6

The long hot summer: December to March

SUMMER. n.s. [rumen, Saxon; somer, Dutch] I. The season in which the sun arrives at the hither solstice.

Dr Johnson's *Dictionary of the English Language* (1766).

The unfavourable season [for plants] is high summer.

Beth Gott, Honorary Research Fellow, Monash University.

Beth Gott is right – from a botanical perspective, there might seem less to say about summer. Let's start with an historical perspective. The year is 1836, the place Sydney Cove: 'The near level country is covered with thin scrubby trees, bespeaking the curse of sterility … Everywhere we have an open woodland, the ground being partially covered with a very thin pasture, with little appearance of verdure [green] … In the whole

country I scarcely saw a place without the marks of a fire … The season, it must be owned, has been one of great drought, and the country did not wear a favourable aspect.' These were the first impressions of Charles Darwin, arriving in Sydney aboard *The Beagle* then travelling by road to inland Bathurst in January 1836. Before we take offence at his attitude, I should add that he had also written that 'In the afternoon we stood out of the Bay of Islands, on our course to Sydney. I believe we were all glad to leave New Zealand. It is not a pleasant place.' Darwin discovered the Antipodes in mid-summer. To his eyes the countryside in any season would not have lived up to verdant England, but at this time of year particularly there were few flowers to divert attention from the shimmering grey-green of the Australian bushland. For Australians this is what tugs at our heart, even with the backdrop of fire and drought. For visitors it can take some getting used to: Mr Darwin, in 18 days, didn't.

Fruit in summer and other seasons

Despite Beth Gott's quite accurate observation (which I contextualised in Chapter 3), summer is a season of plant produce. It's when many fruits ripen. Perhaps the fruit most associated with summer in Sydney is the mango, even though we can get fruit almost all year these days. The mango season still has a formal beginning, although it's several weeks before my long summer. In 2011, 175 years after Darwin's visit, a box of 12 mangoes in a Sydney market fetched AU$30 000. It was the first 'new season' batch to arrive in Sydney at the end of August (late sprinter) and the money raised was given to charity. Within weeks Kensington Pride, the most popular variety (about 80% of the Australian market), and a few other varieties trickled into the market. By December the price has dropped and mangoes from up north are a staple of the summer fruit menu. They are joined by bananas, stone fruits and berries, mostly grown outside coastal Sydney. The mass flowering of plants in sprinter and sprummer has led to mass fruiting and seeding in summer. Summer is the time when seed collectors set out from seed banks all over the world, from nearly every botanic garden and herbarium in Australia to the Millennium Seed Bank at Wakehurst Place in London, part of the Royal Botanic Gardens, Kew. These banks hold more than 15% of the world's 400 000 or so species of flowering plants and are working to store 25% of the species that produce storable seed by 2020. Summer is seed bank season.

So while I've concentrated on flowers for setting my seasons, we could easily use fruits or other aspects of seasonal plant (or of course animal!) biology. Because fruits follow flowers, the crescendo is a few months after the sprinter flush of flowering. Summer is perhaps the most colourful time to visit a market: stone fruits (apricots, peaches), berries (blackberries, blueberries, raspberries), cherries, grapes, bananas and of course mangoes are all at their peak. If we plotted the number of plants in fruit and seed throughout the year we'd expect the same rising curve as occurs for flowers in sprinter, but displaced a season or two (depending on how long it takes for the fruit to form). Apples, for example, take a few months to ripen after they flower in mostly late sprinter or sprummer. The autumn fruiting season is led perhaps by that quintessential Australian apple, the Granny Smith. It comes into good supply in autumn and remains available to the start of the next summer. Golden Delicious starts at the same time but lasts only to the end of sprinter, with a few other popular varieties such as Pink Lady and Royal Gala arriving in winter and with shorter seasons. Chestnuts are their peak in autumn and kiwi fruit, although now imported from countries from New Zealand to Italy so available year-round, peaks locally in autumn and winter. Pears are strong in autumn then through to winter. Winter is also the time for citrus fruit (such as grapefruits, navel oranges, lemons) although good supplies start in late autumn and some, like lemons, have another peak in summer when limes and Valencia oranges are at their best. Anzac Day (25 April; mid-autumn) is the traditional start of the navel season in South Australia, rippling southward and eastward to a late May (effectively winter) start of the season in New South Wales. According to Robin Powell, in an article in the *Sydney Morning Herald* on 1 May 2012, new varieties have brought the navel orange season forward and extended it from a brief winter season 20 years prior. I'm presuming the Anzac Day navels picked from trees in Renmark is one of those new traditional traditions.

Not surprisingly, sprinter and sprummer, the peak flowering seasons, are poor fruit seasons. However, modern transport and long-term storage, coupled with the tip and tail of some fruiting periods extending into early sprinter and late sprummer, mean that it's sometimes hard to notice this lull. Vegetables, being mostly based on flowers, leaves and roots, spread more evenly across the year although with more abundance and diversity in sprinter and sprummer. The tomato, which is of course a vegetable and a fruit, matches up with the

common fruiting peak of summer, followed by the slower-developing vegetable fruits, the pumpkins.

Life and death in summer

While we could define the long hot summer as the peak fruiting season, this implies that no plants are in flower. But it's a fact that, barring a few obvious places (e.g. Antarctica), there is always a plant in flower at any time of year in any habitat or region – if we look hard enough. Summer is the flowering season for a few very charismatic plants. The fleshy spikes of spotted pink flowers of the hyacinth orchid (*Dipodium*) in the otherwise dry and largely drab summer bushland are a surprise. The plant looks like some escaped exotic but it is a native orchid that relies on a fungus for all its sustenance – it doesn't have leaves or any green parts to trap the sun's energy and produce its own sugars. In the first two months of summer the soft pink sacred lotus (*Nelumbo nucifera*) from tropical Australia and Asia bursts from ponds and lakes, and the dusty perfumed flowers of the South American frangipanis (*Plumeria*) emerge in the warmer parts of our seasonal region. There are lots of cacti in flower, although they often start in late sprummer. In London I was thrilled by the variety of cactus flowering inside and out at Kew Gardens during July and August, with the outside ones hauled inside at the end of the season. In the Royal Botanic Gardens Melbourne there is a spectacular new cacti and succulent landscape around what is called Guilfoyle's Volcano. On my return in later summer the flowering cacti against the deliberately rusted fences and sinuous garden displays were unforgettable. The cow itch tree (*Lagunaria patersonia*), from Norfolk and Lord Howe Islands but featured in many Australian parks and gardens, is in pink flower late in December, soon to produce the irritating fruits that school-children shove down the shirts of unsuspecting others. The Sydney Christmas bush (*Ceratopetalum gummiferum*) is in flower in November but in bright red fruit by … Christmas. I could go on and on. The crepe myrtles (*Lagerstroemia*) from southern Asia flower in late February and March, joined by the Japanese sasanqua camellias (*Camellia sasanqua* cultivars) and the South American lassiandra (*Tibouchina*) bloom all over southern Australia. Perhaps it was a mistake to say that nothing much happens in summer? There may be fewer plants flowering but they *are* quite interesting ones.

Aside from fruits and the occasional, interesting flower, the thing we notice most about plants in summer is their wilting. Where there are no summer rains, most plants settle into a kind of hibernation but can at times look visibly stressed. Most obviously, they wilt or start to die from the tips of the plant back to the base. This is how plants respond to water stress (as well as to various plant diseases and, perversely, sometimes to overwatering), sacrificing first the chemical processes needed for further growth and then bits of the plants themselves. Any gardener will know that each plant responds differently to temperature and water. Those adapted to drier conditions may have thick protective skins, store water in succulent stems or leaves, or be covered in hairs to reduce evaporation. Unsurprisingly, cacti mostly thrive through the hot dry summer months. Tropical rainforest plants will cope with the heat but struggle if the humidity drops around the leaves. Most trees will

suffer in a prolonged drought as they use up the water in the soil around their roots.

A few plants actually allow themselves to 'die', then spring back to life when the rains come. Of course they don't really die, but botanists do call them resurrection plants. The most commonly encountered resurrection plants are mosses and lichens, like the ones growing on paths, rocks or even the roof at home.[1] They spend much of their time in a dried-out state, swelling back to life and colour when it rains (or we pour water on them). What they do is allow their stems and leaves to lose water and the cells go into a dormant state – their metabolism is slowed right down. They can survive in this state for years.

Various flowering plants and ferns also do this, including several that grow naturally in southern Australia, such as the Australian pincushion lily (*Borya*) and rock ferns (*Cheilanthes*). The rock felt-fern (*Pyrrosia rupestris*) is a local succulent with a thick coating of hairs, but it can feign death and be resurrected when it receives water. Better known around the world is the rose of Jericho, also called siempre viva (i.e. everlasting), rosa mariae, dinosaur plant or simply resurrection plant. These names seem to refer to several different plants, including in North America a selaginella (a plant closely related to ferns), sometimes called the false rose of Jericho. The 'true' rose of Jericho is *Anastatica hierochuntica*, found in deserts throughout the Middle East, including the Sahara, where it rolls around in the wind when dry. It's also a tumble-weed. If wetted, it will expand from the size of a small fist to approximately 15 cm wide.

Unlike the 'false' rose of Jericho, this plant is probably not really a true resurrection plant in that when dried all the leaves fall off and just the stems curl up, holding seeds inside. It does uncurl when wet, but generally the seeds germinate rather than the stems springing back to life. *Anastatica* is in the cabbage and mustard family, the Brassicaceae. Presumably the name 'rose of Jericho' refers to the beauty of it coming back to life. Certainly it looks nothing like a rose.

All very interesting, of course, but most plants are not resurrection plants. They do, however, often tolerate much more drying than we expect. Like many other gardeners in Australia, I found that watering restrictions introduced during the severe droughts in the late 2000s showed that most of my garden plants could survive with less water. We had been overwatering. The enjoyment of hosing the plants on a summer evening outweighed the plants' need for water. The water was

either flowing through or over the soil and into stormwater drains, seeping below the root zone or simply accumulating in too great a quantity near the roots. Very few of my plants died when I reduced the watering regime. Some plants sustained damage from hot days or prolonged dry spells, but many or most of these recovered over time. The best thing is to leave intact any scorched or dried parts of the plant and wait to see if they reshoot when autumn returns – in April, of course.

The endless summer

The end of summer is more problematic. I like to use 31 March. Traditionally, of course, it's the last day of February. Although daylight hours are rapidly reducing in March there is still residual summer heat. On my arrival back in Melbourne in March 2013 I enjoyed nine days with maximum temperatures exceeding 30°C. That's not every year – this was a record-breaking stretch – but it's not unusual for much of March to feel summery across much of southern Australia. In some countries and eras the equinox, 21 or 22 March, is the changeover date, taking us very close to the end of March anyway. Daylight Saving or Summer Time ends early in April, and with the clocks moving back an hour it feels very much like summer has finished – the long evenings are over. Plant-wise, March is a transition month. I've already mentioned the sasanqua camellias and crepe myrtles flowering in my late summer (March). Freesia leaves are emerging. Autumn crocuses are flowering. Some deciduous trees (e.g. the golden elm, *Ulmus glabra* 'Lutescens') are beginning their leaf senescence. So, change is afoot. March could sit in summer or autumn but for southern Australia an extra month of summer fits the mood and feel of this transitionary month.

While I was writing this in London, in March, my Australian seasonal colleague Rick Kemp sent a short essay summarising his astronomical/solar framework for seasons (see Chapter 1). He began with 'A hot topic of conversation in Sydney at the moment has been: "Where did our summer go?"' He used this as a lead into the bigger question of where our seasons are going more generally, and the observation that seasons are not what they used to be. His conclusion was that the seasons haven't gone anywhere in particular and that we just need to observe them within a sensible framework. Rick favours seasons centred on solstices and equinoxes with mini-seasonal transitions in between, as defining important and more-or-less

universal changes in daylength (again, see Chapter 1). I prefer local (romantic, in Rick's view) seasons reflecting changes in the biological world around us. But he pointed out a weakness in my system – what if we have an unseasonably cold or wet summer? First, this may alter biological patterns and throw out my correlated observations. Second, it won't feel like summer (or any other season), making things just as bad as using a standard Vivaldian system and complaining about it all the time. Third? Well, third, environmental alterations such as accelerated climate change will mess with any system based on biological observations. I'll return to this in the final chapter.

If we extract Rick's summer from Chapter 1, it starts in mid-November (18 November) and finishes at the end of January (26 January) – Australia Day! His transition period takes summer–autumn through to the middle of February and his spring–summer from the end of October. This is quite a different view of summer and one based on tracking the relatively stable period of long days around the summer solstice on 23 December. For me the Australian summer is a longer, more leisurely season. Yes, I turn to romance rather than science here, but the animals and plants stretch out their seasonal siesta beyond a mere two months (Kemp) or even three (Vivaldi). In March, in Sydney or Melbourne, there is certainly no hint of winter and usually little sign that something like an autumn has arrived. In years when it's not such a hot late summer, when Rick is overhearing questions about the summer being lost, there is still something summery going on March. I like to still call this plain old summer, but perhaps it's the Indian summer …

'Indian summer' is an odd term and one often misused linguistically and seasonally. In late September 2011 I blogged (*talkingplants.blogspot.com*) about whether London was experiencing an Indian summer or a 'double-dip spring'. I began by asking whether this was the summer we missed in August, or a second spring? Either way London gardens got another flush of flowers as well as spectacular autumn colours. Head of Royal Botanic Garden, Kew's estate at Wakehurst Place, Andy Jackson, was particularly impressed by *Viburnum plicatum* 'Mariesii', in the middle of a second flowering flush while its leaves turned autumn red. The cool dry August followed by an unusually warm late September seemed to trick some plants into thinking it was time to flower again; in Sydney, I'm arguing that a warm March (= London September) is the norm. What about this Indian

summer thing? Was London experiencing it, and is it what southern Australia experiences every year?

In general parlance, Indian summer is a patch of warm weather late in the season, just when we think it is safe to start whinging about cold nights and winter being around the corner. Its origin is North America, and it seems to have been used widely in the late 18th century. The 'Indians' are the native North Americans who, in the east of the country, depended on these early autumn stretches of fine sunny weather to harvest enough food for the winter. In the north-east of the USA this early autumn weather was a pleasant break from the hot and humid summer, and a good time to harvest. In this region there were usually one or more Indian summers in early autumn, often after the first severe frost. In fact, some people won't accept an Indian summer without a preceding frost, presumably arguing that otherwise it's just summer dribbling on a little longer. It's this extra dribble I think is the norm in southern Australia, so I'm happier with an extended summer rather than calling any warm weather in March (or London September) unseasonable. That said, in current usage (and as defined in the UK Meteorological Glossary) the Indian summer is a 'a warm, calm spell of weather occurring in autumn, especially in October and November [in the Northern Hemisphere]'. This doesn't preclude September (March in Australia) according to local weather experts but perhaps we can keep the term Indian summer for bouts of 'unseasonable' weather in my autumn. Or choose from a few UK alternatives such as 'St Luke's little summer' and 'All Halloween summer' (Australia April/London October), 'St Martin's summer' (May/November) or 'old wives' summer' (any autumnal month). In the UK these mini-summers are largely unpredictable and may occur at any time in autumn. In southern Australia the start of the traditional autumn is better treated as plain old summer.

For the animal world this longer summer works just fine. Snakes and other reptiles become active when it's sunny and relatively warm (I say 'relatively' because they'll seek out a warm rock or patch of tarmac if there is enough direct sun to heat it up). So they can be active any time of year, even though they spend a lot of time sleeping during the colder parts of the year – in a semi-hibernation state called torpor. November and December seems to be when most appear in southern Australia, warming up rather than trying to stay cool, and by April they are heading into logs and crevices for their torpor, as my summer finishes.

I gather snake torpor is an imprecise season and difficult to link to a date-based system such as mine. Skink breeding season is from December to March (at least that is when the young hatch), and this may be a better reptilian marker for my summer – the presence of those cute little skinklets on rocks and scaling brick walls.

Insect appearances are equally difficult to tie down to calendar dates. This is in part due to the 30 million or so different species that inhabit Earth, each with their own seasonal cycle, but also because many respond to weather conditions rather than to daylength or broader climatic trends. How many insects we see will also be influenced by pests, diseases and predators, which are equally influenced by weather. Summer is traditionally considered mosquito and fly season in Australia and we can be sure of finding both in varying quantities across the country. But neither flies nor mosquitoes track the seasons closely and as soon as there are a few warm days in November insects in general begin to emerge, or at least be noticed. Traditional autumn is considered a peak time for mosquito-borne disease, and warm weather and rain will bring both flies and mosquitoes at almost any time of year.

Even using plants, the end of the summer season can be tricky to define. I was comforted by the comments of gardening guru Elizabeth Swane, who in a regular segment on Simon Marnie's *Weekend Show* (Radio 702 AM) at the end of March 2010 warned Sydneysiders that the autumn planting of poppy and pansy seeds should wait until April because in Sydney it's still summer weather in March.

An English summer, if you're lucky

In London the summer is elusive and much discussed, but I like to define it as starting in June with peak salvia flowering and in an exceptional year, perhaps, extending four months (as long as the Sydney summer) into September with water lilies, coneflowers (*Echinacea*) or a bunch of other late summer annuals in flower and not an autumn leaf to be seen. I only spent two years in London so I may have it all wrong. But it seems to me that the English summer is like a game of football, or soccer as I persist in calling it. I played a lot of soccer at school in Melbourne and understand the game. I also understand its inherent unfairness, although I struggle to convince everyone of this theory. My thesis is that a game decided on a total of one or two scoring successes is likely to, more often

than we'd want, reward luck rather than talent. Take a game where one team has 10 shots at goal but none goes into the net, while the other team has one shot which makes it past the goalie for a successful score. Team two wins 1–0, but was it the best team on the day?

The element of luck means that there is always a chance that your team will win even if they aren't very good – on average, that's a good thing for most supporters. What I now add to the great pantheon of western thought is the link between soccer and the English summer.

Having enjoyed a few days of warm weather in London, something approaching what I am used to calling summer back in Australia, I realised how enjoyable it was to have a low-scoring season. In Australia we tend to get too much of a good thing in summer. Yes, it's lovely to have the long summer days but after a while it can become rather too hot and bothersome. In most places in Australia there will a few bad (cold) summers, and patches of cold or wet weather to break the pattern, but we can be fairly sure we'll get summer weather when it's summer. In England, in my experience, you just can't be sure. You don't know when summer is going to arrive or how convincing it is going to be. The British watch the jet stream (and tea leaves!) in anxious anticipation. And then it hits, the warming, almost without warning. I've heard locals grumble that a spell of summer weather 'came too quickly', without the chance to adapt. There is a sense that it wasn't done properly, that it lacked appropriate dignity. But what we got was the massive 'high' that comes with a single soccer goal. A score!

Thinking about summer as a game of soccer helped me appreciate the upside of the English summer. It's not as long and hot as my Australian summer season but even if the whole summer thing is a flop, the country still has considerable experience in celebrating near-wins. Alternatively, locals give up on summer and wait until autumn, which England does much better than most of Australia.

Plants on fire

There is a fair chance in southern Australia that we will face the threat of fire during summer: early in summer in the north near Sydney, generally later in the south as the grasslands and forests dry out. Plants respond selectively to fire and this isn't the place for a comprehensive review of the way Australian plants have become adapted to fire. Instead I'd like to tell the stories of two southern Australian plants[2]

with differing responses to fire. Both were saved through the timely collection of seed and its storage in one of the seed banks mentioned at the top of this chapter. Malcolm Gill summarises the responses of Australian plants more generally to fire in his chapter in the first volume of *Flora of Victoria*. Our flora includes a mix of what might be called colloquially avoiders, ephemerals, seeders, sprouters and I guess susceptibles. In all cases the frequency and intensity of a fire will move them from one category to another. Fires assist some plants to survive and dominate, from reducing competition through to producing chemicals that are required for germination of seeds, and fires kill other plants. Here are two examples.

She-oak wood has been described as the best firewood in the world: easy to split, burning even when green, and making excellent charcoal. Until the advent of electric ovens it was the fuel of choice for Australian bakeries. Yet she-oaks, or casuarinas, thrive in some of the most fire-prone forests of southern Australia. This is just one of the apparent contradictions of the quintessentially Australian plant family, the Casuarinaceae, that extends through to south-east Asia and the Pacific islands.

The wood of she-oaks, when not being burnt to bake our bread, has been used to make shingles, tool handles, bullock yokes, boat masts, beer barrels, piano legs and boomerangs. The Thai elephants at Taronga Zoo in Sydney shelter under a lofty shingle roof of forest oak (*Allocasuarina torulosa*). Yet just across Sydney Harbour the Nielsen Park she-oak (*Allocasuarina portuensis*) is on the brink of extinction. While it's not so strange for one species in a genus to be common enough to clad buildings (although she-oak shingles are now unavailable) and another to be rare, to many people she-oaks all look the same. At best there seem to be two kinds: the pine-like trees scattered across rocky hillsides or beside snaking rivers, and the tangled, dull-grey shrubs that occupy heathy woodlands and heathlands in places like Nielsen Park.

Indeed the 60 species of *Allocasuarina*, six species of *Casuarina* and one species of *Gymnostoma* that represent the she-oak family in Australia are remarkably similar except to the trained eye. The first thing we notice about all she-oaks is that they don't have broad flat leaves typical of most flowering plants (although the first seedling leaves are 'normal'). Instead they seem to have long segmented needles, much like those of a pine tree. In fact, the 'needles' are green stems, or

branchlets, and at each of the constrictions in the stem there is a ring of minute, usually shrivelled, leaf-tips like little triangular teeth. These leaves are little more than a scrap of dry tissue. Taxonomists count the number of these 'teeth' in each ring as the first step in identifying the species. For everyone else, the stem is where the action is.

We might need a magnifying glass to see it, but each branchlet is grooved along its length. The four to 20 or so grooves can be hairy or hairless inside, but they all contain a row of breathing pores called stomata. Having these pores deep in the grooves means that the rate of water loss is minimised, allowing she-oaks to grow in some of the most inhospitable places in Australia – belahs (*Casuarina pauper* and *C. cristata*) are the dominant, and often only, trees on loamy rises in semi-arid inland Australia. They are very much a plant that can tough out the Australian summer. In fact, they are highly specialised survivors of drought and fire. Their stem anatomy already makes them one of the stingiest plants in terms of water loss, and during dry periods the stems of some species brown off, springing back to life with the first rains. Under severe water stress the branchlets are shed. A subterranean clan of fungi, bacteria and various other microorganisms lives on and in the extensive root system, providing she-oaks with extra water and nutrients such as phosphorus and nitrogen.

Different she-oak species have their own strategies for surviving fire. The desert she-oak (*Allocasuarina decaisneana*) in central Australia will survive even the fiercest bushfire, and some species will resprout from their base. Most, however, rely on seed released from cones that are prised open by the heat of the fire. The valves open slowly, and the seed is released onto a cool, nutrient-enriched soil. Mature cones are usually common but not always on all individuals – quite a few species have separate male and female plants.

As an aside, few other plants grow under she-oaks. Their seeds may be unable to germinate in the dry layer of slowly decaying branchlets, or there may be chemical inhibition by salts leached from the branchlets or antibiotics from the root bacteria. It may simply be due to competition for water, given the she-oak's extensive root system. However, there is one notable exception. Many Australian terrestrial orchids seem to favour soil covered in she-oak needles, whether in the wild or in cultivation. Some of the most spectacular displays of mosquito orchids (*Acianthus*), greenhoods (*Pterostylis*) and spider orchids (*Caladenia*) I've seen have been in she-oak woodlands.

Although successful as a family, there are some precarious species. *Allocasuarina fibrosa* is known from a single population in the Charles Gardner National Park in Western Australia, a park created to conserve the species. *Allocasuarina glareicola* from Castlereagh Nature Reserve, in the western suburbs of Sydney, and the Nielsen Park she-oak mentioned earlier, were only formally named in 1989. Both have been considered endangered since their discovery earlier in the 1980s: the Nielsen Bay she-oak had declined to a single 'she-she-oak' (with no 'he-she-oak') in 2002. That last tree died the year after.

The survival of the Nielsen Park she-oak now depends on seed collected and stored in PlantBank (the seed bank at the Australian Botanic Garden at Mount Annan, just south of Sydney) and the success of replanted seedlings (both male and female!) in Nielsen Park and neighbouring areas over the last decade or so. With the critical soil organisms also possibly lost or in low numbers, competition from aggressive weeds and shading from trees with denser canopies, it may be difficult to get this species re-established. The aim is to get the transplanted shrubs to reproduce and survive on their own. Carefully controlled burns (to remove competition and encourage germination of new plants) are part of the recovery plan, but in the middle of a city of four million people, even a tough plant like the she-oak can meet its match.

A slightly more positive fire recovery story comes from Victoria. It concerns a rare species in the genus *Phebalium*, described by one current and one former colleague from the Royal Botanic Gardens Melbourne (Neville Walsh and David Albrecht), but recently moved to a new genus, *Nematolepis*, by the person they named the species after, Western Australian botanist Paul Wilson. When we published the *Flora of Victoria* in 1999 (Neville and I were editors, and Marco Duretto wrote the account of this plant's family, Rutaceae), *Nematolepis wilsonii* was known from a single population of some 200 individuals near Marysville. As most readers will know, the fierce fires that ripped through Victoria 10 years later (February 2009) destroyed most of the town of Marysville and burnt and blackened much of the surrounding vegetation. More than 4500 km^2 of land was burnt, more than 2000 homes were destroyed and 173 people lost their lives. The entire population of shining nematolepis, a common name uncommonly used for the species, was apparently wiped out by the Black Saturday fires.

Three months after the fire there were no seedlings to be found and it was feared the species might be extinct in its natural habitat.

Thankfully, seed had been collected as part of the Millennium Seed Bank Partnership, the project led by Royal Botanic Gardens Kew and involving many environmental organisations around the world. A good representative sample of the 200 plants was, and is, held in the Victorian Conservation Seedbank, with duplicates sent to Kew. All up, an insurance policy of 16 000 seeds. Was it time to cash in that policy? Turns out, not. Come sprinter of 2009, thousands of healthy seedlings appeared near Marysville. As reported at the time on the website of Kew Gardens, 'although this is not a surprising response for the hard, black-seeded Rutaceae … there were fears that owing to the intensity of the fires and the deep-burning of the humus-rich soils … the soil-stored seed bank might have been destroyed'.

For added protection, the seedlings were fenced to avoid damage by animals (and accidental damage by humans!). There is also a cheering report of a new population. Parks Victoria staff were checking on the well-being of the rare broad-toothed rat, also an inhabitant of the area burnt on Black Saturday. They found a small population of shining nematolepis that had been mostly burnt in the fires but that had a 'handful of surviving adult trees' and 'numerous seedlings'. Seed from the new population will be collected, in due season, to improve the genetic representation in the various seed banks.

So despite the fruity produce, summer in southern Australia can be the dying season for plants: it's hot and dry and there is the likelihood of bushfire. It's certainly a tough time for bushland and gardens in southern Australia, and in my mind that tough time runs from December right through to the end of March. Starting summer on 1 December seems about right. The second peak of the flowering season is finishing and the days are getting longer. The first day of December also marks the earliest sunrise of the year in Australia (not the solstice as you might expect), a nice solar milestone to celebrate.

Plant survivors

To end this chapter about the season of death on an optimistic note, let me pose the interesting question: are plants immortal?[3] This is a fun topic I've spoken about to various groups of people, from Supreme Court judges to members of the Cactus and Succulent Society of NSW. My interest in this topic began a few years ago when I read a book by idiosyncratic French tropical-botanist Francis Hallé. His wonderfully titled *In Praise of Plants* is amusing and captivating. I loved it. Hallé is

particularly keen to show that most animals and plants are fundamentally different, and that we can't simply generalise from what we know about animal biology to plants. To my delight, Hallé also concludes that plants are far more interesting!

One of Hallé's key concepts is that a tree can be viewed as a close-knit colony of many individuals, rather than a single organism, and that this colony has the potential to live forever. What he means is that there is a repeated pattern, and each unit can continue to grow (whether as part of the tree or as a cutting or graft) as long as it contains a bud. The bud, according to this interpretation, can be considered the true individual – it cannot be divided any further. (Even if we use genetic uniformity to define an individual, in a long-lived tree a slow build-up of mutations in vegetative cells can result in some branches having a distinct fingerprint.) So a tree is like an ant nest or sea anemone: individuals die, but the colony persists.

Apart from providing an interesting linguistic or philosophical exercise, does any of this matter? It does if you consider colonial organisms to be, to all intents and purposes, immortal. Clearly most trees are mortal: Australian wattles tend to flourish and die within a decade or two, and even our most majestic street trees have a maximum life span of one or two centuries. Structural problems develop. Food and water supplies can't be guaranteed. Fungal pathogens somewhat short-sightedly kill their host. Winds blow them down. And so on. Then on a hot dry summer day, they die.

In fact, the longest-lived plants are not the grand trees. Granted, a bristlecone pine (*Pinus longaeva*) that was chopped down in California in 1964 is often cited as having been the oldest tree. It was just under 5000 years old when felled, although there are claims that other individuals of this species are 8000 years or more old. A massive Huon pine, spread over 2.5 ha (the size of a city block) in the Mt Read area of Tasmania, is estimated to be about 10 000 years old, but there is some debate over whether to call it an 'individual' tree or a 'colony of clones'.

If we accept Hallé's view that most plants are colonial anyway, we shouldn't care too much if trees like the Huon pine survive only because they spread vegetatively at their base by producing new stems to replace the old (i.e. they sucker or layer). This brings into contention the creosote bush (*Larrea tridentata*) from California, now over 11 700 years old. But this is a baby compared to a strange plant lurking in the Tasmanian World Heritage Area. Some years ago, I took part in an *Australian*

Geographic-sponsored expedition to Bathurst Harbour in south-western Tasmania. While I was wading through tea-coloured streams searching for new species of red algae, Jayne Balmer from the Tasmanian Department of Primary Industries, Water and Environment was collecting samples from one of Australia's oddest, perhaps its oldest, and certainly one of its rarest, plants. A member of the family Proteaceae and closely related to waratahs (*Telopea*), King's holly (*Lomatia tasmanica*) was first discovered in 1934 by local identity Denny King. That plant is now assumed dead, but King found a second population, confirmed by Tasmanian botanist Winifred Curtis, in 1965. It looks healthy enough, extending along creek gullies for over a kilometre, but none of the plants produces fruit or seed. Genetic testing by Jasmyn Lynch (who worked with Balmer) and colleagues from the University of Tasmania showed no detectable variation across the entire population. This is usually good evidence of a vegetatively reproducing species (although some plants that grow from seed may be genetically indistinguishable from one another, such as the wollemi pine, and, like the branches on an old tree, vegetative offshoots are not necessarily genetically identical).

Microscopic examination demonstrated that King's holly had three sets of chromosomes. When it comes to chromosome numbers, plants do mix it up a lot, and multiple copies are not uncommon. But triploids, as they are called, are rare. In *Lomatia*, and in fact in all its close relatives, a double (diploid) set of 11 chromosomes is standard. The fact that King's holly has 33 chromosomes explained why it couldn't produce fertile seed – triploid plants rarely find a way to split this odd number up and produce viable gametes (the reproductive cells that have a single or haploid set of chromosomes). It's thought that this odd set of chromosomes resulted from the successful fertilisation of a freak diploid gamete, with a normal haploid gamete, many years ago. Two plus one equals three!

Lynch and colleagues hypothesised that every plant in the 1 km stretch was once connected, and that it was probably fire that fragmented the 'clone'. Based on a combination of its current extent, carbon-dated fossils, the lack of genetic diversity, absence of seed and the unlikelihood of triploids occurring twice, they hypothesised that this clone may have started life over 43 000 years ago. Hard to confirm, but a tantalising proposition.

A few thousand kilometres north, plant ecologist Rob Kooyman discovered another long-lived clone. He suggested, provocatively, that

the peach myrtle (*Uromyrtus australis*) in New South Wales' Nightcap Range is, at least functionally, an immortal plant. That is, in the right circumstances it could live for ever. Kooyman and his research supervisor Peter Clarke from the University of New England are still trying to confirm the exact age and life history of this intriguing plant. Like King's holly, the peach myrtle has found a way to survive without reproducing from seed. Each individual consists of a large group of stems up to 12 m high, the biggest of which seem to be about 1500 years old. The plant 'regenerates' itself by replacing old stems with new, and is likely to be at least 10 000 years old.

But all this ignores the real stayers of the living world. Giant fungal networks are said to be the largest living organisms in the world, and they may be functionally immortal as well. Plenty of algae, fungi, bacteria and other microbes reproduce almost exclusively by splitting in two (without any sexual fusion), and we could describe their extended families as exceedingly old but disjointed individuals. They overshadow the paltry efforts of most animals, which at best live for a few hundred years or, if sea anemones, for a couple of thousand years. Being a plant, or a microbe, has benefits! And we can help a plant achieve immortality. The message for us, and for gardeners throughout the world, is to not give up on that wilting plant – to not let summer be the season of death and destruction. You have before you something that might live 'forever'. Or at least until the weather becomes less harsh in our Australian autumn.