Temporal Variation in Leaf Litter Invertebrates Available to *Plethodon cinereus*

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Plethodon cinereus

- Slender woodland salamander
- Lungless salamander
- Ash color with red/orange stripe middorsal (can exhibit a lead phase)
- Males
  - 42.3mm SVL and 83mm ToL (average)
- Females
  - 44mm SVL and 83mm ToL (average)

(Hulse et al. 2001)
Life History

- **Activity**
  - Live under rocks, logs, leaf litter, small burrows  
    (Frisbie and Wyman, 1991)
  - 10% active on surface  
    (Taub, 1961)
  - Approx. 1 animal/m²  
    (Heatwole, 1962)

- **Development**
  - Terrestrial
  - Direct Development  
    (Burger, 1935)

- **Lifespan**
  - Plethodontid salamanders- 32 years  
    (Hairston, 1983)
  - *P. jordani* - 9.8 years  
    (Hairston, 1983)
Why Study *P. cinereus*?

- Important components to the trophic structure in some forests (Burton and Likens, 1975)

- High efficiency in converting consumed energy to biomass (60%) (Burton and Likens, 1975)
  - May equal the amount of biomass of mice and shrews (Burton and Likens, 1975)

- Common species, easy to find and study

- They can be marked to identify individuals
Why Study Invertebrates?

- *P. cinereus* prey on several different types of invertebrates:
  - Termites, flies, earthworms, spiders, springtails and more (Cockran, 1911)
- Give insight to *P. cinereus* activity
- General knowledge of species to species relationships
Questions to be Answered

- Does diversity of leaf litter invertebrates available to *P. cinereus* differ temporally though the year?
  - What is the phenology of invertebrate diversity?
  - Does moisture content play a role in activity?
  - Does the abundance of invertebrates have a relationship with abundance of salamanders?
Hypothesis

- When *P. cinereus* are more active, the invertebrate diversity will be lower

Predictions

- Invertebrate diversity will fluctuate due to phenology
- Depending on leaf litter moisture content, we expect to see a difference in the number of invertebrates
Site Description

- Camp Karoondinha
- Eastern deciduous forest
  - 3 Sites with 3 plots each
  - Each plot, 50 cover boards
Methodology: *P. cinereus*

- Collect salamanders
- Determine if it has been marked
- If so: recapture
- If not: new capture
  - Measure SVL & ToL
  - Determine sex
  - Count eggs
  - Mark with VIE (visible implant elastomer) under each limb
- Abiotic Measurements
  - Air and soil temp
Methodology: Invertebrates

- Field Sampling
  - Random sampling
  - 20cm x 20cm samples
    - 3 samples per plot (n=27)
    - Collect down to organic layer of soil
Methodology: Invertebrates

- Berlese Funnel Methods
  - Weigh samples
  - 3 times (Wet, Dry 1, Dry 2)
  - In funnel for one week
  - Collect invertebrate samples in alcohol
Methodology: Invertebrates

- Analysis and Quantification of Invertebrates
  - Using a dissecting scope
  - Identify to taxonomic order
  - Quantity
Analysis - Summary of Data

- 9 plots (3 in each of 3 sites)
- Multiple sampling dates:
  - 6 in spring, 6 in fall
- Biotic measures:
  - salamander activity (number found/plot)
  - Invertebrate diversity (per plot)
- Abiotic measures:
  - Leaf litter moisture, air temperature, soil temperature
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Shannon –Wiener Index of Diversity: species richness and the proportion of each species
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Correlation Coefficients: strength of the relationship between invertebrates and *P. cinereus* activity
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Analysis of Variance (ANOVA): how invertebrate diversity varies by site and sampling date
Preliminary Results

Diversity and Abundances of Invertebrates

- Oribatida (mites)
- Trombidiformes (mites)
- Diplopoda (millipedes)
- Diptera (flies)
- Unidentified
- Collembola (springtials)
- Opilioacarida (mites)
- Chilopoda (centipede)
- Pseudoscorpionida
- Mesostigmatida (mites)
- Araneida (spiders)
- Hymenoptera
- Larvae

[Images and links to images provided in the text]
Number of Salamanders vs Number of Invertebrates

Sample Site

- CH
- CO
- ECO
Average Number of Invertebrates per g of Dry Leaf Litter

Sampling Date

Estimated Marginal Means of MEASURE_1

Sample Site
ECO April 2, 2014

- Acari (mites)
- Collombola
- Pseudoscorpionida
- Araneae
- Hemiptera
- Hymenoptera
- Coleoptera
- Diptera
- Class Diploponda
- Class Chilopoda
- Opilioacarida
- Larvae
- Snail
- Unidentifiable
- Thysanoptera (thrip)
- Class Pauropoda
- Psocoptera (psocids)
- Blattodea
- Haplotaxida
- Orthoptera
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