



Life History of the Small Oak Bark Beetle, *Pseudopityophthorus minutissimus*, Associated with Oak Wilt Killed Trees in Minnesota



Angie Ambourn¹, Jordan Eggers², and Jennifer Juzwik²

¹University of Minnesota, Department of Entomology and ²USDA Forest Service St. Paul and University of Minnesota, Department of Plant Pathology

INTRODUCTION

Oak wilt, caused by the fungus *Ceratocystis fagacearum*, is spread overland by insect vectors. Sap beetles (Coleoptera: Nitidulidae) and oak bark beetles (Coleoptera: Scolytidae) have been implicated as vectors in different parts of the Eastern U.S. (Figure 1) (Rexrode, 1968; 1965).

The role and importance of sap beetles as vectors in Minnesota have been documented, but the role of the small oak bark beetle *Pseudopityophthorus minutissimus* Zimm, is unclear. The life history of this insect has been studied in Wisconsin (McMullen et al., 1955) and Ohio (Rexrode, 1965; 1969) but not in Minnesota.

Field and laboratory studies were conducted in 2003 to:

- Determine seasonal flight activity and emergence times of *P. minutissimus* in Minnesota,
- Determine when and what rates emerging and dispersing beetles are carrying *C. fagacearum*, and
- Summarize the life history of *P. minutissimus* in Minnesota.



Figure 1. Overland spread of oak wilt

MATERIALS AND METHODS

1. Seasonal Flight Activity

a. Sites: 4 oak wilt centers in Carlos Avery Wildlife Management Area (CAWMA) near Stacy, Minnesota.

b. Traps and Trees: 3 trees per site were equipped with 2 canopy window traps per tree and were installed by a professional tree climber and emptied weekly from 28 April-15 Sept. (Figure 2)

c. Sample Processing

- Insects were sexed (yellow tufts of hair on the head were used as indicators to identify males).
- Insects were stored in a freezer in micro-centrifuge tubes in groups of 5.
- Serial dilutions were conducted on groups of 5 insects to isolate for *C. fagacearum*. Males and females were assayed separately.

2. Beetle Emergence

a. Sites: In May we sampled 5 oak wilt centers in CAWMA and in August we sampled 5 oak wilt centers in CAWMA and one in Blaine, MN.

b. Trees and Sample Collection: Trees sampled in May had wilted late in 2002 and had evidence of *P. minutissimus* presence. Cambial, bark, crown condition and emergence holes were used as indicators as to when the tree wilted. Eighteen trees were examined and samples collected from 9. Two branch samples per tree were collected by a professional tree climber. Trees sampled in August were similar to those sampled in May. The presence of larvae, pupae, and adults were used as indicators for selecting sample material (Figure 3). Eighteen trees were examined and samples collected from 12. Trees were felled and 2 branch samples were collected per tree as pupation occurred.

c. Sample Processing

Samples were placed in emergence boxes built according to Browne, 1972, until insects emerged. Sex determination, storage, and fungal isolation protocol was the same as in 1c.

3. Observational Data: Life stages were recorded 12 times throughout the summer while other quantitative data were gathered from 10 April - 11 August.



Figure 2. Canopy window trap



Figure 3. Adult *P. minutissimus* in galleries, ready to emerge.

RESULTS

Window Trap Data : *P. minutissimus* Seasonal Flight Activity and Fungal Isolations

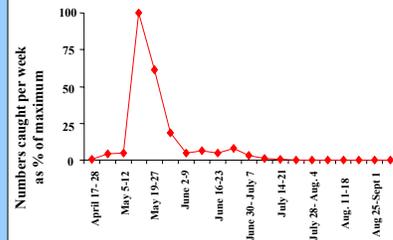


Figure 4. Proportion of adults oak bark beetles trapped during 7-11 day intervals between 17 April and 25 September, 2003

- Peak catch occurred 12-19 May (869 total beetles)
- Total trap catch for the season was 1099 females and 752 males (1.5:1 ratio)

Table 1. Frequency of *C. fagacearum* (CF) isolation from groups of *P. minutissimus* caught in window flight traps in oak wilt killed red oaks*

Month	Fungal Isolation Data		
	No. groups Assayed**	No. groups yielding CF	Ave. No. cfu/group*** (x 10 ³)
April	1	0	0
May	282	6	15
June	120	8	3.7
July	15	0	0
August	0	0	0
September	1	0	0

*Based on 24 traps (see materials and methods). **Five adult beetles per group. ***Number of colony forming units of fungus per group. CFUs are mostly likely to be obtained from 1 or 2 beetles per group.

P. minutissimus Emergence Data

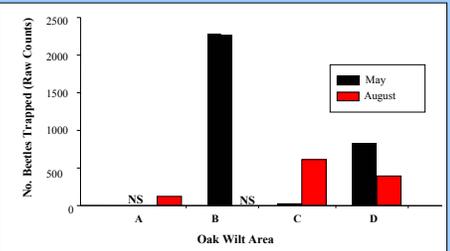
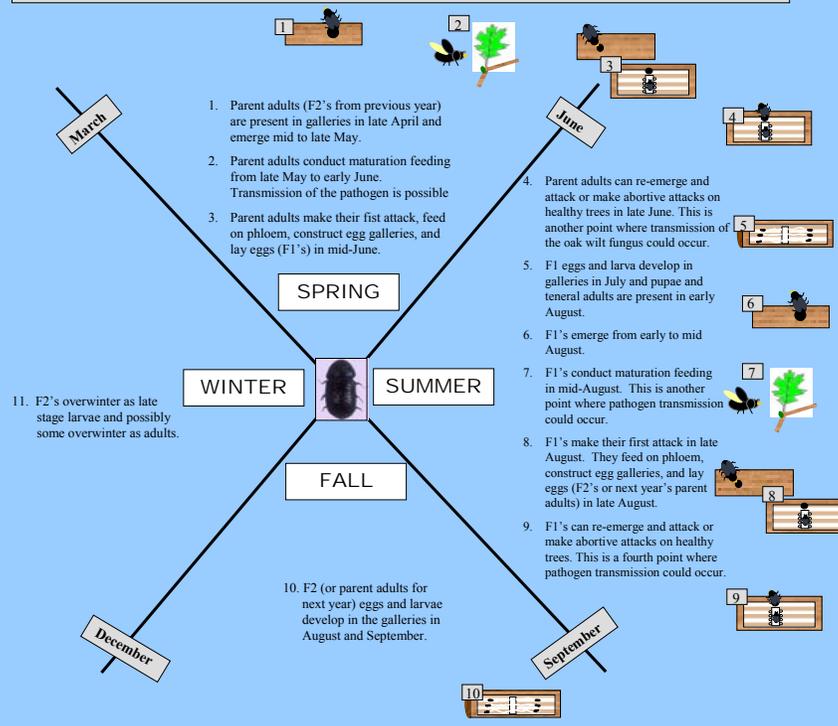


Figure 5. Numbers of oak bark beetles emerging from branches of oak wilt infected trees collected in May or August, 2003 from 4 oak wilt areas. (NS = not sampled). Note: Number of oak wilt centers sampled per area varied from 1 to 4 and number of branches used per area ranged from 2 to 10.

182 groups of 5 were assayed in the spring and 183 in the fall. No beetles assayed carried the fungus.

Figure 6. Oak Bark Beetle Life Cycle - Based on Field Observations and Literature



DISCUSSION AND CONCLUSIONS

- Seasonal Flight Activity:** There is a peak in *P. minutissimus* flight that occurs in mid-May. In 2003, peak flight occurred from May 12-19 in Minnesota, which corresponds to findings in Wisconsin. We suspect there is a 2nd peak in August based on emergence traps, field observations, and literature; however, our window traps did not catch this second dispersal period.
- Generations Per Year:** Based on seasonal flight activity, emergence traps and branch sampling, there are 1.5 generations per year in Minnesota, which differs from literature about Wisconsin and Ohio. (Figure 6). **Overlap of generations** is common starting in July, making it difficult to study life history. Teneral adults were present as early as 10 April (Figure 4). Sex ratio is approximately 1.5:1 female:male in Minnesota (Figure 4).
- Attacking and breeding** is common in trees infected with *C. fagacearum*. Trees wilting in May and June produce F1's (1st generation of current year) in early August of the same year. Trees wilting in July-September produce parent adults for the following May (Figure 6 and 7).
- Oak Bark Beetles Carrying *C. fagacearum*:** Emerging adults beetles in the spring and summer were not found to carry the oak wilt fungus. Free flying *P. minutissimus* were carrying the fungus on or in their bodies in spring and early summer in Minnesota (Table 1).
- Further Study:** We do not know when and where free flying oak bark beetles pick up spores of *C. fagacearum*. It would also be useful to know the timing of beetle emergence in relation to the time colonized trees wilt and how that overlaps with the time when free flying beetles are carrying the fungus.

ACKNOWLEDGMENTS

S. Burks, Minnesota DNR, St. Paul, MN, and M. Mielke, USDA Forest Service, State and Private Forestry for logistical and financial support. Dan Rhode, Carlos Avery Wildlife Management Area, Minnesota DNR, Paul Castillo, Colin Haverkamp and Wendy Francesconi, USDA Forest Service, St. Paul, MN Tom Dunlap, Canopy Tree Care and Chad Brey, Tree Climbing Team USA for field assistance.

Funding for this project provided by the USDA Forest Service Fire Evaluation Monitoring Project Grant #01-DG-1124425-264