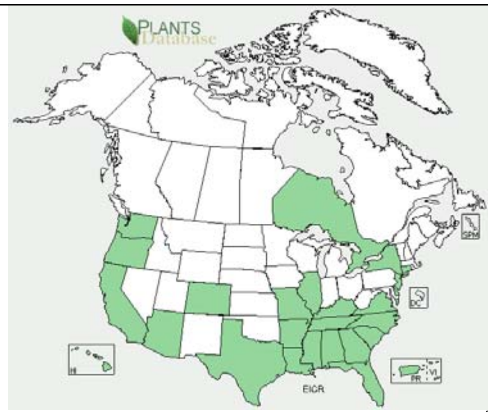
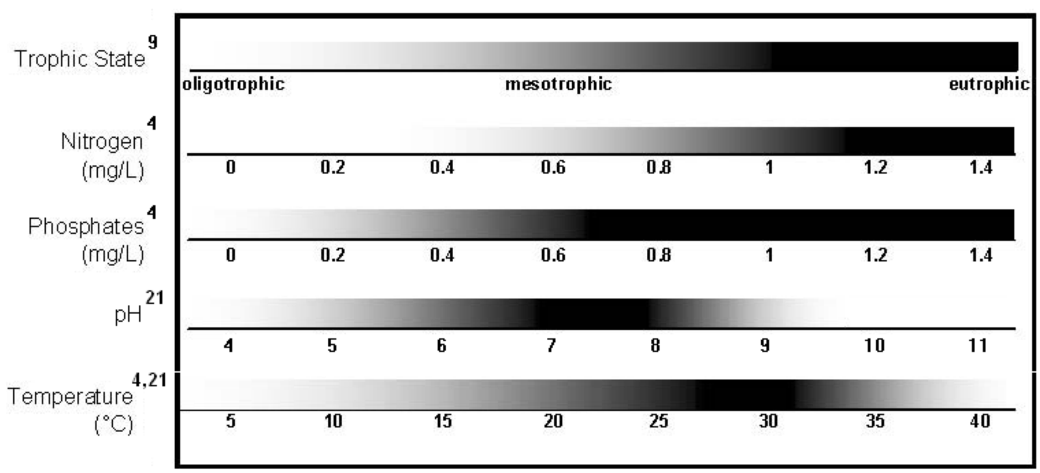
I. Current Status and Distribution — *Eichhornia crassipes*

a. Range	Global/Continental	Wisconsin
Native Range Amazon River Basin[1]	 *Figure 1: U.S and Canada Distribution Map[2]*	Found in Fifield, Price Co. sewage treatment pond in 2003 where it had overwintered for 5 to 6 years[3]; reported in Milwaukee area in 2003[3]; found in Center Lake, Kenosha Co., 2005 and removed the same year, no reports of continued presence; found in Dane Co. stormwater ponds, 2010
Abundance/Range		
Widespread:	Crisis level in 75% of countries surveyed[4]	Not widespread
Locally Abundant:	Southern United States	Warm, nutrient-enriched water
Sparse:	Salinity and wave action limit its distribution[1]	Undocumented
Range Expansion		
Date Introduced:	New Orleans, 1884[17]	2003 or earlier
Rate of Spread:	Highest of any vascular macrophyte[5]; net production is 10-15 tons/ha[(6)]	Undocumented; possibly limited by climate
Density		
Risk of Monoculture:	High; among the world's worst weeds[7]	Undocumented
Facilitated By:	Warm temperatures, eutrophication, disturbance	Warmer water conditions (artificially or naturally produced)
b. Habitat	Lakes, reservoirs, ponds, rivers, marshes, ditches, canals, low energy systems[1,4]; can also root in damp mud[8]	
Tolerance	Chart of tolerances: Increasingly dark color indicates increasingly optimal range	



Preferences	Eutrophic to hypereutrophic disturbed systems[9,10]
c. Regulation	
Noxious/Regulated[2]:	AL, AZ, CA, CT, FL, SC, TX
Minnesota Regulations:	*Not regulated*
Michigan Regulations:	*Not regulated*
Washington Regulations:	*Secondary Species of Concern*
II. Establishment Potential and Life History Traits	
a. Life History	Perennial aquatic herbaceous free floating macrophyte
Fecundity	High; leaf and daughter plant production were more than double at high versus low nutrient concentration[11]
Reproduction Importance of Seeds: Vegetative:	Sexual; Asexual Limited; especially when nutrient concentration is high[11] Very important; doubling time of 3.2 days for total biomass (after drawdown)[12]; stoloniferous rhizomes
Hybridization	Undocumented
Overwintering Winter Tolerance: Phenology:	 Low; frost-intolerant[7] Flowers year-round in mild climates, producing abundant seed[5]
b. Establishment	
Climate Weather: Wisconsin-Adapted: Climate Change:	 Mild winters facilitate growth Unknown; overwintering may be limited by climate Likely to facilitate growth and distribution
Taxonomic Similarity Wisconsin Natives: Other US Exotics:	 Medium; family Pontederiaceae High; *E. azurea* and *E. paniculata* noxious in Florida[2]
Competition Natural Predators: Natural Pathogens: Competitive Strategy: Known Interactions:	 Many Many, including *Cercospora piaropi* (fungi)[1,11] One of the fastest growing plants; rapid biomass expansion dwarfs growth rate of other species; shades submersed native species *Salvinia herzogii*[12] and *S. molesta*[8] replaced by *E. crassipes*; fish populations increased after treatment and removal of *E. crassipes*[13]
Reproduction Rate of Spread: Adaptive Strategies:	 High Very rapid vegetative spread
Timeframe	Can dominate a system in one year
c. Dispersal	
Intentional: Unintentional: Propagule Pressure:	Ornamental use, aquarium trade, phytoremediation projects Water currents, animals, humans (used as animal feed, spread by boats, escape from cultivation, etc.) Medium; fragments not easily accidentally introduced, but often sold and planted

Figure 2: Courtesy of Willey Durden, USDA Agricultural Research Service, Bugwood.org[14]
Figure 3: Courtesy of Fred Hrusa, CalFlora[15]

III. Damage Potential

a. Ecosystem Impacts	
Composition	Dense mats prevent growth of submerged and emersed plants[10]; zooplankton abundance significantly lower beneath mats[16]; displaces native birds and fish[1]
Structure	Retention of suspended solids in root system[16]; shades out submerged vegetation[4]; fish kills due to oxygen depletion[4]
Function	Deoxygenation and acidification of the environment with a reduced euphotic zone; reduced primary and secondary productivity[13]
Allelopathic Effects	Multiple compounds inhibit algae growth[9,16]
Keystone Species	Undocumented
Ecosystem Engineer	Yes; dense floating mats alter ecosystem[5,17]
Sustainability	Impoverishes ecosystem[4]
Biodiversity	Decreases at multiple trophic levels[4]
Biotic Effects	Impacts native species at multiple trophic levels[4]
Abiotic Effects	Reduced dissolved oxygen concentrations and light penetration; changes in water temperature and hydrology[4]; increases organic sediment[5]
Benefits	Increases clarity; can improve conditions in severely degraded systems[18]; provides some local habitat for macroinvertebrates and juvenile fish[5,8,10]

b. Socio-Economic Effects	
Benefits	Phytoremediation of heavy metals (cyanide)[19]; urban sewage treatment[20]; agricultural/industrial waste treatment, biosorbent, biogas production[21]; duck and livestock food[5,21]; fibers[21]
Caveats	Risk of release and population expansion outweighs benefits of use
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Completely blocks streams, irrigation and drainage channels, greatly reducing water flow[6]; disrupts electricity generation, irrigation, fishing, recreation, fresh water supply[17,21]; habitat for human parasites and disease vectors[17,21]; dense mats can sweep away buildings during floods[4]
Expectations	More negative impacts can be expected in impacted, eutrophic systems[17]
Cost of Impacts	$500 million annual revenue loss in Nigeria[13]; decreased recreational and aesthetic value; decline in ecological integrity; increased research expenses
“Eradication” Cost	Very expensive, sometimes impossible

IV. Control and Prevention	
a. Detection	
Crypsis:	Medium; *Limnobium spongia* and *Calla palustris*
Benefits of Early Response:	High; curbing population at low biomass extremely helpful[4]
b. Control	
Management Goal 1	Eradication
Tool:	Integrated herbicidal, mechanical and biological control[13]
Caveat:	Plant can cover large areas, chemical concentrations and residuals may be high[4]; (e.g. 70,000 acres needed to be treated in Lake Victoria)[4]
Cost:	Billions of dollars (Africa and the Middle East)[4]
Efficacy, Time Frame:	Often too large to control in one year; constant and annual effort needed[4]
Management Goal 2	Nuisance relief
Tool:	Small-scale chemical (2,4-D or glyphosate) or mechanical harvest
Caveat:	Rapid growth rate limits efficacy of control; negative impacts on non-targets species
Cost:	Expensive
Efficacy, Time Frame:	Only successful in controlling small infestations
Tool:	Many biological control options, including: *Neochetina eichhorniae* and *N. bruchi* (weevils), *Niphograpta albiguttalis* (moth larvae)[1,4], and several pathogens[22,23]
Caveat:	If nutrient influx is not addressed, success is unlikely[17]
Cost:	Varies; depends on agent used
Efficacy, Time Frame:	Must stock very high levels and complementary groups of control agents
Minimum Effort	Obligate yearly (one year of no control would return infestation to crisis levels in Florida)[4]
Documented Cost	$1 million/year for 985 ha in California; over $12 million/year in China[5]

[1] US Forest Service, Pacific Island Ecosystems at Risk (PIER). 2010. *Eichhornia crassipes* (Mart.) Solms., Pontenderiaceae. Retrieved December 22, 2010 from: http://www.hear.org/pier/species/eichhornia_crassipes.htm

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