Reproduction, feeding, and ecology of predatory flat bark beetles in a scolytine-infested agricultural landscape

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ABSTRACT

The Kona coffee growing region of the Big Island, Hawai`i, has two main scolytid pests that infest crops. Coffee berry borer (*Hypothenemus hampei*) damages coffee beans and tropical nut borer (*Hypothenemus obscurus*) infests macadamia nut. Pesticides are only effective if the scolytid has not bored into the bean or nut, making management of infestations challenging. Silvanid and lined flat bark beetles, *Cathartus quadricollis* and *Leptophloeus* sp., are common predators of scolytid bark beetles and could be effective in reducing pest populations, especially between harvesting and spraying months. Ecology and reproduction in the field was previously unknown.

- Flat bark beetle larvae were not found in high abundance in coffee, and therefore, coffee may not be a sufficient host plant in supporting source populations to suppress borers effectively
- Plants in the agricultural landscape were sampled, including macadamia nut *(Macadamia integrifolia*). We found all life stages of flat bark beetles in macadamia nut sticktights, making it an important reproductive plant host for flat bark beetles
- Plants in the Fabaceae family common to the region support populations of *Leptophloeus* sp.


Coffee berry borer (CBB)


CBB entrance hole in a ripe coffee cherry


Tropical nut borer (TNB)


TNB damage in a mac nut

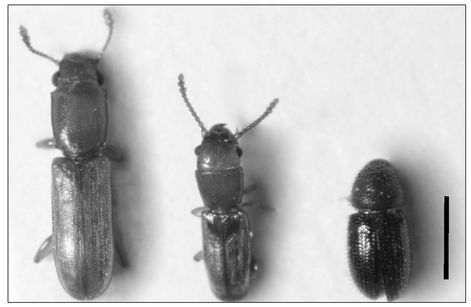
PREDATION IN COFFEE

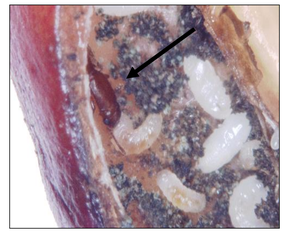
- In both choice and no-choice laboratory feeding assays, both species of flat bark beetles consumed eggs, larvae, and pupae of coffee berry borer
- Molecular markers were developed to determine cryptic feeding on coffee berry borer by flat bark beetles using species-specific primers from CO1 region sequences
- CBB DNA was detected in both species from field collections on 5 farms

Farm	1	2	3	4	5
N = *C. quadricollis* (proportion with CBB DNA)	5 (40%)	4 (25%)	5 (20%)	0	0
N = *Leptophloeus* sp. (proportion with CBB DNA)	19 (89%)	15 (60%)	14 (0%)	20 (30%)	19 (37%)

Presence of CBB DNA was determined through presence of PCR product amplified by CBB-specific primers. Table adapted from Sim et al. (2016)

From left to right: *C. quadricollis*, *Leptophloeus* sp., and coffee berry borer. Scale bar = 1mm

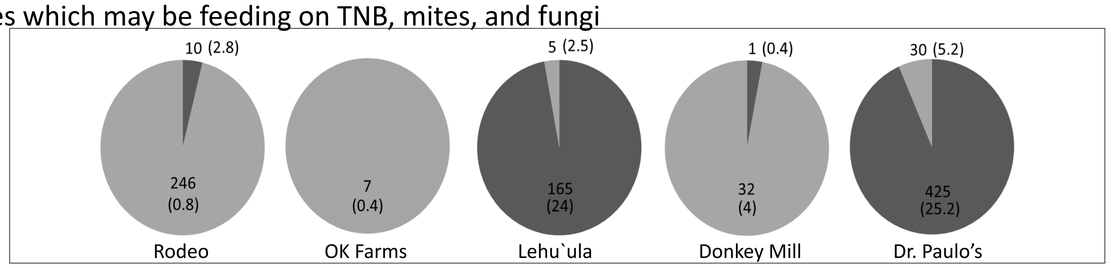



C. quadricollis chewing on a CBB larva

REPRODUCTION IN MACADAMIA NUT

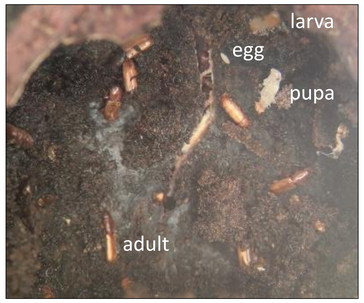
Sampled 5 farms, 20 macadamia trees per farm, 25 infested sticktights per tree, and 25 infested ground nuts per tree (N = 5000 mac nuts)

- All life stages of flat bark beetles found in some sticktights, both species found
- <1% beetles found in ground nuts → reproduction occurs in sticktights in the tree
- TNB causes initial borer hole and damage to sticktight – allows entryway for predatory flat bark beetles which may be feeding on TNB, mites, and fungi



Total abundances of adult *C. quadricollis* (dark grey) and *Leptophloeus* sp. (light grey) found in sticktights per farm (% total sticktights that contained FBB)

Sticktights – old macadamia nuts that have not fallen and remain on the tree



All life stages of *C. quadricollis* inside a sticktight

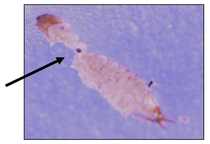
ONGOING STUDIES

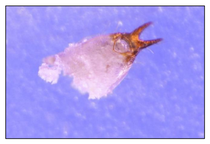
- Sleeve cage trials to determine impact on CBB populations and rate of predation by flat bark beetles
- Develop species-specific primers for coffee berry borer, tropical nut borer, and black twig borer (*Xylosandrus compactus*) using Lep F-1/R-1 primers to molecularly detect predation on different farms and landscapes

Serial dilution of starting concentration of 2ng/uL; can detect very low concentrations of DNA for all three species

- Do *C. quadricollis* and *Leptophloeus* sp. eat each other? Hyperpredation studies underway. So far, *C. quadricollis* adults ate *Leptophloeus* sp. larvae in 16 out of 20 trials

"Sharkbite" caused by a *C. quadricollis* adult feeding on a *Leptophloeus* sp. larva




Only the cerci of a *Leptophloeus* sp. larva is left after being placed with a *C. quadricollis* adult

OTHER HOST PLANTS, FAMILY FABACEAE

- *Leptophloeus* sp. larvae and adults and *C. quadricollis* adults were found in seed pods of koa haole (*Leucaena leucocephala*)
- *Leptophloeus* sp. adults were also found in seed pods of scrambled egg plant (*Senna* sp.), ice cream bean (*Inga* sp.), and monkeypod (*Samanea saman*)
- Other scolytids found in these plants: *Hypothenemus birmanus* (Eichoff), "kiawe scolytid"


Hypothenemus birmanus


Leucaena leucocephala

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