
2) Discussion of timing of each method including time of year, length of deployment, how many deployments, ….
3) Update from each participant… Do you have a site picked out? Is it instrumented to measure hydrology at each transect point? What sampling and analysis have you completed or need to do?
4) Methodology to share.
5) Tea and litter bag results.
6) Discussion on potential publications.
7) Additional discussion.

Minutes from the NE-1938 Multistate Meeting. 9 am to 5:00 pm eastern time via video conference

One by one we went through each component of the proposal and discussed our progress. This included a review of the methods. Parts that needed to be amended or changed were discussed.

Sites

Our first discussion focused on site selection. Most participants had already chosen and instrumented sites. Colby and Judy discussed their sites, and Patrick mentioned some vandalism to his.

Colby

- Has 12 bison wallows identified, will be selecting 3 with similar size and plant community

- Plant survey conducted in July showed only 3 met the wetland plant indicator at the center, and none met the plant indicator at the edge
- Will redo the plant survey in the spring (April or May) while the sites are still ponded

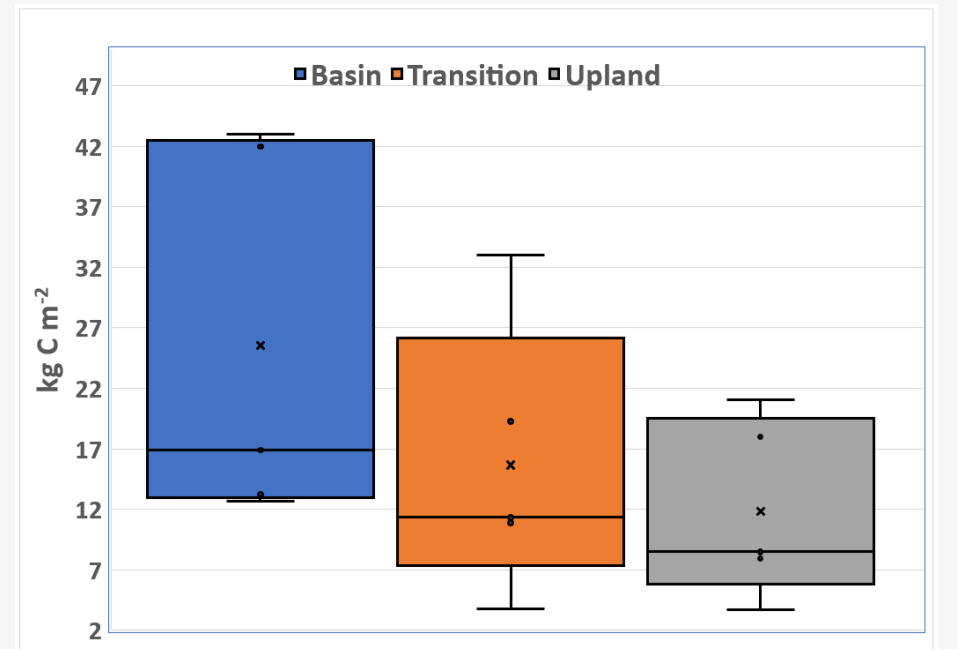
Judy

- Has a site established, wells installed, will be installing temperature sensors this year.

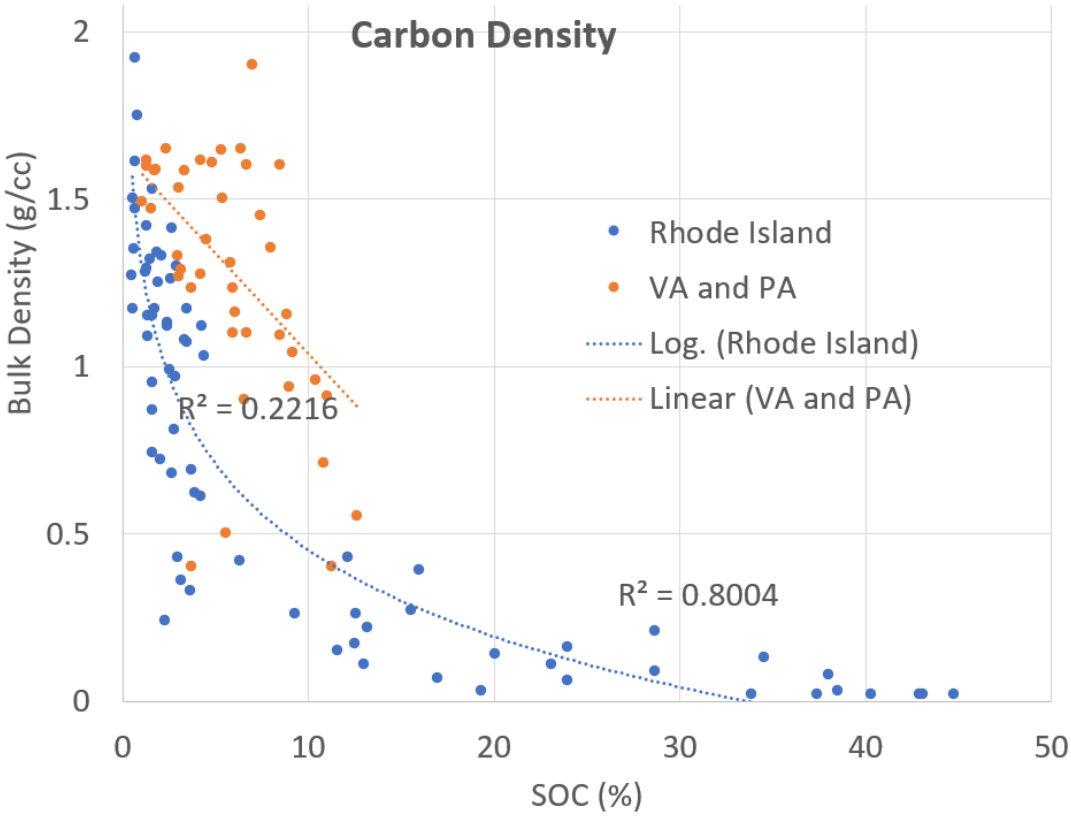
Methodology Discussion

- Profile Darkness Index (Jim and Judy are working on a manuscript).
    - Hypothesis is wetter soils would have thicker dark colors
    - WV and Pennsylvania sites don't follow the predicted trends while the other sites do
        - WV data likely influenced by a coal seam present on the site. A photo from a 2019 poster was shown, which depicted the coal seam in the transition and upland area
        - Pennsylvania data could be influenced by charcoal due to the history of burning in the region. There's also been disturbance from logging.
- Carbon Stocks:

    Pooled carbon stock values across the sites, as expected, showed more carbon is stored in the wetter basin and decreases across the transects (see figure). These data did not include the WVA data because of the coal seams. Pools from ridge and valley sites (VA and PA) were much higher (basin stocks averaged 42.5 kg/m^2) than stocks from the coastal plain (DE and MD) and glaciated northeast (RI) which averaged 14.2 kg/m^2 in the basin. In addition, the carbon density for the glaciated site (RI) was much different than for the ridge and valley sites (VA and PA) (see figure). The differences in carbon stocks and densities will be further investigated across all of the sites.



Box plot of carbon stocks from the RI, MD, DE, VA, and PA vernal pools.



Carbon density plot for samples collected from the RI, VA, and PA vernal pools.

- Soil temperature
  - Was not included in the proposal, but needs to be measured by everyone
  - Depths preferred: 30 cm (for sure) and possibly also 10 cm
- Weather station data:
  - 30 year averages
  - WETS table data to document that data used was in a normal year
    - https://www.nrcs.usda.gov/wps/portal/wcc/home/climateSupport/agAcisClimateData/
    - http://agacis.rcc-acis.org/
  - At a minimum, identify the weather station that will be used to represent the site and where data can be downloaded
    - Preferred reliable weather stations with long records
  - If possible, on-site (or near site) data
  - Still needs to be done in DE, PA, RI (and pasted into spreadsheet)

Tea and litter bag decomposition:

- Several sites experienced tea bags getting eaten. Green tea seems to have been preferred.
- Data should be analyzed along with water table depth/depth of ponding during the time the litter bags and tea bags were deployed
- Add this information to these spreadsheets for the periods of deployment
    - Cumulative days of saturation (actual hydrology record for the deployment periods)
    - Daily soil temperatures during the periods of deployment (10 cm would probably be preferred to 30 cm for these data if available?) But since some folks don't have 10 cm, may be important for everyone to include 30 cm for comparisons.
- Leaf Litter
    - John (VT)
        - Zone 1 (basin) showed the most loss of mass, but there was evidence of a coating of organic material from stirring within the pool. Zone 1 was sig. More decomposed than Zone 2
        - Zone 2 had less decomposition that Zone 1, but no difference vs Zone 3
        - Zone 3 showed almost no change in color
    - Marty (MD)
        - Showed the basin area had the most lost to decomposition than the other zones
        - Reported on some extra steps in washing for the methods for the basin samples
    - Bruce (DE)
        - No report. Bruce was at home and data is on campus
        - Tried to brush off sediment, but doesn't think it was as big of a problem as John's and Marty's sites (Bruce's is sandier)
    - Jim (WV)
        - Had similar problem with muddy bags, very caked with mud
        - Didn't process data because he wanted feedback on how to process samples
        - Had similar problem with sphagnum moss growing into the bags like Patrick discussed
    - Patrick (PA)
        - Dipped sample bags in wash basins, would swap out water between dipping the sample bags
        - Most % loss in upland, least in basin
        - Was a really dry summer
        - Had sphagnum growing into the bag, which was cut and pulled from the bag
    - Karen (WY)
        - Went there on June 1, came back in July, couldn't return to the site
        - She will do this in 2022 growing season
        - Will try the fake leaf experiment to determine how much sediment gets added to bags/leaves

    - Mark (RI)
        - Did not experience sediment on the bags
        - Average percent loss by weight ranged from 22.7 to 27.9%. Analysis of variance showed a significant ($p = 0.004$) difference among stations along the transects with the upland having significantly more decomposition than the transition position by LSD statistical analysis.

- Tea bags
    - Please add your data to this spreadsheet
        - https://docs.google.com/spreadsheets/d/1L-TcAqdUy81wfAAKFzj6qD86hUzSx0hFKl3z95DecpI/edit?usp=sharing
    - Patrick
        - Less decomposition in upland
        - Green tea had higher rates of decomposition
    - John
        - Green tea had sig. More loss in pool compared to transtion and upland
        - No difference in decomposition of red tea among locations
    - Marty
        - Higher decomp of green tea in transition and upland than the basin
        - No difference in decomp for red tea
    - Judy
        - More decomp in green tea
        - Not much difference between zones
    - Jim
        - More change in green
        - Difference between zones more pronounced among red tea than the green tea
        - No ponding at retrieval, not sure about deployment
    - Mark
        - Not much difference between zones for green
        - Red showed the basin and transition had less decomp compared to uplands
        - He thinks the red tea was better at showing differences since the green tea decomposed so fast
    - General discussion
        - Could try a smaller time period to see if there is a difference
        - Need temperature and hydrology data during time of deployment for each site
        - The mass of the bags and string should be factored out of percent loss of mass of the tea bags (no one was sure if they did that)
            - Could be done by cutting open bags and weighing bags, string, and tea at the beginning and repeating this at the end.

- Could also be done by finding average mass of bags and string and using a standard correction for all masses

6) Discussion on potential publications.

As mentioned above, Judy and Jim were working on a manuscript focused on potential of using profile darkness index along the transects. The variety of sites and settings seems to have complicated the analysis.

7) Additional discussion.

- Root growth
- Potential methods:
    - Root cores
    - Ingrowth cores
- Ingrowth cores was the consensus method
    - Approximately 3" diameter cores
    - Installed 5-15 cm
    - 3 cores for each of the 3 zones (plots) along the main transect with the wells (9 cores total)
    - Nylons are filled with soil from nearby; soil material is sieved to remove roots. Generally, this is done with B-horizon material due to fewer roots.
- At the end of discussion, agreed to also do a root core at the time of deploying of the ingrowth bags (3 from each plot along the main transect)

Action Items: everyone responsible unless individual identified

- Get WETS Table Data http://agacis.rcc-acis.org/
- Identify closest weather station with 30 years of records and web page for data downloads - enter link in the spreadsheet above
- Upload vegetation data (create spreadsheet and template for all - BRUCE)
- Upload soil temperature data at 10 and 30 cm depths for deployment periods (create folder and template for all MARTY)
    - Litter bag deployment period (could be done now)
    - Tea bag deployment period (could be done now)
    - Full year for decomposition sticks (should be done after sticks are retrieved)
- Collect/upload carbon stock data (send data to MARK - he will create complete spreadsheet)
- Upload hydrology data for deployment periods (create folder and template for all - KAREN)
    - Litter bag deployment period (could be done now)
    - Tea bag deployment period (could be done now)
    - Full year for decomposition sticks (should be done after stick are retrieved)

- Upload site photos https://drive.google.com/drive/folders/1GOlA8RIb9fMEkbMTcoRpDxNixBTemrcA
- Upload nitrogen data (Kansas and Nebraska)
    - Need **date of collection** for everyone that has completed this HERE
- Upload all data for leaf and tea bag decomposition data (see spreadsheet link above)
- Root ingrowth experiment protocol - BRUCE & MARK (5-15 cm; 3" diameter, 10 cm height)

Accomplishments: This year was the second actual year of the study. Our research plans focused on activities in the late spring, summer, and fall. Unfortunately, these plans have been severely hindered by the Covid-19 pandemic and the Omicron and Delta variants. Thus, our accomplishments have been minimal so far. In 2021 we published our work with the Mn IRIS: Rabenhorst, M.C., P.J. Drohan, J.M. Galbraith, C. Moorberg, L. Spokas, M.H. Stolt, J.A. Thompson, J. Turk, B.L. Vasilas, and K.L. Vaughan. 2021. Manganese-coated IRIS to document reducing soil conditions. Soil Science of America Journal. doi.org/10.1002/saj2.20301

Short-term Outcomes: This is essentially the 2nd year of this study, although some of the decomposition data has been recorded our overall carbon budget is incomplete. Our hope is by next year to have a complete set of decomposition data. We are still measuring inputs and will need to measure fluxes after that.

Outputs: Our overall goals are to understand of the role depressional wetlands play in control and emissions of greenhouse gases and to understand the effect of increasing temperatures on C stocks and fluxes in wetlands.

Activities: (See above from annual project meeting notes on planned activities for 2022)

Milestones: For 2022, our plans are 1) to complete site selection and site instrumentation; 2) continue temperature and hydrology monitoring; 3) complete sampling where needed; 4) measure carbon inputs from litter traps and deadfall plots; 5) deploy ingrowth cores to measure root inputs, 6) collected decomposition sticks and analyze; 7) analyze tea bag and leaf litter decomposition data; and 8) continue examine profile darkness data to complete the manuscript.

Impacts: This is essentially the 2nd year of the project and thus we have minimal results to report that would be considered an "impact". We published our manuscript on the effectiveness of Mn IRIS to identify reducing conditions in soils. We found that Mn IRIS were much more effective than Fe IRIS in identifying reducing conditions in the early (colder) growing season. We propose that the National Technical Committee for Hydric Soils (NTCHS) consider accepting Mn IRIS for identifying reducing conditions when soil temperatures are between 5 and 11 degrees C.

Publications: In 2021 we published our work with the Mn IRIS (see above). WE plan on continuing to develop a manuscript linking profile darkness index to hydrology and potentially carbon stocks.