Diversity through the flames of time

David Pearce on Pyrophytic ecosystems: their importance to the planet and their place at Ventnor Botanic Garden

In the Cape Floristic Provence of South Africa, there are 9000 vascular plant species, of which 69 per cent are endemic. In 0.5 per cent of the continent's land space are 20 per cent of its plant species, making it one of the most biodiverse places on the planet. Just south of Cape Town, Table Mountain alone contains a higher vascular plant diversity than the entirety of the British Isles, and this largely comes down to the infertile, geologically unique mosaic that is regularly refreshed and, importantly, 'reset', every 10-20 years by nature's gardener. Fire.

Banksia sphaerocarpa: It retains the hair-like pollen-presenters to aid its flammability (fig.1)

Fire can influence the ecology and persistence of many plant species. Such species can be termed 'pyrophytic' and consist of two types – 'active' and 'passive'. Active pyrophytes are so called because they encourage fires. Mediterranean species, such as *Cistus albidus,* contain volatile and flammable oils, which under high temperatures can combust spontaneously at around 35°C. Another active pyrophyte, *Banksia spaerocarpa* (Figure 1) has the additional ability to provide flammable incendiary devices.

The King Protea (Protea cynaroides): National flower of South Africa, growing in VBG's acidic bed in the South African Garden. Photographed in 2016 (fig 2)

Unlike their active counterparts, passive pyrophytes have evolved to resist fire. Their many adaptions include having thick, fire resistant bark, e.g. the American redwood *(Sequoiadendron giganteum)* – visible in the America's arboretum – or by having lignotubers (wood stem tubers from where the plant regrows after being burnt down), which are common in many South African Proteaceae (and can be seen in Ventnor's acidic bed in the South African Garden) (Figure 2).

Fire regimes are extremely important for many plants' phenological pattern of breaking seed dormancy. Many pyrophytic species require specific chemicals that are only induced by fire to break dormancy, while species which possess 'serotinous' seeds are only released from protective seed pods by specific heats, often specific to climate or region.

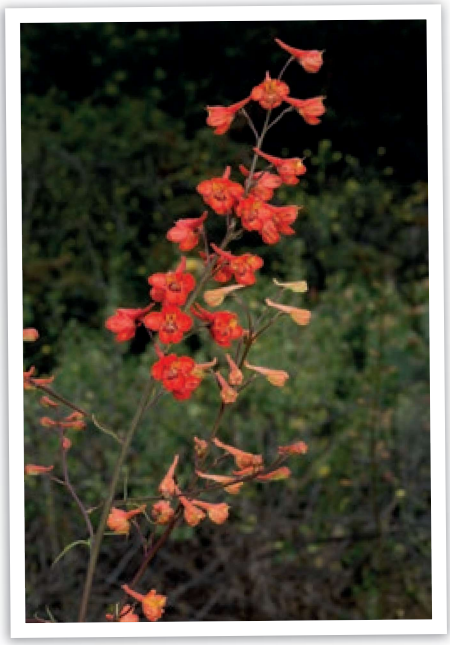
However, pyrophytes are feeling the effects of climate change. Increasing summer temperatures, in tandem with increasingly erratic weather events, such as storms and

lightning, have led to an overall increase in the occurrence and severity of wildfires throughout the globe. Most notable are the wildfires that have occurred throughout California and Western Australia. Hotter weather and human attempts at restricting and preventing wildfires (leading to a build-up of dry flammable detritus) has meant that fire regimes that have dominated these landscapes for the past thousands of years, shaping the ecosystem, are now disrupted.

As a result, the ecological benefits which pyrophytic plants commonly possess, such as having a head start over potentially competing species, are becoming less advantageous in the new environment, and struggle to persist. For species reliant on post-fire seed germination e.g. King Protea *(Protea cynaroides)* a slight increase in fire regularity can lead to long built-up seed stores being germinated and then burnt down before having the opportunity to set seed again.

Spectacular phenomenon: Annuals, such as Californian poppies, bursting into flower four months after a wildfire (fig 3)

It is not all doom and gloom though! Back in California, and four months after the large 2008 wildfire, one of nature's most fascinating and beautiful events occurred. Annual species including Californian poppies *(Escholtzia californica), Delphinium cardinale, Mimulus brevipes* and *Phacelia minor* burst from their mass of seed stores (Figure 3). These are succeeded by biennials, short-lived perennials e.g. *Dicentra chrysantha, Zauschneria californica* and short-lived woody shrubs, and scrub emerging from seed stores or from sub-terranean ligno-tubers e.g. *Romneya coulteri.* In the western cape of South Africa, for example, wildfires, which are often naturally caused by lightening, are subsequently followed by high rainfall. Plants can utilise the readily available moisture to germinate and grow, resulting in a burst of floral life and an increased chance in successful plant-pollinator interactions through mass blooming.



Delphinium cardinale (fig 4)

Botanic Gardens, such as Ventnor, play home to many species of pyrophytic plants. Indeed, pyrophytes can thrive in a British horticultural setting. Typically, they are more resistant to frost and cold due to characteristics evolved to grow back from fire damage, or to resist the burning through insulation. VBG therefore provides a perfect place for spreading awareness and encouraging the conservation and protection of these beautifully complex and much misunderstood ecosystems, which shape a large proportion of the world's biodiversity.

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