Permaculture PLANTS

A Selection

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WATER PLANTS

Water plants can provide direct food to humans and to fish and other aquatic animals and also oxygenate water. No aquatic system is complete without a range of plants. The plants of water systems can be classed into four broad and not always clearly defined groups:

Submerged Plants. These plants are valuable in fish production. The only part of these plants that may rise above the water is the flowers. The roots (if any) act only as anchors. Transfer of nutrients, carbon dioxide and oxygen takes place over the entire surface of the plant. Oxygen released during photosynthesis is given off directly to the water which increases water oxygen levels to the benefit of fish and those bacteria which require oxygen and break down organic matter.

Floating - Leaved Plants. Often directly useful to humans but of less direct benefit to fish, these plants are usually only found in calm waters. Some anchor themselves to the bottom and absorb nutrient from the soil while others float on the surface and derive nutrient from the water. Their leaves often shade the entire water surface reducing the amount of light, heat and oxygen actually reaching the water.

Emergent Plants. These plants live at the waters edge where their roots and stems live below water, but their leaves and flowers rise above water. By arranging shallows in ponds large areas can be dedicated to emergent plants.

Margin Plants. These plants do not actually grow in the water, although their roots may be submerged for a portion of the year. They grow in association with the water system and derive extra moisture from the moist soils of the edge.

UTILITY SUBMERGED PLANTS

Plankton, including algae, bacteria, flagellates and diatoms

A reasonable balance of these organisms can usually be gained by simply introducing water from an established aquatic system such as a lake, creek or large pond.

UTILITY FLOATING - LEAVED PLANTS

Azolla spp

Family: AZOLLACEAE

A small, perennial, free - floating fern which hosts a microscopic alga, *Anabaena azolla*, in its leaves. The alga fixes nitrogen from the atmosphere and makes it available to the *Azolla* in the form of ammonia. Laboratory research has found that the alga can also be made to produce hydrogen from water, which shows much promise as a method of harnessing and storing solar energy cheaply. *Azolla pinnata* is used extensively in Vietnam as a companion in rice paddies because of the nitrogen that it makes available to the rice plants. It also feeds the tilapia and other fish in a rice paddy system. It is a valuable food for pigs, poultry and waterfowl and has been reported to be valuable for controlling mosquitoes and weeds by covering the water surface. It is also a good nitrogen - rich mulch material, which once dried, has similar water holding properties to peat moss.

Wolffia spp, Wolffiella spp, Spirodella spp, Lemna spp (duckweed)

Family: LEMNACEAE

The 40 or so known, perennial, free - floating species of duckweed are among the most vigorously growing of plants on the planet, some doubling their numbers every three days. They are valuable plants for removing excess nutrient from water. Tests on *Lemna minor* and *Lemna trisulca* have shown that they can concentrate boron, aluminium, manganese, iron, titanium, copper and cobalt into their tissue from water. They are good fodder for some fish, ducks and domestic animals. It has also been used as human food.

***Wolffia arrhiza* (khai - nam, mijinko - uki - kusa)**

The smallest flowering plant on the planet and is edible to humans. On a dry weight basis it contains 20% protein, 44% carbohydrate and 5% fat, vitamins A, B2, B6 and C. It is cultivated in Burma, Laos and Thailand as a vegetable, tasting somewhat like sweet cabbage. In Thailand, the calculated annual yield is 265 tons wet weight or 10.5 tons dry weight/ha/year.

It is an ideal animal feed for water fowl and other poultry, cattle and pigs.

Spirodella oligorhiza, Spirodella polyrhiza

These species have the potential to produce the equivalent feed value of 60 ha of soybeans in 1 ha. (Protein 37 - 45%, nitrogen 6 - 7%, phosphorous 1.4 - 3%, potassium 1.5 - 3%, calcium 1%, ash 8 - 14%, fibre 7 - 10%, fat 4 - 6%, metabolisable energy 1958 calories/kg.

***Neptunia oleracea* (neptunia, water mimosa, rau nhút, pak kachet)**

Family: MIMOSACEAE

This floating, leguminous plant is native to Asia, Africa and tropical America, where it can be found growing on still or slow moving fresh water. In Thailand and Vietnam it is grown in tanks. The leaves and stems are eaten in salads and the seed pods are cooked and eaten. The plants are also cooked as greens.

***Trapa spp* (Indian water chestnut, water caltrop, Jesuit nut, ling - chio)**

Family: TRAPACEAE

This perennial, floating, attached, native to Europe, India and eastern Asia grows in water depths from 0.3 - 1 m. There are some 9 species which range from tropical to temperate. The kernels of the spiny fruit are eaten. It has become a pestilent weed in the USA and is a prohibited import into Australia, although it already occurs in some parts of Australia.

***Nympha alba, Nympha gigantea, Nympha odorata, Nympha tellata* (water lilies)**

Family: NYMPHAEACEAE

These plants take root in the mud and the leaves float on the water (depths up to 1.5 m). The roots are edible and in Europe, *Nympha alba* is used as a feed for pigs.

UTILITY EMERGENT PLANTS

Ceratopteris thalictroides

Family: PARKERIACEAE

An aquatic fern growing wild along ditches, in swamps and paddy fields of the tropics and semi - tropics. The fiddleheads are eaten raw and cooked. The entire plant, except the root may be cooked and eaten as greens.

***Colocasia esculenta, syn. Colocasia antiquorum* (taro, coco - yam)**

Family: ARACEAE

Taro is possibly the earliest grown plant and is usually grown in paddy culture like rice or on dry land under irrigation. There must be a 6 - 7 month frost - free period for successful cropping. Both corm and cormel of the plant are eaten by humans. The roots are comparable in nutrition to those of potatoes and sweet potatoes and the leaves and petioles can be cooked and eaten like spinach. The plant must be cooked.

Nutritional composition of taro **leaves and stems** per 100 grams of edible portion is: Water - 87.2%, Energy - 40 calories, Carbohydrate - 7.4 g, Fat - 0.8 g, Protein - 3.0 g, Ash - 1.6g, Calcium - 76 mg, Iron - 1.0 mg, Ascorbic acid - 31 mg.

Nutritional composition of taro **corms and tubers** per 100 grams of edible portion is: Water - 73%, Energy - 98 calories, Carbohydrate - 23.7 g, Fat - 0.2 g, Protein - 1.9 g, Ash - 1.2 g, Calcium - 28 mg, Potassium - 514 mg, Sodium - 7 mg, Iron - 1.0 mg, Phosphorous - 61 mg, Vitamin A - 20 I.U, Thiamin - 0.13 mg, Riboflavin - 0.04 mg, Niacin - 1.1 mg, Ascorbic acid - 4 mg.

Some cultivars are highly salt tolerant. The small tubers and the crown of the main tuber are used for propagation.

***Eleocharis dulcis, syn. Eleocharis tuberosa* (Chinese water chestnut)**

Family: CYPERACEAE

This perennial, rush - like plant with emergent, cylindrical, narrow, spike leaves is native to N. Australia, Malaysia, SE Asia, Madagascar, Fiji and New Caledonia. It grows in 50 - 200 mm of water and is usually grown in flooded fields, often in rotation with rice. Yields of the rhizome, which is said to be as nutritious as the potato (carbohydrate 30%, protein 1.5%) can exceed 7 tons per ha. It can also be grazed by stock. It grows as companion to taro, lotus and water lilies.

***Glyceria fluitans* (floating manna grass)**

Family: POACEAE

A perennial grass to 120 cm, usually found in stagnant or slow moving water. It has a creeping rhizome and the weak stems and leaves bend to float on the water. It is not prone to forming dense stands and is a useful plant because insect larvae and other small animals shelter in the leaves, which lie loosely on the water. The seed has been used for human food.

***Glyceria maxima, syn. Glyceria aquatica* (great water grass)**

A dense, clumping, perennial grass which grows up to 2 m and spreads by creeping rhizomes. The leaves are a good fish food and the seed has been used for human food. The seed flour can be made into a good quality bread, used for thickening soups and stews and for making puddings.

***Ipomea aquatica* (kang kong, water spinach, engsai, ong choy)**

Family: CONVOLVULACEAE

A native of southern China, India, south east Asia and Taiwan, this tropical trailing herb is found in muddy streams, freshwater ponds and marshes. The seed is usually germinated and grown on land until about six weeks when the plant can be flooded. Annual yields of up to 90,000 kg/ha have been recorded. Protein varies from 1.9 - 4.6% in the fresh plant and carbohydrate averages 4.3%. The leaves are a good source of vitamins A, C, and E, iron and other minerals. It is a good source of animal feed which does not require dewatering and also a valued food for herbivorous fish. The fresh young leaves and shoots are boiled or cooked in oil and eaten as a vegetable. Young tips are selected for salads. The young stems are used in pickles. With yields of up to 60 t/ha this is one of the most productive leaf vegetables known. It is cold sensitive and is usually grown as an annual in cooler climates.

***Limnocharis flava* (yellow velvetleaf, berek)**

Family: LIMNOCHARITACEAE

Native to Mexico, West Indies, Peru and Brazil, it is cultivated in the rice paddies of Malaysia and marketed as a fresh vegetable. Old plants are ploughed into the rice fields as green manure and the plant is readily eaten by cattle (leaf protein 1 - 1.6%).

***Nasturtium officinal, syn. Rorippa nasturtium - aquatica* (water cress)**

Family: BRASSICACEAE (CRUCIFEREAE)

Native to Europe and northern Asia, this fast growing (30 - 60 days), emergent, broad - leafed herb of the mustard family requires cool or cold flowing water. It grows submerged, floating or spread over mud surfaces. It is usually grown in beds covered with 10 cm of water.

Nutritional composition of water cress per 100 grams of edible portion is: Water - 93.3%, Energy - 19 calories, Carbohydrate - 3 g, Fat - 0.3 g, Protein - 2.2 g, Ash - 1.2g, Calcium - 151 mg, Potassium - 282 mg, Sodium - 52 mg, Magnesium - 20 mg, Iron - 1.7 mg, Phosphorous - 54 mg, Chlorine - 775 mg, Sulphur - 5390 mg, Vitamin A - 4900 I.U, Thiamin - 0.08 mg, Riboflavin - 0.16 mg, Niacin - 0.9 mg, Ascorbic acid - 79 mg and the digestion time is 3.25 hours.

Water cress should not be grown for human consumption in polluted waters. Leaves and shoots are eaten fresh in salads and sandwiches, cooked in soups and stews. The seeds can be made into a mustard or sprouted as a salad green. It has many medicinal properties, but Lust, JB "The Herb Book" (1980) warns "Excessive or prolonged use can lead to kidney problems. It should not be taken daily and no longer than four weeks even with interruptions."

***Nelumbo nucifera* (lotus, Chinese lotus, sacred lotus)**

Family: NELUMBONACEAE

A herbaceous perennial growing to 2 m tall, the lotus is cultivated for the seed, leaves (harvested in spring) and the roots (rhizomes), which are harvested in the autumn. The leaves can grow up to 1 m in diameter. It is native to the north of Australia but some varieties are suited to more temperate sites.

***Oryza sativa* (floating rice)**

Family: POACEAE

This species floats on water up to 6 m deep, although the seed is usually broadcast onto dry or damp soil before flooding occurs. The plants will withstand being flooded for up to 30 days.

***Phragmites spp* (trinius)**

Family: POACEAE (GRAMINEAE)

Found growing in water depths to 1.5 metres, this perennial, emergent, narrow - leaf grass grows to heights of up to 4 m. It is a good habitat for fish and wildlife although unchecked it can become invasive. Its uses include thatching and building, reed mats and fodder.

***Phragmites australis, syn. Phragmites communis* (common reed grass, wild broomcorn)**

A cosmopolitan plant which is common in Australia where it is usually found growing in dense clumps at the margins of swamps, lakes and water courses. It is tolerant of brackish water. This tall (2 - 3 m) grass has edible shoots which are eaten like bamboo sprouts or pickled. They have to be harvested young, preferably before they turn green, and are said to taste like asparagus. Native North Americans made a marshmallow - like confection from the dried stems, and also ate the rhizome boiled or roasted like potatoes. Dried young leaves are mixed with cereal flour to make dumplings in Japan. The plant has been used for making bags and baskets, matting, sandals, thatching, arrows, spears, paper and musical reeds. A sugary gum which exudes from the stem can be rolled into balls and eaten as a sweet. The grain is difficult to remove from its hull but is claimed to be nutritious.

***Sagittaria latifolia, Sagittaria fasciculata* (arrow - head or duck potatoes)**

Family: ALISMATACEAE

This plant occurs at the water's edge, and to a depth of 0.5 m. The tubers were eaten by the American Indians (who called them wapatoo) and are said to be as good as potatoes.

***Sagittaria sagittifolia* (arrow - head)**

This native of Europe grows to about 1.5 m and may spread extensively throughout ponds. The walnut - sized roots are the plant's means of over - wintering, and are edible. They should be harvested in autumn. It is considered a good water fowl plant.

***Sagittaria trifolia, syn. Sagittaria sinensis* (arrowhead)**

A native to tropical and sub - tropical Asia this plant produces eight or more underground stems, each with a corm on the end. These corms are boiled and eaten like potatoes and are high in protein (5 - 7%) for a root crop. It requires a 6 - 7 month growing season.

***Typha spp* (cumbungi, cattail, bullrush)**

Family: TYPHACEAE

These narrow, linear - leafed plants occur throughout the world. One species *(Typha orientalis)* is native to the south west of WA. Cumbungi was the Australian Aboriginal name for the plant which is known as bullrush and cattail in other parts of the world. It is a tall growing plant (to 2 m) with grass - like leaves and a strong stem.

Its uses are many and varied. As a food, the pollen (rich in protein, carbohydrate, oil, sulphur and phosphorous) can be used as an additive to flour, with a mix ratio of up to 1:1. The young, white spring shoots may be cut a few centimetres below the ground, steamed to make a pleasant vegetable and eaten. Young stems can be peeled and steamed or used in stews or finely cut for a salad. The flower head whilst still green can be steamed and eaten as a corn cob.

Tubers of the roots can be cooked like potatoes and have a nutty flavour. The roots are high in starch and can be dried and ground into a sweet flour, which compares nutritionally to rice and corn flour. One hectare can yield 7,000 kgs.

The American Indians crush and boil the roots which yield a syrup, a favourite in their diet. Oil can be pressed from the seed and the left over meal is suitable as a stock feed. The flour has been successfully fermented to ethyl alcohol.

As a pulp source, cumbungi can be used for making paper. The paper is strong and difficult to bleach so would only be useful as a packaging paper and for cardboards. The leaves yield a soft fibre which can be used in mats, baskets, chair seats and woven articles. Because they swell when wet, the leaves are reportedly good for caulking cracks in houses, barrels and boat building. Fibre can be extracted chemically to provide 7 - 10 tonne/ha of fibres closely resembling jute.

As a water filter plant, cumbungi absorbs many nutrients and contaminants such as PCPs. It seems to have a high salinity tolerance. Its presence around bodies of water can shade direct sun and slow winds, hence reducing evaporation. It is an important food and shelter plant for wild life and is useful in stabilising banks for soil and water conservation.

Zizania aquatica (wild rice)

Family: POACEAE (GRAMINEAE)

A native to the north western USA and southern Canada, this broad - leaved grass grows on stream banks, marshes and shallow ponds. The plant may grow to 3 m and is best suited to fresh water about 1 m deep. The wild rice seed is high in vitamin B and is easily digested. The green seed requires no cooking and it is sufficient to pour boiling water over it, but the dried seed has to be cooked for an hour. The American Indians ate it boiled with blueberries or maple syrup. A closely related species *Zizania caducifolia (syn. Zizania latifolia)* is cultivated in China, Vietnam and Japan.

UTILITY PLANTS OF MARGINS AND WATER MEADOWS

Mentha spp (mints)

Medicinal and aromatic.

Pennisetum spicatum, syn. Pennisetum typhoides (pearl millet)

Family: POACEAE (GRAMINEAE)

Probably a native of Africa, this annual plant has been cultivated for its seed for over 300 years. Yields of 100 tonnes/ha have been recorded and it requires about 120 days to mature. The seed is said to be immune to weevil attack and can be stored in bins and tanks for up to seven years.

Phalaris arundinacea (reed grass, reed canary grass)

A bulky grass used for animal bedding and fodder. It is a good quail and duck forage plant.

Vaccinium spp (blueberry)

Xanthosoma spp (tania, yautia, cocoyams)

Family: ARACACEAE

These plants can grow in soil too damp for conventional root crops such as potatoes, sweet potatoes and yams. There are about 40 species of these plants which are native to the Americas, but only about 6 are important sources of food. They have a central tuberous root (corm) surrounded by smaller tubers (cormels) which are about the size of potatoes. Corms are used for animal feed and for replanting while cormels are a valued source of human food, used in much the same way as potatoes, with which they compare well nutritionally. The tender leaves and shoots are used as a spinach - like vegetable. Some varieties can yield cormels in as short a time as 3 months. In dry areas they can be grown under irrigation.