



Litter-Dwelling Arthropod Abundance Peaks Near Coarse Woody Debris in Loblolly Pine Forests of the Southeastern United States

Authors: Ulyshen, Michael D., and Hanula, James L.

Source: Florida Entomologist, 92(1) : 163-164

Published By: Florida Entomological Society

URL: <https://doi.org/10.1653/024.092.0128>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

LITTER-DWELLING ARTHROPOD ABUNDANCE PEAKS NEAR COARSE WOODY DEBRIS IN LOBLOLLY PINE FORESTS OF THE SOUTHEASTERN UNITED STATES

MICHAEL D. ULYSHEN* AND JAMES L. HANULA
USDA Forest Service, 320 Green Street, Athens, Georgia 30602

*Corresponding author, mulyshen@hotmail.com

Several recent studies have shown that many litter-dwelling arthropod and other invertebrate taxa (e.g., Isopoda, Chilopoda, Diplopoda, Araneae, Pseudoscorpionida, Coleoptera, and Gastropoda) are more numerous near dead wood than away from it in the broad-leaved forests of Europe (Jabin et al. 2004; Topp et al. 2006a, 2006b; Kappes et al. 2006; Kappes 2006; Jabin et al. 2007) and New Zealand (Evans et al. 2003). Whether these trends hold true in pine-dominated forests, such as those in the southeastern United States, remains unknown. To address this question, we sampled litter dwelling arthropods adjacent (≤ 15 cm) to, and away (> 2 m) from, logs at 3 stages of decay in loblolly pine (*Pinus taeda* L.) forests in South Carolina, USA.

This project took place on the 80,267-ha Savannah River Site (SRS) located in the upper Coastal Plain Physiographic Province of South Carolina. The SRS, a facility owned and operated by the United States Department of Energy, was established in 1951, and was designated a National Environmental Research Park in 1972 (Kilgo & Blake 2005). Most of the land now owned by the SRS was formerly used for agricultural purposes and most forests currently standing, including those used in this study, were planted in the early 1950s (Kilgo & Blake 2005).

The 9 logs used in this study were equally divided among trees felled in Aug 1997 ("old" logs), Aug 2001 ("middle-aged" logs) and May 2005 ("young" logs). A hand-held rake about 10 cm in width was used to collect litter samples. We raked along the edges of logs until enough material was collected to fill (gently compressed) a wire mesh basket of known volume (see below). We also sampled from 3 randomly chosen areas > 2 m away from logs. The samples included all material above the soil surface except for large pieces of bark and pine cones. Due to differences in leaf litter thickness, it was impossible to standardize both ground surface area sampled and leaf litter volume sampled. Because litter layers were often thicker near logs, samples taken away from logs generally came from larger areas of ground than those taken near logs. The samples were placed in plastic garbage bags for transport to the laboratory. Samples were collected 3 times (11 Aug 2006, 16 Mar 2007, and 24 May 2007) from each location.

Twelve Berlese funnels were made to collect arthropods from the litter samples. These con-

sisted of large plastic buckets, wire mesh baskets, and aluminum lamps with 40-watt incandescent bulbs. The wire baskets, which held the leaf litter, were made in the shape of a short cylinder (26 cm in diameter and 10 cm tall) of hardware cloth with 6.35-mm-wide square openings. After 5 d of sampling, any arthropods collected were removed and stored in 70% ethanol until they could be sorted and identified. The data from the 3 sampling periods were combined before analysis. We used SAS (1990) to conduct a one-way ANOVA on $\log(x + 1)$ -transformed abundance data. Means were separated by Tukey's Studentized Range Test.

Data are presented in Table 1. Litter-dwelling arthropods were consistently more abundant or similarly abundant near logs than away from logs. None of the taxa was more abundant away from logs. Arthropods overall and several individual taxa (i.e., Araneae, Coleoptera, Psocoptera, and holometabolous insect larvae) were significantly more abundant near logs than away from logs. Arthropod abundance was generally higher near young and middle-aged logs than old logs, but these differences were not statistically significant.

Our results demonstrate that litter-dwelling arthropods in the loblolly pine forests of the southeastern United States, as in broad-leaved forests of Europe and New Zealand, are more abundant near dead wood than away from it. Because small organisms are particularly prone to desiccation, many litter-dwelling arthropods may seek out the moist microenvironments found in and around dead wood (Jabin et al. 2004). Also, many species may benefit from the higher concentrations of key nutrients (e.g., calcium) and organic matter found near dead wood (Dajoz 2000). More detailed studies are needed to determine which taxa are most favored by coarse woody debris.

Support for this research was provided by the Department of Energy-Savannah River Operations Office through the U.S. Forest Service Savannah River under Interagency Agreement DE-AI09-00SR22188. We thank 2 anonymous reviewers for comments that greatly improved the manuscript.

SUMMARY

We collected leaf litter samples adjacent (≤ 15 cm) to and away (> 2 m) from logs at 3 stages of

TABLE 1. MEAN \pm SE ($N = 3$) NUMBER OF COMMON (>50 INDIVIDUALS) ARTHROPOD TAXA COLLECTED FROM LEAF LITTER TAKEN NEAR (≤ 15 CM) AND FAR (>2 M) FROM LOBLOLLY PINE LOGS AT DIFFERENT STAGES OF DECAY (YOUNG ~ 1.5 YR, MIDDLE ~ 5 YR, AND OLD ~ 9 YR) IN SOUTH CAROLINA, USA. FOR EACH TAXON, MEANS FOLLOWED BY DIFFERENT LETTERS ARE SIGNIFICANTLY DIFFERENT BASED ON TUKEY'S STUDENTIZED RANGE TEST BASED ON LOG ($X + 1$)-TRANSFORMED DATA. ASTERISKS INDICATE SIGNIFICANT DIFFERENCES ($\alpha = 0.05$).

	Near			
	Young	Middle	Old	Far
Acari	139.3 \pm 6.4	122.7 \pm 19.0	96.0 \pm 42.2	41.0 \pm 14.0
*Araneae	25.3 \pm 2.2 a	29.7 \pm 7.0 a	29.7 \pm 5.6 a	7.3 \pm 2.2 b
Chilopoda	4.7 \pm 0.7	7.3 \pm 2.9	6.0 \pm 2.1	2.0 \pm 1.0
*Coleoptera	14.0 \pm 2.7 a	20.3 \pm 4.1 a	5.7 \pm 1.8 ab	3.0 \pm 1.5 b
Collembola	79.7 \pm 23.5	79.7 \pm 20.8	30.0 \pm 5.5	26.7 \pm 9.3
Diplopoda	10.0 \pm 1.2	30.7 \pm 22.9	16.7 \pm 11.7	4.3 \pm 3.8
Diptera	3.0 \pm 1.2	10.3 \pm 0.7	4.0 \pm 2.1	4.0 \pm 1.5
Formicidae	15.3 \pm 1.9	176.3 \pm 158.9	33.0 \pm 8.7	24.0 \pm 10.7
Hemiptera	6.0 \pm 3.0	8.7 \pm 1.3	1.3 \pm 0.9	4.3 \pm 2.2
Isoptera	2.3 \pm 2.3	2.0 \pm 2.0	52.0 \pm 51.0	0.3 \pm 0.3
Pseudoscorpiones	6.7 \pm 4.4	10.7 \pm 3.3	6.3 \pm 3.8	5.3 \pm 4.4
*Psocoptera	13.7 \pm 2.4 a	14.0 \pm 7.0 a	6.3 \pm 0.9 ab	2.3 \pm 0.9 b
Thysanoptera	7.0 \pm 1.5	6.3 \pm 1.8	3.3 \pm 0.3	7.7 \pm 4.3
*Holometabolous insect larvae	21.0 \pm 4.2 a	34.3 \pm 9.3 a	18.0 \pm 4.6 a	5.3 \pm 0.9 b
*Total arthropods	353.7 \pm 14.5 a	558.3 \pm 115.9 a	312.0 \pm 96.2 ab	140.0 \pm 13.5 b

decay to determine how arthropod abundance varies with proximity to coarse woody debris in loblolly pine (*Pinus taeda* L.) forests of the southeastern United States. Arthropods overall and several individual taxa (i.e., Araneae, Coleoptera, Psocoptera, and holometabolous insect larvae) were significantly more abundant near logs than away from logs. None of the taxa was more abundant away from logs and there were no differences in abundance among decay classes.

REFERENCES CITED

- DAJOZ, R. 2000. Insects and Forests: The Role and Diversity of Insects in the Forest Environment. Intercept Ltd, New York.
- EVANS, A. M., CLINTON, P. W., ALLEN, R. B., AND FRAMPTON, C. M. 2003. The influence of logs on the spatial distribution of litter-dwelling invertebrates and forest floor processes in New Zealand forests. *Forest Ecology and Management* 184: 251-262.
- JABIN, M., MOHR, D., KAPPES, H., AND TOPP, W. 2004. Influence of deadwood on density of soil macroarthropods in a managed oak-beech forest. *Forest Ecology and Management* 194: 61-69.
- JABIN, M., TOPP, W., KULFAN, J., AND ZACH, P. 2007. The distribution pattern of centipedes in four primeval forests of central Slovakia. *Biodiversity and Conservation* 16: 3437-3445.
- KAPPES, H. 2006. Relations between forest management and slug assemblages (Gastropoda) of deciduous regrowth forests. *Forest Ecology and Management* 237: 450-457.
- KAPPES, H., TOPP, W., ZACH, P., AND KULFAN, J. 2006. Coarse woody debris, soil properties and snails (Mollusca: Gastropoda) in European primeval forests of different environmental conditions. *European J. Soil Biol.* 42: 139-146.
- KILGO, J. C., AND BLAKE, J. I. [Eds.]. 2005. *Ecology and Management of a Forested Landscape: Fifty years on the Savannah River Site*. Island Press, Washington, DC.
- SAS INSTITUTE. 1990. *SAS Guide for Personal Computers*. SAS Institute, Cary, NC.
- TOPP, W., KAPPES, H., KULFAN, J., AND ZACH, P. 2006a. Litter-dwelling beetles in primeval forests of Central Europe: does deadwood matter? *J. Insect Conservation* 10: 229-239.
- TOPP, W., KAPPES, H., KULFAN, J., AND ZACH, P. 2006b. Distribution pattern of woodlice (Isopoda) and millipedes (Diplopoda) in four primeval forests of the western Carpathians (Central Slovakia). *Soil Biol. & Biochem.* 38: 43-50.