Field Release of the Nonindigenous Leaf-mining Flies, *Hydrellia pakistanae* Deonier and *H. balciunasi* Bock (Diptera: Ephydridae), for Biological Control of *Hydrilla verticillata* (L.F.) Royle (Hydrocharitaceae)

Environmental Assessment

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Agency Contact:
Robert V. Flanders, Ph.D.
Plant Protection and Quarantine
USDA – APHIS
4700 River Road, Unit 133
Riverdale, MD 20737
Phone (301) 734-5930
Fax (301) 734-8700
Email Robert.V.Flanders@aphis.usda.gov

Proposed Action:	The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is proposing to issue permits for the continued release of the non-indigenous leaf mining flies, *Hydrellia pakistanae* Deonier and *H. balciunasi* Bock (Diptera: Ephydridae) in the continental United States. These agents would be used by the permit applicant for the biological control of *Hydrilla verticillata* (L.F.) Royle (Hydrocharitaceae).
Type of statement:	Environmental Assessment
For further information:	Robert V. Flanders, Ph.D.

1.0 Purpose and Need for the Proposed Action

1.1 The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service is proposing to issue permits to a researcher at the U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS, for the continued release of the nonindigenous, leaf-mining flies, *Hydrellia pakistanae* Deonier and *H. balciunasi* Bock (Diptera: Ephydridae), in the continental United States. These agents would be used by the applicant for the biological control of *Hydrilla verticillata* (L.F.) Royle (Hydrocharitaceae). Before permits are issued for the continued release of these insects, APHIS needs to analyze the potential effects of their expanded release throughout the continental United States.

The applicant's purpose for the continued release of *H. pakistanae* and *H. balciunasi* is to reduce the severity and extent of hydrilla in the continental United States. Hydrilla, which is native to the warmer areas of Asia, was first discovered in the United States in 1960. It is a submersed aquatic plant that is a major problem in the United States, causing navigational interference, hindering waterflow, and detracting from recreational uses of water bodies (Yeo *et al.,* 1984). It has the ability to multiply profusely producing large, thick, stands and become a major nuisance in many aquatic systems (Miller *et al.,* 1976). When established, it can displace native aquatic plants such as pondweeds (*Potamogeton* sp.) and eelgrass (*Vallisneria americana* Michaux).

Maintaining hydrilla populations is sometimes advocated by waterfowl scientists because it increases the feeding habitat for ducks (Johnson and Montalbano, 1984; Esler, 1989; and Langeland, 1996). However, preliminary results from surveys conducted by the U.S. Army Corps of Engineers and the Wildlife Resources Division of the Georgia Department of Natural Resources have determined that reduction in hydrilla has not affected the total number of ducks wintering at Lake Seminole, Georgia (Balkcom, 2002).

The proposed biocontrol agents, *H. pakistanae* and *H. balciunasi* are flies in the family Ephydridae. Female *Hydrellia* spp. lay their eggs on hydrilla which, after several days, hatch into larvae. The larvae of both species damage hydrilla plants by mining leaves (Baloch *et al.,* 1976) during three larval stages. Once the three stages are complete, the insect pupates, and then the adult emerges as a fly (Baloch and Sana-Ullah, 1974).

Both of these species have been released previously in the United States. *H. pakistanae* was released in Florida in 1987 and then eventually in Louisiana, Alabama, Georgia, Texas, and California. Currently, it is established in Florida, Alabama, Georgia, and Texas and is spreading naturally. *H. balciunasi* was released at numerous sites in Florida and Texas in 1989, and currently, is only established in Texas. Although all past releases of these insects were authorized by APHIS permits, environmental assessments were not prepared and made available to the public. The researcher has requested APHIS permits to release these insects into new areas infested with hydrilla. Therefore, APHIS has prepared this environmental assessment to analyze the potential effects of additional releases of these agents into the continental United States.

1.2 APHIS must decide among the following alternatives:

A. To deny the permit application (no action)
B. To issue the permit as submitted
C. To issue the permit with management constraints or mitigation measures.

1.3 Issues arising from the field release of *H. pakistanae* and *H. balciunasi*:

A. Will *H. pakistanae* and *H. balciunasi* attack non-target plants within and outside of the area infested with hydrilla?

B. Will *H. pakistanae* and *H. balciunasi* affect a federally listed threatened or endangered species or their critical habitat?

1.4 The pending application for release of these biocontrol agents into the environment was submitted in accordance with the provisions of the Plant Protection Act of 2000 (7 United States Code (U.S.C.) 7701 *et. seq*.). This environmental assessment (EA) was prepared by APHIS in compliance with the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et. seq*.) as prescribed in implementing regulations adopted by the Council on Environmental Quality (40 Code of Federal Regulations (CFR) 1500-1508), by USDA (7 CFR 1b), and by APHIS (7 CFR 372).

2.0 Alternatives Including the Proposed Action

2.1 This chapter explains the alternatives available to APHIS. Although APHIS' alternatives are limited to a decision whether to issue permits for additional releases of *H. pakistanae* and *H. balciunasi*, other methods for control of hydrilla are also described. These control methods are not decisions to be made by APHIS and may continue whether or not additional permits are issued for releases of these insects. These are methods currently being used to control hydrilla by public and private concerns and are presented to provide information to the reader.

2.2 Description of the alternatives.

2.2.1 Alternative 1 – No Action: Under this alternative, APHIS would not issue a permit to a researcher at the U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS, for additional field releases of *H. pakistanae* and *H. balciunasi*. Intentional releases of these organisms into new areas infested by hydrilla would not take place.

2.2.2 Alternative 2 – Issue the Permit: Under this alternative, APHIS would issue a permit to a researcher at the U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS, for additional field releases of *H.*

pakistanae and *H. balciunasi* in the continental United States. This permit would contain no special provisions or requirements concerning release procedures or mitigating measures.

2.2.3 Alternative 3 – Issue the Permit with Specific Management Constraints and Mitigating Measures: Under this alternative, APHIS would issue a permit to a researcher at the U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS, for additional field releases of *H. pakistanae* and *H. balciunasi* in the continental United States. However, the permit would contain special provisions or requirements concerning release procedures or mitigating measures.

2.3 The following are presently being used to control hydrilla. These controls will likely continue under the "No Action" alternative but may continue even if permits are issued for additional releases of *H. pakistanae* and *H. balciunasi.*

2.3.1 Chemical Control: Chemical controls for hydrilla include the use of the following herbicides (Madsen, 2000):

1. Complexed Copper (Cutrine-Plus, Komeen, Koplex, K-Tea)
2. Diquat (Reward)
3. Endothall (Aquathol K, Hydrothal 191, Aquathol granular)
4. Fluridone (Sonar AS, Sonar SRP)

These products are safe when used according to the label (Madsen, 2000); however, all of these herbicides are listed as broad-spectrum in their plant species response and may affect non-target submersed vegetation.

2.3.2 Mechanical Control: Mechanical controls that can be used for hydrilla include (Madsen, 2000):

1. Hand-cutting/pulling
2. Cutting
3. Harvesting (cut and remove)
4. Grinder or "Juicer" (cut and grind)

Hand-cutting/pulling, although labor-intensive can be very effective in localized areas while cutting, harvesting, and grinding are all considered cosmetic, nonselective, and short-term (Madsen, 2000).

2.3.3. Cultural/Physical Control: Cultural/physical controls that can be used to control hydrilla include (Madsen, 2000):

1. Dredging/sediment removal
2. Drawdown
3. Benthic barrier
4. Shading/light attenuation

Dredging is usually done more for lake restoration and is considered a multipurpose lake remediation technique. Due to its high cost, environmental impacts, and the problem of sediment disposal it should not be done solely for aquatic plant management (Madsen, 2000). Drawdown involves removing the water of a lake to a given depth and holding it at that level for at least a month to provide complete drying (Cooke, 1980). For hydrilla it is only effective for one to two years (Ludlow, 1995). Benthic barriers (covering plants with a growth-inhibiting substance) are too expensive for widespread use and also heavily affect benthic communities so should just be considered for high-intensity use areas (boat docks, swimming areas, etc.) (Madsen, 2000). Shading or light attenuation (controlling plants by light reduction) has only limited applicability (Madsen, 2000).

2.3.4 Biological control: Four insect biocontrol agents have been released for the management of hydrilla in the United States; *H. pakistanae, H. balciunasi*, and two species of weevils (Julien and Griffiths, 1998). The two weevil species are in the genus *Bagous*. The tuber feeding weevil, *Bagous affinis*, which originates from India, has been released at sites in Florida, California, and Texas, but has never established (Grodowitz *et al.,* 1995 and Julien and Griffiths, 1998). The stem-feeding weevil, *B. hydrillae*, was released in 1991 in Florida and a limited number of sites in Alabama, Georgia, and Texas (Julien and Griffiths, 1998). It was tentatively established in Florida and possibly Texas (Julien and Griffiths, 1998), but no individuals have been collected recently (Grodowitz *et al.,* 1995). *H. pakistanae*, was released in Florida in 1987 and then eventually in Louisiana, Alabama, Georgia, Texas, and California. Currently, it is established in Florida, Alabama, Georgia, and Texas and is spreading naturally. *H. balciunasi* was released at numerous sites in Florida and Texas in 1989, and currently, is only established in Texas.

3.0 Affected Environment

3.1 Evidence of host specificity: Extensive host-specificity testing was accomplished for both species of ephydrid flies.

H. pakistanae, which has a native range including India, Pakistan, and China (McCann *et al.,* 1996), was imported from Bangalore, India in May 1985 and taken to the Florida Biological Control Laboratory Quarantine, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida, for evaluation and host specificity testing (Buckingham *et al.,* 1989) (Appendix 1). In choice tests with 29 plant species, *H. pakistanae* oviposited on all plant species as well as on inert objects but preferred hydrilla (Buckingham *et al.,* 1989). In larval no choice tests, fifty-one plant species were included and adults developed on five species. In all cases, very few adults were produced. Of those five plants, curly leaf pondweed (*Potamogeton crispus* L.), which grows in conjunction with hydrilla in Asia and is an introduced weed in the U.S., produced the most adults and supported the most larval development during no-choice tests (Buckingham *et al.,* 1989). However, in additional testing this plant was unable to

sustain continuous generation of insects (Buckingham *et al.,* 1989). In Asia, the only known field host of *H. pakistanae* is hydrilla.

H. balciunasi, is native to Australia. In no-choice larval developmental tests, fourteen species of plants representing 4 families, plus rice were tested on *H. balciunasi* (Appendix 2), and adults emerged from 1 test plant species, *Potamogeton crispus* (Buckingham *et al.,* 1991). In multi-choice larval developmental tests of *H. balciunasi* (Appendix 2), no adults emerged from the 27 plant species representing 17 families and no plants were damaged (Buckingham *et al.,* 1991).

3.2 Federally listed threatened and endangered plant species present in the infested area and which may be affected if the biocontrol agent were to spread beyond the present target weed infested area:

Johnston's seagrass (*Halophila johnsonii*) is a seagrass in the same plant family as hydrilla (Hydrocharitaceae). It forms low mats either in pure stands or with shoalgrass (*Halodule wrightii*) in intertidal areas (6" to 6' depth). It is narrowly endemic to coastal lagoons in eastern Florida. The species is threatened with destruction from dredge and fill, turbidity, eutrophication, and thermal pollution - all due to the high population pressure along Florida's east coast (NatureServe Explorer,).

Little Aguja Creek pondweed (*Potamogeton clystocarpus*) is an aquatic fern endemic to a few kilometers of a single stream in Little Aguja Canyon, West Texas. Except for small, cylindrical spikes of flowers, this species grows completely submerged. It occurs in relatively shallow, usually quiet, but hydrologically dynamic pools and flowing streams with igneous-derived alluvium. Threats to this plant include periodic flooding and extreme drought, and changes in water quality from chemical contamination and increased livestock numbers in nearstream areas (NatureServe Explorer). In host specificity tests, *H. pakistanae* was found to mine the leaves of some *Potamogeton* spp. tested.

3.3 No minority low income populations, or children should be negatively affected due to the proposed action. Potential reductions in herbicide usage to control hydrilla may even be beneficial to human populations.

4.0 Environmental Consequences

4.1 This chapter analyzes the potential environmental consequences of each alternative on the resources described in Chapter 3.

4.2 Effects of Alternative 1 – No Action

4.2.1 Effects on Non-Target Organisms: The continued use of chemical herbicides, mechanical, cultural, and existing biological controls at current levels would be a result if the "no action" alternative is chosen. Most herbicides used for hydrilla, are

also effective on other submersed species of aquatic plants (Madsen, 2000). Therefore, many non-target organisms would be affected. Harvesting, although environmentally better than herbicides, removes non-target plants as well as hydrilla (Madsen, 2000). Drawdowns have been shown to be effective for hydrilla control for 1 to 2 years; however, they may have other significant environmental effects on the water body (Madsen, 2000).

4.2.2 Effects on Threatened and Endangered Species: Impact on threatened and endangered species as a result of chemical, mechanical, and cultural control would be similar to effects on non-target species and habitats described in section 4.2.1.

4.3 Effects of Alternative 2 – Issue Permit

4.3.1 Effects on Non-Target Organisms: Host specificity testing has indicated that these organisms are specific and will not have negative impacts on native plant species. In addition, there have been no reports of these insects attacking plants other than hydrilla since their release into the U.S. environment in the late 1980s.

4.3.2 Effects on Threatened and Endangered Species: Although Johnston's seagrass occurs in the same plant family as hydrilla, it occurs in a marine rather than freshwater habitat and would be an unlikely target for either insect. These insects would be unable to survive in a marine habitat. In addition, both insects have already been released in Florida, and *H. pakistanae* is established in Florida.

H. pakistanae may feed on Little Aguja Creek pondweed (*Potamogeton clystocarpus*) since other plant species in the same genus were attacked in host specificity tests. Of the *Potamogeton* spp. tested, *H. pakistanae* larvae mined the leaves of *P. indicus, P. perfoliatus*, and *P. crispus*. Further testing indicated that *H. pakistanae* would lay eggs on *Potamogeton* spp. but could not be reared through successive generations. *H. balciunasi* was not found to attack any other species than hydrilla in host specificity tests. However, both insects are already established in Texas. In addition, the nearest hydrilla occurs in the Armistad Reservoir, which is almost 200 miles east of the Little Aguja Canyon, the location where this pondweed occurs.

The Program has determined that there will be no effect on these plants by additional releases of *H. pakistanae* and *H. balciunasi*.

4.4 Effects of Alternative 3 – Issue the Permit with Specific Management Constraints and Mitigating Measures

4.4.1 Effects on Non-Target Organisms: No specific management constraints or mitigating measures have been recommended for these species. Therefore, under this alternative, impacts on non-target organisms would be identical to those described in 4.3.1.

4.4.2 Effects on Threatened and Endangered Species: No specific management constraints or mitigating measures have been recommended for these species. Therefore, under this alternative, impacts on threatened and endangered organisms would be identical to those described in 4.3.2.

4.5 No disproportionate effects are expected to impact low income or minority populations or pose undue risks for children.

4.6 An unavoidable effect of the proposed action would be the lack of complete control of hydrilla. Should the proposed action be unsuccessful, the present chemical, biological, mechanical and cultural control activities would continue at current levels. Hydrilla would continue to expand into areas presently uninfested.

4.7 Once a biological control agent such as *H. pakistanae* or *H. balciunasi* is released into the environment and it becomes established, there is a slight chance it could move from the target plant to non-target plants and itself become a pest. Host shifts by introduced weed biocontrol agents to unrelated plants are uncommon (Pemberton, 2000). If a host shift does take place, it could result in environmental impacts that may not be easily reversed. Biological control agents generally spread without the agency of man, as demonstrated by *H. pakistanae* and *H. balciunasi.* In principle, therefore, release of these insects at even one site must be considered equivalent to release over the entire area in which potential host plants occur and in which the climate is suitable for reproduction and survival.

5.0 List of Preparers

This environmental assessment was prepared by Dr. Alfred F. Cofrancesco, Dr. Jan E. Freedman, and Dr. Michael J. Grodowitz, U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS, and Dr. Tracy Horner, USDA – APHIS – Policy and Program Development, Riverdale, MD.

6.0 List of Agencies Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *H. balciunasi* on May 5, 1989. TAG members that reviewed the release petition included representatives from the United States Department of the Interior (Fish and Wildlife Service, National Park Service, and Bureau of Reclamation), the USDA (APHIS and Agricultural Research Service), and the Department of the Army. The TAG recommended the release of *H. pakistanae* on August 25, 1987. TAG members that reviewed the release petition included representatives from the USDA (APHIS and Agricultural Research Service), and the Department of the Army.

7.0 List of Reviewers

This document was reviewed by Dr. Robert Flanders and Dr. Michael Firko, USDA – APHIS – Plant Protection and Quarantine, Riverdale, MD.

8.0 References Cited:

Baloch, G.M. and Sana-Ullah (1974). "Insects and other organisms associated with *Hydrilla verticillata* (L.f.) L.C. (Hydrocharitaceae) in Pakistan," *Proc. 3rd Int. Symp. Biol. Control Weeds*, Montpellier, France.

Baloch, G.M., Sana-Ullah, Aslam, M., and Shah, A.A. (1976). "Final report on insects and other Phytophagous organisms which attack Florida Elodea (*Hydrilla verticillata*) in Pakistan," Pakistan Station, Commonwealth Institute of Biological Control, Rawalpindi.

Buckingham, G.R., Okrah, E.A., and Thomas, M.C. (1989). "Laboratory host range tests with *Hydrellia pakistanae* (Diptera: Ephydridae), an agent for biological control of *Hydrilla verticillata* (Hydrocharitaceae)," *Environmental Entomology*, 18(1).

Buckingham, G.R., Okrah, E.A., and Christian-Meier, M. (1991). "Laboratory biology and host range of *Hydrellia balciunasi* (Diptera: Ephydridae)," *Entomophaga* 36 (4), 575-586.

Cooke, G. D. (1980). "Lake level drawdown as a macrophyte control technique." Water Resources Bulletin 16, 317-322.

Esler, D. (1989). An assessment of American Coot herbivory of hydrilla. J. Wildl. Manage.
53:1147-1149.

Balkcom, G. 2002. Update on Hydrilla Research Project at Lake Seminole Georgia Department of Natural Resources. 2002. http://georgiawildlife.dnr.state.ga.us/content/displaycontent.asp?txtDocument=200 *last accessed* 28 April 2003.

Grodowitz, M. J., Center, T.D., and Snoddy, E. (1995). "Current status on the use of insect biological control agents for the management of hydrilla," *Proceedings, 29th Annual Meeting, Aquatic Plant Control Research Program,* Miscellaneous Paper A-95-3, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Johnson, F. A. and F. Montalbano III. (1984). Selection of plant communities by wintering waterfowl on Lake Okeechobee, Florida J. Wildl. Manage. 48:174-178.

Julien, M.H., and Griffiths, M.W. (1998). *Biological control of weeds: A world catalogue of agents and their target weeds.* 4th ed. CABI Pub., New York.

Langeland, K.A. (1996). Hydrilla verticillata (L.F.) Royle (Hydrocharitaceae), "The Perfect Aquatic Weed". Castanea 61:293-304.

Ludlow, J. (1995). "Management of aquatic plant communities in Rodman reservoir from 1969-1994." Aquatics 17(3), 11-15.

Madsen, J.D. (2000). "Advantages and disadvantages of aquatic plant management techniques," ERDC/EL MP-00-1, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

McCann, J.A., Arkin, L.N., and Williams, J.D. (1996). "Nonindigenous aquatic and selected terrestrial species of Florida," National Biological Service, Southeastern Biological Center, 7920 N.W. 71st Street, Gainesville, FL 32653. Published on the Internet by the University of Florida, Center for Aquatic Plants.

Miller, J.L., Garrard, L.A., and Haller, W.T. (1976). "Some characteristics of hydrilla tubers taken from Lake Ocklawaha during drawdown," *Journal of Aquatic Plant Mangement* 14, 29-31.

NatureServe Explorer http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Halophila+Johnsonii *last accessed* 20 March 2003.

NatureServe Explorer http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Potamogeton+clystocarpus *last accessed* 20 March 2003.

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

Yeo, R. R., Falk, R. H., and Thurston, J. R. (1984). "The morphology of hydrilla (*Hydrilla verticillata* (L.f.) Royle)," *Journal of Aquatic Plant Management* 22, 1-17.

Appendix 1. Host specificity test list for *Hydrellia pakistanae*

Females tested on 29 plant species in choice tests oviposited on all but preferred hydrilla (Buckingham *et al.,* 1989):

1. Alismataceae *Echinodorus cordifolius* (L.) Griseb.
2. Alismataceae *Sagittaria latifolia* Willd.
3. Hydrocharitaceae *Elodea canadensis* Michx.
4. Hydrocharitaceae *Limnobium spongia* (Bose) Steud.
5. Najadaceae *Najas guadulupensis* (Spreng.) Magnus
6. Potamogetonaceae *Potamogeton crispus* L.
7. Potamogetonaceae *Potamogeton nodosus* C. and S.
8. Potamogetonaceae *Potamogeton pectinatus* L.
9. Ceratophyllaceae *Ceratophyllum demersum* L.
10. Characeae *Chara* sp.
11. Cruciferae *Nasturtium officinale* R. Br.
12. Cyperaceae *Eleocharis* sp. 2 (small)
13. Haloragaceae *Myriophyllum heterophyllum* Michx.
14. Haloragaceae *Proserpinaca pectinata* Lam.
15. Juncaceae *Juncus effusus* L.
16. Lemnaceae *Lemna perpusilla* Torr.
17. Lemnaceae *Spirodela punctata* (Meyer) Thomps.
18. Lentibulariaceae *Utricularia purpurea* Walt.
19. Nymphaeaceae *Nuphar luteum* (L.) Sibth. and Sm.
20. Nymphaeaceae *Nymphaea tuberosa* Paine
21. Onagraceae *Ludwigia repens* Forst.
22. Poaceae *Oryza sativa* L.
23. Poaceae *Hydrochloa caroliniensis* Beauv.
24. Polygonaceae *Polygonum densiflorum* Meissner
25. Pontederiaceae *Pontederia cordata* L.
26. Ruppiaceae *Ruppia maritima* L.
27. Salvinaceae *Azolla caroliniana* Willd.
28. Typhaceae *Typha latifolia* L.
29. Umbelliferae *Hydrocotyle umbellata* L.

Fifty-one plant species were tested in *H. pakistanae* larval no-choice tests with emphasis placed on pondweeds, *Potamogeton* (eight species), Hydrocharitaceae (four species), and southern naiad, *Najas guadalupensis* (Buckingham *et al.,* 1989). Plants that were considered "high risk" were those in families closely related to the Hydrocharitaceae, and thus more likely to be attacked by *Hydrellia*.

Plants Tested Included:
High-risk Families:

Alismataceae
Alisma subcordatum Raf.
Echinodorus cordifolius (L.) Griseb.
Sagittaria kurziana Gluck
Sagittaria latifolia Willd.

Hydrocharitaceae
Hydrilla verticillata (L.f.) Royle
Elodea canadensis Michx.
Elodea nuttalli (Planch.) St. John
Egeria densa (Planch.
Limnobium spongia (Bosc) Steud.
Vallisneria americana Michx.

Najadaceae
Najas guadulupensis (Spreng.) Magnus

Potamogetonaceae
Potamogeton crispus L.
Potamogeton diversifolius Raf.
Potamogeton illinoensis Morong
Potamogeton nodosus C. and S.
Potamogeton pectinatus L.
Potamogeton perfoliatus L.
Potamogeton pulcher Tuckerm
Potamogeton richardsonii (A. Bann.) Rydb.

Miscellaneous Families:

Araceae
Pistia stratiotes L.

Cabombaceae
Brasenia schreberi J.F. Gmel.
Cabomba caroliniana A. Grey

Ceratophyllaceae
Ceratophyllum demersum L.

Characeae
Chara sp.

Cruciferae
Nasturtium officinale R. Br.

Cyperaceae
Eleocharis sp. 1 (large)
Eleocharis sp. 2 (small)
Rynchospora inundata (Oakes) Fern.

Eriocaulaceae
Eriocaulon decangulare L.

Haloragaceae
Myriophyllum heterophyllum Michx.
Myriophyllum spicatum L.
Proserpinaca pectinata Lam.

Juncaceae
Juncus effusus L.

Lemnaceae
Lemna perpusilla Torr.
Spirodela punctata (Meyer) Thomps.

Lentibulariaceae
Utricularia purpurea Walt.

Menyanthaceae
Nymphoides aquatica (floating leaves) (S.G. Gmel.) Kuntze
Nymphoides aquatica (submersed) (S.G. Gmel.) Kuntze

Nymphaeaceae
Nuphar luteum (L.) Sibth. and Sm.
Nymphaea tuberosa Paine

Onagraceae
Ludwigia repens Forst.

Poaceae
Oryza sativa L.
Hydrochloa caroliniensis Beauv.
Zizaniopsis miliacea (Michx.)

Polygonaceae
Polygonum densiflorum Meissner

Pontederiaceae
Pontederia cordata L.

Ruppiaceae
Ruppia maritima L.

Salvinaceae
Azolla caroliniana Willd.
Salvinia rotundifolia Willd.

Scrophurlariaceae
Bacopa monnieri (L.) Penell

Typhaceae
Typha latifolia L.

Umbelliferae
Hydrocotyle umbellata L.

Filamentous algae
Unidentified green alga

Larvae mined in eight of the high-risk species, but adults emerged from only five species, *Elodea canadensis*, *Najas guadulupensis*, *Potamogeton crispus*, *P. nodosus*, and *P. perfoliatus*, (Buckingham *et al.,* 1989).

Appendix 2. Host specificity test list for *Hydrellia balciunasi.*

Fifteen plant species in five families and seven genera were tested in no-choice larval tests (Buckingham *et al.,* 1991). All of these plant species, except rice, were considered to be at a high risk for attack by *H. balciunasi* because they were closely related to hydrilla and many were hosts for other species of *Hydrellia* (Buckingham *et al.,* 1991).

Plants Tested Included:

Alismataceae
- *Sagittaria kurziana* Gluck
- *Sagittaria subulata* (L.) Buchen.

Hydrocharitaceae
- *Hydrilla verticillata* (L.f.) Royle
- *Elodea canadensis* Michx.
- *Egeria densa* (Planch.)
- *Vallisneria americana* Michx.

Najadaceae
- *Najas guadulupensis* (Spreng.) Magnus

Potamogetonaceae
- *Potamogeton crispus* L.
- *Potamogeton diversifolius* Raf.
- *Potamogeton illinoensis* Morong
- *Potamogeton nodosus* C. and S.
- *Potamogeton pectinatus* L.
- *Potamogeton perfoliatus* L.
- *Potamogeton richardsonii* (A. Bann.) Rydb.
- *Potamogeton pusillus* L.

Poaceae
- *Oryza sativa* L.

An additional twenty-seven plant species not closely related to hydrilla were tested in multi-choice larval development tests (Buckingham *et al.,* 1991).

Alismataceae
- *Echinodorus* sp.
- *Sagittaria graminea* Michx.

Aponogetonaceae
- *Aponogeton* sp. (exotic aquarium species)

Azollaceae
Azolla caroliniana Willd.

Cabombaceae
Brasenia schreberi J.F. Gmel.
Cabomba caroliniana A. Grey

Ceratophyllaceae
Ceratophyllum demersum L.

Cruciferae
Nasturtium officinale R. Br.

Haloragaceae
Myriophyllum aquaticum (Velloso) Verdc.
Myriophyllum spicatum L.

Hydrocharitaceae
Hydrilla verticillata (L.f.) Royle
Limnobium spongia (Bosc) Steud.

Lemnaceae
Lemna valdiviana Phil.
Spirodela polyrhiza (L.) Schleid.

Lentibulariaceae
Utricularia floridana Nash.
Utricularia purpurea Walt.

Menyanthaceae
Nymphoides aquatica) (S.G. Gmel.) Kuntze (submersed leaves)

Nymphaeaceae
Nuphar luteum (L.) Sibth. and Sm.(submersed leaves)
Nymphaea odorata Aiton (submersed leaves)

Onagraceae
Ludwigia repens Forst.

Poaceae
Hydrochloa caroliniensis Beauv.
Oryza sativa L.
Panicum dicotomiflorum (Michx.)

Polygonaceae
Polygonum densiflorum Meissner

Scrophulariaceae
Bacopa monnieri (L.) Penell.

Ruppiaceae
Ruppia maritima L.

No adults emerged from the twenty-seven plant species representing seventeen families tested in groups of three, and no plants were damaged (Buckingham *et al.,* 1991).

Decision and Finding of No Significant Impact
for
Field Release of *Hydrellia pakistanae* and *H. balciunasi* (Diptera: Ephydridae), for Biological Control of Hydrilla, *Hydrilla verticillata* (Hydrocharitaceae)
Environmental Assessment
June 2003

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ) is proposing to issue permits for the continued release of two nonindigenous, leaf-mining flies, *Hydrellia pakistanae* Deonier and *H. balciunasi* Bock (Diptera: Ephydridae). These agents are used for the biological control of hydrilla, *Hydrilla verticillata* (Hydrocharitaceae) in the continental United States. Both of these species have been released previously in the United States.

The alternatives available to APHIS are No Action (no permits), Issue Permit, and Issue Permit with Management Constraints or Mitigating Measures. Because of the action being proposed by APHIS, the Issue Permit and the Issue Permit with Management Constraints or Mitigating Measures alternatives will result in the continued release of these biological control agents into the environment. APHIS has therefore analyzed the potential effects of the extended release of these agents into the environment. The No Action alternative, as described in the environmental assessment (EA), would likely result in the continued use at the current level of chemical, mechanical, cultural/physical, and biological control methods for the management of hydrilla. These control methods described are not alternatives for decisions to be made by APHIS, but are presently being used to control hydrilla in the United States and may continue regardless of permit issuance for continued and extended field releases of *H. pakistanae* and *H. balciunasi*.

I have decided to authorize the PPQ permit unit to issue permits for the continued field release of *H. pakistanae* and *H. balciunasi* without management constraints or mitigating measures. The reasons for my decision are:

- These biological control agents are sufficiently host specific and pose little, if any, threat to the biological resources of the United States

- These species will not disproportionately affect minority or low- income populations, nor will they disproportionately affect children or result in any environmental health risks or safety risks to children.

- *H. pakistanae* and *H. balciunasi* pose no threat to the health of humans or wild or domestic animals.

- *H. pakistanae* and *H. balciunasi* are not likely to adversely affect endangered or threatened species or their habitat.

- While there is not total assurance that the release of *H. pakistanae* and *H. balciunasi* into the environment will be reversible, there is no evidence that these organisms will cause any adverse environmental effects.

Based on the analysis found in the EA, I find that issuance of permits for the continued field release of *H. pakistanae* and *H. balciunasi* without management constraints or mitigating measures will not have a significant impact on the quality of the human environment.

/s/

Michael J. Firko June 23, 2003
Assistant Director
APHIS Plant Health Programs
Plant Protection and Quarantine