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Pistia stratiotes L. (Water Lettuce) Discovered in Southeastern Virginia

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ABSTRACT

Pistia stratiotes L. (water lettuce) is newly reported for Virginia. The species was prevalent in Reedtown Lake in Virginia Beach during November 2007. The invasion of *P. stratiotes* can be detrimental to a waterbody because it can rapidly reproduce and form dense mats, increase siltation, reduce or deplete oxygen levels, and reduce the suitability of benthic substrates for nesting by fish or as a habitat for macroinvertebrates.

Key words: aquatic invasive species, hydrophyte, *Pistia stratiotes*, Virginia, Virginia Beach, water lettuce.

INTRODUCTION

Pistia stratiotes L. (water lettuce) is a free-floating monocotyledonous (Anonymous, n.d.) perennial (but may act as an annual) herb in the Aroid family (Dray & Center, 2002) that was first reported in Florida, USA in

1765. It now occurs on all continents except Europe and Antarctica, making it one of the most widely distributed hydrophytes (Hilhorst, n.d.). Water lettuce has been found in lakes, ponds, reservoirs, canals, and slow-flowing streams and rivers (Dray & Center, 2002). The most common means of spreading the species from

continent to continent is through ballast water in ships (primarily from South America). For years, *P. stratiotes* has been used in the aquarium trade as an ornamental plant and most recently has been used in wastewater treatment for nutrient removal (Wisconsin Department of Natural Resources, 2008). Water lettuce can be introduced into a waterbody when local citizens empty landscape ponds containing this species into a lake or storm water drain.

DISCOVERY IN SOUTHEASTERN VIRGINIA

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service Plants Database (2010), *P. stratiotes* has been recorded in the Southeast from North Carolina, South Carolina, Georgia, and Florida, but it does not occur in Virginia. South Carolina has declared *P. stratiotes* as an invasive aquatic species, whereas Florida has prohibited the plant. The Digital Atlas of the Virginia Flora indicates the species was discovered on the campus of the University of Richmond in 2008 and persisted over the winter. Additionally, *P. stratiotes* was collected in the Diascund Reservoir in New Kent County in 2009 (J. Perry, pers. comm.).

The Hampton Roads Sanitation District began monitoring Reedtown Lake in Virginia Beach, Virginia, in the fall of 2005 with the goal of evaluating water quality improvements that may result from vertical and horizontal circulation of water. *Pistia stratiotes* was discovered in the lake on 14 November 2007 during a monthly water quality monitoring event, at which time it was found to cover approximately 60% of the lake surface. A sample was collected and identified in the laboratory at Christopher Newport University by Dr. James Perry, Professor of Marine Science at the Virginia Institute of Marine Science. No voucher specimen was retained, but photographs were taken (Fig. 1).

Pistia stratiotes was prevalent in Reedtown Lake until January 2008 and reappeared from July 2008 through December 2008, but has not been found in the lake on subsequent visits. We hypothesize that *P. stratiotes* was initially introduced into the lake by one or more neighboring landowners. Reedtown Lake is located in an upper-class neighborhood, with immaculate landscaping and possibly landscaping ponds or Koi ponds that frequently contain *P. stratiotes* that can be purchased from a local nursery. Drainage of a landscape pond into the lake could have deposited live plants or seeds of this species into Reedtown Lake. From the beginning of the monitoring study until the present, the lake has also been dominated by *Lemna minor* L. (common duckweed) and submerged aquatic



Fig. 1. Presence of *Pistia stratiotes* and *Lemna minor* in Reedtown Lake (photo courtesy of the City of Virginia Beach).

vegetation. Flowering and/or fruiting of *P. stratiotes* was not evident upon its discovery.

Reedtown Lake has a surface area of 0.024 km², an average depth of 0.7 m, and an average pH of 7.8. Recorded pH levels within the lake have ranged from 5.6 in shallow areas during the winter months to 10.0 during the spring months in other portions of the lake. We believe the elevated pH levels result from the application of lime to lawns bordering the lake. Temperature stratification is not apparent throughout the majority of the lake due to its shallowness. Reedtown Lake does not contain a central "main stem" but consists of north and south embayments of roughly equal surface area that drain towards the main station and then into the Lynnhaven River east of the confluence of the two lake arms. An aerator station is located in each arm with a third monitoring aerator station at the discharge point from Reedtown Lake (City of Virginia Beach, 2005).

Discussions with a City of Virginia Beach employee confirmed that *P. stratiotes* has not been discovered in any other waterbody in the city (S. McLaughlin, pers. comm.). Furthermore, there are no reports of *P. stratiotes* from the Great Dismal Swamp in southeastern Virginia and northeastern North Carolina (D. Schwab, pers. comm.). Discussions with a fisheries biologist based in northeastern North Carolina confirmed the presence of *P. stratiotes* in Snug Harbor, Yeopim Creek in Perquimans, NC in the fall of 2008 (K. Dockendorf, pers. comm.). This site is 92 km southwest of Reedtown Lake. However, there have been no confirmed sightings in the neighboring North Carolina counties of Camden and Currituck. The

Diascund Reservoir in New Kent County is 92 km northwest of Reedtown Lake.

BIOLOGY OF WATER LETTUCE

Water lettuce grows most rapidly in polluted, impacted systems (Ghavzan et al., 2006) with silty, muddy substrates and clear, shallow waters (Benson et al., 2004). Additional favorable conditions for water lettuce include aquatic environments with moderate hardness and neutral pH (Wisconsin Department of Natural Resources, 2008). The species is able to rapidly colonize fertile waters with temperatures of ~20°C for a significant part of the year and can spread by the production of daughter plants on stolons (Hilhorst, n.d.). Water lettuce reproduces rapidly and can colonize available open-water portions of lakes in a single growing season and attain total biomass of up to 2,000 g/m² (Dray & Center, 1992). Hydrosols have been shown to hold 4,196 water lettuce seeds/m² (Dray & Center, 1989). The leaves and stems are frost intolerant (Dray & Center, 2002), but seeds remain viable when exposed to -5°C for several weeks (Pieterse et al., 1981). The species also reproduces asexually (Dray & Center, 2002).

Natural predators of water lettuce include 21 insects, 14 of which are beetles (Dray & Center, 2002). Its main natural pathogens include *Ramularia pistiae* (leaf spot fungus), *Cercospora pistiae* (a pathogenic fungus) (Silvia et al., 2005), and *Sclerotinia sclerotiorum* (Waipara et al., 2006). Water lettuce has been known to outcompete other invasive aquatic plants including *Eichhorria crassipes* (Water hyacinth) (Wisconsin Department of Natural Resources, 2008), *Ceratophyllum demersum* (Coontail), *Myriophyllum spicatum* (Eurasian water milfoil), *Najas marina* (Spiny Naiad), and *Trapa natans* (Water Chestnut) (Sajna et al., 2007) through its rapid growth rate and ability to shade the underlying waterway that it invades.

ECOLOGICAL IMPACTS AND CONTROL

Water lettuce forms dense mats in a waterbody that deplete oxygen in underlying water and sediments by blocking the air-water interface, by respiration of the roots, and decay of dead plants (Hilhorst, n.d.). The root system of water lettuce increases siltation in the waterway by its massive root hairs that penetrate into lake mud (Clowes, 1990). Siltation in lakes causes the underlying benthic substrate to become unsuitable for nesting by fish or as habitat for macroinvertebrates such as mosquitoes (family Culicidae) and other biting insects (Dunn, 1934).

Biological control of water lettuce includes using a weevil, *Neohydronomus affinis*, and a moth, *Namangana pectinicornis*. Successful herbicidal control has been achieved through the use of 2, 4-D amine. During an experimental study in New Zealand, hand removal was successful in eliminating the species after it was deliberately planted (Hilhorst, n.d.).

The City of Virginia Beach does not use any control actions to prevent or reduce the prevalence of *P. stratiotes* in Reedtown Lake, nor did the City use any control actions to remove *P. stratiotes* after the discovery. However, the species is no longer present in Reedtown Lake.

CONCLUSION

Since 2008, *P. stratiotes* has not been observed in Reedtown Lake. This is a surprising finding considering the fact that the City of Virginia Beach did not use any measures to remove and/or treat the species. However, the possibility of a re-colonization still exists if local residents are not informed and educated about the detrimental effects of *P. stratiotes* if it is not disposed of properly. If introduced to a remote waterway, it may be difficult to control the spread of this invasive species.

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