

Succession of Coleoptera on Freshly Killed Loblolly Pine (*Pinus taeda* L.) and Southern Red Oak (*Quercus falcata* Michx.) in Louisiana

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ABSTRACT

Overlapping complexes of insects invade dead wood according to the species of tree, stage of decomposition, and ambient conditions. We studied beetle succession in felled loblolly pines and southern red oaks by documenting beetle arrival and residency in freshly killed standing tree trunks. Six trees of each species at Feliciana Preserve in West Feliciana Parish, LA were felled during October 2004 and April 2005 for a total of 24 trees sampled from October 2004 – September 2005. Four 48-inch bolts were cut from each felled tree. Each bolt was further cut into eight six-inch sections, reassembled in proper order, and positioned standing upright. Insects were aspirated from the interfaces of sections one a week for the first month and then monthly for the duration of the study. Specimens from each sample were identified to species and counted. A species checklist and accumulation curves are presented. Beetle species richness on red oak wood was higher than on pine. Fungivores was the most abundant functional group represented in both types of wood, followed by predators, with wood boring beetles surprisingly infrequent in our samples.

INTRODUCTION

Wood is important in forest ecology because its large biomass serves as a nutritional substrate for many organisms, including Coleoptera, and beetles contribute greatly to nutrient recycling in forests. Forest insect biodiversity is impacted by coarse woody debris and forest structure. As a tree decays, an overlapping succession of insects invade according to the state of the tree. The patterns of succession vary according to moisture content, weather, and tree species (Howden and Vogt 1951). Previous studies detailing succession were conducted on entire standing, severed trees and used passive and pheromone traps to assess which insect species were present (Hines and Heikkinen 1977, Ferrel 1971). This method is certainly useful, but these indirect methods of detection and collection seem inaccurate (Cronin et al. 2000). A more direct approach is desired.

A unique collection method for beetles conceived by coleopterist Karl Stephan involving felling a living tree and cutting it into stackable disks which could be examined for beetles. A standardization of this collection method was used to study beetle succession on felled loblolly pines (*Pinus taeda* L.) and southern red oaks (*Quercus falcata* Michx.) by documenting beetle arrival and residency. This study took place in Louisiana where loblolly pines and southern red oaks are of great economic importance.

MATERIALS AND METHODS

- Field site Feliciana Preserve (150 acres), West Feliciana Parish, LA, represents southern mixed mesophytic hardwood forest.
- Six trees of each species were felled during October 2004 and April 2005 for a total of 24 trees sampled from October 2004 – September 2005.
- Four 48-inch bolts were cut from each felled tree.
- Each bolt was further cut into eight six-inch sections, reassembled in proper order, and positioned standing upright.
- Each section was labeled and realigned with triangular-shaped flashing.
- Insects were aspirated from the interfaces of sections one a week for the first month and then monthly for the duration of the study.
- Beetle specimens from each sample were counted and identified.

RESULTS

Beetles rapidly colonized the felled trees. A species checklist of accumulated and processed Coleoptera from the sample months October 2004 – March 2005 is presented in Table 1. A total of 85 taxa were collected from the trees in this study. Of this total, 28 species (32.9%) were collected from both loblolly pine and southern red oak. Species richness was higher on oak than pine, 66 species (77.6%) and 47 species (55.2%), respectively. There were 38 species (44.7%) found in oak alone while only 19 species (22.3%) were found only on pine.

The most species-rich family is **Staphylinidae** (19 taxa; Fig. 2), followed by the **Nitidulidae** (9 taxa; Fig. 3), **Zopheridae** (9 spp.; Fig. 4), and **Histeridae** (7 spp.; Fig. 5). Fungivores were the most species-abundant functional group represented in both types of wood, followed by predators, with wood boring beetles surprisingly infrequent in our samples.

The species accumulation curves (Fig. 1) show that species richness is consistently higher on oak than pine. The subparallel slopes indicate that the differences in species richness are due to tree species rather than temporal effects.

Fig. 1 Species Accumulation Curves

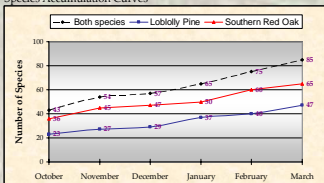


Table 1. Species Checklist

Indigo = Loblolly pine species; Red = Southern red oak species; Black = shared species

Family	Species	Family	Species
Amblyderidae	<i>Eurypus murmurens</i> (Olivier)	Coleoptera	<i>Coleopterus niger</i> (Say)
Biphylidae	<i>Diplolepis rufus</i> (Le Conte)		<i>Coleopterus semitectus</i> (Say)
	<i>Cymidichne</i> sp. (new species)		<i>Coleopterus transatlanticus</i> Randall
	<i>Meligethes fuscicornis</i> (Say)	Nitidulidae , cont.	<i>Coleopterus sinicola</i> (Say)
Carabidae	<i>Mochtherus tetraspilotus</i> (MacLeay)		<i>Eparus erichsoni</i> Reitter
	<i>Pezomachus submarginatus</i> (Say)		<i>Eparus transatlanticus</i> Marseus
	<i>Phloeotanus signatus</i> (Dejean)		<i>Promethopis sermuntulata</i> (Say)
Cerylonidae	<i>Cerylon umicola</i> (Ziegler)	Philiidae	<i>Morphosphecus</i> 4
	<i>Phloeotanus subglaber</i> (Le Conte)	Hydrophilidae	<i>Hydrophilus</i> sp. (new species)
Corylophidae	prob. <i>Corylophus</i> sp.	Sitonaidae	<i>Sitona muticus</i> Sharp
Cucujidae	<i>Pediacus subglaber</i> Le Conte		<i>Microphecodes</i> 5
	<i>Microphecodes</i> 1		<i>Microphecodes</i> 6
	<i>Microphecodes</i> 2		<i>Albeta</i> sp.
	<i>Cosmus</i> sp.		<i>Belomachus rufipennis</i> (F.)
	<i>Dendrotarsus laevipes</i> (Olivier)		<i>Ceprenurus</i> sp.
Curculionidae	<i>Eupallipes compressus</i> (Say)		prob. <i>Cyphus</i> sp.
	<i>Hyalestus tenuis</i> Eichhoff		<i>Habitus</i> sp.
	<i>Xylotermus sabulosus</i> (Ratzeburg)	Staphylinidae	<i>Hamatolus</i> prob. <i>Diamus</i> sp.
	<i>Ampelus</i> sp.		<i>Lantidolus latellus</i> (Say)
	<i>Melanotus</i> sp.		<i>Leptusa</i> sp.
	<i>Dumetia angustata</i> (Rehnwaldt)		<i>Hamatolus</i> sp. (new species)
	<i>Microphecodes</i> 3		<i>Myrmecoclypeus</i> sp.
	<i>Rhizophagus angustatus</i> Lechen & Carlton		<i>Naryctus tenuis</i> (Le Conte)
	<i>Rhizophagus umicola</i> (Ziegler)		prob. <i>Omalium</i> sp. (new species)
	<i>Adetes simplex</i> (Le Conte)		<i>Platycus</i> sp.
Endomychidae	<i>Peromachus semivittatus</i> (Erichson)		<i>Platycus</i> sp.
	<i>Platycus curvicauda</i> Le Conte		<i>Staphylinus</i> sp.
	<i>Platycus lecontei</i> Marsden		<i>Thanaosiphus costalis</i> (Erichson)
	<i>Platycus parallelus</i> Say		<i>Xantholinini</i> Gen. sp.
	<i>Platycus</i> sp. (new species)	Tenebrionidae	<i>Platycus</i> sp. (new species)
	<i>Phloeotanus nigropunctatus</i> (Lottave)		<i>Tenebrionella</i> sp. (new species)
	<i>Phloeotanus chrysogaster</i> (Schwarz)		<i>Tenebrionella</i> sp. (new species)
	<i>Phloeotanus</i> sp. (new species)	Trogossitidae	<i>Trogossita</i> sp. (new species)
	<i>Phloeotanus zimmermanni</i> (Le Conte)		<i>Trogossita</i> sp. (new species)
Laemophloeidae	<i>Aquidulius</i> sp.	Zopheridae	<i>Zopherus</i> sp. (new species)
Leiodidae	<i>Aquidulius</i> sp.		<i>Zopherus</i> sp. (new species)
Meinuridae	<i>Meinurus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
Monotomidae	<i>Monotomus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
	<i>Rhizophagus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
Mycetophagidae	<i>Mycetophagus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
	<i>Mycetophagus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
Nitidulidae	<i>Morphosphecus</i> 3		<i>Zopherus</i> sp. (new species)
	<i>Corylophus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)
	<i>Corylophus</i> sp. (new species)		<i>Zopherus</i> sp. (new species)

Species of Interest

Carabidae: *Mochtherus tetraspilotus* (MacLeay) (Fig. 9)

Many carabids are known to be predators and this species is no exception. It can be distinguished by the setulose pronotum that is wider than the head, the elytra each with two pale orange spots, and with elytral interval 3 with two punctures (Choate 2001). *Mochtherus*, 7mm, has been seen scurrying around on recently felled logs (Darlington 1968; Choate 2001). The single specimen obtained in this study was collected on loblolly pine two weeks after felling. *Mochtherus tetraspilotus* is native to Japan, Burma, Philippines, Laos, Taiwan, Borneo, Java, Ceylon, India (Jedlicka 1963, Habu 1967), Sri Lanka (Bengtson 2005), and Australasia (Calder 2002). The first United States collections were in 1992 from Palm Beach Co., Highlands Co., and Alachua Co., FL (Choate 2001). This study confirms that this species has expanded its range into Louisiana.

Cucujidae: *Pediacus subglaber* Le Conte (Fig. 8)

These beetles are ~5mm, elongate, parallel-sided, and dorsoventrally flattened. Unlike other cucujids, the temples are absent or represented at most by a small denticle. Whereas most North American *Pediacus* species are distributed in the west, *P. subglaber* is found in the east (Thomas 2004). This represents a new state record for Louisiana.

Elateridae: *Drapetes quadripustulatus* Bonvouloir (Fig. 7)

Distinguishing characteristics include total length ~4mm, serrate antennae, simple claws, tarsomeres 1-4 with membranous ventral lobes, black prothorax, and black elytra each with a pair of red spots. This species is reported from TX, WI, MD, and FL. Our research has helped to establish that it is now distributed in Louisiana as well (Thomas 1995).

Endomychidae: *Microphecodes lundgreni* Lechen & Carlton (Fig. 6)

Known distribution of this minute (1-1.2mm) spherical handsome fungus beetle includes FL, LA, and TN. Lechen and Carlton (2000) give a complete species description. The sampled specimens from southern red oak at the Feliciana Preserve add to the few specimens previously collected.

DISCUSSION

Characteristics of each tree species affects the arrival rate and host selection of colonizing beetles. Fine species exuding oleoresin are able to "pitch out" and impede attacking beetles. Thus species richness is expected to be low compared to southern red oak, which produces less resin. Oaks have higher moisture content than pine and are thus able to support a greater abundance of fungi, a common food source for saproxylic coleoptera. Previous work on standing dead trees used passive traps such as emergence and sticky traps to collect insects. The study design employed here targets the species that are actually occupying the sampled tree. The results have increased the number of species known to inhabit recently dead loblolly pine and southern red oak, two economically important tree species. Timing of insect arrival, especially known injurious pest species, can help timber managers to develop pest management strategies and better work schedules, particularly when trees must be harvested but can not be collected until a later date. Further comparable and especially long-term studies are needed to estimate succession patterns comprehensively and to supplement investigations into the importance of coarse woody debris in forests.

LITERATURE CITED

Bengtson, S. 2005. Coleoptera. Lund University's Museum of Entomology. Available at: <http://www.biotaxa.uu.se/entomology/Species/VetSamZooEnt/col/col04008.html>

Calder, A. A. 2002. Group: ADEPHAGA. Australian Faunal Directory Checklist Output. Available at: <http://www.dah.gov.au/cgi-bin/abs/austratree.pl?pr=Vol:ADEPHAGA&prM=col1>

Choate, M. M. 2001. A new ground beetle, *Mochtherus tetraspilotus* (MacLeay) in Florida (Coleoptera: Carabidae: Lebiini). Entomology Circular No. 404. Fla. Dept. Agric. & Consumer Services, Division of Plant Industry, Gainesville, FL, 2p.

Cronin, J. T., J. L. Hayes, and P. Harkin. 2000. Evaluation of traps used to monitor southern pine beetle aerial populations and sex ratios. Agricultural and Forest Entomology 2: 68-76.

Darlington, F. J., Jr. 1968. The Carabid beetles of New Guinea Part III. Harpalinae (Continued). Perigone to Pseudomorphini. Bulletin Museum Comparative Zoology 137: 1-253.

Ferrel, C.T. 1971. Host selection by the fungivore, *Scaphisoma* (Coleoptera: Scolytidae). Preliminary field studies. The Canadian Entomologist 103: 173-175.

Habu, A. 1967. Fauna Japonica. Carabidae: Transpaciferae Group. (Insecta: Coleoptera) Biogeographical Society of Japan. Tokyo Electrical Engineering College Press, pp. 338 p., 27p.

Hines, J. W., and H. J. Heikkinen. 1977. Beetles Attracted to Severed Young Pine (*Pinus virginiana* Mill.). Environmental Entomology 6: 123-127.

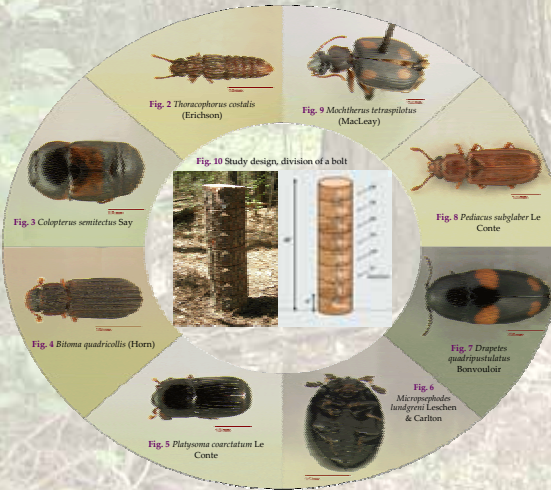
Howden, H. F., and C. B. Vogt. 1951. Insect Communities of Stranded Dead Pine (*Pinus virginiana* Mill.). Annals of the Entomological Society of America 44: 381-395.

Jedlicka, A. 1968. Monographie der Transpaciferae aus Ostasien. Lebiinae - Odoxichinae - Brachyninae (Coleoptera, Carabidae). Entomographische Abhandlungen und besuche aus dem Staatl. Museum für Tierkunde in Dresden 28:269-368.

Lechen, R. K. B., and C. E. Carlton. 2000. A new species of *Microphecodes* from Southern United States (Coleoptera: Endomychidae: Acanthophrinae). Coleoptera Bulletin 54: 232-238.

Thomas, M.C. 1995. Family Elateridae. A Distributional Checklist of the Beetles (Coleoptera) of Florida. Available at: <http://www.fica-dip.org/Coleoptera/Mkdelater.htm>

Thomas, M.C. 2004. A revision of *Pediacus* Stuckard (Coleoptera: Cucujidae) for America north of Mexico, with notes on other species. Insecta Mundi 17: 137-177.



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