

SCIENTIFIC NOTE

Attraction of Lacewings (Neuroptera: Chrysopidae) to Methyl Eugenol in Asia

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Abstract. The attraction of *Ankylopteryx anomala* (Brauer) (Neuroptera: Chrysopidae) to the fruit fly male lure methyl eugenol was observed during fly surveys in Cambodia, Laos, Nepal, Taiwan, and Thailand. All of the 622 adults attracted to the lure were male.

Green lacewings (Neuroptera: Chrysopidae) are known to be attracted to food lures and male kairomone lures used to monitor and control pest fruit flies (Diptera: Tephritidae) (Szentkirályi 2001). During studies on nontarget species attraction to food lures in Greece, Mexico, Guatemala, Texas, and Hawaii, nectar and pollen-feeding adult lacewings were drawn to traps baited with protein hydrolysate, torula yeast, and BioLure (Neuenschwander et al. 1981, Thomas 2003, Martinez et al. 2007, Conway and Forrester 2007, Leblanc et al. 2010), but no carnivorous species were attracted to these food lures. Methyl eugenol, a powerful kairomone lure for males of many species of *Bactrocera* (Tephritidae: Dacinae), also attracts several species of lacewings: *Mallada basalis* (Walker) in Hawaii (1.6 per trap per day, males and females) (Suda and Cunningham 1970), *Cunctochrysa* probably *albolineata* (Killington) in the Philippines (2.7 per trap per day, sexes not reported) (Umeya and

Hirao 1975), and *Ankylopteryx anomala* (Brauer), referred to until very recently as *A. exquisita* (Nakahara) (Breitkreuz et al. 2015), in Japan (large numbers, all male, at night from July to October, and most abundantly in July) (Tsukaguchi 1995), and Taiwan (as many as 52.9 per trap per day, sexes not reported) (Pai et al. 2004). The closely related compound eugenol was also found to attract *Glenochrysa* sp. (up to 4.8 per trap per day, sexes not reported) in Malaysia (Sajap et al. 1997).

In a comprehensive survey of nontarget attraction to methyl eugenol in Hawaii, Leblanc et al. (2009, 2013) determined that the lure attracted six species in four orders across broad range of unrelated families: Apidae, Crambidae, Nitidulidae, Scarabaeidae, and Syrphidae. All these species had the common habit of visiting flowers and feeding on pollen and/or nectar. On that basis, Leblanc et al. (2009) suggested that methyl eugenol possibly emulates a floral chemical component. Methyl eugenol is actually commonly found in flower

blossoms of numerous species of plants (Tan and Nishida 2012). Additionally, females of one species of endemic Hawaiian Sciaridae (Diptera) were attracted to methyl eugenol, even though conspecific males and females and males of several other sciarid species were common at the trapping sites (Leblanc et al. 2009). The specific nature of this attraction, floral kairomone or possible emulation of pheromone, is not known. Because the lacewing species attracted to methyl eugenol cited above are all known to be palyno-glycophagous, feeding on flower pollen, nectar and honeydew (Tjeder 1966, Brooks & Barnard 1990, Tsukaguchi 1995, Canard 2005, Chang and Hsieh 2005), Leblanc et al. (2009) suggested an attraction to methyl eugenol as a floral compound for the lacewings. However, this conclusion overlooked Tsukaguchi's (1995) earlier findings of attraction to methyl eugenol by male *A. anomala* from the Yayema Islands of Japan.

Here, we confirm Tsukaguchi's report on *A. anomala*, and we extend the observation to a broad range of *A. anomala* populations in Asia. We collected lacewings in bucket traps baited with 2-gram plugs of methyl eugenol (Leblanc et al. 2015) maintained for a few days in February 2011 in Laos (Luang Nam Tha Province), Cambodia (Koh Kong Province), and Thailand (Chiang Mai Province), during July 2014 in Taiwan (Chaiyi, Nantu, Pingtung, and Taitung Counties), and May 2015 in Nepal (Nawalparasi District). Total numbers of lacewings collected were 143 specimens among 18 of the 24 trapping sites in Laos (3.0 ± 4.6 SD per trap per day), 12 specimens among 7 of the 22 sites in Cambodia (0.4 ± 0.7 per trap per day), 1 at each of 2 sites out of 14 sites in Thailand (0.07 ± 0.18 per trap per day), 444 among 45 of 113 sites in Taiwan (2.0 ± 4.2 per trap per day), and 19 among 2 of 5 sites in Nepal (0.6 ± 0.8 per trap per day). All specimens

were identified as *Ankylopteryx anomala* (Figure 1). As in Tsukaguchi's (1995) study, all our specimens were males. The differences in mean numbers of insects attracted to the lure, and large numbers reported in Taiwan and Japan, are probably reflective of local lacewing density, rather than differential attractiveness of the lures.

Ankylopteryx anomala has been reported from Japan, Taiwan, and Thailand (Oswald 2013). Our record from Nepal therefore represents a significant range extension for the species, also very recently reported by Breitreuz et al. (2015). Moreover, our samples show that the male-biased attraction to methyl eugenol is a consistent characteristic of that species throughout its known range of distribution. Interestingly, in Taiwan *A. anomala* occurs in sympatry with a closely related, sympatric species, *Ankylopteryx gracilis* (Nakahara), and this latter species is not attracted to methyl eugenol (Tsukaguchi 1995). These sex-related, interspecific differences in attraction are consistent with methyl eugenol possibly acting as a pheromone analogue or used as a precursor to pheromone synthesis, as hypothesized in fruit flies (Tan et al. 2014).

Voucher specimens of the *A. anomala* collected in our Asian surveys are deposited in insect collections at the University of Hawaii Insect Museum, in Honolulu and the Essig Entomological Museum, University of California, Berkeley.

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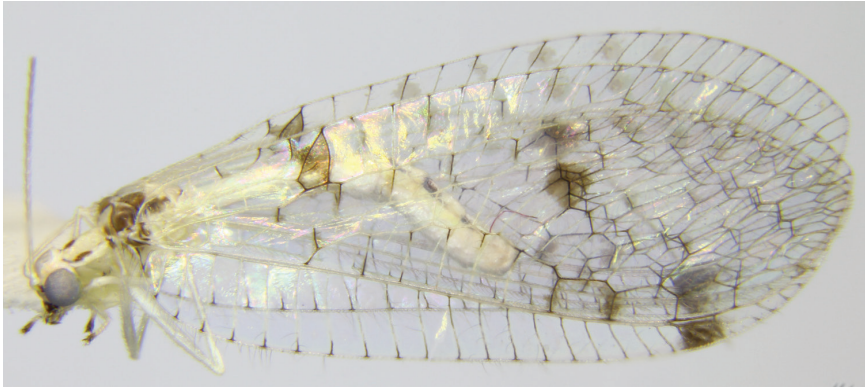


Figure 1. *Ankylopteryx anomala* (Brauer) male. Photo by Shu-Pei Chen.

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