True blue

Colours of the kangaroo paw

The iconic Western Australian kangaroo paw has dazzled the world with its unique flowers and form. Delve into the colourful world of kangaroo paws and catspaws and the launch of the 'Masquerade' blue kangaroo paw (*Anigozanthos*) developed by the Botanic Gardens and Parks Authority.

by Alan Gill and Digby Growns

It would be difficult to name more iconic Western Australian wildflowers than kangaroo paws with the red and red species (*Anigozanthos manglesii*) being the State's floral emblem. Although kangaroo paws are endemic to Western Australia, they can be found in gardens across the world.

There are (to date) 12 species of kangaroo paws and catspaws—11 in the *Anigozanthos* genus, while the black kangaroo paw (*Macropidia fuliginosa*) is in a genus of its own. Despite their variety and diversity across WA, kangaroo paws are vulnerable to diseases (*Pythium*, *Phytophthora*), ink spot (*Alternaria anigozanthi*) and rust (*Puccinia haemodori*).

Plant breeders at the Kings Park and Botanic Garden have been tackling the plant's susceptibility to diseases through a program of cross-pollination, developing hardier varieties for home gardens and expanding the colour-range through a process known as hybridisation. One variant emerged in 2013 that had the team excited—this one was blue.

INTO THE BLUE

A teal blue kangaroo paw started flowering from a cross-pollination conducted by plant breeders in 2012 in their quest to find a more robust variant.

"It had an absolute wow factor," Kings Park's senior plant breeder Digby Growns said. "I knew we had to target this one."

The plant breeding process typically involves the creation of hybrids: the cross pollination of similar species with a view to combine desirable traits and forms, such as colour, size, disease tolerance or drought-resistance.

"We want to breed plants that use less water, have less disease and provide habitat for local fauna," Digby said.

"Plants that have unique colours or forms and an extended flowering season are attractive to gardeners and can continue to increase the popularity of native plants."

Blue flowers are rare in bird-pollinating flowers and have never been seen before in kangaroo or catspaws.

"The new 'Masquerade' kangaroo paw came from cross-pollinating green and red-green varieties over many years," Digby said. "What makes this so remarkable is that the genes to produce blue flowers have been sitting there all this time yet have never been expressed. We just needed to find the right hybrid to bring it to the fore."

BIRDS NOT THE BEES

Kangaroo paws and catspaws rely on nectar-feeding birds for pollination, not insects such as bees and wasps.

"Pollination success plummets without native birds feeding on nectar in kangaroo paw flowers," DBCA's Biodiversity and Conservation Science principal research scientist Siegy Krauss said.

"Birds like wattlebirds and other honeyeaters play a key role in reproduction and hybridisation of kangaroo paws."

Hybrids can naturally occur when pollen from one species is transferred to another. In addition to needing to be co-located, plants must also be flowering at the same time for the opportunity of hybridisation to arise.

"A few things have to go right for hybrids to occur in nature and there's a range of barriers that reduce the likelihood," Siegy said.

"Kangaroo paw flowers can differ in length, depth, height: these physical differences change pollen deposition and retrieval sites on a bird's beak, head or neck when feeding on nectar. This means

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Main 'Masquerade' blue kangaroo paw.
Photo – Kings Park and Botanic Garden

Above Red and green kangaroo paw detail. (*Anigozanthos manglesii*).
Photo – John Huisman

Above right Tall kangaroo paw (*Anigozanthos flavidus*).
Photo – Marie Lochman

Discover more about kangaroo paws

Scan this QR code or visit Parks and Wildlife Service's '*LANDSCOPE*' playlist on YouTube.

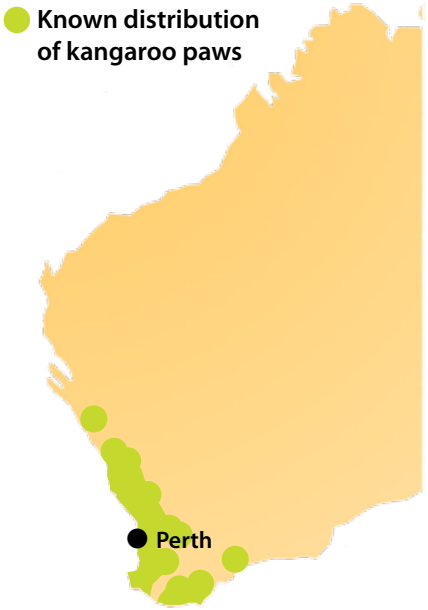
Enigmatic emblem

The red and green kangaroo paw (*Anigozanthos manglesii*) was proclaimed as WA's floral emblem in 1960.

In announcing the choice, then Premier Sir David Brand said: "The kangaroo paw is so outstanding that it was the logical choice. It has grace and beauty, striking colour and distinctive outline, and it grows naturally only in Western Australia".

The kangaroo paw was incorporated into the Coat of Arms of the State of Western Australia by Her Majesty Queen Elizabeth II in 1969, framing the Crown.

It is truly a unique flower, and its scientific name reflects this: French botanist J.J.H de Labillardière coined a genus name that loosely translates to 'irregular flower' when describing the genus in 1800.



Left Red and green kangaroo paw. (*Anigozanthos manglesii*).
Photo – Rob Davis

Below left Black kangaroo paw (*Macropidia fuliginosa*).

Below Catspaw (*Anigozanthos humilis*).
Photos – Marie Lochman

pollen isn't necessarily delivered to the right location on the receiving flower.

"If there is a successful pollen transfer, there is no guarantee seeds will set or even germinate. A lot has to go right."

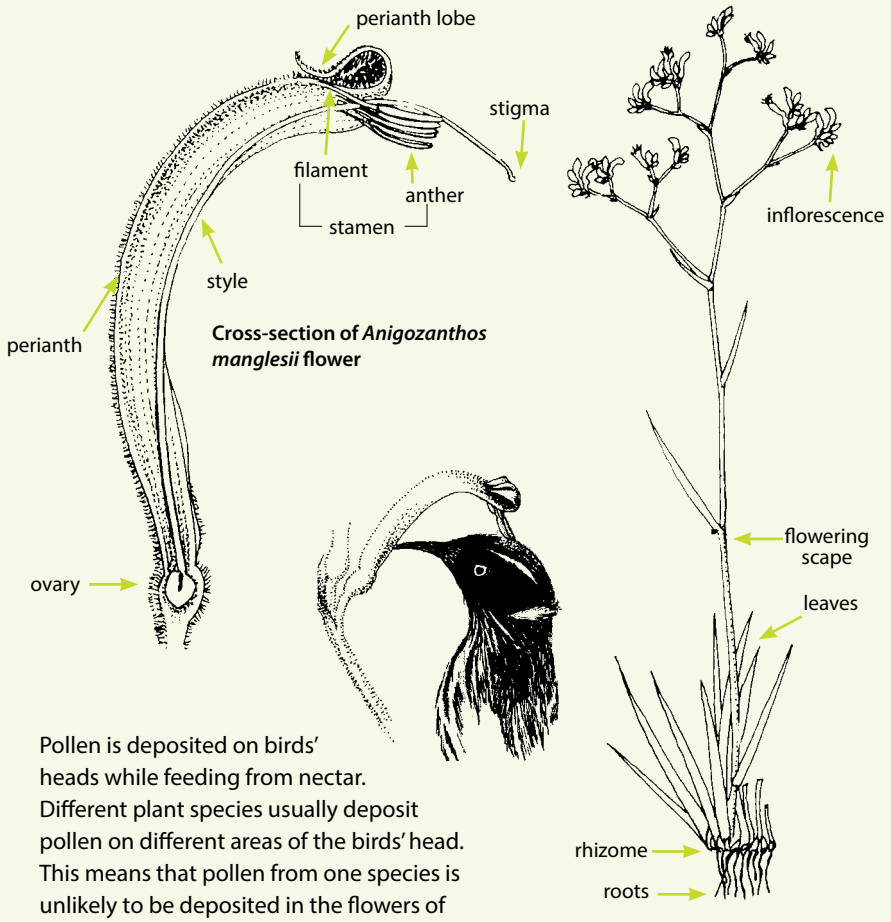
Even the birds themselves have a say in the success of hybrids. Researchers have observed birds choosing to feed from one species of kangaroo paw over another during its peak in flowering, despite others being available in the same landscape.

"Pollinators are in it for the nectar so they will choose to feed from flowers that will give them the most reward for effort," Siegy said.

"The opportunity for hybrids to occur naturally is limited if birds are choosing to feed exclusively from one species at a time."

In a botanic garden hybridisation and crossbreeding can occasionally be highly successful, resulting in the evolution of new lineages and species over large timescales. Plant breeding programs seek to speed up

Parts of the kangaroo paw plant



Pollen is deposited on birds' heads while feeding from nectar. Different plant species usually deposit pollen on different areas of the birds' head. This means that pollen from one species is unlikely to be deposited in the flowers of another species.

Top left Brown honeyeater on kangaroo paw.
Photo – Cliff Winfield

Above Kangaroo paw cross pollination.
Photo – Kings Park and Botanic Garden

Left Parts of the kangaroo paw plant and bird pollination.
Illustrations – Margaret Pieroni as featured in Kangaroo paws and catspaws *by Stephen D. Hopper*

crossbreeding and bring about hybrids that would be unlikely to occur in nature.

"Hybrids and cultivars can bring about varieties and traits that are unlikely to emerge in the wild such as this blue colouration," Siegy said.

"Accelerating these natural processes can bring about exciting developments in plant biology and provide glimpses into the genetic diversity these plants harbour."

GENOME LAID BARE

A research project inspired by the ground-breaking blue kangaroo paw development has been awarded an Australian Research Council grant to uncover the mysteries behind kangaroo paw flower colour expression.

Blue flowers are so rare in bird-pollinated flowers that the unique hybrid has begun an interdisciplinary collaboration to map the first entire kangaroo paw genome.

The project is a collaboration between the Botanic Gardens and Parks Authority, Department of Biodiversity, Conservation and Attractions and Edith Cowan University, along with other collaborators and funding from the Friends of Kings Park.

"Mapping the genome of Western Australia's floral emblem would open up the possibilities for kangaroo paw research for years to come," Digby said.

"Nobody's ever done work to uncover the science behind colours in *Anigozanthos* and therefore we don't know how to expressed," he said. "This is really globally significant science that we're about to undertake that will further our world-leading native plant development program."

Edith Cowan University Chief Investigator Dr David Field said the project would use cutting edge genomic sequencing technology integrated with biochemical analysis to uncover the genes behind the colours.

"The project aim is to assemble the first kangaroo paw genome, identify the genomic regions' driving colour variation in cross-breeding programs, identify some of the biochemical compounds responsible and, lastly, describe the genetic sources of these flower colour genes in nature," Dr Field said.

"The complete genetic blueprint held in the sequence of the DNA molecules directs all the biochemical processes required for life and biological diversity."

This project will not only develop new scientific techniques but also inspire more research into native Western Australian plants.

"We're using techniques that have never been used before in Australia," Digby said.

"There are many questions that can be answered once we map the genome, including the impact of variable colours on pollination and biodiversity."

The 'Masquerade' blue kangaroo paw is now available in commercial nurseries across Western Australia.

Top left Digby inspecting *Anigozanthos* hybrids.

Top Foliage affected by rust.

Above Newly potted *Anigozanthos* hybrids.
Photos – Andy Milner/DBCA

Below 'Masquerade' blue kangaroo paws.
Photo – Kings Park and Botanic Garden

Alan Gill is a science communicator with DBCA's Biodiversity and Conservation Science. He can be contacted at alan.gill@dbca.wa.gov.au

Digby Growns is a senior plant breeder at the Botanic Gardens and Parks Authority. He can be contacted at (08) 9480 3627 or digby.growns@dbca.wa.gov.au