Evaluating the effects of forest management on animal and plant communities

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Conservation and Integration

- MOFEP is an adaptive experiment, “learning while managing”
- Conserving the state’s biodiversity by managing land sustainably is central to MDC mission
- Important to understand how plants and animals interact with each other as well as respond to management
- Requires simultaneous evaluation of multiple species responses to management actions over long periods of time
Acknowledgements

**Collaborators**

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Treatments
No Harvest (control)
Even-aged Management
Uneven-aged Management
MOFEP Data
Site 9

Data Collection Locations
Vegetation Plot
Forest Stand Boundaries
Small Mammal Grid
Genetic Sample Stand
Armillaria Sampling
Hard Mast Plot
Amphibian and Reptile Array
Litter Invertebrate Sample
Canopy Invertebrate Sample
Soil Nutrient Sample
Bird Mist Net Line
Responses to Disturbance

Population/community
Ovenbird

Density (#/100 ha)

No Harvest  Uneven-aged  Even-aged

Hooded Warbler

Density (#/100 ha)

No Harvest
Uneven-aged
Even-aged

Acadian flycatcher

0 5 10 15 20 25 30 35

Density (#/100 ha)

- No Harvest
- Unevenage
- Evenage
Evaluating Effects of Disturbance

- **Spatial Scale**
  - Local, Landscape, Region

- **Temporal Scale**
  - Month, Season, Year, Decade

- **Ecological Scale**
  - Population, Ecological Group, Community, Ecosystem
Mice
(Peromyscus spp.)

![Graph showing the number of individuals of Mice (Peromyscus spp.) from 1994 to 2001. The x-axis represents the years 1994 to 2001, and the y-axis represents the number of individuals. The graph is divided into three categories: No Harvest, Uneven-aged, and Even-aged. The graph shows a peak in 1999 for Uneven-aged and Even-aged categories, with a subsequent decrease in 2000. The No Harvest category remains relatively constant throughout the years.]
Northern fence lizard

Sceloporus undulatus

- • 200 m from even-aged opening
- • 50 m from even-aged opening
- ▲ 0 m from even-aged opening
Conservation Questions

- Does even-aged or uneven-aged management (disturbance) affect animal communities in the Missouri Ozarks?

- Which forest management technique is most beneficial or least harmful to animal communities in the Missouri Ozarks?
MOFEP Calendar

1991–1995  Collect pre-treatment data
1996      First round of treatments
1997–2010 Collect post-treatment data
2011      Second round of treatments
2012–2025 Collect post-treatment data
2026      Third round of treatments
2090      End 100 year experiment?
## Summary of Pre-treatment Variation

<table>
<thead>
<tr>
<th>Yearly Differences</th>
<th>Treatment Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds</td>
<td>No</td>
</tr>
<tr>
<td>Mammmals</td>
<td>No</td>
</tr>
<tr>
<td>Herps</td>
<td>No</td>
</tr>
<tr>
<td>Caterpillars</td>
<td>Yes</td>
</tr>
<tr>
<td>Birds</td>
<td>No</td>
</tr>
<tr>
<td>Mammmals</td>
<td>No</td>
</tr>
<tr>
<td>Herps</td>
<td>No</td>
</tr>
<tr>
<td>Caterpillars</td>
<td>No</td>
</tr>
</tbody>
</table>
Meta-analysis Project

- Created ecological groups of similar species (i.e., similar resource requirements)
- Changes in density or relative abundance unit of study
- Calculated effect size as standardized difference between control sites and either even-aged or uneven-aged treatment sites
Ecological Groups

- *Ambystoma* salamanders
- *Plethodon* salamanders
- Toads
- Skinks
- Small snakes
- *Peromyscus* species
- Forest bird species
- Edge bird species
- Free-feeding caterpillars, black oak
- Free-feeding caterpillars, white oak
- Leaf-rolling caterpillars, black oak
- Leaf-rolling caterpillars, white oak
Meta-analysis

Used to combine results of different experiments

\[ \text{Effect Size} = (\text{Mean}_C - \text{Mean}_E) \frac{J}{\text{sd}_{CE}} \]
where J = weight based on sample size

Calculate Effect Size:

- 0.2 = “small” effect
- 0.5 = “medium” effect
- 0.8 = “large” effect
- 1.0 = “very large” effect
## Effects on Animal Groups

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect Size 1997</th>
<th>Effect Size 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Even-aged</td>
<td>0.399</td>
<td>0.563**</td>
</tr>
<tr>
<td>Uneven-aged</td>
<td>0.337</td>
<td>0.521**</td>
</tr>
<tr>
<td>All treatments</td>
<td>0.368**</td>
<td>0.542**</td>
</tr>
</tbody>
</table>

## Significant Treatment Effects

<table>
<thead>
<tr>
<th>Group</th>
<th>( F_{(2,4)} ) 1997</th>
<th>( F_{(2,4)} ) 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toads</td>
<td>4.83*</td>
<td>12.97**</td>
</tr>
<tr>
<td>Early Successional</td>
<td>21.33**</td>
<td>33.79**</td>
</tr>
<tr>
<td>Birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest Interior Birds</td>
<td>0.368**</td>
<td>0.542**</td>
</tr>
</tbody>
</table>

Animal Group Densities/Relative Abundances
All communities experienced significant changes after cutting on control and treatment sites.

Even-aged treatments may have larger short-term effects than uneven-aged treatments.

Scale of experiment may not fit all communities.

Sites may not be independent.

Pre-treatment and post-treatment data are critical for evaluation of treatment effects.

Treatment effects vary with spatial, temporal, and ecological scales.

Management and conservation strategies depend on scale of interest.
Short-term MOFEP Responses

Population/community
Challenges of Integration

- **Data**
  - Management & Availability
  - Design relative to integration questions

- **Scale of interest**
  - Temporal
  - Spatial
  - Ecological

- **Time and Priorities**
  - Collaboration takes far more time than individual projects
  - Integration may not be priority

- **Personnel/expertise**

- **Planning integration studies** BEFORE data are collected for individual projects

- **Funding**
MOFEP and Conservation

- Forest management influences animal community densities in the Ozarks, at least in the short-term, but effects are probably localized.

- Challenges of integration are also challenges for conservation:
  - Data
  - Funding
  - Expertise
  - Time and Priorities

- Collaboration is essential for successful conservation and integrated research.