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Insects Damaging Hydrilla in the USA[1]

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ABSTRACT

A two year survey, consisting of 285 collections, of the macroinvertebrates associated with hydrilla (*Hydrilla verticillata* (L.f.) Roye) in Florida, Texas, Georgia, and Louisiana produce 17,358 insect specimens representing 191 species. Few of these species actually damaged hydrilla. The most readily observed damage was caused by the larvae of aquatic moths (Lepidoptera: Pyralidae), of which *Parapoynx diminutalis* (Snellen) and *Synclita obliteralis* (Walker) were the most abundant. Shorefly larvae (Diptera: Ephydridae) in the genus *Hydrellia* mined hydrilla leaves and stems, but their damage and presence were difficult to detect. Caddisfly larvae were frequently collected, but only 5 species in the family Leptoceridae occasionally fed on hydrilla. Likewise midge larvae, while sometimes extremely abundant, would only occasionally damage hydrilla by boring short tunnels into the stems. We provide illustrations and a key, based on larval cases and type of damage, to aid in the identification of these hydrilla-damaging insects.

Key words: Hydrilla verticillata, natural enemies, host specificity, moths, caddisflies, shoreflies, *Parapoynx, Synclita, Nectopsyche, Hydrellia.*

INTRODUCTION

Hydrilla is a submersed, aquatic macrophyte in the family Hydrocharitaceae which was introduced into the USA as an aquarium plant and first became established in Florida about 25 years ago (Mahler, 1979). Since then it has invaded 9 additional states and the District of Columbia (Haller, 1982) and has become a severe nuisance in many areas. These hydrilla infestations provide a new habitat for aquatic fauna. Hydrilla negatively impacts some native fauna, but like other aquatic macrophytes, provides shelter, breeding and oviposition sites, and attracts abundant small invertebrate and vertebrate prey. Relatively few among the many species of organisms which dwell in hydrilla mats use living hydrilla tissue as a food resource. During an intensive, two-year survey of the macroinvertebrates associated with hydrilla many of these herbivores were found and identified. This limited group of insects that feed on hydrilla is of primary importance to persons concerned with the management of this noxious weed. In this paper, we discussd feeding behavior and present brief descriptions of hydrilla-damaging insects. We also provide a key and figures so that these insect groups can be identified by their immature stages and the type of damage they cause.

MATERIALS AND METHODS

From July 1978 through July 1980, the senior author amassed 285 collections of hydrilla and its associated macrofauna from 72 locations in the U.S. Over 93% of the collections (n=267) were from 58 different sites in Florida. Additional collections were from the following states: California (n=2), near the Mexican border; Georgia (n=5), Lake Seminole and vicinity; southern Louisiana (n=2); central and east Texas (n=9).

Each site was usually sampled from a boat. Hydrilla samples, each 1 to 4 kg wet weight, were obtained from a dense portion of the mat, with a rake, a quantitative sampler, or by hand. At sparsely infested areas, single samples were gathered from several clumps of hydrilla. Most Florida collections were made with a quantitative sampler, specially-constructed for this survey, which removed from the water surface to the hydrosoil, a 0.125 m^2 portion of mat and associated fauna. When the sampler was used, 5 samples were usually gathered in order to estimate the variability of both insect populations and hydrilla biomass. All samples collected at the same site on the same day are considered as a single collection.

Each hydrilla sample was placed in a plastic bag marked with an identifying collection number. Although preliminary samples were searched for macroinvertebrates in the field, all others were immediately placed on ice and transported to the USDA Aquatic Plant Management Laboratory in Ft. Lauderdale, FL where they were frozen. Frozen samples were later thawed, thoroughly searched under a microscope, and the fauna removed and placed in labeled vials containing 80% isopropyl alcohol.

The specimens were identified using taxonomic keys, species descriptions, and previously determined specimens from our reference collection. Taxonomists later confirmed our identifications by examining voucher specimens. We determined which insects were damaging hydrilla by personal observations and from literature records.

RESULTS AND DISCUSSION

A list of the collection dates and locations, and preliminary lists of all macroinvertebrates collected, can be found in Balciunas and Minno (1984). We collected and identified a total of 59,010 faunal specimens during this survey. Of these, 17,358 (29.4%) were insects. Considering the diversity of aquatic habitats in which hydrilla occurs and the wide geographic scope of this survey, it is not surprising that 191 species of aquatic insects were recorded. The average increase in species richness of insects inhabiting hydrilla mats (0.67 new insect species/collection) was lower than the 0.93 new species/collection (Balciunas 1982a) recorded for Eurasian watermilfoil, (*Myriophyllum spicatum* L.), and substantially lower than the 1.67 new species/collection found in waterhyacinth, (*Eichhornia crassipes* (Mart.) Solms) roots (Balciunas 1977).

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TABLE 1. LIST OF INSECT SPECIES DAMAGING *Hydrilla verticillata* IN THE UNITED STATES.

Insect Group	Scientific Name	Number of Specimens	Number of Collections	States	Type of Damage
HOMOPTERA: Aphids	*Rhopalosiphum nymphaeae* (Linnaeus)	4	2	FL, LA	Sap-sucking on emersed hydrilla
TRICHOPTERA: Leptocerid Caddisflies	*Leptocerus americanus* (Banks)	1593*	30	FL	Feeds on leaves of aquatic vascular plants (McGaha, 1952)
	Nectopsyche tavara (Ross)	440	32	FL	Hydrilla leaf feeder (Daigle and Haddock, 1981)
	Oecetis prob *cinerascens* (Hagen)	95*	36	FL	Aquatic vascular plant feeder (McGaha, 1952)
	Oecetis spp.	106*	29	FL, TX	Probable aquatic vascular plant feeders
	Triaenodes sp.	2	2	FL	Aquatic vascular plant feeder (Wiggins, 1977)
LEPIDOPTERA: Pyralid Moths	? *Oxyelophia callista* (Forbes)	4	3	TX	Possible hydrilla leaf feeder
	Parapoynx a. allionealis (Walker)	5	4	FL	Hydrilla leaf and stem feeder
	Parapoynx diminutalis (Snellen)	179	18	FL	Hydrilla leaf and stem feeder
	Parapoynx obscuralis (Grote)	6	3	FL, TX	Hydrilla leaf and stem feeder
	Synclita obliteralis (Walker)	150	6	FL, LA	Hydrilla leaf and stem feeder
DIPTERA: Chironomid Midges	*Cricotopus* spp.	113**	19	FL	Occasionally burrow into hydrilla stems
	Endochironomus spp.	1646**	25	FL, GA, TX	Occasionally burrow into hydrilla stems
	Glyptotendipes spp.	3500**	72	FL, GA, TX	Occasionally burrow into hydrilla stems
Ephydrid Shoreflies	*Hydrellia* spp.	50	22	FL, LA, TX	Hydrilla leaf and stem miners

*These caddisflies only occassionally feed on living aquatic plants. including hydrilla.
**These midge larvae, although very numerous, only infrequently damaged hydrilla.

In general, most aquatic insects are predaceous or eat detritus or algae. Relatively few insects feed on the living tissue of submersed vascular plants such as hydrilla. Table 1 lists the hydrilla-damaging insects encountered during this survey. It includes the herbivorous species which feed on vascular plants as well as the omnivores that only occasionally damage hydrilla. The various insect species which merely use hydrilla as an oviposition site are not included in our list.

The larvae of aquatic moths (Lepidoptera:Pyralidae) in the tribe Nymphulini caused the most easily observed damage to hydrilla. Nymphulini larvae build distinctive cases of plant material and feed on aquatic vascular plants. *Synclita obliteralis* (Walker) and 3 species of *Parapoynx* were the only Nymphulini collected from hydrilla during this survey. The larvae usually feed on the basal and middle portions of hydrilla leaves, frequently detaching them from the stems. During periods of high larval populations, hydrilla stems may also be eaten or partially gnawed, causing the plants to fragment. *Parapoynx diminutalis* (Snellen) (Fig. 1 and 2) and *Synclita obliteralis* (Walker) (Fig. 3 and 4) larvae were the most common Nymphulini in our collections. *Synclita obliteralis* ranges widely throughout most of eastern North America. *S. obliteralis* feeds on numerous aquatic macrophyte species both in the field and in the laboratory (D. H. Habeck, personal communication). In contrast, *P. diminutalis,* feeds on a broad range of plants in the laboratory, but appears to prefer hydrilla in the field. *P. diminutalis* is an Asiatic species accidentally introduced into the U.S. and first found in Florida in 1975 (Del Fosse *et al.,* 1976). Its range is expanding and this insect could play a significant role in the natural control of hydrilla (Balciunas and Habeck, 1981). Two closely related moths, *Parapoynx allionealis* (Walker) and *Parapoynx obscuralis* (Grote) were also infrequently found on hydrilla, but larvae of both species appear to prefer other aquatic plants as hosts.

Four moth larvae of what are thought to be *Oxyelophila callista* (Forbes), in the closely related tribe Argyractini, were collected on hydrilla in Texas. The larvae of this rare species are unknown and we were unsuccessful in rearing them to confirm Dr. Dale Habeck's tentative identification. The few Argyractini whose larval feeding habits are known, feed on algae (Munroe, 1972). However, our analysis of the gut contents of 2 of these larvae showed the presence of some macrophyte tissue. Until more is known about this rare species, we cannot be sure that the larvae feed on living hydrilla tissues.

Shorefly larvae (Diptera:Ephydridae), *Hydrillia* spp. (Fig. 7 and 8), mine (burrow between the cuticular layers) the leaves and bore the stems of hydrilla. While only 50 immatures of *Hydrellia* were found during this survey, they are probably much more common. Their small size and habit of mining hydrilla leaves and boring the stems made *Hydrellia* larvae very difficult to locate, even with the aid of a microscope. Although several species may occur on hydrilla, *Hydrellia bilobifera* Cresson attacks hydrilla in our outdoor tanks in Ft. Lauderdale.

The caddisflies (Trichoptera) were frequently collected and comprised 24 species with 4261 specimens. Only the

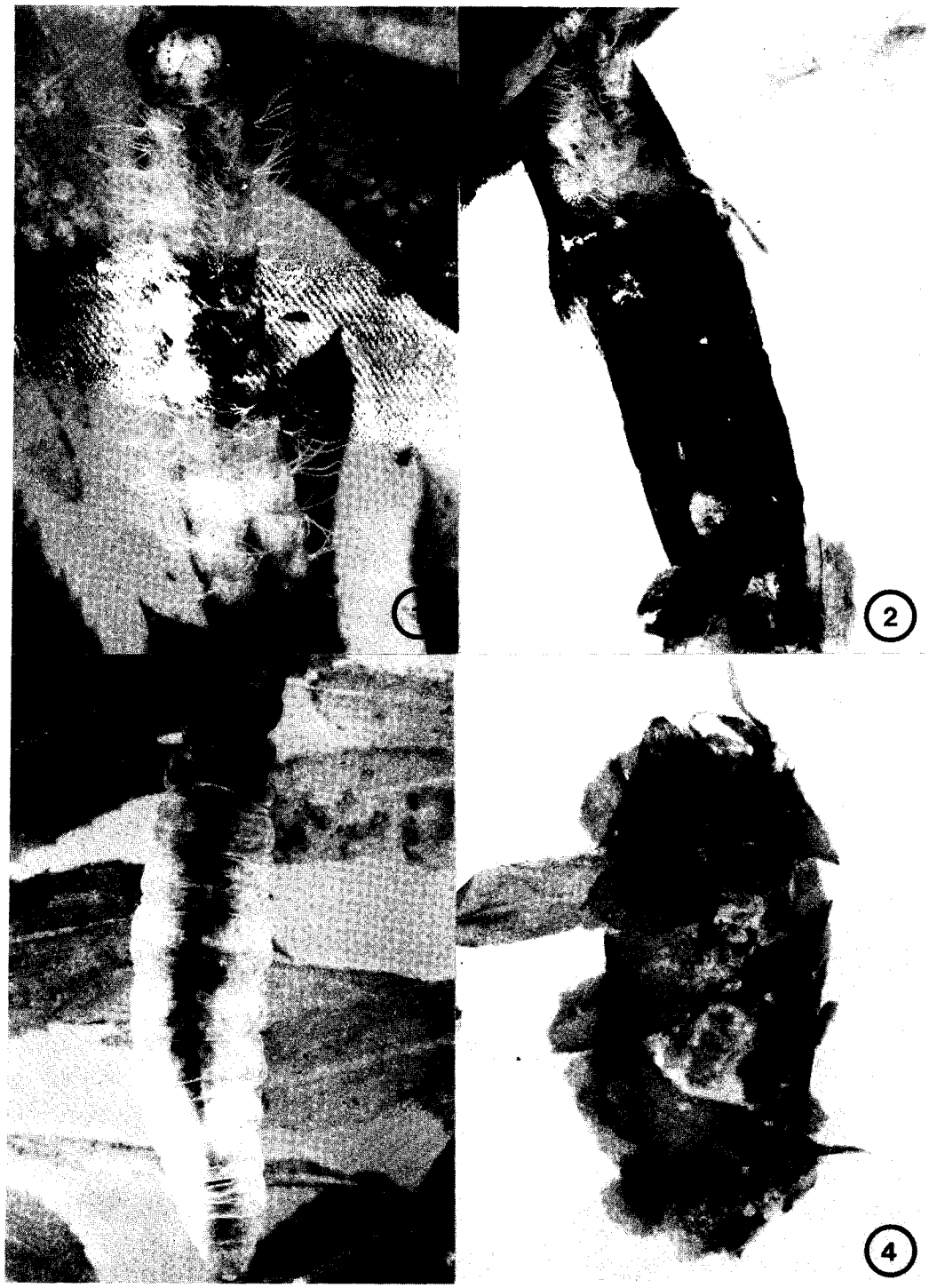

Figure 1. Late instar larva (length = 10 mm) of *Parapoynx diminutalis* an Asiatic aquatic moth recently established in Florida. Figure 2. Tubular larval case (length = 13 mm) of *Parapoynx diminutalis* composed of hydrilla leaves arranged longitudinally. Figure 3. Late instar larva (length = 11.5 mm) of *Synclita obliteralis* a common aquatic moth in eastern North America. Figure 4. Flattened, oval-shaped case (length = 12.5 mm) of *Synclita obliteralis* composed of a mosaic of hydrilla leaves.

larvae of 5 species in the family Leptoceridae damaged hydrilla, with *Leptocerus americanus* (Banks) (Fig. 9) and *Nectopsyche tavara* (Ross) (Fig. 10) being the most abundant. *N. tavara* is known to feed on hydrilla (Daigle and Haddock, 1981).The other species probably occasionally feed on hydrilla. Many larval leptocerid caddisflies do not seem to exhibit specificity in their food preferences (Wiggins, 1977).

Although midge larvae (Diptera:Chironomidae) (Fig. 14) comprised 72 species and 56.5% of all the insects collected their damage to hydrilla was relatively slight. Larvae of a few species, especially in the genera *Glyptotendipes* and

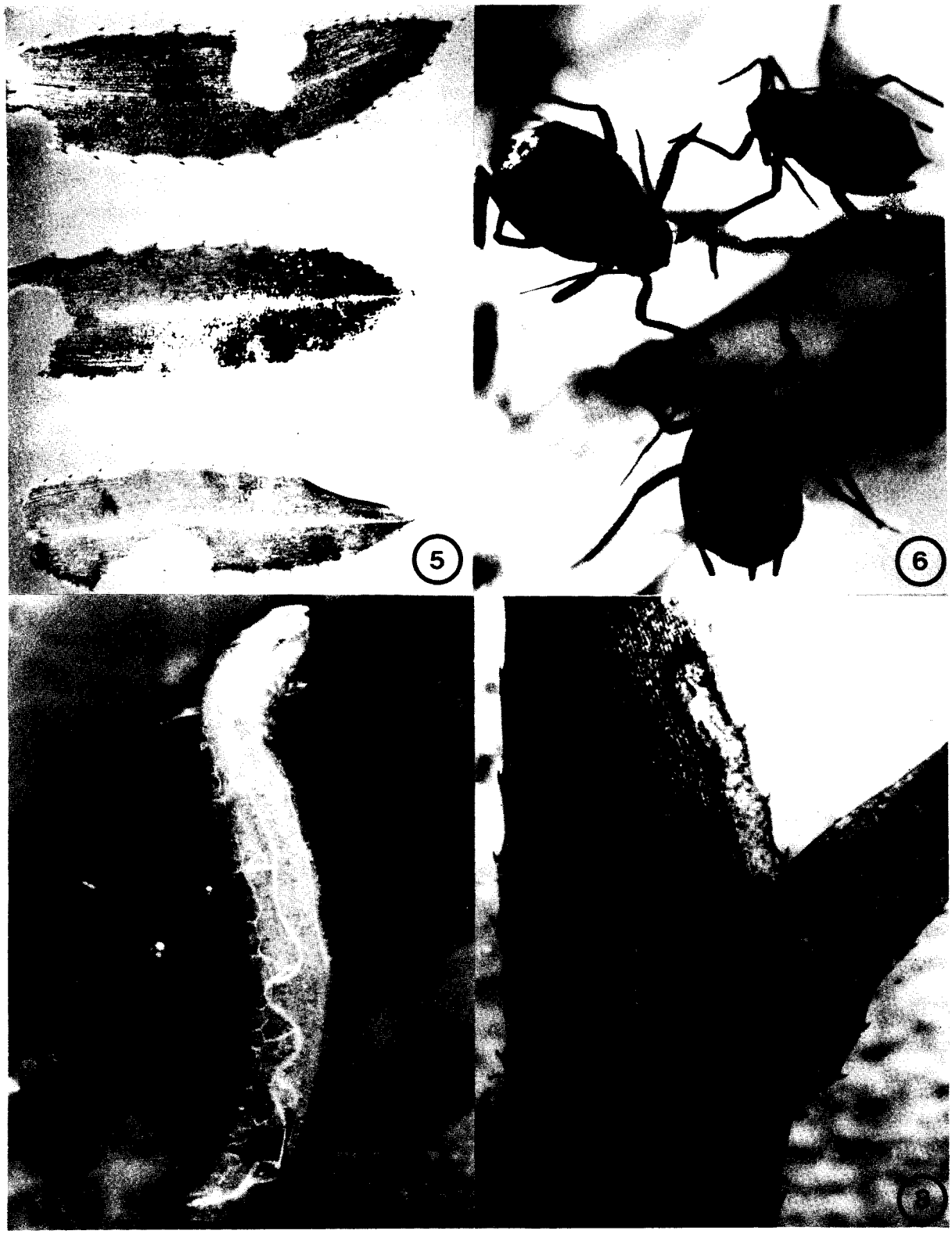

Figure 5. Typical damage to hydrilla leaves caused by aquatic moths in the tribe Nymphulini. Figure 6. *Rhopalosiphum nymphaeae* aphids (length = 1.5 mm) feeding on a hydrilla leaf. Figure 7. Late instar larva (length = 5 mm) of *Hydrellia* species. Note the lack of a distinct head capsule in upper portion of figure. Figure 8. Early instar larva of *Hydrellia bilobifera* feeding inside of hydrilla leaf.

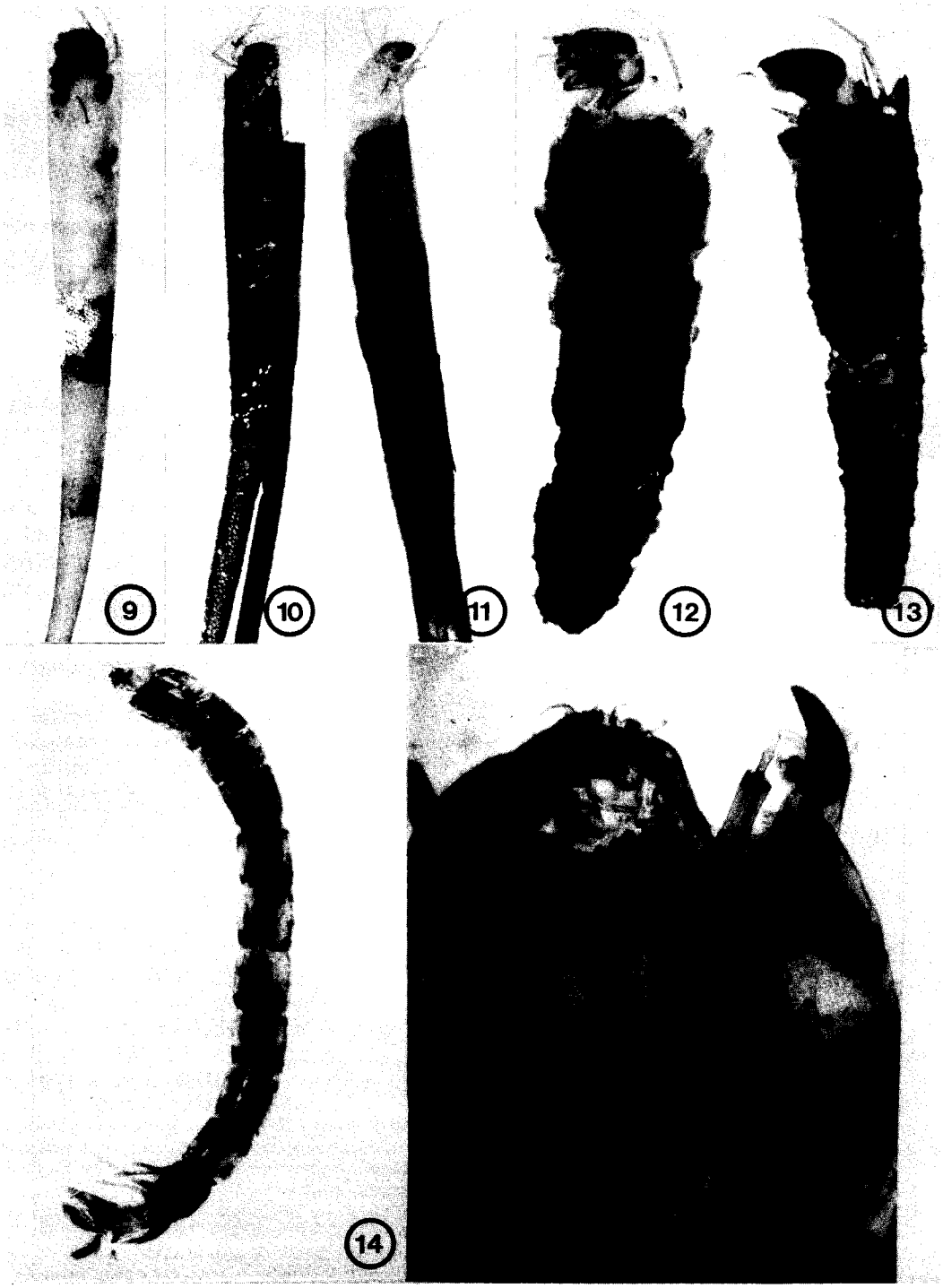

Figure 9. Late instar larva and case (length = 10.5 mm) of *Leptocerus americanus*. Figure 10. Late instar larva and case (length = 27.5 mm) of *Nectopsyche tavara*. Figure 11. Late instar larva and case (length = 16 mm) of a *Triaenodes* species from Florida. Figure 12. Late instar larva and case (length = 7.5 mm) of *Oecetis* probably *cinerascens*. Figure 13. Mid-instar larva and case (length = 5.5 mm) of an *Oecetis* species from Florida. Figure 14. Late instar larva (length = 7 mm) of a chironomid midge. Note distinct head capsule. Figure 15. Close-up of *Glyptotendipes seminole* head capsule.

Endochironomus, occasionally excavated short tunnels in lower portions of hydrilla stems. Of these, *G. seminole* Townes (Fig. 15), with 2641 larvae in 61 collections, and *E. nigricans* (Johannson), with 1483 larvae in 21 collections, were the most abundant. The infrequently collected larvae in the genus *Cricotopus* may also damage or feed on hydrilla.

The aphid, *Rhopalosiphum nymphaeae* (Linnaeus) (Fig. 6), represented by only 4 specimens, was extremely rare on hydrilla. This terrestial insect feeds by sucking sap and could only utilize hydrilla exposed above the water surface, as sometimes occurs in mature mats.

Noticeably absent from this survey were any aquatic weevils which feed on hydrilla. Weevils in the genus *Bagous* are important natural enemies of hydrilla in Pakistan (Baloch, *et al.* 1980) and recent surveys have shown them to be widespread in Asia and in parts of Australia (Balciunas, 1928b; Balciunas, 1983). Apparently, none of the numerous native U.S. species of aquatic weevils, which are often very host specific, have accepted this newly introduced plant and utilize this now abundant resource.

The following key and the accompanying figures, should allow field identification of the hydrilla-damaging stages of the insects discussed above. This key may not apply to very young larvae, but these early instars are unlikely to be noticed in the field.

Key to Insect Groups Damaging Hydrilla Using Type of Damage and Larval Cases.

1a. Hydrilla stems damaged 2
1b. Hydrilla leaves damaged or missing 4
2a. Short tunnels in stems or apical buds 3
2b. Stems notched or completely gnawed through and fragmented, case-bearing insects present 6
3a. Larva with a distinct head capsule, mandibles present (Figures 14 and 15) ..... midges (Diptera: Chironomidae—frequently *Endochironomus* spp. and *Glyptotendipes* spp. occasionally *Cricotopus* spp.)
3b. Larva without a distinct head capsule, feeding hooks present (Figure 7) ..... shoreflies (Diptera:Ephydridae—*Hydrellia* spp.)
4a. Leaf mines present, only mesophyll portion of leaf eaten leaving transluscent patches (Figure 8) ..... shoreflies (Diptera: *Hydrellia* spp.)
4b. Damage other than leaf mines 5
5a. Tips or entire leaves missing, remaining portions with ragged edges ..... usually herbivorous fish, possibly waves or other mechanical damage
5b. Circular to elliptical pieces or entire leaves eaten; remaining portions with smooth, rounded edges (Figure 5), case-bearing insects present 6

Key to Larval and Pupal Cases

6a. Case composed of plant materials, flattened or cylindrical, both ends the same size ..... aquatic moths (Lepidoptera:Pyralidae) 7
6b. Case cylindrical, tapering toward one end, composed of various materials ..... caddisflies (Trichoptera:Leptoceridae) 8
7a. Case flattened, more or less oval (Figure 4), air-filled, larva without gills (Figure 3) . *Synclita obliteralis*
7b. Case cylindrical, water-filled, usually consisting of 4-6 hydrilla leaves cemented edge to edge, (Figure 2), larve with numerous gills (Figure 1) ..... *Parapoynx* spp. (mostly *P. diminutalis* in Florida)
8a. Case composed mostly of plant materials 9
8b. Case composed mostly of silk or sand grains 10
9a. Case with smooth appearance, composed of rectangular pieces of leaves (frequently hydrilla) neatly arranged in a spiral (Figure 11) ..... *Triaenodes* spp.
9b. Case with rough appearance, plant materials attached laterally, protruding beyond edges of case (Figure 12) ..... *Oecetis* prob. *cinerascens*
10a. Case composed entirely of silk, semitransparent, less than 15 mm in length (Figure 9) *Leptocerus americanus*
10b. Case composed mostly of sand grains, opaque 11
11a. Case with smooth appearance, sand grains and bits of shell embedded in a silk matrix, usually with a long, narrow piece of plant material attached longitudinally to one side, up to 25 mm in length (Figure 10) ..... *Nectopsyche tavara*
11b. Case with rough, pebbly appearance, less than 15 mm in length (Figure 13) ..... *Oecetis* spp.

All of the insects noted here damage hydrilla in their larval stages. Immature forms of insects are difficult to identify and species level determination will usually require rearing to the adult stage. Merritt and Cummins (1978) provide keys which will identify aquatic larvae to family. Caddisfly larvae can usually be determined to generic level using Wiggins (1977). Simpson and Bode (1980) provide excellent keys which will aid in the identification of many common species of chironomid midge larvae. We offer our assistance in identifying insects which damage hydrilla or other aquatic plants.

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