

Relationships among Songbird Communities, Calcium Availability, and Acidic Deposition in the Adirondacks

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Introduction

- Acidic deposition depletes soil calcium. Highly buffered sites may preserve biodiversity by retaining potential for long-term acidification resistance and recovery.
- Availability of calcium in acidified Adirondack forest soils shapes land snail communities.¹
- Snails are a critical source of calcium for many breeding songbirds.²
- Soil calcium depletion and subsequent reduction in snail availability has been linked to reproductive limitations and declines in some bird species in Europe and North America.^{2,3}



Objective

How does available soil calcium affect bird abundance and diversity in the Adirondacks?

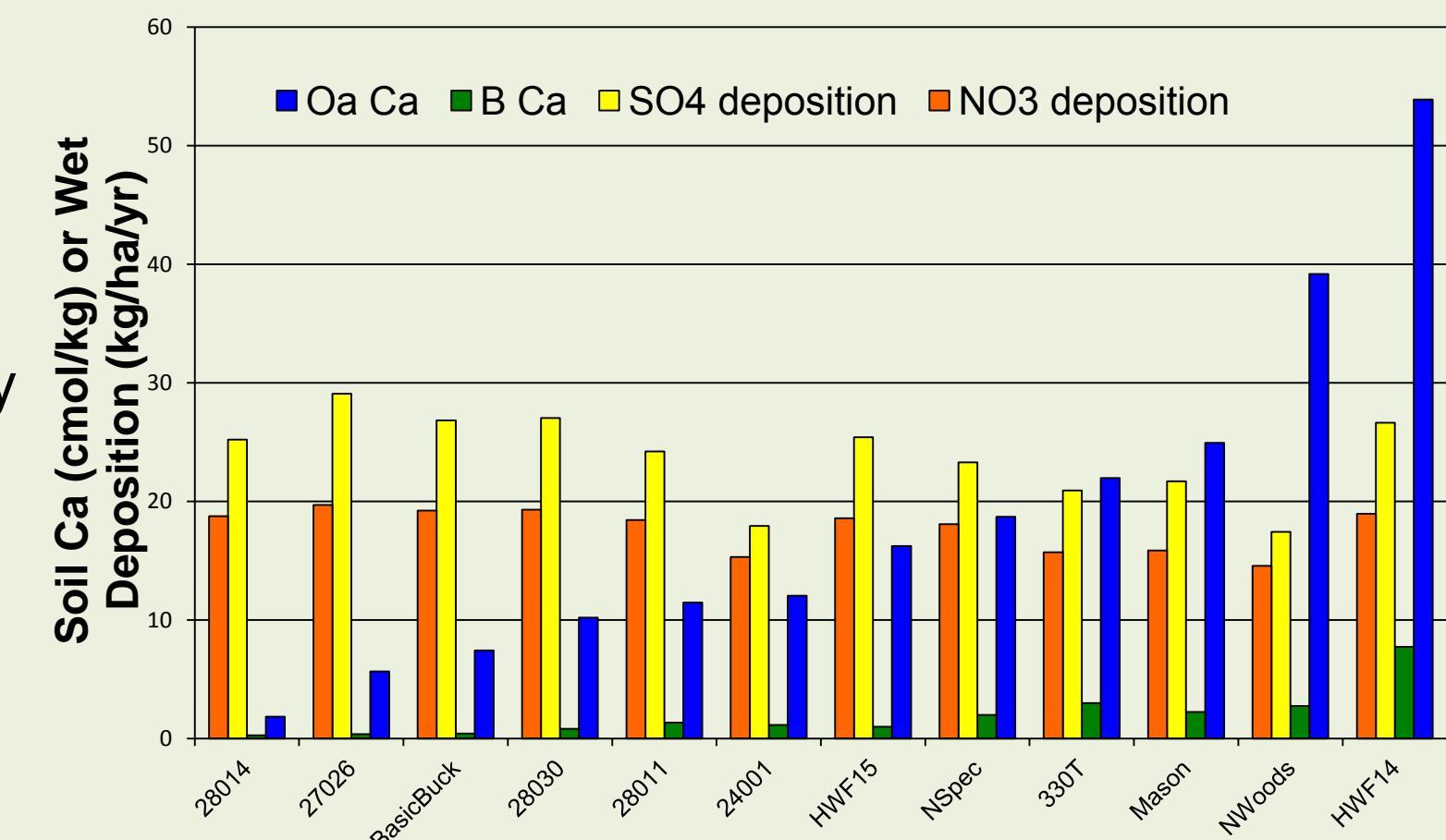


Methods

- Three point count surveys at each site.
- Prior work at study sites evaluated available soil calcium, plant communities, salamander communities, and snail abundance.
- Estimates of nitrate and sulfate deposition from a geospatial model.⁴

Figure 1.

Fourteen upland hardwood forest sites capture the full range of soil calcium availability in the Adirondack region.



Preliminary Results

Is species richness related to calcium and acidic deposition?

Figure 2. The relationship between available Oa horizon calcium and species richness.

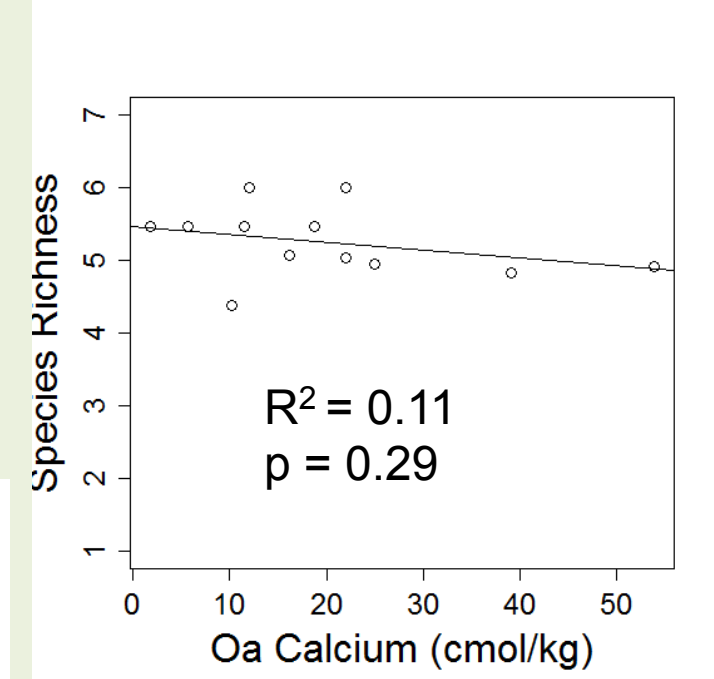
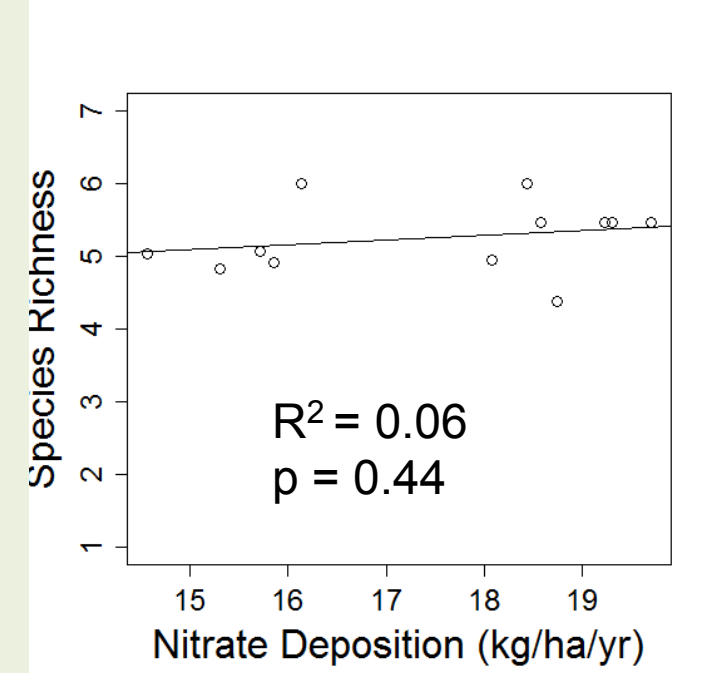


Figure 3. The relationship between nitrate deposition and species richness.



No significant relationships.

Are any species found only at higher calcium sites?

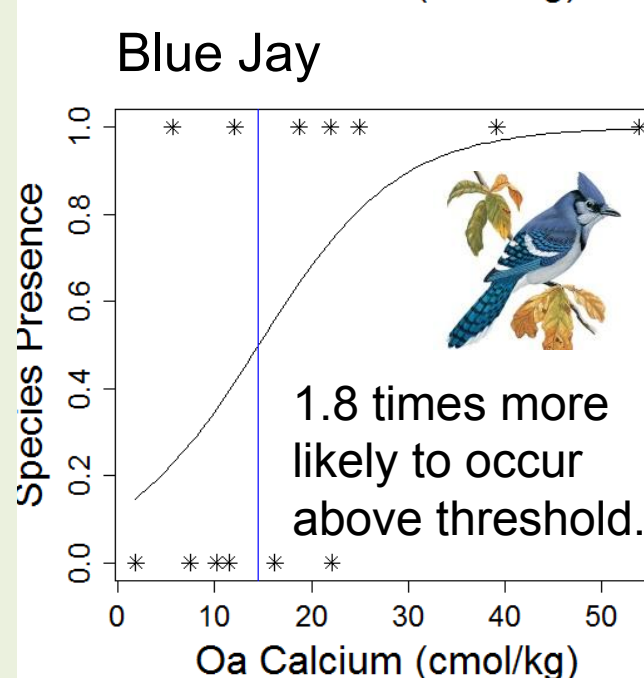
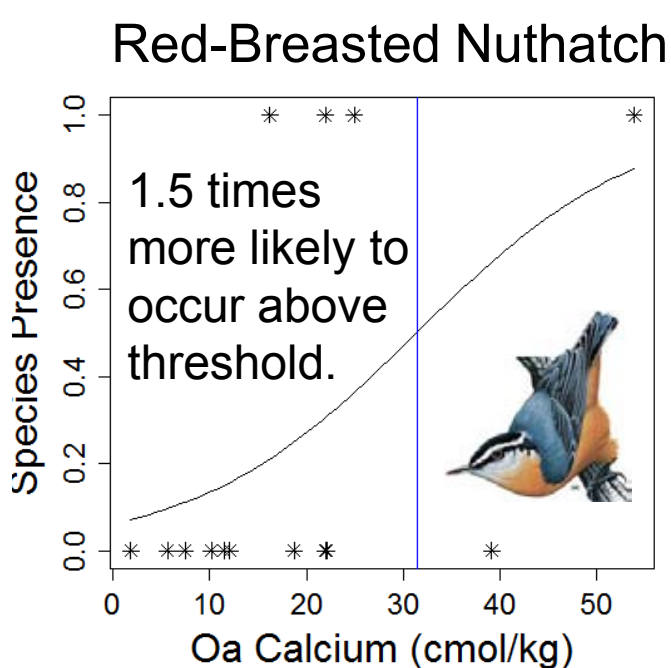
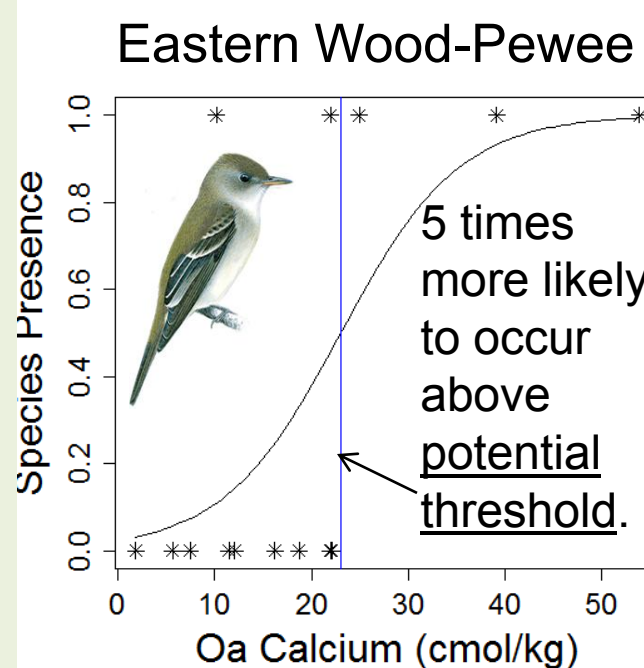


Figure 4. The relationship between available Oa horizon calcium and species presence.

3 species had significant positive relationships with calcium.

Are any songbird families found only at sites with lower acidic deposition?

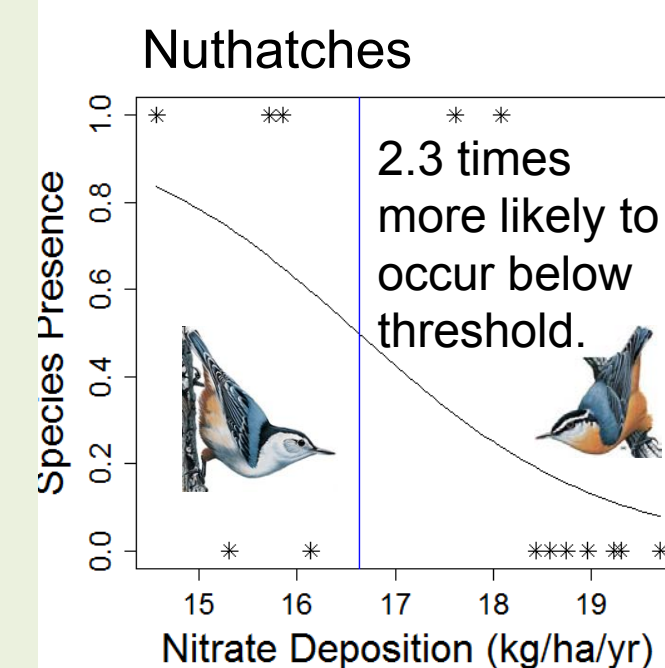


Figure 5. The relationship between nitrate deposition and nuthatch presence.

One family had significant negative relationship to nitrate deposition.

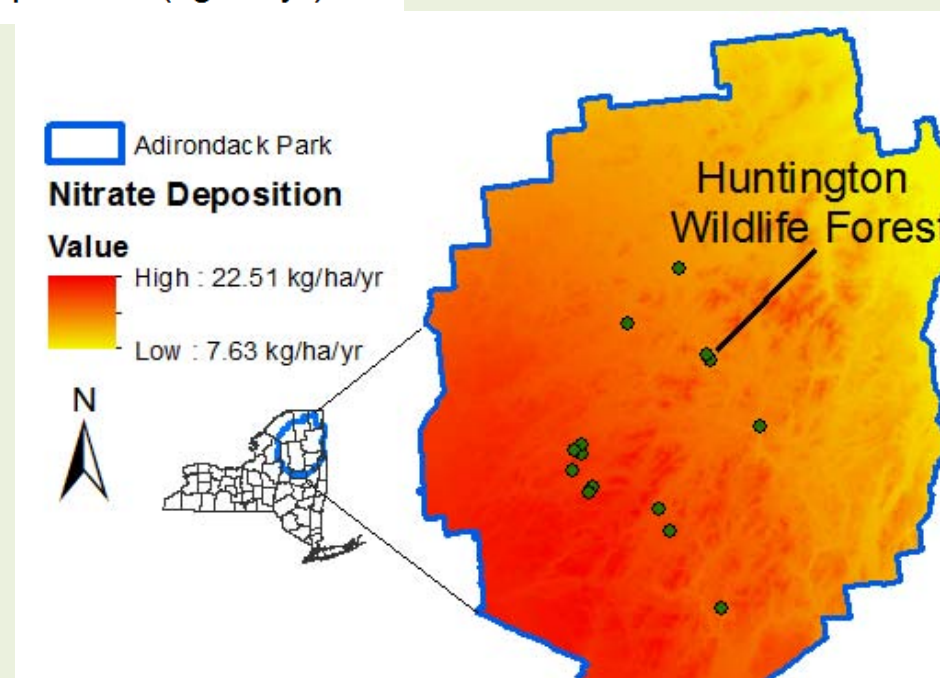


Figure 6. Study site positions along a nitrate deposition gradient in the Adirondack Park.

Conclusions

- No relationship between songbird species richness and soil calcium concentration or acidic deposition levels (Fig. 2, 3).
- Some species more sensitive to calcium depletion than others (Fig. 4). Potential thresholds between 14 and 32 cmol/kg.
- Some songbirds favor higher calcium sites with lower acidic deposition inputs for establishing breeding territories (Fig. 5).

Literature Cited

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Ongoing Analysis

- Relate overall songbird abundance and diversity to plant and prey communities, soil characteristics, and acidic deposition.
- Group species into guilds:
 - Feeding and nesting habit (e.g. forest canopy vs. ground)
 - Family (e.g. flycatchers, nuthatches, thrushes)
 - Relationships with calcium in previous studies³
- Relate guild abundance and diversity to plant and prey communities, soil characteristics, and acidic deposition.

Applications

- Links effects of calcium availability to multiple trophic level interactions.
- Links effects of calcium availability to distributions of both mobile (birds) and localized (snails, salamanders, plants) taxonomic groups along a calcium and deposition gradient (Fig. 1, 7).
- Provides initial calcium availability thresholds that maintain maximum diversity at each trophic level.
- Helps identify conservation priorities in the Adirondacks: some areas may be more likely to preserve biodiversity due to geophysical factors that resist acidification.