Aquatic Plant		Parrot Feather; Brazilian Watermifoil
I. Current Status and Distribution		*Myriophyllum aquaticum*
a. Range	**Global/Continental**	**Wisconsin**
Native Range South America[1]	 *Figure 1: U.S and Canada Distribution Map*[2]	Not recorded in Wisconsin *Wisconsin water gardener reports this species overwinters in ornamental garden pond*

Abundance/Range
  Widespread:
 	
  Locally Abundant:
 	
  Sparse:
	Infests 600 miles, 500 acres of California waters[3]
	Southern New England[4]; Washington[3]; Australia and New Zealand[1]
	Not often reported as a problem in the United States[4]
		Not applicable
		
		Not applicable
		
		Not applicable

Range Expansion
  Date Introduced:
  Rate of Spread:
	Haddonfield, New Jersey, 1890[4]
	Rapid[3]; expanding mainly in southern United States[4]; well established after 11 years in New York[4]
		Not applicable
		Not applicable

Density
  Risk of Monoculture:
  Facilitated By:
	Can be high[5]
	High-nutrient environments[5]
		Unknown
		Unknown

b. Habitat	Lakes, ponds, streams, canal, saturated shorebanks; more frequently found in low-energy systems[5]	
Tolerance	Chart of tolerances: Increasingly dark color indicates increasingly optimal range	

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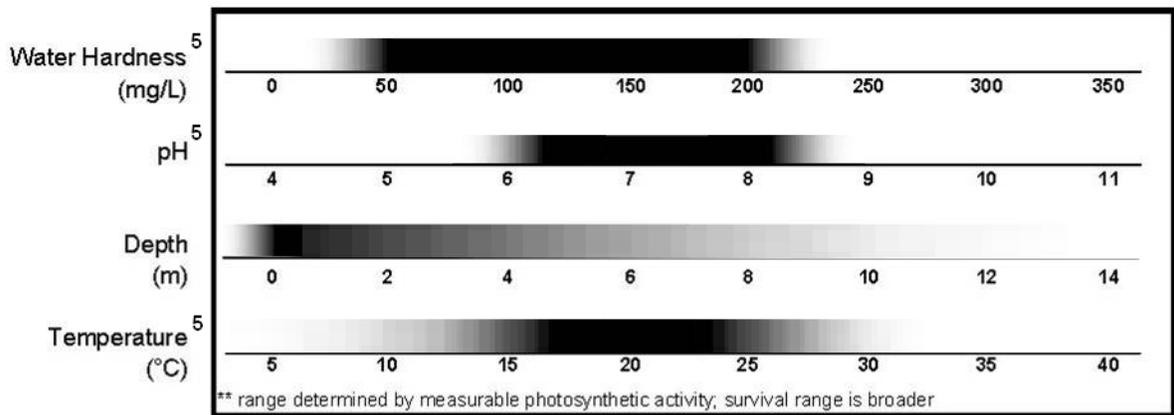
Preferences	Enriched sites with slow-moving, moderately alkaline water[5]; shallow water, but can occur as a floating mat in deep water of enriched lakes
c. Regulation	
Noxious/Regulated[2]:	AL, CT, MA, ME, VT, WA
Minnesota Regulations:	*Regulated*; One may not introduce without a permit
Michigan Regulations:	*Prohibited*; One may not knowingly possess or introduce
Washington Regulations:	*Priority Species of Concern*; Class B Noxious Weed; State Wetland and Aquatic or Noxious Weed Quarantine List
II. Establishment Potential and Life History Traits	
a. Life History	Submersed, floating, or emergent perennial dioecious herb[5]
Fecundity	High[3]
Reproduction	Sexual; Asexual[6]
Importance of Seeds:	Low; only pistillate flowers known in North America; no seed set occurs[6]
Vegetative:	Most important
Hybridization	Undocumented
Overwintering	
Winter Tolerance:	Medium: survives freezing winters in northern California[6]; can be killed by extended periods of frost[4]
Phenology:	Undocumented
b. Establishment	
Climate	
Weather:	Killed by long periods of frost[4]
Wisconsin-Adapted:	May be able to survive in Southeastern Wisconsin[4,7]; does not store phosphorus or carbon in rhizomes (which overwinter)[5]
Climate Change:	Likely to facilitate growth and distribution
Taxonomic Similarity	
Wisconsin Natives:	High; genus *Myriophyllum*
Other US Exotics:	High; genus *Myriophyllum*
Competition	
Natural Predators:	*Lysathia* spp.; high tannin content means it is generally unpalatable[5]
Natural Pathogens:	*Pythium carolinianum* (fungus)[3]
Competitive Strategy:	Prolific vegetative spread by rhizomes
Known Interactions:	Undocumented
Reproduction	
Rate of Spread:	High[4]
Adaptive Strategies:	Amphibious species which tolerates water level fluctuations[3]; hardy rhizomes spread with mechanical fragmentation[3]
Timeframe	Undocumented
c. Dispersal	
Intentional:	Aquarium trade; ornamental[1,3]
Unintentional:	Wind, water, animals, humans (boats/trailers)
Propagule Pressure:	Medium; fragments hardy and easily introduced, but does not autofragment[5]

Figures 2 and 3: Courtesy of Murray Severinsen; Environment Bay of Plenty[8]

III. Damage Potential	
a. Ecosystem Impacts	
Composition	May outcompete and replace native species that are of more value to fish and wildlife[9]; can outshade primary producing algal species[3]
Structure	Floating mats may change community architecture; fish respond to change in architecture
Function	Can alter the physical and chemical characteristics of lakes and streams[3]
Allelopathic Effects	Undocumented
Keystone Species	Undocumented
Ecosystem Engineer	Floating mats may decrease light penetration
Sustainability	Undocumented
Biodiversity	Undocumented
Biotic Effects	Undocumented
Abiotic Effects	Undocumented
Benefits	May provide habitat for fish and aquatic invertebrates[4]
b. Socio-Economic Effects	
Benefits	Can be used for phytoremediation because it metabolizes trinitrotoluene[10]; also used for antibiodics[11], ornamental use[4]
Caveats	Risk of release and population expansion outweighs benefits of use
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	May dominate small ponds and sloughs; impedes water flow in drainage ditches, irrigation canals[9]; provides mosquito habitat[3]
Expectations	More negative impacts can be expected in enriched, low-energy systems
Cost of Impacts	Decreased recreational and aesthetic value; decline in ecological integrity; increased research expenses
"Eradication" Cost	Undocumented
IV. Control and Prevention	
a. Detection	
Crypsis:	High; confused with other *Myriophyllum* spp.
Benefits of Early Response:	Undocumented

b. Control	
Management Goal 1	Eradication
Tool:	Chemical (various)
Caveat:	May be impossible; submersed and emersed parts must be treated[3]; emergent leaves covered in waxy cuticle that inhibits contact herbicide uptake[3]
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Management Goal 2	Nuisance relief
Tool:	Mechanical harvesting
Caveat:	Harvesting causes fragmentation which increases distribution and density[3]
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Tool:	Small-scale chemical treatments
Caveat:	Adverse effects on non-targets organisms
Cost:	Undocumented
Efficacy, Time Frame:	Success reported with 2,4-D, diquat, glysophate, endothall, copper[1]
Tool:	Biological control (*Lysathia* spp.)
Caveat:	Efficacy and non-target effects unknown[3]
Cost:	Undocumented
Efficacy, Time Frame:	*Lysathia* spp. rarely found on *M. aquaticum* in the field; effects on other species unknown[3]
Documented Cost	$30,000-$40,000 per year for control in Southwestern Washington[3]; $50,000 per year from the Washington Longview Diking District[3]

[1] US Forest Service, Pacific Island Ecosystems at Risk (PIER). 2010. *Myriophyllum aquaticum* (Vell.) Verdc., Haloragaceae. Retrieved December 28, 2010 from: http://www.hear.org/pier/species/myriophyllum_aquaticum.htm

[2] United States Department of Agriculture, Natural Resource Conservation Service. 2010. The PLANTS Database. National Plant Data Center, Baton Rouge, LA, USA. Retrieved December 28, 2010 from: http://plants.usda.gov/java/profile?symbol=MYAQ2

[3] Washington State Department of Ecology. Nonnative Freshwater Plants. Parrotfeather (*Myriophyllum aquaticum*). Retrieved December 28, 2010 from: http://www.ecy.wa.gov/programs/wq/plants/weeds/parrot.html

[4] Les, D.H. and L.J. Mehrhoff. 1999. Introduction of nonindigenous aquatic vascular plants in southern New England: a historical perspective. Biological Invasions. 1:281-300.

[5] Global Invasive Species Database. 2005. *Myriophyllum aquaticum.* Retrieved December 28, 2010 from: http://www.invasivespecies.net/database/species/ecology.asp?si=401&sts=sss

[6] Aiken, S.G. 1981. A conspectus of *Myriophyllum* (Haloragaceae) in North America. Brittonia 33(1):57-69.

[7] Herman, L. 2007. Personal communication.

[8] Severinsen, M. Environment Bay of Plenty. Retrieved March 4, 2010 from: http://www.envbop.govt.nz/Environment/Weed323.aspx

[9] Army Corps Engineer Research and Development Center Aquatic Plant Information System. *Myriophyllum aquaticum* (Vell.) Verdc. (Parrot feather) Retrieved November 12, 2010 from: http://el.erdc.usace.army.mil/aqua/apis/PlantInfo/plantinfo.aspx?plantid=30

[10] Bhadra, R., R.J. Spanggord, D.G. Wayment, J.D. Hughes and J.V. Shanks. 1999. Characterization of oxidation products of TNT metabolism in aquatic phytoremediation systems of *Myriophyllum aquaticum*. Environmental Science Technology 33(19):3354-3361.

[11] Gujarathi, N.P., B.J. Haney and J.C. Linden. 2005. Phytoremediation potential of *Myriophyllum aquaticum* and *Pistia stratiotes* to modify antibiotic growth promoters, tetracycline, and oxytetracycline, in aqueous wastewater systems. International Journal of Phytoremediation 7(2):99-112.