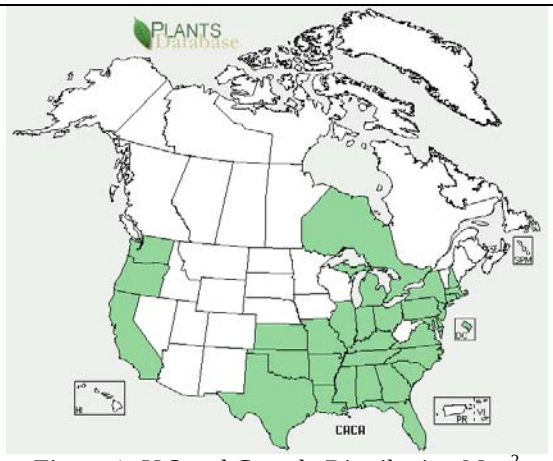
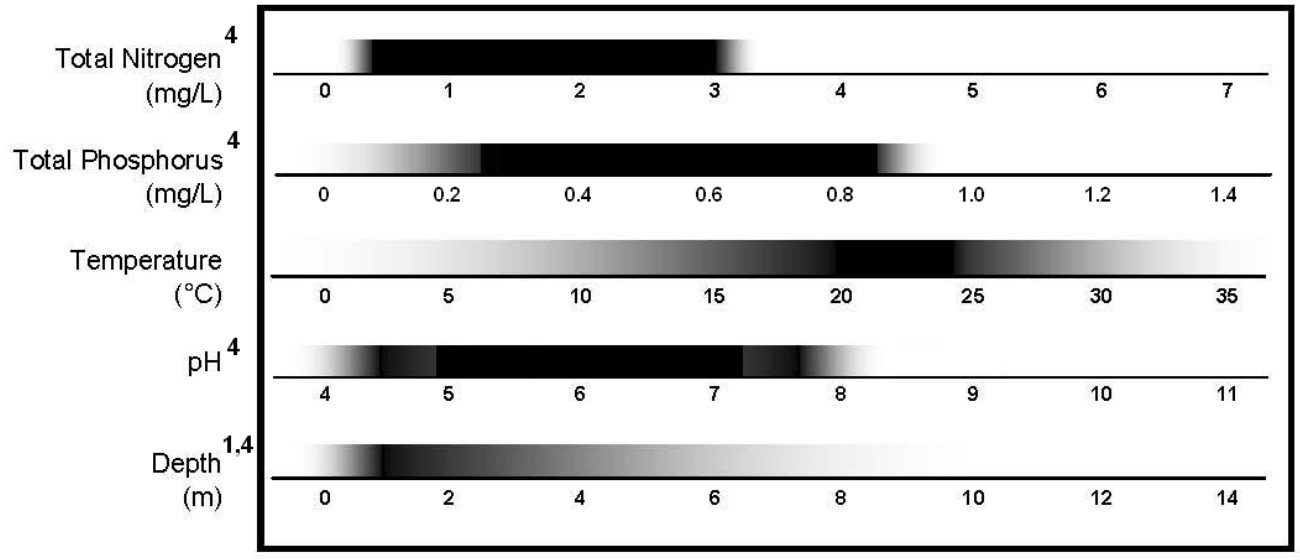
Aquatic Plant		Fanwort; Cabomba
I. Current Status and Distribution		***Cabomba caroliniana***
a. Range	**Global/Continental**	**Wisconsin**
Native Range Brazil, Paraguay, Uruguay, Northeast Argentina, Southern U.S.[1]	 *Figure 1: U.S and Canada Distribution Map*[2]	Not recorded in Wisconsin[3]
Abundance/Range Widespread: Locally Abundant: Sparse:	 Native to southeastern U.S. Invasive in northeastern and western U.S. Michigan	 Not applicable Not applicable Not applicable
Range Expansion Date Introduced: Rate of Spread:	 Native to southeastern U.S. Growth of 50mm per day has been reported in Australia[1]	 Not applicable Not applicable
Density Risk of Monoculture: Facilitated By:	 High High nutrient water[4]	 Unknown Unknown
b. Habitat	Lakes, reservoirs, ponds, streams, small rivers, ditches, canals, sloughs, low energy systems[1,6]	
Tolerance	Chart of tolerances: Increasingly dark color indicates increasingly optimal range	



Preferences	Low energy and high nutrient environments; high light conditions; silt substrate; low pH; low calcium[1,4,5]
c. Regulation	
Noxious/Regulated[2]:	CA, CT, MA, ME, VT, WA
Minnesota Regulations:	*Regulated*; One may not introduce without a permit
Michigan Regulations:	*Not regulated*
Washington Regulations:	*Secondary 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, perennial, dicotyledonous forb[2]
Fecundity	High
Reproduction	Sexual; Asexual
Importance of Seeds:	Low in New Jersey; seeds readily germinate within native range[6]
Vegetative:	Most important[7]; rhizomes and stem fragments easily broken[1]
Hybridization	Undocumented
Overwintering	
Winter Tolerance:	High
Phenology:	Flowers from May-September in U.S.[1]; grows year round in Australia
b. Establishment	
Climate	
Weather:	Prefers hot, humid weather in range of 13-27°C, but plant fragments can remain viable under ice[1]
Wisconsin-Adapted:	Likely
Climate Change:	Likely to facilitate growth and distribution
Taxonomic Similarity	
Wisconsin Natives:	Medium; family Cabombaceae[3]
Other US Exotics:	Low
Competition	
Natural Predators:	Waterfowl and some fish[6]; *Hydrotimetes natans* (herbivorous weevil) and *Paracles* spp. (moths)[8]
Natural Pathogens:	Undocumented
Competitive Strategy:	Rapid growth; shades sub-surface vegetation; tolerates turbid water[1]
Known Interactions:	*C. caroliniana* dominance is negatively correlated with *Hydrilla verticillata* and *Vallisneria natans*[4]; can also outcompete *Potamogeton* spp., *Chara* spp., and *Ceratophyllum demersum*[8]
Reproduction	
Rate of Spread:	High
Adaptive Strategies:	Fragments can survive free-floating for 6 to 8 weeks[1]
Timeframe	Undocumented
c. Dispersal	
Intentional:	Aquarium trade, local small-scale cultivation[1]
Unintentional:	Wind, water, birds, boats, trailers, recreational equipment[1]
Propagule Pressure:	High; fragments easily accidentally introduced and source populations near Wisconsin

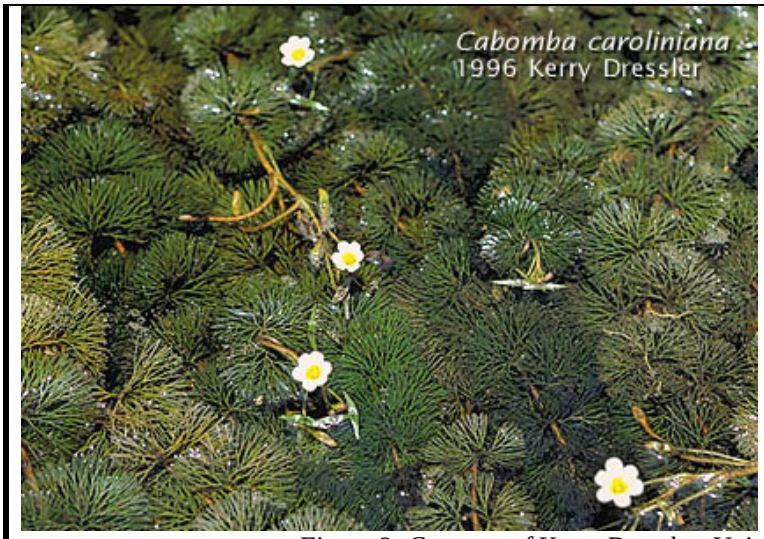


Figure 2: Courtesy of Kerry Dressler, University of Massachusetts-Amherst[9]
Figure 3: Courtesy of Ann Murray, University of Florida[10]

III. Damage Potential	
a. Ecosystem Impacts	
Composition	Native plant richness and abundance decreases[1,5,11]; in Australia, water rat and platypus numbers are lower in infested creeks[1]
Structure	Monocultures[8]; changes community architecture[8]
Function	Decreases in dissolved oxygen concentration and light penetration; temperature fluctuations in dense populations[1,4]
Allelopathic Effects	Yes[12,13]
Keystone Species	Undocumented
Ecosystem Engineer	Yes; dense canopy decreases light penetration
Sustainability	Undocumented
Biodiversity	Decreases[5]
Biotic Effects	Reduces local plant diversity and animal populations; inhibits blue-green algae growth[12]
Abiotic Effects	Decreases in dissolved oxygen concentration
Benefits	May provide habitat for some small fish and plankton[1]
b. Socio-Economic Effects	
Benefits Caveats	May be used in heavy metal (lead) removal from water systems[14] Risk of release and population expansion outweighs benefits of use
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Dense growth inhibits recreation and aesthetics[1]; may clog drainage and irrigation canals or water treatment pipes[1,8]; decreases native diversity and abundance; requires expensive control: non-target species are negatively affected
Expectations	More negative impacts can be expected in low energy, high nutrient, acidic systems
Cost of Impacts	Decreased recreational and aesthetic value; decline in ecological integrity; increased research expenses; water treatment can increase by up to $50 a megalitre[1]
"Eradication" Cost	Quite expensive

IV. Control and Prevention	
a. Detection	
Crypsis:	High; confused with native *Ranunculus* spp., *Ceratophyllum* spp., *Myriophyllum* spp., and *Megalodonta beckii*
Benefits of Early Response:	High; early response might prevent negative impacts of dense growth
b. Control	
Management Goal 1	Eradication
Tool:	Habitat modification (drawdown, shading, dyes)
Caveat:	Eradication may be impossible; no confirmed long-term success
Cost:	Extremely expensive
Efficacy, Time Frame:	Repeat treatments or large-scale drawdown
Management Goal 2	Nuisance relief
Tool:	Chemical (endothall, fluridone)[6,15]; mechanical or manual harvest
Caveat:	Harvesting causes fragmentation which increases distribution and density
Cost:	Affordable to expensive
Efficacy, Time Frame:	Yearly management likely necessary; negative effects on other non-target species
Tool:	Biological control (i.e. grass carp, invertebrate herbivores)
Caveat:	Options are available, however not fully developed or tested[8]
Cost:	Undocumented
Efficacy, Time Frame:	Grass carp has been effective in the southern U.S.

[1] Global Invasive Species Database. 2006. *Cabomba caroliniana*. Retrieved December 21, 2010 from: http://www.invasivespecies.net/database/species/ecology.asp?si=402&fr=1&sts=sss

[2] United States Department of Agriculture, Natural Resource Conservation Service. 2010. The PLANTS Database. National Plant Data Center, Baton Rouge, LA, USA. Retrieved December 21, 2010 from: http://plants.usda.gov/java/profile?symbol=CACA

[3] University of Wisconsin – Madison. 2005. Wisconsin Botanical Information System, Wisflora. Retrieved December 21, 2010 from: http://www.botany.wisc.edu/cgi-bin/SearchResults.cgi?Family=Cabombaceae

[4] Yu, M., B. Ding, J. Yu, X. Jin, H. Zhou and W. Ye. 2004. Basic characteristics of submerged plant communities invaded by *Cabomba caroliniana* and its habitat in China. Acta Phytoecologica Sinica 28(2):231-239.

[5] Lyon, J. and T. Eastman. 2006. Macrophyte species assemblages and distribution in a shallow, eutrophic lake. Northeastern Naturalist 13(3):443-453.

[6] Washington State Department of Ecology. Technical information about *Cabomba caroliniana* (Fanwort). Retrieved December 21, 2010 from: http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua006.html

[7] Jin, X., B. Ding, S. Gao and J. Weimei. 2005. Invasion and spreading of *Cabomba caroliniana* revealed by RAPD markers. Chinese Journal of Oceanology and Limnology 23(4):406-413.

[8] Schooler, S., M. Julien and G.C. Walsh. 2006. Predicting the response of *Cabomba caroliniana* populations to biological control agent damage. Australian Journal of Entomology 45(4):327-330.

[9] Dressler, K. 1996. *Cabomba caroliniana* (Fanwort). Retrieved November 16, 2010 from: http://www.fosterspond.com/fanwort.htm

[10] Murray, A. 1998. *Cabomba caroliniana*. Retrieved November 16, 2010 from: http://plants.ifas.ufl.edu/node/76

[11] Cao, P., M. Yu, X. Jin and B. Ding. 2006. Studies on niche characteristics and interspecific association of main populations in submerged communities invaded by *Cabomba caroliniana*. Journal of Zheijiang University Agriculture and Life Sciences 32(3):334-340.

[12] Nakai, S., M. Hosomi, M. Okada and A. Murakami. 1996. Control of algal growth by macrophytes and macrophyte-extracted bioactive compounds. Water Science and Technology 34(7/8):227-235.

[13] Randall, R. 1997. Weed potential of Cabomba, *Cabomba caroliniana* A. Gray (Family: Cabombaceae). Agriculture Western Australia.

[14] Yaowakhan, P., M. Kruatrachue, P. Pokethitiyook and V. Soonthornsarathool. 2005. Removal of lead using some aquatic macrophytes. Bulletin of Environmental Contamination and Toxicology 75:723-730.

[15] Nelson, L.S., A.B. Stewart and K.D. Getsinger. 2002. Fluridone effects on fanwort and water marigold. Journal of Aquatic Plant Management 40:58-63.