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Utilization of an introduced weed biological control agent, *Megamelus scutellaris* (Hemiptera: Delphacidae), by a native parasitoid

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Waterhyacinth, *Eichhornia crassipes* (Mart.) Solms (Commelinales: Pontederiaceae), is a floating aquatic plant that originated in lowland tropical South America, probably in the Amazon basin (Barrett & Forno 1982). It was first introduced into the U.S. in the late 1800s (Gopal 1987). Problems caused by *E. crassipes* in its adventive range are well documented (Center 1994) and result from its rapid growth, clonal propagation, and ability to re-infest via the seed bank or from plant fragments. Infestations deleteriously affect water traffic, water quality, infrastructure for pumping and hydroelectric operations, water use, and biodiversity (Schmitz et al. 1993). Additional problems include property damage during floods, water loss due to evapotranspiration, and increases in populations of vectors of human and animal diseases (Mack & Smith 2011).

Megamelus scutellaris Berg (Hemiptera: Delphacidae) was first released into Florida as a biological control agent for *E. crassipes* in 2010 (Tipping et al. 2014). This species is now considered to be established with more than 700,000 insects released in 15 counties in Florida (unpublished data). Five native congeners of *M. scutellaris* occur in Florida: *M. davisi* VanDuzee, *M. palaetus* (VanDuzee), *M. gracilis* Beamer, *M. trifidus* Beamer, and *M. lobatus* Beamer (Beamer 1955; Bartlett 2014). *Megamelus davisi* feeds on yellow pond lily (*Nuphar advena* [Aiton]; Nymphaeaceae), and its eggs are parasitized by *Kalopolynema ema* (Schauff and Grissell) (Hymenoptera: Mymaridae) (Fig. 1) (Wilson & McPherson 1979, 1981; Triapitsyn & Berezovskiy 2002). Triapitsyn & Berezovskiy (2002) noted that it is highly likely that *K. ema* can parasitize the eggs of other *Megamelus* species.

Nuphar advena is a common aquatic plant in southern Florida and has been planted widely at the University of Florida Ft. Lauderdale research station where the United States Department of Agriculture (USDA), Agricultural Research Service (ARS), Invasive Plant Research Laboratory (IPRL) is co-located. *Megamelus davisi* is one of several common herbivores found on *N. advena* at the station, and *K. ema* has been collected repeatedly from *N. advena* leaves. In 2014, *K. ema* was observed on *E. crassipes* plants that were growing in 10 × 20 m outdoor tanks at IPRL used to mass-rear *M. scutellaris*. Preliminary identification of *K. ema* was determined by C.



Fig. 1. *Kalopolynema ema* (Hymenoptera: Mymaridae) adults that emerged from eggs of *Megamelus scutellaris* (Hemiptera: Delphacidae), a biological control agent of waterhyacinth, *Eichhornia crassipes*. Female (left) and male (right). Photos taken by Jeremiah Foley, USDA-ARS Invasive Plant Research Laboratory.

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R. Minteer using the keys in Triapitsyn & Berezovskiy (2002) and later confirmed by S.V. Triapitsyn. In order to first confirm and then estimate parasitism by *K. ema*, individual *E. crassipes* plants were collected without bias from the outdoor rearing tanks, soaked in a 2% solution of Safer® insecticidal soap to kill any surface insects, rinsed with fresh water, and placed individually in aquaria (28 × 31 × 40 cm). These aquaria were covered with fine mesh screens, placed in environmental chambers set at 27 °C and a 12:12 h L:D photoperiod, and monitored daily for the emergence of *M. scutellaris* and *K. ema*. Individuals of both *M. scutellaris* and *K. ema* were tallied and removed to prevent activities by either species that would alter parasitism estimates that were calculated by dividing the number of *K. ema* (K) individuals that emerged from a plant by the sum of the total number of *M. scutellaris* (M) and *K. ema* individuals that emerged from the plant.

$$\% \text{ parasitism} = K/(K + M)$$

Samples were collected from the outdoor tanks several times a month from Jan to Jun 2015 and from Oct 2015 to Jan 2016. *Megamelus scutellaris* and *K. ema* were the only 2 species observed emerging from the tissues of the *E. crassipes* plants in the aquaria, although we did observe midges, springtails, and spider mites on occasion. Parasitism rates of *M. scutellaris* by *K. ema* ranged between 29 and 78% and varied widely by month with no obvious pattern.

Parasitism rates were also investigated in the field by using sentinel plants of *E. crassipes*. Twenty *M. scutellaris* adults (1:1 sex ratio was assumed) were placed in aquaria with a single *E. crassipes* plant (sentinel plant) per aquarium in the laboratory for 2 d then removed. Sentinel plants were placed into 1 of 2 field sites for 2 d, returned to the laboratory and processed and monitored as before. Plants in the field were supported by a circular (diameter about 18 cm) Styrofoam float to support and mark the plant. The float was attached to a *N. advena* plant by using a twist tie to hold it in place. One field site consisted of small ponds (about 700 m^2) at the University of Florida Ft. Lauderdale research station with populations of *N. advena* and cattail (*Typha* spp.; Typhaceae). The other field site was a canal in a South Florida Water Management District Storm Water Treatment Area with *N. advena*, as well as a population of *E. crassipes* within 40 m. Sentinel plants were deployed in field sites several times monthly from May 2015 through Jan 2016. Parasitism rates at the field sites ranged from 0 to 26% and were much less variable among months than the parasitism rates seen in outdoor rearing tanks.

Parasitism rates in the outdoor rearing tanks were much higher than those seen from sentinel plants placed in the field, which may be an artifact of the artificially high densities of *E. crassipes* and *M. scutellaris* present in the tanks. Although more research is necessary to investigate these differences, it is clear that *K. ema* can utilize *M. scutellaris* as a host in tank and field settings.

Thanks to Serguei Triapitsyn for confirming our original ID of *K. ema* and to Rudy Scheffrahn for developing the method we used to get clear pictures of the parasitoids. Partial funding was provided by the Florida Fish and Wildlife Conservation Commission.

Summary

A native parasitoid, *Kalopolynema ema* (Schauff and Grissell) (Hymenoptera: Mymaridae), has begun utilizing a new host, *Megamelus scutellaris* Berg (Hemiptera: Delphacidae), the introduced biological control agent for waterhyacinth, *Eichhornia crassipes* (Mart.) Solms (Commelinales: Pontederiaceae). Parasitism rates varied between outdoor *M. scutellaris* rearing tanks and sentinel plants placed in the field, with parasitism rates in the tanks being higher.

Key Words: waterhyacinth; *Kalopolynema ema*; rearing tank; sentinel plant

Sumario

Un parasitoide nativo, *Kalopolynema ema* (Schauff y Grissell) (Hymenoptera: Mymaridae), ha comenzado a utilizar un nuevo hospedero, *Megamelus scutellaris* Berg (Hemiptera: Delphacidae), el agente de control biológico introducido por el jacinto de agua, *Eichhornia crassipes (*Mart.) Solms (Commelinales: Pontederiaceae). La tasa de parasitismo varió entre los *M. scutellaris* en tanques de cría externos y las plantas centinelas puestas en el campo, con la tasa de parasitismo en los tanques siendo la más alta.

Palabras Clave: jacinto de agua; *Kalopolynema ema*; tanque de cría; planta centinal

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