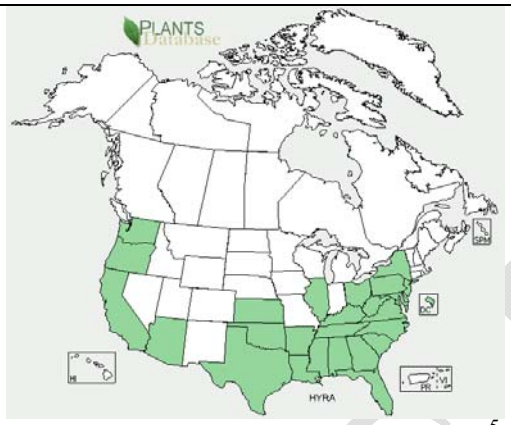
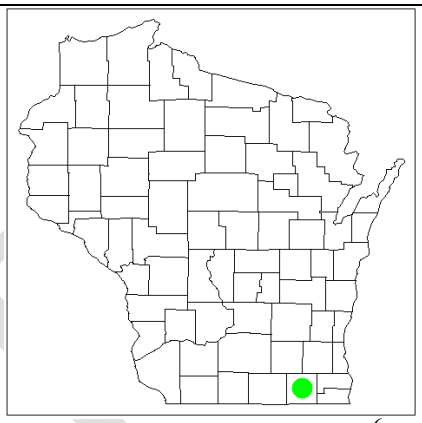
Aquatic Plant	Floating pennywort; Marsh pennywort
I. Current Status and Distribution	***Hydrocotyle ranunculoides***

a. Range	**Global/Continental**	**Wisconsin**
Native Range North America[1,2,3]; Africa[1,2] (considered naturalized[4]); South and Central America[1,2,4] (considered naturalized[3])	 *Figure 1: U.S and Canada Distribution Map*[5]	 *Figure 2: WI Distribution Map*[6]
Abundance/Range		
Widespread:	Undocumented	Undocumented
Locally Abundant:	Europe, United Kingdom, Netherlands, Western Australia[2]	Lake Delavan (Walworth Co.) inlet and outlet[6]
Sparse:	Endangered in Illinois, New Jersey, and New York[5]	Undocumented
Range Expansion		
Date Introduced:	Southern Europe, 1970s[(2)]; Australia, 1983[(2)]	First discovered in October 2010[(6)]
Rate of Spread:	Rapid; can grow up to 20 cm per day and 15 m from the bank in a single season[3]; can double its biomass in 3 to 7 days[3]	Undocumented
Density		
Risk of Monoculture:	High; can form dense interwoven mats[2]	Can form 'patchy' monocultures[6]
Facilitated By:	Undocumented	Undocumented

b. Habitat	Ponds, ditches, dykes, streams, rivers, marshes, wetlands, lake margins, wet ground, fenland pools[2]
Tolerance	Environmental tolerances undocumented
Preferences	Slow-flowing systems[2]; eutrophic to mesotrophic conditions[2]; high levels of nitrate, phosphate, and organic matter[2]; grows below 1500m[(2)]; full sun to light shade[7]
c. Regulation	
Noxious/Regulated[5]:	*Not regulated*
Minnesota Regulations:	*Not regulated*
Michigan Regulations:	*Not regulated*
Washington Regulations:	*Not regulated*

II. Establishment Potential and Life History Traits	
a. Life History	Aquatic floating leaved to emergent stonoliferous perennial plant[2]
Fecundity	High
Reproduction	
Importance of Seeds:	Can reproduce by seeds[2]; achenes can float, aiding in spread to new locations[7]; flower and seed production may be stimulated by conditions unfavorable for vegetative growth[8]
Vegetative:	Primary means of reproduction[2]
Hybridization	Different levels of ploidy between populations may influence invasiveness[2]
Overwintering	
Winter Tolerance:	Low frost tolerance[2]; surrounding natural vegetation may provide protection from frost damage[8]; hardy to zone 7 (-15°C)[2]; overwinters in the margins and on banks in the United Kingdom[3]
Phenology:	Flowers from July to October in native range[2]; flowers and fruits in May in the Netherlands[2,9]; peak growth starting in early July[3]; maximum growth in late summer[3,6]
b. Establishment	
Climate	
Weather:	Associated with temperate to tropical forests, temperate steppes, and Mediterranean forests[2]
Wisconsin-Adapted:	Yes[6]
Climate Change:	Longer growing season and higher summer temperatures will support the further spread of *H. ranunculoides*[10,11]
Taxonomic Similarity	
Wisconsin Natives:	High; *H. americana*[12]
Other US Exotics:	High; *H. sibthorpioides, H. moschata, H. bowlesioides*[5]
Competition	
Natural Predators:	*Listronotus elongatus* (weevil)[2,3,13]; *Myocastor coypus* (nutria)[10]
Natural Pathogens:	Unidentified pathogen[3]
Competitive Strategy:	Rapid growth rate[2]
Known Interactions:	Can outcompete nearshore emergent plants[2]; can shade out submerged aquatic plants[2]
Reproduction	
Rate of Spread:	Can double its biomass in 3 to 7 days in its non-native range[3]
Adaptive Strategies:	Can regenerate from small root fragments[2,3]
Timeframe	Can become dominant in less than two years[14]
c. Dispersal	
Intentional:	Aquarium trade, garden ornamental[2,3,6]
Unintentional:	Water and wind currents[2,7]; waterfowl[2]; contaminant of other aquatic plants[2,6]
Propagule Pressure:	High; fragments relatively easily accidentally introduced

Figure 2: Courtesy of John Hilty, Illinois Wildflowers[7]
Figure 3: Courtesy of Lisa Reas

III. Damage Potential	
a. Ecosystem Impacts	
Composition	Can form dense interwoven mats[2]; can outcompete native flora[2]; can affect fauna through habitat modification[2]
Structure	Undocumented
Function	Reduces light penetration and dissolved oxygen content[2]; alters ecosystem function[2]; can reduce water flow[15]
Allelopathic Effects	Allelopathic anti-algal compounds[16]
Keystone Species	Undocumented
Ecosystem Engineer	Undocumented
Sustainability	Undocumented
Biodiversity	Can reduce biodiversity[2]
Biotic Effects	Can reduce keystone and endangered species[2]; reduced dissolved oxygen may induce fish mortality[2]
Abiotic Effects	Decaying plants can cause eutrophication[17]
Benefits	Provides habitat for aquatic invertebrates[6,18]
b. Socio-Economic Effects	
Benefits Caveats	Aquaria and water garden plant[2,3]; remediation of wastewater[19] Risk of release and population expansion outweigh benefits of use
Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Dense mats can inhibit recreational and aesthetic value[2]; can damage waterworks and clog drainage systems, which can lead to flooding[2]; dense mats can be a hazard to humans who mistake them as solid ground[17]; serves as a host for the destructive bacterial wilt *Ralstonia solanacearum*[20]
Expectations	Undocumented
Cost of Impacts	Decreased recreational and aesthetic value; decline in ecological integrity; increased research expenses
"Eradication" Cost	First year of control cost 200,000 AUD (204300 USD) in Western Australia[2]; have spent over 1 million EUR (1379500 USD) in the Netherlands[2]

IV. Control and Prevention	
a. Detection	
Crypsis:	Confused with *Hydrocotyle* spp.[2,7,21]; *Ranunculus* spp.[18]; *Marsilea* spp.[18]
Benefits of Early Response:	Eradication may be possible in the very early stage of invasion[2,3]
b. Control	
Management Goal 1	Control
Tool:	Mechanical removal[2,3,14,22]
Caveat:	Harvesting causes fragmentation which can increase distribution and density[2,3,14]; negative impacts on non-target species
Cost:	Estimates of £10,000 ($15,800 USD) per km[(14)]
Efficacy, Time Frame:	All cut material must be removed from the waterbody[2,3,22]; downstream areas should be netted or fenced off to prevent spread[2,3,22]; short term reduction; repeated cuttings necessary throughout the growing season[3,22]
Tool:	Handpulling[6]
Caveat:	Time and labor intensive[6]; plant interweaves with other vegetation making removal off all plant material very difficult[6]
Cost:	Undocumented
Efficacy, Time Frame:	Not very efficient[6]
Tool:	Chemical herbicide (2,4-D amine)[6,14]
Caveat:	Non-target impacts on native species
Cost:	Undocumented
Efficacy, Time Frame:	Applied at 4.23 kg/ha active ingredient[14]; should be applied at the end of the growing season[14]; follow up treatments or mechanical removal should occur 2-4 weeks after the first treatment[6,14]; new runners and shoots observed spreading to new areas a week after vegetative death[6]; plants in full sun died quicker than those in shade[6]; surfactant beneficial in maximizing herbicide contact with target plants[6]
Tool:	Chemical herbicide (glyphosate)[3,14]
Caveat:	Resistant to glyphosate at 2.16 kg/ha active ingredient[14]; non-target impacts on native species
Cost:	Early season treatments reduce labor and chemical costs[3]
Efficacy, Time Frame:	Application rates of 4-6 L/ha[(3)]; spray applications may not reach all plant material if dense mats are present[3]; follow up treatments or mechanical removal should occur 2-4 weeks after the first treatment[3]; decomposition of plant material may take up to 6 weeks[3]
Tool:	Shading[3]; increasing water flow[3]; dredging[3]; barriers[3]
Caveat:	Not practical to implement in large scale invasions[3]
Cost:	Expensive[3]
Efficacy, Time Frame:	Efficacy undocumented[3]

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