NAS - Nonindigenous Aquatic Species

Hydrilla verticillata (L.f.) Royle

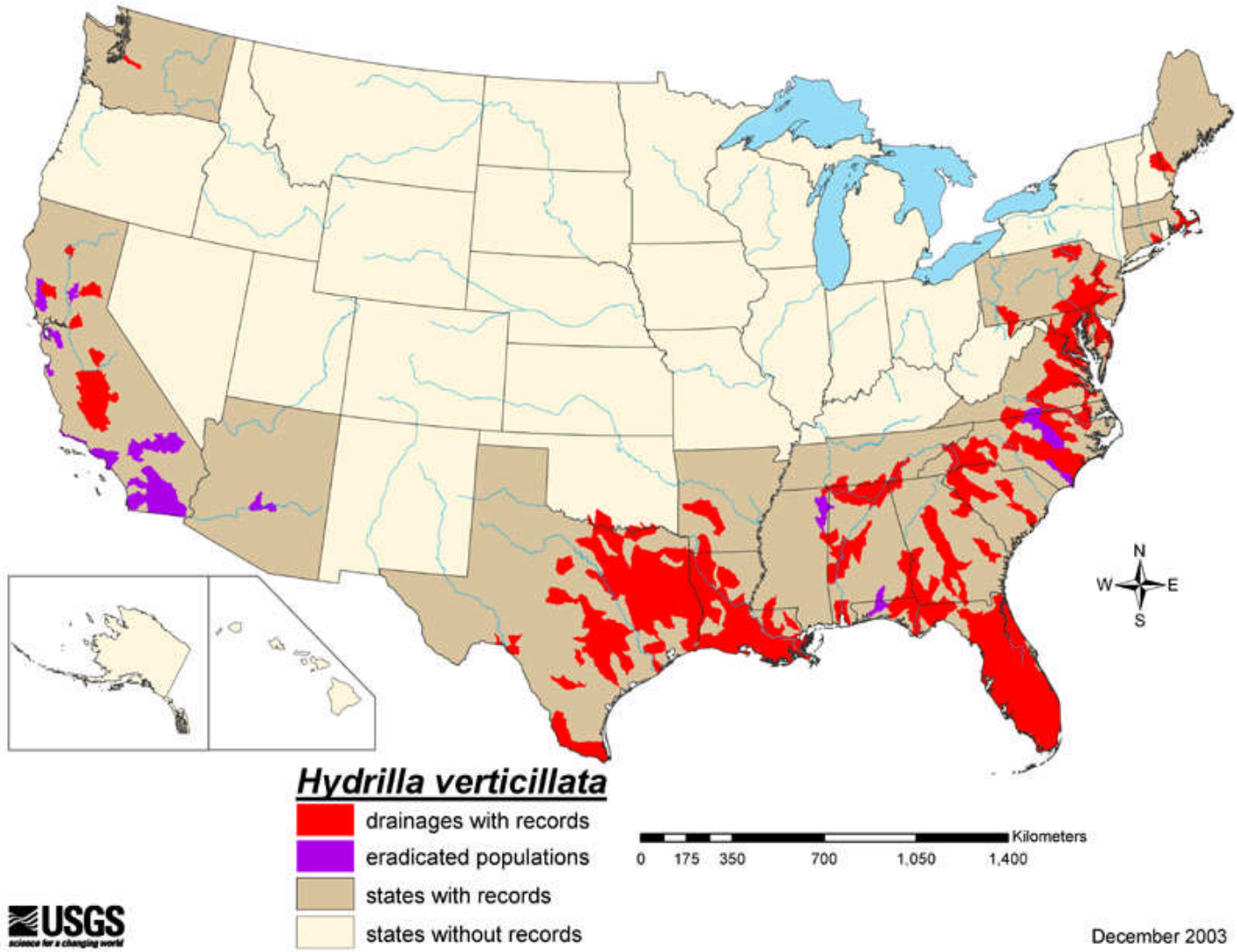
Common Name: hydrilla, water thyme.

Taxonomy: Family-Hydrocharitaceae (Frog's Bit Family); Order-Hydrocharitales; Subclass-Alismatidae; Class-Liliopsida (Monocots); Division-Magnoliophyta (Angiosperms).

Identification: Submersed perennial herb. Rooted, with long stems that branch at the surface where growth becomes horizontal and dense mats form. Small, pointed leaves are arranged in whorls of 4 to 8. Leaves have serrated margins and one or more sharp teeth under the midrib (see Godfrey and Wooten 1979). Development of these features may vary with location, age, and water quality (Kay 1992).
Southern populations are predominantly dioecious female (plants having only female flowers) that overwinter as perennials. Populations north of South Carolina are essentially monoecious (having both male and female flowers on the same plant) (Madiera et al. 2000; link to map of hydrilla biotypes). They set some fertile seed, and depend on tubers for overwintering.

Native Range: The common dioecious type originates from the Indian subcontinent. Historical reports specify the island of Sri Lanka (Schmitz et al. 1991) while random amplified polymorphic DNA (RAPD) analysis point to India's southern mainland (Madeira et al. 1997). Korea appears the likely origin for the monoecious type (Madeira et al. 1997).

Habitat: Freshwater lakes, ponds, rivers, impoundments and canals.



Map indicates recorded presence in at least one site within the drainage (USGS Hydrologic Unit 8), but does not necessarily imply occurrence throughout that drainage.

Nonindigenous Occurrences:

East of Mississippi River - The most abundant aquatic plant in **Florida** public waters (Schardt 1994), seventy percent of Florida's freshwater drainage basins contain waterbodies infested with hydrilla (FLDEP 1988-94 and other data). Less common throughout **Alabama**, although widespread in the Mobile Delta and northern portion of the Mobile Bay (Zolcynski 1997); common at Coffeeville, Aliceville and Oak Mountain reservoirs of central Alabama (D. Powell, Alabama Power Company, pers. comm. 1996), and well established at Guntersville, and other northern impoundments on the Tennessee River (Bates and Smith 1994). Extending along the Tombigbee River from Aliceville Reservoir, AL into eastern **Mississippi** (E. Dibble, Mississippi State Universiy, pers. com. 1998). Also, restablished in the Tennessee-Tombigbee Waterway, at Beckner boat ramp and in the old bendway, (D. Franks, Mississippi Dept. Wildlife, Fisheries and Parks, pers. comm. 2000). Reported in southeastern **Tennessee** from the middle Tennessee River drainage, where herbicide and natural decline in Lake Chickamauga have precluded recent collection; yet, still found downstream, as scattered stands, in Nickajack Reservoir (Tennessee Valley Authority 1990, D. Webb, Tennessee Valley Authority, pers. com. 1997). Know primarily in the southwestern drainages of **Georgia**; problematic at Lake Seminole for over a decade (Eubanks 1996). Occurring, otherwise, at a few smaller waterbodes in Georgia's upper Ocmulgee drainage and at the Strom Thurmond Reservoir on the upper Savannah River (L. Ager, Georgia Department of Natural Resources, pers. com. 1998). Expanding over 32,000 acres in Lakes Marion and Moultrie, **South Carolina** following the 1989 hurricane, Hugo (Roach et al 1993). Problematic at six additional reservoirs in South Carolina (S. de Kozlowski, South Carolina Department of Natural Resources, pers. comm. 1997), within the Seneca, Saluda, Wateree, Four Hole Swamp, and Cooper drainages. Covering approximately 5,800 acres in **North Carolina**, primarily at eastern sites, including reservoirs in the upper Neuse River drainage, yet reported from as far west as Buncombe county, in the western mountains (NCDWR 1996). Established in the

Potomac, Rappahannock, Anna, Chickahominy, and Appomattox Rivers of **Virginia's** coastal plain; extending into piedmont Virginia, at several reservoirs (E. Steinkoenig and J. Kauffman, Virginia Game and Inland Fisheries; J. Tate, Virginia Department of Agriculture and Consumer Services; pers. comm. 1998). Although reduced in abundance, continuing to dominate beds of submerged vegetation in the tidal freshwater reaches of the Potomac River on the**Virginia/Maryland border** (Orth et al. 1996). Established in **Maryland** at marsh creeks and rivers on the western and northeastern shores of the Chesapeake Bay, including the Pautuxent River, where it has become the most abundant plant species (M. Naylor, Maryland Dept. of Natural Resources, pers. comm. 2000; Orth et al. 1996; Posey et al. 1993). Also common at reservoirs in mid-Maryland, especially those draining the Patuxent River, and in the Ohio drainage of far western Maryland, at Deep Creek Lake (M. Naylor, Maryland Department of Natural Resources, pers. comm. 2000). Discovered recently at three sites in **Pennsylvania:** in scattered stands in the Schuylkill River, downtown Philadelphia (P. Madeira, USDA/ARS, Aquatic Weed Control Research, pers. comm. 1996); at Highland Lake, a 28 acre impoundment on Southwick Creek (Colangelo 1998); and at Lake Nockamixon, where plants are abundant in a drowned portion of Haycock Creek [*E. Zacharias and A. Schuyler* 8345 (PH), 1998]. Common in **Delaware** ponds (AREC 1995), especially in southern Sussex Couty where it has spread to nearly 1200 acres in 14 ponds and portions of the Nanticoke River (C. Martin, Delaware Dept. of Natural Resources, 1999). Present since the late 1980s at two ponds in southeastern **Connecticut** (Balcom 1997), where plants were originally misidentified due to the absence of midrib teeth (Les 1996). New to **Massachusettes** from a pond on Cape Cod (B. Hellquist pers. comm. 2001). New to the state of **Maine** in **2002** in the Saco drainage at Pickerel Pond, York County, where plants are established and abundant throughout the pond (R. Bouchard, ME DEP, pers comm. 2003). First documented in **2003** for the state of **New Jersey** in the Lower Delaware drainage at Lake Mallard in the Pinelands National Reserve (*Sullivan s.n.* DOV, FLAS). This small lake is one of several connected ponds. As of April 2003, hydrilla had not been detected in any of the other linked ponds (G. Sullivan, Allied Biological, Inc., pers. comm. 2003).

West of Mississippi River - Appearing more frequently at lakes and reservoirs in **Louisiana**, especially along Highway 1 as it stretches diagonally across the state, in canals and bayous of the Atchafalaya Basin, and through the coastal marsh region south of Interstate 10 (C. Biggar, Louisiana Department of Wildlife and Fisheries, pers comm 1998). Also present at Lake Bruin (indicated by the dot in the eastern Tensas drainage) which is disjunct from other infested regions in Louisiana. Known from over 80 **Texas** reservoirs, residing in drainages that extend from north-central to eastern Texas, and south to the Rio Grande, at the Mexico border (Helton and Hartman 1997; E. Reyes, U.S. Fish and Wildlife Service, pers comm 1998). Eradicated in the mid 1980s from two ponds in Phoenix, **Arizona**, where no new infestations have been found (E. Hall, Arizona Dept.of Agriculture, pers. comm. 1996). Eradicated from private ponds and several reservoirs in nine **California** counties; presently occurring at less than 50 sites in Imperial, Tulare, Madera, Mariposa, Calaveras, Yuba, Lake and Shasta Counties (PPDC 1997). Recent infestations in Clear Lake threaten the highly productive Sacramento/San Joaquin River Delta area (Anderson 1996). Occurring in **Washington**, in a lake east of Puget Sound, where early biomass measurements reflect high growth potential in the northwestern climate (K. Hamel, Washington State University, pers. comm. 1995). New to the state of **Arkansas**, established in Lake Ouachita and DeGray Lake, in the Ouachita Headwaters and the Upper Ouachita drainages, respectively. First identified in Lake Ouachita in 1999 during creel surveys. Lake Ouachita is a 42,000 acre lake, with an approximate hydrilla infestation size of 4,000 acres. DeGray Lake is nearly half the size of Lake Ouachita and has 3-4 confirmed acres of hydrilla infested waters. Hydrilla has been verified growing in waters of 7.3 m in depth with expected growth to be in the 9.1 - 10.7 m level in the near future due to light pentration to 12.2 m in depth and to the sedimentary composition of the lake. Lake Ouachita personnel are working on a project to initiate biological control efforts in the lake (R. Stokes, USACE, Manager, Lake Ouachita, pers. comm. 2003).

Means of Introduction: The dioecious strain was imported to the United States in the early 1950s for use in aquariums. It entered Florida's inland water system after plants were discarded or planted into canals in Tampa and in Miami (Schmitz et al 1988). The monoecious strain was a separate introduction, first found decades later in the Potomac Basin (Environmental Laboratory 1985).
Hydrilla is mainly introduced to new waters as castaway fragments on recreational boats, their motors and trailers and in live wells. Stem pieces root in the substrate and develop into new colonies, commonly beginning near boat ramps. Once established, boat traffic continues to shatter and spread hydrilla throughout the waterbody. Both types propagate primarily by stem fragmentation, although axillary buds (turions) and subterranean tubers are also important. Tubers are resistant to most control techniques (Schardt 1994) and may be viable as a source of reinfestation for years (Van and Steward 1990).
Hydrilla may be unknowingly transplanted into private ponds as a contaminant on watergarden plants. It is often found spreading after extensive 2,4-D use in public waters once heavily populated with Eurasian water-milfoil (*Myriophyllum spicatum*) (Bates and Smith 1994).

Status: Recorded from over 690 water bodies within 190 drainage basins of 21 states.

Impact of Introduction: Once established, hydrilla results in an array of ecosystem disruptions. Changes often begin with its invasion of deep, dark waters where most plants can not grow. Hydrilla grows aggressively and competatively, spreading through shallower areas and forming thick mats in surface waters that block sunlight penetration to native plants below (van Dijk 1985). In the southeast, hydrilla effectively displaces beneficial native vegetation (Bates and Smith 1994) such as wild-celery (*Vallisneria americana*) and coontail (*Ceratophyllum demersum*) (van Dijk 1985; Rizzo et al. 1996).
It has been shown to alter the physical and chemical characteristics of lakes. Colle and Shireman (1980) found sportfish reduced in weight and size when hydrilla occupied the majority of the water column, suggesting that foraging efficiency was reduced as open water space and natural vegetation gradients were lost. Stratification of the water column (Schmitz et al. 1993; Rizzo et al. 1996), decreased oxygen levels (Pesacreta 1988), and fish kills (Rizzo et al. 1996) have been documented. Changes in water chemistry may also be implicated in zooplankton and phytoplankton declines (Schmitz and Osborne 1984; Schmitz et al. 1993).
Hydrilla seriously affects water flow and water use. Infestations in the Mobile Delta are reducing flow in small tidal streams and creating a backwater habitat (J. Zolcynski pers. comm. 1998). Its heavy growth commonly obstructs boating, swimming and fishing in lakes and rivers and blocks the withdrawl of water used for power generation and agricultural irrigation.

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