

2.12 Waterlettuce

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Pistia stratiotes L.; floating plant in the Araceae (Arum) family
Derived from the Greek *pistos* (water) and *stratiotes* (a common soldier)

Introduction history uncertain, considered native to the southeastern US by some sources
Present throughout the southeastern US north to New Jersey and New York, west to Texas, Arizona and California; also present in Idaho, Ontario, Hawaii, Puerto Rico and the Caribbean

Introduction and spread

Pistia stratiotes is the only species in the genus *Pistia*. The origin of waterlettuce is unclear, but various sources suggest the plant is native to South America, Africa or the southeastern US. Waterlettuce is cosmopolitan in distribution and has been documented in aquatic systems around the world. The species is considered one of the world's worst weeds



and is a noxious species in most regions where it has been introduced, such as Hawaii, Australia and the Canary Islands. In addition, waterlettuce is considered invasive in the US, Puerto Rico and Africa, despite reports that the species could be native to these areas.

Fossil records show that waterlettuce was present in Africa, the species' center of diversity, 85 million years ago and that the plant was present in Florida at least 50 million years ago. The first modern report of waterlettuce in North America was made by John and William Bartram, who described dense, nearly impenetrable populations of the species while surveying the St. Johns River in Florida on New Year's Eve in 1765. The USDA considers waterlettuce to be native to the continental US and does not categorize the species as a noxious weed, but a number of state lists include waterlettuce as a noxious, invasive or prohibited plant.

Although not as productive as waterhyacinth (Section 2.11), waterlettuce spreads very rapidly and can double its population size in as little as a few weeks, so it can quickly cover the surface of invaded waters. The species is not cold-hardy and rarely establishes permanent populations in temperate areas. Waterlettuce will survive moderate freezes but



requires temperatures of greater than 50 °F to produce new growth. A number of states – including Alabama, California, Connecticut, Florida, South Carolina and Texas – prohibit the sale of waterlettuce, but the species is still available for purchase from aquarium supply stores, aquatic plant nurseries and internet sources in other states. The species continues to inhabit many bodies of water in Florida, along with aquatic systems throughout most of the southeastern and southwestern US, Hawaii, Puerto Rico and the Virgin Islands. Despite the well-documented problems associated with waterlettuce, the species is still widely cultivated as an ornamental in water gardens and has been evaluated for its utility as a phytoremediation agent to reduce nutrients and heavy metals in contaminated waters.

Waterlettuce spreads in natural systems by producing seedlings and daughter rosettes – small plantlets that are attached to the mother plant by a floating stolon or runner. Rosettes can easily become caught on boat trailers or in live wells, which results in the introduction of the species to new bodies of water. Waterlettuce is also spread accidentally as a result of escapes from cultivation and intentionally by uninformed water garden and pond owners, who believe they are beautifying canals and lakes by tossing extra plants into natural systems.

Description of the species

Waterlettuce is a floating flowering monocot that grows as an annual (in temperate regions) or as a perennial (in tropical and subtropical climates) in all types of bodies of water. Muddy or turbid water often limits growth of submersed plants, but since waterlettuce is a floating plant, it is unaffected by these conditions. The leaves of waterlettuce have wavy or scalloped margins and are thick, light green, covered with short hairs and water-repellant. Each leaf can reach up to one foot in length; leaves are attached to one another at the plant's base to form a free-floating rosette (although plants will sometimes root in soft saturated sediments when stranded by drought or wave action). The white to tan roots of waterlettuce are long and feathery and hang beneath the rosette of leaves. Waterlettuce grows throughout the year in the tropics, but freezing temperatures kill the leaves of the plant in the northern portions of its range.

The flowers of waterlettuce are borne in a spathe and spadix arrangement. The greenish spadix, a spike-like structure in the center of the inflorescence that houses separate female and male flowers, is sheathed by the white spathe, a hairy leaf-like bract. Although other members of the Araceae family – including caladiums, peace lilies and anthuriums – are ornamental species that are prized for their showy inflorescences, the spathe and spadix of waterlettuce

is small and inconspicuous. It was long thought that waterlettuce did not produce seeds and that all reproduction by the species was vegetative via the formation of daughter plants; however, it is now known that waterlettuce produces

copious, viable seeds and that this strategy allows the plant to maintain a presence in areas where droughts or winter freezes kill mature plants.



Reproduction

Waterlettuce spreads by both seed and vegetative reproduction. Each plant produces multiple fruits and each 2 mm-long fruit can contain up to 20 tiny, golden-brown seeds. As a result, hundreds of seeds may be produced per square foot of coverage. Most seeds remain in the upper 2 inches of sediments and germination can be greater than 90% but it is not known how long these tiny seeds remain viable. Seed reproduction can be important in temperate climates since waterlettuce is killed by freezing temperatures and recolonization in spring may be dependent on the seed bank established during the previous growing seasons. Once seeds have germinated and conditions are favorable for growth, waterlettuce rapidly produces new daughter plants from

horizontally growing stolons. In fact, the rapid growth and spread of waterlettuce during the growing season is due primarily to vegetative reproduction.

Problems associated with waterlettuce

Waterlettuce grows almost entirely on the surface of the water as a floating plant and its growth potential is limited only by temperature and the availability of nutrients. Waterlettuce prefers a habitat similar to that favored by desirable fish populations – mesotrophic and eutrophic waters with sufficient calcium and a pH ranging from 6.5 to 7.2. There is no doubt that waterlettuce is a serious aquatic weed, regardless of whether the species is native or introduced to the southeastern US. Under optimum conditions, a population of waterlettuce is composed of as many as 100 plants per square foot with a combined fresh weight of up to 5 pounds. An acre (43,560 square feet) of waterlettuce could therefore have millions of plants and a fresh weight of around 100 tons. Since 95% of the plant weight is attributable to water, only 5% of the fresh weight – about 5 tons per acre – remains after plants are harvested and dried.

Large colonies of linked mother and daughter waterlettuce plants form dense mats that can quickly cover a body of water from shore to shore and interfere with human use of waters. For example, large populations of waterlettuce can drastically impede boating, fishing and swimming and commercial activities. Also, water flow is greatly reduced where mats of waterlettuce occur, which hinders irrigation and flood control efforts. Several species of mosquito are known to breed in water held in the rosettes of waterlettuce; in fact, the larvae of some of these disease-causing insects attach to the underwater roots of waterlettuce and obtain oxygen through air tubes they insert into the plant's roots (Section 1.5). Infestations of waterlettuce can have serious ecological impacts as well. Dense waterlettuce populations reduce species richness or plant diversity by limiting the light that reaches native submersed plants and by crushing communities of emergent plants along the shoreline. The loss of these native plants also eliminates habitats for animals that depend on native plants for shelter, nesting and food. In addition, large mats block the air-water interface and reduce dissolved oxygen, which often makes the system uninhabitable to fish and other aquatic fauna.



Management options

The best method to control waterlettuce is to prevent the species from entering a water body. Waterlettuce is not on the Federal Noxious Weed List. However, waterlettuce is on the State Noxious Weed Lists of Alabama, California, Connecticut, Florida, Puerto Rico, South Carolina and Texas, so its sale and transport is prohibited in these states. Even in states where waterlettuce is listed, it is easy to purchase plants at farmers' markets, local plant sales, on the internet and from other unregulated sources. Although waterlettuce has been deemed eradicated in some invaded areas such as small field sites in New Zealand, it is difficult or impossible to completely eliminate waterlettuce once a larger body of water has been invaded. Between existing populations that are left uncontrolled, accidental transfer from infested areas and escapes from cultivation, waterlettuce still manages to slowly increase its range and to colonize new bodies of water.

Physical (Section 3.4) or mechanical (Section 3.5) control measures such as hand removal or mechanical harvesters should be designed to prevent the spread of waterlettuce plantlets to other parts of the water body. Hand removal is labor-intensive and typically involves raking plants to the shoreline or into a boat. This may seem like a simple job, especially in a small pond; however, a single acre can support as much as 100 tons of waterlettuce that must be pulled out by hand! Plants are then offloaded along the shoreline until they desiccate and die. Hand removal may be an effective means to control waterlettuce in small ponds, but is not practical in larger systems. Mechanical harvesting is usually used to remove plants from larger systems and involves heavy machinery that ranges from a backhoe on a barge to specialized equipment. A problem associated with mechanical harvesting of waterlettuce is disposal of the harvested plants. There are no large-scale uses of harvested waterlettuce, so most plant material is usually disposed of in farm fields or a landfill.

Drawdowns can be used to “strand” and desiccate waterlettuce on exposed shorelines, but the time needed to effectively dry large mats of plants can be long. Also, drawdowns and drought have been known to trigger seed germination of other invasive species such as waterhyacinth. Although there are as many as 50 species of insects that feed on waterlettuce, only two have met the criteria for biocontrol agents (Section 3.6.1). The waterlettuce leaf moth (*Spodoptera pectinicornis*) was imported from Thailand and released in Florida in 1990, but failed to establish. The waterlettuce leaf weevil (*Neohydronomus affinis*) was imported from South America to the US in mid-1980s and is now established throughout Florida, but its effect on waterlettuce growth is negligible. Therefore, most waterlettuce management programs in the US rely on the use of herbicides to keep plant populations low and to reduce growth potential of waterlettuce. Herbicide selection is based on water use, selectivity to reduce damage to non-target native plants and cost. Several herbicides can be used as foliar sprays to selectively control waterlettuce (Section 3.7.1). Contact herbicides such as diquat, carfentrazone and flumioxazin are quickly absorbed by plant tissue and cause obvious damage within a few days, whereas systemic herbicides such as imazapyr, penoxsulam and bispyribac provide slower but very effective control. Submersed application of the contact herbicide flumioxazin is currently being evaluated for selective control of waterlettuce, as are topramezone and the ALS herbicides.

Summary

Waterlettuce is one of the world's worst aquatic weeds and causes problems in virtually all waters it has invaded. It is currently distributed throughout the southeastern US north to New Jersey and New York, west to Texas, Arizona and California. While waterlettuce is found throughout New England and other temperate regions, it typically does not persist where waterways are subject to ice formation and prolonged freezing temperatures. Florida and the Gulf states are particularly impacted by waterlettuce due to the moderate climate and shallow, naturally nutrient-rich lakes, but the species can colonize virtually any region in North America where winter temperatures remain above freezing and mesotrophic or eutrophic waters are present. Aggressive maintenance control programs have kept populations of waterlettuce in check in most areas, but these efforts have to be employed on a continual basis to avoid population explosions of this noxious invasive species.

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Page 75: Infestation of waterlettuce; Lyn Gettys, University of Florida

Page 76: Long feathery roots of waterlettuce; Lyn Gettys, University of Florida

Page 77 upper: Spathe and spadix inflorescence of waterlettuce; Lyn Gettys, University of Florida

Page 77 lower: Young waterlettuce with daughter plant; Lyn Gettys, University of Florida

