WEED RISK ASSESSMENT FORM

Botanical name: *Hydrilla verticillata* (L. f.) Royle

Common name: hydrilla

Assessors:

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Outcome score:

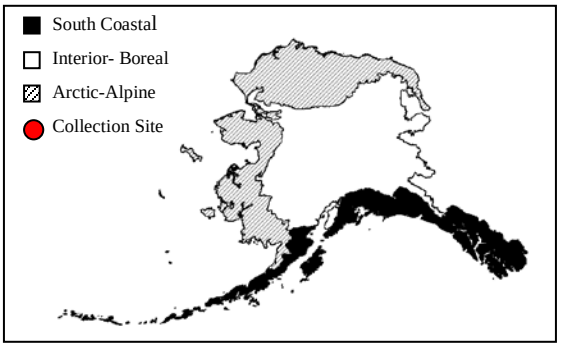
	A. Climatic Comparison		
	This species is present or may potentially establish in the following eco-geographic regions:		
1	South Coastal	Yes	
2	Interior-Boreal	Yes	
3	Arctic-Alpine	Yes	

B.	**Invasiveness Ranking**	Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	38
2	Biological characteristic and dispersal ability	25 (22)	17
3	Ecological amplitude and distribution	25 (25)	14
4	Feasibility of control	10 (10)	9
	Outcome score	100 (97)[b]	78 [a]
	Relative maximum score†		0.80

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."
† Calculated as [a]/[b].

A. CLIMATIC COMPARISON:

	1.1. Has this species ever been collected or documented in Alaska?
Yes	Yes – continue to 1.2
	No – continue to 2.1
	1.2. Which eco-geographic region has it been collected or documented (see inset map)? *Proceed to Section B. Invasiveness Ranking.*
Yes	South Coastal
Yes	Interior-Boreal
Yes	Arctic-Alpine



Documentation: *Hydrilla verticillata* has not been documented in Alaska (Hultén 1968, Pfauth and Sytsma 2005, UAM 2004).
Sources of information:

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

Pfauth, M. and M. Sytsma. 2005. Alaska aquatic plant survey report 2005. US Fish and Wildlife Service Contract number: 7012050114, Center of Lakes and Reservoirs, Portland State University, Portland, OR. Available online http://www. clr.pdx.edu [March 13, 2006].
University of Alaska Museum. University of Alaska Fairbanks. 2004. http://hispida.museum.uaf.edu:8080/home.cfm

2.1. Is there a 40% or higher similarity (based on CLIMEX climate matching) between climates any where the species currently occurs and

a. Juneau (South Coastal Region)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No

b. Fairbanks (Interior-Boreal)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No

c. Nome (Arctic-Alpine)?
Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*
No

– If "No" is answered for all regions, reject species from consideration

Documentation: The CLIMEX climate matching program indicates a climatic similarity between south coastal region of Alaska and areas of documented species' occurrence is high. The native range of hydrilla includes Akita, Japan and Thredbo, Australia (Cook and Lüönd 1982) which have 55% and 53% of climate similarity with Juneau, Alaska. The distribution range of hydrilla also includes Minsk, Belarus and Semipalatinsk, Russia (Cook and Lüönd 1982) which have a 62% and 61% climate similarity with Anchorage, respectively. Semipalatinsk and Blagoveshchensk, Russia, and Qiqihar, China have a 64%, 61%, and 50% climatic similarity with Fairbanks respectively. Further, aquatic species are generally less impacted by variation in terrestrial climates. *Hydrilla verticillata* is therefore likely to become established in the South Coastal and Interior Boreal Regions of Alaska.

Sources of information:

CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.
Cook, C.D.K. and R. Lüönd. 1982. A revision of the genus *Hydrilla* (Hydrocharitaceae). Aquatic Botany 13: 485-504.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes

A.	No perceivable impact on ecosystem processes	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score 8

Documentation:

Identify ecosystem processes impacted:

Hydrilla infestations slow the movement of water, causing flooding. Slow water flow can also increase the sedimentation rates, water temperature, pH level (Estes et al. 1990, Joyce et al. 1992) and decrease dissolved oxygen (Bossard et al. 2000). It also affects water nutrient turnover (Bole and Allan 1978, Sinha et al. 2000).

Rational:

Sources of information:

Bole, J.B. and J.R. Allan. 1978. Uptake of phosphorus from sediment by aquatic plants, *Myriophyllum spicatum* and *Hydrilla verticillata*. Water research 12: 353-358.

Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.
Estes, J.R., W.A. Sheaffer and E.P. Hall. 1990. Study I. Fisheries studies of the Orange Lake chain of Lakes. Florida Game and Fresh Water Fish Commission, Completion Report as Required by Federal Aid in Sport Fish Restoration Wallop-Breaux Project F-55-R Lower Ocklawaha Basin Fisheries Investigations, Tallahassee, Florida. 86 pp.
Joyce, J.C., K.A. Langeland, T.K. Van and V.V. Vandiver, Jr. 1992. Organic sedimentation associated with hydrilla management. Journal of Aquatic Plant Management 30: 20-23.
Sinha, S., R. Saxena and S. Singh. 2000. Fluoride removal from water by *Hydrilla verticillata* (l.f.) Royle and its toxic effects. Bulletin of Environmental Contamination and Toxicology 65: 683-690.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score 10

Documentation:

Identify type of impact or alteration:
Hydrilla forms a dense mat of vegetation at the water surface and limits light penetration degrading or eliminating all layers below (Bossard et al. 2000).
Rational:
Haller and Sutton (1975) reported ed that light penetration is reduced by at least 95% at one feet of depth. An aquatic vegetation sturdy in Florida found that areal coverage of submersed aquatic macrophytes increased from 8% in 1987 to 90% in 1989 and 1990 due to expansion of hydrilla (Estes et al. 1990).
Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.
Estes, J.R., W.A. Sheaffer and E.P. Hall. 1990. Study I. Fisheries studies of the Orange Lake chain of Lakes. Florida Game and Fresh Water Fish Commission, Completion Report as Required by Federal Aid in Sport Fish Restoration Wallop-Breaux Project F-55-R Lower Ocklawaha Basin Fisheries Investigations, Tallahassee, Florida. 86 pp.
Haller, W.T., D.L. Sutton and W.C. Barlowe. 1974. Effect of salinity on growth of several aquatic macrophytes. Ecology 55: 891-894.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 10

Documentation:

Identify type of impact or alteration:
Hydrilla infestations can cause reduction or extirpation of the population of native aquatic species (Bossard et al. 2000). Hydrilla may also shift the phytoplankton composition (Canfield et al. 1984). Infestations also adversely affect fish populations.
Rational:
Hydrilla may reduce seed production of native species, resulting eventually in a

reducing of a number of native species in the community (de Winton and Clayton 1996). An study in Florida found that frequency of occurrence fro the most abundant native submersed plants, coontail and southern naiad decreaded from 11% to 4% and 56% to 4% of samples, respectively, from 1987 to 1990 (Ester et al. 1990).

Sources of information:

Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.

Canfield, D.E.Jr., J.V. Shireman, D.E. Colle, W.T. Haller, E.E. Watkins and M.J. Maceina. 1984. Prediction of chlorophyll a concentration in Florida Lakes: importance of aquatic macrophytes. Can. J. Fish. Aquatic. Sci. 41: 497-501.

de Winton, M.D. and J.S. Clayton. 1996. The impact of invasive submerged weed species on seed banks in lake sediments. Aquatic Botany 53: 31-45.

Estes, J.R., W.A. Sheaffer and E.P. Hall. 1990. Study I. Fisheries studies of the Orange Lake chain of Lakes. Florida Game and Fresh Water Fish Commission, Completion Report as Required by Federal Aid in Sport Fish Restoration Wallop-Breaux Project F-55-R Lower Ocklawaha Basin Fisheries Investigations, Tallahassee, Florida. 86 pp.

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

A.	Negligible perceived impact	0
B.	Minor alteration	3
C.	Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins)	7
D.	Severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites)	10
U.	Unknown	

Score 10

Documentation:

Identify type of impact or alteration:

Hydrilla is eaten by waterfowl and fish. Some studies support the view that hydrilla is beneficial as a fish food and cover (Estes et al. 1990), other researches suggest that fish populations are adversely affected when hydrilla coverage exceeds 30% (Colle and Shireman 1980). Hydrilla appears to be an important habitat for a number of mosquito species (Hearnden and Kay 1997).

Rational:

Sources of information:

Colle, D.E. and J.V. Shireman. 1980. Coefficients of condition for largemouth bass, bluegill, and redear sunfish in *Hydrilla*-infested lakes. Transactions of the American Fisheries Society 109: 521-531.

Estes, J.R., W.A. Sheaffer and E.P. Hall. 1990. Study I. Fisheries studies of the Orange Lake chain of Lakes. Florida Game and Fresh Water Fish Commission, Completion Report as Required by Federal Aid in Sport Fish Restoration Wallop-Breaux Project F-55-R Lower Ocklawaha Basin Fisheries Investigations, Tallahassee, Florida. 86 pp.

Hearnden, M.N. and B.H. Kay. 1997. Importance of *Hydrilla verticillata* (Hydrocharitaceae) as habitat for immature mosquitoes at the Ross River Reservoir, Australia. Journal of the American Mosquito Control Association 13: 164-170.

Total Possible 40

Total 38

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2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode of reproduction

A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction)	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m^2)	1

C. Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m²) 2
D. Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m²) 3
U. Unknown

Score 3

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Hydrilla reproduces by seeds, but seed production has minor importance. Vegetative reproduction is very efficient and occurs by fragmentation of the stem, or by the production of axillary buds (turions) and below-ground tubers. One plant can produce an average of 6,046 tubers per season (Sutton et al. 1992). An experiment by Thullen (1990) showed that hydrilla can produced up to 46 axillary turions per 1.0 g dry weight (estimated of 2803 turions per m³).
Rational:
About 50% of the fragments with a single whorl can sprout and form new plant, more than 50% of the fragments with three whorls can sprout (Langeland and Sutton 1980).
Sources of information:
Langeland, K.A. and D.L. Sutton. 1980. Regrowth of hydrilla from axillary buds. Journal of Aquatic Plant Management 18; 27-29.
Sutton, D.L., T.K. Van and K.M. Portier. 1992. Growth of dioecious and monoecious hydrilla from single tubers. Journal of Aquatic Plant Management 30: 15-20.
Thullen, J.S. 1990. Production of axillary turions by the dioecious *Hydrilla verticillata*. Journal of Aquatic Plant Management 28: 11-15.

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

A. Does not occur (no long-distance dispersal mechanisms) 0
B. Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations) 2
C. Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.) 3
U. Unknown

Score 2

Documentation:
Identify dispersal mechanisms:
Tubers, turions and stem fragments disperse with flooding. Tubers survive ingestion by waterfowl and might be transported from one water body to another (Joyce et al. 1980). The importance of tubers dispersal, therefore, is unknown.
Rational:

Sources of information:
Joyce, J.C., W.T. Haller and D.E. Colle. 1980. Investigation of the presence and survivability of hydrilla propagules in waterfowl. Aquatics 2: 10-14.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

A. Does not occur 0
B. Low (human dispersal is infrequent or inefficient) 1
C. Moderate (human dispersal occurs) 2
D. High (there are numerous opportunities for dispersal to new areas) 3
U. Unknown

Score 2

Documentation:
Identify dispersal mechanisms:
Hydrilla was first introduced into North America as an aquarium plant. Turions or small pieces of hydrilla stems can travel on boat trailers or planes. Accidental introductions with planted waterlily have been reported (Washington State Department of Ecology

2004).
Rational:
Hydrilla twigs survive 16 hours of desiccation (Basiouny et al. 1978, Kar and Choudhuri 1982). Tubers can remain viable to several days out of water (Basiouny et al. 1978).
Sources of information:
Basiouny, F.M., W.T. Haller and L.A. Garrard. 1978. Survival of hydrilla (*Hydrilla verticillata*) plants and propagules after removal from the aquatic habitat. Weed Science 26(5): 502-504.
Kar, R.K. and M.A. Choudhuri. 1982. Effect of desiccation on internal changes with respect of survival of *Hydrilla verticillata*. Hidrobiological bulletin 16(2): 213-221.
Washington State Department of Ecology: Water Quality Home. 2004. Non-Native Freshwater Plants. Hydrilla (*Hydrilla verticillata*). Available: http://www.ecy.wa.gov/programs/wq/plants/weeds

2.4. Allelopathic

A.	No	0
B.	Yes	2
U.	Unknown	

Score 2

Documentation:
Describe effect on adjacent plants:
In experiments by Elakovich and Wooten (1989) extracts of hydrilla exhibit high allelopathy potential and inhibited the growth of lettuce seedling and duckweed frond.
Rational:

Sources of information:
Elakovich, S.D. and J.W. Wooten. 1989. Allelopathic potential of sixteen aquatic and wetland plants. Journal of Aquatic Plant Management 27: 78-84.

2.5. Competitive ability

A.	Poor competitor for limiting factors	0
B.	Moderately competitive for limiting factors	1
C.	Highly competitive for limiting factors and/or nitrogen fixing ability	3
U.	Unknown	

Score 3

Documentation:
Evidence of competitive ability:
Hydrilla is highly adaptive to the environment and competitive with most other aquatic plants (Haller and Sutton 1975). It is able to outcompete native submerged plants for light and nutrient.
Rational:
The growth habit of hydrilla enables it to compete effectively for sunlight. It can elongate up to one inch per day, and produces the majority of the stems in the upper 2-3 feet of water (Haller and Sutton 1975). This mat of vegetation intercepts sunlight and leads to exclusion of other aquatic plants. Hydrilla is also adapted to use low light levels for photosynthesis (Barko and Smart 1981, Van et al. 1976). Hydrilla efficiently uses a limited supply of nutrients such as carbon, nitrogen and phosphorus.
Sources of information:
Barko, J.W. and R.M. Smart. 1981. Comparative influences of light and temperature on the growth and metabolism of selected submersed freshwater macrophytes. Ecological Monographs 51(2): 219-235.
Haller, W.T. and D.L. Sutton. 1975. Community structure and competition between *Hydrilla* and *Vallisneria*. Hyacinth Control Journal 13: 48-50.
Van, T.K., W.T. Haller and G. Bowes. 1976. Comparison of the photosynthetic characteristics of three submersed aquatic plants. Plant Physiology 58: 761-768.

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

A. No 0
B. Forms dense thickets 1
C. Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation 2
U. Unknown

Score 2

Documentation:
Describe grow form:
Hydrilla can form a dense mat near the water surface (Bossard et al. 2000).
Rational:

Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.

2.7. Germination requirements

A. Requires open soil and disturbance to germinate 0
B. Can germinate in vegetated areas but in a narrow range or in special conditions 2
C. Can germinate in existing vegetation in a wide range of conditions 3
U. Unknown

Score N/A

Documentation:
Describe germination requirements:
Germination of seeds is not a significant factor in reproduction. (Bossard et al. 2000).
Rational:

Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.

2.8. Other species in the genus invasive in Alaska or elsewhere

A. No 0
B. Yes 3
U. Unknown

Score 0

Documentation:
Species:
None
Sources of information:

2.9. Aquatic, wetland, or riparian species

A. Not invasive in wetland communities 0
B. Invasive in riparian communities 1
C. Invasive in wetland communities 3
U. Unknown

Score 3

Documentation:
Describe type of habitat:
Hydrilla is a submerged aquatic perennial. Typical habitats of hydrilla include ditches, canals, ponds, reservoirs. It can be found in fresh and brackish, flowing and still waters (Bossard et al. 2000, Thorne 1993).
Rational:

Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.
Thorne, R.F. Hydrocharitaceae Waterweed family. In: Hickman, J.C., editor. The Jepson manual higher plants of California. Berkeley, Los Angeles, London:

University of California Press; 1993. Pp. 1150-1151.

Total Possible 22
Total 17

3. DISTRIBUTION

3.1. Is the species highly domesticated or a weed of agriculture

A. No 0
B. Is occasionally an agricultural pest 2
C. Has been grown deliberately, bred, or is known as a significant agricultural pest 4
U. Unknown

Score 0

Documentation:
Identify reason for selection, or evidence of weedy history:
Hydrilla is not an agricultural weed.
Rational:

Sources of information:

3.2. Known level of ecological impact in natural areas

A. Not known to cause impact in any other natural area 0
B. Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska 1
C. Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska 3
D. Known to cause moderate impact in natural areas in similar habitat and climate zones 4
E. Known to cause high impact in natural areas in similar habitat and climate zones 6
U. Unknown

Score 1

Documentation:
Identify type of habitat and states or provinces where it occurs:
Hydrilla causes severe alterations of plant community composition, community structure and ecosystem processes in water bodies in California (Bossard et al. 2000). This aquatic weed displaces native plants and adversely impacts freshwater habitats in Florida (Langeland 1996). Hydrilla is reported from one lake system in Washington. This is the only known occurrence of hydrilla in the Pacific Northwest and impact on native aquatic ecosystem has not been recorded (Washington State Department of Ecology 2004).
Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.
Langeland, K.A. 1996. *Hydrilla verticillata* (L.F.) Royle (Hydrocharitaceae), "The perfect aquatic weed". Castanea 61: 293-304.
Washington State Department of Ecology: Water Quality Home. 2004. Non-Native Freshwater Plants. Hydrilla (*Hydrilla verticillata*). Available: http://www.ecy.wa.gov/programs/wq/plants/weeds.

3.3. Role of anthropogenic and natural disturbance in establishment

A. Requires anthropogenic disturbances to establish 0
B. May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances 3
C. Can establish independent of any known natural or anthropogenic disturbances 5
U. Unknown

Score 5

Documentation:
Identify type of disturbance:
Hydrilla can be readily established in undisturbed aquatic ecosystem (Bossard et al. 2000).

Rational:

Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of California's wildlands. Pp. 218-221.

3.4. Current global distribution

A.	Occurs in one or two continents or regions (e.g., Mediterranean region)	0
B.	Extends over three or more continents	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions	5
U.	Unknown	

Score 3

Documentation:
Describe distribution:
Hydrilla is probably native to the warmer regions of Asia (Cook and Lüönd 1982). It is a cosmopolitan species that occurs in Europe, Asia, Australia, New Zealand, the Pacific Islands, Africa, North and South America.
Rational:

Sources of information:
Cook, C.D.K. and R. Lüönd. 1982. A revision of the genus Hydrilla (Hydrocharitaceae). Aquatic Botany 13: 485-504.

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

A.	0-5% of the states	0
B.	6-20% of the states	2
C.	21-50%, and/or state listed as a problem weed (e.g., "Noxious," or "Invasive") in 1 state or Canadian province	4
D.	Greater than 50%, and/or identified as "Noxious" in 2 or more states or Canadian provinces	5
U.	Unknown	

Score 5

Documentation:
Identify states invaded:
In the United States hydrilla populations occur in all southeastern states and in Arizona, California and Washington (USDA, NRCS 2006). *Hydrilla verticillata* is declared a Federal Noxious Weed in US. It is also listed noxious in 17 American states (Rice 2006, USDA, NRCS 2006).
Rational:

Sources of information:
Rice, P.M. INVADERS Database System (http://invader.dbs.umt.edu). Division of Biological Sciences, University of Montana, Missoula, MT 59812-4824.
USDA, NRCS. 2006. *The PLANTS Database*, Version 3.5 (http://plants.usda.gov). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Total Possible 25
Total 14

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4. FEASIBILITY OF CONTROL

4.1. Seed banks

A.	Seeds remain viable in the soil for less than 3 years	0
B.	Seeds remain viable in the soil for between 3 and 5 years	2
C.	Seeds remain viable in the soil for 5 years and more	3
U.	Unknown	

Score 2

Documentation:
Identify longevity of seed bank:
Seed production and seed viability is probably low. However, propagules of hydrilla, tubers survived in undisturbed sediment for a period of over four years. Axillary turions usually do not remain viable for more than one year (Van and Steward 1990).
Rational:

Sources of information:
Van, T.K. and K.K. Steward. 1990. Longevity of monoecious hydrilla propagules. Journal of Aquatic Plant Management 28: 74-76.

4.2. Vegetative regeneration

A.	No resprouting following removal of aboveground growth	0
B.	Resprouting from ground-level meristems	1
C.	Resprouting from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	

Score 3

Documentation:
Describe vegetative response:
Hydrilla can regenerate from stem fragments, tubers, and turions (Basiouny et al. 1978, Spencer and Rejmanek 1989, Steward 1992, Sutton et al. 1992).
Rational:
About 50% of the fragments with a single whorl can sprout and form new plant. More than 50% of the fragments with three whorls can sprout (Langeland and Sutton 1980).
Sources of information:
Basiouny, F.M., W.T. Haller and L.A. Garrard. 1978. Survival of hydrilla (*Hyrdilla verticillata*) plants and propagules after removal from the aquatic habitat. Weed Science 26: 502-504.
Langeland, K.A. and D.L. Sutton. 1980. Regrowth of hydrilla from axillary buds. Journal of Aquatic Plant Management 18: 27-29.
Spencer, D.F. and M. Rejmanek. 1989. Propagule type influences competition between two submersed aquatic macrophytes. Oecologia 81: 132-137.
Steward, K.K. 1992. Survival and growth of stem fragments from various hydrilla races. Florida Scientist 55: 129-135.
Sutton, D.L., T.K. Van and K.M. Portier. 1992. Growth of dioecious and monoecious hydrilla from single tubers. Journal of Aquatic Plant Management 30: 15-20.

4.3. Level of effort required

A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance)	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment	3
D.	Management requires a major, long-term investment of human and financial resources	4
U.	Unknown	

Score 4

Documentation:
Identify types of control methods and time-term required:
Cost of hydrilla management is extremely high. Management methods currently include mechanical removal, herbicides applications, and biological control. Hydrilla is fragmented easily and damaged plants that are not removed by mechanical control methods can act as a source of reestablishment. Several species of weevils, leaf-mining flies, and moth have been introduced to control hydrilla (Bossard et al. 2000, Langeland 1996).
Rational:

Sources of information:
Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. Invasive plants of

California's wildlands. Pp. 218-221.
Langeland, K.A. 1996. Hydrilla verticillata (L.F.) Royle (Hydrocharitaceae), "The perfect aquatic weed". Castanea 61: 293-304.

Total Possible	10
Total	9

Total for 4 sections Possible	97
Total for 4 sections	78

References:

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