What's Up With The Mud

Quantifying the Phosphorus Sorption Capacity of Hawaiian Coastal Wetlands

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A Brief Outline...

- Introduction & Background
- Objectives & Hypotheses
- Methodology
- Results
- Conclusion
COASTAL WETLANDS

- Provide many valuable functions
  - Protect & Stabilize Shoreline
  - Flood Control
  - Act as Sediment Traps
  - Biogeochemical Cycling

Kawaiele Wetland, Kauai
PHOSPHORUS

✓ Primary limiting nutrient
✓ Travels attached to soil particles
✓ Strength of sorption determines bioavailability
✓ Factors affecting sorption...

✓ Texture
✓ Mineralogy
✓ Competing Ions
✓ Organic Content

Schematic of phosphate (PO$_4^{3-}$) molecule
PHOSPHORUS

But too much P can lead to...

1) Waterway Eutrophication
2) Invasive Species Dominance
3) Coral Reef Degradation

Wetlands are a primary defense mechanism
OBJECTIVES

i. Measure P sorption capacity

ii. Examine any variability in P sorption
   i. Within sites along the hydrologic gradient
   ii. Among sites of different wetland types

iii. Determine if P sorption is correlated to commonly-measured soil variables
i. Position along hydrologic gradient will account for a significant amount of variance within sites

ii. P sorption will vary across different site types (i.e. soil orders, created vs. natural, fresh vs. euhaline)

iii. Soil variables will be correlated with P sorption
METHODOLOGY

40 sites on 5 islands

- 2 transects / site
- 3 cores / transect
- P sorption measured
- PSI Index created

PSI = x/log c

(Bache & Williams 1971)
## STATISTICAL SUMMARY

**PSI**

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Mean</td>
<td>139.9</td>
</tr>
<tr>
<td>Standard Error</td>
<td>14.9</td>
</tr>
<tr>
<td>Median</td>
<td>76.7</td>
</tr>
<tr>
<td>Range</td>
<td>1748.9</td>
</tr>
<tr>
<td>Minimum</td>
<td>-16.4</td>
</tr>
<tr>
<td>Maximum</td>
<td>1732.5</td>
</tr>
<tr>
<td>Count</td>
<td>242</td>
</tr>
</tbody>
</table>

**PSI = x/log c**

![Histogram showing frequency distribution of PSI values]
HYDROLOGIC EFFECTS

1-Way ANOVA
F = 4.95, p = 0.008

Bars represent the means (± 1 standard error). Different letters indicate a significant difference (p<0.05)
SALINITY EFFECTS

1-Way ANOVA
F = 2.90, p = 0.036

Bars represent the means (± 1 standard error). Different letters indicate a significant difference (p<0.05)
EFFECTS OF STATUS

1-Way ANOVA
F = 2.10, p = 0.126

Bars represent the means (± 1 standard error). Different letters indicate a significant difference (p<0.05)
SOIL ORDER EFFECTS

1-Way ANOVA
F = 3.97, p = 0.000

Bars represent the means (± 1 standard error). Different letters indicate a significant difference (p<0.05)
## CORRELATIONS

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>LOI°</th>
<th>TC°</th>
<th>Clay (%)</th>
<th>Silt (%)</th>
<th>Sand (%)</th>
<th>$A_{\text{ox}}$</th>
<th>$F_{\text{ox}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PSI$</td>
<td>-0.41</td>
<td>0.20</td>
<td>n.s.*</td>
<td>n.s.*</td>
<td>0.17</td>
<td>-0.18</td>
<td>n.s.*</td>
<td>n.s.*</td>
</tr>
</tbody>
</table>

- Not significant at $p$-value $< 0.05$
- Variable log transformed
- Correlation carried out on subset of data ($n = 48$)
CONCLUSION

Objective: To examine P sorption in coastal wetlands

Result: Yes, hydrologic gradient, salinity & soil order significant, but not wetland status

Implications:
- Help identify wetlands best at sorbing P
- Determine wetlands at risk from P overload
- Identify best predictive characteristics

Future research:
- Continue to measure amorphous Fe and Al
ACKNOWLEDGEMENTS

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Thank You