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

Philip W. Tipping1*, Alejandro Sosa2, Eileen N. Pokorny1, Jeremiah Foley1, Don C. Schmitz3, Jon S. Lane1, Leroy Rodgers5, Lori McCloud6, Pam Livingston-Way6, Matthew S. Cole4 and Gary Nichols6

1USDA-ARS Invasive Plant Research Laboratory, 3225 College Ave., Davie, Florida, USA 33314

2FUEDEI Simón Bolívar 1559, Hurlingham (B1686EFA), Buenos Aires, Argentina

3Florida Fish and Wildlife Conservation Commission, 3900 Commonwealth Blvd. MS 705, Tallahassee, Florida, USA 32399

4U.S. Army Corps of Engineers, 701 San Marco Blvd., Jacksonville, Florida, USA 32207

5South Florida Water Management District, 3301 Gun Club Rd., West Palm Beach, Florida, USA 33406

6St. Johns River Water Management District, 4049 Reid Rd., Palatka, Florida, USA 32178-1429

*Corresponding author; E-mail: philip.tipping@ars.usda.gov

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>
<thead>
<tr>
<th>Site Name</th>
<th>CPS Coordinates</th>
<th>Habitat</th>
<th># Released</th>
<th>Study Interval</th>
<th>Evidence of Overwintering?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPRL</td>
<td>N26.08503 W080.23989</td>
<td>tanks</td>
<td>12,720</td>
<td>Nov. 2011 - present</td>
<td>yes</td>
</tr>
<tr>
<td>Grandiflora</td>
<td>N29.43293 W082.28299</td>
<td>pond</td>
<td>14,530</td>
<td>Mar. 2010 - Jun. 2010</td>
<td>na</td>
</tr>
<tr>
<td>St. Johns #1</td>
<td>N28.02697 W080.46171</td>
<td>marsh</td>
<td>1,020</td>
<td>Nov. 2011 - Aug. 2013</td>
<td>no</td>
</tr>
<tr>
<td>St. Johns #2</td>
<td>N28.03845 W080.46102</td>
<td>canal</td>
<td>1,020</td>
<td>Nov. 2011 - Aug. 2013</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Na = not applicable
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$^2$) 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$^2$) 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 overarching trees. At this latter site, *M. scutellaris* dispersed from the floating frame into the surrounding mat. The Bull Creek site was also situated under overarching branches but it was repeatedly vandalized and finally abandoned.

*Megamelus scutellaris* readily dispersed through mats of *E. crassipes* as evidenced by the difficulty in keeping 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 place one 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 (Commelinaceae: 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 periodo de 2 a 3 años en 10 sitios en un intento por establecerse poblaciones sostenibles sobre el jacinto de agua, *Eichhornia crassipes* Mart. Solms (Commelinaceae: 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 pareció 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

**REFERENCES CITED**