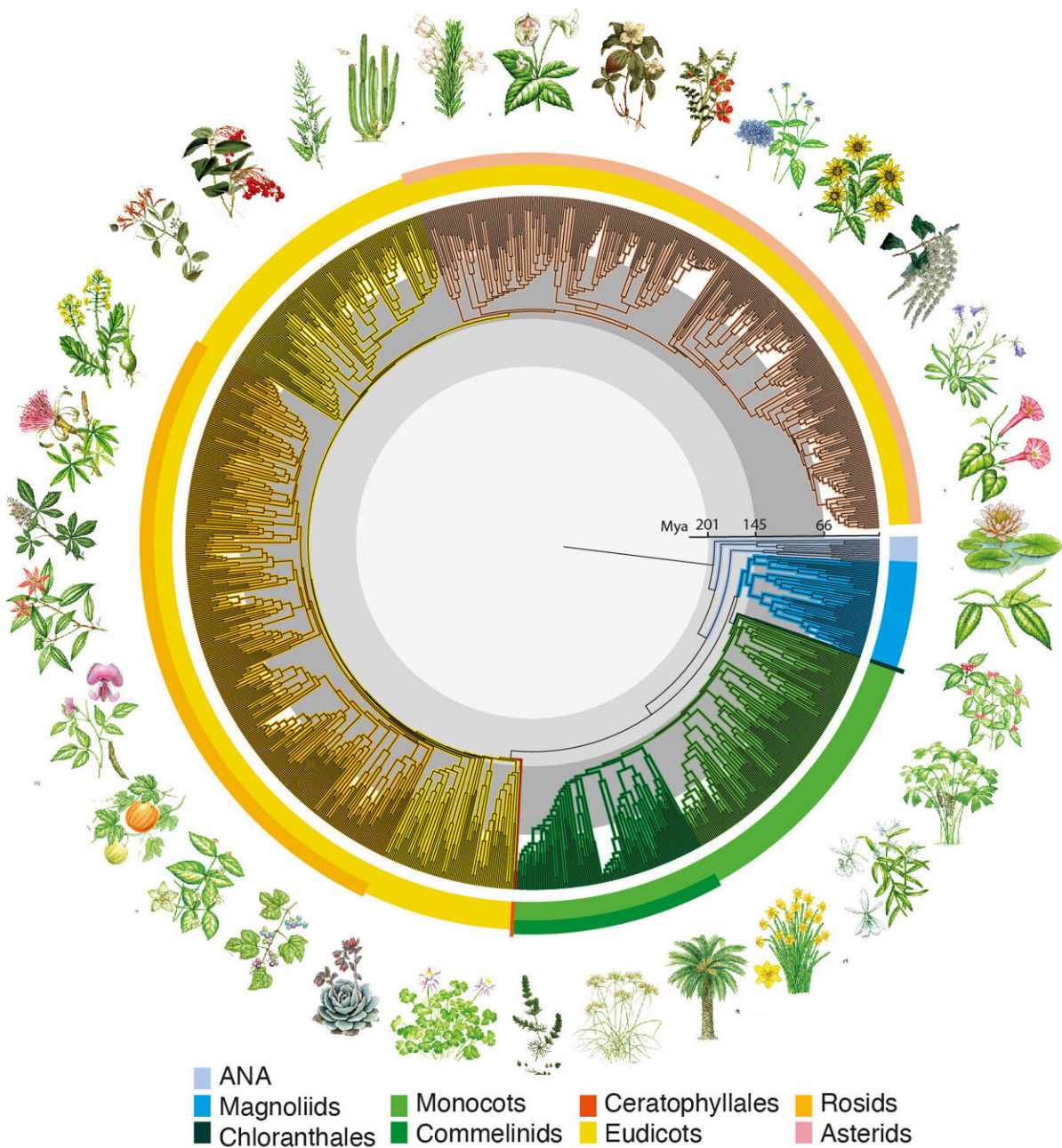


New global study reveals 'time tree' of Earth's flowering plants

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Angiosperm (flowering plants) "time tree." Credit: Dr Santiago Ramírez-Barahona

New research published today in *Nature Ecology & Evolution* by

scientists from Australia and Mexico reveals the world's first complete angiosperm "time tree"—a reconstruction of the evolution of the Earth's flowering plants through time.

The rise of angiosperms (flowering plants) began about 140 million years ago, sparking one of the most dramatic biological revolutions of our planet's recent history.

Crucial questions around the timing and location of the origin of the families involved in creating the most diverse type of plants on Earth were until now, largely unanswered.

Dr. Hervé Sauquet from the Australian Institute of Botanical Science and Senior Visiting Fellow at the University of NSW is based at the Royal Botanic Garden Sydney and coordinated the dataset of 238 angiosperm fossil calibrations, the largest ever assembled.

"Fossils are the most important pieces of evidence needed to understand these important evolutionary questions around angiosperm divergence times," said Dr. Sauquet.

"Previous studies of this nature only used 30 to 60 [fossil records](#) and we wanted to increase this number significantly and set a higher standard for fossil calibration by documenting every part of the process. We often had to translate records from different languages and do relentless detective work to get centuries old as well as the latest fossil descriptions in our hands," Dr. Sauquet said.



Icacanthium tainiaphorum fossil. Flowers embedded in amber are rare. Fossils are important to our understanding of evolutionary process and past diversity due to the exceptional preservation of fragile structures not normally preserved.

Credit: Del Rio et al. 2017 (*Scientific Reports*)

The researchers also analyzed the geographic distribution of existing flowering plants and looked at how angiosperm family ages were distributed across the globe by combining their new 'time tree' with over 16 million occurrence records of angiosperm species.

Lead author of the study from the National Autonomous University of Mexico, Dr. Santiago Ramírez-Barahona, said we now have the most comprehensive confirmation to date that angiosperms originated in tropical environments.

"But there is a twist, although tropical ecosystems are home to old families, our results imply that the angiosperm-dominated rainforests of today are a relatively recent development in Earth's history," Dr. Ramírez-Barahona said.

"Every group of living species on Earth has a 'stem' age (the age of its origin) and a 'crown' age (the beginning of its diversification into the living species we see today) and birds provide a great example of this. The stem age of birds is marked by their split from crocodiles around

240 million years ago and their crown age is marked by the most recent common ancestor of all living birds, around 100 million years ago. What happened between the stem and crown ages is very interesting because this was when the dinosaurs roamed the Earth. It's also when all the traits that define modern birds evolved and this is exactly what we set out to understand in our angiosperm study," said Dr. Ramírez-Barahona.



Eupomatia laurina. Guava native to Australia. This species is a member of a lineage that might have existed (the lineage, not the species) when the ancient super continent Gondwana was still breaking about 180 million years ago. Credit: Dr Hervé Sauquet

Senior author from the National Autonomous University of Mexico,

Professor Susana Magallón, said the study further supports the idea that the ecological dominance of modern-day flowering species was delayed until after the end of the dinosaurs, some 66 million years ago.

"By estimating both the stem and crown ages for angiosperm families we found a difference of 37 to 56 million years between family origins and the beginning of their diversification into the living species we see today," said Professor Magallón. "To put this into context, the average time lag corresponds to around a third of the entire duration of angiosperm evolution, which is at least 140 million years."

Dr. Sauquet said the new study sheds new light on crucial temporal and geographic aspects of the most critical phases of [angiosperm](#) evolution after their origin.



Akebia quinata. Commonly known as 'chocolate vine' and is native to Japan, China and Korea. Credit: Dr Herve Sauquet

"During this time is when flowering plants came to be the dominant and most important group of terrestrial plants—the primary food source for most organisms on land and virtually all human agricultural crops," said Dr. Sauquet.

The new research will also help contribute to the broader understanding of all evolution on Earth by adding another key piece to the puzzle of life.

All scientific facilities, programs and living collections at the Royal Botanic Garden Sydney, Australian Botanic Garden Mount Annan and Blue Mountains Botanic Garden Mount Tomah have been united under the new Australian Institute of Botanical Science.

The new Institute is advancing fundamental knowledge of flora and driving effective conservation solutions to ensure the survival of plants, and all life that depends on them.

More information: Santiago Ramírez-Barahona et al. The delayed and geographically heterogeneous diversification of flowering plant families, *Nature Ecology & Evolution* (2020). [DOI: 10.1038/s41559-020-1241-3](https://doi.org/10.1038/s41559-020-1241-3)

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