Diversity of Saproxylic Coleoptera in Great Smoky Mountains National Park

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Definitions for this Study

• Fine woody debris: 2.5 – 7 cm diameter
• Coarse woody debris: 8 – 20 cm diameter
• Mixed Hardwoods
Definitions for this Study

• Decay class: 1 (least) – 5 (most)*

Definitions for this Study

• “Species”: lowest identifiable taxon

*Clinidium valentinei* Bell
1 species

*Cryptophagus* spp.
1 “species”
Leaf Litter & CWD5

- Fall 2006, Spring 2007
- 3 Leaf Litter, 3 CWD5 sifted samples
- 72 samples total
- Berlese funnel extraction
216 species
4261 specimens

Specimens per Species

Red = CWD5
Blue = Leaf Litter

Species (216)

Number of Specimens

7 (611 – 101)
64
27
66 (31%)
52 (99-10)
<table>
<thead>
<tr>
<th>Insect Order</th>
<th>Family</th>
<th>Genus</th>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter &amp; CWD5</td>
<td>Staphylinidae</td>
<td>Sunius</td>
<td>Sunius rufipes</td>
<td>611</td>
</tr>
<tr>
<td></td>
<td>Ptiliidae</td>
<td>Acrotrichis</td>
<td>Acrotrichis spp</td>
<td>477</td>
</tr>
<tr>
<td></td>
<td>Carabidae</td>
<td>Anillinus</td>
<td>Anillinus langdoni</td>
<td>556</td>
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<tr>
<td></td>
<td>Cerylonidae</td>
<td>Mychocerus</td>
<td>Mychocerus striatus</td>
<td>250</td>
</tr>
</tbody>
</table>

### Summary

- **216 species**
- **4261 specimens**
- 7 (611 – 101)
- 52 (99-10)
- 91 (9-2)
- 66 (1)
- **0% ---- 100% CWD5**
Litter & CWD5: Season

<table>
<thead>
<tr>
<th>Season</th>
<th>Number of Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>(173)</td>
</tr>
<tr>
<td>Fall</td>
<td>(149)</td>
</tr>
<tr>
<td>Total</td>
<td>(216)</td>
</tr>
</tbody>
</table>
Litter & CWD5: Forest

Number of Specimens

Total (216)

Secondary (146)

Primary (144)

Number of Species

Number of Specimens
Litter & CWD5: Substrate

Number of Specimens

- CWD5 (111): 46 unique (21%)
- Leaf litter (170): 105 unique (49%)
- Total (216)

65 in both (30%)

Sorensen Similarity Index

0.46
Chi-square Analysis

59 species (n≥10) (α = 0.05)

<table>
<thead>
<tr>
<th></th>
<th>SUBSTRATE</th>
<th>FOREST</th>
<th>SEASON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CWD5</td>
<td>Primary</td>
<td>Spring</td>
</tr>
<tr>
<td></td>
<td>Litter</td>
<td>Secondary</td>
<td></td>
</tr>
<tr>
<td># significant</td>
<td>8</td>
<td>28</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td># not significant</td>
<td>11</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>
CWD5 Associates

Cerylonidae: *Mychocerus striatus*
CWD5: 246  Litter: 4  $P < 0.0001$

Eucinetidae: *Tohlezkus inexpectus*
CWD5: 34   Litter: 1  $P < 0.0001$

Curculionidae: *Dryophthorus americanus*
CWD5: 20  Litter: 0  $P < 0.0001$

Staphylinidae: *Conoplectus canaliculatus*
CWD5: 20  Litter: 3  $P < 0.001$

Ptiliidae: *Pteryx spp*
CWD5: 15  Litter: 2  $P < 0.01$

Staphylinidae: *Sonoma spp (♀)*
CWD5: 22  Litter: 6  $P < 0.01$

Staphylinidae: *Thoracophorus costalis*
CWD5: 17  Litter: 5  $P < 0.05$

Staphylinidae: *Leptusa pusio*
CWD5: 11  Litter: 2  $P < 0.05$
Conclusions

- CWD5
  - Fauna distinct from Leaf Litter
  - Overlooked habitat
  - High species richness
  - Many “rare” species
  - 216 spp associated with Leaf Litter and CWD5
  - Easy to collect!
CWD Emergence
CWD Emergence

• 15 samples of wood from each site
  – 3: fine, Fresh (2.5-7 cm)
  – 3: fine, Weathered
  – 3: CWD 1 (8-20 cm)
  – 3: CWD 2
  – 3: CWD 3-4

90 chambers total (68-L)
Specimen Collection

- 2006
  - May, June, July, August, October
- 2007
  - April, June, October

Specimens per Species

306 species
5673 specimens

Number of Specimens

Species (305)

10 (1130 – 125)
77
42
115 (38%)
61 (84 – 10)

CWD3/4
CWD2
CWD1
Fine/Weathered
Fine/Fresh

306 species
5673 specimens
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throscidae</td>
<td><em>Aulonothroscus distans</em></td>
<td>1130</td>
</tr>
<tr>
<td>Staphylinidae</td>
<td><em>Thoracophorus costalis</em></td>
<td>856</td>
</tr>
<tr>
<td>Ptiliidae</td>
<td><em>Pteryx spp</em></td>
<td>404</td>
</tr>
<tr>
<td>Curculionidae</td>
<td><em>Dryophthorus americanus</em></td>
<td>306</td>
</tr>
</tbody>
</table>

**CWD Emergence**

- **Species**: 305
- **Specimens**: 5673
- **Emergence Range**: 0% – 100%
- **Emergence Results**: 61 (84-10), 119 (9-2), 10 (1130 – 125), 115 (1)
- **Condition**: Fine
Emergence - Total

Number of Species

Number of Specimens

Total (306)

5673
### Emergence – Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Species</th>
<th>Number of Specimens</th>
<th>2006 (225)</th>
<th>2007 (205)</th>
<th>Total (306)</th>
<th>81 unique</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>(225)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2007</td>
<td>(205)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(306)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Number of Species**
- **Number of Specimens**
- **2006 (225)**
- **2007 (205)**
- **Total (306)**
- **81 unique**
Emergence – Forest

Number of Specimens

Secondary (207)

Primary (207)

Total (306)

Number of Species

Number of Specimens
Emergence – Size and Decay Class

- Total (306)
- CWD 1 (111)
- CWD 2 (156)
- CWD 3-4 (128)
- Fine- Weathered (118)
- Fine- Fresh (91)

- 18 chambers (20%)
- 156 species (50%)

Number of Specimens vs. Number of Species graph.
**Emergence – Size and Decay Class**

**Sorensen Similarity Index**

<table>
<thead>
<tr>
<th></th>
<th>Fine- Fresh</th>
<th>Fine- Weathered</th>
<th>CWD 1</th>
<th>CWD 2</th>
<th>CWD 3-4</th>
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<tbody>
<tr>
<td>Fine- Fresh</td>
<td>x</td>
<td>0.46</td>
<td>0.5</td>
<td>0.48</td>
<td>0.38</td>
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<tr>
<td>Fine- Weathered</td>
<td>x</td>
<td>0.44</td>
<td>0.49</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>CWD 1</td>
<td>x</td>
<td>0.5</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD 2</td>
<td></td>
<td>x</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWD 3-4</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Null = 0.37**  
100 specimens, n=10  
(0.29 – 0.43)
Chi-square Analysis

(α = 0.05)

<table>
<thead>
<tr>
<th></th>
<th>Fine (n=27)</th>
<th>CWD (n=35)</th>
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<tbody>
<tr>
<td></td>
<td>Fresh</td>
<td>Weathered</td>
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<tr>
<td># significant</td>
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<td>11</td>
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<tr>
<td># not significant</td>
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</table>
Emergence – Fine and Forest

<table>
<thead>
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<th>Category</th>
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</thead>
<tbody>
<tr>
<td>Fine- Weathered</td>
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<tr>
<td>Secondary</td>
<td>77</td>
</tr>
<tr>
<td>Primary</td>
<td>76</td>
</tr>
<tr>
<td>Fine- Fresh</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>51</td>
</tr>
<tr>
<td>Primary</td>
<td>60</td>
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</tbody>
</table>

Total: 306
Number of Species vs. Number of Specimens

Emergence – CWD and Forest

- Total (306)
- CWD 1 S (72)
- CWD 1 P (70)
- CWD 2 S (86)
- CWD 2 P (107)
- CWD 3-4 S (85)
- CWD 3-4 P (84)

9 chambers (10%)
107 species (33%)
Conclusions

• **Woody Debris**
  – Different size/decay classes have distinct fauna
  – CWD 2 most species per sample
  – 306 spp associated with woody debris
  – Emergence chambers work!
Taxa Richness from “Habitat Survey”
(not standardized for samples or specimens)

360 spp. Woody Debris
170 spp. Leaf Litter
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Questions?