A survey of insects inhabiting the invasive aquatic plant *Hydrilla verticillata* on the island of Dominica, W.I.

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Abstract

In this study, a survey of the insect fauna associated with the invasive aquatic weed of *Hydrilla verticillata* was conducted on the island of Dominica, West Indies. A total of seven families were collected, including Baetidae, Coenagrionidae, Naucoridae, Gerridae, Veliidae, Curculionidae, and Crambidae in two locations. Some specimens were further identified to genus. Collecting methods, results and interpretations of the aquatic study with respect to biological control are presented in this paper.

Keywords: Dominica, *Hydrilla verticillata*, invasive, aquatic, insects, biological control

Introduction

Hydrilla verticillata is a submersed, rooted aquatic plant that forms dense mats in freshwater habitats. Placed on the Federal Noxious Weed list by the United States Department of Agriculture, hydrilla is an invasive plant capable of significant ecological and economic damage. Hydrilla can form large monocultures that readily displace native vegetation and can alter the dissolved oxygen and pH levels in the body of water. Such growths can reduce the species diversity of both flora and fauna. Eradication of hydrilla is extremely difficult because chemical and mechanical removal are not environmentally appropriate and efficient enough. Forms of Biological Control against hydrilla have been initiated in the United States with candidates such as the *Bagous* Curculionidae, the *Hydrellia* Ephydridae, and the *Parapoynx* Pyralidae. Prior to initiating a biological control project, the target weed hydrilla is surveyed to determine what natural enemies are associated with the invaded area. The primary goal of the study was to survey areas on the island of Dominica that have been invaded by hydrilla for natural insect enemies as an initiation step to ready biological control action against the invasive aquatic weed.

Materials & Methods

A three week study concerning insects inhabiting invasive aquatic plants was conducted on the island of Dominica, West Indies, from May21 to June 7 2009. The majority of the survey took place at the Archbold Tropical Research and Education Center (ATREC), in Springfield, coordinates 15°20’33”N 61°22’41”W. Insects were collected with various techniques including mercury vapor light sheet, trapping, hand and aquatic sifting.

Collecting at Bee Pond at ATREC, coordinates 15°20’52”N 61°22’04”W, was done by entering the *H.verticillata* and hand collecting with a small micromesh fish net and tweezing into 20mL vials containing ethyl alcohol, as well as with the aquatic D-ring insect net. An *Edmunds 1976* aqua cage was constructed in an attempt to collect subimagos present in the *H. verticillata*. See Figure 4. Samples were taken 22-31 May 2009. A mercury vapor light sheet was setup on 28 May 2009 at Bee Pond, sampling by aspiration and placing specimens into 20MmL vials containing ethyl alcohol.

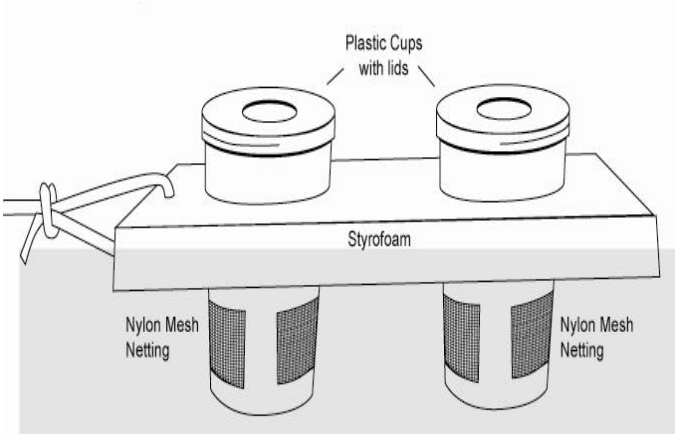

Figure 1 *Edmunds 1976* aqua cage

Sampling was done from the second *H. verticillata* location in the Blenheim River, St. Andrew Parish, coordinates 15°35’31”N 61°23’26”W. This was done by entering the *H.verticillata* and hand collecting with a small micromesh fish net and tweezing into 20mL vials containing ethyl alcohol, as well as with the aquatic D-ring insect net.

Voucher specimen of all species collected during this project have been deposited in the Insect Collection, Archbold Tropical Research and Education Center, Springfield, Dominica.

Results

A total of 112 specimens were collected from *H. verticillata*. The results were identified into Order and Family. Some groups were identified to Genus and Species. Specimens were collected at two different locations.

Location: Bee Pond				
Order	Family	Genus	Adult	Immature
Odonata	Coenagrionidae		2	5
Hemiptera	Naucoridae		9	0
	Gerridae		5	0
	Veliidae		5	21
Lepidoptera	Crambidae	*Parapoynx*	0	9
Ephemeroptera	Baetidae	*Callibaetis*	42	12
Coleoptera	Curculionidae	*Diaprepes*	1	0

Table 1 Insects collected by Order and Family from Bee Pond

Location: Blenheim River				
Order	Family	Genus	Adult	Immature
Ephemeroptera	Baetidae		0	7

Table 2 Insects collected by Order and Family from Blenheim River

Discussion

Most of the Family’s were collected by hand in the bodies of water, as shown by Table 1. However, the Family Baetidae was collected by aspiration on a mercury vapor

light sheet. The majority of the specimens collected from within the *H. verticillata* were immatures at various instar stages. Specimens collected from the plant at the water's surface were primarily adults morphologically.

Baetidae

Baetidae are a large, widespread family of Ephemeroptera. Baetidae mayflies are identifiable by elongated oval front wings and small or absent hind wings. Baetids differ from other mayflies sharing the small or absent hind wing characteristic in having only two caudal filaments, and only one or two short marginal veilets between the main longitudinal veins. In males, the eyes are divided with the upper portion turbinate (Triplehorn 2005).

Genus *Callibaetis*

Present in lentic waters, *Callibaeti*s are popular around vascular hydrophytes. They have the habit of being both swimmers and clingers. Their tropic relationship is as a collector/gather of filamentous algae (Merrit 2008).

Coenagrionidae

Coenagrionidae nymphs are found in bodies of water where they will complete their metamorphosis cycle. They will conceal themselves by climbing onto vascular plants waiting to feed. Nymphs usually have either 3-5 dorsal premental setae on each side of median. The adults range in length from 20-50mm. Most often the males are more brightly colored than females (Triplehorn 2005)(Merrit 2008)

Figure 2 Coenagrionidae, dorsal view

Naucoridae

Naucorids are brownish, broadly oval insects with the front femora greatly thickened. They may be found on submerged vegetation ready to feed on various small aquatic animals (Triplehorn 2005).

Figure 3 Naucoridae, dorsal view

Gerridae

Water striders, Gerridae, are long legged insects that live on the surface of the water. Their front legs are short and used for capturing food that falls on to the waters surface. The middle and hind legs are long, majoring in locomotion. The hind femora are long, exceeding the apex of the abdomen. Most species are dark (Triplehorn 2005)(Merrit 2008)

Figure 4 Gerridae, dorsal view

Veliidae

The family Veliidae is characterized in length by 1.6-5.5 mm and is usually wingless. The hind femora are usually short. Veliids live on the surface of the water and in some cases are gregarious (Triplehorn 2005).

Figure 5 Veliidae, dorsal view

Curculionidae

Cuculionidae is one of the largest families of animals with total world fauna greater that 60,000 species. Few of the species have invaded the aquatic environment. A majority of this family are plant feeders, both living and dead tissue. Curculionids may attack the plant from the roots upward. In adults, the head produces anteriorly as a rostrum. The tarsi are pseudotetramerous. Eggs are known to be deposited within the roots or on the leaves of aquatic plants. Larvae usually feed inside the tissue of the plant while the adults drill holes in fruit, nuts, and other plant parts. Pupation of aquatic weevils can occur on or within the leaf petioles. Larvae of Curculionidae identify as not possessing legs. Association of adults and larvae on host plants is a method of tentative identification of immature weevils (Triplehorn 2005)(Merrit 2008).

Genus *Diaprepes*

The tropical Diaprepes root weevil is native to the Caribbean. It is an agricultural pest in several countries. The adult weevil is somewhat variable in size but just over 1cm in length. The larvae is plump with a dark head, up to 2.5cm in length. A female weevil might lay 5,000 eggs, depositing them in clusters on leaves, then folding and gluing the leaves together. After a week the larvae emerge from the eggs, fall to the ground, and burrow down to the roots of the host plant.

Figure 6 *Diaprepes doublierii, dorsal view*

Figure 7. *Diaprepes doublierii*, lateral view

They feed on the roots for several months, which is very damaging to the plant. While the adult weevil does feed on the foliage of the plant, it is the larvae that do the most damage. While they often eat the taproot of the plant, which can kill it by depriving it of water and nutrients or by making it vulnerable, it is inconclusive whether or not the larvae feed on the roots of aquatic plants.

Crambidae

In Crambids, the tympanum is open mesally as well as the praecintorium being present. There are eight subfamilies in North America including the Crambinae. The larvae are identified by their crochets in a circle or incomplete circle. In adults, the CuP vein is absent (Triplehorn 2005)(Merrit 2008).

Genus *Parapoynx*

Larvae of the *Parapoynx* have gills that are branched. The larvae will live, feed, and develop in cases cut from leaves of aquatic plants. The adults will have strongly annulated antennae (Merrit 2008).

Figure 8 *Parapoynx*, lateral views

The collection site for the Blenheim River, ran northeast along the roadside. The area among the banks was heavily vegetated. The soil consistency was sandy with some small pebble gravel inserts. The river bottom was very loose and soft within the area supporting the plant. The location that was sampled was approximately 60% infested with *H. verticillata.* The area was heavily sampled but with few specimens collected of the Baetidae family. Larger fish and prawns lived within the open water sections of the Blenheim. Because the infestation has not reached its maximum capacity the ecosystem of the Blenheim still contains a substantial amount of life diversity. Of the area sampled, no vegetation was seen growing within the river other than the hydrilla. As time progresses, this will allow for adaptive hydrilla growth at an increasing rate because of the lack of vegetation competition that would be occupying the same ecological niche as the hydrilla.

Figure 9 Blenheim River

Figure 10 Blenheim River *Hydrilla*

The Bee Pond location was almost completely surrounded by vegetation, but leaving the southern area open. The northern end of the pond was the most heavily vegetated. The north eastern wall had a small climbing plant growing along it, but once at the water surface level, *H. verticillata* dominated the complete area of the pond by competitive exclusion. The denseness of the *H. verticillata* covered 95% of the pond. Small minnows were noted, aside from the insects, living among the infested waters. The bottom soil was loose sandy soil and gave way to pressure easily.

Figure 11 Bee Pond

Figure 12 *Hydrilla* sample from Bee Pond

A root and subsoil turion system was collected, measuring 14’3.5” with nine extensions growing off. These asexual reproductive structures are resistant to herbicides. The *D. doubleirii* weevil collected will feed on these tubers and plant appendages causing significant damage to the hydrilla, which in turn limits its reproductive rate. With the reproductive cycle altered by this biological control effort, the hydrilla cannot spread as readily, making containment and elimination more viable and approachable.

Another insect containing the potential to produce a harmful amount of damage to Hydrilla is aquatic lepidoteran larvae of genus *Parapoynx* (Crambidae). Obtaining the larvae was achieved by collecting from within the hydrilla. The larvae were found in leaf casings made from the leaves of the hydrilla. As the larvae consume the leaves and utilize them for developmental casings, the defoliating of the hydrilla stems causes a considerable amount of damage by limiting the photosynthesizing organs available within the hydrilla.

For other specimens that were collected from the hydrilla at Bee Pond, Baetidae, Coenagrionidae, Naucoridae, Veliidae, and Gerridae, it is not yet determined whether or not their existence is beneficial to or negatively impacting the hydrilla. The presence of immature insects collected is a positive result in that it allows for certain developmental stages to take place within the hydrilla. If a new organism were to be used towards biological control the life cycle types could be further compared to test for developmental compatibility. The recording of the insects’ presence and location is also available for further assistance on the matter. These species are apparently able to develop and live within the hydrilla habitat. This is important information pertaining to the diversity supported in hydrilla.

This study was completed as an aid to further tactics towards biological control of the invasive plant *Hydrilla verticillata*. More research and data are needed to further the process of environmental eradication of the weed.

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