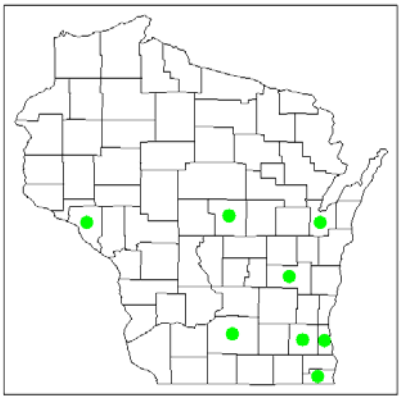
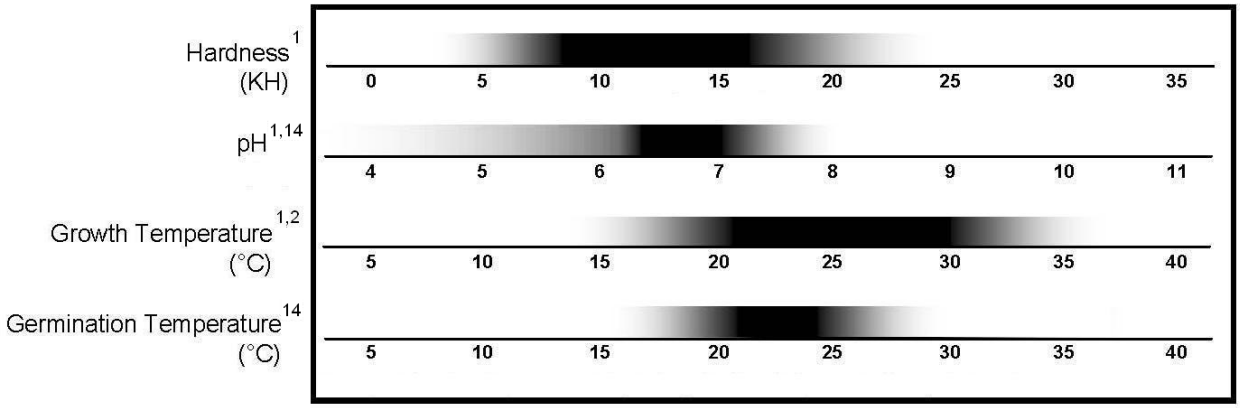
Aquatic Plant		Water lettuce
I. Current Status and Distribution		***Pistia stratiotes***
a. Range	**Global/Continental**	**Wisconsin**
Native Range Uncertain: likely South America[1], possibly Africa[2]; disagreement as to whether it is native to the United States[2,3]; currently pan-tropical in range[4]	 *Figure 1: U.S and Canada Distribution Map*[5] *Also reported from Illinois, Iowa, Minnesota, Connecticut, Rhode Island, Virginia, & Alabama*[6,7]	 *Figure 2: WI Distribution Map*[8,9,10,11]
Abundance/Range Widespread: Locally Abundant: Sparse:	 Subtropical Florida[3] Impacted eutrophic warm systems Temperate regions	 Not applicable Mississippi River Pool 5[(8)] ; Dane Co. stormwater pond[9] Duck Creek, Green Bay, WI (did not overwinter)[12]; Lake Winnebago[10]; Jefferson Ditch, Washington Co.[11] ; Center Lake, Kenosha Co.; Springville Pond, Portage Co.
Range Expansion Date Introduced: Rate of Spread:	 Soon after European settlement[3] Rapid[3]	 Reports of several independent introductions Does not overwinter well
Density Risk of Monoculture: Facilitated By:	 Among world's worst weeds[3]; can reach 2,000 g/m^2 in one season[3]; in Florida up to 1000 rosettes/m^2 [(13)] Undocumented	 Undocumented Warmer water conditions (artificially or naturally produced)
b. Habitat	Lakes, ponds, reservoirs, marshes, canals, slow-flowing streams and rivers[3,4]; can also survive in mud[3]	

Tolerance	Chart of tolerances: Increasingly dark color indicates increasingly optimal range[1,2,14]
	
Preferences	Polluted, impacted systems[15], silty or muddy substrates; clear shallow water, warm temperatures[6]; moderate hardness[1]
c. Regulation	
Noxious/Regulated[3,5]:	AL, CA, CT, FL, LA, MS, SC, TX
Minnesota Regulations:	*Not regulated*
Michigan Regulations:	*Not regulated*
Washington Regulations:	*Not regulated*
II. Establishment Potential and Life History Traits	
a. Life History	Free-floating aquatic monocotyledonous perennial[2] (but may act as annual)
Fecundity	High
Reproduction Importance of Seeds: Vegetative:	Sexual; Asexual[3] High (temperate)[3]; hydrosoil under mats holds 4,196 seeds/m^2 [(3)] Primary means of expansion[3]; up to 15 secondary rosettes may be attached to a single plant and up to four generations of rosette may be connected to one stolon[3]
Hybridization	Undocumented
Overwintering Winter Tolerance: Phenology:	 Plant is frost intolerant[3,6], but seeds will tolerate ice (-5°C) for several weeks[14]; overwinters by seed in the Netherlands; survives harsh winters in Slovenia by overwintering in thermal streams[16]; observed for last 2 years in the Puce River (Ontario)[17]; population reported to have successfully overwintered in the Mississippi River for 3-4 years before a particularly strong winter caused a population crash Emerges late relative to natives (may change with climactic shifts)
b. Establishment	
Climate Weather: Wisconsin-Adapted: Climate Change:	 Warm winters may allow spread Uncertain; could persist in cold temperate climates by repopulating from seed in spring[3] Milder winters likely to facilitate growth and distribution[17]
Taxonomic Similarity Wisconsin Natives: Other US Exotics:	 Medium; family Araceae Medium; family Araceae

Competition	
Natural Predators:	Neotropics: 21 insects (including 14 weevils): 9 occur in Florida[3]
Natural Pathogens:	*Ramularia pistiae*, *R. aromatica*, *Cercospora pistiae*[18], *Sclerotinia sclerotiorum*[19] and other fungi
Competitive Strategy:	Rapid growth rate; competitive exclusion (shading)[1]
Known Interactions:	Outcompeted by *Eichhornia crassipes* (water hyacinth)[3]; caused declines in *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Najas marina*, and *Trapa natans* in their respective native ranges[16]
Reproduction	
Rate of Spread:	High
Adaptive Strategies:	Rapid clonal reproduction; floating rosettes can spread with current
Timeframe	Can reach 2,000 g/m^2 in one season[3]
c. Dispersal	
Intentional:	Aquarium trade, ornamental use, wastewater treatment[3]
Unintentional:	Wind, water, animals, humans, boats and trailers[1]
Propagule Pressure:	Medium; fragments relatively easily accidentally introduced

Figure 2: Courtesy of Forest and Kim Starr, Starr Environmental, Bugwood.org[20]
Figure 3: Courtesy of Ken A. Langeland, University of Florida[21]

III. Damage Potential	
a. Ecosystem Impacts	
Composition	Disrupts submersed animal and plant communities[3]; greatly reduces biological diversity (submersed and emersed plants)[2]; decreases dissolved oxygen concentrations, causing fish kills[3]; decreases in planktonic diversity[22]
Structure	Miniaturization of plankton volume[22]; floating mats change community architecture; fish respond to change in architecture[4]
Function	Increased siltation, nutrient loading, alkalinity, and thermal stratification; reduced dissolved oxygen[3]
Allelopathic Effects	Undocumented
Keystone Species	Undocumented
Ecosystem Engineer	Yes; dense canopy decreases light penetration; increases siltation and causes thermal stratification
Sustainability	Undocumented
Biodiversity	Decreases[1,2]
Biotic Effects	Planktonic structure, diversity decreases[22]

Abiotic Effects	Decreases in dissolved oxygen concentration, pH and permanganate index[22]; increase in siltation, transparency, nitrate, ammonium, total nitrogen, total phosphorous, and total bacteria[3,22]
Benefits	Increases water clarity[22]; provides habitat for macroinvertebrates[23,24]
b. Socio-Economic Effects	
Benefits	Wastewater treatment[25,26,27,28,29,30,31,32,33,34,35]; ethno-medicinal plant[36]
Caveats	Risk of release and population expansion outweighs benefits of use; favorable breeding ground for mosquitoes[37]
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Blocks navigational channels[3]; impedes water flow in irrigation and flood control canals[1]; breeding ground for mosquitoes (disease vectors)[1,3,4]; bioaccumulation of heavy metals[3]; can interfere with hydroelectric operations[3]
Expectations	Undocumented
Cost of Impacts	Decreased recreational and aesthetic value; decline in ecological integrity; increased research expenses
"Eradication" Cost	Depends on population size
IV. Control and Prevention	
a. Detection	
Crypsis:	Low[2]
Benefits of Early Response:	High; prevents prolific seed set crucial to survival in temperate zones
b. Control	
Management Goal 1	Eradication
Tool:	Hand pulling; seining[1,9,11]
Caveat:	Labor intensive; many regions do not report success
Cost:	Undocumented
Efficacy, Time Frame:	Successful in New Zealand[38]; small deliberately planted populations may be quickly removed
Management Goal 2	Nuisance relief
Tool:	Mechanical chopping; harvesting[2]
Caveat:	Plants must be removed from the water to prevent vegetative spread
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Tool:	*Spodoptera pectinicornis* (noctuid moth)[4,39,40,41]
Caveat:	Populations establish, but fail to persist, restocking is necessary[3]
Cost:	Undocumented
Efficacy, Time Frame:	Only larvae feed on *P. stratiotes*; short life cycle[1]
Tool:	*Neohydronomus affinis* [*pulchellus*] Hustache (weevil)[3,42,43,44,45,46,47]
Caveat:	Research still being conducted
Cost:	Undocumented
Efficacy, Time Frame:	Produces 90% declines but is cyclical (long term suppression elusive); one pair per plant is can control *P. stratiotes* over a six-week period[42]

Tool:	*Samea multiplicalis* (pyralid moth)[4]
Caveat:	Feeds on other species of plants
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Tool:	*Argentinorhynchus breyeri, A. bruchi, A. squamosus* (weevils)[47,48]
Caveat:	No studies into host specificity
Cost:	Undocumented
Efficacy, Time Frame:	*A. breyeri* showed potential to kill plants if enough larvae develop
Tool:	Endothall[1,3], diquat[3,49,50], glyphosate[3,50,51,52], 2,4-D[53], triclopyr[53]
Caveat:	Non-target plant species are negatively impacted
Cost:	Undocumented
Efficacy, Time Frame:	Good to excellent control reported; potential oxygen depletion with die-off
Documented Cost	Estimate total expenditures exceed $1 million annually in Florida[3]

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