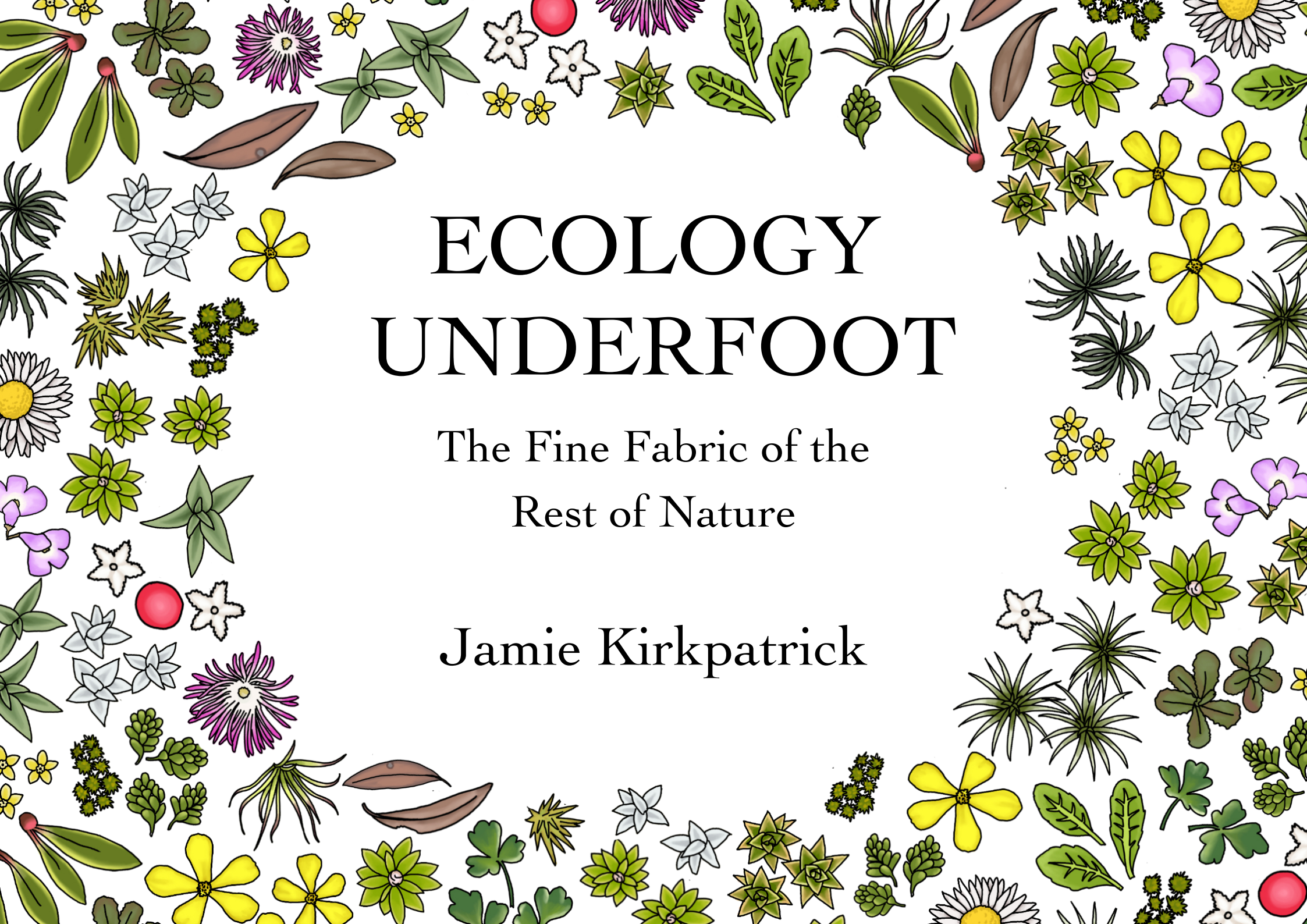


ECOLOGY UNDERFOOT

The Fine Fabric of the Rest of Nature

Jamie Kirkpatrick

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Hobart

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PREFACE

The rest of nature soothes and inspires us in a way denied to concrete driveways. There has been much celebration and cerebration of the rest of nature in the arts of photography and painting and the sciences of ecology and biogeography. You might think that we have enough output in both the arts and the sciences to sate the celebratory and cerebratory appetites of all, but I sensed a small gap, with a double emphasis on ‘small’.

In the many landscapes lacking grandeur in the ancient worn-down continent of Australia, there are places where the fabric of life, soil and rock at my feet, in closely oblique view, or near to my eyes in the vertical plane, have produced a jolt of aesthetic pleasure mixed with the esoteric delights of scientific curiosity. These places are, more often than not, forgotten or just never remembered. The aesthetic jolt has definitely been felt by others, as evidenced by much Indigenous art, the nature prints of William Morris and the closeup plan photographs of the rest of nature that dot the publications of Peter Dombrovskis. Scientific curiosity about processes that lead to patterns at this close up scale has been widely addressed if not assuaged. Indeed, science never ends in certainty about the relationships between process and pattern, while being very good at rejecting stories about them.

Herein, I present close up Morrisesque images of the rest of nature I know in southeastern Australia with scientific descriptions of their content and scientific speculations about their genesis. Most of the images are from non-iconic ecosystems. Some are from ecosystems that have enormous conservation value, but are little known. Most are from lutruwita aka Tasmania where I have worked as a geographer and ecologist in the University of Tasmania since 1972. They are roughly organised by type of ecosystem. I hope that you enjoy them as much as I enjoyed my part in creating this book.

Jamie Kirkpatrick

ANCIENT ALKALINE WETLANDS

The eye of God

Those flying over limestone and dolomite floored valleys in the remoter parts of southwestern lutruwita may notice white lines and oblong bare patches, occasionally with edges jagged enough to suggest bulldozer activity. These are rest of nature features of apparently ancient provenance, caused by seepage of alkaline waters from rocks full of lime. The alkaline water breaks up any peat that tries to encroach on waterways, often depositing fine black organic material further downstream. We suspect that these alkaline wetlands are ancient habitats, as they support plant species that date from the Cretaceous and the even more ancient stromatolites. During last glacial times, the valleys within which they occur were covered by grasses and herbs on which grazed wallabies which were hunted by Indigenous people. The warm, wet weather of the interglacial period in which we live has allowed acid, nutrient-poor peats formed by sedges, heaths and trees to cloak most of the alkaline soil that supported the grasslands. The iris in the eye of God in this scene is a mound spring. The whites of the eye are blearily yellowed by stromatolites. Alkaline waters flow in and out of the eye, the streams variously white or black depending on short term deposition patterns of the disaggregated peat particles. Fire boundaries are visible in the heath and sedgeland.



ANCIENT ALKALINE WETLANDS

Stromatolites and flowstones

Stromatolites are layered composites of micro-organisms and inorganic material that grow as life cements sediment into distinct layers. They are rare in the world today but are thought to be among the first expressions of life. They have been around for at least 3.7 billion years. Shallow saline marine and coastal wetlands are their usual habitat. The stromatolites in Lutruwita are highly unusual in that they are inland and not necessarily inundated. A bilious billowing stromatolite sits centrally in this scene in the upper Giblin River valley, one of the most remote areas of western Tasmania, at least two days walk from any road. Not surprisingly, the stromatolites at this site were only discovered in the two thousand and teenies, the proof of their existence being published in 2017. The authors of this paper suggest that the high alkalinity of the water prevents the local snails from snacking on the cyanobacteria that coat the outside of the hemispheres.

The calcite that binds the stromatolites may also be deposited along plant roots and in flowstones visible in the right centre. The plant is a sedge, bare twig-rush (***Baumea juncea***). The dark water is laden with organic colloids. The water-rounded gravel has been sorted by stream flow. Some may, or may not, be ironstone concretions, washed from the subsoil.



ANCIENT ALKALINE WETLANDS

Rippled beach sand

Although there is constant seepage from below feeding the alkaline wetlands, variation in precipitation causes fluctuations in depth. The precipitation comes in westerly waves, delivering more than two metres in toto in normal years, of which there are none. The swash of water over the fine sandy sediment that gives the dry wetlands their whiteness creates the same ripples we find on gently sloping coastal beaches. The fierce south-westerly winds that bring much of the rain create the flows that form the ripples.

A sedge, soft twig-rush (*Baumea rubiginosa*), sparsely occupies the lower part of this beach in the Maxwell River Valley. The sedge is rhizomatous (shoots connected by horizontal underground roots), which is a good strategy for persistence in a dynamic stream wetland.

The carnivorous plant, alpine sundew (*Drosera arcturi*), hunts the upper reaches, trapping and ingesting small invertebrates on its sticky leaves. This sundew is more typical of the high mountain alpine moors than lowland Tasmania, emphasising the distinctiveness of the alkaline wetland habitat. It is a geophyte, which means that it retreats to an underground organ during the unfavourable season for growth.



ANCIENT ALKALINE WETLANDS

Rippled river sand

Ripples in the alkaline streams that form with downstream flow are easily diverted by small tufted semi-aquatic plants. These plants form smooth islands by slowing down water flow, which, in turn causes deposition of sediment. Many of these streams are dry in summer, as with the plate from the Maxwell River Valley below, taken above the one on the adjacent page.

The photograph beside this text shows the ongoing dynamics of peat invasion and organic matter dissolution that control the boundaries of the stream bed. Outside the influence of intermittent alkaline flow, the heaths and trees grow tall and dense, forming peatlands with their detritus.





ANCIENT ALKALINE WETLANDS

Ancient plants in an alkaline stream

The Cretaceous was a moderately long time ago, 145 to 66 million years to be approximate. It is most noted for its dinosaurs, which sort of survive in the form of birds. There are a few plant species that appear from fossils to be less changed than dinosaurs from 66 million years ago. Tasmania has more than its fair share of these palaeoendemics, mostly found in fire-protected places on high mountains. In the centre of this alkaline stream in the Maxwell River Valley there are the rosettes of a rhizomatous palaeoendemic lily, short milligania (*Milligania johnstonii*). This species appears to be largely confined to alkaline wetlands in lowland western Tasmania, one of the many species that make this environment floristically distinctive. The veiled quillwort, *Isoetes jarmaniae*, the finer leaved rosette plant more visible in the next plate, was only described in 2021. It too is largely confined to the alkaline wetlands of inland western Tasmania. The two sedges and the shrub shown in this plate are not confined to alkaline wetlands. The shrub is the western swamp-heath, *Sprengelia propinqua*. The mat sedge is a western Tasmanian endemic, western cushion sedge (*Oreobolus tholicarpus*), described by Dennis Morris in 2001. The other sedge is *Baumea rubiginosa* (see above).

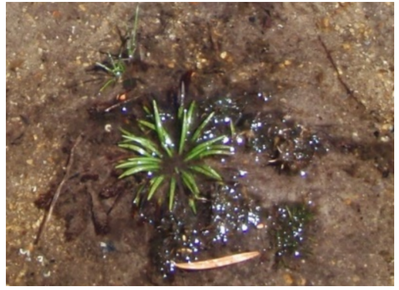


ANCIENT ALKALINE WETLANDS

Colouration in karst streams

Hemmed in by limestone outcrops, the dynamics of erosion and deposition of the stream within the karst landscape reveal the different colours of the horizons of the soil that once formed upon them. The yellow and red sediment is coloured by iron translocated down from the bleached horizon by acids in the rain and vegetation.

The alkaline wetland endemic veiled quillwort, ***Isoetes jarminiae***, is the prominent plant (see detail this page). Bryophytes cling to the limestone margin. Sparse sedges protrude from the mud.





ANCIENT ALKALINE WETLANDS

Rillenkarren on a red beach

Rillenkarren are grooves formed by the dissolution of rock by chemical weathering. On limestone they are often separated by sharp ridges, as with parts of the protruding bed rocks here. The red beach is a zone of seepage of alkaline waters, as seen in the image on the present page.

Wetland species, like *Milligania johnstonii*, occur in this seepage zone, as does the carnivorous geophyte, *Drosera arcturi*.





EASTERN WETLANDS

A lowland marsupial lawn

On the margins of streams and around the edges of freshwater and brackish enclosed wetlands it is common to find short vegetation dominated by herbs. We think that these marginal herbfields are created and maintained by intensive native animal grazing in places where the soil is moist throughout the year. They are often called marsupial lawns. Wombats, wallabies and pademelons prevent any tree or shrub establishment by eating all the seedlings along with the more delicious herbs, grasses and sedges. This lawn adjacent to a brackish wetland in the Midlands of Tasmania is dominated by fleshy pratia (*Lobelia irrigua*), whose flower and leaf details are below, and a sedge, the shiny bog-rush (*Schoenus nitens*). Both have flowers and fruits that cling close to the ground, hoping that the marsupial lawn mowers will miss their reproductive parts.





EASTERN WETLANDS

Another lowland marsupial lawn

This herbaceous lawn is in a remnant *Poa labillardierei* tussock grassland on a river flat in a back paddock in the northern Midlands of Tasmania. The sedge is well harvested by mammals, but the flowering herb appears less touched. The herb is the rhizomatous swamp mazus (*Mazus pumilio*) which flowers in summer when the black, cracking clays of the valley flats tend to be at their driest.

Because the image is from a back paddock grazed by sheep since the 1820s, it is not surprising that there is an occasional plant that belongs to a species introduced with domestic stock. In this case, the lesser hawkbit, *Leontodon saxatilis*, protrudes its deeply serrated leaves through the chewed sedge in the top middle of the plate.





EASTERN WETLANDS

A highland short herbfield

This community of herbs, sedges and grasses is found on grazed, disturbed ground at 1200 m above sea level on the eastern Central Plateau. Among buttercups (*Ranunculus*), the rosette daisy, alpine cotula (*Cotula alpina*), mosses and a spreading sedge, the purple flowers of the Tasmanian bladderwort, *Utricularia monanthos*, attempt to attract pollinators.

The purple flowers need very little foliage as the bladderwort gains sustenance by trapping and ingesting tiny invertebrates that frequent the soil solution.

Fleshy fruits from an adjacent shrub sit hopefully on the herbfield. Their chances of establishment are low, as any seedlings are likely to be eaten by the wombats, wallabies and pademelons as they graze the lawn. Also, the seeds of many of the fleshy-fruited shrub species require processing in the crops or alimentary systems of birds to break their dormancy.



EASTERN WETLANDS

Chewed on kunanyi

The mountain called kunanyi crouches over nipulina (Hobart), its back covered by a complex alpine garden. Past fires and differential peat growth have created many ephemeral small wetlands. These are often colonised by herbs, in this case a buttercup (*Ranunculus*).

The buttercup is kept prostrate by grazing, several leaves having been obviously truncated.

The pademelon shown on this page was photographed grazing lawns on lungtalanana (Clarke Island) in Bass Strait. The coastal sedge, the knotted club rush *Ficinia nodosa*, has managed to escape into inedibility.





EASTERN WETLANDS

Water-worked in the Vale

(photograph by Pippi Lawn)

The delightfully named subalpine Vale of Belvoir has vegetation reminiscent of parts of lowland western Tasmania during the Last Glacial. Palawa hunted wallabies here, there and then. In the Vale, the wallabies shelter in collapsed caves called dolines and, with wombats and pademelons, create many a marsupial lawn.

This lawn is also worked by water. Floods move the mounds imperceptibly downstream, eating away at the steep side, while soft snow grass (*Poa hiemata*), which largely forms the mound, traps sediment in its lee.

The round-leaved herb that fills most of the matrix is the Tasmanian mudleaf *Gunnera cordifolia*. It is too early for it to produce the mass of succulent red fruit that seasonally attracts flocks of screeching white cockatoos.

The dropping of macropods (wallabies and pademelons) are scattered over the *Gunnera*. These can be carried by wind and water, so have not necessarily dropped in place. They seem somewhat weather-worn.

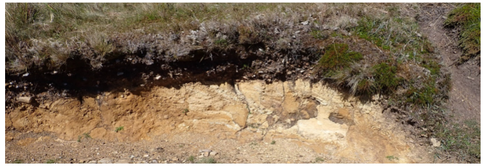


EASTERN WETLANDS

Vernal pond herbfield in the Vale

Vernal ponds fill up during the wet season and dry out at other times, creating a rare environment that often succours rare plants. The bright green plant that occupies the centre of the photo is very much succoured in this situation. It is an alpine mignonette (*Stackhousia pulvinaris*), which is common in mainland alpine areas, but rare in Tasmania, with the Vale of Belvoir being its stronghold. The reddish prostrate plant is a creeping raspwort (*Gonocarpus micranthus*). Also discernible are violets (*Viola*) and bent grasses (*Agrostis*).

The dolerite rock in the midst of the scene has been transported from Black Bluff to the north by glaciers that dropped it and other detritus as they retreated. This grey detritus, known as till, overlays much of the limestone-floored valley (see below).





EASTERN WETLANDS

Sphagnum in the Vale

Sphagnum (*Sphagnum cristatum*) bogs occur in the Vale of Belvoir where acid water slowly flushes through the ground. This water largely comes from the walls of the valley which are constituted of rocks that produce acid soils and are less prone to solution than the limestone that lies under the floor of the Vale.

Sphagnum forms mounds that continue growing until the constant flush of water is cutoff or other plants shade it out. Sphagnum is a favourable substrate for the establishment of other species of plants, in the past being used for this purpose in hanging baskets.

As the mounds grow, the sphagnum turns to peat, also highly valued in horticulture. The pollen taken from cores in the peat can tell us much about the course of vegetation change in the surrounding landscapes.

In this plate the sphagnum is the yellow matrix, while darker green mosses, bluish-green native grasses and the reddish-green foliage of woodrush (*Luzula*) can also be discerned.



EASTERN WETLANDS

Drying mud

Many wetlands are seasonally dry. Aquatic plants survive as tubers or seeds in the apparently barren mud, which cracks into pleasingly chaotic patterns. When the wetland wets up, they spring back to life. The fibres from their dried foliage can be seen in the mud.

The shallow wetland from which the main photograph was taken is typical of many in northeastern Tasmania and the Bass Strait islands in being a product of wind deflation. Dunes form on the leeward sides of these wetlands, the sediment being derived from the dry wetland floor. They are often brackish, like the one on the photo on this page, which is close to the east coast of lungtalanana.





EASTERN WETLANDS

Succulents mould drying mud

One solution to salinity is dilution. The least inundated parts of brackish and saline enclosed wetlands support succulent-leaved plants reminiscent of tidal saltmarshes. Narrow-leaved wilsonia (*Wilsonia backhousei*), the succulent, rhizomatous plant in this scene, enlarged to show detail on this page, does indeed occur in tidal saltmarshes, where it also occupies the least inundated zones.

Wilsonia holds the mud in place, while the wind removes sediment not so fastened. Its root system may also inhibit the cracking evident in the previous plate from the same wetland on lungtalanana.





EASTERN WETLANDS

Milfoil in the stream

The Vale River runs exceedingly clear as is typical of chalk streams. This clarity and the low acidity of the water seem to encourage profuse growth of aquatic plants, among which may hide the introduced trout that are hunted by fisher people hazardously throwing artificial fly lures. Despite this recreational boon, the almost ubiquity of trout in permanent streams and lakes has been a disaster for many of the small native fish, which are predated by trout past the point of local extinction.

The aquatic plant fashioned by the flow of the river in this scene is a milfoil, probably *Myriophyllum salsugineum*. Riverine aquatic plants are thought to be able to maintain themselves in the upper reaches of streams by hitching rides on the outside of birds. Such animal dispersal is necessary in a situation in which seed and plant fragments can only be carried downstream by water.



COASTAL ECOSYSTEMS

Wombats overgraze the coast

Maria Island has been used as a wild repository for threatened native Tasmanian animals for over fifty years. One of the early introductions was the Furneaux Group subspecies of the common wombat. The population has thrived to the extent that its grazing pressure has almost defoliated some coastal areas.

The largest of the native plants surviving the grazing pressure in the salt spray zone on this dolerite coast (see photograph this page) is the Australian salt-grass, *Distichlis distichophylla*.



The yellow leaves of *Distichlis* form fans in one plane as it trails across the scene. A close perusal will also reveal the natives, kidney weed (*Dichondra repens*) and soursob (*Oxalis perennans*). The most common plant in the photograph is the exotic buckshorn plantain (*Plantago coronopus*), which forms distinctive rosettes.



COASTAL ECOSYSTEMS

Wombats overgraze the saltmarshes

The tidal saltmarshes of Maria Island (see photograph this page) are also heavily grazed by wombats, making their vegetation close to two-dimensional.

There are only two plant species in the plate. The species with the spathulate leaves is a succulent herb, swampweed (*Selliera radicans*), usually found in marshes occasionally inundated by fresh water, as indeed is the case in this marsh, fed from Mt Maria. The other species is a wiry-leaved sedge, *Schoenus nitens*.



Because the marsh lies close to white gum (*Eucalyptus viminalis*) forest, as shown in the plate on this page, it is garnished by eucalypt litter carried by high tides.



COASTAL ECOSYSTEMS

Karkalla in bloom

In late Spring-early Summer, karkalla (*Carpobrotus rossii*) lights up the coasts of temperate Australia with its iridescent pink flowers. As a spreading plant it requires places free from dense shrubs. These are on the edges of saltmarshes, or where the salt spray is fierce enough to eliminate taller plants.

The fruits of karkalla are sweetly edible when ripe, but full of oxalic acid when not. They are much enjoyed by native herbivores and omnivores and people lucky enough to find and recognise them.

The coastal plant communities in which karkalla occurs have many plants that are edible for our species and also attract grazing and browsing animals that humans can eat. These resources were and are used by palawa people to supplement the profusion of delicious shellfish gathered from the adjacent waters. The discarded shells and bones at occupation sites form, in turn, a favourable substrate for the edible plants.



COASTAL ECOSYSTEMS

A coastal daisy bush

The coast has lots of shrub species that are only found there, all of them resistant to the desiccation that can result from salt spray deposited on leaves and other photosynthetic organs. This one is *Ozothamnus bracteolatus*, a coastal bush daisy confined to eastern Tasmania. Its reddish buds are about to burst into flower. Bracken (*Pteridium esculentum*) and sword sedge (*Lepidosperma*) grow in its shelter.

Many coastal shrubs, including *O. bracteolatus* have a waxy covering on their leaves. Wax on the leaf surface is effective in inducing salty water drops to fall off. It also presents a physical barrier, as salt spread from drying drops on unprotected leaves sucks out their moisture. The degree of salt resistance of shrubs on coasts can be judged from their relative asymmetry.



COASTAL ECOSYSTEMS

Patterns in a pea

Coastal heathlands are dominated by woody plants less than two metres tall, which sounds, and is, very unromantic. At most times of the year heathlands have an equally unromantic khaki mien. Mass flowering in Spring transforms them into a colourful garden, as with the scene on this page, looking towards Brown Mountain on the Tasman Peninsula.

Heaths are dominated by hard and small-leaved plants that are adapted to extremely low levels of nutrients, especially nitrogen and phosphorus. Pea shrubs, like this one, the golden pea (*Aotus ericoides*), contribute nitrogen to the soil, while the meagre phosphorus largely comes in salt spray captured in rainfall.



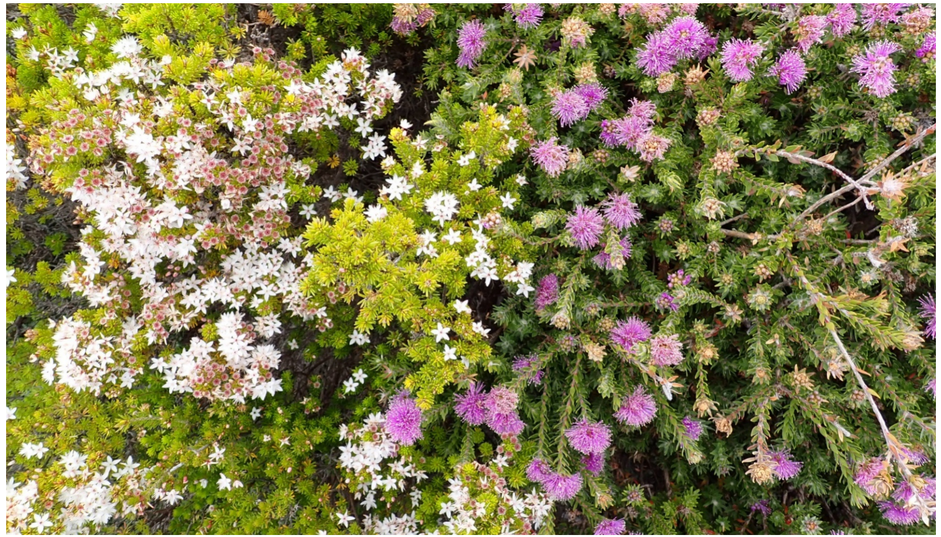


COASTAL ECOSYSTEMS

Mass-flowering myrtaceous shrubs

Many of the dominant shrub species in Tasmanian coastal heathlands belong to the Myrtaceae, the family that includes eucalypts (*Eucalyptus*), paperbarks (*Melaleuca*) and tea trees (*Leptospermum*). These shrubs and trees are all well-adapted to surviving fire, most resprouting from the base. Most also have massive seed release after fire. The seed is protected from heat by woody capsules that open after the fire.

The profusely white-flowered common fringe myrtle (*Calytrix tetragona*) forms part of the canopy of this heathland near Brown Mountain on the Tasman Peninsula. The purple-flowered canopy species is common honey myrtle (*Melaleuca squamea*). The *Melaleuca* turns whole landscapes purple in Spring wherever the soils are acid and the drainage poor, as can be seen above. *Calytrix* prefers better-drained ground than the *Melaleuca*, indicating a marginal environment for both species.



COASTAL ECOSYSTEMS

Scented paperbark

Like common honey myrtle, the scented paperbark (*Melaleuca squarrosa*) is a species of poorly drained ground. It may grow faster than common honey myrtle where the soils are slightly more fertile. The scented paperbark often grows to tree size, unlike common honey myrtle, being one of the heath species that can turn heathland into scrub then forest in the absence of fire for three or more decades. This transition has been widespread in eastern Tasmania. Many of the species that contribute to the high richness of Tasmanian coastal heath do not survive this transition, even as seeds or tubers in the soil.

Here, the yellow-flowered scented paperbark grows inter-tangled with a species more typical of eucalypt forests than heathlands, native currant (*Coprosma quadrifida*) whose fleshy fruits can be seen in the top right of the image. Native currant has an ambivalent relationship with the animal world, relying on birds for dispersal, but having leaves that are highly palatable to mammals. It protects its fragile foliage by developing fierce spines wherever browsed.



DRY FORESTS AND WOODLANDS

White gum belies its name

White gums (*Eucalyptus viminalis*) have white bark for most of the year. This bark is deciduous, falling to reveal a cloak of many vibrant colours to be whitewashed during the next year. Also revealed are many brownish-yellow fresh splits in the trunk. These are a bad sign, called gingering, indicating the severe drought stress that has killed a large proportion of white gums in Tasmania as climate has become warmer and drier from the 1950s onwards. White gum is thought to be the most drought-resistant of the Tasmanian native eucalypts, so is on the front line of decline. It has been particularly susceptible to dieback where a lack of frequent fire and grazing pressure has allowed more drought-resistant understorey species, like drooping sheoak (*Allocasuarina verticillata*) and prickly box (*Bursaria spinosa*) to form dense understories.

White gum foliage is highly palatable to many invertebrates and possums. Where it has an open understorey, a native bird, the noisy miner, forms breeding colonies and scares away smaller insectivorous birds, leading to overconsumption of leaves. Brushtail possum populations are elevated closed to crop and pastures, also causing defoliation.



DRY FORESTS AND WOODLANDS

A healthier peel

Mountain white gums (*Eucalyptus dalrympleana*) differ from white gums mainly in the shape of their juvenile leaves. They occupy naturally more moist places than white gum, so are not as susceptible to drought-induced dieback. They commonly occur with gum-topped stringybark (*Eucalyptus delegatensis*) in mountain forests on dolerite slopes.

Not all eucalypts have deciduous bark. The stringybarks and peppermints accumulate rough bark from year to year. This bark burns when a fire passes through, sending dense showers of sparks in advance of the fire front. The deciduous bark can hang in long tassels which are carried aloft as they burn, potentially to be deposited kilometres away in a phenomenon known as spotting.

The species with deciduous bark have thinner insulation for the business part of the tree than those with persistent bark but are equally protected, as deciduous bark reflects heat to a degree commensurate with the effects of extra thickness.



DRY FORESTS AND WOODLANDS

Coarse woody debris

Eucalypts can become coarse wood debris by snapping because their base and interior gets eaten away by invertebrates, fungi and fire. They can alternatively be wind-thrown in which case their root system becomes vertical as their trunk becomes horizontal. With the trunk in the horizontal position, invertebrates, fungi and fire continue the process of dissolution, revealing complex historical patterns of growth and disease in the harder parts of the trunk.

Coarse woody debris is not only important habitat in the forest, but also creates new habitats. Tree trunks burn extremely hot and long in dry forest. This heating aggregates soil particles, increasing water infiltration rates and aeration. When the fallen logs are eventually burned out after successive fires, there remain the shadows of logs discernible in varying vegetation growth rates.

The ultimate dissolution of wind-thrown trees is marked by paired mounds and hollows in the landscape, the mounds being where the soil attached to the roots falls as the roots disappear and the hollows, or pits, being the places from which the soil was removed.



DRY FORESTS AND WOODLANDS

Standing dead trees

Standing dead eucalypts have been increasing in abundance in the drier parts of temperate eastern Australia, largely because of warmer and drier climates and their effects on fire frequency and intensity. For example, in the forests around nipulina (Hobart), lutruwita, standing dead trees increased from 1.7 to 2.3 per ha between 2011 and 2021.

Standing dead trees can be important habitat for many species. Microbats utilise them for roosting. Birds and possums nest within them. Fungi and invertebrates feed on them.

Like fallen trees they have a limited lifespan. Most of the dead trees that covered kunanyi after the 1967 fire had fallen by 2021. This one may be close to horizontality, with a vertical split forming in the trunk.



DRY FORESTS AND WOODLANDS

Litter

Litter in its technical sense is just dead plant material. It can smother understorey growth and provides the fuel to make fires ferocious.



Most litter drops directly under the foliage of a tree, as can be seen under a drooping sheoak (*Allocasuarina verticillata*) in the plate on this page.

The sheoak litter is particularly effective in suppressing other growth. It is not because it releases chemicals that suppress other plants. In fact, it releases the macronutrient, nitrogen. It is because the litter is thick and underlain by thirsty surface feeder roots of the most drought-resistant tree in lutruwita.

Sheoak has male and female trees. The litter we see here is female.



DRY FORESTS AND WOODLANDS

More litter

The litter in eucalypt forests tends to be much less compact than that under sheoaks, as in this subalpine forest at Mount Buffalo, Victoria, where the dead leaves of eucalypts intermingle with bark from wattles (*Acacia*) and the dried leaves of tussock grasses (*Poa*).



The tussock grass will only burn when composed of 60% or more dead leaves. The eucalypt and wattle litter is too sparse to burn by itself. The drying out of these subalpine grasses can take place in hot summers. There have been extensive fires in the Australian Alps since 2000 that have left little of this type of forest unburned.

The eucalypt leaves range from fresh to decayed, indicating that fire has spared this area for several years, as eucalypt litter is long-lived. In some places, as with the forests on Maria Island (photo this page), the ground layer is almost all litter after a long period with no fire.



DRY FORESTS AND WOODLANDS

Fungi

Organisms that break down litter and dead wood, otherwise known as saprophytes, keep the ecosystem from choking up. Fungi are particularly effective in achieving such decomposition. Mostly, all we see of them is their reproductive parts, designed to produce and spread spores that can colonise other places. This plate depicts a coral fungus (*Ramaria*). The hyphae of the coral fungus that eat away underground are not visible.



DRY FORESTS AND WOODLANDS

The ecology of toilets

Even poos can make attractive underfoot patterns as with this wombat toilet on the Tasman Peninsula, Tasmania. Wombats appear to use toilets to mark their territorial claims, being careful at the same time not to place their cubes in places where they eat. Their reluctance to eat where they defaecate is ecologically important, as hoovering of short vegetation by wombats usually eliminates shrub seedlings, which may be their equivalent of chillies. Thus, the scat piles protect shrub seedlings, in this case manuka (*Leptospermum scoparium*). The hairy rice grass (*Tetrarrhena distichophylla*) is also prospering in the absence of wombat grazing.

Wombat scats can persist on the ground for over a year. Different ages of scats are marked by a transition from young glossy black outputs to yellowish decayed remnants which are often crushed underfoot.



DRY FORESTS AND WOODLANDS

Dwarf sunray

The yellow flowers of dwarf sunray (*Triplodiscus pygmaeus*), a rare annual daisy, brighten up a weedy abandoned gravel pit in the Tom Gibson Nature Reserve in the northern Midlands of Tasmania. It shares the ground with some other more common natives, including a spear grass (*Austrostipa*), a wallaby grass (*Rytidosperma*) and a guinea flower (*Hibbertia*). The small rosette plant is a non-native, small catsear (*Hypochaeris glabra*). Abandoned gravel pits and scrapes are among the best places to find rare and threatened plants, many of which require a lack of competition from other plants to prosper.

The ironstone nodules and the orange soil that can be seen between the plants probably formed in the warm, wet times of the Tertiary era, 2.6 to 65 million years ago when iron was leached down deep sandy soil profiles to leave the surface soil horizon grey.



DRY FORESTS AND WOODLANDS

Guinea-flower

The yellow flowers of the prostrate guinea-flower (*Hibbertia prostrata*) are half hidden by a tangle of dead and alive native grass leaves in this forest in the Midlands of Tasmania. The small distichous leaves of pointed ricegrass (*Tetrarrhena acuminata*) contrast with the long culms, leaves and litter of speargrass (*Austrostipa*). The eucalypt litter is that of white gum (*Eucalyptus viminalis*). Some flat, dead leaves of sagg (*Lomandra longifolia*), with their characteristic jagged ends, protrude into the top of the plate.



DRY FORESTS AND WOODLANDS

Blue beetle party

The larvae of the blue metallic flea beetle (*Altica corrusca*) feed on buzzies (*Acaena novae-zelandiae*) inflorescences. The blue metallic flea beetles can often be found in big gatherings like that depicted here, presumably to promote procreation possibilities.

The buzzie is the compound-leaved spreading herb mixed with mosses in the plate. The seeds of buzzies are famed for their ability to cling to socks and dogs. Buzzies quickly over-run any disturbed ground. Disturbed ground not being ubiquitous, animal dispersal is the answer for plants. The beetles fly.



DRY FORESTS AND WOODLANDS

Subalpine patterns

The subalpine Tasmanian snow gum (*Eucalyptus coccifera*) forests and woodlands are considered ‘dry’ because they do not have an understorey dominated by rainforest trees, broad-leaved shrubs or ferns, but do receive a metre or two of rain each year, enough to support the red-flowering Tasmanian waratah (*Telopea truncata*) in the woodland at Mt Field shown on this page.



The part of the forest floor in the main plate is punctuated by the white flowers of snowdrop wood-sorrel (*Oxalis magellanica*), a species with the Gondwanic distribution of Tasmania, New Zealand, Chile and Argentina.

The Tasmanian endemic high mountain shrub, alpine everlasting bush (*Ozothamnus rodwayi*), and the herbs alpine buzzy (*Acaena montana*), mountain cranesbill (*Geranium potentilloides*), mountain cudweed (*Euchiton traversii*) and mountain pennywort (*Hydrocotyle sibthorpiodes*) also nestle into the eucalypt litter.



GRASSLANDS

Scaly buttons

Scaly buttons (*Leptorhynchos squamatus*) are a common herb in the native grasslands of southeastern Australia. Here, shallow soil on Jurassic dolerite may have allowed them to persist in competition with a rich assemblage of native grasses. These grasses include wallaby (*Rytidosperma*), spear (*Austrostipa*), tussock (*Poa*) and weeping (*Microlaena stipoides*).

Lowland temperate grassland is considered threatened at the national level. Most of it has been transformed into cropland or non-native pastures since the British invasion of Australia. Attrition continues, as some of the best remnants are in the expansion zones of big cities, temporarily protected from destruction by land speculation. It is important to ensure that all elements of this ecosystem can survive until glacial times return, as it was much more extensive in these times than during the warmth and wetness of the Holocene and Anthropocene.



GRASSLANDS

Paper daisy

The paper daisy (*Leucochrysum albicans*) is a threatened short-lived perennial grassland daisy species with a wide distribution on fertile ground, but a tendency to disappear from sites in which it was once abundant and manifest itself on sites from which it was previously absent.

The paper daisy releases seed that can be carried long distances by wind but does not persist in the soil seed store. Protection from animal access results in local extinction of the species which appears to require freedom from competition from other vascular plants to establish seedlings.

Here, the competition is very sparse, consisting of the scattered rosettes of the variable plantain (*Plantago varia*), two individuals of the exotic lesser hawkbit (*Leontodon saxatilis*) and an occasional struggling grass. The shallow soils around a dolerite rock outcrop may be the ultimate reason for the success of the paper daisy here.



GRASSLANDS

Paper daisy on the way out

The paper daisy (*Leucochrysum albicans*) in flower in this plate is one of several that established on an animal path through grassland. The grazing pressure here has been reduced to such an extent that it seems unlikely that the paper daisy will retain possession of the site once these plants die. There are scats of wallabies, but in an advanced state of decay.

Rodway's tussock grass (*Poa rodwayi*) is a species widespread in lowland grasslands and grassy woodlands. Its blue-green foliage contrasts with the red-green of the often codominant kangaroo grass (*Themeda triandra*). The plant with the crossed leaves in the top left of the plate is a shrub, dwarf riceflower (*Pimelea humilis*).



GRASSLANDS

Bindweed

Not all flowering plants in lowland grassland are as susceptible to disappearance as the paper daisy. The pink-flowered Australian bindweed (*Convolvulus erubescens*) twines among the grasses, emerging from a woody taproot. This root was used by Indigenous people to make a sustaining dough. The yellow flower is that of a native soursob (*Oxalis perennans*).

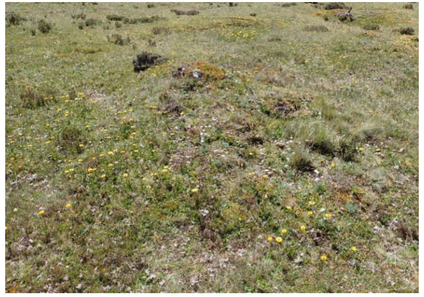
The diversity of herbs in lowland native grassland is increased by reduction of the biomass of grasses and their litter. We suspect that, under Indigenous management, this reduction was mainly by consumption of grasses by kangaroos, pademelons, wallabies and wombats, and occasionally by cultural burning. The grasslands and grassy woodlands were intensively managed to produce root and grain crops for people and forage for the animals that people hunted. Digging for tubers and roots created an environment suitable for regeneration of the food plants and cultural burning removed rank grasses in favour of tender green shoots.



GRASSLANDS

A daisy-covered lawn

The highland native grasslands have not been depleted as badly as those in the lowlands. They are associated with fertile ground on rocks like basalt and limestone. Some have remained treeless since the Last Glacial through a combination of the inability of most trees to invade into full grassland cover, fire management by Indigenous and later peoples and the consumption of tree seedlings by grazing animals. Alternatively, they have been converted from forest by burning. The daisy-rich grassland depicted on this page and the next has the pit and mound topography that suggests that it was a forest in the past.



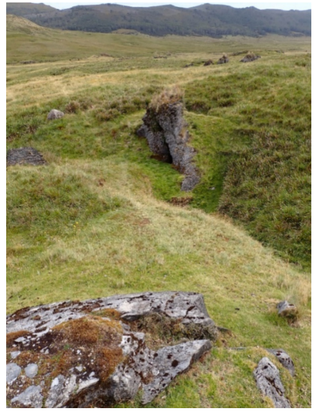
The golden alpine everlasting (*Xerochrysum subundulatum*) forms rhizome-linked patches, whereas the white flowers of the paper daisy (*Leucochrysum albicans*) emerge from individuals occupying a linear disturbance possibly created by animal foot traffic.



GRASSLANDS

A lichen-dotted lawn

The limestone that underlies the Vale of Belvoir surfaces occasionally, as in the plate on this page. The patterning of vegetation on the floor of the Vale is strongly influenced by the degree to which limestone forms the soils, as the Vale is top-dressed in large part with less fertile till, the detritus from a past valley glacier.



The browner vegetation visible in the Vale is on the till. It is dominated by a flag iris (*Diplarrena latifolia*). The more lime-rich soils are covered by grasslands dominated by tussock grass (*Poa*).

On some of these slopes, but not others, the tussock grass is garnished by the occasional golden flower of alpine everlasting (*Xerochrysum subundulatum*), in turn decorated by coral lichen (*Pulchrocladia retipora*). We do not know why.



GRASSLANDS

Glowing landscape

There are many places on land on planet sea where a profusion of wildflowers can turn drab into glowing landscapes. These are usually places where there are strong temporal contrasts in the availability of pollinators. These can be seasonal contrasts as in the Mediterranean and high mountain climate zones of the world. In desert and semidesert areas, the occasional heavy rain, unpredictable in year and season, also produces masses of colourful wildflowers. The time of the year in which the rain occurs affects the species composition of the floriferous sward.

The alpine everlasting (*Xerochrysum subundulatum*) forms the most outstanding flower displays in Tasmania. Here, again in the high mountain Vale of Belvoir in Tasmania, it appears to have occupied previously bared ground, spreading through its system of rhizomes (roots parallel to the surface with the capacity to produce new shoots).



GRASSLANDS

Soft snow grass

The soft snow grass (*Poa hiemata*) forms small soft starry tussocks in highland grassland and herbfield on fertile ground in the Australian Alps and eastern Tasmania. Its delicate light green foliage makes it distinct from the many other *Poa* taxa that are found in the alpine zone.

Poa is one of many genera in which the anastomosing river of evolution creates taxonomic difficulties. Distinct species may be apparent in each of many areas, but few of these taxa share the same characteristics between areas. The soft snow grass appears to be an exception to this lack of constancy.

In this plate, the interstices between the soft snow grass are occupied by mountain pennywort (*Hydrocotyle sibthorpioides*). This creeping plant in the ivy family (Araliaceae) is associated with constantly moist places.



GRASSLANDS

Grassland herbs invade dead shrub

Liawenee Moor is a basalt plain to the east of Great Lake on the Central Plateau of Tasmania. Pollen records show it to have been grassland between the Last Glacial and the invasion of the British and their domestic stock which resulted in substantial shrub invasion. This photograph was taken in an area fenced to keep out stock and native grazers a half century ago. The main invading shrub, the alpine grevillea (*Grevillea australis*), has senesced in its middle. Foliose lichen festoon its dead stems, while mountain billybuttons (*Craspedia gracilis*) extend their globular compound flower heads above the chaos.



ALPINE ECOSYSTEMS

Creeping pine

There is less than 100,000 ha of alpine and subalpine vegetation in Tasmania, yet this area supports most of the species confined to Tasmania (Tasmanian endemics) and almost all of the palaeoendemic plant species, those that have survived since the Cretaceous 66 million years ago. Several of the palaeoendemic plant species are pine relatives (Gymnospermae) that dominate the parts of the alpine areas that are long unburnt.

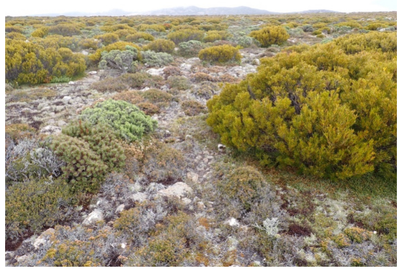
The palaeoendemic creeping pine (*Microcachrys tetragona*) has succulent red fruits that taste of turpentine and leaves that are arranged to be square in cross-section. The fruits are dispersed by clinking currawongs in their cigar-shaped regurgitates. They carry fleshy fruits up to 300 metres from the parent plant.



ALPINE ECOSYSTEMS

Alpine heathlands

Tasmanian alpine vegetation is unusually shrubby because the highly maritime climate makes snow sporadic, even in winter, and the ground is usually rocky, which favours shrub roots over those of grasses and herbs. The alpine heath bears a strong resemblance to the fynbosch of South Africa in both appearance and in dominant plant families, notably the proteas (Proteaceae) and the heaths (Ericaceae). The proteaceous yellow bush (*Orites acicularis*) dominates the scene from kunanyi on this page and peeks into the scene beside.



Also in the scene beside are the revolute orites (*Orites revolutus*), the ericaceous broomheath (*Monotoca submutica*) and the alpine everlasting bush (*Ozothamnus rodwayi*), which is one of the many shrub daisies found in the Tasmanian alpine zone. It is the blue green bush in the centre left of the picture on this page.



ALPINE ECOSYSTEMS

Non-tree violet

While most shrubs in the alpine zone are not found in the lowlands of Tasmania, the tree violet (*Melicytus dentatus*) is an exception, even being found on coastal dunes. The form of the alpine plant belies its name. The tree violets in the alpine zone are prostrate with coarse woody thorns protecting the leaves and lilac fleshy fruits from the grazing animals who find them one of the more delicious alpine offerings. In alpine areas they are usually in situations where seedlings would be protected from marsupial grazing by rocks or a combination of rocks and steepness.



ALPINE ECOSYSTEMS

Resprouter

Most alpine shrubs are obligate seed regenerators, unlike the shrubs in lowland heath, almost all of which resprout from the base after fire or felling. The revolute orites (*Orites revoluta*) both resprouts, and establishes from seed, after fire in the alpine zone, so is often the most prominent shrub in alpine heath in the decade or two after fire (see photo this page). It also persists and reproduces in alpine heathlands for at least 75 years after fire.





ALPINE ECOSYSTEMS

Rigid candleheath

The rigid candleheath (*Richea sprengelioides*) belongs to an Australian endemic ericaceous genus that has been suggested to be more appropriately subsumed in the genus *Dracophyllum*. The Tasmanian taxonomists who produce the Census of Tasmanian Vascular Plants have decided not to accept this revision, which is a relief for ecologists who all too frequently have to cope with changes in scientific names caused by variations in the finer judgements of those who erect formal names. Common names are even more chaotic, mostly varying in space rather than time.

The rigid candleheath is one of the most common species in its genus, occurring in heathland in dry situations on almost all of the mountains with alpine vegetation in Tasmania. Its leaves are rigid and prickly. It does not resprout after fire but does readily return from seed, possibly held in the soil seed store.



ALPINE ECOSYSTEMS

Scoparia

Scoparia (*Richea scoparia*) is seldom underfoot, more commonly manifesting as a dense, prickly wall ranging in stature from knee height to head height. Most forgive it because of its glorious flowers. On most mountains in the centre and east of Tasmania these form a tapestry of different colours. Here on Mt Mawson, we can see two of these colours as we behold the prickly wall. In the western mountains, scoparia has white flowers. We suspect that the difference may relate to variation in pollinators, but do not really know.

Scoparia is killed by fire, but returns in the following few decades, possibly from the soil seed store. New plants establish in a matrix of existing vegetation for at least three quarters of a century after fire. It is the dominant that often replaces the fire-sensitive native pines after fire, but it is not a species that disappears from long-unburned vegetation.



ALPINE ECOSYSTEMS

Alpine heath

Alpine heath (*Epacris serpyllifolia*) is among the most widespread alpine shrubs in Tasmania, to which it is confined. Like most Tasmanian alpine shrubs it is an obligate seed regenerator, probably from a soil seed store. Its profusion of white flowers attract a wide range of pollinating insects.

A stem of rigid candleheath (*Richea sprengelioides*) and some leaves of tussock grass (*Poa*) poke through the dense foliage of the heath.



ALPINE ECOSYSTEMS

Kerosene bush

This is one of several alpine shrub daisy species that have been labelled kerosene bush because of the ease of ignition of adult plants. The two most common of these species are *Ozothamnus hookeri* and *O. ledifolius*. The former species is widespread and abundant on most eastern Tasmanian mountains, while the latter, depicted here, is sporadic in its occurrence in the same region, while being extremely common on kunanyi (Mount Wellington), where this picture was taken.

The volatile oils that make kerosene bushes so flammable give them a gorgeous scent and a slight stickiness. On kunanyi, both the kerosene bushes were highly common 10-30 years after the 1967 fire, but after 50 years are becoming infrequent with little sign of regeneration.



ALPINE ECOSYSTEMS

Alpine baeckea

The geometric patterning in this stand of alpine baeckea (*Baeckea gunniana*) on kunanyi (Mount Wellington) may result from abrasion as individual plants are moved by the many murderous gales that sweep the alpine zone.

Alpine baeckea is associated with poorly-drained places in the alpine zones of Tasmania and the Australian mainland. Its leaves are highly aromatic, as befits a member of the Myrtaceae family. Bushwalkers who have exhausted their tea supply often use it as a substitute.



ALPINE ECOSYSTEMS

Mountain rocket

Mountain rocket (*Bellendena montana*) is among the most ancient of Tasmanian endemic plants, having survived since the Cretaceous, 66 million years ago. It belongs to the Proteaceae family. It is widespread in the eastern and central Tasmanian mountains in montane, subalpine and alpine treeless habitats where it regenerates from seed after fire but persists well where there is no fire. This photograph was taken on Bonds Plain near Cradle Mountain where it occurs in a matrix of tussock grass (*Poa*). The dissected leaves of a mountain cranesbill (*Geranium potentilloides*) and the entire leaves of an everlasting daisy (*Coronidion scorpioides*) can be seen among the grasses. The red fruits seen in this plate follow attractive white flowers.



ALPINE ECOSYSTEMS

Native pepper

The native pepper (*Tasmannia lanceolata*) is one of the few Tasmanian native plants that is cultivated for a crop, in this case, the black fruits which are used for a distinctive condiment. The species extends from close to sealevel in coastal rainforest in southwest Tasmania, where it forms a small tree, to the highest altitudes, where it forms a wind-flattened shrub.

This plate is in the latter situation near the peak of Mount Field East at 1270 m above sea level. Fleshy-fruited species are common in alpine ecosystems in lutruwita. Many of the shrubs with such fruit seem to start their lives sheltered among the profusion of dolerite rocks and boulders that garnish peaks and plateaus.



ALPINE ECOSYSTEMS

Thyme-leaved heath

Thyme-leaved heath (*Trochocarpa thymifolia*) has the most gorgeous lilac fruits which develop from equally attractive pink flowers that terminate branchlets. It is found on both sides of the boundary between Tasmanian snow gum (*Eucalyptus coccifera*) woodland and eastern alpine heath. Like most alpine heaths (Ericaceae) it only regenerates after fire from seed. Like most of the many fleshy-fruited plants found in the alpine and subalpine zones of Tasmania it is dispersed in cigar-shaped regurgitates by the clinking currawong.



ALPINE ECOSYSTEMS

Gunn's geebung

Gunn's geebung (*Persoonia gunnii*) is one of two Persoonia species found in the alpine areas of western Tasmania, here on the Needles. Moscal's geebung (*Persoonia moscalii*) is confined to a very few peaks in the far southwest. It has flattened rather than curved leaves. The naming of species after collectors of plants has a long history in Tasmania. Gunn and Milligan were collectors in the early nineteenth century. Gunn mainly frequented eastern Tasmania, while Milligan collected in the west, meaning that one can usually tell which half of the State a species list comes from. Tony Moscal was a Rumanian refugee who migrated to Tasmania after World War Two. Drawn to western Tasmania by his passion for bushwalking, he became fascinated with the many Tasmanian endemic plants. In his wanders through remote and difficult country he discovered a few new ones.



ALPINE ECOSYSTEMS

Rosette land

The quartzite mountains of western Tasmania have highly distinctive alpine vegetation with a large proportion of Tasmanian endemic species, many of which do not occur on other substrates. The Needles is the easternmost of these alpine areas. Most of its alpine zone was burned in the 2019 fires (see photo this page).



Five years after this fire, plants of rosette form cover most of the ground. The most abundant of these is Milligan's dragonleaf (*Dracophyllum milliganii*). The dark silvery-blue rosette is the alpine daisy (*Celmisia asteliifolia*). The reddish rosette with blunt leaves is trigger plant (*Stylidium graminifolium*). The rush with flattened leaves is Isophysis (*Isophysis tasmanica*). Other species include bauera (*Bauera rubioides*) and the alpine everlasting bush (*Ozothamnus rodwayi*).



ALPINE ECOSYSTEMS

Carpet heath

The carpet heath (*Pentachondra pumila*) is a palaeoendemic species currently found in alpine and treeless subalpine vegetation in Tasmania, Australia and New Zealand. Its shiny leaves shed snow and ice. Its fruits develop over winter, so both flowers and fruits are visible in early summer. Silver mat heath (*Montitega dealbata*) is a subsidiary species in the mix. It is a Tasmanian high alpine endemic. One individual of alpine carraway (*Oreomyrrhis sessiliflora*), another high mountain Tasmanian endemic, can also be seen.

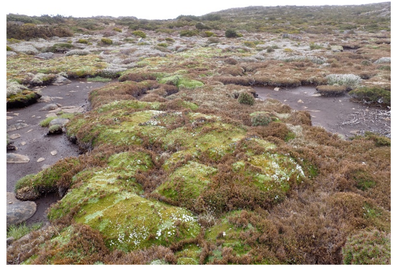


ALPINE ECOSYSTEMS

Mosaic bolster heath

Mosaic bolster heath occurs in wet, windy places where taller plants fail to get traction, as on Mount Mawson in the photograph on this page where the bolster heath has dammed two vernal peaty ponds. Although resembling soft cushions, the bolsters can easily support a human being without collapsing. Each bolster in mosaic bolster heath is composed of several different species that colonise each other to maintain their proportions but not the precise patterns.

There are two bolster species in this plate. The blue-green one is an herbaceous daisy, the sage cushion plant (*Pterygopappus lawrencei*) . The red-green cushion plant in profuse flower is the shrubby cushion plant (*Dracophyllum minimum*), a heath shrub. They are colonised by rope-rush (*Empodisma minus*).





ALPINE ECOSYSTEMS

Epiphytes in mosaic bolster heath

It is not only the bolster species that establish in other bolster species, but also many other vascular plants, some of which are almost restricted to bolster surfaces. Here, the surface of the cushion is composed of the reddish shrubby cushion plant (*Dracophyllum minimum*), the blue-green sage cushion plant (*Pterygopappus lawrencei*) and the mid-green eastern cushion plant (*Abrotanella forsteroides*). These cushions are scattered with the red leaves of the carnivorous alpine sundew (*Drosera arcturi*). Other epiphytes that can be seen are the alpine heath (*Epacris serpyllifolia*), an undescribed cushion species of *Sprengelia* and an orchid.

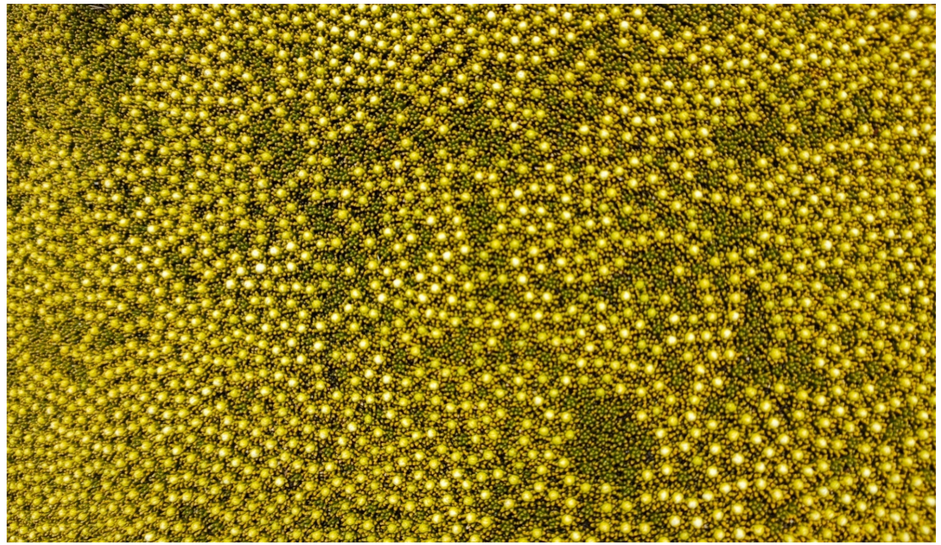


ALPINE ECOSYSTEMS

Western cushion plant

Photograph Deniz Yaldiz

The western cushion plant (*Donatia novae-zelandiae*) is common in the western and central mountains but absent from the eastern mountains. It also occurs in New Zealand but not on the Australian mainland. It can easily be identified from the silky hairs at the base of its leaves, unfortunately not evident in this plate. It is about to be covered with white flowers. The few days of summer in which mass flowering of cushion plants takes place and calm sunny weather prevails produce a deep hum of insect pollinators in fragrant air. The cushions, as approximations of geodesic domes, are well-shaped to soak up heat from the sun, even in winter, so grow the year round.



ALPINE ECOSYSTEMS

Bolster plantain

The eastern cushion plant (*Abrotanella forsteroides*) and the sage cushion plant (*Pterygopappus lawrencei*) host the star-like rosettes of the Tasmanian endemic bolster plantain (*Plantago gunnii*) on the eastern Central Plateau.

The bolster plantain is confined to the surfaces of these two bolster species. The bolsters can be overwhelmed by other plants, destroying its habitat. The higher fire frequency on the eastern mountains than in the central and western mountains helps prevent this transition.

The photograph on this page was taken five years after a fire killed the shrubs that were shading out the bolsters.





ALPINE ECOSYSTEMS

Ciliolate hebe

The ciliolate hebe (*Veronica ciliolata*) is one of the vegetable sheep found widely in the high country of New Zealand. It is known from only one crag on Ben Lomond in Australia, where it is in turn confined to sites more than 1500 m above sea level (see general habitat photograph on this page). Many of the plants in this restricted population appear to be dying back, as is the case in this plate, possibly the result of warming or less mist.



The blue-green mat shrub that covers most of this area is the silver mat heath (*Montitega dealbata*) a Tasmanian alpine endemic. The carrot-scented alpine carraway (*Oreomyrrhis sessiliflora*), another Tasmanian alpine endemic, forms rosettes in both the cushion and the mat shrub.



ALPINE ECOSYSTEMS

Leonine hebe

A healthy ciliolate hebe (*Veronica ciliolata*), looking leonine, creeps onto a dolerite rock face. It does battle with soft tussock grass (*Poa hiemata*) and a mat coprosma (*Coprosma*) for space where there is soil. Several herb species also take advantage of the shallow soil. These include the alpine buzzy (*Acaena montana*), the snow gentian (*Chionogentias*), a Tasmanian eyebright (*Euphrasia collina*) and the alpine sundew (*Drosera arcturi*).



ALPINE ECOSYSTEMS

Lanoline hebe

The ciliolate hebe (*Veronica ciliolata*), like other bolster plants, accumulates its dead leaves below its green surface. In most places in Tasmania, the bolsters are used as resting places by wallabies, their weight depressing hemispherity. Steep rocky slopes are an exception, the potential for the development of vegetable sheep obviously being present.

Alpine environments above the upper limit of trees are a rarity in Tasmania, although most plant species that occur within them are common in the extensive treeless subalpine areas of the State. There are a very few species that are found above the treeline that are not usually found below. The ciliolate hebe is one of them. The increase by over a degree in daily maximum temperatures between the 1940s and 2020s is in the process of pushing these species into thin air. Their future may be as cultivated plants with no habitat left in the wild.



ALPINE ECOSYSTEMS

Short alpine herbfield

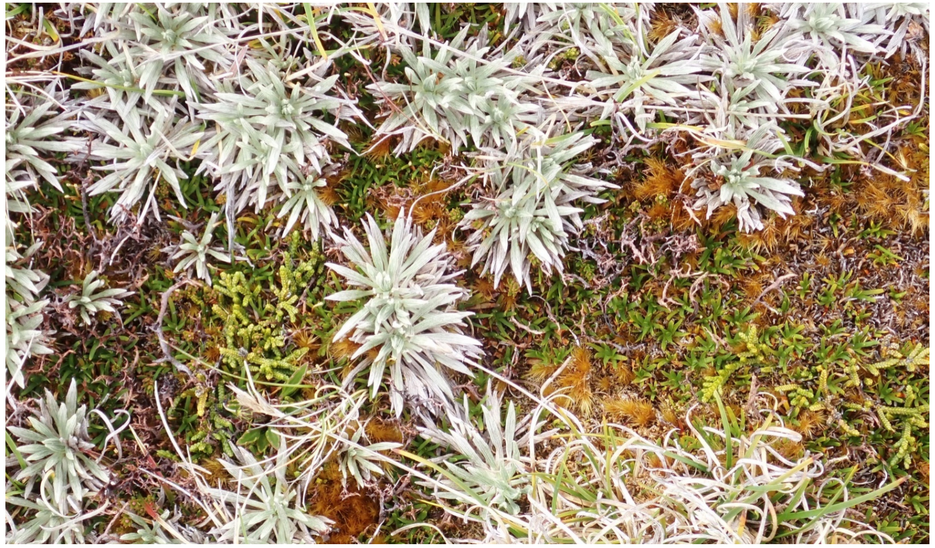
The blue-green leaves of the edelweiss-like, rhizomatous mat herb, rusty cushion plant (*Ewartia meredithiae*), dominate the vegetation on the shallow soils of a wind gap high on the Hartz Mountains. The green rosettes of the equally rhizomatous alpine rosette fleabane (*Erigeron stellatus*) add to the herb cover. The dark vegetation is a crust of moss and lichen. The western cushion plant (*Donatia novae-zelandiae*) is at its eastern extent here. The mountain swamp heath (*Sprengelia montana*) hugs the ground. Sedges, including the small flower-rush (*Carpha alpina*) and a tuft-rush (*Oreobolus*) add to the lifeform mixture. Dolerite rock protrudes from the vascular vegetation, largely covered by moss and lichen.



ALPINE ECOSYSTEMS

White snow daisy

The white snow daisy (*Celmisia saxifraga*) is a rhizomatous rosette-forming herb that dominates short alpine herbfield on shallow soils above the climatic treeline on many Tasmanian mountains. Here it grows in a matrix of moss, lichen, a cushion-forming tuft-rush (*Oreobolus pumilio*) and creeping pine (*Microcachrys tetragona*). An occasional small flower-rush (*Carpha alpina*) extends above the white rosettes.



ALPINE ECOSYSTEMS

Mountain cudweed

In the 1970s, the Tasmanian Parks and Wildlife Service put bulldozers into the alpine vegetation on Mt Mawson to ‘groom’ the slopes. In complicity with global warming, the rest of nature punished them by refusing henceforth to produce more than a few days of skiable snow. Native plants have occupied most of the scraped areas. Mosses were the initial colonisers, followed by herbs. The blue-green herb is mountain cudweed (*Euchiton traversii*). The widespread rosette plant is hair tuft plantain (*Plantago paradoxa*). The other rosette plant is mountain raspberry (*Rubus gunnianus*), which produces fruits that are edible by humans and many other animals, so we are very lucky to get any.



ALPINE ECOSYSTEMS

Striate eyebright

The striate eyebright (*Euphrasia striata*) is one of many species and subspecies of its genus of root parasites that occur in the alpine vegetation of Tasmania. The genus *Euphrasia* in Tasmania has many species of highly limited distribution. Many of these highly localised species occur on the cliffs of the east and southeast of the Tasman Peninsula where the coast during the Last Glacial period was very close to the present coast. The present plate was taken on kunanyi, which has its own endemic eyebright, *E. collina* ssp. *wellingtonensis*. The striate eyebright is more widespread. It is easily identified from the purple lines on its flowers.



ALPINE ECOSYSTEMS

Matted lignum

The matted lignum (*Muehlenbeckia axillaris*) also goes under the name of wire shrub because of its wiry stems that interweave into complex patterns. It is found in high country on mainland Australia, in New Zealand and in Tasmania where it is rare. This plant grows in a small patch of vegetation in a block stream on the eastern Central Plateau. Grazing animals have shortened the tussock grass (*Poa*) in the mat but appear not to have eaten the leaves, flowers or red fruits of the lignum. It seems likely to be a species that depends on the absence of taller plants for its survival, perhaps provided by a combination of shallow soils and selective herbivory.



ALPINE ECOSYSTEMS

Mountain celery

The mountain celery (*Anisotome procumbens*) is confined to a few of the highest peaks in Tasmania, always above the climatic treeline among jumbles of rocks. Most *Anisotome* species occur in the New Zealand highlands where their edible foliage was ungrazed by mammals until the human invasion less than a millenium ago. It may be that the Tasmanian mountain celery grows where it does to avoid mammal grazing.

This plant on Hartz Peak has finished flowering and fruiting, with the old inflorescences still attached. It is mixed with carpet heath (*Pentachondra pumila*) which is in flower in late summer.



ALPINE ECOSYSTEMS

Frost polygons and stripes

Patterned ground is characteristic of places subject to freeze-thaw cycles. The expansion of water when frozen and its contraction when melting have the capacity to systematically sort and move sediment, creating frost polygons (main plate) and frost stripes (plate this page). In the Tasmanian highlands, most of the work is done by needle ice. Moisture in the pores of the surface soil freezes and extends vertically, accumulating ice by sublimation, which is the direct transition from water vapour in the atmosphere to ice. As the ice needle grows upward it encounters soils and rock particles that it lifts.

The larger particles fall further away from the needles than the small particles. The needles are more likely to form in soil with small particles than with big ones. Thus, there is a positive feedback mechanism to create patterning. Stripes generally form when the slope exceeds eight degrees, polygons when the slope is less.





ALPINE ECOSYSTEMS

Frost-shattered dolerite

The high mountains of Tasmania are famed for their block streams. The large rocks in these streams are rounded on their edges, as with the boulders in the foreground of the plate on this page. The streams appear to be largely lag deposits which have formed after deep weathering of rock and the removal of the finer particles by water erosion. In both the middleground of the plate on this page and the main plate, the rocks are likely to be the product of the shattering of dolerite along lines of weakness by freeze-thaw.



The angularity and consistent orientation of the rocks indicates freeze-thaw products produced more or less in situ.

The crustose lichen cover on these rocks indicates contemporary stability, a stability that probably dates from the end of the Last Glacial period.



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ABOUT THE AUTHOR / ARTIST

Jamie Kirkpatrick

Jamie Kirkpatrick is a geographer/ecologist/humourist who has worked at the University of Tasmania and submerged himself in the rest of nature and people since 1972. He has written a lot about the ecology of the rest of nature and the social and political geography of nature conservation, as well as some humour, largely on the same themes. He has helped generations of students to read its rest of nature and laugh. He lives with Christina, Tor, Hildie and numerous less domesticated animals and birds in Sandy Bay, lutruwita.

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