N O T E

Predation of an Ambrosia Beetle (Coleoptera: Platypodidae) by a Checkered Beetle (Coleoptera: Cleridae) Congregating on Pines Containing Brood Adult Southern Pine Beetles (Coleoptera: Curculionidae)[1]

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In the southern United States, *Thanasimus dubius* (F.) is a primary natural enemy of the southern pine beetle, *Dendroctonus frontalis* Zimmermann. Adults feed on adult *D. frontalis* on the bark surface, whereas the larvae feed on *D. frontalis* larvae beneath or in the bark. This predation may have a significant impact on *D. frontalis* population fluctuations (Reeve 1997, Oecologia 112: 48-54). *Thanasimus dubius* often are observed on trees under attack by *D. frontalis*, with peak abundance occurring 4-11 days following attack initiation (Camors and Payne 1973, Environ. Entomol. 2: 267-270). However, the life cycle of *T. dubius* is longer than that for *D. frontalis*, plus they may undergo a prolonged diapause (Reeve 2000, Agric. For. Entomol. 2: 233-240). Therefore, large numbers of *T. dubius* may not be evident until a *D. frontalis* outbreak is well established.

A widespread southern pine beetle outbreak occurred in east Texas in the early 1990s, peaking in 1992 (Clarke and Billings 2003, South. J. Appl. For. 27: 122-129). Large infestations developed in wildernesses on the National Forests in Texas because *D. frontalis* suppression in these areas was restricted. The growth of these infestations was monitored at least weekly. In late 1993, as spot expansion slowed, *T. dubius* were observed not only on trees currently under attack by *D. frontalis*, but also on pines that had been infested for several weeks. These pines had been attacked secondarily by an ambrosia beetle, *Platypus flavicornis* (F.). These beetles colonize dying pines, and in *D. frontalis* infestations their peak landing occurs 10 d after *D. frontalis* attack (Coster 1969, Ann. Entomol. Soc. Amer. 62: 1008-1011). Adult *P. flavicornis* bore into the heartwood, usually within 1 m of the root collar, and their presence is characterized by an accumulation of white, powdery boring dust around the base of the tree. Adult *T. dubius* were seen crawling through this boring

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dust, preying on adult *P. flavicornis*. Though *T. dubius* preys on a wide range of bark beetles, including species of *Ips*, *Dendroctonus*, and *Hylastes* (Erbilgin and Raffa 2001, Entomol. Exper. et Appl. 99: 205-210), it has not previously been reported as a predator of *P. flavicornis*.

The distribution of *T. dubius* on trees attacked by *P. flavicornis* did not appear uniform. Many infested trees with large accumulations of boring dust and with *P. flavicornis* present had no detectable *T. dubius* activity. A check of the *D. frontalis* brood stage within the bark at 1 m revealed that *T. dubius* were congregating on trees containing *D. frontalis* brood adults. However, few *T. dubius* were observed on the bark, rather most were at the base of the trees feeding on *P. flavicornis*. Pines with *D. frontalis* late larval or pupal stages had very few *T. dubius*, and trees vacated by *D. frontalis* had none. We implemented a study to determine if *T. dubius* were selectively feeding at trees with specific *D. frontalis* brood stages.

The study was conducted in November and December 1993 in large *D. frontalis* infestations in the Indian Mounds Wilderness and Turkey Hill Wilderness. At both infestations, the boring dust around pines with current *P. flavicornis* activity was examined and the trees classified as having *T. dubius* either present or absent. A *D. frontalis* emergence trap was installed on each study tree. The traps were constructed from a 100 × 12 × 6.5 cm section of polyvinyl rain gutter (Fred Stephen, U. Arkansas, pers. comm). The large end of a 15-cm plastic funnel was glued over the open end of the gutter. The spout of the funnel was inserted in a hole drilled in the cap of a 250-ml polyethylene bottle and glued. Sixteen holes (ten 3 cm and six 5.5 cm) were drilled in the trap and covered with saran screening to allow air circulation within the trap. Foam padding was glued around the outer edge to allow traps to fit snugly against the bark and reduce the possibility of beetle escape. A collection bottle half filled with a propylene glycol-water mix was screwed into the cap on the bottom of the trap. The traps were secured vertically to the tree using four 20-cm wood screws, with the collection bottle approx. 0.67 m above the ground. Traps were attached to 3 trees per class in Indian Mounds, and to 2 trees per class in Turkey Hill. The traps were left in place from 11-30 November in Indian Mounds. In Turkey Hill, traps were run from 30 November through 7 December, and then 4 new trees were selected and trapped from 7-21 December. Collections were made at the end of each trapping period. The number of *D. frontalis* and *T. dubius* collected per tree was counted. The counts were transformed using LOG(Y + 1), and an unpaired *t*-test was used to check for significant differences between the two classes (GraphPad Software. 2005. San Diego, CA).

In general, higher numbers of emerging *D. frontalis* were collected from trees with *T. dubius* actively preying on *P. flavicornis* than from trees without noticeable *T. dubius* (Table 1). When the results were pooled, this difference was significant ($t = 3.799$; $df = 12$; $P = 0.0025$). There was no significant difference in the number of *T. dubius* collected ($t = 1.855$; $df = 12$; $P = 0.088$). Given the longer development times for *T. dubius*, it is probable that the *T. dubius* collected were not emerging adults, but were already present and hiding in bark crevices at the time of trap installation. Only one *Ips* bark beetle adult was collected in the traps.

Adult *T. dubius* are attracted to aggregation pheromones produced by their prey, such as ipsdienol, ipsenol, and frontalin (Mizell et al. 1984, J. Chem. Ecol. 10:177-187; Raffa and Klepzig 1989, Oecologia 80: 566-569). Male *P. flavicornis* produce an aggregation pheromone containing sulcatol plus 1-hexanol and/or 3-methyl-1-butanol (Renwick et al. 1977, Naturwissenschaften 64: 226). The unequal distribution of *T.*

Table 1. Emergence trap catches of *Dendroctonus frontalis* (SPB) and *Thanasimus dubius* on pines attacked by SPB and the ambrosia beetle *Platypus flavicornis* in Indian Mounds and Turkey Hills wildernesses, TX, 1993*

Location and trapping dates	*Thanasimus dubius* activity	Number SPB collected	Number *T. dubius* collected
Indian Mounds 10-30 Nov.	Present	61	10
	Present	1	1
	Present	70	7
	Absent	1	0
	Absent	5	2
	Absent	5	0
Turkey Hill 30 Nov.-7 Dec.	Present	9	0
	Present	22	1
	Absent	0	0
	Absent	0	0
Turkey Hill 7-21 Dec.	Present	9	0
	Present	16	0
	Absent	0	0
	Absent	1	0

* Half the study trees had *T. dubius* noticeably preying on *P. flavicornis* at the base of the tree, while the other half did not.

dubius on trees attacked by *P. flavicornis* suggests that these pheromones elicited no kairomonal response by *T. dubius*.

There was no indication that bark beetles were currently attacking the trees and producing aggregation pheromones that might have attracted *T. dubius*. *Dendroctonus frontalis* and secondary beetles such as *Ips* spp. had completely colonized the pines to near the base of the tree, so there appeared to be no fresh phloem available for attack. Alternatively, *T. dubius* may have been attracted to kairomones released by preemergent and emerging *D. frontalis* brood. *Dendroctonus* spp. generally possess primary pheromones upon emergence (Smith et al. 1993, VA Agric. Exp. Sta. Bull. 93-4). Though no studies have been conducted to ascertain if *D. frontalis* release pheromones just prior to or at emergence, our results indicate that this possibility should be explored. This attraction to emerging *D. frontalis* may be discernable only when *T. dubius* populations are high (near the end of *D. frontalis* outbreaks), in large infestations, and/or when spot expansion subsides and fresh *D. frontalis* attacks diminish.

Though *T. dubius* are attracted to a specific habitat (a bark beetle-infested tree), they function as generalist feeders once reaching this habitat (Aukema et al. 2004,

Oecologia 139: 418-426). As implied by our trap catch, some *T. dubius* may congregate on bark containing *D. frontalis* brood adults and prey on them as they emerge. However, *T. dubius* attracted to emerging *D. frontalis* may switch to attacking *P. flavicornis* if they are relatively more plentiful. *Thanasimus dubius* are active in the morning and evening, and typically hide in the duff at the base of trees at other times (Dixon and Payne 1979, Environ. Entomol. 8: 178-181). This behavior may present them with the opportunity to easily locate and prey on *P. flavicornis.* Plans to further investigate attraction of *T. dubius* to emerging *D. frontalis* and to document their prey items were disrupted by the collapse of the *D. frontalis* outbreak in early 1994.

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