Vermont Wetland Bioassessment: A look into the past, present and future of the program

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Vermont Wetlands Program
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Outline For Today

- Program Purpose & History
- Methods
- Biocriteria
- Data and Results
- The Future of Vermont Wetland Bioassessment
- Questions

So why do we have this Program?

- **Purpose**
  - To monitor the health of Vermont's wetlands
  - To provide support for planning and regulatory activity
  - **To monitor the effectiveness of restoration and rehabilitation projects**
  - To monitor long-term trends of wetland health

- **Survey Types**
  - Level 1: broad landscape-scale assessment
  - Level 2: rapid assessment at the wetland scale
  - Level 3: site- intensive biological assessment

Objectives: how do we do this?

- 1) conduct assessments of wetlands across a condition gradient;
- 2) record and gather chemical and physical data at each wetland site including water quality, hydrology, soils and landscape characteristics;
- 3) sample and describe the vegetation in assessed wetlands to develop vegetation-related metrics of wetland biological integrity;
- 4) complete rapid assessments and evaluate the ability of the methods to reflect the overall wetland condition, and
- 5) begin to expand the use of metrics in assessing the overall ecological health of Vermont's wetlands.

A "Brief" History…

- **1998-1999:** Vernal Pools and Northern White Cedar Swamps
- **2006-2007:** Stream & lake- associated wetlands, bug sampling, Human Disturbance Ranking (HDR)
- **2008-2010/11**: All wetlands with a focus on condition ranking methods using flora and water quality, VRAM
- **2011**: National Wetland Condition Assessment (NWCA)
- **2012**: Sentinel sites, introduction of FQAI
- **2013**: Rapid assessments of Class I candidate wetlands
- **2014-2015:** adoption of NWCA methods, creation of database
- **2016:** Round 2 of NWCA, full-time position created
- **2017:** NHI-based field methodology; WQ Monitoring Program Integration; refining vegetation metrics; VRAM

Current Approach

- Collect data on a 5-year rotational basin schedule
- Integrated approach for site selection
- Conduct detailed field surveys (Level 3)
  - Biological- vegetation data (plant plots)
  - Chemical- water quality sampling
  - Physical- soil and hydrology characterization, stressors
- Utilize the VRAM (Level 2)
- Refined mapping
- Classify wetlands via VT Heritage natural community methodology

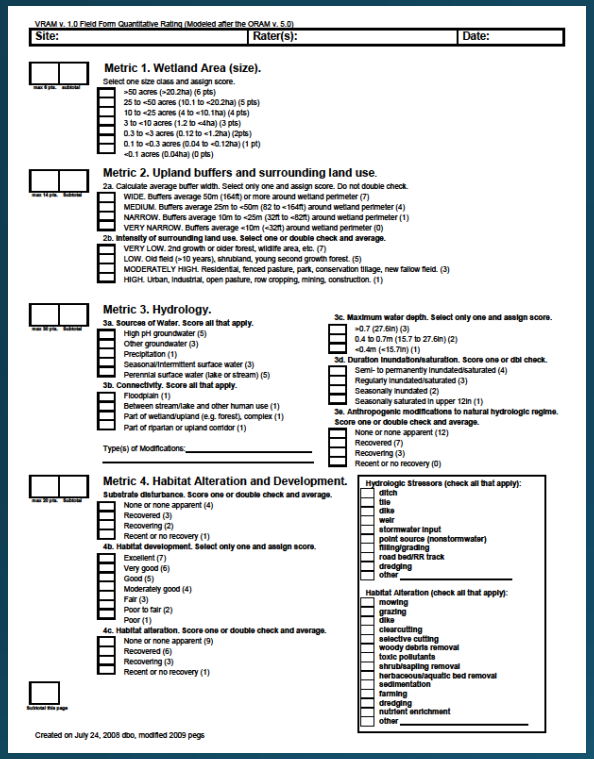
Development of Wetland Biocriteria

- Use of vegetation as an indicator of biological integrity =

Floristic Quality Assessment Index (FQAI)

- Works best when compared to other similar NC types
- Evaluate wetland condition with Coefficient of Conservation (CoC)
- Drawing connections between CoC, wetland condition and natural community type
- Should not be the only measurement of condition for a site

Level 2: Vermont Rapid Assessment Method



VRAM v. 1.0 Field Form Quantitative Rating (Modeled after the ORAM v. 5.0)

Site: | Rater(s): | Date:

Metric 1. Wetland Area (size).

Select one size class and assign score.

- >50 acres (>20.2ha) (6 pts)
- 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- 10 to <25 acres (4 to <10.1ha) (4 pts)
- 3 to <10 acres (1.2 to <4ha) (3 pts)
- 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- VERY LOW. 2nd growth or older forest, wildlife area, etc. (7)
- LOW. Old field (>10 years), shrubland, young second growth forest. (5)
- MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

3a. Sources of Water. Score all that apply.

- High pH groundwater (5)
- Other groundwater (3)
- Precipitation (1)
- Seasonal/intermittent surface water (3)
- Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- Floodplain (1)
- Between stream/lake and other human use (1)
- Part of wetland/upland (e.g. forest), complex (1)
- Part of riparian or upland corridor (1)

Type(s) of Modifications:_____

3c. Maximum water depth. Select only one and assign score.

- >0.7 (27.6in) (3)
- 0.4 to 0.7m (15.7 to 27.6in) (2)
- <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- Semi- to permanently inundated/saturated (4)
- Regularly inundated/saturated (3)
- Seasonaly inundated (2)
- Seasonally saturated in upper 12in (1)

3e. Anthropogenic modifications to natural hydrologic regime. Score one or double check and average.

- None or none apparent (12)
- Recovered (7)
- Recovering (3)
- Recent or no recovery (0)

Metric 4. Habitat Alteration and Development.

Substrate disturbance. Score one or double check and average.

- None or none apparent (4)
- Recovered (3)
- Recovering (2)
- Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- Excellent (7)
- Very good (6)
- Good (5)
- Moderately good (4)
- Fair (3)
- Poor to fair (2)
- Poor (1)

4c. Habitat alteration. Score one or double check and average.

- None or none apparent (9)
- Recovered (6)
- Recovering (3)
- Recent or no recovery (1)

Hydrologic Stressors (check all that apply):

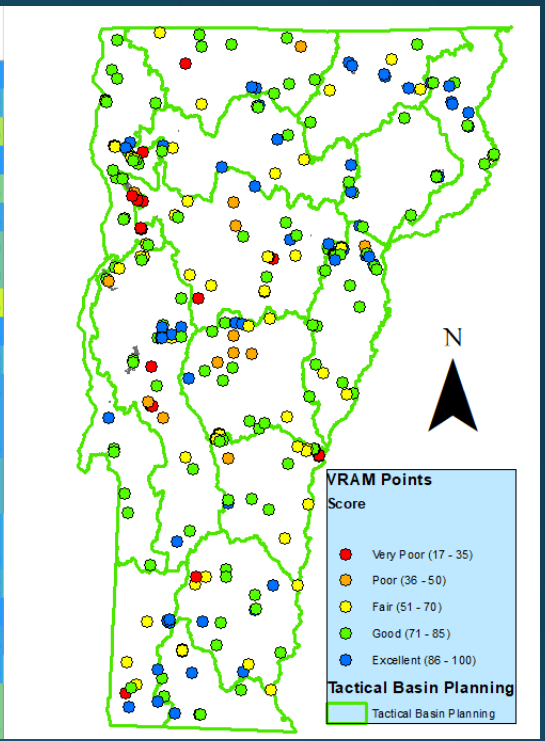
- ditch
- tile
- dike
- weir
- stormwater input
- point source (nonstormwater)
- filling/grading
- road bed/RR track
- dredging
- other _____

Habitat Alteration (check all that apply):

- mowing
- grazing
- dike
- clearcutting
- selective cutting
- woody debris removal
- toxic pollutants
- shrub/sapling removal
- herbaceous/aquatic bed removal
- sedimentation
- farming
- dredging
- nutrient enrichment
- other _____

Created on July 24, 2008 dbo, modified 2009 pegs

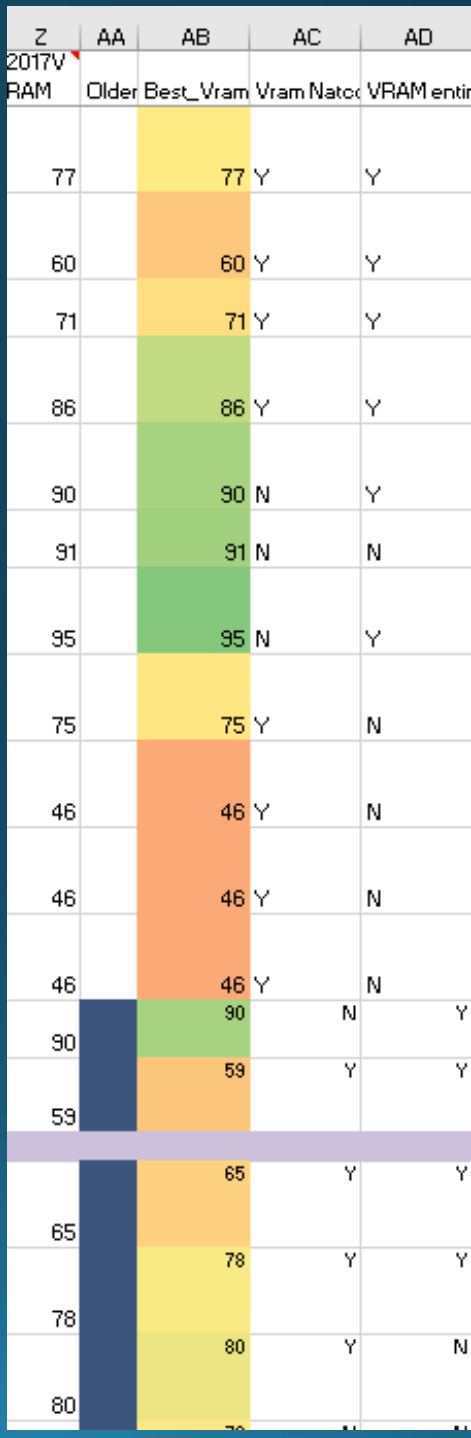
Site	Wetland Area	Buffer Width	ng Land Use	Surroundi ng Land
NOFA03	3	7	7	14
EWPO01	6	6	6	12
PEPO03	6	1	4	5
BOBR01	6	6	7	14
SOBA01	6	5	3	8
OLTA01	3	6	7	13
BRRI01	3	4	5	9
CAHR01	2	4	5	9
SMRO01	2	0	3	3
BEME01	6	7	7	14
Flagg Pond	6	6	6	12
Forester Pond	3	7	6	13
Cobb Hill Brook Swamp	5	7	6	13
Belvedere Entire Complex	6	5	6	11
Sandbar Floodplain North	6	6	7	13
STCS01	3	6	6	12
DRBW01	3	7	7	14
DRBR01	4	6	7	13
Eshqua Bog	2	7	6	13
Little Lake Poultney	6	3	5	8



Condition + Function + Value = Quality

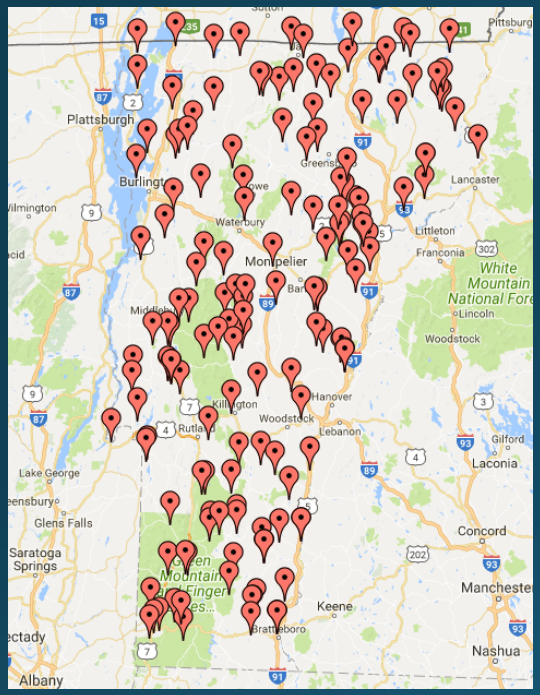
Data and Results

- Over 700 data points that include vegetation and/or VRAM data.
  - 100 data points with vegetation surveys and water quality data.
  - 275 VRAM assessments
  - Over 400 natural community vegetation plots from Natural Heritage Inventory
  - Other data exists that is not yet included in this data set
  - Wetlands is continuing to develop database and data display options.



Z	AA	AB	AC	AD
2017V RAM	Older	Best_Vram	Vram Natc	VRAM entir
77		77	Y	Y
60		60	Y	Y
71		71	Y	Y
86		86	Y	Y
90		90	N	Y
91		91	N	N
95		95	N	Y
75		75	Y	N
46		46	Y	N
46		46	Y	N
46		46	Y	N
90		90	N	Y
59		59	Y	Y
65		65	Y	Y
78		78	Y	Y
80		80	Y	N

Existing Data, 2006-2017



Name: Lewis Conte WMA Wetland
Site ID: YEBR01
Date: 6/21/2011
Type: Wetland Palustrine-Shrub-Scrub

VRAM	
Metric 1: Wetland Area	5
Metric 2: Upland buffers and surrounding land use	14
Metric 3: Hydrology	27
Metric 4: Habitat Alteration and development	19
Metric 5: Special wetlands	10
Metric 6: Plant communities, interspersion, microtopography	15
VRAM	90

Species Richness	46	Cover Weighted Mean CoC	2.84
Native Species Richness	45	Cover Weighted FQI	19.28
Mean Wetness	3.26	FAQ Wet	18.32
Mean CoC	5.27	Shannon's Diversity Index	2.38
FQAI	32.50	Evenness	0.62
Adjusted FQAI	52.13	Simpson Diversity Index	0.84

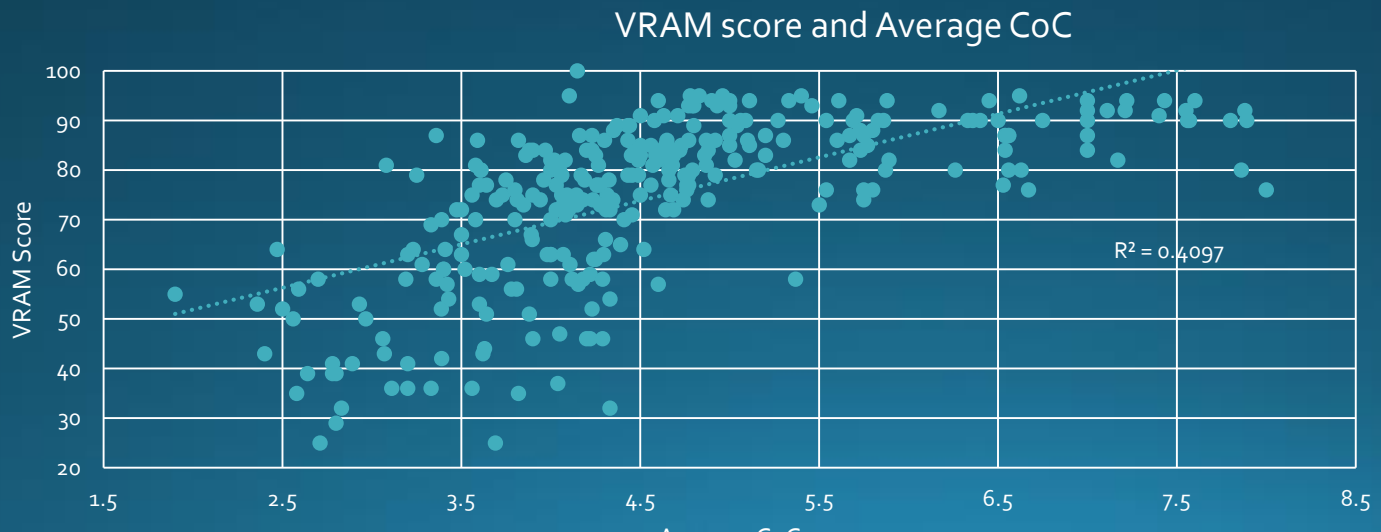
Family	Plot Frequency	Relative Coverage	Relative Importance Value
Cyperaceae	100.0	14.5	57.3
Poaceae	90.0	1.5	45.8

Plant Name	1	2	3	4	5	6	7	8	9	10	Avg	CoC Score	Confidence	Native	Wetness Coeff	Indicator Status
Acer rubrum	75	25	*	10	20	0	1	*	77	5	21.3	2	5	Y	0	FAC
Alnus incana ssp. rugosa			80	*	*	*	80	12	25	*	19.7	4	5	Y	3	FACW
Amphicarpaea bracteata						*	0		*		0.0	4	4	Y	0	FAC
Apios americana	12	5	12	*							2.9	6	4	Y	3	FACW
Arisaema triphyllum			1	*	2		0				0.3	5	5	Y	0	FAC

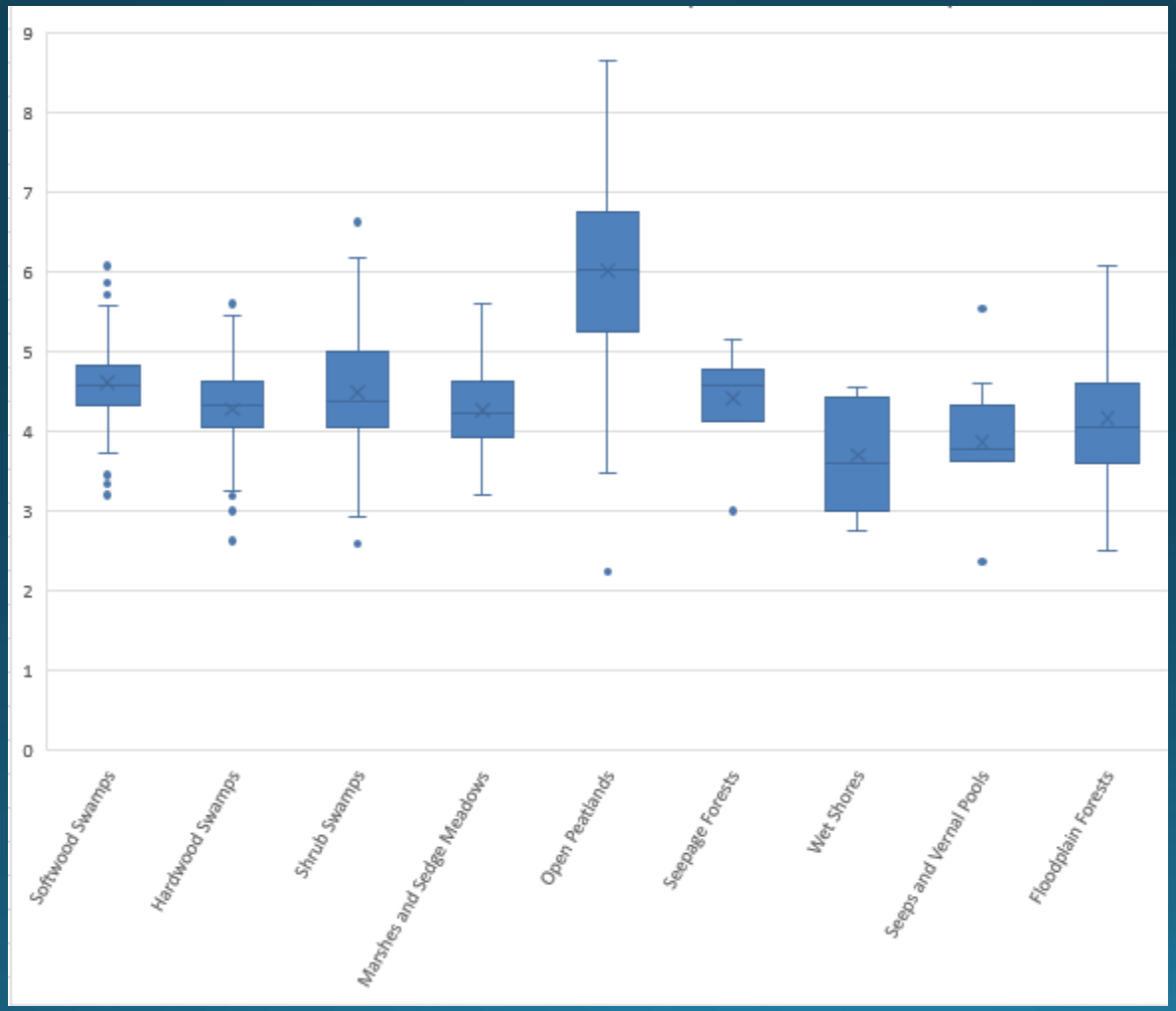
Screenshots from the Watershed Data Portal, where information from wetland sampling sites is stored. The portal shows a number of calculated vegetation metrics, VRAM scores, and the plant species list

Viability of Wetland Metrics

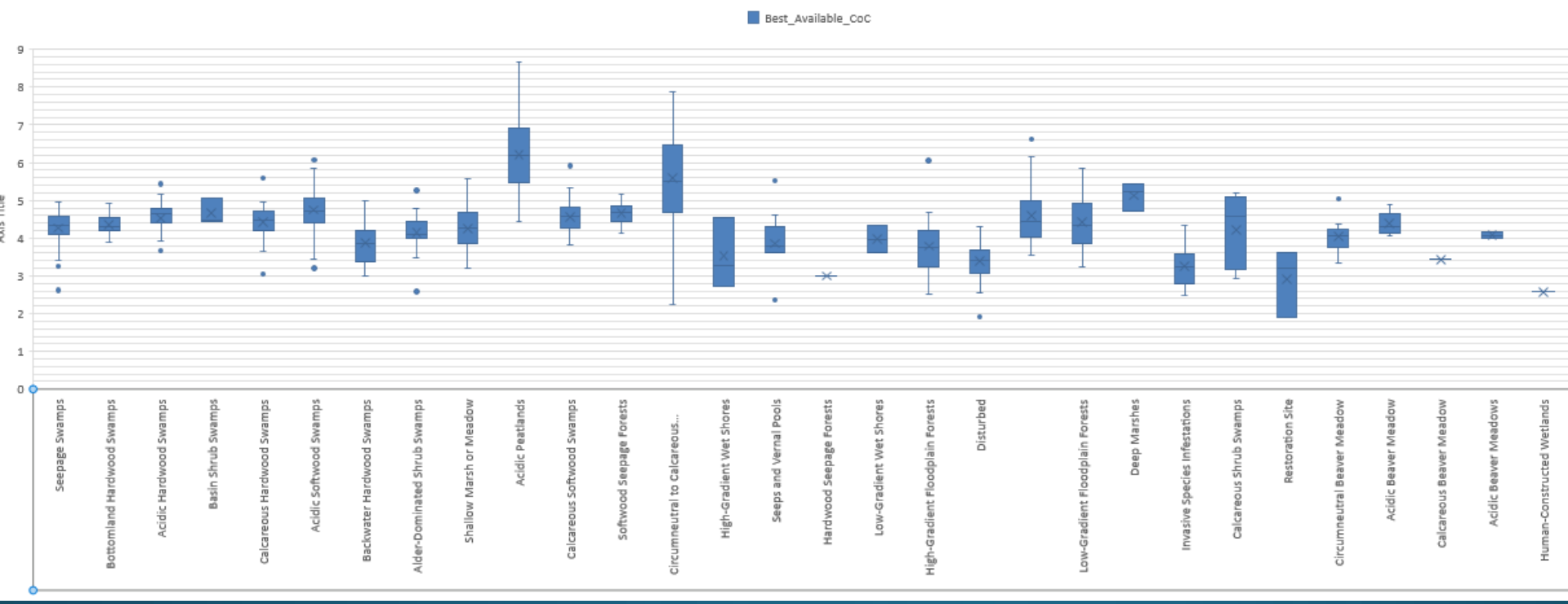
- Regional studies have shown a link between FQAI and wetland condition, but only with wetland natural community taken into account.
- In Vermont there are correlations between FQAI, VRAM score, and Natural Heritage Inventory rank.
- Natural Heritage Inventory data allows us to look at Vermont FQAI by natural community type.
- New FQAI numbers by bioregion are being regionally applied as of 2018.



CoC by Natural Community Formation



CoC by Natural Community Subgroupings

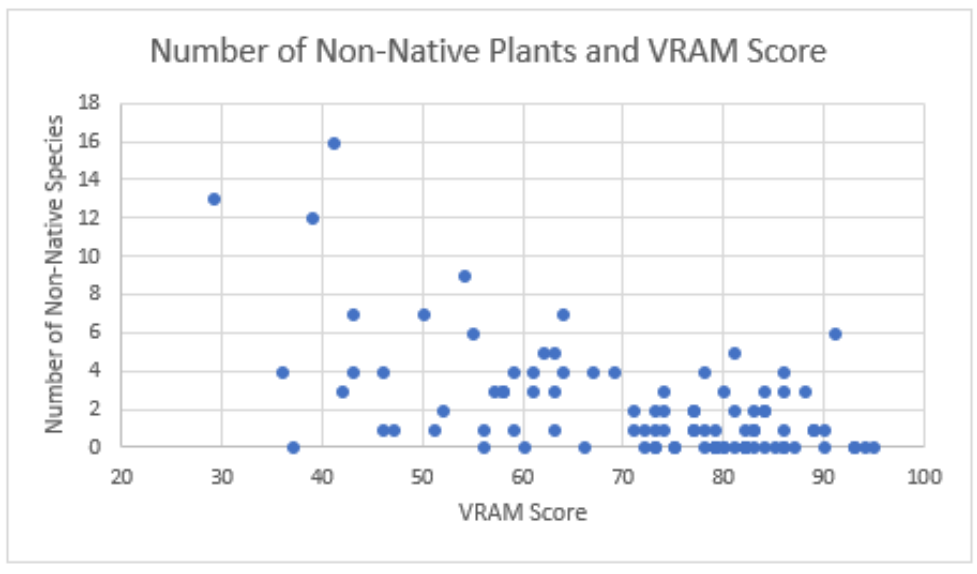


Analysis methodology

- Our analysis methodology is still being developed and is not currently complex.
- Variability in methodology also creates an obstacle.
- Correlations between factors were reviewed.
- ANOVA was conducted for a few select metrics (thanks Sean!)

Results as of 2018

- There is a link between cover and number of non-native species and overall wetland condition.
- Less buffer and more intensive surrounding land use correlates with poorer wetland condition.
- Sodium and Chloride both correlate with poor wetland condition.



More Results

- Wetter" wetlands tend to be in better condition.
- Wetlands with more habitat diversity tend to be in better condition (or vice versa).
- High-elevation wetlands tend to be in better condition than lowland wetlands.
- Human-created wetlands receive lower VRAM scores than natural wetlands, but dataset limited and with caveats.
- Bogs, fens, and softwood swamps tend to be in good condition
  - This may be in part due to the fact that disturbance can turn those wetland types into different wetland types.

‘Negative’ Results

- We have not detected a consistent signal between abundance of nitrogen and phosphorus and wetland condition.
- Turbidity correlates with poor wetland condition but not consistently.
- Size of wetland does not strongly correlate with wetland condition.

More 'Negative' Results

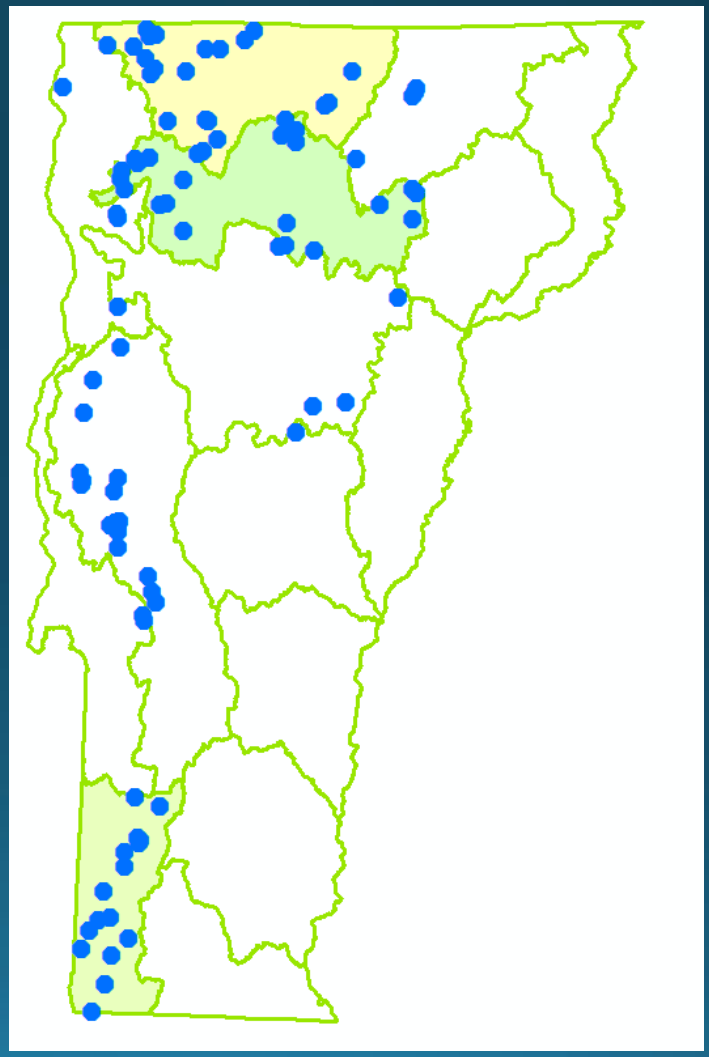
- There was not a link between wetland condition and iron, manganese, potassium, calcium, barium, or magnesium.
- We tested for a large range of other metals and most were not detected in any wetlands, or were barely detectable in one or two wetlands only.

The Future of Bioassessment: This Field Season and Beyond

The (level II) field season has started, but is off to a slow start due to conditions.

2018 Potential Sampling Sites

- Level 3 vegetation plots, restoration monitoring sites, and restoration rapid assessments.
- Not all will be visited, due to time and landowner permission issues.
- Other sites will be assessed with Level 2 methodology as needs arise.



Restoration Monitoring Project

Purpose:

- To improve our understanding of wetland restoration success

- Achieved through monitoring physical characteristics, function, and condition of pre-and post restoration sites

Restoration Site Monitoring

- Monitoring and mapping based on existing bioassessment protocols
  - Restored wetlands compared with natural wetlands in varying stages of condition and type

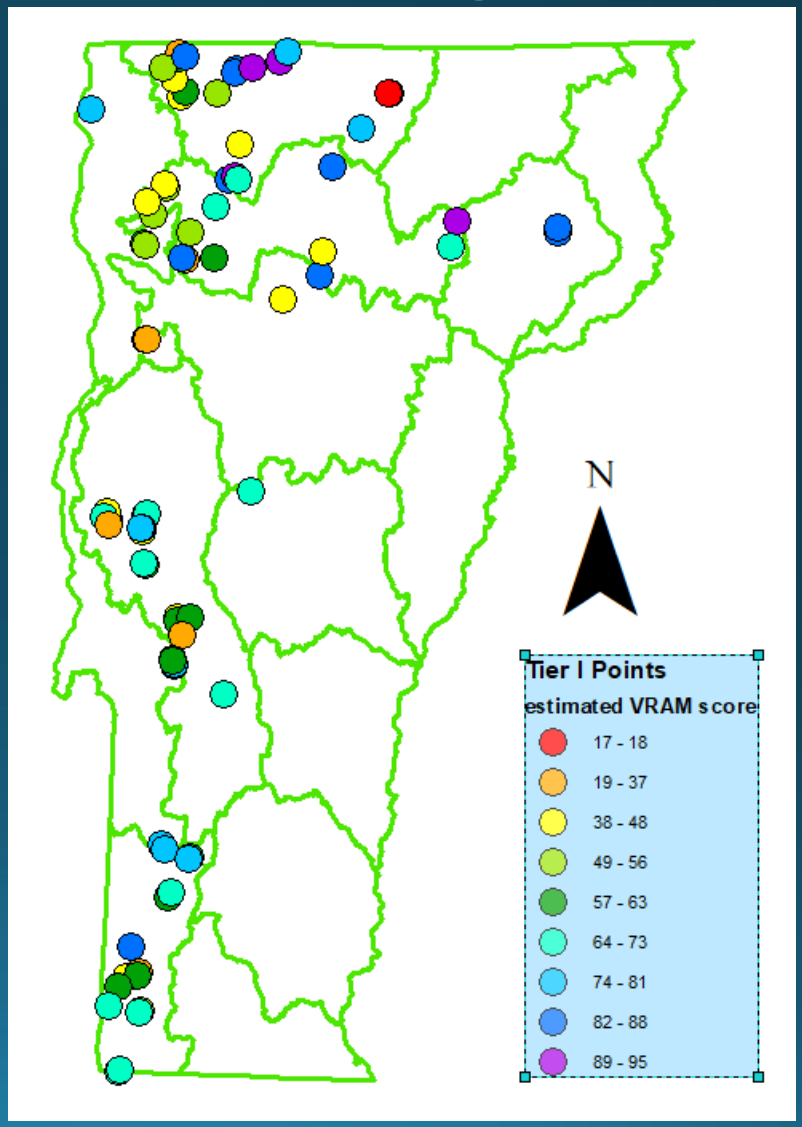
- Now that biocriteria and assessment methodologies have been tested these methods can be expanded

Need for More Restoration Information

- Agricultural conversion is ongoing
- Development pressures increase
- Regulatory protections advance
- Voluntary conservation and restoration opportunities grow

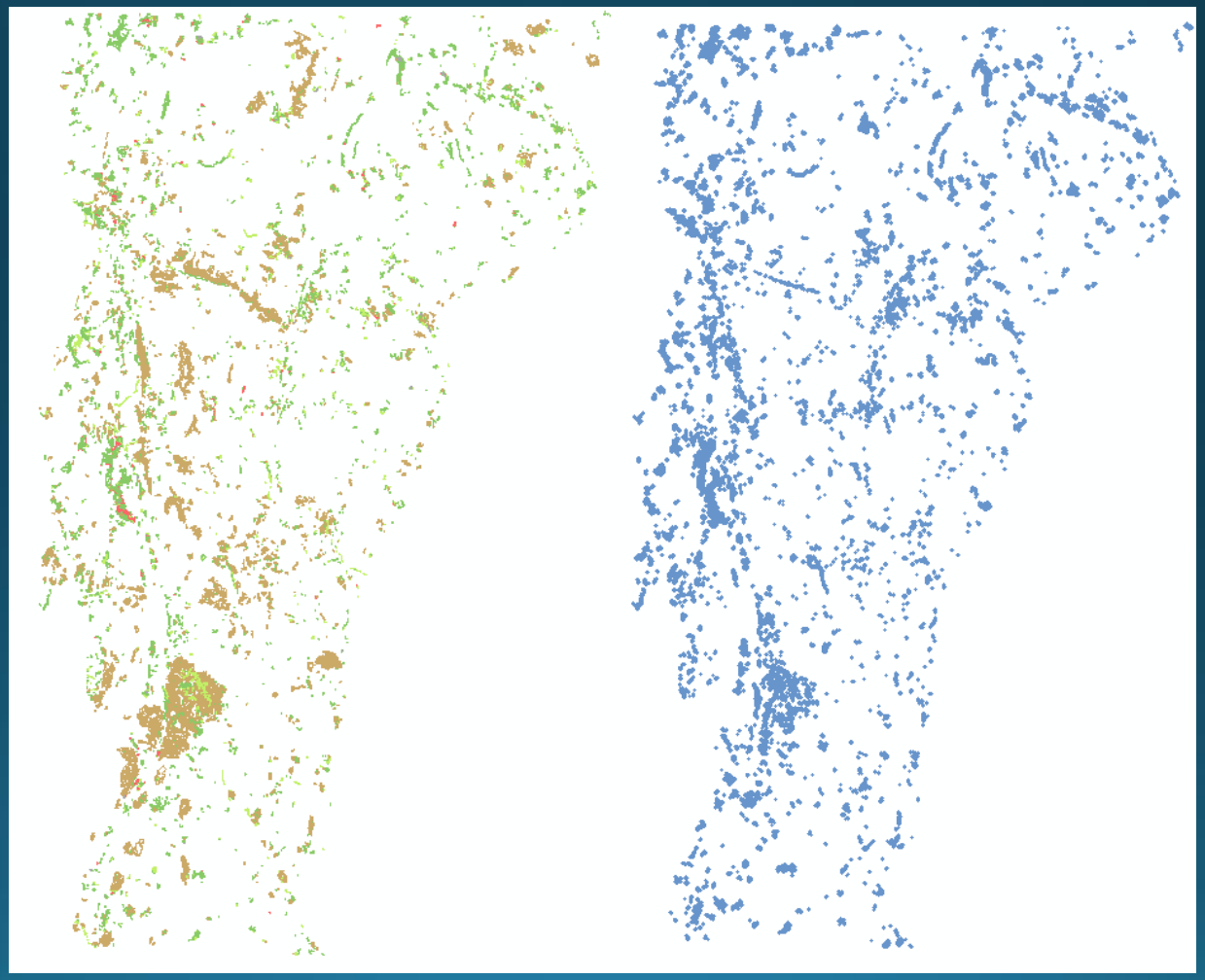
Testing a 'Level I' methodology

- Tier I 'surveys' are desktop surveys only.
- Our protocol is currently under development – field testing in 2018.
- Estimated VRAM score assigned using parallel methodology.
- Natural communities mapped based on aerial photos.
- Not a replacement for field work but can occur on demand, in winter, and in places we can't access.



Charlie's draft natural community mapping

- Includes mapping Charlie created for NHI and Wetlands.
- Includes upland and wetland mapping.
- Much of it is not field verified – currently for internal use only.
- Precision is increasing thanks to LIDAR.



Questions to answer

- How can we expand our analysis to offer more detailed and statistically robust results?
- Will Tier I assessments accurately reflect wetland condition?
- How successful is restoration? Is it possible beyond floodplains?
- How are wetlands affected by broader factors such as invasive plants, climate change, Emerald Ash Borer, and changes in deer and moose population?

Moving Forward

- Additional staff and resources offer likelihood of a productive 2018 field season.
- Will continue to use the basin planning process to choose sites.
- Collaboration within WSMD as well as NHI, EPA, and adjacent areas.
- Will continue to examine connection between data and policy.
- When better mapping is available, consider doing some stratified random sampling
- Consider a few ‘sentinel sites’.

Potential for Collaboration

- We are interested in any and all wetland data you can share!
- What other metrics would help determine restoration success?
- Questions?