The Effects of Fire on the Community Composition, Diversity, and Abundance of Carabidae in an *Artemisia filifolia* Habitat

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Pinon Canyon Maneuver Site

- Model, Colorado
- 235,895 acres / 955 km²
- Used by the U.S. Army for tactical training and live fire exercises
- Managed for military personnel safety, training exercises, and wildlife use

(Shaw et al. 1989)
Introduction to the Insect Study

• This research is part of a larger study with additional taxonomic groups of interests and other habitats that were studied

• Primary goal of the research was a base line inventory of insects
Artemisia filifolia
Sand Sagebrush

- Selected for
  - Sensitivity of the habitat
  - Habitat specificity of organisms that utilize sand sagebrush habitat (Walker et. Al. 2007)
  - Frequently burned for military safety and naturally by wildfire
Carabidae Importance

• Historically utilized as ecological status indicators
• Predators and primary consumers
• Some species are associated with sandy habitats

(Larochelle and Lariviere 2003)
(Holland 2002)
Question

• Is the frequent burning of sand sagebrush detrimental to the invertebrate community associated with this habitat?
  – Study constrained by
    • Small patch size (less than 1% of the area of the base)
    • Uncontrolled burning
    • 3 year duration of the project
Methods

- Carabids sampled using 9 pitfall traps at two sites
  - Site 1: 1 year post burn in 2007 and 2008
  - Site 2: 2 years post burn in 2007, 3 years post burn in 2008
- Samples were collected every two weeks from June-October in 2007 and May-October in 2008
Data Analysis

• Community level
  – ANOVA
  – Compared total abundance, species richness, Shannon’s diversity index, Evenness of Shannon’s diversity index and modified Simpson’s diversity index
  • Main effects
    – Year
    – Time since burn
    – Year*Time since burn
Abundance and Diversity Collected

- 1,020 individuals
- 23 species of Carabidae
### ANOVA Results Comparing 2007 and 2008

<table>
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<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Abundance</td>
<td>77.3</td>
<td>22.5</td>
<td>&lt;0.000</td>
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<tr>
<td>Species Richness</td>
<td>7.9</td>
<td>4.5</td>
<td>&lt;0.000</td>
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<tr>
<td></td>
<td>2007</td>
<td>2008</td>
<td>p</td>
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<td>--------------------------------</td>
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<tr>
<td>Shannon’s Diversity Index</td>
<td>1.31</td>
<td>1.02</td>
<td>0.050</td>
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<tr>
<td>( H=-\sum p_i \ln(p_i) )</td>
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<tr>
<td>Evenness of Shannon’s Index</td>
<td>0.55</td>
<td>0.43</td>
<td>0.050</td>
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<tr>
<td>( E=H/\ln(S) )</td>
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<tr>
<td>Modified Simpson’s Index</td>
<td>0.59</td>
<td>0.54</td>
<td>0.378</td>
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<tr>
<td>( D=1-\sum (p_i^2) )</td>
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</tbody>
</table>
Results: Time Since Burn

• No difference for abundance, species richness, Shannon’s diversity index, Evenness of Shannon’s diversity index, or Simpson’s index

Results: Interaction of Time Since Burn and Year

• No interaction of time since burn and year
Data Analysis

• Species level
  – Nonmetric Multidimensional Scaling Ordination
    • Determine habitat specialist and generalists associated with Sand Sagebrush
  – ANOVA on selected species
    • Main effects
      – Year
      – Treatment
      – Year*Treatment

Photo by Alex Wild
Nonmetric Multidimensional Scaling Ordination
Average of Each Pitfall at All Sites Each Year

- Axis 1
- Axis 2

- Sand Sagebrush Habitats
- All Other Habitats
- Carabid Species
Nonmetric Multidimensional Scaling Ordination
Average of Each Pitfall at All Sites Each Year

- Axis 1
- Sand Sagebrush Habitats
- Carabid Species

Graph showing the ordination of sand sagebrush habitats and carabid species across two axes.
### ANOVA Results of Sand Sagebrush Specialists Comparing 2007 and 2008

<table>
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<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>p-value</th>
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<tbody>
<tr>
<td><em>Cicindela punctulata</em></td>
<td>4.43</td>
<td>8.25</td>
<td>0.043</td>
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<td><em>Cymindis interior</em></td>
<td>0.64</td>
<td>1.37</td>
<td>0.032</td>
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<td><em>Euryderus grossus</em></td>
<td>16.08</td>
<td>6.18</td>
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<tr>
<td><em>Pasimachus obsoletus</em></td>
<td>8.13</td>
<td>3.91</td>
<td>0.047</td>
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<tr>
<td>Species</td>
<td>2007</td>
<td>2008</td>
<td>p-value</td>
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<td>-------------------------------</td>
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<tr>
<td>Amara quenseli</td>
<td>24.42</td>
<td>0.01</td>
<td>0.002</td>
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<td>Amblycheila cylindriformis</td>
<td>5.16</td>
<td>1.76</td>
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<tr>
<td>Cyclotrachelus constrictus</td>
<td>3.25</td>
<td>0.01</td>
<td>&lt;0.000</td>
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<tr>
<td>Chlaenius tomentosus</td>
<td>8.13</td>
<td>3.91</td>
<td>0.042</td>
</tr>
</tbody>
</table>
Results: Time Since Burn

• No difference for either generalist or specialist species that utilize Sand Sagebrush

Results: Interaction of Time Since Burn and Year

• No interaction of time since burn and year for either generalist or specialist species that utilize Sand Sagebrush
Impact of Fire on Carabids at this Sand Sagebrush Habitat

• These preliminary data indicate that:
  – No differences in fire treatments detected
  – Climatic variability obscures treatment differences
  – Multiple years of data are necessary to assess the impact of fire on this Sand Sagebrush Carabid community
  – Additional burned plots are necessary for replication
References


• Larochelle, A. and M. C. Lariviere. 2003. A natural history of the ground-beetles (Coleoptera: Carabidae) of America north of Mexico. Pensoft, Sofia-Moscow, Russia


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