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**PARASITISM OF *UROPHORA AFFINIS* (DIPTERA: TEPHRTIDAE)  
BY *APROSTOCETUS* SP. (HYMENOPTERA: EULOPHIDAE)  
IN MICHIGAN**

Jordan M. Marshall<sup>1</sup>

*Urophora affinis* Frfld. and *U. quadrifasciata* (Meig.) (Diptera: Tephritidae) are Eurasian gallicolous fruit flies introduced to North America in 1972 as biological control agents for *Centaurea biebersteinii* DC (spotted knapweed, Asteraceae, = *C. maculosa* auct. non Lam.) (Harris 1980). Through natural dispersal and numerous introductions, both *Urophora* species have become distributed throughout the introduced range of *C. biebersteinii* (Foote et al. 1993, Lang et al. 1997, Mays and Kok 2003). Use as biological control agents for *C. biebersteinii* focused on the diversion of energy from seed production to the development of *Urophora* spp. larvae within galls (Harris 1980). In the introduced range of *U. affinis* and *U. quadrifasciata*, mortality of these species has occurred as a result of predation by bird and mammal species, as well as parasitism by *Pteromalus cardui* (Erdős) (Hymenoptera: Pteromalidae) (Story et al. 1995, Pearson 1999, Marshall et al. 2004).

*Aprostocetus* sp. (Hymenoptera: Eulophidae) was initially observed emerging from *C. biebersteinii* seed heads in rearing during February 2008. Typically the subfamily Tetrastichinae, containing the genus *Aprostocetus* Westwood, is endoparasitic of eggs, larvae, or pupae of Coleoptera, Diptera, Hymenoptera, and Lepidoptera, with a distinct association with gall inducing hosts (Noyes 2003, Yegorenkova et al. 2007). Species within *Aprostocetus*, approximately 670, are distributed globally (Graham 1987, LaSalle 1994, Yegorenkova et al. 2007).

*Centaurea biebersteinii* seed heads were collected from three sites in Livingston County, MI, on 18 February 2008. Sixty seed heads from each site were randomly selected and placed into 8 dram plastic shell vials for rearing. Vials were a third filled with wet sand, topped with a layer of dry sand, and were capped with cotton fabric. Each vial contained 2 *C. biebersteinii* seed heads (30 vials/site), stored at 80° C at 45 percent humidity, and were checked every 2 days until emergence began. Following initial emergence, vials were checked daily and *Aprostocetus* sp. adults were removed and sexed. Adult *Urophora* species were identified using Foote et al. (1993). Chi-square tests were used to test for the independence of *U. affinis* from the occurrence of *Aprostocetus* sp. A *t*-test was used to test for differences in *U. affinis* emergence in the presence of *Aprostocetus* sp.

*Aprostocetus* sp. first emerged after 14 days. Seed heads were left in vials for an additional 10 weeks, which resulted in 34.4 percent of vials producing a total of 373 adult *Aprostocetus* sp. All emergence of *Aprostocetus* sp. occurred during days 14-17. In vials that produced adult *Aprostocetus* sp., 12.03 ± 9.04 individuals emerged per vial with a sex ratio of 0.36 males/females. A total of 36 adult *U. affinis* emerged from 26.7 percent of vials with a sex ratio of 0.89 males/females. In vials that produced adult *U. affinis*, 1.50 ± 0.83 individuals emerged per vial. The presence of *U. affinis* was independent of the presence of *Aprostocetus* sp. individuals ( $\chi^2 = 0.404$ , *df* = 1). There was no significant difference in the count of *U. affinis* in vials with and without *Aprostocetus* sp. emergence (*t* = 0.672, *df* = 88). In addition to *Aprostocetus* sp. and *U. affinis*, three *P. cardui* females and 10 *U. quadrifasciata* (6 males and 4 females) emerged.

Seed heads not placed into rearing were dissected and inspected for *U. affinis* and *U. quadrifasciata* galls. Galls produced by these two *Urophora* species are structurally different, with *U. affinis* producing woody, lignified galls and

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*U. quadrifasciata* producing papery, non-lignified galls (White and Korneyev 1989, Burkhardt and Zwölfer 2002). Only galls produced by *U. affinis* were encountered. A sample of 15 *U. affinis* galls was dissected and 8 contained multiple *Aprostocetus* sp., with a mean parasitism rate of  $8.36 \pm 4.07$  *Aprostocetus* sp. individuals per *U. affinis* gall.

The gregarious endoparasitism of *Aprostocetus* sp. on *U. affinis* caused mortality in *U. affinis* at the sites in Livingston County, MI, where seed heads were collected. While this mortality did reduce the mean number of *U. affinis* individuals emerging within vials, it did not create significant differences in the vials with and without *Aprostocetus* sp. and did not significantly influence the presence of *U. affinis* individuals. With this first record of *Aprostocetus* sp. parasitizing *U. affinis*, further investigations into host selection and the geographic distribution of this parasitoid within the introduced ranges of *Urophora* spp. are warranted.

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