Use of Indicator of Reduction in Soils (IRIS) tubes as a Performance Measure in Wetland Restoration

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IRIS Tubes

- **Indicator of Reduction In Soils**
  - **Used to evaluate the presence of reducing soil conditions**
  - **Ferrihydrite coating on Polyvinyl Chloride (PVC) pipe**
  - **Developed by B.J. Jenkinson, Purdue University and M. Rabenhorst, University of Maryland**
  - **Available commercially**

IRIS Tubes

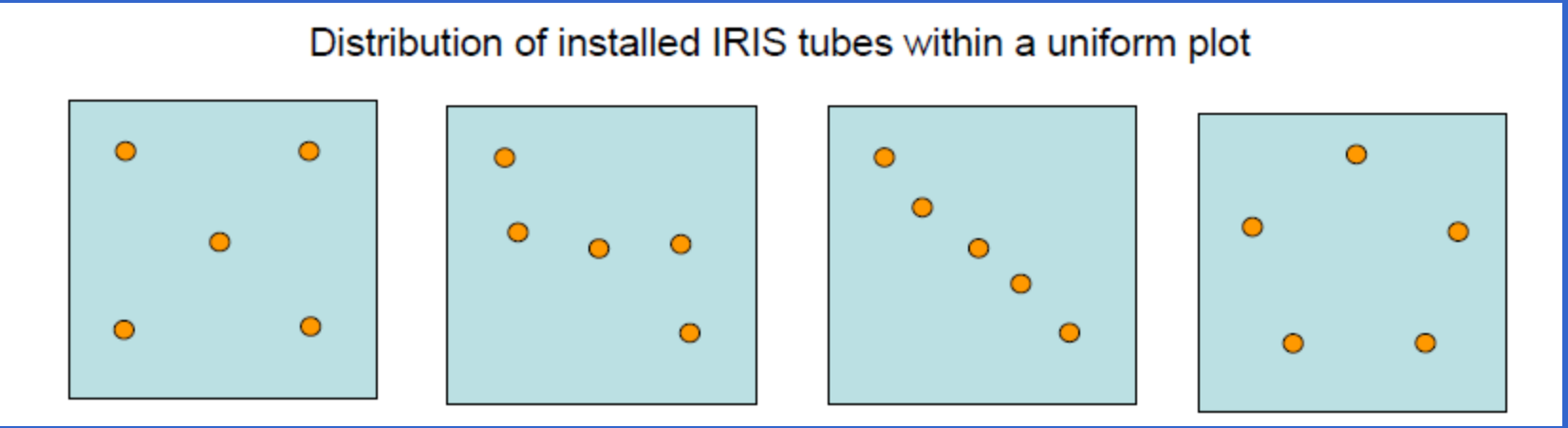
- **Indicator of Reduction In Soils**
  - **Approved by NTCHS (2007) as an alternative way to document reducing soil conditions**
  - **3 of 5 tubes having at least 30% removal over 15 cm of tube; top of removal zone considered is within 15 cm of surface**

IRIS Tubes

- **Indicator of Reduction In Soils**
  - **Installation recommendations provided by US Army Corps of Engineers Research and Development Center, Wetland Regulatory Assistance Program (ERDC TN-WRAP-09-1)**
  - **Typically 5 tubes in multiple nests along upland-wetland gradient depending upon purpose of study**
  - **Remain in place 2 to 4 weeks, or site specific monitoring strategy**

IRIS Tubes

- **Indicator of Reduction In Soils**



- **Tubes can be used for evaluation outside of NTCHS criteria**

- **For regulatory purposes follow NTCHS criteria**

Evaluation of IRIS tube use on Wetland Restoration Projects

Project Example 1

- Bottomland hardwood restoration in northeast Louisiana
- USACE recommended use of IRIS tubes
- 13 Sampling plots

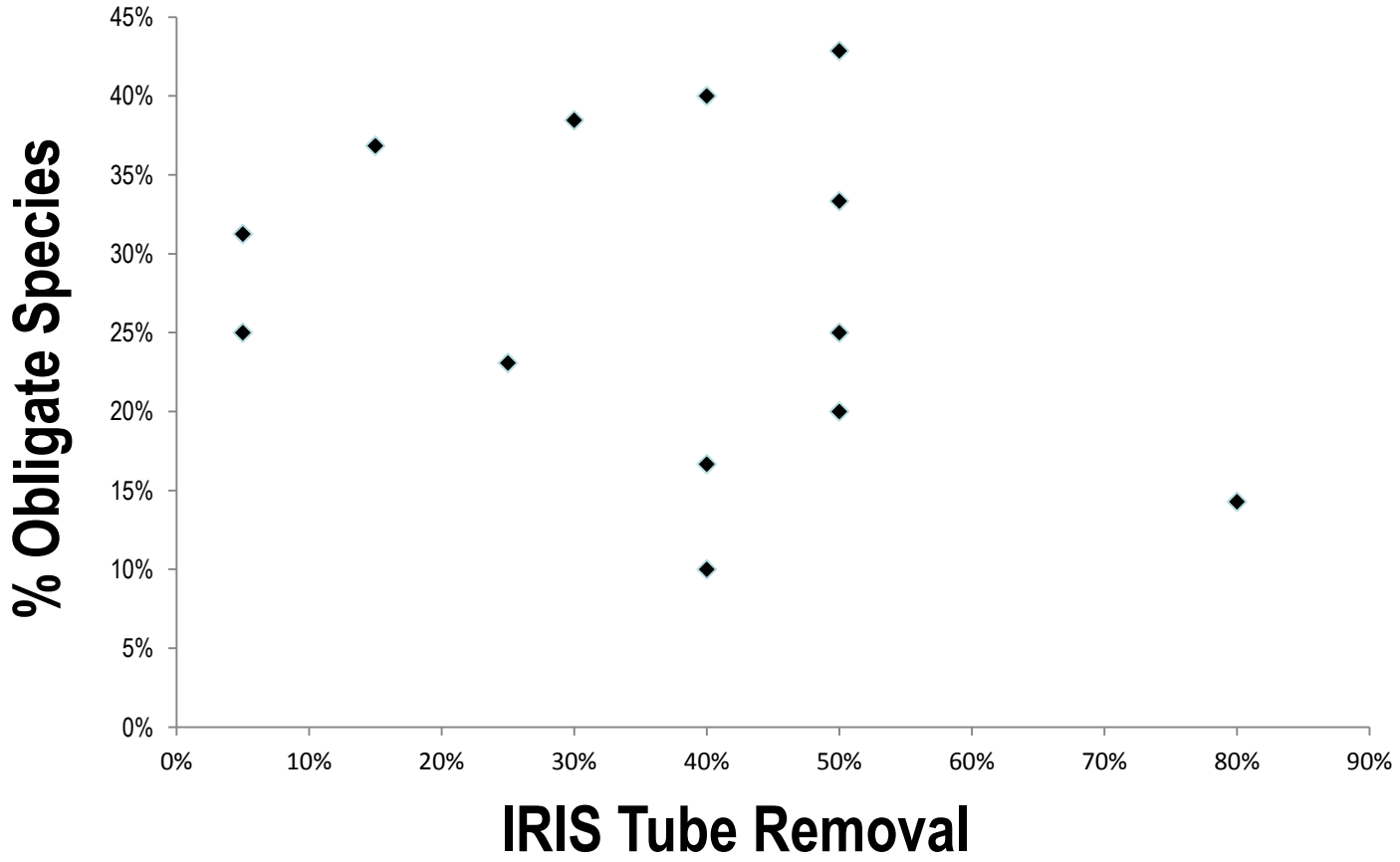
Evaluation of IRIS tube use on Wetland Restoration Projects

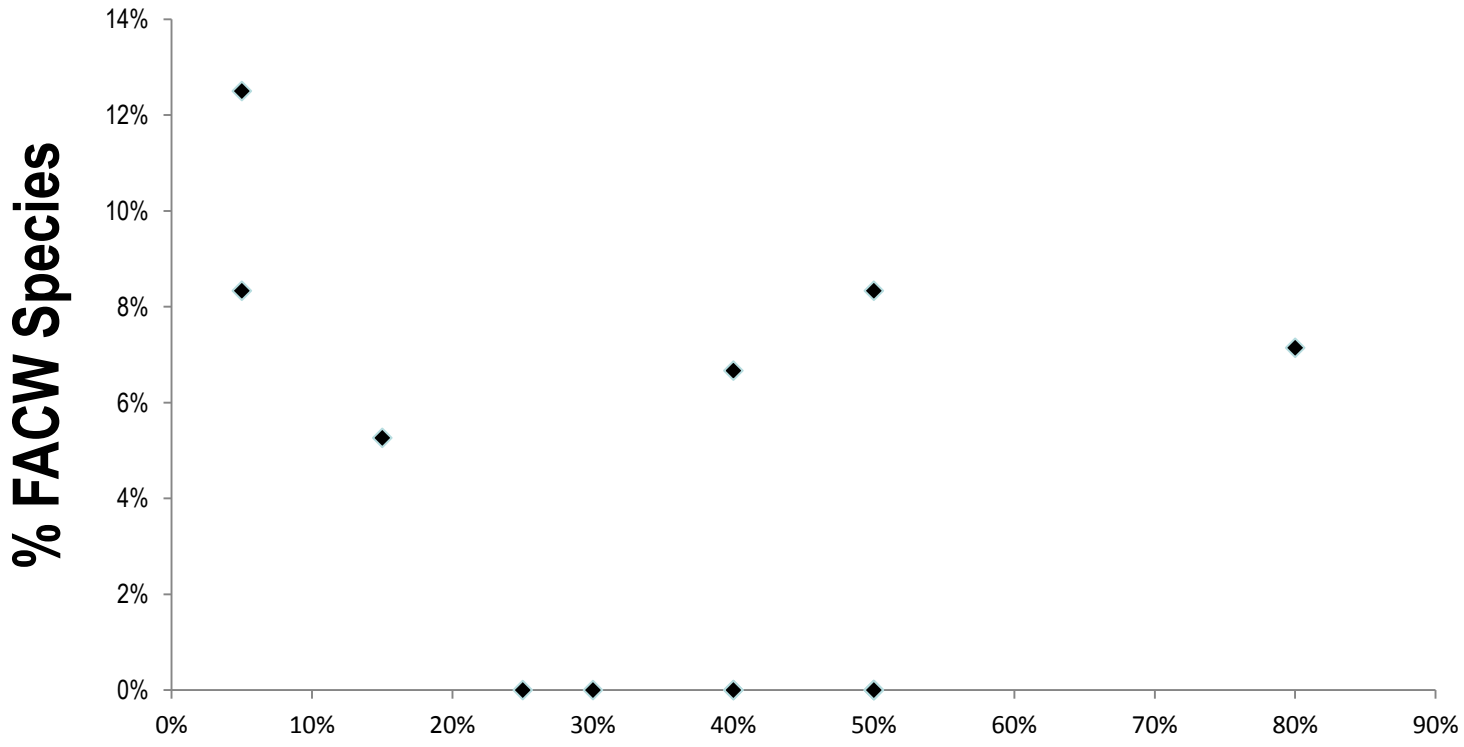
- One 12 inch IRIS tube installed at center of sample plots
- IRIS tubes were allowed to remain in place for one year
- Documented percent removal after one year
- Compared removal with other vegetative monitoring data

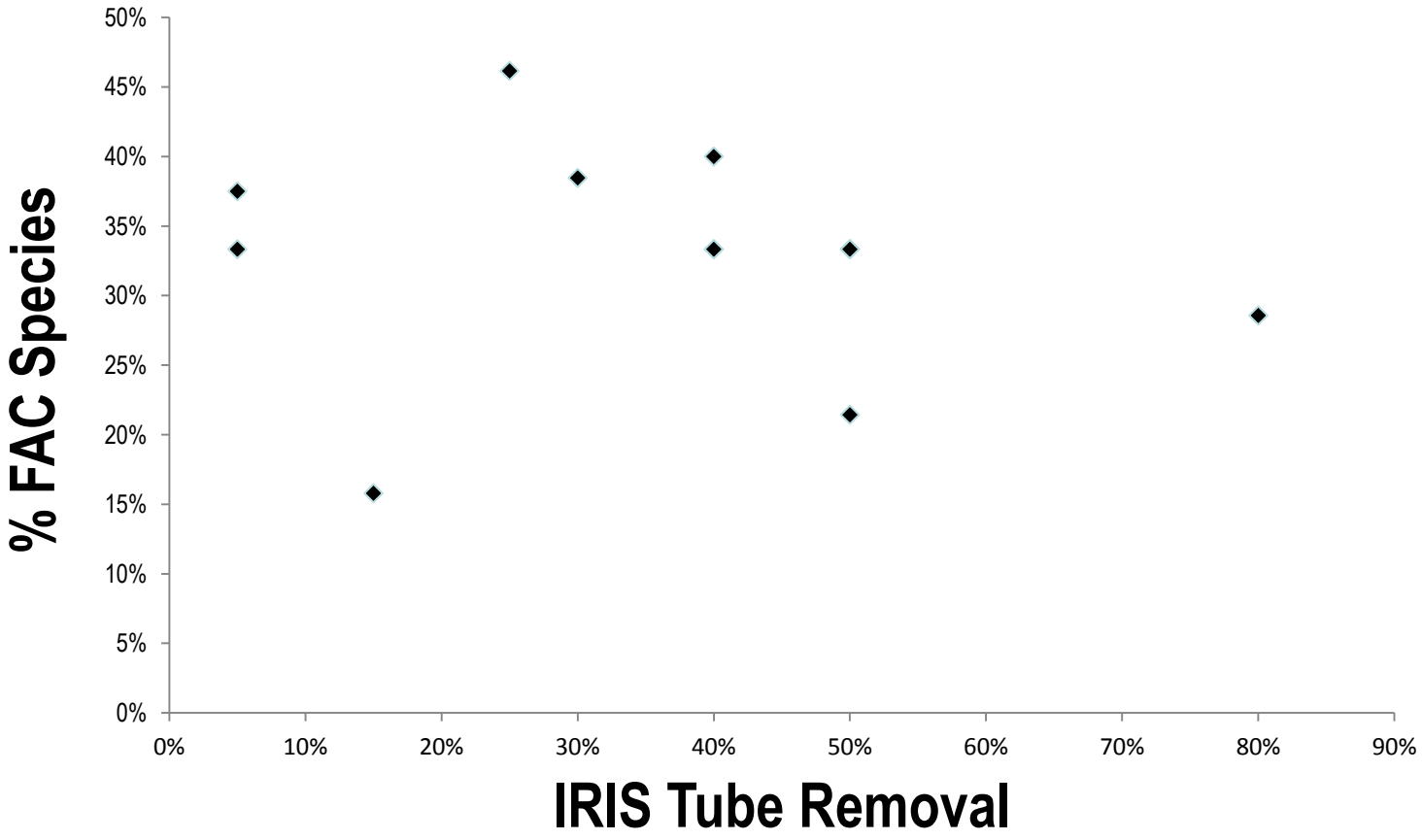
Evaluation of IRIS tube use on Wetland Restoration Projects

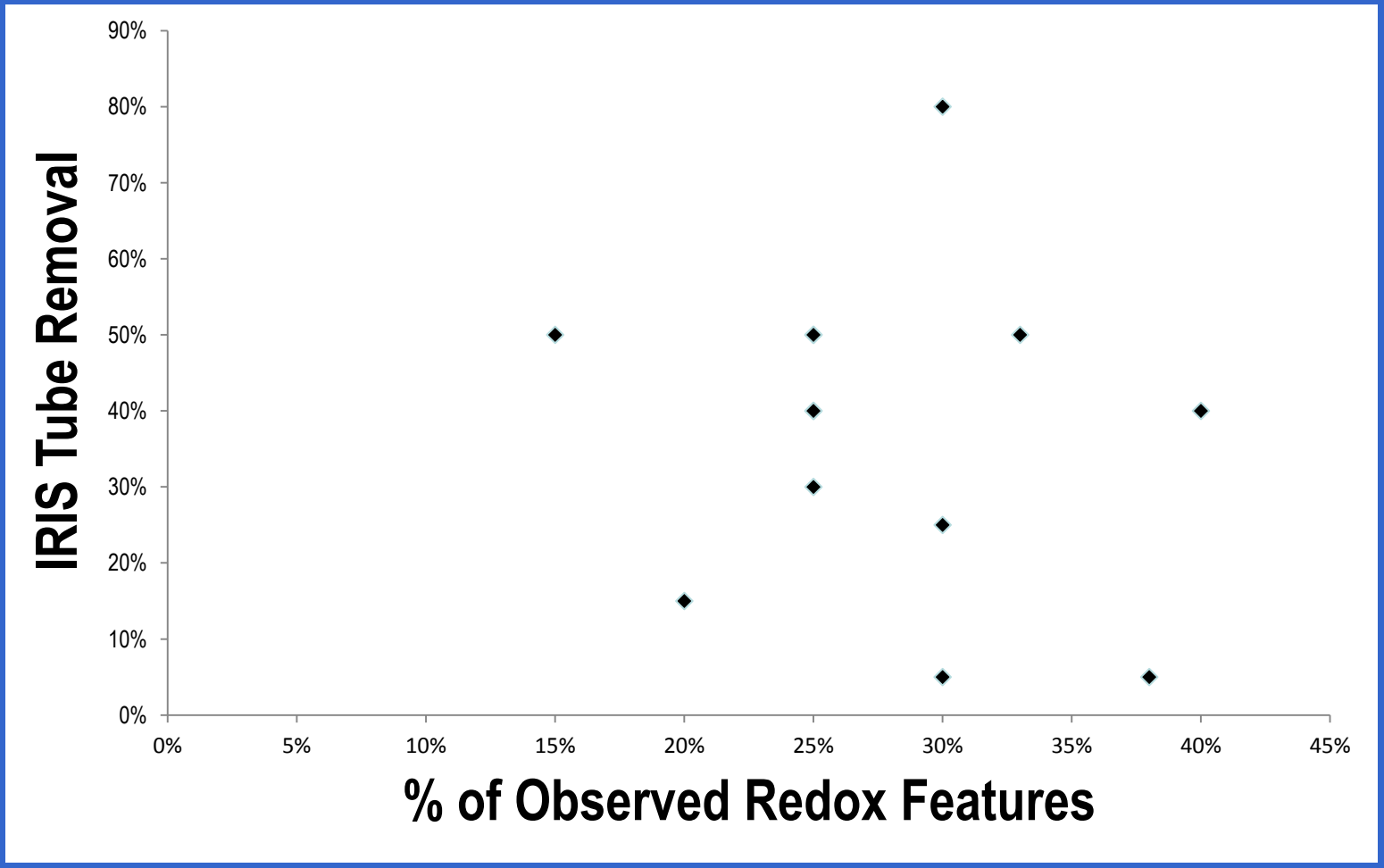
- IRIS Tube Removal

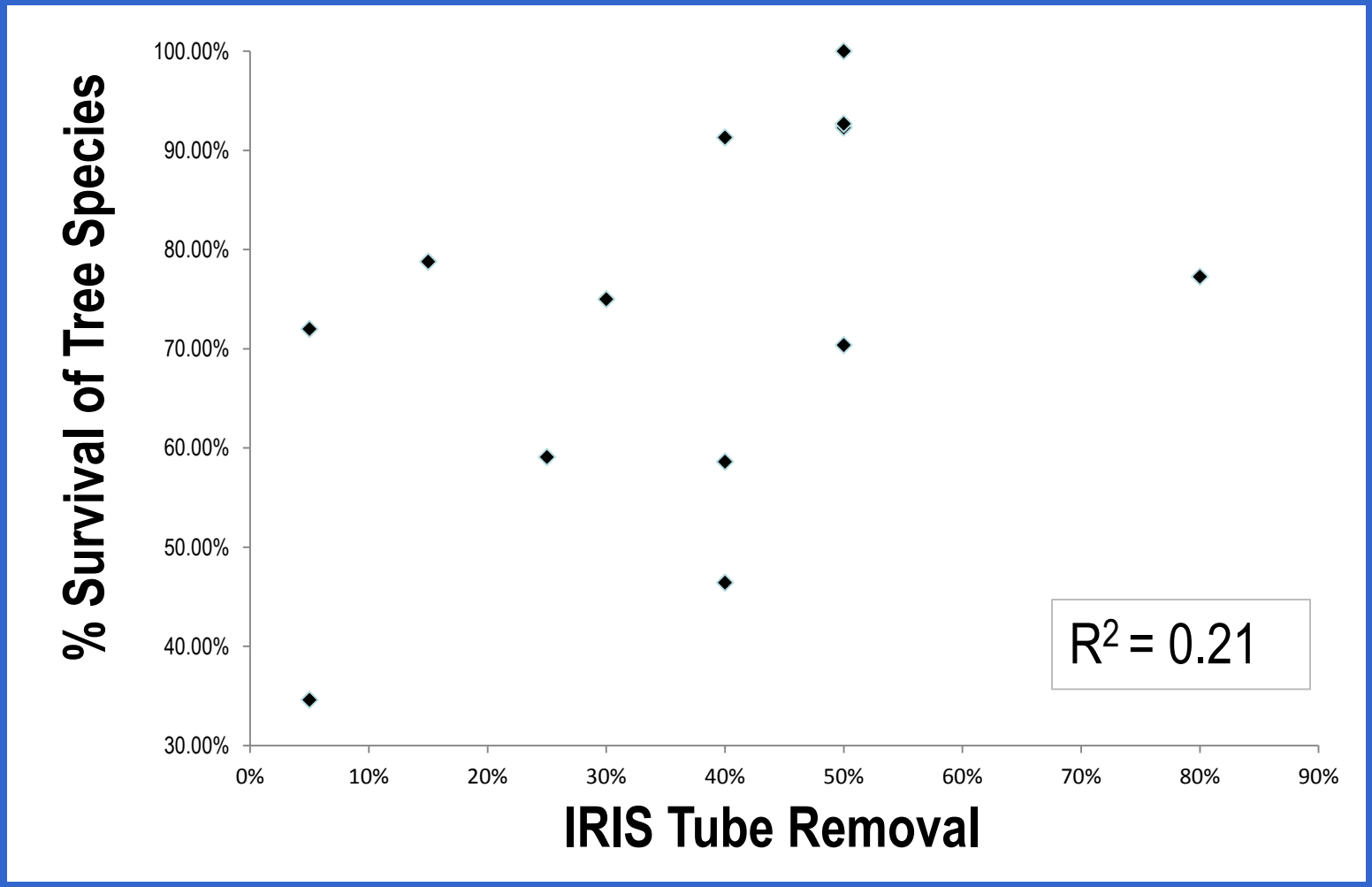
Plot	IRIS Tube Loss	Plot	IRIS Tube Loss
1	80%	7	50%
2	40%	8	25%
3	40%	9	5%
4	50%	10	5%
5	50%	11	40%
6	50%	12	30%
		13	15%


% Obligate Species
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
IRIS Tube Removal


% FACW Species
14%
12%
10%
8%
6%
4%
2%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
IRIS Tube Removal


% FAC Species
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
IRIS Tube Removal


IRIS Tube Removal
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
% of Observed Redox Features


% Survival of Tree Species
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
IRIS Tube Removal
R2 = 0.21

Evaluation of IRIS tube use on Wetland Restoration Projects

Lessons Learned

- Follow ERDC and NTCHS guidance
- Develop monitoring strategy that fits need
- NTCHS criteria vs. regulatory requirements in wetland jurisdictional determinations (e.g. hydrologic data)

Evaluation of IRIS tube use on Wetland Restoration Projects

Project Example 2

- Wetland restoration and Stormwater Treatment Area in Central FL
- Compare IRIS tube response to Eh measurements in a constructed system

Evaluation of IRIS tube use on Wetland Restoration Projects

- Pre and Post Construction

Evaluation of IRIS tube use on Wetland Restoration Projects

- Construction involved significant soil disturbance
- Soils mapped as Basinger Series
- Mixing of organic matter into surface of exposed argillic horizon

Evaluation of IRIS tube use on Wetland Restoration Projects

- Measurements observed across upland-wetland gradient over 5m x 5m area
- Installed nine IRIS tubes in groups of 3 perpendicular to slope
- Tubes remained in place over 14 days

Evaluation of IRIS tube use on Wetland Restoration Projects

- Eh and pH measurements were recorded parallel to IRIS tubes and at 15 and 30 cm depths at each location.
- Eh was measured using platinum electrodes and Ag/AgCl reference electrode with commercial grade digital multimeter
- Water level measurements also recorded along gradient

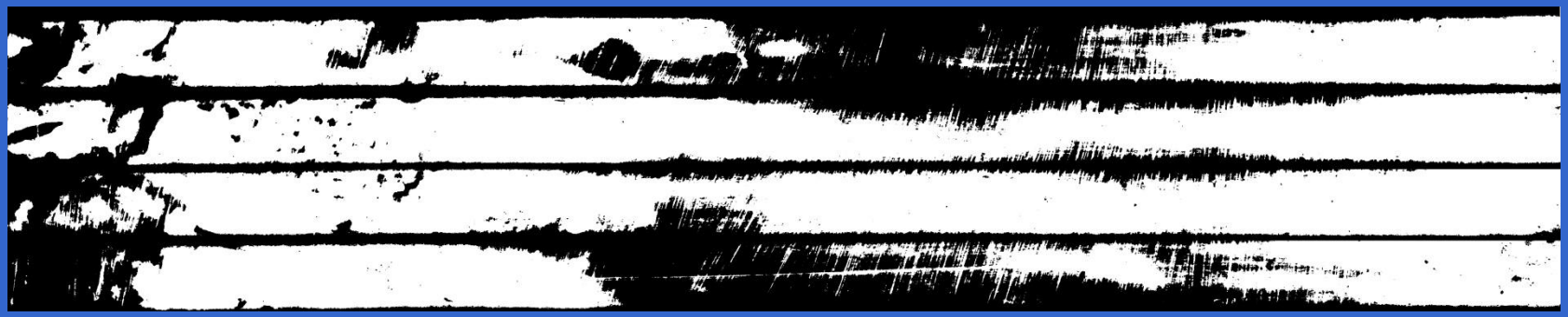
Evaluation of IRIS tube use on Wetland Restoration Projects

IRIS Tube Evaluation

- Tubes scanned on each 90º axis
- Scans stitched using Adobe Photoshop
- Percent removal analyzed using ImageJ Software (Wayne Rasband, NIH)
- Converted to binary images to isolate areas of removal

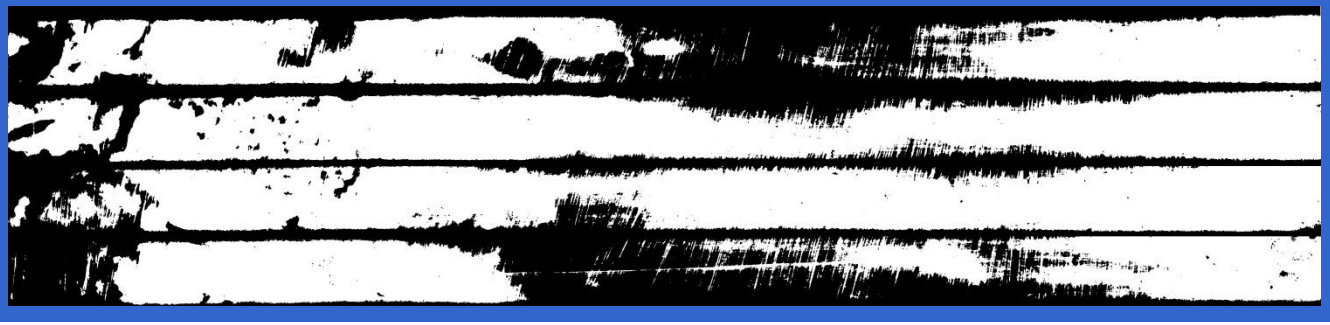
Evaluation of IRIS tube use on Wetland Restoration Projects

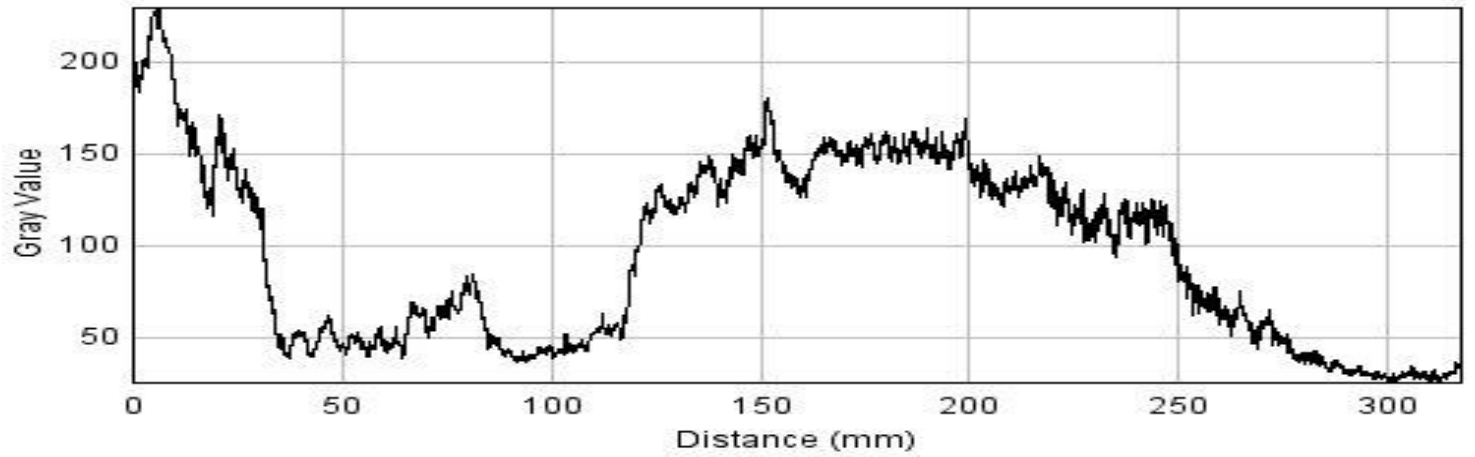
IRIS Tube Evaluation



Evaluation of IRIS tube use on Wetland Restoration Projects

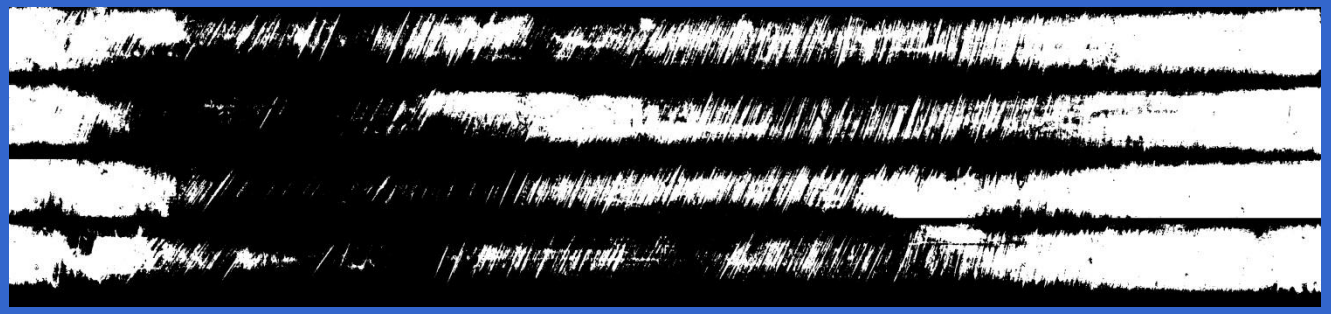
IRIS Tube Evaluation

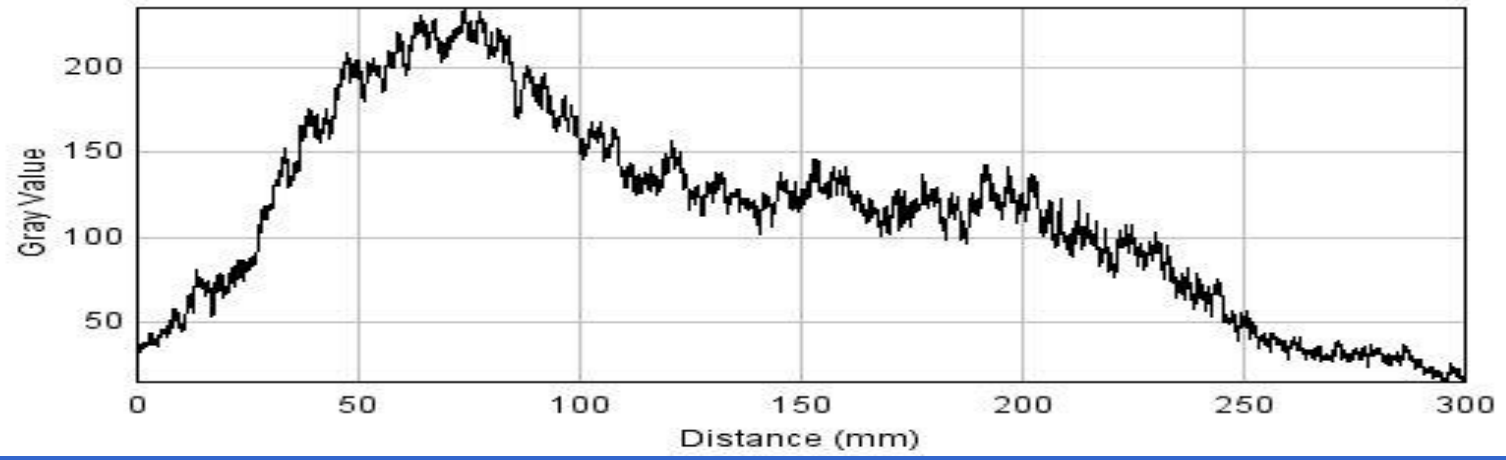




Evaluation of IRIS tube use on Wetland Restoration Projects

IRIS Tube Evaluation





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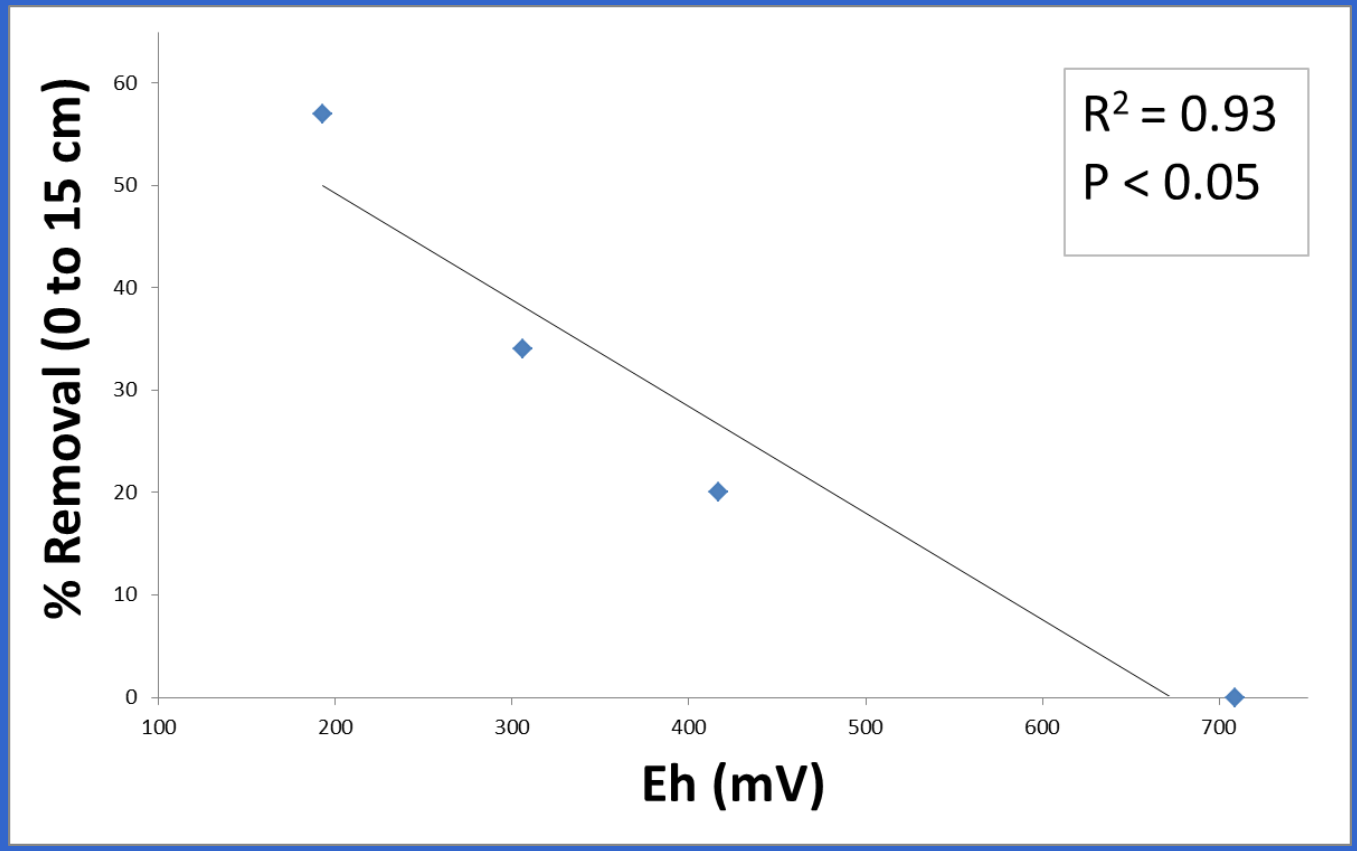

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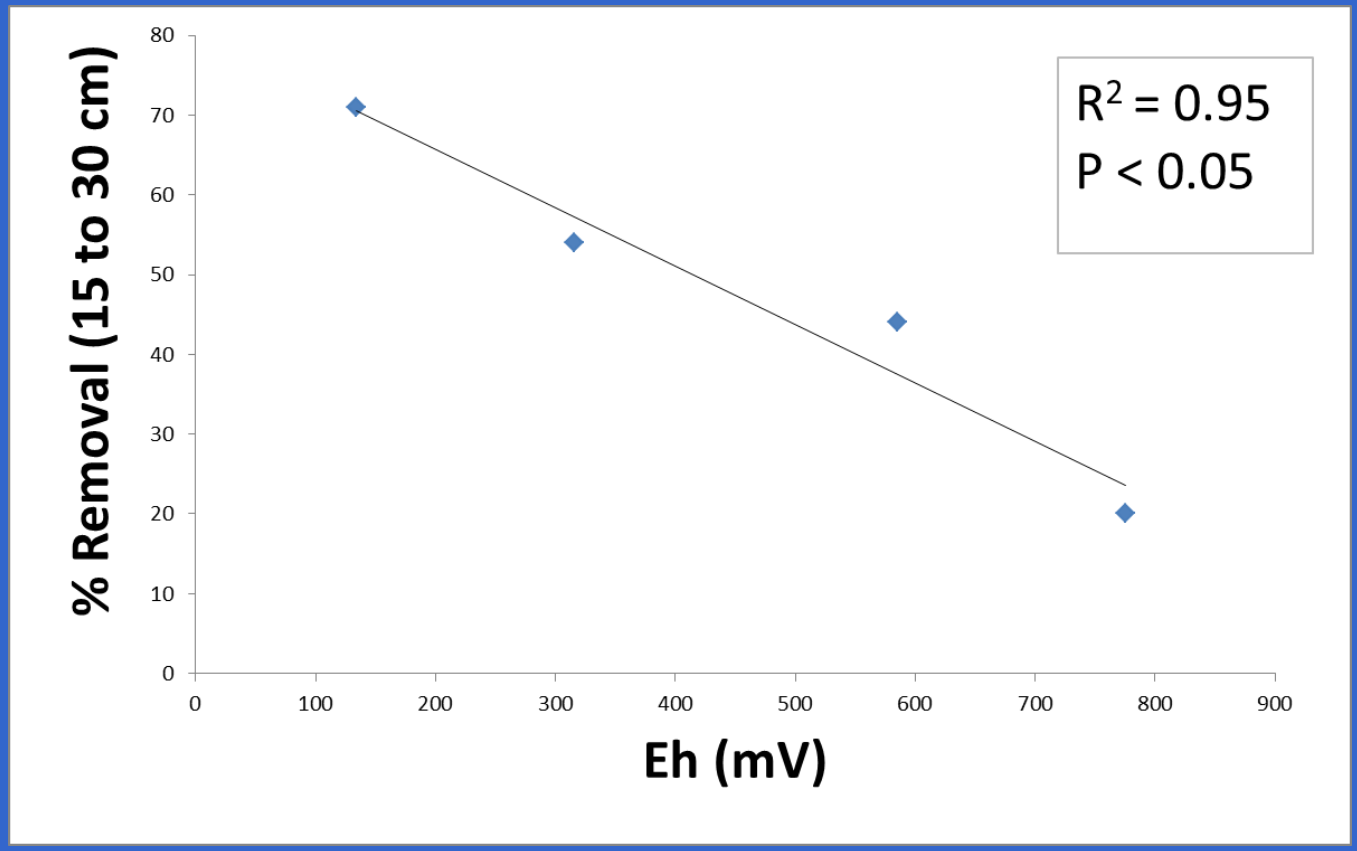

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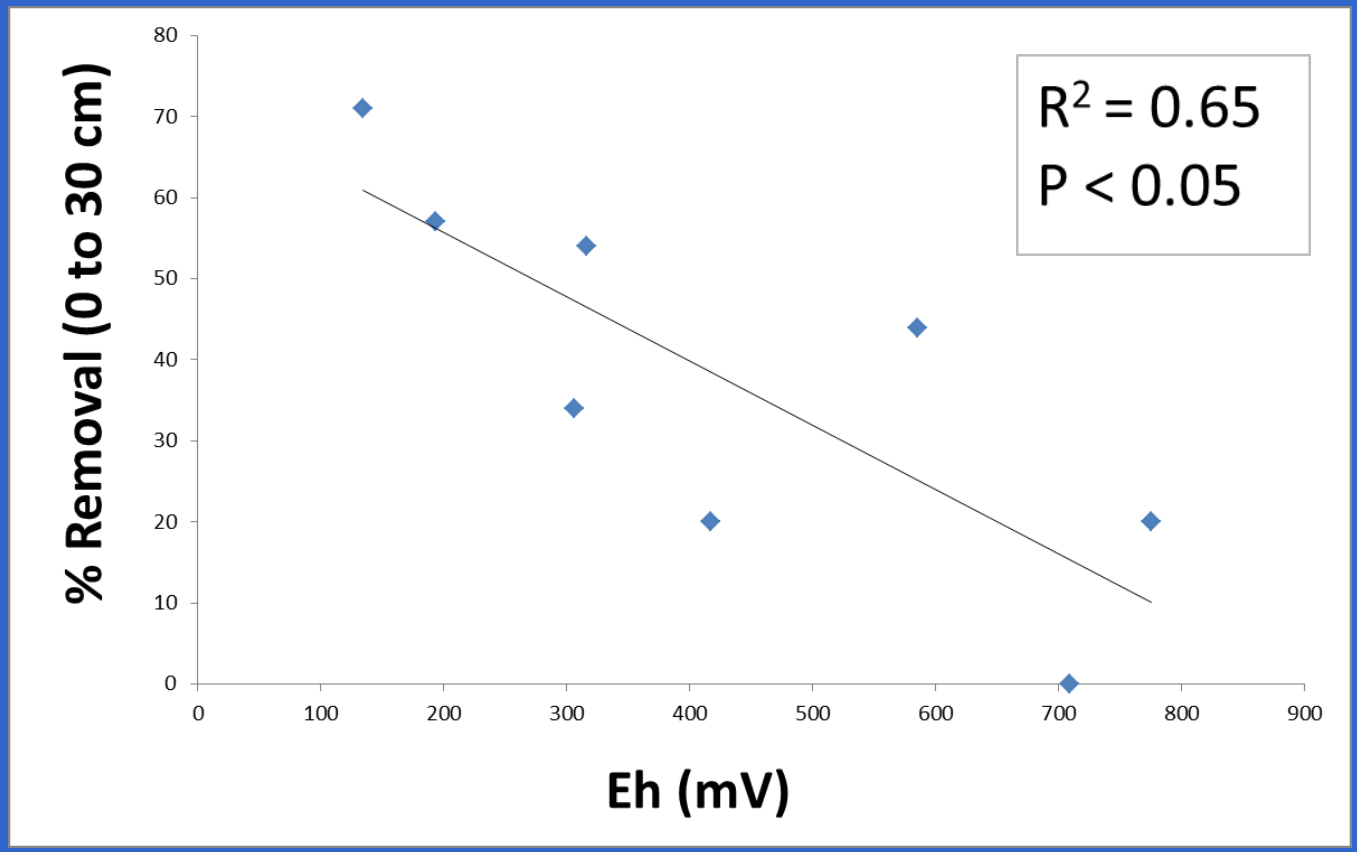

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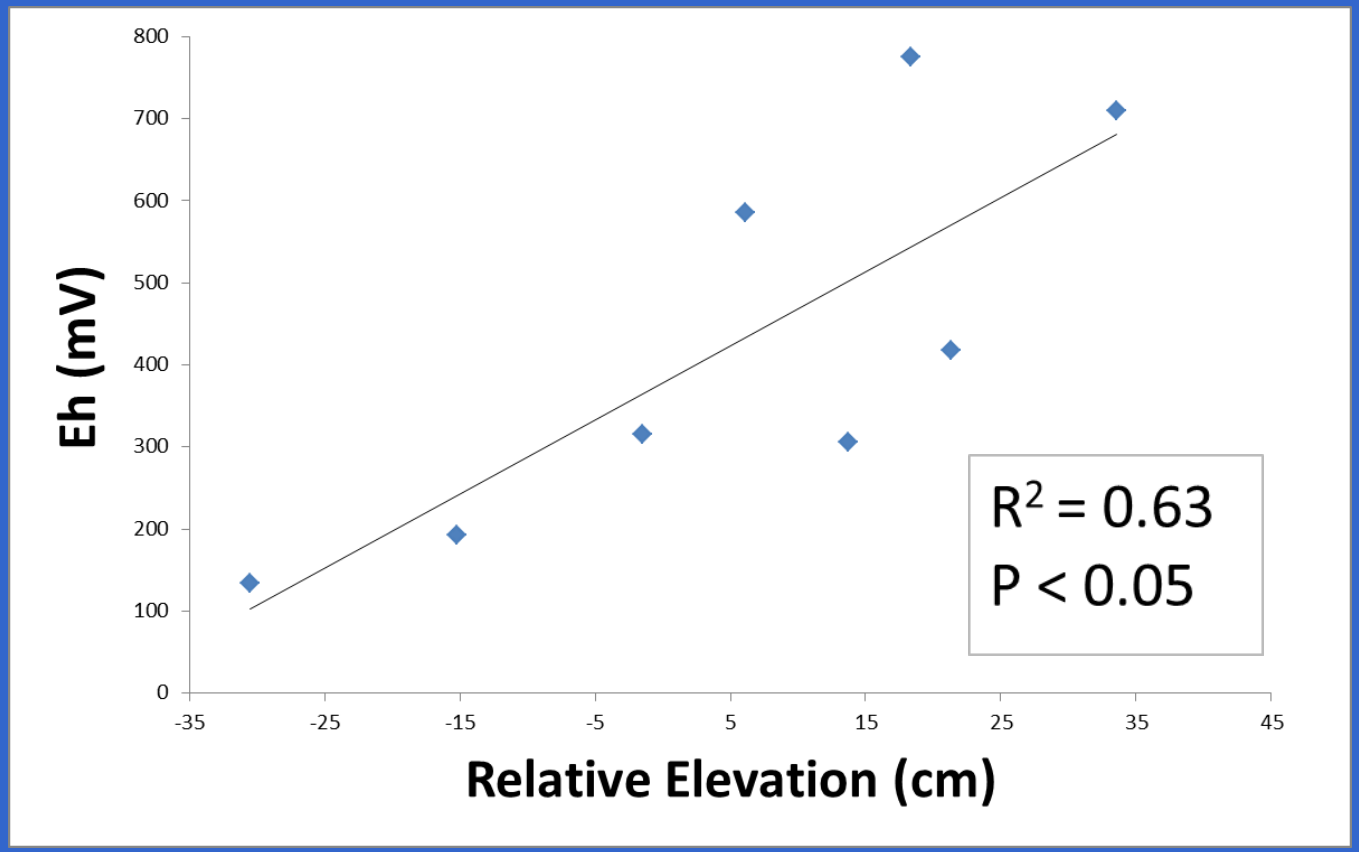

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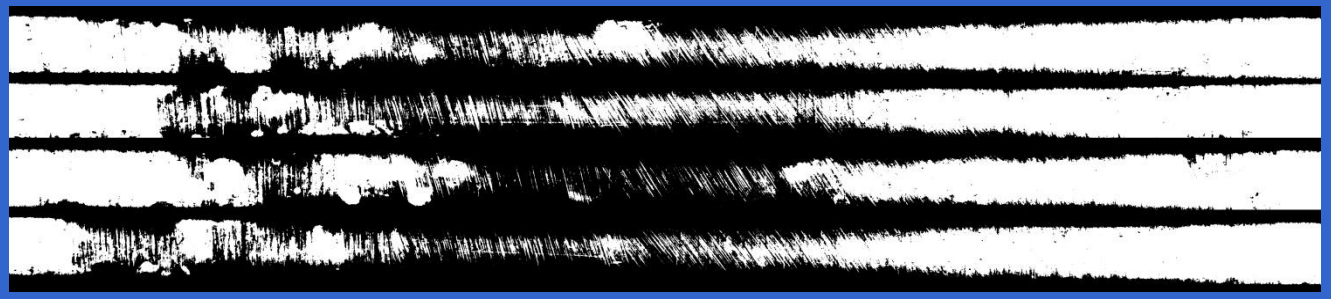

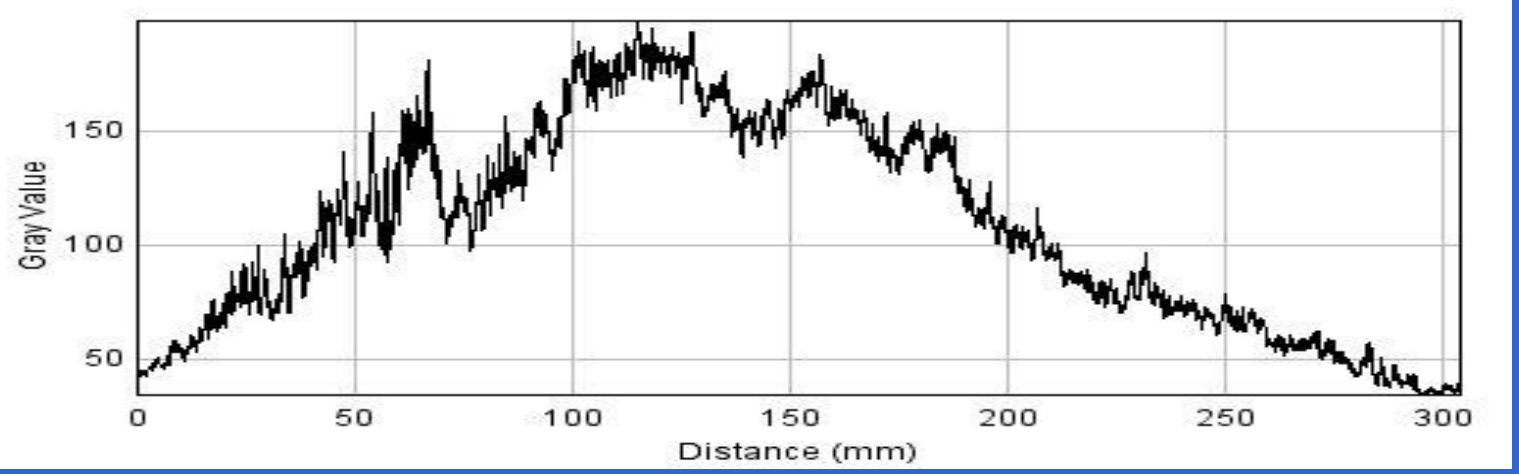

Evaluation of IRIS tube use on Wetland Restoration Projects

Lessons Learned

- Evaluate IRIS tubes in segments that correspond to soil profile; consistent with NTCHS criteria
- Understand soil morphology effect on IRIS tube response
- Understand effect of application of soil amendments on ability to demonstrate development of hydric soils

Evaluation of IRIS tube use on Wetland Restoration Projects

Questions?

Special thanks to Ecosystem Renewal and ENCO Laboratory for their help and support