CONSERVATORY OF FLOWERS

GOLDEN GATE PARK • SAN FRANCISCO

Aquatics Gallery

Overview

Giant Water Lilies (*Victoria spp.)*

Pitcher Plants *(Nepenthes spp.)*

Taro (*Colocacia spp.)*

Other Notable Plants

Aquatics Gallery: Overview

Aquatics Gallery: Overview

The pools of the Aquatic Plants Gallery simulate the flow of a river winding through the tropics. This gallery features plants from the rivers, lakes, estuaries and bogs of the lowland tropics. Countries represented include Borneo, Brazil, Ecuador, Costa Rica and India, among others.

Rivers in the Rainforest

From the Amazon to the Mekong, the tropics are home to some of the world's largest and most legendary rivers. All of the precipitation that makes rainforests so special also makes for some tremendous watersheds. Countless streams, creeks and tributaries feed into mighty rivers thousands and thousands of miles long.

Rivers in the tropical lowlands fork, meander in incredible twists and turns, and sometimes almost turn back on themselves. Since these rivers are in very flat areas without any significant slope and have a soft clay-like soil, there is not much to predetermine the course and the rivers snake lazily along as they wish, changing direction frequently and leaving large lakes and swamps where water once flowed.

The sheer volume of water keeps things pumping, however. Mind-boggling amounts of water flow through the jungle, flooding vast areas of forest and carving great river cliffs sometimes 100 feet high. The Amazon is the most voluminous river on earth. One fifth of the world's river water flows from its mouth.

Most rainforest rivers, like the Amazon, are a muddy brown. With the vast amount of rain, sediment is constantly running off into waterways – a billion tons of it a year in fact. Torrential downpours can turn a dry creek bed into a raging river in a matter of hours, taking soil, plants, trees and even an occasional hut with it. Black water rivers are common in the tropics as well. Like deep, clear black tea, these rivers get their dark color from the quantity of dissolved vegetation they contain.

The above was excerpted from Treasures of the Conservatory of Flowers by Nina Sazevich.

Aquatics Gallery: Overview

The Amazon River and the Mekong River form two of the world's largest tropical river systems. Each river is fed by an enormous network of smaller tributary rivers.

Aquatics Gallery: Overview

ARCHITECTURE / DESIGN / ARTWORK

- In this gallery the visitor will find a glass and metal Amazon water lily sculpture, a sculpted strangler fig laden with epiphytes, aerial root planters dripping with bromeliads, aroids and orchids.

- The suspended water lily sculpture allows visitors to see the bottom of a giant *Victoria amazonica* plant with its impressive structure. This species of water lily influenced Joseph Paxton's design of the entrance to the Crystal Palace built in London in 1851. The large water lily pad is made of three layers of kiln-formed glass (green, white and magenta) and an elaborate network of cast bronze veins. The flowers are hand-blown glass supported with cast bronze stems. Each petal was individually made, then torch fused to form the flower.

- The bronze aerial root planters were created by local artist Eric Powell and rise out of the pools to support bromeliads, aroids and vining plants. Dave Tuthill crafted the elegant, iron-forged art metal railings with the water lily flower bud motif.

- The upper pool holds 9,000 gallons of water and the lower pool 4,500 gallons. The water is kept at 82 degrees.

- Master stone mason Edwin Hamilton built the stone veneer around the upper and mini pool walls. The veneer is constructed of colorful Mariposa slate

- The water in the upper pond is circulated through a coarse, in-line basket filter, a cartridge filter, biofilter, water heater, and UV filterbefore being returned to the pool. The same process occurs in the lower pond without the cartridge filter.

Aquatics Gallery: Amazon Water Lily

Botanical Name: *Victoria 'Longwood Hybrid'* – a hybrid of *Victoria amazonica* and *Victoria cruziana*, developed at Longwood Gardens.

Common Name(s): Amazon Water Lily

Family: Nymphaeaceae (Water Lilies)

Native Habitat: *Victoria amazonica* grows in the Warm, shallow waters lakes and rivers of Amazon basin, such as Brazil's Pantanal Wetlands. *Victoria cruziana* grows in similar habitats but in Bolivia, Argentina and Paraguay.

Adaptations:

- **The Amazon Water Lily's leaves have several unique adaptations to life along the Amazon river. The massive leaves have features that help them float on the water, maximize sunlight absorption, and avoid being eaten.**
- The leaves have turned-up edges that act as bumpers. As the leaves grow, the leaves can push competing leaves or plants out of the way. This prevents any leaf from being covered maximizes the amount of sunlight each leaf can access.
- A small "v" shaped notch on each leaf's bumper allows water to drain, preventing water from pooling on the leaf's surface.
- Spines under the leaves and along the leaf stalks prevent predation, it is believed that this deters manatees and fish from eating the leaves.
- The enormous leaves are structurally supported by large spongy veins which help keep the leaf buoyant

Amazon Water Lily Life Cycle:

- **The plant has adapted to the seasonal floods of the Amazon river with quick growth and the ability to complete its life cycle over the course of the wet season.**
- **Although Victoria plants in the Amazon can live for years in a continually wet environment, this plant has adapted so that it can grow seasonally in areas that are intermittently wet.**
- The plant's seeds begin to grow as the water levels rise, growing stems and new leaves. The plant flowers at high water, and fruits as the water recedes. The seeds

survive during the low water season because they are equipped with an impervious coat that protects against desiccation.
- At the Conservatory of Flowers, our cultivated *Victoria* are grown from seed each year. Generally the leaves will reach their full size in late summer. New leaves in the fall grow smaller, as the plant begins to shrink and fade away for the winter. Sometimes, our plants will survive through the winter into another growing season – the leaves will grow large again by the following spring!

Flowers:
The large flowers open for a brief 2-3 days, and during this time the flower undergoes dramatic changes to attract the pollinators and ensure seeds are fertilized

Day 1: a white flower opens in the evening. The female parts of the flower (stigma) are receptive to pollen. The flower emits a sweet pineapple scent and begins to produce its own heat, which volatilizes the scent. This attracts the Victoria's pollinator – a scarab beetle – to visit the flower and pollinate it.
Day 2: In the morning, the flower closes slightly, trapping the beetles inside. Over the course of the day, the flower changes : the male pollen producing parts of the flower (anther) open , and the petals turn pink. The pollen covers the trapped beetles. As Day 2 turns to evening, the flower reopens and the beetles, newly covered in pollen, fly off to pollinate another flower.

Sometimes this process is described as the female lily flower "turning into" a male flower. In fact, water lilies are considered perfect flowers, meaning they have both male and female parts. By temporally separating when this flower functions as a female vs. male flower, the water lily ensures it does not self-pollinate.

FAQs

What is the giant water lily and where does it come from?

The model water lilies displayed at the Conservatory of Flowers are recreations of the Amazon water lily, *Victoria amazonica*, which has a vast range in South America, from Bolivia in the south to Guyana in the north.
This year the Conservatory exhibited the hybridized giant water lily, called the Victoria x 'Longwood hybrid', developed by the Longwood Gardens in Pennsylvania. This hybrid is a cross between the *Victoria amazonica,* Amazon water lily, with its lesser known relative the Santa Cruz water lily, *Victoria cruziana*. *Victoria cruziana* is found in wetlands further south in Argentina, Paraguay, and Uruguay.

Aquatics Gallery: Amazon Water Lily

How big does the giant water lily grow?

This plant is known for its massive leaves, which allow it to absorb as much sunlight as possible. As it matures, the individual leaves can grow 4-6 feet in diameter.

How much weight can the leaf support?

Birds can walk on the leaf and feed for fish and other animals from the surface. Our horticulturists describe the leaves of our lilies as “buoyant but fragile” and limited in their ability to support weight. In some places *Victoria*s have been reported to be able to support the weight of a baby or small child, and some photos reflect this. It may depend on the plant!

Why is it called the Victoria water lily?

The name *Victoria* was given in 1837 to honor Queen Victoria of England, who ascend the throne that year. The quickly developing Victorian era and its interest in exotic plants led to the giant water lily entering cultivation. In 1849 a private grower succeeded in the first giant water lily bloom in England and presented the flower to Queen Victoria.

How long has the giant water lily been at the Conservatory?

Giant water lilies are short-lived and at our northern latitudes are usually grown as an annual. Every spring new seeds and seedlings are planted and raised in nursery ponds behind the scenes. Once the plants are large enough, they are transferred to the Aquatic Plants Gallery where they spend the summer. This year the amazon water lilies were growing in the Aquatics gallery from April through November. Newly recovered history now tells us our first bloom of the Amazon Water Lily was one year after opening in August of 1879, making it our first ‘blockbuster’ event!

Tell me about the giant water lily sculpture hanging from the ceiling in the Aquatic Plants Gallery.

This botanically inspired sculpture uses glass and bronze to showcase the intricate details of the giant water lily. The veins and spines on the leaf underside are clearly visible, as are two flowers- one white and one pink. Each petal for the flowers was individually made, then torch-fused to form the complete flower. This sculpture was in place for the Conservatory’s grand re-opening in 2003.

Tell me about the giant water lily sculptures (plastic mold prop)

Aquatics Gallery: Amazon Water Lily

We took a leaf out of the water and made a mold of it, then cast these leaves from the (probably plaster) mold. The leaf model is made of acrylic. We worked with a local artist and fabricator to build this, the same person who built the strangler fig in Aquatics.

INSIDE THE NEW YORK BOTANICAL GARDEN

The Amazon Water Lily: Adapted to the River's Rise and Fall

Posted in Science on July 22 2013, by Scott Mori

Scott A. Mori is the Nathaniel Lord Britton Curator of Botany at the The New York Botanical Garden. His research interests are the ecology, classification, and conservation of tropical rain forest trees.

Ghillean T. Prance showing the underside of a leaf of the Amazon water lily. Photo by S. A. Mori.

The waters of the Amazon fluctuate as much as 45 feet in years of heavy rainfall, meaning plants growing along the river are alternately subject to flooding in the wet season and dry soils in the dry season. To tolerate these extreme habitats, some Amazonian plants have evolved adaptations to both situations. A perfect example is the Amazon water lily (*Victoria amazonica*), which has adjusted its annual life cycle to the rise and fall of the rivers by growing rhizomes and new leaves from seeds, flowering at high water, fruiting as the water recedes, and surviving low water levels as seeds—each one surrounded by an impervious seed coat that protects against desiccation.

However, despite all of its miraculous adaptations, my focus falls on the fascinating interactions this amazing plant has with the beetles that pollinate its flowers, as well as the water that disperses its seeds. This incredible life cycle is only one of countless plant/animal interactions that occur in all habitats of the world—and these interactions contribute disproportionately to the high diversity of plants and animals in the tropics.

In order to protect the leaves needed to produce the photosynthate required to form flowers and seeds, the Amazon water lily has sharp prickles growing along the veins which run along the underside of the large, round leaves. These leaves are also characterized by their upturned edges. Although the prickles do not deter insect predation, they dissuade mammals such as manatees from munching on the leaves, a destructive activity that limits the plant's ability to manufacture flowers and seeds.

Although it has long been known that beetles frequent the flowers of the Amazon water lily, the details of this interaction were not studied until 1976 by Ghillean T. Prance (former Vice-President of Science at NYBG). He and his colleagues discovered that the white flowers emit a pleasant aroma at dusk which, combined with their white color, attract large scarab beetles. The principal beetle pollinator turned out to be a new species to science subsequently named *Cyclocephala hardyi*.

Aquatics Gallery: Amazon Water Lily (*Victoria Amazonica*)

Leaves showing the upturned margins and a first day flower. Photo by S. A. Mori.

Prance's team noted that the temperature within the flowers was about 15 degrees Fahrenheit higher than ambient temperatures and that the higher temperature volatilized the aromas that attracted the beetles. Later in the evening, the flowers closed and trapped the beetles inside through the night and most of the next day. By the next morning, the anthers had opened and the beetles became dusted with pollen while feeding on the fleshy staminodes. By the evening of the second day, the flowers had turned red, no longer produced aroma, and opened for the second time. This allowed the beetles to escape and fly off to another first day, white-flowered plant, where the pollen on their bodies rubbed off onto the stigmas.

Aquatics Gallery: Amazon Water Lily

The movement of pollen from one flower to another is called **pollination**. Prance's team also observed that the stigma was receptive to pollen only in the first evening's flowers. The pollen germinates on the stigma and produces a pollen tube that carries the sperm to the egg, where fertilization occurs. This process results in the formation of an embryo and the development of seeds. When the stigma is receptive at a different time than when pollen is released, it is called **protogyny**, which ensures **cross-pollination**. This process enhances genetic diversity, and ensures that plants have the genetic variation necessary for them to adapt to changes in their environment.

Although the beetles are originally attracted to the flowers by color and aroma, they are rewarded for their efforts by food in the form of succulent staminodes, a warm and safe place for them to spend the night, and a chamber in which they can mate; thus, both the plant and the beetles benefit by this mutualistic relationship.

After pollination, the flowers are pulled under water by their contracting stalks and remain submerged until the seeds are mature. After the seeds are ripe, the remaining part of the flower disintegrates and the seeds float to the surface, aided by the buoyant air sac that surrounds each one. The seeds are carried away by the receding waters of the Amazon, and, as the waters continue to fall, they become lodged in the mud where they pass the rigors of the dry season. During the following rainy season, the seeds germinate and grow into the next season's plants, thus initiating the annual life cycle of the Amazon water lily—a process that takes place in harmony with the rise and fall of the Amazonian Rive

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*

Common Name: “Pitfall” Pitcher Plant
Botanical Name: *Nepenthes spp.*

*(V*arious species in the genus *Nepenthes*.)

Family: Nepenthaceae (Old world pitcher plants)

Native Habitat: Most grow in humid areas with high precipitation. Found in lowland, highland and even alpine areas. There are some whose range is limited to a single mountainside.

Country of Origin: The greatest biodiversity is in Borneo and Sumatra, but also found in the area of Indonesia, Australia, Madagascar, Seychelles, Thailand, India, Malaysia, and Vietnam.

About this Plant

- ***Nepenthes* pitcher plants are carnivorous plants that passively lure and trap prey, generally small insects. The pitcher-shaped leaf has digestive fluid inside.**
- **Carnivores like the pitcher plant often grow in nutrient-poor soils. The plant has adapted to acquire nutrients by capturing insects and other organic material in its pitcher.**
- **The pitcher plant is also a habitat: many organisms have evolved to live inside the Nepenthes pitcher, or to visit it in search of food. Most help the pitcher by facilitating prey breakdown[1] while some are “nutrient thieves” that take insects the pitcher captured.**
- Fly larvae are the most common residents, but pitchers have also been found to contain crabs, spiders, frogs and many microorganisms. A study of *Nepenthes ampullaria* found 59 different species surviving in its pitchers. [2]
- With over 150 known species *Nepenthes* in existence, there is a great diversity of luring and trapping strategies that have evolved among them. The adaptations described below are found in some, but not necessarily all, *Nepenthes* species.

[1] https://royalsocietypublishing.org/doi/10.1098/rsbl.2017.0716
[2] https://academic.oup.com/aob/article/107/2/181/188441

Luring Strategies

- **Pitcher plants lure their prey with a range of strategies that are similar to the ways that flowers attract their pollinators, including flowery scents, nectar, or distinct coloration.**
- Some pitchers have pigments that appear fluorescent to insects that can see ultraviolet light. This is similar to nectar guides on flowers that draw in pollinators. [3]
- Potential prey is enticed to land on the edge of the pitcher by nectar, which is concentrated on the edge of the trap and on the inside of the cap**.**

Trapping Strategies

- **The ridges on the edge of the pitcher opening are waxy and become extremely slippery when wet. Prey that crawls along the edge will lose its grip and slide down into the interior of the pitcher. [4][5]**
- Some *Nepenthes* species have a rough wax crystal layer on the inner pitcher wall. Scientists have described the microscopic structures on this layer to be "too rough for [an insect's] adhesive pads but not rough enough for claws." [6] This prevents the insect from being able to climb up the pitcher walls.

Prey Digestion

- **At the bottom of the Nepenthes pitcher, there is an acidic liquid of enzymes that allows the plant to break down its prey to absorb the nutrients. [7]**
- The "lid" above the pitcher is thought to prevent rain from entering the pitcher and diluting the digestive liquid. It does not move or actively trap prey, a common misconception about pitcher plants.
- The digestive liquid of *Nepenthes rufflesiana* was discovered to have viscoelastic properties (think "viscous" and "elastic") that helped prevent the escape of trapped insects.
- While *Nepenthes* are generally insect eaters, there are some documented cases in which the plant trapped and digested a small mammal like a mouse or rat, usually in captive environments. Generally a *Nepenthes* will digest anything that is small

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[3] https://doi.org/10.1111/j.1438-8677.2012.00709.x

[4] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0038951, https://www.pnas.org/content/101/39/14138

[5] https://www.pnas.org/content/101/39/14138

[6] https://jeb.biologists.org/content/213/7/1115

[7] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4765550/

enough to fit into its pitcher, and some may occasionally trap leaf litter or animal feces as an additional source of nutrients.

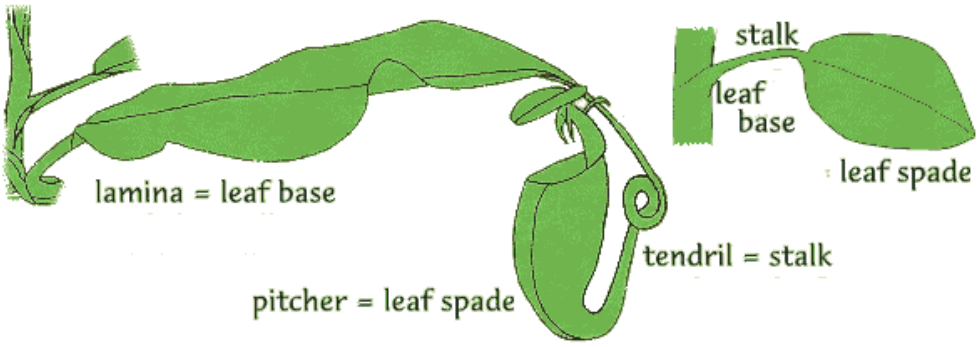
- **Other Facts: *Nepenthes* usually grow as lianas, vining plants with tendrils that help them to climb and wrap around things as they grow.**
- **At the Conservatory, our Nepenthes regularly trap cockroaches, ants, and gnats. We occasionally use a very dilute fertilizer to augment their "diet".**
- *Nepenthes* often display leaf dimorphism: there are two types of differently sized and shaped pitchers on each plant. The larger pitchers near the base of the plant are closer to the ground, and or specialize in trapping crawling insects. Smaller pitchers on the upper part of the plant specialize in trapping flying insects.
- *Nepenthes* produce smelly flowers that are pollinated by flies. This creates a "pollinator-prey conflict" in which the plant would be negatively impacted it if it trapped and killed its pollinator. Many carnivorous plants have adapted strategies to avoid eating their pollinator, such as having flowers grow far away from traps, or producing different scents or colors at traps versus flowers. [8]

Nepenthes Leaves:

In *Nepenthes* these characteristics are shaped very different from a "regular" leaf. The section that looks like a leaf is in fact the leaf base, which has broadened to increase its surface for capturing light. The tendril, the part that assists the plant in holding on to other structures as it grows, is the leaf stalk. The pitcher itself is the leaf spade and has specialized cells that release enzymes to digest and absorb nutrients.

[8] https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-185X.2011.00213.x

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*



Source: http://www.merbach.net/nepenthes/english/plant.html

Nepenthes Conservation:

- There are hundreds of species of *Nepenthes* of varying conservation status, including some species that are threatened and endangered. Some species have very small ranges, making them especially susceptible to impact.

- Borneo is one of the regions that has the greatest diversity of *Nepenthes*, and is generally renowned for its biodiversity. Borneo is a large tropical island that is part of both Malaysia and Indonesia. Deforestation of this region has accelerated in recent years, largely driven by palm oil production and logging. The island of Borneo was ~75% forested in the early 1970s and today is estimated to be 52.8% forested.[9]

- In the last few years the rate of deforestation has been trending slightly downward, and there is hope that increased efforts by Indonesia and Malaysia to curb deforestation. International news coverage, consumer pressure, and adoption of sustainability standards for Palm Oil production have all showed promise in reducing deforestation in Borneo, but significant deforestation continues to this day. [10]

[9] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0101654
[10] https://forestsnews.cifor.org/59378/has-borneos-deforestation-slowed-down?fnl=en

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*

Article:
Pitcher Plant Captures Prey in Batches
A design flaw in the carnivorous plant could be its greatest asset
By Rachel Kaufman, Inside Science News Service on January 26, 2015

Carnivorous plants hold a place of special fascination in elementary science classrooms and botany labs alike. Many of these plants have an obviously predatory look about them (think: Venus flytrap). But pitcher plants, as successful as they are at capturing insects for their nutrients, don't make a lot of sense at first glance. A new study aims to make sense of the fact that the plants' traps aren't always slippery along the edges, even though a slippery edge would, in theory, catch more insects not sure of their footing.

A pitcher plant's trap contains a deep cavity filled with liquid, which has a slippery coating along the insides. Along its rim is a bug lure: bright colors or sweet nectar. But the rim itself is only slippery when wet.

In the case of *Nepenthes rafflesiana*, a pitcher plant native to Borneo, "wet" means after a rainstorm or at night, when humidity increases. During a dry day, *N. rafflesiana* might not catch a single insect.

But, says a new study, published this month in *Proceedings of the Royal Society B*, that design quirk may be intentional.

Lead author Ulrike Bauer, a botanist at the University of Bristol in the United Kingdom explained that about two thirds of *N. rafflesiana's* diet is ants, and with ants, the longer you wait, the more you get.

"It's a self-reinforcing mechanism," she said. "You have one scout going back to the colony, bringing a nectar sample back. Then you get maybe four or five ants following that scout. They all leave chemical trails."

It's only a matter of time before 20 or more ants are all traipsing back to the pitcher plant. In the late afternoon, the rim becomes slippery, and they march to their doom.

Bauer and her colleagues studied this model in *N. rafflesiana* in the field, by hooking plants up to IV drips that kept their rims constantly moist, and counting the number and types of insect the plants caught versus control plants. The moist traps caught more individual insects but fewer "batches" of ants. Bauer hypothesizes that the batch capture strategy, while less reliable, is more favorable to pitcher plants once they reach a certain number of traps—some *Nepenthes* plants can have hundreds of pitchers.

However, pitcher plant species across the world have a similar slippery-when-wet rim, including in Australian or American pitcher plants, which "are as unrelated [to Asian pitcher plants] as you and I are to a flatworm or marine sponge," Bauer said. Yet even these unrelated plants have wettable surfaces. "This mechanism may be a far more general adaptation than we initially thought."

Other scientists are waiting for more data. "I love the idea of IV drips leading to pitchers—this is a scene right out of the 1951 movie, 'The Thing from Another World,'" said Barry Rice, a botanist and astronomer at Sierra College in Rocklin, California, in an email to *Inside Science*. But, he said, the paper shows that pitcher plants can capture ants in bulk, not necessarily that the plants have evolved to encourage bulk capture. To prove that to his satisfaction, Rice said, he would have to see a plant with features that encourage drying or increase nectar production during dry times. That would imply that the pitcher plant is actively increasing the time the trap is inactive to attract more scout ants, rather than simply, passively, waiting out the dry periods in the day.

Either way, don't feel too badly for the ants tricked into leading their sisters to certain doom. Bauer said, with the usual caveats about further research being required, that the ants and pitcher plants may be in much more of a mutualistic relationship, "an exchange rather than exploitation," she said. Losing even 20 or 100 ants doesn't mean much for a colony. "Especially if the trap is such a good sugar resource [that helps] the colony grow faster."

Pitcher plants produce pitchers, and therefore nectar, year-round, and live many years. That's "crucial" for an ant colony in need of carbohydrates. The ants as a group may in fact benefit overall from this arrangement.

N. rafflesiana isn't endangered, but a number of pitcher plants are lost due to poaching, climate change and habitat loss.[11]

[11] The original study upon which the article was based : https://doi.org/10.1098/rspb.2014.2675

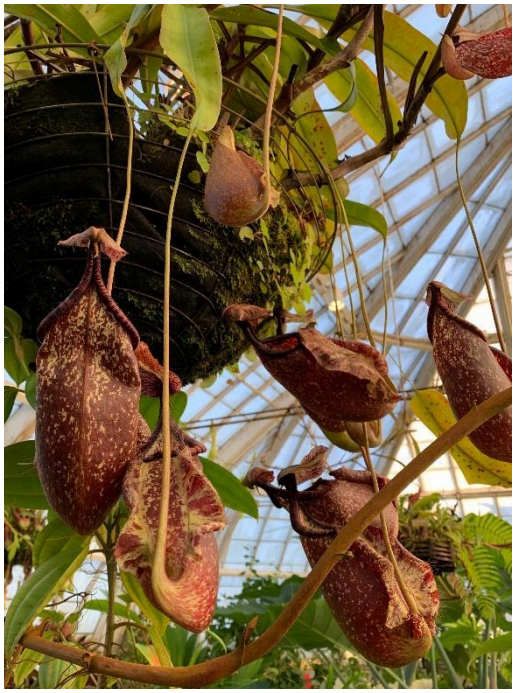
Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*

There is no need to be able to identify the different pitcher plants we display by their species name, but here are a few identified species found in the aquatics gallery.

Nepenthes raflesiana **('Rafle's Pitcher Plant')**

Upper pitchers **Lower pitchers**

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*



Nepenthes raflesiana is on display beside the bridge in the Aquatics gallery. This common species was referenced above in studies of the slippery-when-wet rim, and the composition of the digestive liquid inside the pitchers.

Nepenthes truncata

Nepenthes truncate is the largest species of pitcher plant on display in the Aquatics Gallery, with forearm-sized pitchers.

It is an endangered species native to the Philippines.

The pitchers of *N. truncata* are so large that they have been occasionally documented to catch a rodent. Indeed, even here at the Conservatory the horticulture team once found a rodents skull in one of the pitchers! This species certainly doesn't specialize in eating rodents, but it can.

Nepenthes bicalcarta ('Fanged Pitcher Plant')

The fanged pitcher plant is on display above the lower pool, near the emergency exit to the aquatics gallery.

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*

This is the species is distinct because of the two “fangs” on the upper lid. It is the only

Nepenthes species that is known to be an ant plant! The fanged pitcher plant is the exclusive home of a species of ant: *Camponotus schmitzi*, commonly called the “pitcher plant ant”.

The ants live on the plant and raise their young in hollow pitcher tendrils. The ants can walk across the slippery rim without sliding into the trap, and safely eat the nectar produced by the pitcher. The ants’ waste products provide nutrients to their pitcher host.[12] A recent study found that the ants also help the plant by eating its “nutrient thieves” - fly larvae that live inside the plant’s pitcher and consume some of the pitcher’s prey.[13]

The Conservatory’s fanged pitchers do not have these symbiotic ants present; they do not need them to survive.

Ants inside a tendril of the Fanged Pitcher Plant

[12] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0063556
[13] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0063556

Aquatics Gallery: Pitcher Plants (*Nepenthes spp.)*

Common Name(s): Taro, Poi (when cooked)

Botanical Name: *Colocasia spp.*

Family: Araceae

Country of Origin: Native to Southeast Asia and India, but is now grown throughout the pacific.

Native Habitat: moist or shady areas; often grows in the water.

General Plant Description & Characteristics: A perennial herb with clusters of long heart or arrowhead shaped leaves that point earthward. Inflorescence is an open yellow-white calla lily like tube enclosing a spike covered by flowers.

Taro in Agricuture:

- **Taro is an important food for many people in the tropics, and has been cultivated for over 6,000 years.**
- **The root and corm (underground stem) are the parts usually eaten. The plant is poisonous raw, but cooking destroys the poison. If eaten raw, the poison causes mouth numbness and sometimes airway obstruction.** [14]
- The tubers are eaten baked, boiled or steamed, or cooked and mashed with water. The resulting food is often called poi. High gluten content in the tuber is important to make quality poi. Poi is

[14] https://pubs.ciphi.ca/doi/full/10.5864/d2014-027?src=recsys&

eaten fresh or allowed to ferment for a few days, often for longer, creating a sour taste considered pleasant.
- Taro is also extremely common in Chinese cuisine.
- The species is thought to be a native of India and perhaps other parts of southern Asia. From there its cultivation has extended as an agricultural crop. It reached Egypt about 2,000 years ago and spread into the Pacific area.
- In Hawaii that the cultivation of taro, called kalo, reached its most sophisticated level. Pre- European exploration and colonization, about 300 varieties of taro were grown on the islands.
- Hawaiians cultivated taro mixed with other species, such as banana, papaya, coconut, green peas, which ensured the maintenance of the health of taro species.
- The 20th century brought the monoculture technique, the cultivation of just a few varieties of taro. in the 21st century there are only seven to 12 varieties of Taro that are regularly grown. The lack of genetic diversity among monoculture crops makes them more susceptible to disease.

Hydrophobic Leaves

- **Taro's leaves repel water so readily they are described as "superhydrophobic." Water easily beads and slides off the leaf.**
- **The leaves' ability to shed water helps prevent growth of fungus, bacteria, and other pathogens that thrive in wet, warm conditions. This keeps the leaf and plant healthy.**
- As the water rolls of the leaf, it cleans it along the way – some have described the leaf surface as "self-cleaning"
- The leaf is covered in microscopic waxy crystals that help the leaf shed water and give it a rough texture. [15]
- The "bio-wax" on Taro has been extracted by scientists and studied for potential applications in creating water-repellent materials.
- One recent study tested using Colocasia bio-wax to coat paper bags. They found these bags weren't just waterproof, but the wax had antibacterial properties. They were biodegradable and could be a sustainable alternative to plastic bags. [16]

[15] https://pubs.acs.org/doi/full/10.1021/la2010024?src=recsys
[16] https://ijpbs.com/ijpbsadmin/upload/ijpbs_5b29a72987027.pdf

Other facts:

- The stems of the taro have hollow tubes that bring air down to the plant's underwater roots, allowing them to grow in water.

 [17]

Taro leaf with water beaded on the top.

<u>Taro Root & Corm</u>

[17] Photo Credit: CC-by-SA 4.0. Wikimedia Commons Author: SureshMukhiya. https://commons.wikimedia.org/wiki/File:The_DROPLET.jpg

Aquatics Gallery: Taro

 [18]

The corm is the rounded section, which may have small roots coming off of it.

[18] Photo Credit: CC-by-SA 2.0. Wikimedia Commons User: Tim Evanson.

Aquatics Gallery: Other Notable Plants

Taro Flower

The taro flower is an inflorescence, or group of tiny flowers on the spadix (small white spike.) They are surrounded by a large bract (orange in this photo) also called the spathe . This is a similar flower structure to Cala Lilies and Anthuriums, other members of the Araceae family (also known as Arums.)[19]

Imperial Bromeliad

Alcantarea imperialis

er: Cleombrotus.
nt_Ear_Flower_One.jpg

Aquatics Gallery: Other Notable Plants

This giant terrestrial bromeliad can be found growing on inselbergs (isolated rock outcrops) in southeastern Brazil. This species plays an important ecological role as it stores rainwater in the pockets created by its leaves, offering a home to frogs, insects, and even other small aquatic plants. *Alcantarea imperialis* is becoming increasingly threatened in the wild due to habitat loss, which in turn affects the creatures that are dependent on the plant.[20]

Dancing Lady Orchid
Oncidium spp.

Native to Central and South America. Some species of *Oncidium* have long bouncing stems with abundant flowers that flutter in the breeze and look like male bees. Pollination occurs when actual angry male bees attack the flowers thinking they are a competitor. The common name, dancing lady orchid, refers to the elaborate lip that looks like a dress with a full skirt. The petals and sepals look like the arms and head of a tiny lady.

[20] https://pdfs.semanticscholar.org/c100/e98950a9b989c78b5400e208ee78fb80ccdf.pdf

Begonias

Family: Begoniaceae

Genus: Begonia

Number of species: 1500+ documented

Etymology: Charles Plumier illustrated six new plant species and, in 1700, published them in a friend's book as *Begonia.* Plumier chose the name to honor Michel Begon who recommended him to King Louis XIV of France for the position of plant collector in the French Caribbean.

Range: Tropical & Subtropical regions on all continents except Australia and Antarctica. The greatest number of species occur in humid, montane forests of South America and mainland Asia.

Habitat type: Wide variety of ecological niches from mist-splashed sides of waterfalls to the moss-covered branches of trees

Aquatics Gallery: Other Notable Plants

Growth habit: Begonias exhibit quite a range of growth habits. Some are large and shrubby with a spread of more than 9 feet. Others lack aerial stems and arise directly from an underground stem or rhizome.

The story of variable foliage.

Begonias are most definitely known for t people w ll you they nd e things are mewhat m . Some ex eaves su d peltate (ch es.

T a species t d fe *luxurians* he P angement ite va ecies and nnate, o e leaves a ety of h pecies tak oscopic, st hairs can even be useful in distinguishing between closely related genera!

Aquatics Gallery: Sources Cited