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Common Aquatic Plants of Lake Okeechobee: Identification, Value, and Management[1]

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Introduction

Aquatic and wetland plants are essential to the ecology of Florida lakes, such as Lake Okeechobee, but they can also pose ecological and water use problems. Plants provide food and habitat for sport fish and other wildlife, help improve water clarity, and help stabilize shorelines and bottom sediments. However, certain fast-growing species of plants can become too abundant, which can be unhealthy for lakes and cause problems for recreational water uses, navigation, and flood control. Many plants that are considered a problem to Lake Okeechobee were brought here from other parts of the world. When these non-native plants grow out of control and out-compete native plants, they are referred to as invasive plants. Some plants, especially invasive plants, must be managed on Lake Okeechobee to protect the health and recreational uses of the lake. Lake Okeechobee is unique because of its vast size (730 square miles), shallow water (9-ft average depth), high nutrient levels, and extensive marsh (147 square miles), which is heavily used for fishing, hunting, and birding. Lake Okeechobee, especially its marsh, is home to numerous plant species that play roles in the lake's ecology.

This fact sheet provides information about the plants of Lake Okeechobee and outlines the importance of certain plants to the lake, problems caused by some plants, and the methods used to manage plants for the benefit of the entire lake environment.

More information on aquatic plants and their management can be found on http://plants.ifas.ufl.edu.

Types of Aquatic Plants

Aquatic plants are separated into two major groups: 1) algae, which are composed of single cells or chains of attached cells, and 2) vascular plants, which usually have distinguishable roots, stems, leaves, and flowers (except for ferns). Vascular plants are described by the way they grow and where they occur at different depth gradients in the lake:

1. **Emersed (or emergent) plants** occur along the shoreline and in the shallower zone. They are rooted to the bottom and grow above the water surface.
2. **Submersed plants** occur mostly in deeper zones. They are usually rooted to the lake bottom and mostly remain beneath the water surface.
3. **Floating-leaved plants** are rooted to the bottom and have leaves attached underneath the water. The leaves float on the water surface, with some leaves somewhat emersed.
4. **Floating plants** are not attached but float freely on the water surface and can occur anywhere on the lake from the shoreline to deep water.

Algae

Algae can be free-floating single cells in the water (called phytoplankton) or stringy and mat-forming (called filamentous algae). Phytoplanktonic algae are usually too

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small to see as individuals, but their presence causes water to appear green or sometimes brown.

Phytoplankton is important to lakes because it provides food for small organisms, which in turn produce food for larger animals such as fish and waterfowl. Phytoplanktonic algae are also important because they produce oxygen in the water, which is necessary for fish to breathe. The amount of phytoplankton in a lake is related to the fertility of water. Highly fertile water contains high amounts of the plant nutrients, nitrogen and phosphorus. It can produce more phytoplankton than less fertile water and, in turn, larger and greater quantities of fish can grow. Lake Okeechobee is naturally fertile, producing large amounts of phytoplankton, and has an excellent fishery.

Excessive amounts of phytoplankton, called blooms, sometimes occur. When blooms occur during hot weather and are followed by several days of cloudy cover, large amounts of phytoplankton can die and the result is a depletion of oxygen in the water, sometimes followed by death of fish. These natural "fish-kills" have always occurred in shallow, warm-water southern lakes.

There is concern over larger and more frequent phytoplankton blooms in Lake Okeechobee. There is even greater concern for these blooms because they are composed of a type of algae known as blue-green algae (cyanobacteria), which produces chemicals in the water that are toxic to fish. It is believed these blue-green algae blooms are related to elevated fertility in Lake Okeechobee water caused by runoff from urban areas that drain into the Kissimmee River, from farming practices and nutrients already in the lake sediments, re-suspended into the water after high-wind events. Several species of blue-green algae can utilize nitrogen from the air and therefore bloom even when nitrogen levels in the water are low. Efforts by the South Florida Water Management District (SFWMD) and the U.S. Army Corps of Engineers (US COE) are under way to correct these problems.

Emersed Plants

Emersed plants are the most evident vegetation on Lake Okeechobee. The underwater portions of emergent plants provide refuge for small animals, which are forage for game fish such as largemouth bass. The upper portions of taller emergent plants such as bulrushes and cattails are used for nesting birds such as flycatchers and the endangered snail kite. Birds eat the seeds produced by bulrushes, smartweed, and aquatic grasses. Emersed plants are also important for protecting near-shore areas from wave action. However, emersed plants, particularly cattails, can become so thick that they cause stagnant conditions in backwater areas by preventing exchange of water. They can also block boating access and cause narrowing of boat channels, creating a boating hazard. Lake Okeechobee's most common emersed plants are described below as found from shoreline to deeper water.

Arrowheads

Arrowheads are hefty shoreline plants that hold their large leaves upright on sturdy leaf stalks, which become very spongy at the base. They produce flowering stalks summer-round that hold flowers in a series of whorls along the upper portions. Three white petals make up each flower, which appear as light and thin as paper confetti surrounding a central yellow disk. The **bulltongue arrowhead** is named for the long, elliptic shape of its upward-pointing leaves. Like the other arrowheads, the bulltongue persists through the changing wet and dry conditions that occur along Lake Okeechobee's shoreline. **Broadleaf arrowhead** differs from the bulltongue by its triangular lobes at the

Figure 1. Bulltongue arrowhead. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Figure 2. Broadleaf arrowhead. Credits: KAL

Figure 3. Maidencane. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Figure 4. Spikerush. Credits: David Sutton

base of the leaf, resulting in a leaf shaped like the broad point of an arrow.

Maidencane

Maidencane is an important native aquatic grass that stretches along the coastal plain from New Jersey to southern Florida. Its leaves are wider and flatter than torpedograss, with edges that feel scratchy to the touch and taper toward the tip. The plants are larger and the stems grow taller and more upright than torpedograss, and the leaves are held at a wider angle from the stem. Maidencane forms the backbone of the wet prairies inhabited by the Florida panther, offers prime forage for deer, and creates upright habitat in the shallow marshes, ponds, and shorelines of Lake Okeechobee. Maidencane is a paradise for the insects, small reptiles, and fish that support wading bird populations. Its fibrous stems and hefty underwater runners are good nesting material for larger birds, and its seeds,

Figure 5. Southern amaranth. Credits: Ann Murray, http://plants.ifas.ufl.edu

though not plentiful, are nutritious. Where it moves into deeper waters that lack a firm mineral bed, maidencane can be used as nest substrate by largemouth bass. Unfortunately, this important plant disappears if seasonal fluctuations are eliminated, such as when water levels are permanently increased, stabilized, or lowered.

Spikerush

Spikerush (also called needlegrass) isn't a rush or a grass, but a sedge that grows like a field of olive-colored straw leaning this way and that in the shallow marsh. Its stems are circular and grow to 30 in. in height. The tips of the stems develop minute braided rows of flowers that mature and dry into tan seed heads. Spikerush plants have underground stems that spread through the lake bottom, producing many round tubers as they grow. Spikerush fields are excellent duck habitat, offering a thick, camouflaged cover and food in the form of both tubers and seeds. The Florida mottled duck, a non-migratory mallard, is especially known to eat its seed.

Southern Amaranth

Southern amaranth (also called **giant pigweed**) is a fast-growing giant of the marsh that returns from seed every spring on high mounds along shorelines that dry down or on levees around Lake Okeechobee. Southern amaranth has lance-shaped leaves on stalks that attach to the massive stem, and it produces multiple spikes of flowers. It resembles the common pigweed of fields and gardens.

Even though some people harvest common pigweed as a high-protein grain, birds are not known to favor the seeds of southern amaranth. This plant usually has wide, red, basal stems, which offer hollows for benthic organisms and resources for wildlife at the end of the growing season.

Swamp Rosemallow

Swamp rosemallow (also called **marsh mallow**) is a towering native in the marshes of Lake Okeechobee and is related to the cotton plant and ornamental hibiscus. The broad-leaved plant will re-grow annually from old basal parts. Its leaves have serrations (or deeply pointed lobes) along the margins and a white, downy coating on the surface. The five petals of the pink flowers resemble strips of crepe paper attached at the base with a central red splotch. The swamp rosemallow is a summertime beauty that offers high perches and vantage points to marsh birds.

Figure 6. Swamp rosemallow. Credits: KAL

Giant Bulrush

Giant bulrush is the tallest rush at Lake Okeechobee, growing to a height of 6–8 ft. Its stems are smooth, green, and nearly circular when cut. Thin, brownish wrappings at the base of the stem are all that exist as leaves. It forms dense clumps that extend toward the cattails as the lake deepens. Several species of birds eat the seeds of bulrushes, and the stems of giant bulrush are important to midges. Midges are the tiny insects that fly into your nostrils when your boat pulls into a bulrush stand. Although an irritant to humans, midges are a valuable food for fish. Midge larvae spin black tube cases on the stems of giant bulrush where they leave after feeding. They feed on the film of filamentous algae and diatoms associated with the surface of the plant and are surprisingly territorial in their feeding zones. Over 47,000 midge tubes are supported by every square yard of giant bulrush at Lake Okeechobee. Fish do not eat the midge larvae, waiting instead until the midges turn into flying adults before feasting. Two types of bulrush grow in Lake Okeechobee, one with soft stems, called **softstem bulrush,** and one with very stiff stems, called **buggy whips** or **pencil grass** in Florida.

Figure 7. Giant bulrush. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Common Reed

Common reed is a cane-like grass that grows on the levees and ditch banks around Lake Okeechobee. Its leaves are flat, with bases that wrap around the stem. The 12–16 ft. tall stems are hollow and produce droopy plumes of flowers at the top. Common reed does not branch. It grows upright from a deeply rooted network of underground stems. Its stands offer shelter for redwing blackbirds and puddle ducks.

Figure 8. Common reed. Credits: Ann Murray, http://plants.ifas.ufl.edu

Wild Taro

Wild taro has elongated, heart-shaped leaves held above the water surface by a thick stalk. The stalk attaches to the undersurface of the leaf at a nearly centralized point, where three major veins meet. Wild taro leaves are characterized by a velvety, water-repellent sheen. Many leaf stalks, as well as underwater creeping stems, arise from a buried corm. Corms of certain taro varieties are farmed as a starch crop in tropical countries. Wild taro is non-native and undesirable in Florida water bodies. Steer clear of this plant because calcium oxalate crystals deposited throughout the plant are poisonous and can induce a severe skin reaction. Herbicides are used to counter the growth of wild taro in Lake Okeechobee.

Figure 9. Wild taro. Credits: Alison Fox

Torpedograss

Torpedograss is an emersed grass that grows from extensive rhizomes (underground stems). The tips of the rhizomes are pointed, hard, and glossy-white. The leaves are rolled and have fine hairs on the upper surface. There is a ring of fine hairs at the base of the leaf. The seed heads branch sharply upward, and the flowers are attached individually along branches. The flower stalk is open compared to the tightly closed flower stalk of maidencane. Torpedograss is an invasive plant that was introduced to Florida from South America. It grows so densely that it prevents other plants from growing. Torpedograss is managed on Lake Okeechobee, and efforts are under way for long-term reduction in the lake by using a combination of burning during low water periods and herbicide applications.

Figure 10. Torpedograss. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Primrosewillows

Primrosewillows are broadleaved plants commonly infused with red on the stems and leaves. They produce flowers with 4–5 yellow petals that drop when touched. Seed pods are elongated capsules called "seed boxes" that split open late in the season and drop large numbers of small, black seeds, which are eaten by puddle ducks and ground-feeding birds. More than a dozen different species of primrosewillow might be growing at one time in the marshes and margins of ditches and roadbeds around Lake Okeechobee. The most common is the invasive **Peruvian primrosewillow**, which has larger flowers than other primrosewillows, a bushy frame, a woody base, and boundless growth that often requires control with herbicide.

Figure 11. Peruvian primrosewillow. Credits: KAL

Smartweed

Smartweed grows near the shoreline in mounded areas and at wet sites that occasionally dry. It is most noticeable in late summer, when clouds of pink or white flowers form masses on spikes above its stalks of green, lance-shaped leaves. Smartweed can be identified during the rest of the year by the papery sheath that wraps the stem at the swollen joint where the leaf meets the stem. The sheath is topped with a fringe of bristles. Dabbling ducks, including fulvous tree ducks, mallards, teals, and ring-necked ducks, are attracted to the hard, dark, shiny seeds that fall and collect in great numbers in the shallow lake bed near smartweed colonies. Sometimes managing smartweed is required to maintain boating access.

Figure 12. Smartweed. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Trompetilla

Trompetilla (also called **West Indian marsh grass**) is a large, invasive grass with wide leaves and long, lanky stems that both creep across and grow upright from the water surface. Originating in Central and South America, this grass has mechanisms for coming back and producing seeds every year. In wet springs, when the lake bed remains under water, plants will re-grow from underwater stems. During droughty springs, when the lake bed dries down, plants can come back from seeds. Because of its added ability to push out good native plants, trompetilla is targeted for herbicide treatment on Lake Okeechobee.

Figure 13. Trompetilla. Credits: Brent Sellers

Cattails

Cattails at Lake Okeechobee are mostly the type that forms a flower spike, which is naked at the tip and grows as high as the straight, flat leaves. The tip is revealed after the male flowers drop, having shed their pollen to the female flowers below. The female flowers mature into the brown "cigars," which are composed of seeds and the attached fuzz that carries them to new water bodies. Cattails are valuable to small birds, such as redwing blackbirds and migrating marsh wrens, which find insects to eat within the stands. Cattails can have massive growth and form dense stands accessible only to airboats. They are sometimes managed with herbicides on Lake Okeechobee to keep boating access open and allow water circulation into marsh areas.

Figure 14. Cattails. Credits: KAL

Submersed Aquatic Plants

Submersed aquatic plants provide refuge for fish and small animals. Waterfowl typically eat their seeds, buds, tubers, and other vegetative parts. Pondweed, eelgrass, southern naiad, and coontail are the most common native submersed plants on Lake Okeechobee. Hydrilla, on the other hand, is non-native and invasive. It can grow so extensively that it eliminates native submersed plants and hinders boating. It is intensively managed in many Florida lakes. Because of Lake Okeechobee's large size, it is only practical to manage hydrilla where it becomes a problem in high-use boating access areas.

Submersed plants require light to penetrate through the water for their growth. Therefore, they are affected by water clarity and water depth. When very high water levels exist, especially when water is turbid, quantities of submersed plants decrease because of shading. During the hurricane seasons of 2004 and 2005, bottom sediments of Lake Okeechobee were severely stirred up into lake water. The turbidity and shading effect caused by these sediments prevented submersed plants, especially eelgrass and pondweed, in many areas of the lake from recovering. This situation has improved because time has passed and water has calmed, allowing some submersed plants in Lake Okeechobee to recover. The following are common submersed plants found in Lake Okeechobee.

Pondweed

Pondweed (also called **peppergrass**) roots deep in the lake bed, but its soft branching stems bring its leaves up to the water surface. Its thin and nearly transparent leaves may extend as long as your hand and have wavy margins, which make them look like shreds of brown seaweed. In summer, flower spikes emerge like tiny snorkels above the surface to be pollinated by wind. Flowers produce plump seeds that are eaten by diver and puddle ducks. The underwater stands of this plant are full of insects and create some of the best fishing zones on the lake. Largemouth bass are fond of pondweed in the littoral zone of Lake Okeechobee. This is probably because within every surface square yard of pondweed, fish will find numerous grass shrimp, segmented worms, and midges available as high-quality food.

Eelgrass

Eelgrass (also called **tapegrass** or **ribbongrass**) has ribbon-like leaves that are a 1/2-inch wide and more than 3 feet long. These leaves grow from stems that run and root along the bottom of the lake. The spirally twisted wands seen ascending from the bottom are stalks bringing female eelgrass flowers to the water surface, where they can be pollinated

Figure 15. Pondweed. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Figure 16. Eelgrass. Credits: KAL

by floating grains of pollen. When left undisturbed, eelgrass grows in dense underwater beds, creating some of the best habitat for fish and the insects that fish eat. Eelgrass beds are favorite areas for largemouth bass, and more than 20 different species of insects make their home in eelgrass beds in Lake Okeechobee. According to Gary Warren of the Florida Fish and Wildlife Conservation Commission, every square yard of eelgrass contains an average of 67 grass shrimp, 1,900 segmented worms, and over 13,000 midges, which are food for a variety of locally occurring fish.

Southern Naiad

When it is underwater, southern naiad looks like thin branching twigs. When lifted out, it is soft and falls upon itself. Even though it is not attractive, it builds up a beneficial habitat for fisheries. The flowers are so small that they are hard for us to distinguish, but at the base of many

Figure 17. Southern naiad. Credits: KAL

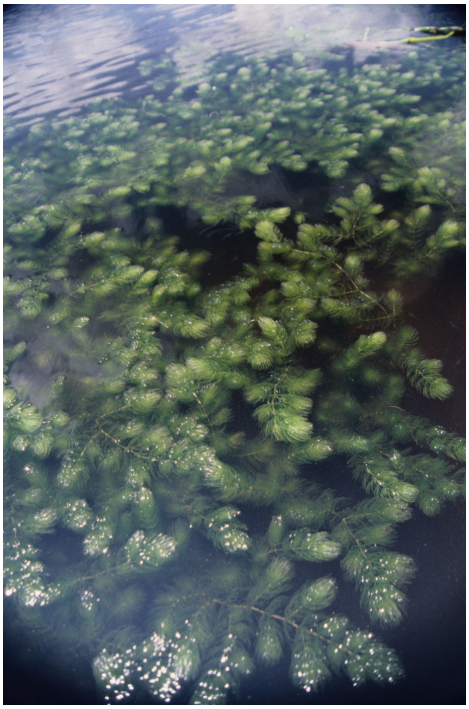

Figure 18. Coontail. Credits: Vic Ramey, http://plants.ifas.ufl.edu

of the leaves a single large seed is produced. The Florida mottled duck and other dabbling and diving ducks eat naiad — seeds and all.

Coontail

Coontail consists of branching masses of stiff strands that grow underwater without being rooted to the lake bottom. The "raccoon-tail" look of the strand comes from the whorled arrangement of the bristly leaves along each branching stem. A close-up look reveals each leaf to be constructed of a series of forked segments, which is why this plant is also called **hornwort**. For some fish, like the Everglades pygmy sunfish, underwater structure from aquatic plants like coontail is preferred over bare lake bottoms for spawning. The juvenile fish find nursery refuge there, as do small animals (zooplankton) that harbor safely in the forked leaf masses. In the fall, waterfowl eat the fruits produced on coontail strands.

Hydrilla

Hydrilla was introduced from Asia as an aquarium plant, but it is now prohibited as a "Noxious Weed" by federal and state governments. It grows in tangled strands that branch horizontally underwater and extend upward at the same time to form dense mats at the surface. Its tiny leaves are arranged in whorls along the stem, with pointed tips and spines along their undersurface, which give a rough feeling when the strands are pulled through the hand. In a simplified view, hydrilla may seem beneficial because it supports lake wildlife for a short period of time. Its rooted stems

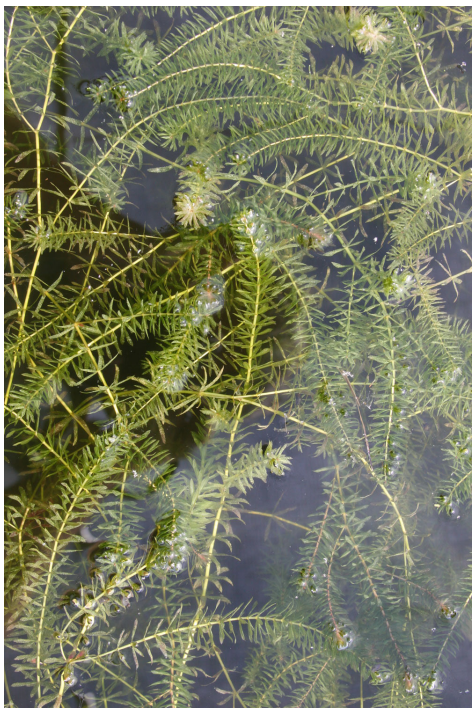

Figure 19. Hydrilla. Credits: KAL

produce starchy tubers that are eaten by ducks, and its underwater canopy supports a great abundance of fish food organisms. On the other hand, the negative consequences of hydrilla far outweigh the benefits. Partly because it is able to grow under poorly lit and turbid water, hydrilla holds a competitive edge over other plant species, including our native pondweed. It almost always turns a mixture of naturally occurring plants into areas where little plant life other than hydrilla exists, eliminating plant diversity, snagging propellers, and making fishing difficult.

Floating-Leaved Plants

Floating-leaved plants remain in place because they root on the bottom of the lake. These plants provide shade and shelter for fish, and waterfowl often eat the seeds they produce. Common floating-leaved plants on Lake Okeechobee include spatterdock (bonnets), American lotus (chinquapin), and several types of waterlilies (pads). The following are common floating-leaved plants found in Lake Okeechobee.

American Lotus

American lotus (also locally called **chinquapin**) is a prominent native plant on Lake Okeechobee. The enormous circular leaves and fragrant, pale yellow flowers arise from long, slender stems rooted in the lake bottom. The leaves can be over 40 in. wide and are centrally attached like an umbrella. Also, they have a water-repellent, dull, blue-green sheen. The flowers are 4–6 in. across, and they are noticeable in the spring when large areas bloom. The fruits persist for a long time after the petals drop off, and they resemble showerheads pointing upward, containing up to 25 seeds that are about 1/2 in. in diameter. Wildlife (and humans) can eat the seeds before they harden. The leaves and stems provide structure and cover for fish, but dissolved oxygen can become low under a dense canopy of leaves.

Figure 20. American lotus. Credits: KAL

Floatinghearts

Floatinghearts resemble miniature waterlilies, except that the cleft on the leaf is not as pronounced and is rounded at the edges, giving an overall heart-shaped appearance to the floating leaf. Their flowers are only about the size of a penny. Up close, you can tell that two different flowers characterize two different species: 1) the native **big floatingheart** (also called banana lily), which has a simple petal, and 2) the non-native **crested floatingheart**, which has a crest running down the center of each petal. The underside of the leaf of big floatingheart has a rough, red texture, while that of crested floatingheart is smooth. Similar to the waterlily, floatingheart leaves both shade and insulate shallow water from the summer sun. Crested floatingheart has rapid rank growth and is an increasing problem in Lake Okeechobee and other water bodies. It is treated with herbicide to prevent its spread.

Figure 21. Big floatingheart. Credits: KAL

Figure 22. Crested floatingheart. Credits: KAL

Spatterdock

Spatterdock (also called **bonnet** or **cow lily**) differs from the American lotus by its shiny, dark green, oval-shaped leaves with deep clefts. The leaves float on or are held just above the water surface. Spatterdock's dark-yellow flowers also emerge from the water on thick stalks, but appear round and tightly closed or spool-shaped, depending on their age. This native plant forms thick, hard, underwater stems, which support reproduction of largemouth bass in lakes with soft bottoms. Male largemouth bass will sweep the stems of spatterdock clean of sediments to use in their nest construction. The yellow waterlily borer, an effective

Figure 23. Spatterdock. Credits: KAL

Figure 24. White waterlily. Credits: KAL

fish-bait, can be found where they have burrowed into the leaf stems of spatterdock.

Waterlilies

Waterlilies (also called **pads**) differ from lotus and spatterdock by having circular floating leaves marked by a cleft that runs nearly 1/3 of the length to where the stem attaches on the leaf underside. The strong pattern of veins on the leaf underside also characterizes the waterlily. Most common is **fragrant waterlily**, with its many-petaled white flowers, although the yellow or **Mexican waterlily**, with smaller yellow flowers, also belongs on Lake Okeechobee. Hybrids between the two sometimes occur. Waterlilies grow as dense stands in shallow water, firmly anchored by hefty, bulb-like bases. Ring-neck ducks feed heavily on lilies; their crops have been found to contain 500–1,000 white waterlily seeds at one time.

Figure 25. Waterhyacinth. Credits: KAL

Floating Plants

A variety of both native and non-native free-floating plants occur year-round on Lake Okeechobee. Waterhyacinth, waterlettuce, and uprooted mats of tropical watergrass are extensively managed because of their harmful effects on the ecological and recreational uses of Lake Okeechobee. The following are common floating plants found on Lake Okeechobee.

Waterhyacinth

Waterhyacinth is recognized by its inflated, bulbous leaf stalk and, when present, its spike of blue to purple flowers with an upper yellow blotch. While it is found throughout Florida, it is not a native plant and is highly invasive, meaning it causes environmental and/or economic harm. It is native to the upper basin of the Amazon River and was brought to this country as an ornamental curiosity for ponds at the 1884 World's Fair Exposition in New Orleans. It has caused problems on Lake Okeechobee since 1905. The USDA has released three different kinds of insects for biological control of waterhyacinth. These insects work to reduce the size and aggressiveness of waterhyacinth. Herbicides must be used to keep waterhyacinth at the lowest levels possible (maintenance control) on Lake Okeechobee. When waterhyacinths are not controlled, they form continuously growing floating masses that destroy native plant communities and impede boat access and flood control. Ten waterhyacinth plants can grow to cover an acre during a single growing season.

Waterlettuce

Waterlettuce, like waterhyacinth, reproduces by forming daughter plants and creates large, floating mats of plants. It is easy to recognize by its rosette of gray-green leaves, with

Figure 26. Waterlettuce. Credits: KAL

soft, dense hairs, that resemble a loose head of lettuce. The dense hairs resist wetting and if the plant is held underwater, upon release it will ascend quickly to the surface, shedding water as it floats. The flower, about 1/4 in. across in the center of the rosette, somewhat resembles that of a Jack-in-the-pulpit plant, to which it is related. Waterlettuce was probably present before the last Ice Age and was killed off by the cold temperatures, but has been re-introduced. Scientists debate whether it is native or non-native, yet it causes problems similar to those caused by waterhyacinth and is managed for maintenance control with herbicides.

Tropical Watergrass

First found in Lake Okeechobee in 2007, tropical watergrass is an invasive grass that has already impacted lake ecology by creating massive, impenetrable mats. The floating mats consist of tropical watergrass stems, floating debris, and other live plants. The long, tough, upright leaves of tropical watergrass are recognizable as they arise from their stems that float just under the surface. If you run your hand down the leaf until it hits the stem, you will find the stem flatten while at the same time thicken as spongy tissue provides air pockets that keep the leaves above water. Tropical watergrass flowers in the fall months, producing millions of seeds that latch onto clothing and contaminate gear, increasing the risk of spread to other water bodies.

Alligatorweed

Alligatorweed is an invasive plant from South America that creates floating tangles of its slick, hollow stems along shorelines, canals, and into Lake Okeechobee. The stems are washed in the color pink and hold oblong leaves opposite each other along their length. The leaves have an obvious central vein. Throughout the growing season, alligatorweed produces papery, white flowers in tight, cylindrical heads. Insects released for biological control of alligatorweed keep its growth in check, and sometimes herbicides are needed to manage it.

Figure 27. Tropical watergrass. Credits: Colette Jacono

Figure 28. Alligatorweed. Credits: KAL

Figure 29. Pennywort. Credits: Vic Ramey, http://plants.ifas.ufl.edu

Pennywort

Pennywort (also called **dollarweed**) has scalloped edging on its disk-shaped leaves (which reach the size of a silver dollar), a central white spot where a spongy, upright stalk attaches underneath, and thick runners that creep along shorelines and extend in tangles into the water. Pennywort adds value to Lake Okeechobee by stabilizing shorelines, offering good places for fish food (which hide at the shaggy stem joints), and producing seed for birds on its tiny "Queen Anne's lace"-like flowers.

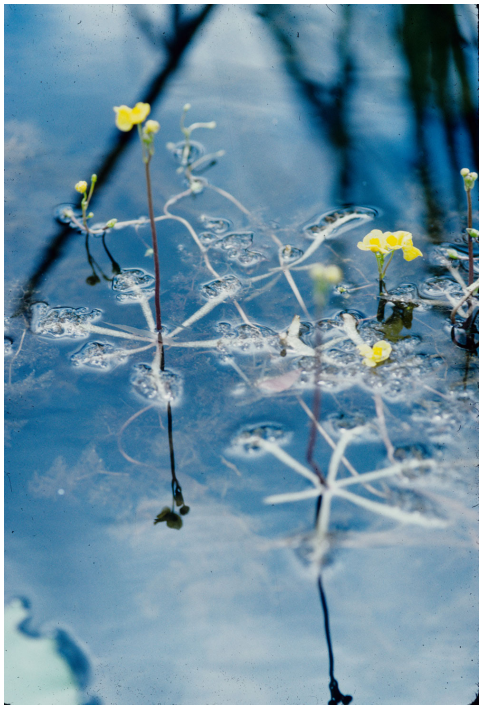

Figure 30. Floating bladderwort. Credits: David Sutton

Floating Bladderwort

Floating bladderwort is primarily an underwater mass of threadlike leaves carrying small, hollow sacs that trap and digest small prey. It is not often noticed until its slender stalks with yellow, pea-like flowers poke up from the water surface. Several leaves enlarged and modified into a spoke-wheel arrangement support the flower stalk at the water level. Trapped animals only supplement the diet of this plant. Like other plants, it produces its food by photosynthesis. The habitat it provides to zooplankton, insect larvae, and other small swimmers likely offsets the number it consumes. Many other forms of bladderwort can be found in Lake Okeechobee.

Frog's-bit

Frog's-bit, a native plant of hard, nutrient-rich waters, assumes two different growth forms during its life. In its early life form, populations are widely spaced and leaves float flatly on a spongy pad of tissue, allowing plants to roam freely across the water surface. As the season progresses and spacing becomes more crowded, the leaves grow upward and become leathery, and the distinctive spongy pad is lost. At the same time, the widely heart-shaped leaves become more egg-shaped and the plants root either in the shoreline or within floating debris and among other plants to create floating beds. Leaves and shaggy white or silvery roots develop in bunches intermittently along the buoyant stem. Holding a leaf up to the light will reveal at least two veins parallel to each side of a central rib. If you shake the roots, be prepared for a spray of insects (or fish food)

Figure 31. Frog's-bit. Credits: KAL

Figure 32. Duckweed. Credits: KAL

hidden in their cover. During summer, frog's-bit produces white, star-shaped flowers and later makes fleshy fruits that curve downward on stalks. Plants can develop dense mats, especially in ditches and canals.

Duckweeds

Duckweeds are the smallest of Lake Okeechobee's floating plants and are usually found mingling among larger plants that afford them protection from wind and waves. The best way to look at duckweed is to tap a cluster with the tip of your finger and draw them into your field of vision. The entire plant is made of a smooth, wax-coated pad of green tissue that acts as both leaf and stem. Underwater roots sprout underneath the floating pads, and pads make new plants by budding. Duckweeds create nursery cover for fish and provide green meals rich in protein for waterfowl.

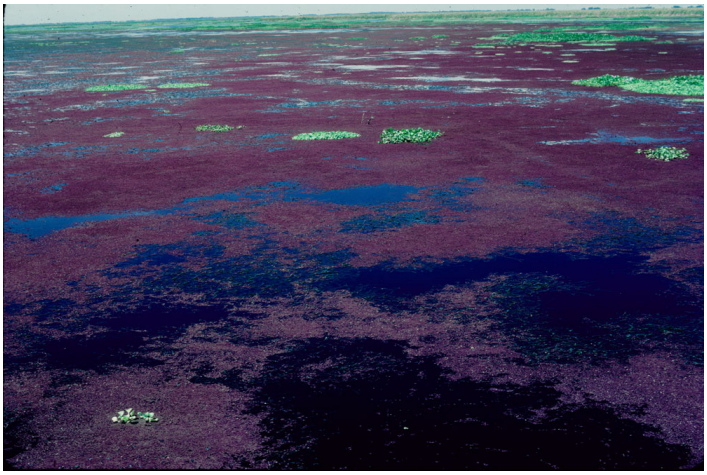

Figure 33. Mosquitofern. Credits: David Sutton

Mosquitofern

Mosquitofern plants are somewhat larger than duckweed, but you still need to look closely to distinguish their features. Mosquitoferns have a textured, lacy appearance formed by a number of tiny, overlapping fronds scattered across their branched, floating stems. Colored from green to deep red, they are common in protected areas of the lake. Although the plants themselves are rarely eaten, their dry surfaces and underwater spaces make good homes for the insects eaten by frogs, wading birds, and other marsh animals.

Management of Aquatic Plants on Lake Okeechobee

Aquatic plants are managed on Lake Okeechobee to benefit the health of the lake and to provide maximum recreational benefits. The U.S. Army Corps of Engineers (US COE) manages vegetation that affects navigation on Lake Okeechobee, principally waterhyacinth and waterlettuce. The South Florida Water Management District (SFWMD) and the Florida Fish and Wildlife Conservation Commission (FWC) manage vegetation for habitat protection and improvement. All operations must be permitted by the FWC.

Because of the lake's complex ecology and many recreational interests, the Lake Okeechobee Interagency Task Force (LOITF) was formed to ensure that the aquatic plant management program serves the needs of all. The LOITF is composed of representatives from the US COE, FWC, UF/IFAS (University of Florida Institute of Food and Agricultural Sciences), and the SFWMD. Anglers, waterfowl hunters, and all interested parties are encouraged to attend these meetings to share their expertise and also to communicate with the task force through agency personnel. Through the task force, the aquatic plant management program is tailored to accommodate many interests, including protecting the endangered snail kite, ensuring sport fish reproductive cycles, and overseeing hunting and fishing seasons.

Methods Used to Control Nuisance Plants on Lake Okeechobee

In the 1970s, insects were released for biological control of alligatorweed. Since then, little to no other control methods have been necessary, even though this plant once caused problems. Extensive research has been done to discover biological controls for waterhyacinth and hydrilla. Several insects have been studied and released but other methods are still needed to manage these plants.

Machines are sometimes used to mechanically remove aquatic plants, but efforts to do large-scale mechanical removal on Lake Okeechobee have not proven feasible. The cost is very high, and the machines are only effective when plants are well above the levels that cause environmental harm to the lake. Additionally, machines harvest all plants (including beneficial native plants) and animals that cannot escape their path.

Herbicides are used in such a way to maintain nuisance plants, especially waterhyacinth and waterlettuce, at the lowest feasible level. This is referred to as maintenance control. This reduces the detrimental impacts of the plants and reduces the amount of herbicide that must be used. Maintaining plants at low levels is difficult because conditions such as wind and rain can prohibit necessary spraying operations.

Herbicides Used on Lake Okeechobee

All herbicide products must be approved by the U.S. Environmental Protection Agency (EPA) for their intended use. For an herbicide to be approved, the EPA must review the manufacturer's application for registration and determine that use of the product does not present an unreasonable risk to humans, wildlife, or the environment. The EPA also ensures the information provided is backed by reliable data submitted by the manufacturer. Herbicides registered to control aquatic weeds must be adequately tested for application to water. Herbicides used in Florida must also be approved for use by the Florida Department of Agriculture and Consumer Services (FDACS). Adjuvants are additives sometimes used in an herbicide mixture to

increase absorption of herbicides into plants. Adjuvants in aquatic herbicide products, such as soaps, must be from an EPA-approved list.

Herbicide products contain the herbicide active ingredient diluted in an inert carrier, often water. Herbicide products with the active ingredients 2,4-D, diquat, endothall, glyphosate, imazapyr, triclopyr, and imazamox are used on Lake Okeechobee to manage unwanted or excessive vegetation. These same active ingredients are used for weed control in food crop production and/or home landscapes.

How Herbicides Work

The way that an herbicide kills a plant is called its mode of action. 2,4-D, diquat, endothall, glyphosate, imazapyr, and triclopyr kill plants by affecting plant processes that are specific to plants. Therefore, they have low toxicity to fish, wildlife, and humans. The herbicide product used by the applicator is a concentrated solution of the active ingredient. Therefore, even though the products have low toxicity, applicators are required to wear protective clothing when mixing the concentrate or applying the herbicide mixture to eliminate or reduce exposure with repeated use.

Who Applies Herbicides

Contractors paid and supervised by the US COE, SFWMD, and/or FWC apply herbicides to Lake Okeechobee. All contract personnel are professional applicators who have been licensed by FDACS. In order to obtain an aquatic herbicide applicator license, the applicator must demonstrate competency by successfully completing training and passing a test administered by UF/IFAS. Applicators are subject to unscheduled inspections by FDACS to confirm compliance with pesticide application rules and adherence to directions provided on the manufacturer's herbicide label.

How Herbicides Are Applied

Almost all herbicide applications on Lake Okeechobee are for emergent or floating plant control, and the herbicide mixture is applied as a foliar application, meaning it is applied directly to the leaves and stems of plants, not to the lake's water. Applications for maintenance control are made with airboat-mounted sprayers and sometimes all-terrain vehicles. Floating vegetation is maintained below 400 acres when possible for maintenance control. Helicopter application is sometimes required on floating vegetation populations because of low water level or weather that prohibits spraying.

Before it is applied, the herbicide concentrate is diluted in lake water 20-fold (aerial application) to 100-fold (airboat application). Although it is impossible to prevent any herbicide from contacting the water during foliar applications, only a very small amount of herbicide actually enters the water. Once applied, the herbicide is absorbed by the plants and/or breaks down on the plant surfaces to non-toxic, naturally occurring compounds. Herbicide that goes into the lake water becomes diluted, inactivated, and/or breaks down. Herbicides become inactivated when they react with substances in the water and break down when they absorb energy from the sun, are acted upon by microbes, or react with water. Because the herbicide is diluted and breaks down quickly, the risk of exposure to boaters who inadvertently come in contact with treated plants is negligible.

Because plants are important in Lake Okeechobee, nuisance plants are managed in ways that cause minimum harm to beneficial plants. Herbicides are applied as carefully as possible so that they only contact target plants. This can be difficult in certain circumstances, such as when waterhyacinth plants are among bulrush plants. In this example, these waterhyacinths must be controlled because they will grow to smother the bulrushes and other desirable vegetation. In this case, the herbicide diquat is used because it only kills plant parts that it contacts. Diquat is applied to the entire waterhyacinth plant, but the herbicide will only reach the portion of the bulrush plants growing above the water. Therefore, only the above-water portions of the bulrush plants are affected, and new shoots grow from beneath the water.

Frequently Asked Questions about Herbicide Applications in Lake Okeechobee*

*These questions were asked during public meetings in 2006.

Why are herbicides applied when there is hardly any or no vegetation?

This can be the perception when floating vegetation, such as waterhyacinth and waterlettuce, is maintained under maintenance control. Using maintenance control, applicators spend more time finding small populations, and they use less herbicide to control those populations so there is less impact to desirable vegetation. This question was often asked when levels of desirable vegetation were critically low in the years following hurricanes of 2004-2005. When the desirable submersed and emergent vegetation was decimated by hurricanes, conditions were ideal for growth

of floating vegetation, which further hindered the re-establishment of desirable vegetation.

When will responsible agencies recognize the importance of fishing to Lake Okeechobee communities and stop spraying in the estuaries and littoral zone and allow fish populations to recover?

The COE's responsibility is to manage vegetation on Lake Okeechobee for navigation, but fisheries health is a major consideration when developing annual vegetation management plants for the lake. The FWC is responsible for making management decisions related to fishing and fisheries, and citizen input is encouraged through the LOITF.

Does vegetation (good and bad) absorb nutrients and help lake water be healthier and clearer?

All plants, including aquatic plants, absorb nutrients, then as they age, die, and decay, they release the nutrients back to the environment. Waterhyacinth and waterlettuce absorb nutrients from lake water and can inhibit phytoplankton growth by competing for nutrients. But unless they are removed, along with the nutrients they absorbed, the nutrients are released back into the water when leaves drop off or plants die. The amount of plants that would have to absorb nutrients from Lake Okeechobee to have an effect on phytoplankton/water clarity is enormous, and these plants would do much greater environmental harm than the beneficial effects of making the water clear. This is one of the reasons waterhyacinth and waterlettuce are managed at maintenance levels – so that only the smallest amounts of nutrients possible are released at the same time from the dying plants. Other reasons include preventing the environmental impact that large amounts of plants would have on desirable vegetation in the lake and preventing the low oxygen conditions created under vast mats of floating plants.

Why does the COE spray waterhyacinth in littoral areas like Moonshine Bay, Monkey Box, North Shore, Bay Bottom, Eagle Bay, etc., where the plants are not a problem to navigation?

There are two reasons for this: 1) Because waterhyacinths are free-floating, the large mats that will develop can move into navigation areas; and 2) more importantly, waterhyacinth and waterlettuce are managed in littoral areas for environmental reasons, such as improving fisheries habitat. It may not appear necessary to control floating plants in these areas when they are under maintenance control. However, history has proven that if these areas are left unmanaged the floating plants will reproduce rapidly and are extremely damaging to desirable plant communities and fisheries habitat.

Should there be a moratorium on spraying of aquatic plants?

This question was asked in the years that followed the hurricanes of 2004-2005. Hurricanes destroyed aquatic plant communities, including submersed plants on Lake Okeechobee, and water was extremely turbid from stirring up of bottom sediments. The turbid water prevented submersed plant communities from returning. Some individuals thought that a moratorium on herbicide use would allow aquatic plants to return more quickly. The only plants sprayed during this time were waterhyacinth and waterlettuce. Those responsible for management of the lake did not consider a moratorium because of the past experiences using moratoriums. In 1986, such a moratorium allowed for even worse conditions and actually made it more difficult for desirable plant communities to return. A combination of low water levels following the hurricanes of 2004-2005, changing of water level schedules, and aggressive maintenance control of nuisance floating vegetation has allowed for a return of desirable submersed and emergent vegetation.

Do fish leave spawning areas after the area is sprayed?

Studies by fisheries scientists at Auburn University and the University of Florida have demonstrated that largemouth bass do not leave spawning beds after a spraying event. Fish will sometimes randomly leave beds or leave beds in response to changing weather conditions. Thus, if fish happen to leave beds for some other reason following spraying, it may be mistaken for a response to spraying.

Why is there spraying during low water levels when there are no weeds?

During low water levels in 2007-2008, ATVs mounted with sprayers were transported by boat to dewatered areas of Lake Okeechobee to spray juvenile waterhyacinth plants that had germinated from seeds on the lake bottom. The purpose of this was to prevent these plants from forming large floating mats when water levels rose. These mats of floating plants would have prevented submersed plants

from returning because of shading and damaged desirable emersed plants like bulrush.

Acknowledgements

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Scientific Names of Plants in This Publication

Emersed Plants

Bulltongue arrowhead – *Sagittaria lancifolia*
Broadleaf arrowhead – *Sagittaria latifolia*
Maidencane – *Panicum hemitomon*
Spikerush – *Eleocharis* spp.
Southern amaranth – *Amaranthus australis*
Swamp rosemallow – *Hibiscus grandiflorus*
Buggy whip – *Schoenoplectus californicus*
Softstem bulrush – *Schoenoplectus validus*
Common reed – *Phragmites australis*
Taro – *Colocacia esculenta*
Torpedograss – *Panicum repens*
Primrose willow – *Ludwigia* spp.
Smartweed – *Polygonum* spp.
Trompetilla – *Hymenachne amplexicaulis*
Cattail – *Typha* spp.

Submersed Plants

Pondweed – *Potamogeton illinoensis*
Eelgrass – *Vallisneria americana*
Southern naiad – *Najas guadalupensis*
Coontail – *Ceratophyllum demersum*
Hydrilla – *Hydrilla verticillata*

Floating-Leaved Plants

American lotus – *Nelumbo lutea*
Big floatingheart (aka banana lily) – *Nymphoides aquatica*
Crested floatingheart – *Nymphoides cristata*
Spatterdock – *Nuphar advena* (aka *N. luteum*)
Fragrant waterlily – *Nymphaea odorata*
Mexican waterlily – *Nymphaea mexicana*

Floating Plants

Waterhyacinth – *Eichhornia crassipes*
Waterlettuce – *Pistia stratiotes*
Tropical watergrass – *Luziola subintegra*
Alligatorweed – *Alternanthera philoxeroides*
Pennywort – *Hydrocotyle umbellata*
Floating bladderwort – *Utricularia inflata*
Frog's-bit – *Limnobium spongia*
Duckweeds – *Lemna* spp.
Mosquitofern – *Azolla caroliniana*