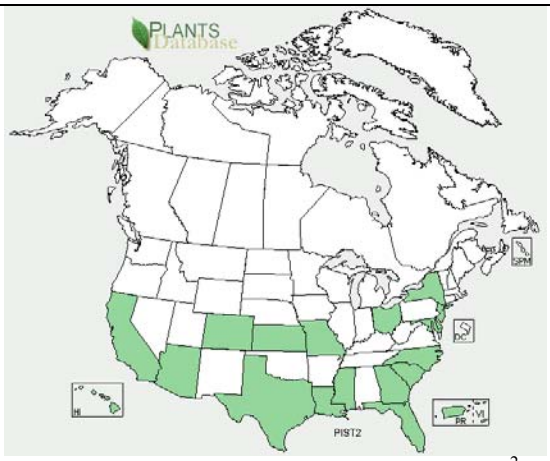
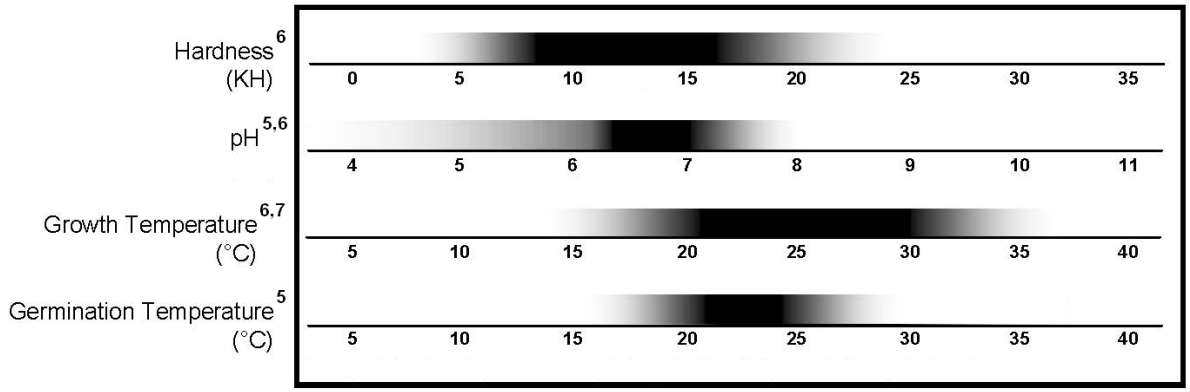
Aquatic Plant		Water Lettuce
I. Current Status and Distribution		***Pistia stratiotes***
a. Range	**Global/Continental**	**Wisconsin**
Native Range Uncertain: likely South America[6], possibly Africa[7]; disagreement as to whether it is native to the United States[4,7]; currently pan-tropical in range[1]	 *Figure 1: U.S and Canada Distribution Map[2]* *Also reported from Illinois & Rhode Island[9]*	Population reported to have successfully overwintered in the Mississippi River for 3-4 years before a particularly strong winter caused a population crash Found in Duck Creek, near Green Bay, WI in 2002; did not overwinter[3]
Abundance/Range Widespread: Locally Abundant: Sparse:	 Subtropical Florida[4] Impacted eutrophic warm systems Temperate regions	 Not applicable Not applicable Not applicable
Range Expansion Date Introduced: Rate of Spread:	 Soon after European settlement[4] Rapid[4]	 Reports of several independent introductions Does not overwinter well
Density Risk of Monoculture: Facilitated By:	 Among world's worst weeds[4]; can reach 2,000 g/m^2 in one season[4]; in Florida up to 1000 rosettes/m^2 [(21)] Undocumented	 Unknown Unknown
b. Habitat	Lakes, ponds, reservoirs, marshes, canals, slow-flowing streams and rivers[1,4]; can also survive in mud[4]	
Tolerance	Chart of tolerances: Increasingly dark color indicates increasingly optimal range	
		
Preferences	Polluted, impacted systems[8], silty or muddy substrates; clear shallow water, warm temperatures[9]; moderate hardness[6]	

c. Regulation	
Noxious/Regulated[2,4]:	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 monocotyledonous perennial[7] (but may act as annual); aquatic herb in the Araceae family[4]
Fecundity	High
Reproduction	Sexual; Asexual[4]
Importance of Seeds:	High (temperate)[4]; hydrosoil under mats holds 4,196 seeds/m^{2} [(4)]
Vegetative:	Primary means of expansion[4]; 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[4]
Hybridization	Undocumented
Overwintering	
Winter Tolerance:	Plant is frost intolerant[4,9], but seeds will tolerate ice (-5°C) for several weeks[5]; overwinters by seed in the Netherlands; survives harsh winters in Slovenia by overwintering in thermal streams[12]
Phenology:	Emerges late relative to natives (may change with climactic shifts)
b. Establishment	
Climate	
Weather:	Warm winters may allow spread
Wisconsin-Adapted:	Uncertain; could persist in cold temperate climates by repopulating from seed in spring[4]
Climate Change:	Likely to benefit growth and distribution
Taxonomic Similarity	
Wisconsin Natives:	Medium; family Araceae
Other US Exotics:	Medium; family Araceae
Competition	
Natural Predators:	Neotropics: 21 insects (including 14 weevils): 9 occur in Florida[4]
Natural Pathogens:	*Ramularia pistiae*, *R. aromatica*, *Cercospora pistiae*[10], *Sclerotinia sclerotiorum*[11] and other fungi
Competitive Strategy:	Rapid growth rate; competitive exclusion (shading)[6]
Known Interactions:	Outcompeted by *Eichhornia crassipes* (water hyacinth)[4]; caused declines in *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Najas marina*, and *Trapa natans* in their respective native ranges[12]
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[4]
c. Dispersal	
Intentional:	Aquarium trade, ornamental use, wastewater treatment[4]
Unintentional:	Wind, water, animals, humans, boats and trailers[6]
Propagule Pressure:	Medium; fragments relatively easily accidentally introduced

Figure 2: Courtesy of Forest and Kim Starr, Starr Environmental, Bugwood.org[13]
Figure 3: Courtesy of Ken A. Langeland, University of Florida[14]

III. Damage Potential	
a. Ecosystem Impacts	
Composition	Disrupts submersed animal and plant communities[4]; greatly reduces biological diversity (submersed and emersed plants)[7]; decreases dissolved oxygen concentrations, causing fish kills[4]; decreases in planktonic diversity[15]
Structure	Miniaturization of plankton volume[15]; floating mats change community architecture; fish respond to change in architecture[1]
Function	Increased siltation, nutrient loading, alkalinity, and thermal stratification; reduced dissolved oxygen[4]
Allelopathic Effects	Undocumented
Keystone Species	Undocumented
Ecosystem Engineer	Yes; dense canopy decreases light penetration; increases siltation and causes thermal stratification
Sustainability	Undocumented
Biodiversity	Decreases[6,7]
Biotic Effects	Planktonic structure, diversity decreases[15]
Abiotic Effects	Decreases in dissolved oxygen concentration, pH and permanganate index[15]; increase in siltation, transparency, nitrate, ammonium, total nitrogen, total phosphorous, and total bacteria[4,15]
Benefits	Increases water clarity[15]
b. Socio-Economic Effects	
Benefits Caveats	Wastewater treatment[16] Risk of release and population expansion outweighs benefits of use; favorable breeding ground for mosquitoes[17]
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Blocks navigational channels[4]; impedes water flow in irrigation and flood control canals[6]; breeding ground for mosquitoes (disease vectors)[1,4,6]; bioaccumulation of heavy metals[4]; can interfere with hydroelectric operations[4]

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[7]
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[6]
Caveat:	Labor intensive; many regions do not report success
Cost:	Undocumented
Efficacy, Time Frame:	Successful in New Zealand[18]; small deliberately planted populations may be quickly removed
Management Goal 2	Nuisance relief
Tool:	Mechanical chopping; harvesting[7]
Caveat:	Plants must be removed from the water to prevent vegetative spread
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Tool:	*Spodoptera pectinicornis* (noctuid moth)[1]
Caveat:	Populations establish, but fail to persist, restocking is necessary[4]
Cost:	Undocumented
Efficacy, Time Frame:	Only larvae feed on *P. stratiotes*; short life cycle[6]
Tool:	*Neohydronomus affinis* [*pulchellus*] Hustache (weevil)[4,19]
Caveat:	Research still being conducted
Cost:	Undocumented
Efficacy, Time Frame:	Produces 90% declines but is cyclical (long term suppression elusive)
Tool:	*Samea multiplicalis* (pyralid moth)[1]
Caveat:	Feeds on other species of plants
Cost:	Undocumented
Efficacy, Time Frame:	Undocumented
Tool:	*Argentinorhynchus breyeri, A. bruchi, A. squamosus*[20]
Caveat:	No studies into host specificity
Cost:	Undocumented
Efficacy, Time Frame:	*A. breyeri* showed potential to kill plants if enough larvae develop
Tool:	Endothall[4,6], diquat[4,22], glyphosate[4,22,23], 2,4-D[24], triclopyr[24]
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[4]

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