CALEYI

Australian Plants SOCIETY NSW

NORTHERN BEACHES GROUP

austplants.com.au/northern-beaches June 2019

Australian Plants Society Northern Beaches
northernbeaches@austplants.com.au

CALENDAR

APS Northern Beaches meeting Thursday June 6, 2019 at Stony Range Botanic Garden, Dee Why.
7.00 pm Plant family. Campanulaceae - **Estelle Burrows**.
7.15 pm Presentation: Katriona Wragg: NBC Community Nursery Supervisor.
Growing A Community Native Plant Nursery. Northern Beaches Council Community Native Plant Nursery started in 2009 and produced less than 1000 plants. In 2018 the nursery produced 20,000 plants and has a vibrant volunteer base. Katriona will discuss the growth and challenges of the nursery.
Supper: David & Julia.

APS Northern Beaches walk Sunday June 16, 2019. The Chiltern North Road. More details later from Anne.

APS NSW Get-Together Newcastle Sat 17 & Sun 18 August, 2019 (See p. 4)

2019 ANPSA 'Blooming Biodiversity' Sunday 29 Sept. to Friday 4 Oct. 2019 **Albany, WA.**

APS NSW Quarterly Saturday November 16 hosted by **APS Northern Beaches** at Curl Curl.

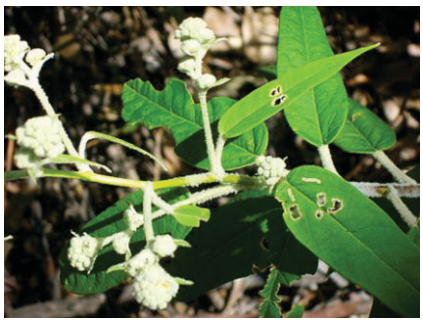
Editor march@ozemail.com.au

APS NORTHERN BEACHES MAY MEETING

Anne Gray

At our May meeting Eleanor continued our education on Plant Families by presenting the Araliaceae Family.

This family is made up of 52 genera and 700 species worldwide. Eleanor looked at the Astrotricha (star-hair) genus which is found in the Sydney area and is closely related to the Apiaceae Family (flannel flowers). The plants usually have star hairs on most parts of the plant except the upper surface of the mature leaf.



Clockwise from top left -

Astrotricha crassifolia - thick leaf star hair. Rare, found in Heathcote and Gosford areas.
Astrotricha floccosa - flannel leaf. Common in the Sydney area. Found in dry sclerophyll woodland or forest on sandstone.
Astrotricha longifolia - long leafed star hair. Uncommon, only found north of the harbour.
Astrotricha latifolia - broad leaf star hair. Rare in Sydney. Found in the Georges Basin.

The main speaker at our May meeting was Wendy Grimm. She is a member of the North Shore Australian Plant Society. She has been studying the orchid *Genoplesium baueri* for the past 9 years.

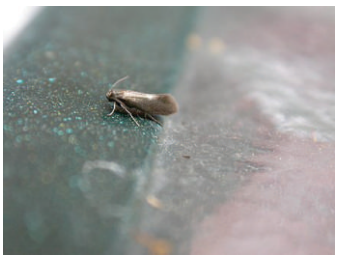
Wendy & Phillip Grimm. pic D. Drage.

Her talk was titled **"Pollination - not just the realm of bees".**

Wendy had beautiful photos to illustrate her talk which was both fascinating and informative. We learnt that insects are motivated to visit plants for rest, warmth, sex, pollen, and nectar.

Different size insects are attracted to the same plant eg. native bees, honey bees, saw flies and the jewel beetle. She spoke about the Blotched Hairy Longhorn Beetle which is attracted to plants by scents, shapes, sex and potential of food.

The wasp family pollinate the midge orchids. The female wasps are flightless and our carried by the male to their plant of choice.



The moth family Heliozelidae pollinate *Boronia serrulata, Phylotheca hispidula, Phylotheca salsolifolia* and *Phebalium sqamulosum*. These are small metallic moths that fly during the day.

Wendy showed us a photo of a spider within a flower head that had camouflaged itself to look like the stamens. She also mentioned that flies that get the pollen on the sticky patch on their heads and are unable to reach it.

She spoke of the Dendrobium beetle (*Stethopachys formosa*) which mainly feeds on dendrobium species but also other orchids and is very destructive.

CONNY'S EXCITING DISCOVERY

Conny found these fascinating items in her bush garden.

Naturally she sought identification from our member and master naturalist Martyn Robinson.

Here is his response.

'Not a moth - but much more exciting! They are the egg cases of the Magnificent Bolas Spider *Ordgarius magnificus*. the adult spider will be hiding by day in an inverted silken 'cup' which you can see traces of in the fern fronds just to the side of where the egg sacs are attached. If you go out at night you will see the female exposed and dangling a single thread with a sticky blob on the end. She then gives off the scent of a female moth and, as the males come towards her, she whirls the sticky blob and it sticks to the moths once it hits them. She then reels in the moth bites it and hangs it up, makes another bolas, and starts all over again. She can change the scent she emits to attract different moth species and is very successful so she will often have been able to produce up to twenty such egg cases. They are interesting in other ways as the males hatch fully mature and never feed but immediately start looking for mature females to mate with. Their sisters are still very immature so no inbreeding can ever occur.'

Ordgarius magnificus. pic.media.australianmuseum.net.au

LOST BOOK OF EXQUISITE SCIENTIFIC DRAWINGS REDISCOVERED AFTER 190 YEARS

nationalgeographic.com.au 22 April 22, 2019 Czerne Reid

Decades of searching uncovered the brilliantly illustrated plants and detailed notes made by a US woman living in Cuba in the 1800s.

Caesalpinia pulcherrima is a species of flowering shrub found in the tropics and subtropics of the Americas. This drawing of the plant, seen in the archives of the Rare and Manuscript. Photograph by Robert Clark

Lost for 190 years, a three-volume manuscript blooming with vivid colour drawings of Cuban flora has resurfaced in upstate New York.

Nondescript marbled cardboard covers and a title page in cursive handwriting announce Specimens of the Plants & Fruits of the Island of Cuba by Mrs. A.K. Wollstonecraft. This simplicity belies the contents of the slim, well-worn volumes. Pages and pages contain 121 illustrated plates showing plants such as red cordia sebestena, deep purple Lagerstroemia, and white angel's trumpet in consummate detail.

Accompanying them are 220 pages of English-language descriptions relating historical facts, indigenous applications, poetry, and personal observations. Hewing faithfully to scientific conventions, the illustrations show vegetation, life cycles, and dissections of reproductive parts. Some pressed plant material is taped in. The author writes that she did not consult botanists or receive any help with her work.

"A jewel of botanical literature in Cuba," is how Cuban botanist Miguel Esquivel describes the work, classifying it among the greatest discoveries of its kind in recent times. (Also find out how historians rediscovered an alchemy manuscript by Isaac Newton.)

"I think the manuscript by Anne Wollstonecraft is of great importance," says ethnobotanist Paul Cox, executive director of Brain Chemistry Labs in Jackson, Wyoming. "Although the plants that she profiles in her drawings and descriptions are generally common, the detailed notes she makes of indigenous uses add a whole new dimension to understanding their possible utility, and could be used today to guide researchers in discovering new pharmaceuticals."

For example, she notes that roots from the soursop tree were used as a fish poisoning antidote, and its leaves as an antiparasitic and antiepileptic. She also suggests that "soursop" comes from a phonetic approximation of the island's indigenous inhabitants' name for the tree, suir sach, which could help explain a paradoxical moniker for a fruit described as sickly sweet.

But if not for historian Emilio Cueto, a retired attorney and self-described collector of all things Cuban, Wollstonecraft and her work may have remained in obscurity.

Word of mouth

In 1828, Cuban exiles and human rights advocates Father Félix Varela and José Antonio Saco mentioned an American woman in Cuba drawing Cuban plants in their periodical El Mansajero Semanal. Almost a century later, in 1912, Cuban scholar and thinker Carlos M. Trelles cited the work, sight unseen. The citations said that New York Horticultural Society members had likened the work to that of respected naturalist Maria Sibylla Merian, whose legendary 1705 work Metamorphosis insectorum Surinamensium is considered seminal to the field of entomology.

"That comparison triggered my belief that this was important," Cueto says. "People exaggerate, but not that much."

Thus began his quest.

Following Trelles' lead, Cueto included Wollstonecraft's work in the catalog bibliography for his own 2002 HistoryMiami Museum exhibit on Cuban flora and fauna without having laid eyes on it or knowing whether it had even survived.

"This was the reality of scholarly networks at that time," says Anne Sauer, director of Cornell's Rare and Manuscript Collections. "Part of the scholarly record included a scholar saying, I haven't seen this thing, but I have heard that it exists and that it is important. You're sort of bleeding into the realm of oral history in some cases, even."

Each documentation of the manuscript and historical mention of the author seemed to bring a different spelling of her last name. Some use her maiden name, Kingsbury, and her first name was alternately reported as Anne and Nancy—which Jane Austen fans will recognise as a diminutive of the former.

Cueto had searched for the manuscript perhaps a hundred times or more in online library catalogs to no avail, but in March 2018, it finally popped up. The author's name was misspelled as "Wollstonecroft," reflecting the ambiguous last cursive vowel on the manuscript's title page. Still, Cueto knew what he had found.

"I said, Oh my God! This is that lady. This is what I've been looking for. This is what everybody has been looking for!" Cueto says. "It was covered by a series of unfortunate misspellings and access to catalogs."

After his Archimedes moment, however, he couldn't find the actual manuscript; the catalog didn't show him where it was. That's when he called on University of Florida Library Dean Judith Russell, with whom he had collaborated for Cuba exhibits. She figured out that it was at Cornell University, which received it in 1923 from a faculty member, the author's descendant. Having caught Cueto's infectious excitement, Russell joined him on a field trip to Ithaca to see the volumes.

"Both of us tried to moderate our expectations," Russell says. "We get there, and, My God, they are full botanical drawings with pages of narrative. And they're exquisite."

"This drawing in Wollstonecraft's manuscript shows a flower from a member of Erythrina, a genus of trees sometimes called coral trees due to the many species that sport bright red blooms. Photograph by Robert Clark

Women in 'stem'

Based on some genealogy sleuthing, Russel reports that Wollstonecraft died in 1828 at age 46, leaving incomplete entries, untranscribed notes and loose draft paper among the volumes."She was not finished," Russell says. "It gives you goosebumps, to know, how close we came to losing it."

Cueto is now working to introduce Wollstonecraft, the sister-in-law of famed women's rights advocate Mary Wollstonecraft, to new generations. He has travelled to her adopted hometown of Matanzas in search of her grave and contemporaneous mentions in local newspaper archives, and he surmises that she was among the US citizens who flocked to the Caribbean island in the 19th century for health reasons.

His many-splendored vision includes having the newfound manuscript on display at the National Museum of Women in the Arts in Washington, DC, where it could be seen by millions who traverse the nation's capital. He also envisions the manuscript finally published as a book, with a foreword recounting how this lost work came to light. And he wants a Spanish translation, to make it more accessible to Cuban audiences.

So far, the manuscript has been digitised and is available for all to experience online.

"We have uncovered a new American scientist and artist who has been forgotten by those disciplines," Cueto says. "Had she lived further, she would have been a major force in illustration.

SAVE THE DATE - 17 TO 18 AUGUST 2019 APS NSW GET-TOGETHER IN NEWCASTLE AREA

Heather Miles (APS NSW Administrator)

You are cordially invited to the 2019 APS NSW Get-Together. This not to be missed event is being held at a varied range of locations in the Newcastle area.

There are a range of different native vegetation communities available to explore. Your visit will take you to some of the gems of the area and you will be able to see the spectacular coastal flora at its peak.

Highlights will include a visit to the Hunter Wetlands Centre where you will be welcomed to the Newcastle Groups home base, this will also include the opportunity to purchase from the wide range of native plants produced by the "Thursday Mob". https://wetlands.org.au

A visit to the award-winning Hunter Region Botanic Gardens and herbarium is also on the agenda. https://huntergardens.org.au. 2100 Pacific Highway, Heatherbrae, NSW 2324 | 02 4987 1655 - 02 4987 1440

MONDAY WALKS & TALKS - Introduction to Australian Native Plants

Monday, 17 June 2019 from 09:45-12:45
Ku-ring-gai Wildflower Garden, 420 Mona Vale Road.

If you love the Australian bush and want to find out more about Australian native plants, then join us at our Walks & Talks event at the Wildflower Garden for an introductory talk and walk. No prior knowledge is required & information sheets are provided.

Meet at Caley's Pavilion at 9.45am for a 10.00am start.
Please wear suitable footwear & bring a hat and water.
Fee is $5 for non-members and $2 for APS members.

APS North Shore Group run talks & walks each Monday during the winter school term. You can download a 2019 program https://austplants.com.au/North-Shore-Walks-&-Talks

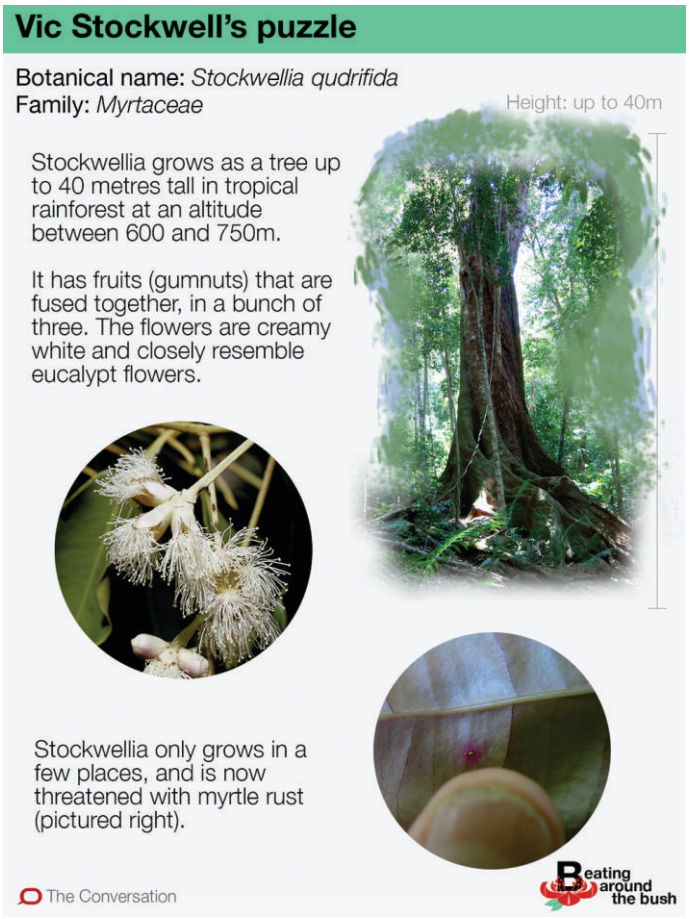
VIC STOCKWELL'S PUZZLE IS AN UNLIKELY SURVIVOR FROM A DIFFERENT EPOCH

theconversation May 17, 2019 Andrew Thornhill, University of Adelaide.

On the western side of Mount Bartle Frere, the tallest mountain in Queensland, grows a tree that shares an ancient link to Australia's most dominant plant group.To get there, you must find a track hidden by rainforest and then walk for around an hour up and down a dirt path, until you reach cathedral-like giant red barked trees.

This is Stockwellia quadrifida, also known as "Vic Stockwell's puzzle": a close but anciently separated relative of the eucalypts.

This ancient tree is best suited for wetter and warmer environments, a throwback to when this continent was still connected to South America and Antarctica 40-50 million years ago, in the supercontinent Gondwana. But this rare plant is now at risk by an introduced threat, myrtle rust, a plant disease that was accidentally introduced to Australia from South America.



Sister to the Eucalypt

In my opinion, Stockwellia trees are in the same league as California Redwoods – they're both old, with very few close living relatives. In fact, they are probably more special, as only around 400 Stockwellia trees remain.

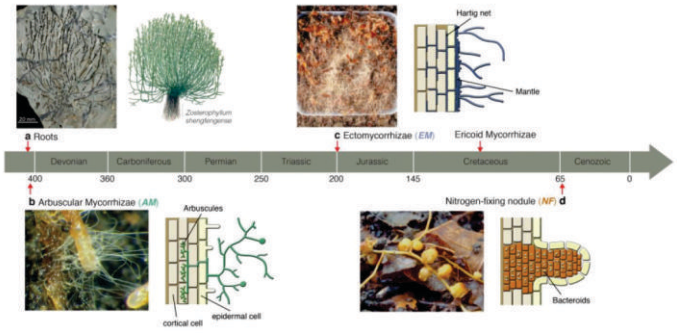
Some of the trees I saw in Queensland have large buttressed roots and are hollowed out so you can walk inside the tree and stare upwards. Their bark is strikingly red, and their enormous size means you have to crane your neck to see the top.

Stockwellia takes its name from a Queensland forest ranger named Victor Stockwell who worked in the Boonjee area on Mount Bartle Frere where the trees grow. While the species wasn't officially scientifically described until 2002, it had been known to botanists for many decades.

PLANTS AND MICROBES SHAPE GLOBAL BIOMES THROUGH LOCAL UNDERGROUND ALLIANCES

sciencedaily.com April 17, 2019 Princeton University

Princeton University researchers report that the distribution of forest types worldwide is based on the belowground relationships plant species forged with soil-dwelling microbes such as fungi and bacteria to enhance their uptake of nutrients, particularly nitrogen and phosphorus. Fungi and bacteria release nutrients through soil decomposition. In return, the microbes thrive on the carbohydrates that plants provide from photosynthesis. Above is a timeline of the plant-symbiont relationship on land from the Devonian geologic period (left) to the Cenozoic (right), Earth's current era. Roots appeared in the fossil record 413 million years ago (a). Plant-fungal symbiosis (b) developed roughly 407 million years ago. Around 60 million years ago, nitrogen "fixing" bacteria known as rhizobia (d) began infecting plant root cells, converting nitrogen in the air to fertilizer in exchange for carbohydrates.



Credit: Mingzhen Lu, Princeton Ecology and Evolutionary Biology

Dense rainforests, maple-blanketed mountains and sweeping coniferous forests demonstrate the growth and proliferation of trees adapted to specific conditions. The regional dominance of tree species we see on the surface, however, might actually have been determined underground long ago.

Princeton University researchers report that the organization of forests worldwide -- such as conifers in northern boreal forests or the broad-leafed trees of the tropics -- are based on the ancient relationships that plant species forged with soil-dwelling microbes such as fungi and bacteria. These tiny organisms, known as symbionts, enhance the roots' uptake of the crucial nutrients nitrogen and phosphorus. The researchers reported in the journal Nature Ecology and Evolution that trees and shrubs came to dominate specific biomes by evolving the most competitive arrangement with local soil microbes -- and cutting competing plants out of the action.

The biome-specific dynamics between plants and soil microbes could help scientists understand how ecosystems may shift as climate change brings about warmer temperatures that alter the interplay between trees, microbes and soil, the researchers report. Because the most competitive symbiotic arrangements for a particular biome triumph, scientists would only need to understand how an ecosystem is changing to gauge which vegetation will be moving in and which will be moving out.

"The pattern we found can be used to tell us the landscapes that are more sensitive to human disturbance," said senior author Lars Hedin, the George M. Moffett Professor of Biology and professor of ecology and evolutionary biology and the Princeton Environmental Institute. "It will predict what communities of trees will go where, their effect on the environment, and how they will respond in the future to climate change and increased carbon dioxide."

First author Mingzhen Lu, a postdoctoral research associate in the Hedin lab, said that symbioses arose because plants needed microbes to unlock the nutrients -- particularly nitrogen and phosphorus -- released through soil decomposition. In return, the fungi and bacteria thrive on the carbohydrates that plants provide from photosynthesis. Lichen -- the frilly white-green algae-fungus amalgamations that grow on rocks and trees -- are an early example of this cooperation.

"The moment plants colonized the land, they formed symbioses," Lu said. "The evolution of those new, powerful symbioses allowed plants to colonize new lands. This biology powers the global carbon and nutrient cycle."

Lu and Hedin focused on trees and shrubs and found that as the plants spread across the globe, they carved out biomes using the nutrient advantage their relationship with microbes bestowed on them, Lu said. For example, maple trees will set conditions so that competing trees can't grow in the areas maples inhabit.

"This is a perfect example of how biological organisms can shape the surrounding environment in favor of themselves," Lu said. "This suggests to us that once the correct biological mechanisms are included, changes in the land can be predicted, but those forecasts need to capture belowground dynamics. By figuring out the most competitive symbiosis under specified conditions, we can determine how plant communities will evolve and develop in that biome in the future."

Lu and Hedin used a game-theory model that allowed plants to use different belowground strategies for acquiring nutrients. Their model examined trees and shrubs -- known as dominant vegetation -- in tropical, temperate and boreal forests. They looked at biome conditions such as sunlight and nutrient turnover to examine the most competitive symbioses that will emerge if ecosystems are allowed to change and mutate naturally. They factored in the amount of carbon and nutrients that cycle through a particular biome, as well as how it responds to disturbances and how plant populations replace each other through succession.

Their model revealed that specific local interactions between plants, soil and nutrients are suitable for those areas. For instance, boreal trees have developed symbiotic relationships tailored for spongy boreal soils, but not the sodden soil of a tropical forest.

"Our findings show that the relationship between plants and their symbionts is central to understanding the organization and history of the land biosphere," Hedin said.

The Hedin lab at Princeton previously found that plants may have a more active role in their evolution -- and the formation of natural systems -- than they are given credit for. In February 2018, Hedin and Lu reported in the journal Nature that the proliferation of plant life across the globe may have been propelled by root adaptations that allowed plants to become more efficient and independent.

In 2015, a paper in Nature Plants suggested that plants found in areas otherwise unsuitable for them -- such as nitrogen-poor rainforest soils -- use secretions to invite soil bacteria known as rhizobia to infect their roots cells. In a give-give relationship similar to that described in the latest publication, the rhizobia convert atmospheric nitrogen into fertilizer in exchange for carbohydrates. This interplay creates a nitrogen cycle that benefits surrounding vegetation.

"Plants have long created the conditions for their own success. What's important is that we are now better understanding how this works based on our models," Hedin said.

"Our new model shows that plants have competed for soil resources and in doing so they have harnessed the help of symbiosis and this has made them successful," he said. "The resulting relationship has been so powerful that not only have they helped other trees and plants, but they also have transformed the environment."

RARE CARNIVOROUS PLANT FOUND IN WA'S NORTH

AAP May 1, 2019

A new population of a critically endangered aquatic carnivorous plants has been found in Western Australia's remote Kimberley region after a long search, with the ecstatic researchers calling it a dream come true.

Curtin University research fellow Adam Cross and honours student Thilo Krueger have combed swamps and billabongs throughout northern Australia for rare species like Aldrovanda vesiculosa for almost a decade.

When they recently discovered thousands of the plants on Theda pastoral station east of the Mitchell Plateau, Dr Cross said he couldn't believe his eyes. It is the first time the species, which captures and digests small insect prey using snapping traps, has been found in the Kimberley for more than 20 years.

The only other known population in WA is more than 2000 kilometres away near Esperance, where a population of only a few dozen plants was found in 2007. "This discovery gives us hope that northern Australia is still a stronghold for the species in the face of its continuing global decline," Dr Cross said.

The species was once widespread around the world, but habitat loss and water quality changes have led to it becoming extinct in up to 30 countries, Mr Krueger said.

THE AMAZING DR RYE

www.taxonomyaustralia.org.au/ May 24, 2019 Kevin Thiele

In the 19th and early 20th centuries, botany was often regarded as a pursuit that was 'suitable' for women, in an era when most scientific disciplines excluded their participation. Nevertheless, even in botany women were generally permitted to dabble, but were rarely permitted to make a serious and substantial contribution.

This social norm of both inclusion and exclusion was highlighted in a paper published in 2015 by Heather Lindon and colleagues from Kew Gardens. Of all the plant names published since 1753 (the starting date for the formal naming of plants), fewer than 3% have been published by female authors.

In this context, we should celebrate the achievements of Dr Barbara Rye from the Western Australian Herbarium in Perth. A 2019 updated analysis of records of all published plant names (from the International Plant Names Index) shows that our Dr Rye is one of the all-time top-10 women authors of plant names in the world.

Barbara Rye grew up in Perth, at a time when there was more bushland than there is at present, and children roamed more widely. Like many children, Barbara was fascinated by creatures and the bush, and spent much time tadpoling, catching insects and marveling at the wildflowers for which Perth is famous. A wildflower-season bus trip in late teen years with her mother (during which participants were allowed to collect and press sprigs of the abundant spring wildflowers, something that would be

Western Australia's Dr Rye is one of the all-time top-10 women authors of plant names in the world

frowned upon now), consolidated a love of nature and a fascination with Western Australia's remarkable biodiversity.

Barbara was able to pursue her interest at the University of Western Australia, with undergraduate studies in both botany and zoology followed by a PhD under the mentorship of Associate Professor Sid James, who inspired a whole generation of Western Australian biologists. As with others in the James lab, Barbara studied genetics, specifically chromosome evolution and reproductive biology in the family Myrtaceae, which is diverse and abundant in Australia (and especially so in the south-west).

Studying chromosome evolution in a biodiversity hotspot like Southwest Western Australia, it wasn't long before the (soon-to-be Dr) Rye discovered her first new species – *Darwinia capitellata*, which she segregated from the widespread *Darwinia diosmoides* based firstly on its different chromosome number, amply confirmed by morphological studies.

Darwinia capitellata, Barbara Rye's first new species. Photo: Roger Fryer and Jill Newland CC-BY-NC.

Her first new species was followed by many more. A position at the Western Australian Herbarium since 1981 has given her ample scope to range across the rich flora of Western Australia, a biodiversity hotspot and an area that still yields many new species every year. She was a co-author of the Flora of the Perth Region and Flora of the Kimberley, produced a Flora of Australia revision of the large family Thymelaeaceae, and revised and described new species in many genera in a range of families.

During her career she has continued to work a rich vein in the taxonomy of the family Myrtaceae. Despite decades of work by Dr Rye and others, this family still has at least 150 undescribed species in Western Australia, including in Darwinia, the genus that first caught Barbara's taxonomic attention during her PhD.

Barbara Rye has clearly made the substantial contribution to the discovery and documentation of Australia's species that was once denied so many talented women. She has named, alone or with co-authors, over 230 new Australian species, and counting.

In 2019, the Australian Academy of Science released the Women in STEM Decadal Plan, which sets out the steps needed to finally bring gender equity to science. It's appropriate then in this year that we celebrate the remarkable achievements of scientists like Dr Barbara Rye, one of the most productive women botanists in the world.

AN END TO ENDINGS: HOW TO STOP MORE AUSTRALIAN SPECIES GOING EXTINCT

Theconversation March 5, 2019 John Woinarski, Sarah Legge, Stephen Garnett.

We need nature. It gives us inspiration, health, resources, life. But we are losing it. Extinction is the most acute and irreversible manifestation of this loss.

Australian species have suffered at a disproportionate rate. Far more mammal species have become extinct in Australia than in any other country over the past 200 years.

The thylacine is the most recognised and mourned of our lost species, but the lesser bilby has gone, so too the pig-footed bandicoot, the Toolache wallaby, the white-footed rabbit-rat, along with many other mammals that lived only in Australia. The paradise parrot has joined them, the robust white-eye, the King Island emu, the Christmas Island forest skink, the southern gastric-brooding frog, the Phillip Island glory pea, and at least another 100 species that were part of the fabric of this land, part of what made Australia distinctive.

And that's just the tally for known extinctions. Many more have been lost without ever being named. Still others hover in the graveyard – we're not sure whether they linger or are gone.

The losses continue: three Australian vertebrate species became extinct in the past decade. Most of the factors that caused the losses remain unchecked, and new threats are appearing, intensifying, expanding. Many species persist only in slivers of their former range and in a fraction of their previous abundance, and the long-established momentum of their decline will soon take them over the brink.

The toolache wallaby is just one of Australia's many extinct species. John Gould, F.R.S., Mammals of Australia, Vol. II Plate 19, London, 1863

Unnecessarily extinct

These losses need not have happened. Almost all were predictable and preventable. They represent failures in our duty of care, legislation, policy and management. They give witness to, and warn us about, the malaise of our land and waters.

How do we staunch the wound and maintain Australia's wildlife? It's a problem with many facets and no single solution. Here we provide ten recommendations, based on an underlying recognition that more extinctions will be inevitable unless we treat nature as part of the essence of this country, rather than as a dispensable tangent, an economic externality.

1. We should commit to preventing any more extinctions. As a society, we need to treat our nature with more respect – our plants and animals have lived in this place for hundreds of thousands, often millions, of years. They are integral to this country. We should not deny them their existence.

2. We should craft an intergenerational social contract. We have been gifted an extraordinary nature. We have an obligation to pass to following generations a world as full of wonder, beauty and diversity as our generation has inherited.

3. We should highlight our respect for, and obligation to, nature in our constitution, just as that fusty document could be refreshed and some of its deficiencies redressed through the Uluru Statement from the Heart. Those drafting the blueprint for the way our country is governed gave little or no heed to its nature. A constitution is more than a simple administrative rule book. Countries such as Ecuador, Palau and Bhutan have constitutions that commit to caring for their natural legacy and recognise that society and nature are interdependent.

4. We should build a generation-scale funding commitment and long-term vision to escape the fickle, futile, three-year cycle of contested government funding. Environmental challenges in Australia are deeply ingrained and longstanding, and the conservation response and its resourcing need to be implemented on a scale of decades.

5. As Paul Keating stated in his landmark Redfern speech, we should all see Australia through Aboriginal eyes – more deeply feel the way the country's heart beats; become part of the land; fit into the landscape. This can happen through teaching curricula, through reverting to Indigenous names for landmarks, through reinvigorating Indigenous land management, and through pervasive cultural respect.

6. We need to live within our environmental limits – constraining the use of water, soil and other natural resources to levels that are sustainable, restraining population growth and setting a positive example to the world in our efforts to minimise climate change.

7. We need to celebrate and learn from our successes. There are now many examples of how good management and investments can help threatened species recover. We are capable of reversing our mismanagement.

8. Funding to prevent extinctions is woefully inadequate, of course, and needs to be increased. The budgeting is opaque, but the Australian government spends about A$200 million a year on the conservation of threatened species, about 10% of what the US government outlays for its own threatened species. Understandably, our American counterparts are more successful. For context, Australians spend about A$4 billion a year caring for pet cats.

9. Environmental law needs strengthening. Too much is discretionary and enforcement is patchy. We suggest tightening the accountability for environmental failures, including extinction. Should species die out, formal inquests should be mandatory to learn the necessary lessons and make systemic improvements.

10. We need to enhance our environmental research, management and monitoring capability. Many threatened species remain poorly known and most are not adequately monitored. This makes it is hard to measure progress in response to management, or the speed of their collapse towards extinction.

Extinction is not inevitable. It is a failure, potentially even a crime – a theft from the future that is entirely preventable. We can and should prevent extinctions, and safeguard and celebrate the diversity of Australian life.