BIOLOGICAL SUCCESSION

STORY: IAN CROWLEY MAILDM MAIH MAHMC

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BELOW
Coprosma hirtella.
Pic: Melburnian / CC BY

In a joint submission by associated landscape industries to the 2020 New South Wales Independent Bushfire Inquiry, we outlined the necessity to advance succession. Advancing biological succession means progressing a series of changes in composition and complexity of an ecological community in order to provide climate stability.

Increasing biodiversity means increasing the diversity within, as well as between, different species of living things – plants, animals, fungi and micro-organisms – including diversity of age, state, longevity, behavioural traits and so on. As biodiversity increases, succession advances and thus creates an efficient functioning ecosystem.

Life on earth began around 3.8 billion years ago through a biological process called primary succession. 'Primary succession' refers to the original colonisation of an

BUSHFIRE INQUIRY SUBMISSION

'Natural Ecosystem Regeneration' is the basis for a 2020 New South Wales Independent Bushfire Inquiry submission – an initiative by Tig Designs, in association with AILDM, the Australian Holistic Management Co-op (AHMC) – Land to Market AustraliaTM, and the Australian Institute of Horticulture (AIH). The submission outlines the implementation of regenerative methodology and management practices for better landscape function, biosecurity, public protection and climate stability.
It recognises that large-scale application of Natural Ecosystem Regeneration requires particular tools and focused investment to achieve the desired outcome, and that in order to achieve true sustainability the execution of any program/s must be financially and socially beneficial as well as culturally enriching.
It puts forward that the supporting bodies are well-positioned to provide additional knowledge along with professional skills for landscape design, consultancy, planning, management, mapping and monitoring for efficient ecosystem regeneration.
It is their intention to provide and promote long-term business opportunities and enterprise creating meaningful employment in urban and regional areas of Australia.
The submission does not represent any political, religious or industry-based lobby groups.

WHAT IS BIOLOGICAL SUCCESSION?

The process by which the structure of a biological community evolves over time is 'ecological succession'. Two types have been differentiated – primary and secondary. Primary succession happens in what are essentially lifeless areas, where soil is incapable of sustaining life as a result of factors such as lava flows, newly-formed sand dunes, or rocks left from a retreating glacier.
Secondary succession happens in areas where a previously existing community has been removed – it is typified by smaller-scale disturbances that do not eliminate all life and nutrients in the environment.
Biological succession pertains to the evolution of the living things within that environment. They are all interdependent – namely plants, animals, birds, insects, and micro-organisms.

> "Life on earth began around 3.8 billion years ago through a biological process called primary succession."

environment by living things (microbes, plants, birds, insects, animals) that initiate biological evolution. Lichens attach to lifeless rock and slowly break parts of it down to mineral soil. Once there is soil, other 'low succession' lifeforms appear and gradually succession advances. It can take millions of years from the initial lichens on barren rocks to become a complex environment supporting 'high succession' or climax communities.

BELOW
Table 1: This table illustrates the characteristics and propensities of low and high succession environments.

LOW SUCCESSION ENVIRONMENTS	HIGH SUCCESSION ENVIRONMENTS
HYDROPHOBIC LANDSCAPE	HYDRATED LANDSCAPE
Fire	No fire
Species loss	Abundant habitat/refuge
Temperature extremes	Moderate temperature
High evaporation/evapo-transpiration	Effective transpiration/condensation
Regular drought	Occasional dry periods
Wind	Wind abatement
Storm damage	Habitat stability
Dust	No dust
Air contamination	Clean air
Run-off	Little to no run-off
Flooding	Little to no flooding
Erosion – soil loss	No erosion – building soil
Water contamination	Clean clear water
Imbalances/disease	Balance/health
Poor nutrient levels	Effective nutrient cycling
Detrimental solar energy flow	Beneficial effects of the sun
WATER ACROSS THE LANDSCAPE	WATER INTO THE LANDSCAPE
EMITS CO^2	SEQUESTERS CARBON
CLIMATE EXTREMES/VOLATILITY	**CLIMATE STABILITY**

'Secondary succession' refers to an instance of biological succession that occurs in an area where primary succession has already taken place – and there is established soil. Normally, secondary succession happens when an environment has suffered some catastrophe, such as severe fire, or human impact, such as over-clearing, tillage, or urban development – anything that renders bare soil.

Primary succession - in lifeless areas - is distinguished from secondary succession, which is the recovery of an existing biological community after a disturbance sets back the community's ecological structure to an earlier stage. With good planning, and appropriate preparation and actions, secondary succession can advance rapidly. →

BELOW:
Table 2: Abbreviated list of fire-retardant plants.

BOTANICAL NAME	COMMON NAME
Acacia fimbriata	Fringed Wattle
Acmena smithii	Lilly-pilly
Ajuga australis	Austral Bugle
Alyxia buxifolia	Sea Box
Angophora costata	Smooth-barked Apple
Brachychiton populneus	Kurrajong
Coprosma hirtella	Rough Coprosma
Corymbia maculata	Spotted Gum
Cyathea australis	Rough Tree-fern
Dianella revoluta	Black-anther Flax-lily
Dichondra repens	Kidney-weed
Eremophila santalina	Sandalwood Emu-bush
Ficus macrophylla	Moreton Bay Fig
Ficus rubiginosa	Rusty Fig
Hymenosporum flavum	Native Frangipani
Myoporum acuminatum	Boobialla
Solanum laciniatum	Large Kangaroo Apple
Solanum simile	Oondoroo
Viola hederacea	Ivy-leaf Violet

BELOW:
Table 3: Abbreviated list of fire-resistant plants.

BOTANICAL NAME	COMMON NAME
Atriplex nummularia	Old-man Saltbush
Atriplex rhagodioides	Silver Saltbush
Atriplex semibaccata	Berry Saltbush
Carpobrotus glaucescens	Bluish Pigface
Carpobrotus modestus	Inland Pigface
Einadia nutans ssp *nutans*	Nodding Saltbush
Enchylaena tomentosa	Ruby Saltbush
Eremophila debilis	Creeping Emu-bush
Hakea salicifolia	Willow-leaved Hakea
Melia azedarach	White Cedar
Myoporum parvifolium	Creeping Myoporum
Rhagodia candolleana	Seaberry Saltbush
Rhagodia crassifolia	Fleshy Saltbush
Rhagodia parabolica	Fragrant Saltbush
Rhagodia spinescens	Hedge Saltbush
Sarcozona praecox	Sarcozona
Scaevola calendulacea	Dune Fan-flower
Scaevola hookeri	Creeping Fan-flower
Sclerolaena diacantha	Grey Copperburr
Sclerolaena spp	All Copperburrs
Selliera radicans	Shiny Swamp-mat
Zygophyllum apiculatum	Pointed Twin-Leaf
Zygophyllum billardierei	Coast Twin-leaf
Zygophyllum spp	All Twin-leaf Plants

I like to think in terms of fire-retardant and fire-resistant environments. We need diversity of (predominantly perennial) species covering the ground, understorey as well as varying canopy. It is as much about 'conditions' as it is about plant selection. Once established, these plants help create 'good conditions' that stay moist more consistently – further increasing biodiversity and advancing biological succession. This all leads towards creating an efficiently functioning biological ecosystem.

BELOW:
Table 4: Other native plants to be considered when planning a fire-retardant/fire-resistant environment.

BOTANICAL NAME	COMMON NAME
Alpinia spp	Native Gingers
Archontophoenix spp	Alexandria/Bangalow Palm
Austromyrtus spp	Midgenberries
Backhousia citriodora	Lemon Myrtle
Brachychiton acerifolius	Illawarra Flame Tree
Brachychiton discolour	Lacebark Tree
Brachychiton rupestris	Bottle Tree
Buckinghamia celsissima	Ivory Curl Tree
Castanospermum australe	Blackbean Tree
Citrus australasica	Native Lime Bush
Cordyline spp	Native Cordylines
Cupaniopsis spp	Tuckeroo/Tamarind
Dendrobium spp	Orchids
Doryanthes excelsa	Gymea Lily
Elaeocarpus reticulatus	Blueberry Ash
Eupomatia spp	Bolwarra
Helmholtzia glaberrima	Creek Lily
Ficus spp	Fig Trees & Vines
Lepidozamia spp	Burrawangs
Macrozamia spp	Native Cycads
Microlaena stipoides	Weeping Grass
Myoporum parvifolium	Creeping Boobialla
Stenacarpus sinuatus	Firewheel Tree
Syzygium spp	Lilli Pillies
Toona ciliata	Red Cedar
Waterhousea spp	Weeping Lilli-pillies
Xanthorrhoea spp	Grass Trees

It is only when the ecosystem is functioning efficiently that we see the effective alleviation of 'natural disasters' and the consequential effects on our climate. To achieve this on the required scale needs a decision-making process and methodology to deliver fire-retardant/fire-resistant environments – blending 'high succession' species into our sclerophyll-dominant landscapes.

Most fire-retardant/resistant species are 'high succession' plants and share many of the following features:

- They moderate temperature (cooling in summer, warming on winter nights and mornings).
- They tolerate both sun and shade.
- They have advanced xylem, making them more efficient at pumping water and nutrients.
- They photosynthesise more efficiently.
- They have highly advanced, often multi-layered, deep root systems.

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- They provide habitat and soil stability, preventing landslip, and are less likely to fall in high wind.
- They are edible, forageable and herbaceous, providing food for animals to recycle.
- Their 'drop' breaks down rapidly and is consumed by the soil (microbial breakdown → humus → organic carbon).
- They are long-lived and/or multiply freely (in the suitable 'conditions' they help to create).
- They out-compete and create conditions that are not suitable for 'lower succession' plant communities or 'weed' invasion.
- They are fire-retardant and/or fire-resistant.

Neil Marriott has compiled lists of fire-resistant (plants that will not burn in the face of continued flame) and fire-retardant plants (plants that will not burn in the first wave →

Solanum laciniatum.

Pic: RI / CC BY-SA


Viola hederacea.

Pic: Peripitus / CC BY-SA

> In agricultural and natural landscapes and in gardens, if the soil surface is covered and there is reasonable vegetative cover, the soil will retain moisture.

of a bushfire, but may burn once dried out) for the Australian Plants Society (APS), taking into account the experience of APS Victoria members - many of whom have properties in areas that are fire-prone or have been affected by bushfires. Refer to Tables 2, 3 and 4 for abbreviated lists of plants suitable for eastern Australia. To see the full lists, go to the APS (Victoria) website.

In addition, there are many non-invasive exotic plants well worthy of consideration. Many deciduous trees provide effective summer shade and have highly valuable leaf drop that provides food for animals and a generous bulk of 'viable litter' for microbes that is soon integrated into soils.

In agricultural and natural landscapes and in gardens, if the soil surface is covered and there is reasonable vegetative cover, the soil will retain moisture. This means much less evaporation and the mitigation of temperature extremes, both hot and cold, creating climate stability. We need to manage the vegetative cover we have - plan for and take actions that increase biodiversity and advance succession. Over a relatively short period of time we can create environments that will not burn.

ABOVE

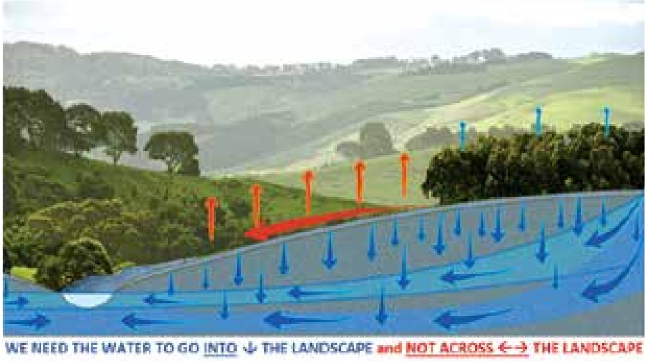
Table 5: On the left is an abundant cover and diversity of species while the right has bare soil. The difference results from how the landscape is managed, and in terms of temperature extremes the difference is profoundly significant. Pic: Stefar Zturisav. Patagonia, 21 July 2020.

RIGHT

Table 7:
Left is a deep carbon rich soil profile - stored, stable and resilient. Right has a volatile 100mm of topsoil, dependent on regular rainfall. These two core soil profiles were taken on the same day, from one side of a fence to another. The difference in water holding capacity and temperature/climate mitigation is the result of different landscape management.
Pic: Dr Christine Jones.

Alyxia buxifolia.

Pic: Melburnian / CC BY



ABOVE

Table 6: An efficient water cycle is essential in order to have an effective nutrient (and carbon) cycle, a beneficial solar energy flow and an ongoing succession of community dynamics. We cannot have one without the others.

ABOVE

Table 8: When we have dysfunctional ecosystems on large areas of land, we have greater evaporation and evapotranspiration, and less transpiration and condensation. The water cycle is less capable of functioning effectively. This, in turn, leads to a 'rejection' or 'pushing back' of weather events entering the land environmnent, which escalates the intensity of storms at sea.

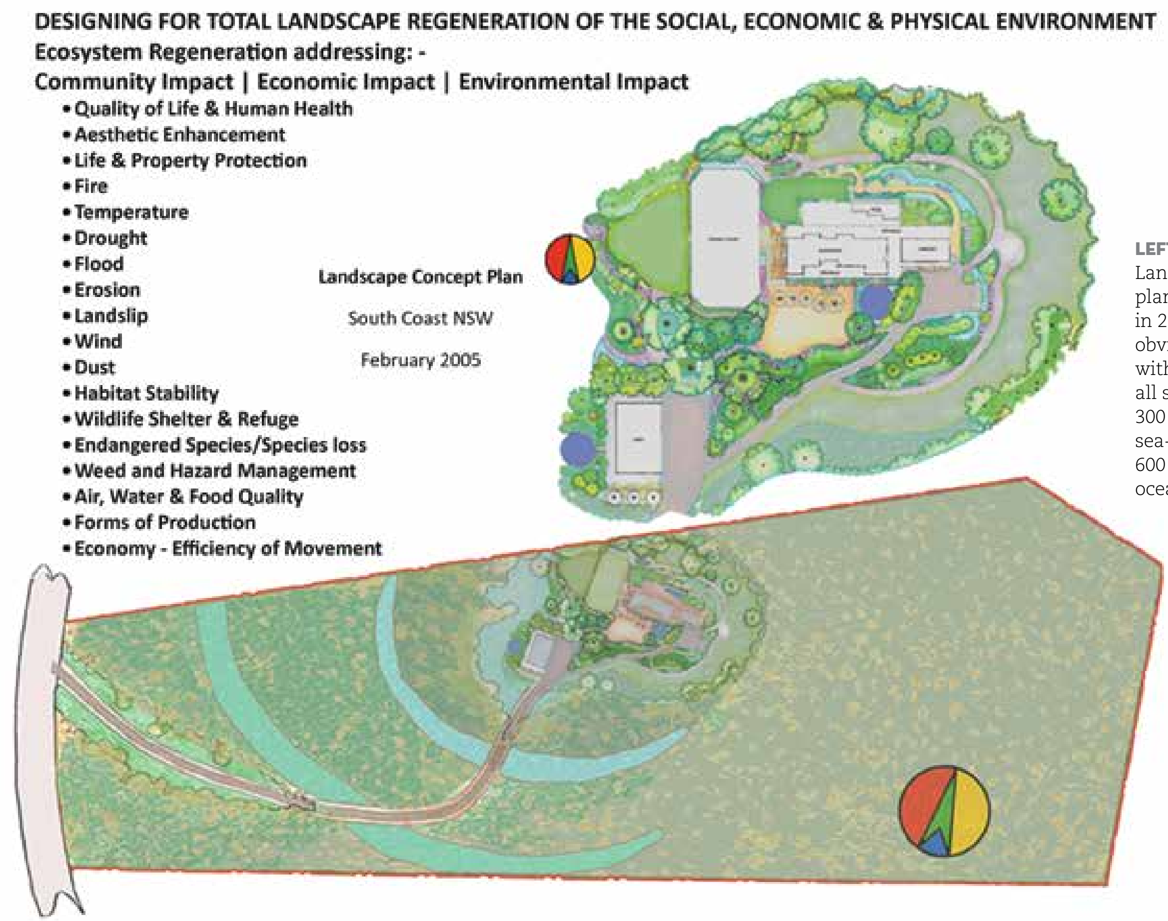
Acacia fimbriata. Pic: CC BY-SA

FURTHER INFORMATION

- **Australian Plants Society (Victoria)** www.apsvic.org.au
- **NSW Bushfire Inquiry** www.nsw.gov.au/nsw-bushfire-inquiry
- **Tig Designs** www.tigdesigns.com.au
- **Land to Market Australia** www.landtomarket.com.au
- **Australian Institute of Horticulture** www.aih.org.au
- **AILDM** www.aildm.com.au →

GARDEN DESIGN FOR BUSHFIRE ZONES

The landscape concept plan of this property near Batemans Bay, on the south coast of New South Wales, shows a layout of open areas, lawns, tennis court, car park, roads and tracks. This design, along with the use of fire-retardant and fire-resistant plants, enabled the buildings to survive the massive fire wave that swept through the property in January 2020.



LEFT
Landscape concept plan by Tig Designs in 2005. It was an obvious fire-risk site with a steep rise from all sides. It sits about 300 metres above sea-level and only 600 metres from the ocean.

ABOVE
New driveway to the garage, with planting that went in around 2008.

ABOVE
Aerial view of the site before and after the 2020 fire, from Google Earth. The owners described the fire as travelling very quickly, with flames up to around 70 metres high.

BELOW
Looking from the car park towards the shed. As well as fire-retardant/resistant plants, the open spaces in the design and the slashed areas were a part of providing effective fire breaks/detours that protected the property.

BELOW
The driveway with trees showing epicormic regrowth.

RIGHT
Looking towards the car park and residence. Road on the right leads to the garage.

BELOW
Predominantly high succession, fire-retardant plants "defused" the fire - these Lilli-pillies are along the drive. The driveway, although narrow, also helped.

BELOW
Lilli-pillies up against the cement tank. LO