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RELEASE AND ESTABLISHMENT OF *MEGAMELUS SCUTELLARIS* (HEMIPTERA: DELPHACIDAE) ON WATERHYACINTH IN FLORIDA

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Megamelus scutellaris (Berg) (Hemiptera: Delphacidae) is a classical biological control agent for waterhyacinth, *Eichhornia crassipes* Mart. Solms (Commelinales: Pontederiaceae), that was released recently in Florida (Tipping et al. 2011). This species is restricted to *E. crassipes* and is capable of producing multiple, over-lapping generations per year in the laboratory. Adults exhibit wing dimorphism, a long-winged dispersal form which is capable of flight (macropterous), and a short winged, non-flying form (brachypterous) (Fitzgerald & Tipping 2013). Nymphs develop through 5 instars and will feed on adaxial and abaxial lamina surfaces, petioles, and laminae. Development of the entire immature stage in outdoor conditions takes about 25 days (Sosa et al. 2005). The objective of this study was to determine if overwintering and establishment of this species is occurring in Florida.

Insects were first released from quarantine as adults into waterhyacinth growing in outdoor tanks at the USDA-ARS Invasive Plant Research Laboratory (IPRL) in Ft. Lauderdale, FL, USA. The progeny of these adults were used in subsequent releases around the state beginning on Mar 2010, with more than 73,000 insects released through Aug 2013 (Table 1). Brachypterous adults were released more often than nymphs and macropterous adults. In addition, plants infested with insects and eggs were also used in releases.

Releases were conducted every 4-6 wks at most sites until late fall then halted until the following spring to determine if overwintering had occurred. No additional new releases were made at

TABLE 1. SITE INFORMATION AND OVERWINTERING STATUS FOLLOWING RELEASES OF *MEGAMELUS SCUTELLARIS* IN FLORIDA, 2010 TO 2013.

Site Name	CPS Coordinates	Habitat	# Released	Study Interval	Evidence of Overwintering?[1]
IPRL	N26.08503 W080.23989	tanks	12,720	Nov. 2011 - present	yes
STA1-E	N26.39999 W080.20852	marsh	14,780	Oct. 2011 - Feb. 2013	na
STA1-W	N26.65658 W080.40120	marsh	23,475	Mar. 2010 - Jul. 2013	yes
Edgefield	N29.69446 W081.56992	marsh	7,280	Mar. 2010 - Jul. 2013	yes
Gainesville	N29.38107 W082.22239	tank	1,370	Apr. 2011 - Aug. 2013	yes
Grandiflora	N29.43293 W082.28299	pond	14,530	Mar. 2010 - Jun. 2010	na
Lake McKethan	N28.64857 W082.33757	lake	3,300	Apr. 2010 - Jun. 2010	na
St. Johns #1	N28.02697 W080.46171	marsh	1,020	Nov. 2011 - Aug. 2013	no
St. Johns #2	N28.03845 W080.46102	canal	1,020	Nov. 2011 - Aug. 2013	yes
Bull Creek	N29.25714 W081.26149	creek	330	Oct. 2011 - Feb. 2012	no

[1]na = not applicable

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sites after overwintering was confirmed except in cases where the sites were reconstituted because of perturbations like flooding or drought. Releases in southern Florida were done without attempting to assess overwintering because the climate permitted plant and insect development throughout the yr. Some sites were used primarily for shorter duration evaluation studies (STA1-East, Grandiflora, Lake McKethan) and thus were also not assessed for overwintering.

Insects or infested plants were placed directly on or within existing infestations of *E. crassipes*, in floating cages (1 m^3) located atop polyvinyl chloride (pvc) frames, in above ground tanks, or in portions of uncaged infestations within floating pvc frames that enclosed 1 m^2 and were surrounded by open water. The number of cages and the sizes of infestations were variable among sites. Smaller, lighter ('throw') cages (0.25 m^3) that rested solely atop mats were also used and relocated with each new release. This latter type of cage was designed to confine the insects for a shorter period before they eventually escaped out from around the unsealed bottom margins. Plants within and adjacent to floating frames or cages were searched for 5 min and the numbers of large and small nymphs and adults were recorded.

The coldest site for releases in Florida was in Gainesville, Florida located in outdoor tanks where *M. scutellaris*, despite several below-freezing nights a year, overwintered for 3 consecutive yr following the initial release. Although the tanks are located in full-sun, large trees were located within 10 m and cast significant shade on the tanks during the day, which may have buffered temperatures. The best side-by-side comparison of environmental influences on *M. scutellaris* establishment might be the St. Johns marsh sites (floating pvc frames) where no overwintering was recorded at the more open St. Johns marsh #1 site, while 2 consecutive yr of overwintering were documented in the nearby and more covered St. Johns marsh #2 site, which had overhanging trees. At this latter site, *M. scutellaris* dispersed from the floating frame into the surrounding mat. The Bull Creek site was also situated under overhanging branches but it was repeatedly vandalized and finally abandoned.

Megamelus scutellaris readily dispersed through mats of *E. crassipes* as evidenced by the difficulty in finding brachypterous adults even within a few days of release. This movement within and among plants in a patch was labeled as 'trivial' by Kennedy (1961) and is poorly understood within the Delphacidae. Although larger cages sealed atop frames appeared to prevent emigration, moats and throw cages appeared to only delay it. Predators of nymphs and adults included fish and spiders, along with occasional egg parasitism by unidentified mymarids, and nymph and adult parasitism by one or more unidentified species in the Dryinidae.

In general, establishment was promoted at sites that were relatively protected with some cover or shading rather than in full-sun sites. The mechanism(s) involved are not known but may include increased humidity which increases survival in this species. Useful cover was provided even by emergent species like giant bulrush, *Schoenoplectus californicus* (C. A. Meyer) Palla (Poales: Cyperaceae), that cast minimal shade. If possible, groups of infested plants should be used in releases or multiple releases of insects be conducted in the same location. Cages helped to hold the insects in one place and concentrated oviposition and aided in monitoring.

Summary

More than 73,000 *Megamelus scutellaris* (Hemiptera: Delphacidae) were released in Florida over a 2 to 3 yr period at 10 sites in an attempt to establish sustainable populations on waterhyacinth, *Eichhornia crassipes* Mart. Solms (Commelinales: Pontederiaceae). Insect populations persisted at most sites including those furthest north and consecutive overwintering was confirmed in as many as three times at some sites. Establishment appeared to be promoted at sites with some cover or shading compared to open areas. Insects readily dispersed over short distances which made detection and monitoring difficult.

Key Words: *Megamelus scutellaris*, *Eichhornia crassipes*, establishment

Resumen

Se libararon más de 73,000 *Megamelus scutellaris* (Berg) (Hemiptera: Delphacidae) en la Florida durante un período de 2 a 3 años en 10 sitios en un intento por establecerse poblaciones sostenibles sobre el jacinto de agua, *Eichhornia crassipes* Mart. Solms (Commelinales: Pontederiaceae). Las poblaciones de estos insectos se mantuvieron en la mayoría de los sitios, incluyendo la región del norte más lejana y la invernación a través de años consecutivos fue confirmada hasta 3 veces en algunos sitios. El establecimiento parecía ser promovido en sitios por tener un poco de cubierta o sombreado en comparación con las áreas abiertas. Los insectos se dispersan fácilmente en distancias cortas lo que hizo difícil la detección y el seguimiento.

Palabras Clave: *Eichhornia crassipes*, establecimiento, delfácido, invernar, chicharrita

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