Marker 1: Trail introduction

Hello and a very warm welcome to Kew Gardens and *Pollinators of the Palm House* audio tour. My name is Andre and along with Shiquerra we will lead you through this magnificent glasshouse looking at stories of plants, their pollination, and pollinators.

Before we get started, let us take a moment to look at this glasshouse. The Palm House was designed by Decimus Burton. Built between 1844 and 1848, it is designed to hold plants from the tropics – the hot and humid regions of the Earth near to the equator. So get ready, as it is very warm in here, and you may wish to remove outdoor clothing before going inside.

This audio tour focuses on pollination; the vital process through which fertilisation occurs in plants, leading to the production of seeds, and the continuation of plant life. Pollen is produced at the stamen, the male reproductive organs of a flower. Pollination is the transfer of this pollen to the female organ of the flower, the stigma.

So how do the male pollen grains reach their destination? Some travel by wind, water, or gravity but many plants rely on insects, birds, mammals and reptiles to transport their pollen. Some of these creatures are lured by the sweet nectar that plants produce, and whilst feeding they become covered in pollen, which they transfer to the next plant they visit. Some insects (such as bees) also use the pollen as food.

Here in the Palm House, you will discover wonderful stories of the pollinators – the mammals, reptiles, insects and birds from the tropical regions of the globe – that are so important for the life cycle of plants.

Let us go in. Once through the door turn right and follow the path, taking the immediate left at the ‘Africa’ sign. On your left there are plants in large wooden boxes. You will find marker 2 in the third wooden box.
Marker 2: *Encephalartos altensteinii* or giant cycad

Hello. You are at marker 2 of Kew Gardens’ *Pollinators of the Palm House* audio tour.

The plant in the pot in front of you is not a palm but the giant cycad that arrived at Kew from the South African Cape in 1775. Its botanical name is *Encephalartos altensteinii*, named after a 19th-century German chancellor, Baron von Stein zum Altenstein. This cycad weighs more than a tonne and measures over four metres in height.

Cycads are dioecious, which means only male cones or only female cones are produced on any one plant. The male plant raises the temperature of its central cone when the pollen is ready, and this warmth attracts the attention of weevils. Why weevils are drawn to the cones is still unclear to science and an area for future research; one theory is that the weevils may use the warmth of the cones as sites to raise their own young.

The weevils land on the cone where they become covered in pollen grains, then they fly to the next cycad. If the plant is female, pollination takes place. Bright red, fleshy fruits containing large heavy seeds then form and it is thought that prehistoric dinosaurs ate this fruit and dispersed the precious seed in their manure. Nowadays the outer coat (which is poisonous to humans) is eaten by birds and mammals in the wild, but the seed is too heavy for these animals to carry them away, so the seeds fall onto the ground beneath the female cycads.

The plant in front of you is a male and throughout its long life has only ever produced a single cone; that was in 1819, over 200 years ago. However, the plant does produce suckers or ‘pups’ around the base of the trunk – a form of asexual propagation. These pups can be removed from the parent plant and grown independently. For the
species to survive, they need the genetic variation that is created through the sexual reproduction of pollination.

To continue our tour, turn around with your back towards the giant cycad and you will see marker number 3.

**Marker 3: *Ravenala madagascariensis* or the traveller’s palm**

You are now at marker 3 of Kew Gardens’ *Pollinators of the Palm House* audio tour.

This plant is *Ravenala madagascariensis* and it takes its name from the island of Madagascar off the African east coast. It is also known as the traveller’s palm. This is because the leaf stems hold water that thirsty travellers can access by cutting into the base of the stems. As well as providing the travellers’ water, it also can provide a crude compass, as in the wild these plants tend to grow on an east–west line.

The *Ravenala madagascariensis* produces large white and green flowers, each with a deep chamber. These flowers are only fertile for 24 hours and during this time these large chambers are filled to the brim with nectar. The smell attracts ruffed lemurs, beautiful animals found only in Madagascar. The lemurs open the tough, protective outer layer of the plant and push their long muzzles deep into the flower to drink the nectar. Whilst drinking, their fur picks up the pollen, which they take to the next plant with them. Once a plant has been pollinated it produces a fruit that is particularly striking, as the black seed is covered in a bright blue skin. Once the fruit ripens the lemurs return – setting about the serious job of eating the fruit and then dispersing the seeds through their droppings across the forest floor.
Let me guide you to the next marker and a tree whose fruit you may know. Go down the right-hand path and marker 4 of the pollinator trail will be a little way along, on your left.

**Marker 4: *Tamarindus indica* or tamarind tree**

You are now at marker 4 of Kew Gardens’ *Pollinators of the Palm House* audio tour.

This is the *Tamarindus indica* or tamarind tree. This tree is native to tropical Africa and belongs to the Fabaceae or pea family. The flowers of the tamarind tree hang in clusters and produce nectar, and although wasps, ants, butterflies and flies all feed on the nectar, it is the bees that do the most of the pollinating.

Good seeds are needed to grow strong plants. One way to achieve this is when the pollen from one plant is taken to the stigma of a flower on an entirely different plant. This is called cross-pollination. The flowers of the tamarind tree have both male and female parts in one flower. To ensure tamarind trees cross-pollinate, the male and female parts of the flower become fertile at separate times – first the female then the male parts of the flower.

Once pollinated, the tree produces edible pods that are used in cooking worldwide. As well as being delicious in many curries, tamarind is also the key ingredient in Worcestershire sauce.

To find marker 5, continue along this path. At the junction go straight over and you will see the spiral stairs on your left. Keep walking straight over the crossroads, and on your right, you will see marker 5.
Marker 5: *Musa acuminata* 'Gros Michel' or banana

Hello, you are at marker 5 of Kew Gardens' *Pollinators of the Palm House* audio tour. This whole bed is full of banana trees.

This one with the marker is called *Musa acuminata* 'Gros Michel'. All banana trees are not actually trees, as it does not have a woody stem or trunk. It is actually the largest herb in the world!

Wild bananas are pollinated by bats, birds and sometimes bees. They produce a single drooping flower stem with male flowers at the bottom of the stem and female flowers closer to the plant. The flowers open at night and have a strong perfume that encourages bats to visit and feed on the nectar. Cross-pollination occurs as the bats visit several flowers on the same plant. The resulting fruits are not edible for humans as they have large, hard seeds. These fruits are eaten by bats and the seeds are dispersed in the bat's droppings.

Today we consume 100 billion bananas a year from plants that have developed fruit without fertilisation, which is called parthenocarpy. These seedless hybrids are cultivated by removing and replanting the side shoots from the banana tree. The fruits develop from these stems in large clusters known as 'hands' with up to 20 fruit each. These are the bananas that you would be familiar with.

Let us move on and find marker 6. Continue straight down the path, crossing over at the junction, and the next marker is on your left.
Marker 6: *Mangifera indica* or mango and *Macadamia integrifolia* or macadamia

Hello, you are at marker 6 of Kew Gardens' *Pollinators of the Palm* House audio tour. Here we have two plants that, following pollination, produce tasty foods.

The first is on your left, *Mangifera indica* or mango tree. It produces small, simple flowers that are pollinated by many different insects, such as wasps, flies, stingless bees and even ants. Scientists have also found that if you prevent insects from reaching the flowers, the tree still manages to pollinate itself and make fruit, using wind or gravity to move the pollen from the male stamen to the female stigma. A large and healthy mango tree can produce up to 1,000 fruits a year!

From a juicy fruit to a tasty nut. On the right is a macadamia tree – *Macadamia integrifolia*. The drooping flowers are mostly pink and resemble a long, thick bottle brush. They are pollinated by the wind, insects, birds and sometimes possums in their native Australia. Researchers have found that if pollinators bring pollen from a variety of different trees, then the nuts are of a better quality and size.

To find our next plant, continue down this path, turning left at the end, and then on the left you will find marker 7.
Marker 7: Areca catechu or betel nut palm

Hello, you are at marker 7 of Kew Gardens’ Pollinators of the Palm House audio tour.

This is Areca catechu, the betel nut palm. Native to the Philippines, these trees are now widespread, especially in tropical East Asia.

The seeds, known as nuts, are often chewed by humans for their stimulating effect. When sold in markets, the nut is wrapped in betel leaf and spices, such as cardamom and cinnamon; these are added to reduce the bitter taste. The packet is then chewed, and the juices spat out.

Betel is chewed by between 200 and 400 million people worldwide despite its potentially harmful impacts, primarily mouth cancer. The use of betel nut is prohibited in the UK.

This palm species is monoecious, having flowers that are either male or female, and flowers of both sexes can be found on the same plant. Bees and other insects visit the sweet-scented male flowers, but not the female ones, so it is thought that this palm is pollinated by the wind. To make sure that there is a reliable chance of cross-pollination and genetic variation, the male flowers open first, and the female flowers later. The betel nut matures after six to eight months following the pollination of the female flowers.

To find marker 8, continue round to your left and walk the length of the Palm House. Keep on this path, and go through the central zone, where the roof reaches 20 metres and houses the tallest plants in the Palm House living collection. You will pass the spiral stairs on your left. Keep going a little further and here you will find, on your left, marker 8. It is just in front of the second spiral staircase.
Marker 8:

8a: *Vanilla* × *tahitensis* or the vanilla orchid and *Phytelephas macrocarpa* or the ivory palm

Hello, you are at marker 8a of Kew Gardens’ *Pollinators of the Palm House* audio tour.

Here we have two interesting pollination stories. Firstly, you can see the vine *Vanilla* × *tahitensis* or the vanilla orchid climbing upwards. This plant is threatened in the wild and is the only orchid to produce an edible seed. Vanilla, which is used to flavour ice cream, cakes and other sweet treats, comes from the seed pods of this plant. The vanilla orchid grows in tropical forests in Central America and was used as long ago as the 1400s by the Aztec peoples as a flavouring mixed with the products of the cacao tree – a plant we will be meeting in a moment!

Scientists are still uncertain which species pollinate vanilla orchids in the wild. A recent paper suggests that it is likely to be an orchid bee that only occurs in Central and South America. Most of the vanilla used today is grown in other parts of the world, such as Madagascar and Réunion Island, and must be hand-pollinated by farmers, as orchid bees are absent in these parts of the world. The method still used today was originally devised by a young enslaved boy called Edmond Albius in 1841, and his story can be heard at marker 8b.

The orchid flowers appear between autumn and spring and are a creamy white colour. There are 10 to 20 small flowers on a stem, but only one opens each day for approximately eight hours. To hand-pollinate these flowers, farmers use a small grass stem, toothpick or thin metal rod to lift a small flap in the flower, called the rostellum, so that the overhanging pollen balls can be pressed against the stigma. Green pods then form, taking five or six weeks
to develop and at least a year to mature. The pods are picked and go through a fermenting and drying process to obtain the perfumed, black, leathery pod we use in our cooking or the essence that is extracted from them.

Our next plant is behind the vanilla orchid. Stay where you are and look over in the corner. This plant is a true palm from the Ecuadorian rainforest, known as the ivory palm, because its nuts have a similar texture to elephant tusks. Its botanical name is *Phytelephas macrocarpa*, and the species is dioecious, meaning that a female plant and a male plant are needed for pollination and seed production. Both the male and female palms produce flowers with a very pungent smell that attracts the beetles that pollinate the plants. Once pollinated, the tree produces hard large seeds or nuts that are still used as an ivory substitute for making jewellery, buttons and ornaments.

In the Palm House we only have this one specimen, which was grown from seed in 1992 and has never flowered. Please stay here to listen to the fascinating story of Edmond Albius at marker 8b.

**8b: Edmond Albius**

Hello, you are at marker 8b of Kew Gardens’ *Pollinators of the Palm House* audio tour.

Please be aware that this part of the audio tour contains references to slavery. This is the story of Edmond, later Edmond Albius, who discovered how to hand-pollinate vanilla. In 1829 Edmond was born into slavery in Sainte-Suzanne, Réunion, an island near Madagascar. His mother died in childbirth, and he never met his father, who passed away when Edmond was 19. As a boy, Edmond was sent by his enslaver to work with her brother Ferréol Bellier-Beaumont on the Belle-vue plantation. Here Bellier-Beaumont taught Edmond horticulture and botany.
The Belle-vue plantation had one solitary 20-year-old vine of vanilla which had never produced any pods. In 1841 Bellier-Beaumont discovered two pods on the vine. To his astonishment, Edmond claimed that he had been able to fertilise the flower by hand. Initially, Bellier-Beaumont did not believe that this 12-year-old enslaved boy had achieved something that so many had failed to do before him. A few days later Bellier-Beaumont noticed more pods developing and requested that Edmond show him his specific technique for hand pollination. Edmond had invented a method to quickly pollinate the vanilla orchid using a thin stick or blade of grass and his thumb, using the stick or grass blade to lift the rostellum, the flap that separates the male stamen from the female stigma, and then, using his thumb, smearing the sticky pollen from the stamen over the stigma. In French, this process is called *le geste d'Edmond*, which translated into English is ‘Edmond’s gesture’.

In a letter Bellier-Beaumont wrote to the Justice of Peace in Sainte-Suzanne he remarked: ‘In this plant [watermelon], the male and female flowers occur on different plants, and I taught the little black boy, Edmond, how to marry the male and female parts together... This clever boy had realized that the vanilla flower also had male and female elements and worked out for himself how to join them together.’

Landowners and planters came to Belle-vue to see this new technique and Edmond was transported around Réunion to provide demonstrations to enslaved people on other plantations. After this discovery, vanilla production on the island boomed. In 1858, Réunion was able to transport two tonnes of vanilla beans back to France; by 1867 this had increased to 20 tonnes and by 1898, 200 tonnes. By the late 19th century, Réunion was outstripping Mexico as the world’s largest producer. Many tried to discredit Edmond, but Bellier-Beaumont saw to it that his achievement was recognised and remembered.
In 1848 slavery was again abolished by France (having first been abolished in 1794) and the 19-year-old Edmond was freed and given the surname Albius. With many freed men looking for work, Edmond Albius struggled to find anything. He finally got a job as a kitchen boy but the house where he had worked was robbed and a white woman was injured. Edmond was blamed and sentenced to five years imprisonment with hard labour. Bellier-Beaumont appealed and with support from the local Justice of the Peace, Edmond was released early. He returned as a free man to Belle-vue where he lived until his death aged 51.

Head onwards to marker 9. Take the first right and stand at the corner of the bed. In front of you is marker 9, with a plant we can thank for chocolate!

**Marker 9: *Theobroma cacao* or the cocoa tree**

Hello, you are at marker 9 of Kew Gardens’ *Pollinators of the Palm House* audio tour.

Here we have the *Theobroma cacao*. The genus name for this plant is *Theobroma*, which translates as ‘food of the gods’. This tree is native to the tropical regions of Central America and its seeds are the cacao beans that are used to make chocolate! The use of cacao dates back over 2,000 years to the time of the Aztec and Mayan peoples of Central and South America.

So how is this plant pollinated? The flowers and fruits of this tree grow directly from the woody branches and trunk. Until the 1950s its method of pollination was a mystery – enter the chocolate midge! These tiny insects, the size of a pinhead, live in the leaf litter under the trees, where the moist soil provides the perfect conditions for their larvae to develop. At dawn, the midges crawl up the stalk to feed on the pollen and pollinate the plant. It is thought that this is why the flowers grow in clusters directly out of the trunk.
and large branches (a phenomenon called cauliflory) – the cacao tree has co-evolved with this tiny helpful midge. The resulting fruits are large pods, first green, changing to yellow and then orange when ripe. Inside each pod there are on average 60 cacao beans.

Every year around three million tons of cacao beans are produced to make chocolate products.

To find marker 10 at the end of our tour, turn right and walk to the end of the bed. In the corner by the door is our last plant.

**Marker 10: Heliconia rostrata or lobster-claws**

Hello, you are at marker 10 of Kew Gardens’ *Pollinators of the Palm House* audio tour.

So far, we have met plants pollinated by bees, beetles, bats and even lemurs. Now I would like to introduce you to one that is pollinated by a bird. This plant with its upright leaves is the *Heliconia rostrata*, also known as the hanging lobster-claw due to the shape of its extraordinary-looking flower. The flowers of this plant have brightly coloured bracts in red, oranges, yellows and greens. The nectar of the tiny flowers within often attracts insects, but they are mostly pollinated by hummingbirds. Only a small number of hummingbirds are the right size to pollinate such a strange-shaped flower; these birds live in the tropical rainforests of South America where the lobster-claws grow. Once pollinated, the plants produce fruits that are blue or purple, which birds eat and then disperse the seeds through their droppings. Sadly, the lobster-claws are now listed by the International Union for Conservation of Nature as Vulnerable in the wild.
We hope you enjoyed the pollination stories that we have shared. Here at Kew, we don’t have the exotic and varied fauna that pollinate most of these magnificent plants, and instead we rely on the constant care and cultivation from Kew’s Palm House staff.

Pollination trail and The Hive

If you are keen to learn more about pollination, you might enjoy Kew’s art installation, The Hive. If you travel from the Palm House towards the Broad Walk Borders, you will soon see The Hive. From there you can pick up the pollinator trail, which extends through the landscape leading from The Hive installation to Kew’s living beehives near the Kitchen Garden.

Thank you so much for joining us.