Impacts of Forest Degradation on Avian Functional Diversity

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Introduction

How does timber quality in a forest impact bird communities and the functions they play in the ecosystem?

Objectives

i. Determine if species diversity is a good proxy for functional diversity.
ii. Evaluate the relationships between degradation and key ecosystem functions: seed dispersal, pest control, and nutrient cycling.

Why focus on economic degradation?

- Landowners typically manage for timber quality and economic yield.
- It is unknown how economically degraded forests may impact wildlife communities and ecosystem function.

What is Functional Diversity?

- Instead of counting species, the traits species possess are measured.
- Functional traits are any morphological, behavioral or physical characteristics that impact species fitness.
- Using functional traits allows for calculating the ecological similarities and differences between species.

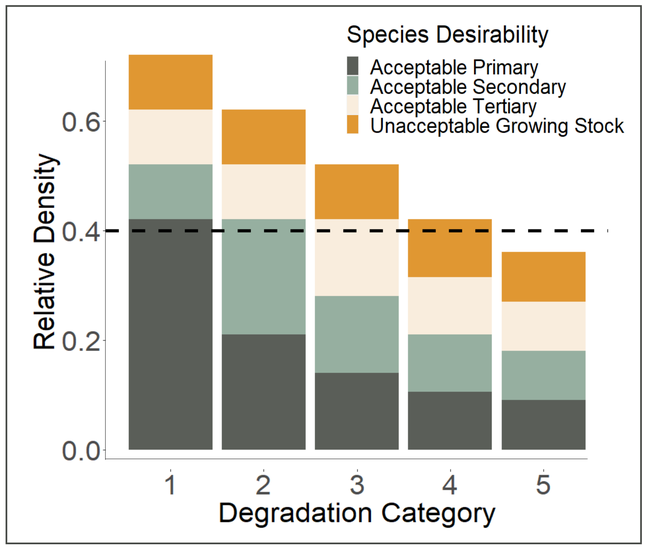

Figure 1. Representative example of tree composition for each degradation category. Degradation category is defined by if primary, secondary, tertiary or unacceptable trees are required to cross 40% relative density (dashed line).

Methods

Study Sites

- Silvio Conte National Wildlife Refuge Nulhegan Basin, VT (15 stands)
- Bartlett Experimental Forest, NH (17 stands)
- Stands were in hardwood, softwood, and mixedwood forests.
- Stands ranged in degradation value from 1-5.

Surveys

- Birds were surveyed using 10 min point-counts tallying all birds seen or heard within 50 m.
- Vegetation was surveyed using 20 BAF prism plots to determine degradation category of stand.

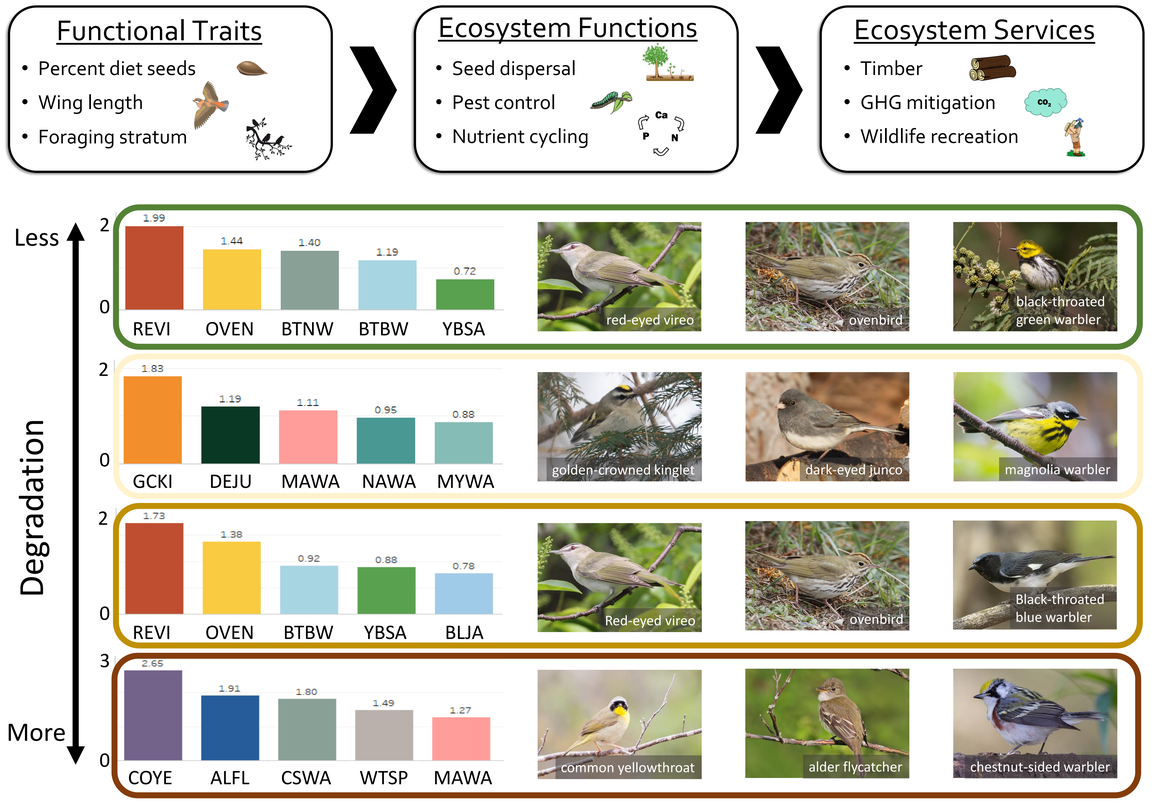

Figure 2. Species abundances by degradation categories 1 (green), 3 (yellow), 4 (orange), 5 (red). Images show most abundant species within each category from most abundant (left) to least (right).

Analysis

Ecosystem Functions

- Functional traits were chosen to reflect each of three ecosystem functions.
- Functional Diversity indices were calculated for each ecosystem function.

Functional Diversity Indices

- Functional Divergence: Proportion of species with extreme trait values.
- Functional Dispersion: Avg. distance of species to the center of the group.
- Mean Functional Distance: Avg. distance between all species.

Statistical Significance

- ANOVA and post hoc t-test was used to compare functional indices between degradation categories.

Ecosystem Function	Traits
Seed Dispersal	HWI, body mass, caching , sociality % diet fruit, % diet seed
Nutrient Cycling	HWI, body mass, % ground foraging, migrant, nest location, caching, fungal disperser, sociality
Pest Control	HWI, body mass, % diet invertebrate, % mid-story foraging, % canopy foraging, migrant, foraging strategy, lepidopteran, sociality

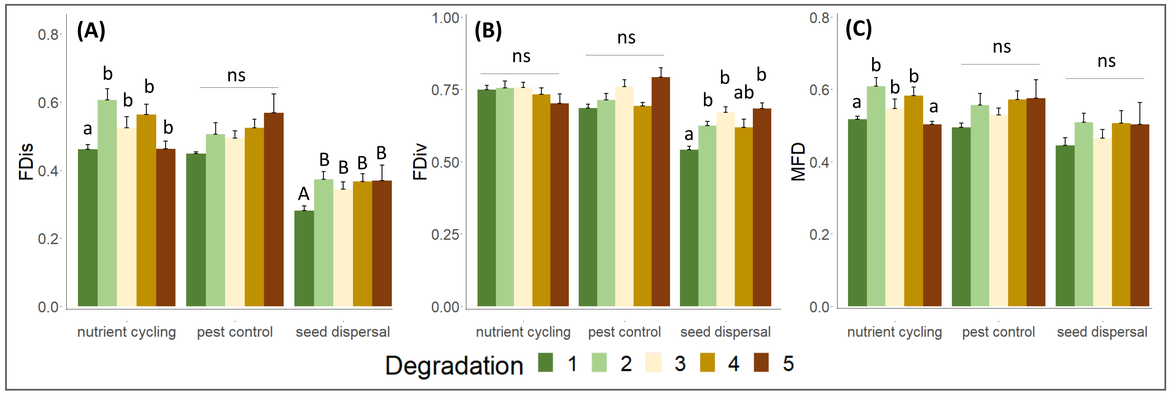

Figure 3. Results from functional diversity analysis showing differences between degradation categories within each ecosystem function. Functional dispersion (A) varied within nutrient cycling and seed dispersal. Functional divergence (B) varied only within the seed dispersal function and mean functional distance (C) varied only within the nutrient cycling function. There was no statistical difference between degradation categories within the pest control function.

Results

Taxonomic vs Functional Diversity

- No correlation between MFD and Shannon's Diversity (fig. 4)

Seed Dispersal

- Functional dispersion (fig. 3)
  - **Category 1** v **category 2** (P = *0.04*)
- Functional divergence
  - **Category 1** v **Category 2** (*P = 0.01*)
  - **Category 1** v **Category 3** (*P = 0.00*)
  - **Category 1** v **Category 5** (*P = 0.04*)

Nutrient Cycling

- Functional dispersion
  - **Category 1** v **category 2** (*P = 0.02*)
- Mean functional distance
  - **Category 1** v **Category 2** (*P = 0.04*)
  - **Category 2** v **Category 5** (*P = 0.02*)

Pest Control

- No significant differences in any functional diversity index

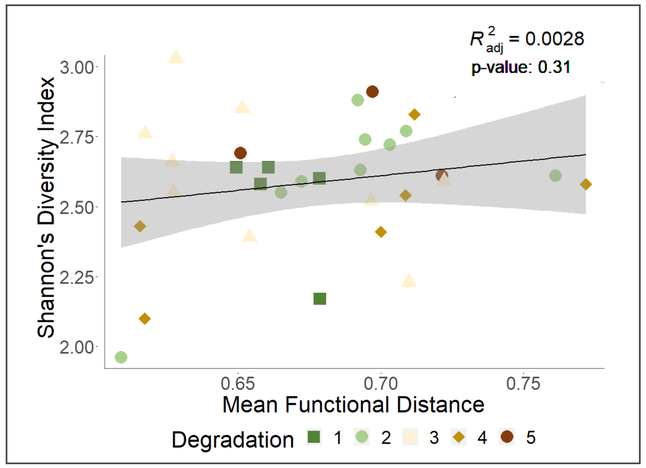

Figure 4. Linear regression between mean functional distance and Shannon's diversity index across degradation categories.

Discussion

Is species diversity a good substitute for functional diversity?

- No, the lack of correlation shows the importance of using functional diversity when trying to answer these questions.

What are the relationships between degradation and three ecosystem functions?

Low functional dispersion in non-degraded category 1:

- Species within these stands are functionally redundant.
- Species may not provide distinctly different functions in nutrient cycling and seed dispersal.

High mean functional distance in non-degraded category 2

- Species are functionally distinct from one another, providing a wider range of nutrient cycling functions.

High functional divergence in degraded category 3 & 5:

- Species in these stands have greater niche differentiation.
- This might be caused by greater species diversity in vegetation

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