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Field Release of *Megamelus scutellaris*, Berg (Hemiptera: Delphacidae), for Biological Control of Water Hyacinth *Eichhornia crassipes* Mart. (Solms) (Pontederiales: Pontederiaceae) in the Continental United States

Environmental Assessment, January 2010

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I. Purpose and Need for the Proposed Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ) Permit Unit is proposing to issue permits for release of the insect *Megamelus scutellaris* Berg (Hemiptera: Delphacidae). The agent would be used by the applicant for biological control of water hyacinth, *Eichhornia crassipes* Mart. (Solms) (Pontederiales: Pontederiaceae), in the continental United States. Before permits are issued for release of *M. scutellaris*, the APHIS–PPQ Permit Unit needs to analyze the potential impacts of the release of this agent into the continental United States.

This environmental assessment[1] (EA) has been prepared, consistent with USDA–APHIS' National Environmental Policy Act of 1969 (NEPA) implementing procedures (Title 7 of the Code of Federal Regulations (CFR), part 372). It examines the potential effects on the quality of the human environment that may be associated with the release of *M. scutellaris* to control infestations of water hyacinth within the continental United States. This EA considers a "no action" alternative and the potential effects of the proposed action.

The applicant's purpose for releasing *M. scutellaris* is to reduce the severity of infestations of water hyacinth in the United States. Water hyacinth originated in lowland tropical South America, probably in the Amazon Basin (Barrett and Forno, 1982). Water hyacinth is a floating plant. Its erect, free-floating habit and showy flowers made it attractive for use in ornamental ponds and garden pools which inevitably led to spread of the plant by humans. It was first introduced into the United States in the late 1800s, and then into many tropical and subtropical (and some warm-temperate) regions of the world (Gopal, 1987). The growth form is sympodial[2] and individual rosettes reproduce to form extensive floating mats which, in mature stands, extend a meter or more above the water surface (Center and Spencer, 1981). Problems caused by water hyacinth in areas where it is has invaded are well documented (Center, 1994), and result from its rapid growth, ability to re-infest via seeds or from plant fragments, and lack of natural enemies. Infestations negatively affect water traffic, water quality, infrastructure for pumping and hydroelectric operations, water use, and biodiversity (Schmitz et al., 1993). Other problems include property damage during floods, water loss

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[1] Regulations implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 et seq.) provide that an environmental assessment "[shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted" (40 CFR § 1508.9).

[2] A plant whose main stem grows horizontally and that has lateral branches that stop growing at a certain point.

due to evapotranspiration, and increases in mosquito populations. Water hyacinth remains one of the world's most troublesome aquatic weed as it continues to invade water bodies and wetlands in new regions (Julien et al., 1996).

Existing water hyacinth management options (discussed below) are ineffective, expensive, temporary, or have non-target impacts. In addition, herbicide programs periodically disrupt the life cycles of the currently released insects used for biological control of water hyacinth, thus, limiting their potential. As a result, more mobile agents with higher reproductive capacities are needed that can survive disruptions of water hyacinth communities by herbicide applications. For these reasons, the applicant has a need to identify an effective, host-specific biological control organism and release it into the environment for the control of water hyacinth.

II. Alternatives

This section will explain the two alternatives available to the APHIS–PPQ Permit Unit—no action and issuance of permits for environmental release of *M. scutellaris.* Although APHIS' alternatives are limited to a decision of whether to issue permits for release of *M. scutellaris*, other methods available for control of water hyacinth are also described. These control methods are not decisions to be made by APHIS, and are likely to continue whether or not permits are issued for environmental release of *M. scutellaris*. These are methods presently being used to control water hyacinth by public and private concerns.

A third alternative was considered, but will not be analyzed further. Under this third alternative, the APHIS–PPQ Permit Unit would have issued permits for the field release of *M. scutellaris*, however, the permits would contain special provisions or requirements concerning release procedures or mitigating measures, such as limited release of *M. scutellaris*. No issues have been raised which would indicate that special provisions or requirements are necessary.

A. No Action

Under the no action alternative, the APHIS–PPQ Permit Unit would not issue permits for the field release of *M. scutellaris* for the control of water hyacinth—the release of this biological control agent would not take place. The following methods are presently being used to control water hyacinth; these methods will continue under the "no action" alternative and are likely to continue even if permits are issued for release of *M. scutellaris*.

1. Chemical Control

Treatment with the isooctyl esters and dimethylamine salts of 2,4-dichlorophenoxy acetic acid (2,4-D) is the principle chemical control alternative employed in the United States, although diquat and glyphosate are also used (Vandiver et al., 1999). The costs depend on the size of the treatment area, the scale of the treatment, and the herbicide dosage. Current costs per acre range from $250 for glyphosate to $300 to $1,000 for 2,4-D (Gibbons et al., 1999).

2. Mechanical Control

This method is better suited to small isolated drainages but all plant fragments must be removed to avoid re-sprouting. Equipment includes rakes, mechanical harvesters, and suction dredgers. Excluding volunteer labor for smaller sites, harvesting costs can range from $500 to $800 per acre with additional costs for mobilization and equipment ($35,000 to $111,000) (WSDE, 2001). There may be additional fees for disposal of plant material.

3. Biological Control

Three insects were released in the United States during the 1970s—*Neochetina eichhorniae* Warner (Coleoptera: Curculionidae) beginning in 1972, *N. bruchi* Hustache (Coleoptera: Curculionidae) beginning in 1974, and *Niphograpta* (=*Sameodes*) *albigutallis* (Warren) (Lepidoptera: Pyralidae) beginning in 1977. These insects now occur throughout the range of water hyacinth in the United States (Center et al., 1999b).

B. Issue Permits for Environmental Release of *M. scutellaris*

Under this alternative, the APHIS–PPQ Permit Unit would issue permits for the field release of *M. scutellaris* for the control of water hyacinth wherever it occurs in the continental United States. These permits would contain no special provisions or requirements concerning release procedures or mitigating measures.

Biological Control Agent Information

1. Description

Insect Taxonomy

Order:	Hemiptera
Family:	Delphacidae
Genus:	*Megamelus* Fieber, 1866
Species:	*scutellaris* Berg, 1883

The genus *Megamelus* is widespread throughout the world and includes 24 species in the Americas (Asche, 1985). Most species in this genus are associated with aquatic plants (O'Brien and Wilson, 1985). Two of the South American species, *M. electrae* in Trinidad and Tobago (Cruttwell, 1973) and *M. scutellaris* in Peru, Brazil, Uruguay, and Argentina (Sosa et al., 2004), are associated with water hyacinth.

2. Life History

Megamelus scutellaris produces multiple, over-lapping generations per year. Adults exhibit two wing forms with a long-winged dispersal form, which is capable of flight (macropterous), and a short-winged, non-flying form (brachypterous). The wing form is determined within the generation and is dependent on environmental cues, such as crowding and host plant quality. The macropterous form enables the insect to disperse from overcrowded or poor quality plants to find better quality water hyacinth plants.

Adults mate at the bottom of the water hyacinth plant (Sosa et al., 2005), as well as on the upper leaves (Tipping et al., 2008). A few days after mating, females begin laying eggs (ovipositing) within plant tissue located in the leaves of water hyacinth. Most egg laying (oviposition) sites contain two eggs (Tipping et al., 2008). Eggs are oval with one end pointed and the other end rounded. They are milky white when laid, and turn yellowish white with reddish eye spots before hatching (Sosa et al., 2005).

Nymphs (immature insect stage) emerge after 7 to 13 days after eggs are laid (Sosa et al., 2005; Tipping et al., 2008), depending upon the temperature. The emerging nymph begins feeding on the plant closest to the water surface. Nymphs develop through five instars (life stages between molts), and will feed on the top and bottom of leaves and leaf stems. Development of the entire immature stage in outdoor conditions can take about 25 days (Sosa et al., 2005). Field observations in Argentina have found that the immature stages of *M. scutellaris* overwinter in decayed mats of water hyacinth (Sosa et al., 2005).

Planthoppers, such as *M. scutellaris*, feed by inserting their stylets (needle-like mouthparts) into the plant and ingesting the sap (Sogawa, 1982). Saliva is secreted during penetration, forming a stylet sheath which acts to hold the stylets together, and facilitate lubrication and movement toward food sources (Sogawa, 1982). The sheath remains imbedded in the tissue after the stylets are withdrawn and may be branched or unbranched, depending upon whether or not the stylets changed direction within the plant after insertion. Spiller (1990) found that stylet probing caused significant damage to cell organs, leading to cell death.

3. Native Range

The native range of *M. scutellaris* includes Argentina—Buenos Aires, Chaco, Corrientes, Entre Rios, Formosa, and Santa Fe Provinces; Brazil—Rio de Janeiro, Sao Paulo, Paraná, and Río Grande do Sul States; Peru—Iquitos; and Uruguay. According to Sosa et al. (2004) the native range is likely to be much more extensive in South America wherever water hyacinth occurs naturally. *M. scutellaris* is not known to have been introduced into any countries outside its native range, although it has been studied in South African quarantine. The expected range of *M. scutellaris* in North America should mirror that of water hyacinth (Tipping et al. 2008).

4. Impact on Water Hyacinth

In quarantine studies, water hyacinth plants are heavily damaged by *M. scutellaris* feeding, and they eventually wilt and die. Water hyacinth plants without *M. scutellaris* grew larger and produced more leaves than plants attacked by the insects. Quarantine study data indicate the potential of *M. scutellaris* to damage water hyacinth, and to rapidly increase in number in a relatively short time (Tipping et al., 2008).

III. Affected Environment

Water hyacinth is a floating plant. Plants vary in size from a few centimeters (cm) to over a meter in height. The glossy green, leathery leaf blades are up to 20 cm long and 5 to 15 cm wide, and are attached to stems that are often spongy-inflated. Numerous dark, branched, fibrous roots dangle in the water from the underside of the plant. The flower is showy light-blue to violet (sometimes white) on a loose terminal spike. Each flower has six bluish-purple petals joined at the base to form a short tube. One petal bears a yellow spot. The fruit is a three-celled capsule containing many tiny, ribbed seeds.

In spring, overwintering water hyacinth plants (old stem bases) initiate growth by producing daughter plants. These plants slowly increase in number and size during the spring and summer until the maximum biomass is reached in September. As the plants become crowded, shading causes many of the lower leaves to die back. In mild climates, water hyacinth can flower year-round, and from early spring to late fall elsewhere. Seeds form in the submerged, withered flower. By late fall, some of the old leaves start dying and by January most plants have declined. Colonization of a new site begins with small plants at low plant densities. These plants increase in number and density without increasing in size until they produce a new mat. As a mature dense mat is formed, individual plant size continues to increase, however, density decreases.

Water hyacinth reproduces sexually by seeds (Müller, 1883), and vegetatively by budding and stolons (a shoot which bends to the ground or which grows horizontally above the ground and produces roots and shoots at the nodes). Daughter plants sprout from the stolons, and doubling times of mats have been reported from 6 to 18 days (Mitchell, 1976). The seeds can germinate in a few days or remain dormant for 15 to 20 years (Matthews, 1967; Gopal, 1987); however, they usually sink and remain dormant through periods of stress (droughts). Upon reflooding, the seeds often germinate and renew the growth cycle.

A. Areas Affected by Water Hyacinth

1. Native and Worldwide Distribution

Water hyacinth is native to South America, but has been introduced throughout much of the tropics and subtropics. The center of origin is unknown but is thought to be Amazonia. It is also common in the Caribbean. In Africa, it has infested the Nile, Congo, and Zaire River watersheds. It also occurs in Senegal, the Central African Republic, South Africa, and Madagascar. It is common in tropical Asia, including Southeast Asia, most of the Indian subcontinent, and extends through coastal China into South Korea and Japan. It is also found throughout Indonesia and in Australia.

2. Present Distribution in North America

Water hyacinth is believed to have been introduced into the United States in 1884 at an exposition in New Orleans. Within 70 years of reaching Florida, the plant covered 126,000 acres of waterways (Schmitz et al., 1993). Worldwide, the limits of distribution are at 40° North and South latitude. In the United States, water hyacinth is most abundant in the southeastern United States. It also occurs in California and Hawaii, with scattered records in other States. Water hyacinth has been reported in Oregon, Washington, Illinois, Maryland, New Jersey, Kentucky, Tennessee, Missouri, and Arkansas where plants escape summertime cultivation but do not persist through the winter. It is annually stocked in farm fish ponds in southern Arizona and southern Delaware, but has not become established in the natural systems of these States.

3. Habitat

Water hyacinth is an aquatic weed which can be found in lakes, rivers, ponds, and ditches of temperate climates. It is not winter-hardy; its minimum growth temperature is 12 ºCelsius (C) (54 ºFahrenheit (F)); its optimum growth temperature is 25 to 30 ºC (77 to 86 ºF); its maximum growth temperature is 33 to 35 ºC (92 to 95 ºF) (Kasselmann, 1995).

B. Plants Related to Water Hyacinth and Their Distribution

1. Taxonomically Related Plants

Information regarding plants taxonomically related to water hyacinth is included because native plant species which are closely related to water hyacinth have the most potential to be attacked by *M. scutellaris*.

Water hyacinth is a member of the pickerelweed family (Pontederiaceae). The families most closely related to the Pontederiaceae are—Commelinaceae, Haemodoraceae, Philydraceae, and Hanguanaceae. There are 6 to 9 genera and 30 to 40 species in the Pontederiaceae worldwide (table 1). Most members of this family are confined to the Americas, and all members of the genus *Eichhornia* (8 species) originate in tropical America, except for *E. natans*, which is from tropical Africa. Horn (2002) recognizes 13 species (including *E. crassipes*) in 4 genera that occur in the United States (table 2). Four of these (*E. azurea, E.*

crassipes, E. paniculata, and *Monochoria vaginalis*) are not native to North America. Two of the 13 (*E. paniculata* and the native *Heteranthera peduncularis*) have been collected in the United States only once, each about a century ago. Pickerelweed (*Pontederia cordata*) is sometimes separated into two varieties, *P. cordata* var. *cordata* and *P. cordata* var. *lancifolia*, based mainly on leaf shape. However, leaf shape is variable (even within an individual) and seems to be influenced by habitat conditions; therefore, this distinction is poorly justified.

Table 1. Worldwide Distribution of Species of Pontederiaceae

Species*	Distribution†
Eichhornia crassipes Mart. (Solms)	NA, CA, SA, AFR, ASIA
Eichhornia azurea (Sw.) Kunth	NA, CA, SA
Eichhornia cordifolia Gand.	CA
Eichhornia diversifolia (Vahl) Urban	NA, CA, SA
Eichhornia heterosperma Alexander	CA, SA
Eichhornia natans (P. Beauv.) Solms	AFR
Eichhornia paniculata (Sprengl) Solms	CA, SA
Eichhornia paradoxa (Mart.) Solms	CA, SA
Heteranthera callifolia Rchb. ex Kunth	AFR
Heteranthera (=*Zosterella*) *dubia* (Jacq.) MacMillan	NA, CA, AFR
Heteranthera limosa (Sw.) Willd.	NA, CA, SA
Heteranthera mexicana S. Watson	NA
Heteranthera multiflora (Griseb.) C.N. Horn	NA
Heteranthera oblongifolia C. Mart. ex Roem. & Schult.	SA
Heteranthera penduncularis Benth.	NA
Heteranthera reniformis Ruiz López & Pavón	NA
Heteranthera rotundifolia (Kunth) Griseb.	NA, CA, SA
Heteranthera seubertiana Solms	CA
Heteranthera spicata J. Presl.	CA, SA
Heteranthera zosterifolia Mart.	SA
Hydrothrix gardneri Hook. f.	SA
Monochoria africana (Solms-Laub.) N.E. Br.	AFR
Monochoria australasica Ridley	AUS
Monochoria brevipetiolata Verdc.	AFR
Monochoria elata Ridl.	ASIA
Monochoria hastata (L.) Solms	SA, ASIA
Monochoria korsakowii Regel & Maack	ASIA
Monochoria plantaginea Kunth	ASIA
Monochoria vaginalis (Burm. f.) K. Presl ex Kunth	NA, ASIA
Pontederia cordata L.	NA, CA, SA
Pontederia crassicaulis Schlecht	CA
Pontederia lagoensis Warm.	SA
Pontederia parviflora Alexander	CA
Pontederia (=*Reussia*) *rotundifolia* L.f.	CA, SA
Pontederia sagittata C. Presl	CA
Pontederia subovata (Seub.) Lowden	SA
Reussia triflora Seub.	SA
Scholleropsis lutea H. Perr.	AFR

* Based on data from Eckenwalderand Barrett (1986), Horm (2002), IOPI (2002) NS MBG (2002).
† Africa (AFR), South America (SA), Central America—including southern Mexico (CA), North America (NA), Europe (EU), Australia (AUS), and Asia (ASIA).

Table 2. Species of Pontederiaceae in the United States.*

Non-native (Introduced) Species	State Status
Eichhornia azurea (Sw.) Kunth	
Eichhornia crassipes (Martius) Solms-Laubach	
Eichhornia paniculata (Sprengl.) Solms‡	
Monochoria vaginalis (Burm. f.) K. Presl ex Kunth	
Native Species	
Eichhornia diversifolia (Vahl) Urban†	
Heteranthera (=*Zosterella*) *dubia* (Jacq.) MacMillan	Special concern in Kentucky, threatened in Maine, endangered in New Hampshire
Heteranthera limosa (Sw.) Willd.	Special concern in Kentucky, threatened in Minnesota and Tennessee
Heteranthera (=*Eurystemon*) *mexicana* S. Watson	
Heteranthera multiflora (Griseb.) C.N. Horn	Threatened in Pennsylvania
Heteranthera peduncularis Benth.‡	
Heteranthera reniformis Ruiz López & Pavón	Special concern in Connecticut, endangered in Illinois and Ohio
Heteranthera rotundifolia (Kunth) Griseb.	
Pontederia cordata L.	

* Derived from USDA (1997), but modified according to Horn (2002).
† Native to Puerto Rico (Horn, 2002).
‡ Known from only a single collection about 100 years ago (Horn, 2002).

IV. Environmental Consequences

A. No Action

1. Impact of Spread of Water Hyacinth

Water hyacinth grows rapidly, forming expansive colonies of tall, interwoven floating plants. It blankets large water bodies, creating impenetrable barriers and obstructing navigation. Floating mats block drainage, causing flooding or preventing floodwaters from subsiding. Large rafts of water hyacinth plants accumulate where water channels narrow, sometimes causing bridges to collapse. Water hyacinth hinders irrigation by impeding water flow, by clogging irrigation pumps, and by interfering with weirs (a low dam built across a stream to raise its level or divert its flow). Multimillion-dollar flood control and water supply projects can be rendered useless by water hyacinth infestations (Gowanloch and Bajkov, 1948).

Infestations block access to recreational areas and decrease waterfront property values, often harming the economy of communities that depend upon fishing and water sports for revenue. Shifting water hyacinth mats sometimes prevents boats from reaching shore, trapping the occupants and exposing them to environmental hazards. Water hyacinth infestations intensify mosquito problems by hindering insecticide applications, interfering with predators, increasing habitat for species that attach to plants, and impeding runoff and water circulation.

Dense mats reduce light to submerged plants, thus depleting oxygen in aquatic communities. The resultant lack of phytoplankton (very small, free-floating plants) alters the composition of invertebrate communities, ultimately affecting fisheries. Drifting mats scour vegetation, destroying native plants and wildlife habitat. Water hyacinth also competes with other plants, often displacing wildlife forage and habitat. Higher sediment loading occurs under water hyacinth mats due to increased production of detritus and siltation.

2. Impact from the Use of Other Control Methods

The continued use of chemical herbicides, mechanical controls, and previously released biological control agents at current levels would result if the "no action" alternative is chosen, and may continue even if permits are issued for environmental release of *M. scutellaris.*

a. Chemical Control

Herbicidal treatment of water hyacinth often damages nearby desirable vegetation, and treatment is costly. Cost of treatment depends on the size of the treatment area, the scale of the treatment, and the herbicide dosage. Current costs per acre range from $250 for glyphosate, and for 2,4-D, between $300 to $1,000 (Gibbons et al., 1999). Use of herbicides in aquatic areas also raises water quality concerns. After herbicide application, massive amounts of dying vegetation can reduce the amount of oxygen in the water column.

b. Mechanical Control

Mechanical harvesting of water hyacinth often damages nearby desirable vegetation. This method is better suited to small, isolated drainages, and all plant fragments must be removed to avoid re-sprouting. Harvesting costs can range from $500 to $800 per acre, with additional costs for mobilization and equipment ($35,000 to $111,000) (WSDE, 2001). There may be additional fees for disposal of plant material.

c. Biological Control

The previously released water hyacinth biological control insects *Neochetina eichhorniae*, *N. bruchi*, and *Niphograpta albigutallis* now occur throughout the range of water hyacinth (Center et al., 1999b). Numerous field studies documented the decline of water hyacinth in diverse geographical areas of the United States after introductions of biological control agents (Goyer and Stark, 1984; Cofrancesco et al., 1985). Surveys conducted by Center et al. (1999a) confirmed that water hyacinth populations not subjected to repeated control operations become stressed by biological control agents, particularly by the two *Neochetina* species. However, herbicide programs periodically disrupt the life cycles of the currently released biological control organisms and limit their potential. This is because the food source of the insect is killed by the herbicide, and their ability to disperse to untreated plants is limited. As a result, more mobile agents with higher reproductive capacities are needed that can survive disruptions of water hyacinth communities by herbicide applications.

These environmental consequences may occur even with the implementation of the biological control alternative, depending on the efficacy of *M. scutellaris* to reduce water hyacinth in the continental United States.

B. Issue Permits for Environmental Release of *M. scutellaris*

1. Impact of *M. scutellaris* on Non-target Plants

Host specificity to water hyacinth has been demonstrated through field observations and host specificity testing.

a. Scientific Literature

In the scientific literature, specificity of *M. scutellaris* has been found to be limited to species in the family Pontederiaceae. In no-choice[3] laboratory tests, potential hosts of *M. scutellaris* included *Pontederia cordata* var. *cordata* and *P. rotundifolia*. However, in field explorations in which the two species coexisted with water hyacinth, *M. scutellaris* was only found on water hyacinth (Sosa, 2007a). In addition, field surveys were conducted from 1997 to 2000 to examine several plant species in the plant family Pontederiaceae for the presence of *M. scutellaris*. Species included *Pontederia cordata, P. rotundifolia, P. subovata, P. parviflora,* water hyacinth, and *Eichornia azurea,* but *M. scutellaris* was only collected from water hyacinth (Sosa, 2007b).

b. Host Specificity Testing

Host range determination of *M. scutellaris* was based on plant species in seven categories listed in table 3, including representatives from the Pontederiaceae (Tipping et al., 2008). Additionally, native and exotic associated wetland species and economic species were also tested.

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[3] A no-choice test is when *M. scutellaris* is placed into a cage in which only the test plants (non-target plants) are present for feeding or egg laying. In a choice test, *M. scutellaris* is offered a choice between water hyacinth and the test plant in the cage.

Table 3. Seven Categories of Plants Considered for the Test Plant List. These plants were used for host specificity tests using *M. scutellaris* and were conducted in quarantine facilities.

Category 1—Genetic Type of the Target Weed Species (water hyacinth).

Genus and Species	Common Name	N. American Status
Eichhornia crassipes (Mart.) Solms-Laub.	Water hyacinth	Exotic

Category 2—Species in the Same Genus (*Eichhornia*) as Water Hyacinth.
(There are no native North American species of *Eichhornia*, except *E. paniculata* from southern Mexico.)

Genus and Species	Common Name	N. American Status
Eichhornia paniculata (Spreng.) Solms	Brazilian water hyacinth	Introduced into Florida
Eichhornia diversifolia (Vahl) Urb.	Variableleaf water hyacinth	Native to Puerto Rico

Category 3—Species in Other Genera but in the Same Family.
(Pontederiaceae) and subfamily as water hyacinth.

Genus and Species	Common Name	N. American Status
Heteranthera dubia (Jacquin) MacMillan	grassleaf mudplantain	Native
Heteranthera limosa (Sw.) Willd.	blue mudplantain	Native
Heteranthera multiflora (Griseb.) Horn	bouquet mudplantain	Native
Heteranthera peduncularis Benth.	egret mudplantain	Native
Heteranthera reniformis Ruiz & Pavón	kidneyleaf mudplantain	Native
Heteranthera rotundifolia (Kunth) Griseb.	roundleaf mudplantain	Native
Heteranthera zosterfolia C. Martius	Stargrass	Exotic
Monochoria vaginalis (Burman f.) C. Presl ex Kunth	heartshape false pickerelweed	Exotic
Pontederia cordata L.	Pickerelweed	Native

Category 4—Threatened and Endangered Species in the Same Family as Water Hyacinth.

There are no federally listed threatened or endangered species in the plant family Pontederiaceae.

Category 5—Species in the Same Order (Pontederiales) as Water Hyacinth.

Family, Genus, and Species	Common name	N. American Status
Commelinaceae, *Commelina erecta* L.	Dayflower	Native
Commelinaceae, *Commelina benghalensis* L.	Benghal dayflower	Exotic
Commelinaceae, *Tradescantia ohiensis* Raf.	Bluejacket	Native

Category 6—Species in Orders Other than Water Hyacinth.

According to Dahlgren et al. (1981; see also Barrett and Graham, 1997), the Pontederiales are most closely related to the orders Haemodorales (2 native species in 2 genera—*Lachnanthes* and *Xiphidium*), Philydrales (no North American natives), and Typhales (22 native species in 2 genera—*Typha* and *Sparganium*). Other wetland species commonly found in close association with water hyacinth were included in host specificity testing. In addition, common exotic plant species were evaluated for their suitability for *M. scutellaris*.

Order	Family	Genus	Species	Common Name	Status
Alismatales	Alismataceae	*Sagittaria*	*falcata*	Duck potato	Native
Alismatales	Alismataceae	*Sagittaria*	*latifolia*	Broadleaf arrowhead	Native
Alismatales	Alismataceae	*Echinodorius*	*cordifolus*	Spade leaf sword	Native
Liliales	Amaryllidaceae	*Crinum*	*americanum*	Swamp lily	Native
Apiales	Apiaceae	*Hydrocotyle*	*umbellata*	Marsh pennywort	Native
Arales	Araceae	*Peltandra*	*virginica*	Green arum	Native
Arales	Araceae	*Pistia*	*stratiotes*	Water lettuce	Exotic
Arales	Araceae	*Orontium*	*aquaticum*	Golden club	Native
Arales	Araceae	*Colocasia*	*esculenta*	Taro	Exotic
Hydropteridales	Azollaceae	*Azolla*	*caroliniana*	Carolina mosquito fern	Native
Zingiberales	Cannaceae	*Canna*	*flaccida*	Golden canna	Native
Zingiberales	Costaceae	*Costus*	*woodsonii*	Red button ginger	Exotic
Capparales	Cruciferae	*Nasturtium*	*aquaticum*	Watercress	Exotic
Eriocaulales	Eriocaulaceae	*Eriocaulon*	*compressum*	Flattened pipewort	Native
Fabales	Fabaceae	*Glycine*	*max*	Soybean	Crop
Cyperales	Graminaceae	*Oryza*	*sativa*	Rice	Crop
Haloragales	Haloragaceae	*Proserpinaca*	*palustris*	Mermaid weed	Native
Haloragales	Haloragaceae	*Myriophyllum*	*aquaticum*	Parrot feather	Native
Hydrocharitales	Hydrocharitaceae	*Limnobium*	*spongia*	Frog's bit	Native
Liliales	Iridaceae	*Iris*	*hexagona*	Prairie iris	Native
Arales	Lemnaceae	*Lemna*	*minor*	Common duckweed	Native
Zingiberales	Marantaceae	*Thalia*	*geniculata*	Alligator flag	Native
Hydropteridales	Marsileaceae	*Marsilea*	*quadrifolia*	European waterclover	Exotic
Solanales	Menyanthaceae	*Nymphoides*	*aquatica*	Floating hearts	Native
Fabales	Mimosaceae	*Neptunia*	*oleraceae*	Sensitive plant	Exotic
Musales	Musaceae	*Musa*	*acuminate*	Dwarf banana	Crop
Nymphaeales	Nymphaeaceae	*Nuphar*	*luteum*	Spatterdock	Native
Nymphaeales	Nymphaeaceae	*Nymphaea*	*odorata*	Fragrant water lily	Native
Nymphaeales	Nymphaeaceae	*Nymphaea*	*mexicana*	Yellow water lily	Native
Myrtales	Onagraceae	*Ludwigia*	*glandulosa*	Primrose-willow	Native
Myrtales	Onagraceae	*Ludwigia*	*peploides*	Water primrose	Native
Orchidales	Orchidaceae	*Epidendrum*	*sp.*		Crop
Orchidales	Orchidaceae	*Vanilla*	*planifolia*	Vanilla	Crop
Orchidales	Orchidaceae	*Dendrobium*	*sp.*		Crop

Order	Family	Genus	Species	Common Name	Status
Poaceae	Poaceae	*Triticum*	*aestivum*	Wheat	Crop
Poaceae	Poaceae	*Saccharum*	*officinarum*	Sugarcane	Crop
Poaceae	Poaceae	*Sorghum*	*bicolor*	Sorghum	Crop
Cyperales	Poaceae	*Zizaniopsis*	*miliacea*	Southern wild rice	Native
Piperales	Saururaceae	*Saururus*	*cernuus*	Lizard's tail	Native
Scrophulariales	Scrophulariaceae	*Bacopa*	*caroliniana*	Blue hyssop	Native
Scrophulariales	Scrophulariaceae	*Bacopa*	*monnieri*	Smooth water hyssop	Native
Solanales	Solanaceae	*Lycopersicon*	*esculentum*	Tomato	Crop
Typhales	Typhaceae	*Typha*	*latifolia*	Cattail	Native
Zingiberales	Zingiberaceae	*Renealmia*	*cernua*	Red renealmia	Exotic
Zingiberales	Zingiberaceae	*Alpina*	*nutans*	Shell ginger	Exotic
Zingiberales	Zingiberaceae	*Curcuma*	*zedoaria*	Tumeric	Exotic
Zingiberales	Zingiberaceae	*Zingiber*	*officinale*	Ginger	Exotic
Zingiberales	Zingiberaceae	*Hedychium*	*coronarium*	Garland lily	Exotic

Category 7—Any Species on which *M. scutellaris* Or Its Close Relatives Are Found.

Plant Order, Family, Genus, and Species	*Megamelus scutellaris* relatives (same genus)	Status in N. America
Nymphaeales, Nymphaeaceae, *Nymphaeae ordorata*	*M. davisii* Van Duzee	Native
Nymphaeales, Nymphaeaceae, *Nuphar luteum*	*M. davisii* Van Duzee	Native
Commelinales, Pontederiaceae, *Pontederia cordata*	*M. palaetus* (Van Duzee) *M. bellicus*	Native Exotic
Hydrocharitales, Hydrocharitaceae, *Limnobium spongia*	*M. timehri*	Native

c. Laboratory Tests

(1) Oviposition Testing

In no-choice oviposition testing, in which *M. scutellaris* is provided only non-target plants as an oviposition choice, adults did oviposit into other non-target plant species before they died and nymphs did emerge from five species. Oviposition occurred on *Eichhornia paniculata* (exotic), *Heteranthera dubia* (native), *H. rotundifolia* (native), *Monochoria vaginalis* (exotic), and *Pontederia cordata* (native) (appendix 1). All of these species occur within the same genus or subfamily as water hyacinth. The species and the mean (± standard error (SE)) number of emerged nymphs were *Eichhornia paniculata* (17.2 ± 4.7), *Heteranthera dubia* (4.4 ± 1.7), *H. rotundifolia* (2.7 ± 2.7), *Monochoria vaginalis* (6.0 + 4.3), and *Pontederia cordata* (0.2 ± 0.2). In contrast, 143.2 ± 6.6 nymphs emerged per water hyacinth plant.

In choice oviposition tests, where *M. scutellaris* was provided a choice of either the non-target host plant or water hyacinth for oviposition, three close relatives were tested—*Eichhornia paniculata, Heteranthera rotundifolia,* and *Pontederia cordata* (appendix 2). Nymph emergence occurred only on *E. paniculata* and *P. cordata*.

(2) Feeding and Survival Testing

To test the potential for *M. scutellaris* to feed on non-target plants if water hyacinth were removed from a site by flooding, drought, or herbicides (a spill-over event), large-nymph transfer tests were conducted. Fifty-nine plants were tested to evaluate large-nymph survival for 7 days. Ten plants, 6 in the Pontederiaceae, supported some survival of large nymphs for 7 days (appendix 3). All test species which supported large nymph survival for 7 days were tested using small nymphs, as well as *P. cordata.* Small nymphs were able to survive and develop only on *H. dubia* and *E. paniculata* (appendix 4). Only a single nymph survived on *H. dubia* after 21 days, and it failed to develop into an adult. Only one nymph was able to develop to adulthood on *E. paniculata,* although most of the surviving nymphs did develop into larger nymphs.

Emerged nymphs were transferred to non-target plant species (appendix 4). A mean percentage (± SE) of 78.2 ± 1.1 percent of nymphs survived to adulthood on water hyacinth while none survived on the other non-target transfer plants except for *E. paniculata*, where 37.5 percent survived to adulthood. Those adults were unable to survive on *E. paniculata* for more than a few days, while 92.3 percent of those adults survived on water hyacinth during the same period.

(3) Discussion

Megamelus scutellaris was unable to sustain populations on any test plant. It is also unlikely to cause problems during spill-over events that may be triggered by perturbations, such as herbicide application, because survival was virtually nonexistent on associated wetland plants regardless of taxonomic distances. It might be possible for displaced adults or nymphs to temporarily feed on the native plant *H. dubia* (grassleaf mudplantain) should the plant be nearby and have foliage floating on the surface. The majority of biomass in this species is submerged and, therefore, any minor feeding is unlikely to damage the plant.

Heteranthera dubia did not support development of *M. scutellaris* to adulthood. The greatest amount of survival occurred on the exotic species *E. paniculata* (Brazilian water hyacinth), which is also a suboptimal host. The native aquatic plant *P. cordata* (pickerelweed) was an unsuitable host because adults and nymphs were unable to survive on it for 7 days.

(4) Accidental Transmission of Plant Viruses

Some insects in the family Delphacidae can transmit viruses from one plant to another. Of the 1,100 known delphacid species, only 27 species have been documented to experimentally transmit plant viruses (Nault, 1994).

There is no evidence of *M. scutellaris* transmitting any virus diseases within or without the water hyacinth system. Water hyacinth pathogens (fungi, such as *Uredo eichhorniae* (Charudattan, 2001)) have received a great deal of attention over the decades from researchers seeking biological antagonists for this weed; however, there are no records of viruses or virus-like diseases in water hyacinth.

2. Uncertainties Regarding the Environmental Release of *M. scutellaris*

Once a biological control agent, such as *M. scutellaris*, is released into the environment and becomes established, there is a slight possibility that it could move from the target plant (water hyacinth) to attack non-target plants, such as the native plant *P. cordata* or *H. dubia.* Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000). Native species closely related to the target species are the most likely to be attacked (Louda et al., 2003). If other plant species were to be attacked by *M. scutellaris*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents, such as *M. scutellaris*, generally spread without intervention by man. In principle, therefore, release of this biological control agent at even one site must be considered equivalent to release over the entire area in which potential hosts occur, and in which the climate is suitable for reproduction and survival.

In addition, these agents may not be successful in reducing water hyacinth populations in the continental United States. Worldwide, biological weed control programs have had an overall success rate of 33 percent; success rates have been considerably higher for programs in individual countries (Culliney, 2005). Actual impacts on water hyacinth by *M. scutellaris* will not be known until after release occurs and post-release monitoring has been conducted.

3. Cumulative Impacts

"Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agencies or person undertakes such other actions" (40 CFR 1508.7).
In the late 1890s, water hyacinth was beginning to block navigable waters in several Southern States. In 1899, Congress authorized the U.S. Army Corps of Engineers (USACE) to remove water hyacinth from navigable waters in Florida and Louisiana. Because of its persistence, water hyacinth removal from waterways became an ongoing function of the USACE. Herbicide and biological control research is being conducted for

USACE by USDA at Ft. Lauderdale, Florida. Since 1960, a cooperative program with the State of Florida Game and Fresh Water Fish Commission has been in place to control water hyacinth.

In Texas, the Texas Parks and Wildlife Department controls water hyacinth throughout Texas using mechanical controls and herbicides.

In California, State legislation in 1982 designated Cal Boating as the lead agency for controlling water hyacinth in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh. Herbicides are used to control water hyacinth.

In Louisiana, the Louisiana Department of Wildlife and Fisheries is charged with the responsibility of controlling water hyacinth in Louisiana's public waters. Chemical control began in 1946, and biological controls are used. Biological control agents were first introduced into Louisiana in 1974 (Manning, 1979).

Release of *M. scutellaris* is not expected to have any negative cumulative impacts in the continental United States because of its host specificity to water hyacinth. Effective biological control of water hyacinth will have beneficial effects for weed management programs, and may result in a long-term, non-damaging method to assist in the control of water hyacinth, and prevent its spread into other areas potentially at risk from invasion.

4. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of critical habitat.

APHIS has determined that, based on the host specificity of *M. scutellaris,* there will be no effect on any listed plant or designated critical habitat in the continental United States. In host specificity testing, the biological control organism oviposited and nymphs survived only on plants within the same genus or subfamily as water hyacinth. No federally listed threatened or endangered plants belong to the family Pontederiaceae (USFWS, TESS, 2009). In addition, no federally listed threatened or endangered species are known to depend on or use water hyacinth.

V. Other Issues

Consistent with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. There are no adverse environmental or human health effects from the field release of *M. scutellaris*, and their release will not have disproportionate adverse effects to any minority or low-income populations.

Consistent with EO 13045, "Protection of Children From Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. No circumstances that would trigger the need for special environmental reviews are involved in implementing the preferred alternative. Therefore, it is expected that no disproportionate effects on children are anticipated as a consequence of the field release of *M. scutellaris*.

EO 13175, "Consultation and Coordination with Indian Tribal Governments," was issued to ensure that there would be "meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications…." In June 2009, APHIS sent out letters to potentially affected tribal leaders and organizations to give notification of the proposed environmental release of *M. scutellaris* and to request input from tribes. APHIS will continue to consult and collaborate with Indian tribal officials to ensure that they are well-informed and represented in policy and program decisions that may impact their agricultural interests, in accordance with EO 13175.

VI. Agencies, Organizations, and Individuals Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *M. scutellaris* on February 2, 2009. TAG members that reviewed the release petition (Tipping et al., 2008) included representatives from the Bureau of Indian Affairs, Cooperative State Research, Education, and Extension Service, U.S. Geological Survey, Environmental Protection Agency, California Department of Food and Agriculture, U.S. Army Corps of Engineers, Bureau of Reclamation, U.S. Forest Service, and Agriculture and Agri-Food Canada, Health Canada.

This EA was prepared and reviewed by APHIS. The addresses of participating APHIS units, cooperators, and consultants (as applicable) follow.

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Animal and Plant Health Inspection Service
Policy and Program Development
Environmental and Risk Analysis Services
4700 River Road, Unit 149
Riverdale, MD 20737

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Registrations, Identification, Permits, and Plant Safeguarding
4700 River Road, Unit 133
Riverdale, MD 20737

U.S. Department of Agriculture
Agricultural Research Service
Invasive Plants Research Lab
3205 College Avenue
Fort Lauderdale, FL 33314

VII. References

Asche, M., 1985. Zur phylogenie der Delphacidae Leach, 1815 (Homoptera Cicadina Fulgoromorpha). Marburger Entomol. Pub. 2:1–910.

Barrett, S.C.H., and Forno, I.W., 1982. Style morph distribution in New World populations of *Eichhornia crassipes* (Mart.) Solms-Laubach (water hyacinth). Aquatic Botany. 13:299–306.

Barrett, S.C.H., and Graham, S.W., 1997. Adaptive radiation in the aquatic plant family Pontederiaceae: insights from phylogenetic analyses. Givnish, T.J. and Systma, K.J., eds., 225–258. In *Molecular evolution and adaptive radiation*. Cambridge University Press, Cambridge, England.

Center, T.D., 1994. Biological control of weeds: water hyacinth and waterlettuce. Rosen, D., Bennett, F.D., and J. L. Capinera, J.L., eds. 481–521. In *Pest management in the subtropics: biological control - a Florida perspective*. Intercept Publ. Co., Andover, United Kingdom.

Center, T.D., and Spencer, N.R., 1981. The phenology and growth of water hyacinth (*Eichhornia crassipes* (Mart.) Solms) in a eutrophic north-central Florida lake. Aquatic Botany. 10:1–32.

Center, T.D., Dray, Jr., F.A., Jubinsky, G.P., and Leslie, A.J., 1999a. Water hyacinth weevils (*Neochetina eichhorniae* and *N. bruchi*) inhibit water hyacinth (*Eichhornia crassipes*) colony development. Biological Control. 15:39–50.

Center, T.D., Dray. Jr., F.A., Jubinsky, G.P., and Grodowitz, M.J., 1999b. Insects and other arthropods that feed on aquatic and wetland plants. USDA–ARS technical bulletin 1870.

Charudattan, R., 2001. Biological control of water hyacinth by using pathogens: opportunities, challenges, and recent developments. Julien, M.H., Hill, M.P., Center, T.D., and Jinaqing, D., eds., 21–28. In *Biological and integrated control of water hyacinth, Eichhornia crassipes.* ACIAR Proceedings 102.

Cofrancesco, A.F., Stewart, R.M., and Sander, D.R., 1985. The impact of *Neochetina eichhorniae* (Coleoptera: Curculionidae) on water hyacinth in Louisiana. In *Proceedings of the VI International Symposium on biological control of weeds,* 525–535. August 19–25, 1984, Vancouver, Canada. Agriculture Canada, Ottawa, Ontario, Canada.

Cruttwell, R.E., 1973. Preliminary investigations on some insects causing minor damage to water hyacinth, *Eichhornia crassipes*. Report West Indian Station, CIBC.

Culliney, T.W., 2005. Benefits of classical biological control for managing invasive plants. Critical Reviews in Plant Sci. 24:131–150.

Dahlgren, R.M.T., Rosendal-Jensen, S., and Nielsen, B.J., 1981. A revised classification of the angiosperms with comments on the correlations between chemical and other characteristics. Young, D.A. and Seigler, D.S., eds., 149–204. In: *Phytochemistry and Angiosperm Phylogeny*. Praeger Scientific, New York.

Eckenwalder, J.E., and Barrett, S.C.H., 1986. Phylogenetic systematics of Pontederiaceae. Systematic Botany. 11: 373–391.

Gibbons, M.V., Rosenkranz, M.G., Gibbons, Jr., H.L., and Systma, M.D., 1999. Guide for developing integrated aquatic vegetation management in Oregon. Center for Lakes and Reservoirs, Portland State University, Portland, OR.

Gopal, B., 1987. *Water hyacinth.* Elsevier, New York.

Gowanloch, J.N., and Bajkov, A.D., 1948. Water hyacinth program. Louisiana Department of Wildlife and Fisheries, Biennial Report (1946/1947). 2:66–124.

Goyer, R.A., and Stark, J.D., 1984. The impact of Neochetina eichhorniae on water hyacinth in southern Louisiana. J. Aquatic Plant Mgmt. 22:57–61.

Horn, C., 2002. Pontederiaceae. Argus, G.W., Ghandi, K., Goldblatt, P., Hess, W.J., Kiger, R.W., Strother, J.L., Utech, F.H., and Zarucchi, J.L., eds. In: *Flora of North America*. Oxford University Press, New York. 26:37–46.

International Organization for Plant Information, 2002. IOPI global plant checklist, [Online]. Available: http://bgbm3.bgbm.fu-berlin.de/iopi/gpc/default.asp [2009, Mar. 9].

IOPI─See International Organization for Plant Information

Julien M.H., Harley, K.L.S., Wright, A.D., Cilliers, C.J., Hill, M.P., Center, T.D., Cordo, H.A., and Cofrancesco, A.F., 1996. International cooperation and linkages in the management of water hyacinth with emphasis on biological control. Moran, V.C. and Hoffman, J.H., eds., 273–282. Cape Town, South Africa, University of Cape Town. Proceedings of the 9th International Symposium on Biological Control of Weeds.

Kasselmann, C., 1995. *Aquarienpflanzen.* Egen Ulmer GMBH & Co., Stuttgart. 472 pp. (In German)

Louda, S.M., Pemberton, R.W., Johnson, M.T., and Follett, P.A., 2003. Nontarget effects—the Achilles' heel of biological control. Retrospective analyses to reduce risk associated with biological control introductions. Annual Rev. Entomol. 48: 365–396.

Manning, J.H., 1979. Establishment of water hyacinth weevil populations in Louisiana. J. Aquatic Plant Mgmt. 17:39–41.

Matthews, L.J., 1967. Seedling establishment of water hyacinth. PANS(C). 13(1):7–8.

MBG─See Missouri Botanical Garden

Missouri Botanical Garden, 2002. In *Tropicos nomenclatural data base* Online]. Available: http://www.tropicos.org/ [2009, Mar. 9].

Mitchell, D.S., 1976. The growth and management of *Eichhornia crassipes* and *Salvinia spp.* in their native environment and in alien situations. Varshney CK, Rzoska J, eds. In: *Aquatic Weeds in Southeast Asia*. The Hague: Dr. W. Junk b.v., Publishers. 396 pp.

Müller, F., 1883. Einige Eigenthümlichkeiten der *Eichornia crassipes*. Kosmos. 13:297–300.

Nault, N. R., 1994. Transmission biology, vector specificity, and evolution of planthopper-transmitted viruses. In *Planthoppers. Their Ecology and Management.* Denno, R.F. and Perfect, T.J., eds., 429–448. Chapman and Hall, New York.

O'Brien, L. B. and Wilson, S.W., 1985. Planthopper systematics and external morphology. In *The leafhoppers and planthoppers.* Nault, L.R., and Rodrigues, J.G., eds., 61–101. Wiley, New York.

Pemberton, R.W., 2000. Predictable risk to native plants in weed biological control. Oecologia, 125:489–494.

Schmitz, D.C., Schardt, J.D., Leslie, A.G., Dray, F.A., Osborne, J.A., and Nelson, B.V., 1993. The ecological impact and management history of three invasive alien aquatic plants in Florida. In *Biological pollution—the control and impact of invasive exotic species.* McKnight, B.N., ed., Indianapolis: Indiana Academy Sci. 261 pp.

Sogawa, K., 1982. The rice brown planthopper: feeding physiology and host plant interactions. Annual Rev. Entomol. 27: 49–73.

Sosa, A.J., Marino de Remes Lenicov, A.M., Mariani, R., and Cordo, H.A., 2004. Redescription of *Megamelus scutellaris* Berg (Hemiptera: Delphacidae), a candidate for biological control of water hyacinth. Annals Entomol. Soc. America. 97:271–275.

Sosa, A.J., Marino de Remes Lenicov, A.M., Mariani, R., and Cordo, H.A., 2005. Life history of *Megamelus scutellaris* with description of immature stages (Hemiptera: Delphacidae). Annals Entomol. Soc. America. 98:66–72.

Sosa, A.J., Cordo, H.A., and Sacco, J., 2007a. Prelminary evaluation of *Megamelus scutellaris* Berg (Hemiptera: Delphacidae), a candidate for biological control of water hyacinth. Biological Control. 42:129–138.

Sosa, A.J., Marino de Remes Lenicov, A.M., and Mariani, R., 2007b. Species of *Megamelus* (Hemiptera: Delphacidae) associated with Pontederiaceae in South America. Annals Entomol. Soc. America, 100:798–809.

Spiller, N.J., 1990. An ultrastructural study of the stylet pathway of the brown planthoper, *Nilaparvata lugens* Stål. Entomol. Exp. Appl. 54: 191–193.

Tipping, P.W., Center, T.D., and Dray, Jr., F.A., 2008. Proposed field release of *Megamelus scutellaris* Berg (Hemiptera: Delphacidae) for control of water hyacinth *Eichhornia crassipes* Mart. (Solms) (Pontederiales: Pontederiaceae). Petition submitted to the Technical Advisory Group for Biological Control Agents of Weeds. 34 pp.

U.S. Department of Agriculture, 1997. The PLANTS database, version 3.5 [Online]. Available: http://plants.usda.gov [2009, Mar. 9]. USDA Natural Resource Conservation Service, National Plant Data Center, Baton Rouge, LA.

U.S. Fish and Wildlife Service, 2009. Threatened and Endangered Species System, 2009 [Online]. Available: http://ecos.fws.gov/tess_public/ [2009, Feb. 12].

USDA─See U.S. Department of Agriculture

USFWS, TESS─See U.S. Fish and Wildlife Service, Threatened and Endangered Species System.

Vandiver, V.V., Center, T.D., Dray, F.A., Hall, D.W., Bagnall, L.O., Sutton, D.L., Neitzke, C.J., Eplee, R.E., and Teem, D.H., 1999. 1999 Florida aquatic weed guide. SP–55, University of Florida, Inst.Food and Agric. Sci., Gainesville, Florida.

Washington State Department of Ecology, 2001. Final supplemental environmental impact statement for freshwater aquatic plant management. Pub. No. 00–10–040.

WSDE─See Washington State Department of Ecology

Appendix A. Results of No-choice Oviposition Tests

Two females and one male *M. scutellaris* (7 to 10 days of age) were placed on single plants for a period of 7 days. The percentage of adults (%P1 Survival), the number of emerged F1 nymphs (No. Progeny), and their survival (% F1 Nymph Survival) were recorded or calculated. All tests involving non-target plant species were replicated four times. Shaded rows indicate plant species oviposited on by *M. scutellaris* and nymphs emerged. Nymphs survived only on the exotic plant *Eichhornia paniculata.*

			% P1 Survival				No. Progeny				% F1 Nymph Survival			
			Test Species		Water Hyacinth		Test Species		Water Hyacinth		Test Species		Water Hyacinth	
	Genus	Species	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
1	Commelina	benghalensis	0.0	0.0	91.7	8.3	0.0	0.0	36.5	4.9	-	-	-	-
2	Commelina	erecta	0.0	0.0	93.9	3.8	0.0	0.0	200.6	31.7	-	-	-	-
3	Eichhornia	diversifolia	0.0	0.0	93.9	3.8	0.0	0.0	200.6	31.7	-	-	-	-
4	Eichhornia	paniculata	8.3	8.3	100.0	0.0	17.2	4.7	176.0	10.7	1.1	1.1	82.5	0.7
5	Heteranthera	dubia	0.0	0.0	93.9	3.8	4.4	1.7	200.6	31.7	0.0	0.0	-	-
6	Heteranthera	multiflora	0.0	0.0	91.7	8.3	0.0	0.0	89.5	13.1	-	-	-	-
7	Heteranthera	reniformis	0.0	0.0	93.9	3.8	0.0	0.0	200.6	31.7	-	-	-	-
8	Heteranthera	rotundifolia	0.0	0.0	91.7	8.3	2.7	2.7	89.5	13.1	0.0	0.0	-	-
9	Heteranthera	zosterfolia	0.0	0.0	93.9	3.8	0.0	0.0	200.6	31.7	-	-	-	-
10	Monochoria	vaginalis	0.0	0.0	91.7	8.3	6.0	4.3	89.5	13.1	0.0	0.0	-	-
11	Pontederia	cordata	0.0	0.0	91.7	8.3	0.2	0.2	113.7	26.8	0.0	0.0	50.0	7.0
12	Echinodorus	chordifolus	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
13	Sagittaria	falcate	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
14	Sagittaria	latifolia	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
15	Crinum	americanum	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
16	Hydrocotyle	umbellate	0.0	0.0	91.7	8.3	0.0	0.0	36.5	4.9	-	-	-	-
17	Colocasia	esculenta	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
18	Orontium	aquaticum	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
19	Peltandra	virginica	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
20	Azolla	caroliniana	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
21	Canna	flaccida	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
22	Nasturtium	aquaticum	0.0	0.0	91.7	8.3	0.0	0.0	113.7	26.8	-	-	50.0	7.0
23	Eriocaulon	compressum	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
24	Proserpinaca	palustris	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
25	Limnobium	spongia	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
26	Iris	hexagona	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
27	Lemna	minor	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
28	Thalia	geniculata	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
29	Marsilea	mutica	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
30	Nymphoides	aquatica	0.0	0.0	91.7	8.3	0.0	0.0	36.5	4.9	-	-	-	-
31	Neptunia	aquatica	0.0	0.0	91.7	8.3	0.0	0.0	113.7	26.8	-	-	50.0	7.0

			% P1 Survival				No. Progeny				% F1 Nymph Survival			
			Test Species		Water Hyacinth		Test Species		Water Hyacinth		Test Species		Water Hyacinth	
	Genus	Species	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
32	Nelumbo	lutea	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
33	Nuphar	luteum	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
34	Nymphaea	oderata	0.0	0.0	91.7	8.3	0.0	0.0	113.7	26.8	-	-	50.0	7.0
35	Nymphaea	mexicana	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	92.3	4.8
36	Ludwigia	glandulosa	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
37	Ludwigia	peploides	0.0	0.0	91.7	8.3	0.0	0.0	113.7	26.8	-	-	-	-
38	Dendrobium	sp.	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
39	Epidendrum	sp.	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
40	Vanilla	planifolia	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
41	Saururus	cernuus	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
42	Bacopa	caroliniana	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
43	Bacopa	monnieri	0.0	0.0	91.7	8.3	0.0	0.0	113.7	26.8	-	-	-	-
44	Typha	latifolia	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
45	Costus	woodsonii	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
46	Glycine	max	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
47	Oryza	sativa	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
48	Musa	sp.	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
49	Saccharum	officinarum	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
50	Sorghum	bicolor	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
51	Triticum	aestivum	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
52	Zea	mays	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
53	Lycopersican	esculentum	0.0	0.0	100.0	0.0	0.0	0.0	176.0	10.7	-	-	82.5	0.7
54	Alpina	natans	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
55	Globba	schomburkii	0.0	0.0	83.4	16.6	0.0	0.0	154.5	22.9	-	-	-	-
56	Hedychium	coronarium	0.0	0.0	91.7	8.3	0.0	0.0	164.0	24.4	-	-	-	-
57	Renealmia	cernua	0.0	0.0	91.7	8.3	0.0	0.0	89.5	13.1	-	-	-	-

Source: Tipping, et al., 2008.

Appendix B. Results of Choice Oviposition Testing

Two females and one male *M. scutellaris* (7 to 10 days of age) were placed in an aquarium with a single non-target test plant and a single water hyacinth plant of similar size for a period of 7 days. The number of emerged nymphs (No. Progeny), their percent survival (%F1 Nymph Survival), and the percent survival of adults (%F1 Adult Survival) were recorded or calculated.

		No. Progeny				% F1 Nymph Survival				% F1 Adult Survival			
Genus	Species	Test Species		Water Hyacinth		Test Species		Water Hyacinth		Test Species		Water Hyacinth	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Eichhornia	*paniculata*	1.5	0.9	121.5	14.6	37.5	12.5	82.5	8.5	0.0	0.0	92.3	4.8
Heteranthera	*rotundifolia*	0	0.0	57.2	22.9	0.0	0.0	84.5	1.3	-	-	-	-
Pontederia	*cordata*	0.3	0.3	168.5	16.9	0.0	0.0	85.0	2.8	-	-	-	-

All tests were replicated four times. Adults emerged only from *Eichhornia paniculata.*

Source: Tipping, et al., 2008.

Appendix C. Results of No-choice Large Nymph Transfer Tests (spill-over scenario)

Ten 3rd to 5th instars were placed on single test plants in sleeve cages for 7 days. The number of surviving life stages were tallied after 7 days, and the percentage of large nymph survival was calculated. Tests were replicated at least four times. Shaded rows indicate species that supported some survival of large nymphs for 7 days.

				% Large Nymph Survival					
				Number Tested	Test Species		Number Tested	Water Hyacinth	
	Family	Genus	Species		Mean	SE		Mean	SE
1	Commelinaceae	Commelina	bengalensis	40	0.0	0.0	40	87.5	0.6
2	Commelinaceae	Commelina	erecta	50	0.0	0.0	50	28.0	13.0
3	Commelinaceae	Tradescantia	ohiensis	50	0.0	0.0	50	96.0	5.0
4	Pontederiaceae	Eichhornia	paniculata	50	5.8	4.0	50	66.9	4.8
5	Pontederiaceae	Heteranthera	dubia	50	88.0	5.8	50	66.9	4.8
6	Pontederiaceae	Heteranthera	limosa	50	12.0	5.8	50	86.6	6.9
7	Pontederiaceae	Heteranthera	multiflora	50	2.0	2.0	50	74.0	4.0
8	Pontederiaceae	Heteranthera	peduncularis	40	0.0	0.0	50	83.0	9.2
9	Pontederiaceae	Heteranthera	reniformis	50	0.0	0.0	50	66.9	4.8
10	Pontederiaceae	Heteranthera	zosterfolia	50	28.0	15.0	50	86.6	6.9
11	Pontederiaceae	Monochoria	vaginalis	50	10.0	6.3	50	66.9	4.8
12	Pontederiaceae	Pontederia	cordata	50	0.0	0.0	50	80.0	5.5
13	Alismataceae	Echinodorus	chordifolus	50	0.0	0.0	50	30.0	7.1
14	Alismataceae	Sagittaria	falcata	50	10.0	7.7	50	78.0	7.3
15	Alismataceae	Sagittaria	latifolia	50	0.0	0.0	50	80.0	5.5
16	Amaryllidaceae	Crinum	americanum	50	0.0	0.0	50	96.0	4.0
17	Araceae	Colocasia	esculenta	50	0.0	0.0	50	83.0	9.2
18	Araceae	Colocasia	sp.	50	0.0	0.0	50	74.0	4.0
19	Araceae	Hydrocotyle	umbellata	40	0.0	0.0	40	87.5	0.6
20	Araceae	Orontium	aquaticum	50	0.0	0.0	50	28.0	13.0
21	Araceae	Peltandra	virginica	50	0.0	0.0	50	96.0	5.0
22	Araceae	Pistia	stratiotes	50	0.0	0.0	50	83.0	9.2
23	Azollaceae	Azolla	caroliniana	50	0.0	0.0	50	83.0	9.2
24	Cannaceae	Canna	flaccida	50	0.0	0.0	50	86.6	6.9
25	Cruciferae	Nasturtium	aquaticum	50	0.0	0.0	50	96.0	5.0
26	Eriocaulaceae	Eriocaulon	compressum	50	0.0	0.0	50	76.0	6.7
27	Haloragaceae	Myriophyllum	aquaticum	50	0.0	0.0	50	86.6	6.9
28	Haloragaceae	Proserpinaca	palustris	50	0.0	0.0	50	86.6	6.9
29	Hydrocharitaceae	Limnobium	spongia	50	0.0	0.0	50	83.0	9.2
30	Iridaceae	Iris	hexagona	50	0.0	0.0	50	83.0	9.2
31	Lemnaceae	Lemna	minor	50	0.0	0.0	50	83.0	9.2
32	Marantaceae	Thalia	geniculata	50	0.0	0.0	50	80.0	5.5
33	Marsileaceae	Marsilea	quadrifolia	50	0.0	0.0	50	96.0	4.0

				% Large Nymph Survival					
				Number Tested	Test Species		Number Tested	Water Hyacinth	
	Family	Genus	Species		Mean	SE		Mean	SE
34	Menyanthaceae	Nymphoides	aquatica	50	6.0	6.0	50	83.0	9.2
35	Mimosaceae	Neptunia	aquatica	50	0.0	0.0	50	96.0	5.0
36	Nymphaeaceae	Nuphar	luteum	50	0.0	0.0	50	83.0	9.2
37	Nymphaeaceae	Nymphaea	oderata	50	0.0	0.0	50	78.0	7.3
38	Nymphaeaceae	Nymphaea	mexicana	50	0.0	0.0	50	83.0	9.2
39	Onagraceae	Ludwigia	glandulosa	50	0.0	0.0	50	66.9	4.8
40	Onagraceae	Ludwigia	peploides	50	4.0	2.4	50	86.6	6.9
41	Orchidaceae	Dendrobium	sp.	50	0.0	0.0	50	83.0	9.2
42	Orchidaceae	Vanilla	planifolia	50	0.0	0.0	50	74.0	4.0
43	Saururaceae	Saururus	cernuus	50	0.0	0.0	50	96.0	4.0
44	Scrophulariaceae	Bacopa	caroliniana	50	0.0	0.0	50	66.9	4.8
45	Scrophulariaceae	Bacopa	monnieri	50	0.0	0.0	50	66.9	4.8
46	Typhaceae	Typha	latifolia	50	2.0	2.0	50	86.6	6.9
47	Costaceae	Costus	woodsonii	50	0.0	0.0	50	76.0	6.7
48	Fabaceae	Glycine	max	50	0.0	0.0	50	76.0	6.7
49	Graminaceae	Oryza	sativa	50	0.0	0.0	50	28.0	13.0
50	Musaceae	Musa	sp.	50	0.0	0.0	50	83.0	9.2
51	Poaceae	Saccharum	officinarum	50	0.0	0.0	50	74.0	4.0
52	Poaceae	Sorghum	bicolor	50	0.0	0.0	50	76.0	6.7
53	Poaceae	Triticum	aestivum	50	0.0	0.0	50	76.0	6.7
54	Poaceae	Zea	mays	50	0.0	0.0	50	96.0	5.0
55	Solanaceae	Lycopersican	esculentum	50	0.0	0.0	50	74.0	4.0
56	Zingiberaceae	Alpina	natans	50	0.0	0.0	50	96.0	5.0
57	Zingiberaceae	Curcuma	zedoaria	50	0.0	0.0	50	83.0	9.2
58	Zingiberaceae	Hedychium	coronarium	50	0.0	0.0	50	83.0	9.2
59	Zingiberaceae	Renealmia	cernua	50	0.0	0.0	50	28.0	13.0

Source: Tipping, et al., 2008.

Appendix D. Results of the No-choice, Small-nymph Transfer Tests

Ten 1st to 3rd instars were placed on single test plants in sleeve cages. The tests ended when all nymphs developed into adults in the water hyacinth controls and the number of surviving life stages were tallied. The percentage of small nymphs that survived was calculated. All tests were replicated four times. Shaded rows indicate species where *M. scutellaris* nymphs were able to survive and develop.

				% Small Nymph Survival					
				Test Species			Water Hyacinth		
	Family	Genus	Species	No. Tested	Mean	SE	No. Tested	Mean	SE
1	Pontederiaceae	Eichhornia	paniculata	50	22.0	7.3	50	78.0	7.3
2	Pontederiaceae	Heteranthera	dubia	50	2.0	2.0	50	78.0	7.3
3	Pontederiaceae	Heteranthera	limosa	50	0.0	0.0	50	34.0	13.2
4	Pontederiaceae	Heteranthera	peduncularis	50	0.0	0.0	50	34.0	13.2
5	Pontederiaceae	Heteranthera	reniformis	50	0.0	0.0	50	78.0	7.3
6	Pontederiaceae	Heteranthera	zosterfolia	50	0.0	0.0	50	34.0	13.2
7	Pontederiaceae	Monochoria	vaginalis	50	0.0	0.0	50	78.0	7.3
8	Pontederiaceae	Pontederia	cordata	50	0.0	0.0	50	30.0	7.1
9	Pontederiaceae	Pontederia	cordata	50	0.0	0.0	50	78.0	7.3
10	Alismataceae	Echinodorus	chordifolus	50	0.0	0.0	50	30.0	7.1
11	Alismataceae	Sagittaria	falcata	50	0.0	0.0	50	28.0	8.0
12	Onagraceae	Ludwigia	peploides	50	0.0	0.0	50	34.0	13.2
13	Typhaceae	Typha	latifolia	50	0.0	0.0	50	34.0	13.2

Source: Tipping, et al., 2008.

Appendix E. Response to comment on draft EA

The Arizona Game and Fish Department submitted a comment on draft environmental assessment for release of *M. scutellaris* for biological control of water hyacinth on December 16, 2009. Specific issues are indicated in bold text and the response follows.

The commenter recommends that USDA clearly identify how release sites will be chosen and if interagency coordination will occur prior to release, and to describe how rapidly the beetle is expected to reproduce and spread to adjacent habitats prior to this release and include methods of control once it has been released.

The agent for release is not a beetle but is a planthopper in the insect order Hemiptera. Permit applications for environmental release of this organism are submitted to the appropriate state department of agriculture for review and comment prior to permit issuance.

Monitoring of *M. scutellaris* will be conducted by researchers at the USDA-ARS Invasive Plant Research Laboratory. Four long term sites currently serving as ecological study sites in Florida will become the first release and evaluation sites for *M. scutellaris*. Establishment and rates of spread in the field will be determined.

Undesired effects of *M. scutellaris* are not predicted, so mitigation of local populations is not expected. However, the planthopper's narrow host range suggests that locally undesirable effects could be mitigated by using herbicides to eliminate water hyacinth infestations on which the insect resides.

The commenter has suggested that USDA develop a strategy to identify where "tamarisk" will be suppressed but native vegetation may not reestablish naturally due to altered hydrology. Also, the commenter has indicated that USDA develop a vegetation monitoring protocol to determine the response on the riparian plant community and to document evidence of native tree recruitment and survival.

Water hyacinth is an aquatic plant and its removal would not require subsequent riparian plant restoration projects. Removal of water hyacinth is not expected to have an impact on native tree recruitment and survival.

The commenter raises general concerns regarding unexpected effects of biological control agents, and in particular, the potential for host shifting.

Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000).

The commenter uses the tamarisk leaf beetle as an example of a biological control agent that has exhibited unexpected behavior. However, the commenter is not completely correct in his statements regarding releases of the beetle. As for releases of vertebrate species as biological control agents, it is well known that this has often resulted in adverse environmental consequences. This practice is discouraged (Howarth, 1991) and APHIS does not approve it.

The commenter indicates that water hyacinth does not currently occur in Arizona, and that two sites where it has occurred have been eradicated since July of 2000.

Because *M. scutellaris* does not currently occur in Arizona, it would not likely be released in that State and would not likely spread there because its host (water hyacinth) does not occur there.

The commenter requests that an independent scientific review be completed concerning the ecology and behavior of this insect.

An independent review has occurred. The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *M. scutellaris* on February 2, 2009. The TAG is an independent interagency group of scientists and regulatory specialists that reviews the research petition submitted by the biological control researcher and provides a recommendation to APHIS. TAG members that reviewed the release petition (Tipping et al., 2008) included representatives from the Bureau of Indian Affairs, Cooperative State Research, Education, and Extension Service, U.S. Geological Survey, Environmental Protection Agency, California Department of Food and Agriculture, U.S. Army Corps of Engineers, Bureau of Reclamation, U.S. Forest Service, and Agriculture and Agri-Food Canada, Health Canada.

The commenter suggests that there is inherent risk in the use of biological control agents, and that home range testing and screening may not adequately address the ability of a biological control agent to use and cause considerable population level damage to non-target species.

The risk analysis provided by quarantine host range testing indicated that there would be no risk to non-target species. In contrast to the reviewer's comment, quarantine host range testing has repeatedly been shown to be highly predictive of the eventual environmental host range of biological control agents following release. The host specificity screening process used for biological control agents of weeds is inherently conservative which contributes to the good safety record of recent weed biological control introductions (Messing and Wright, 2006).

The commenter states that the EA fails to show that *M. scutellaris* could not persist on and affect native species in the genus *Heteranthera* and members of the Pontederiaceae.

The data are clear that *M. scutellaris* cannot sustain itself on *Heteranthera* species (Tipping et al., 2008). In all of the testing, only a single nymph of *M. scutellaris* was able to survive on *H. dubia* after 21 days, and this single nymph was never able to develop into an adult. Although insects can lay eggs on many plants, this is not evidence of utilization or future damage. For example, many lepidopteran species will freely lay eggs on cages or non-target plants that do not support growth and development by immatures. In host specificity testing, *M. scutellaris* failed to survive on all the non-target plant species, including all *Heteranthera* species.

The commenter indicated that the experiments were not thorough because only four repetitions using two females and one male were conducted.

The number of replications in any experimental design should be guided in large part by the amount of variation that is present. As a result of low variability, we believe four replications were appropriate as a part of the experimental design. Some studies were replicated five times as a response to increased variability.

Using only two females in the test minimized intraspecific competitive interactions which may have confounded the interpretation of the results. For example, adding too many females actually reduces oviposition, a condition that might underestimate the insect's host range.

The commenter states that *Heteranthera* species are used for cover, oviposition, and feeding sites, by certain frogs and salamanders, and that the EA did not address potential effects to these species from host shifting by *M. scutellaris*.

Many insect herbivores (including *M. scutellaris*) can survive on relatively few plant species, most of which are close relatives. These relationships between insect herbivores and their host plants have coevolved over millennia, resulting in insect herbivore diets that are as stable as they are predictable. Because it has been shown quantitatively that *M. scutellaris* will not develop on *Heteranthera* species in host specificity testing (Tipping et al., 2008) there is no reason to discuss potential impacts on amphibian and reptile species that may utilize *Heteranthera* species.

Control of water hyacinth is expected to benefit organisms in fresh water ecosystems and is not expected to negatively impact non-target organisms. No endangered or threatened organisms are dependent on water hyacinth. Large infestations of water hyacinth in small ponds have been implicated in causing declines in phytoplankton abundance (McVea and Boyd, 1975), which likely impacts zooplankton densities and diversity (Schmitz et al., 1993). Reduced plankton abundance and dissolved oxygen levels under modest water hyacinth infestations (10-25% cover) caused declines in fish productivity in experimental ponds (McVea and Boyd, 1975). Further, depleted oxygen levels under water hyacinth mats have been implicated in fish kills (Timmer and Weldon, 1967). Also, Griffen (1989) partially attributed declines in the federally endangered kite (*Rostrhamus sociabilis*) to destruction of kite habitat by water hyacinth. Thus, reductions in water hyacinth infestations would likely benefit a variety of native fauna.

References:

Griffen, J. 1989. The Everglades kite. Aquatics 11(3):17–19.

Howarth, F.G. 1991. Environmental impacts of classical biological control. Annual Review Entomology. 36:485–509.

McVea, C. and C.E. Boyd. 1975. Effects of waterhyacinth cover on water chemistry, phytoplankton, and fish in ponds. Journal of Environmental Quality 4(3): 375–378.

Messing, R.H. and M.G. Wright. 2006. Biological control of invasive species: solution or pollution? Front. Ecol. Environ. 4: 132–140.

Pemberton, R.W., 2000. Predictable risk to native plants in weed biological control. Oecologia, 125:489–494.

Schmitz, D.C., J.D. Schardt, A.J. Leslie, F.A. Dray Jr., J.A. Osborne, and B.V. Nelson. 1993. The ecological impact and management history of three invasive alien aquatic plant species in Florida, pp.173–194. *In*: McKnight, B.N. Biological Pollution: The control and impact of invasive exotic species. Indiana Academy of Sciences, Indianapolis, Indiana.

Timmer, C.E. and L.W. Weldon. 1967. Evapotranspiration and pollution of water by waterhyacinth. Hyacinth Control Journal. 6:34–37.

Tipping, P.W., Center, T.D., and Dray, Jr., F.A., 2008. Proposed field release of *Megamelus scutellaris* Berg (Hemiptera: Delphacidae) for control of water hyacinth *Eichhornia crassipes* Mart. (Solms) (Pontederiales: Pontederiaceae). Petition submitted to the Technical Advisory Group for Biological Control Agents of Weeds. 34 pp.