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Cultural artefacts or 'neglected old parks': the colonisation of rainforests in north-western Tasmania

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Introduction

> …we went on in an excellent country, consisting of gently rising, dry, grassy hills, divided from each other by brooks, the sides of which are adorned with blackwood and other elegant trees and shrubs…The plains, or rather hills, I call the Surrey Hills…They resemble English enclosures in many respects, being bounded by brooks between each, with belts of beautiful shrubs in every vale…The whole country here is grassy…The timber found on these hills is, in general, of fine growth, very tall and straight; some of it would measure more than 100 feet to the lowest branch. The trees are in many places 100 yards apart…[1]

This description by Henry Hellyer forms part of his report on the discovery of Surrey Hills and nearby Hampshire Hills on St Valentine's Day in 1827. He was seeking a parcel of land suitable as a land grant from the Colonial Government. His employer, the Van Diemen's Land Company (VDL Co.), wanted to graze sheep on the native plains and send the wool back to England. The VDL Co. was formed in 1824 by a syndicate of wealthy and influential Englishmen closely connected with the wool and textile trades. They applied to the Secretary of State for the Colonies, Earl Bathurst, for a grant of 500,000 acres in Van Diemen's Land. They were attracted by the concept of being able to

develop a business as absentee landowners and the opportunity of using assigned convicts as free labourers, but the lieutenant-governor of Van Diemen's Land at the time, George Arthur, did not trust a group of wealthy merchants based in London. He thought they might undermine his authority in the colony and wanted their grant located 'several days travelling distance from the settled districts to ensure the continuing availability of known natural grazing land for private settlement'.[2] Arthur heavily influenced the decision to send the VDL Co. to the unexplored north-western corner of the island—'beyond the ramparts of the unknown'—to claim their land grants.[3]

The discovery of the Surrey Hills and Hampshire Hills area followed fruitless earlier attempts to locate grazing country for merino sheep in north-western Tasmania. The north-west was in stark contrast to the closely settled areas in the central and eastern districts. The climate was not mild, and open woodlands and grassy plains were the exception rather than the norm. The rugged terrain of the north-west experienced high rainfall and cold harsh winters, and supported thick dense rainforest that had remained unexplored by Europeans prior to Hellyer's arrival.

> Dead logs and branches impeded us at every step, and we were continually meeting with large tracts of dense thicket, from thirty to forty feet high, so closely interwoven and matted together as to be impenetrable below; and we were often obliged to be walking upon these never-dry, slippery branches, covered with moss, as much as twenty feet above the ground, which, being many instances rotten, occasioned us many awkward falls, and tore our clothes to rags. We were not able to force our way on five hundred yards in an hour in some of these horrid scrub.[4]

Hellyer should not have found plains of tussock grasses and open woodlands when he climbed Valentines Peak in 1827. He should have continued to struggle through dense rainforest in his search for pastoral land. Located on a plateau over 600 metres above sea level with relatively cool temperatures and a seasonally well-distributed mean annual rainfall exceeding 1,100 mm, Surrey Hills should have been totally dominated by cool temperate rainforest.

Henry Hellyer was one of the early colony's foremost explorers and arguably one of Australia's most unheralded. He was employed by the Van Diemen's Land Company as chief surveyor architect in 1826. During the next six years, as he explored some of the most rugged

and densely forested country in Tasmania and plotted its features, he very nearly died of starvation and exhaustion. His exploration work determined the location of the Van Diemen's Land Company grants totalling 350,000 hectares in north-western Tasmania. The failure to establish the merino sheep farm at Surrey and Hampshire Hills is thought to have figured in his suicide in 1832.

Climatic influences on past vegetation patterns in western Tasmania

During the past several millions of years, the climate of Tasmania has alternated between ice ages and warmer interglacial periods, and vegetation has ebbed and flowed across the landscape in waves. When the climate cooled, forests declined on the higher land, but low altitude coastal areas provided refuges for forests. Conversely, as the climate warmed and the ice melted, forests expanded from their coastal refuges. Higher rainfall during the early part of the current interglacial period (the Holocene period spanning the last 10,000 years) allowed rainforests to expand in western, central and south-eastern Tasmania, re-occupying much of the landscape that, in the previous glacial period, had been covered by grasslands and herb fields. The pollen record shows that after this initial expansion of forests, about 7,000 years ago, rainforest cover in central Tasmania declined and was replaced by eucalypt-dominated forests in response to increased fire frequency.[5]

There has been much debate about whether climate or humans are responsible for this increased fire frequency. Palaeontologist Robin Clark wrote that:

> …climate has been and is far more important than fire in determining the distribution of Australian vegetation, but Aboriginal burning might have affected the rate of vegetation change.[6]

Archaeologist David Horton took a much stronger view. He believed that climatic change was the driving force behind the development of contemporary Australian vegetation patterns, since fire has always been a component of Australian ecosystems.

> Aboriginal use of fire had little impact on the environment and…the patterns of distribution of plants and animals which obtained 200 years ago would have been essentially the same whether or not the Aborigines had previously been living here.[7]

During the Holocene period the climate has been relatively stable. So, if we believe Horton, any changes in vegetation were virtually completed by 10,000 years ago. Yet there is evidence for some important changes in some vegetation associations during the Holocene. Fire aggressive species such as eucalypts exploded across the landscape. The rise in eucalypt pollen recorded in sediments accompanies a parallel rise in charcoal; both coincide roughly with Aboriginal colonisation of Australia.[8]

If climate was the sole factor influencing the distribution of vegetation communities, there would be patterns. Rainforests should dominate the sheltered areas—southerly aspects, leeward slopes and wetter positions. Communities reliant on fire should be found on exposed sites—ridges and sites facing drier winds. But this is not the case. There are no patterns; no one rule that can be applied. The boundaries are random—they set their own rules. This randomness requires another explanation. We need to show why fire-dependent communities have replaced rainforest. We need to know why the vegetation pattern in the last ice age was so different from that in the many preceding ice ages. Without clear topographic patterns in the vegetation, the only plausible explanation is the influence of humans. Although lightning strikes can be an important source of fires on mainland Australia, their frequency in Tasmania is not enough to explain the template seen across the western Tasmanian landscape.[9]

Human influences on past vegetation patterns in western Tasmania

It is not known exactly how long Aborigines have lived in Tasmania but it is believed to be at least 40,000 years.[10] There is a continuing debate about whether Aborigines continually occupied western Tasmania as climate changed and conditions favoured rainforest expansion after the last glacial period. Evidence from cave deposits in western and southern Tasmania show that people were living in fixed sites in large valleys. It is commonly believed that these sites were occupied continuously between 30,000 years and 12,000 years ago, and then were abandoned.[11] Recent analysis of a pollen sequence in south-western Tasmania, however, shows the persistence of fire-induced buttongrass moorland across the region, and the restriction

of rainforest expansion to sites that it occupies today from the last glacial period until present.[12] This suggests that these moorlands were an artefact of continuous human presence in western Tasmania during the Holocene. In north-western Tasmania, archaeologist Rhys Jones carried out ground-breaking excavations of cave sites at Rocky Cape and at West Point on the west coast. He found evidence of habitation from about 8,000 years before present.[13]

Aborigines maintained a hunter-gatherer existence and they used fire extensively. Fire was used to clear the understorey and make travel easier, to hunt large and small game, and to increase the abundance of certain types of food plants. Fire historian Stephen Pyne summed up their management by stating that Aborigines:

> …used fire to massage the indigenous environment with such skill that they became, in effect, cultivators of that landscape'.[14]

Rhys Jones was one of the first to suggest that Aborigines managed the landscape through intentional use of fire—he called it 'fire-stick farming.'[15] The fire-stick carried fire and Aborigines set the bush alight as they moved through it. Jones provides quotes from early French explorers as examples of this practice in Tasmania:

> …[an Aborigine] carried a piece of decayed wood in his hand, lighted at one end, and burning slowly…he…amused himself now and again by setting it to a tuft, where there were some very dry herbs;[16] and

> …a [man holding a] lighted firebrand in his hand, setting fire here and there to the bushes which covered the land.[17]

Betty Hiatt commented on the extensive nature and long-term results of fire-stick farming in north-western Tasmania.

> …the inhabitants of the west coast extended their narrow coastal environment by burning rain forest areas which in some places came down to the sea. The resultant sedgeland provided much more food than in the rain forest. Similar burning occurred in other parts of Tasmania and in most cases it changed existing vegetation into one which provided more or different food sources…[18]

It was not only the vegetation that changed due to more frequent fires. The arrival of humans coincided with increases in soil erosion and megafaunal extinctions. Soil studies have shown that continued fires deplete the soil nutrients, and this then encourages fire-tolerant vegetation adapted to lower soil nutrients, and thus a feedback

mechanism is created whereby frequent fire can cause progressive soil nutrient depletion.[19] The widespread occurrence of texture-contrast soils in Tasmania and their almost complete absence in areas of comparable rock types and climates in New Zealand is a result of regular and widespread forest fires in Tasmania.[20]

It therefore seems likely that during the latter part of the last glaciation, and in the Holocene period, continuous disturbance from fire-stick nomadic hunting practices contributed to the more sclerophyllous disclimax vegetation. Burning favours this sclerophyll vegetation, whilst a moist climate without fire favours rainforest.

Mixed forests—the true expression of anthropogenic influence on a cold and wet environment

In late 1955, Max Gilbert successfully won a three-year research fellowship offered by Australian Newsprint Mills to study the life cycle of the *Eucalyptus regnans* forests in the Florentine Valley in southern Tasmania.[21] Gilbert saw large eucalypts more than 250 years old, all the same age regardless of size, with a rainforest understorey. There were no younger eucalypts—seedlings, saplings or poles—and he wondered if the older eucalypts had grown through the rainforest understorey. He studied the younger forests regrowing from the 1934 fires and found tall 20-year-old eucalypt regrowth and myrtles, not much bigger than shrubs, and all the same age. When he found charcoal in the soil he soon realised that repeated fires played a vital role in the regeneration of the eucalypts. Climatic and physical factors had a much lesser impact on the distribution of these forests. Neither aspect nor soil drainage were determinants for their distribution; elevation only influenced the species composition, not forest type. Gilbert called this unique vegetation community 'mixed forests'.[22]

Fires prevent the development of the climax vegetation—rainforest. Where the fires are regular, the closest approach to the climax vegetation is what Gilbert termed the 'fire-climax'[23] in which mature eucalypts overtop the rainforest. Eucalypts cannot regenerate unless the understorey is completely removed. Where a dense rainforest understorey exists, fire is required. This means that a mixed forest is a disclimax community, i.e. it requires some form of disturbance to

sustain itself. If a fire occurs infrequently (at an interval less than the oldest age eucalypts can attain, 500 years[24]), the forest still remains a mixed forest. This is because both the eucalypt and rainforest species present before the fire regenerate immediately afterwards. With more frequent fires (at least once or twice a century), a wet eucalypt forest replaces the mixed forest. Without fire the eucalypts can persist for up to 500 years after which they eventually die and are replaced by the rainforest understorey.

The forests described above are unique to Tasmania.[25] Rather than a forest type *per se*, they really represent a broad ecotone between rainforest of higher rainfall and lower fire frequency locales and the wet eucalypt forests of lower rainfall locales. In the absence of fire this ecotone would be more restricted. Climate 'wants' rainforest but anthropogenic influence 'demands' something more hospitable. Mixed forest is the compromise—a true expression of the influence of fire frequency on the make-up of vegetation communities in the higher rainfall areas of western and southern Tasmania. Fire has been the major factor preventing rainforest from occupying more area.

At the time of European settlement in north-western Tasmania, a vast area of mixed forests was present for 13 kilometres (8 miles) south of Emu Bay (now called Burnie). Hellyer described some of this forest (Figure 1) in one of his diaries:

> …no part of the sky visible being completely darkened by dripping evergreens consisting of Myrtle, Sassafras, Ferntrees, immensely tall White Gum and Stringy-bark trees from 200-300 feet high and heaps of those which have fallen lying rotting one over the other from 10 to 20 feet high…[26]

We get an appreciation of the size of the eucalypts and their age from Hellyer:

> …came to the largest log or trunk [on the ground] that I have seen since I have been in the Country—it measures 192 feet now and has lost all the upper part of which must have broken off in falling and as that part is 3ft 6 thro' it is fair to imagine it must have been from 80 to 100 feet higher—it is a White Gum tree and straight as an arrow. After this who will doubt there are trees in this Island 300 feet high…[27]

And also from George Augustus Robinson, conciliator of the Tasmanian Aborigines and commandant at the Flinders Island aboriginal settlement:

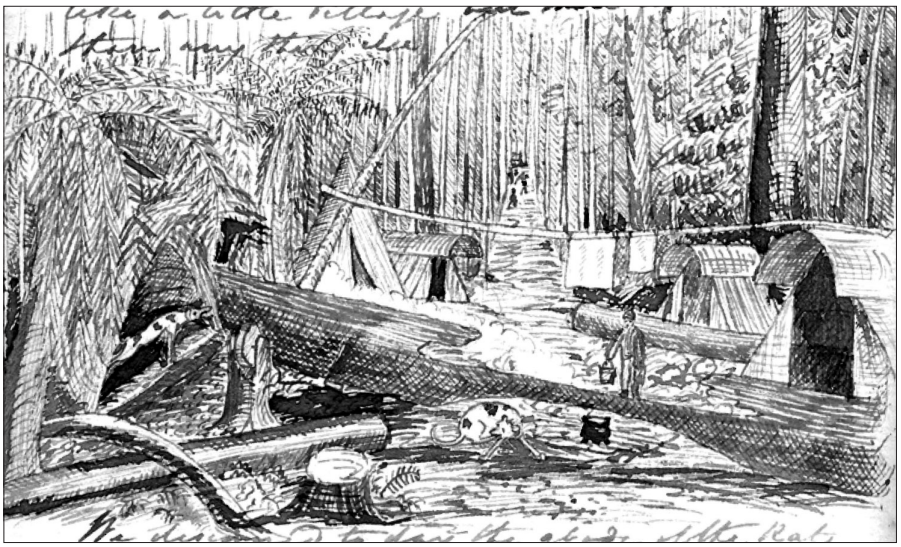

Figure 1: Drawing by Henry Hellyer of his camp at Cascade Creek. It shows the fire-climax mixed forest at Emu Bay with tall eucalypt trees and a dense rainforest understorey.
Source: Journal of Henry Hellyer, 3 July to August 1827, Rare/Special Collection, University of Tasmania Library, R12

> Set out to travel to Hampshire Hills [from Emu Bay]…for about eight miles it leads through a thick forest of lofty gum, peppermint and stringy bark, with thick underwood of fern-tree…The forest trees are of immense size and great height, very straight, some measuring sixty feet in circumference.[28]

Edward Curr travelled through this same forest as part of his first visit to Surrey Hills in October 1827.

> The first eight miles the road lies through a forest altogether unlike anything I have seen in the island. The myrtle tree scarcely known except in this district and environs. Stringybark trees many of them three hundred feet high and thirty feet in circumference near the root exclude the rays of the sun and in the gloom which their shade creates those trees flourish which affect darkness and humidity, and in other parts of the Colony are only found in the deepest ravines and by the sides of creeks, sassafras, dogwood, peppertree, musk tree, and in some situations, blackwood of the best quality. The forest trees and under growth described which latter rise to the height of from eighty to one hundred feet…[29]

Curr owned land at Kempton, near Hobart, and had written a small book, *An Account of the Colony of Van Diemen's Land,* to help

potential emigrants. He was in London on family business at the time of the VDL Co. formation and returned in 1826, only 27 years old, as a confident and forthright first chief agent for the company. He was described by Burnie historian Kerry Pink as the 'potentate' of the north.

Hellyer, Robinson and Curr describe what appears to be the fire-climax mixed forest, comprising very large mature eucalypts overtopping a dense understorey of large rainforest trees up to 30 metres tall. According to Gilbert, no fire should have occurred for at least 300 years to achieve this size in the rainforest trees. Comparing tree density measurements by Hellyer with Gilbert's in the south confirms the Emu Bay forest as a fire-climax mixed forest. Hellyer's diary records the quantity of timber on three quarter-acre plots (Figure 2)[30] and Gilbert counted trees along transects.[31] Hellyer recorded 1,032, 2,296 and 1,864 stems per acre. Gilbert counted 938, 1,448 and 781 stems per acre.

We know that Aborigines moved through this area at one time. Hellyer's map shows scattered grasslands as islands surrounded by a sea of mixed forest along his route from Emu Bay to Surrey Hills.[32]

> Six of them which I [Curr] saw I judged to be of the following dimensions namely 5, 30, 80, 120, 120, and 600 acres though Mr Hellyer estimates this last, which he named Highclere, at 1000 acres.[33]

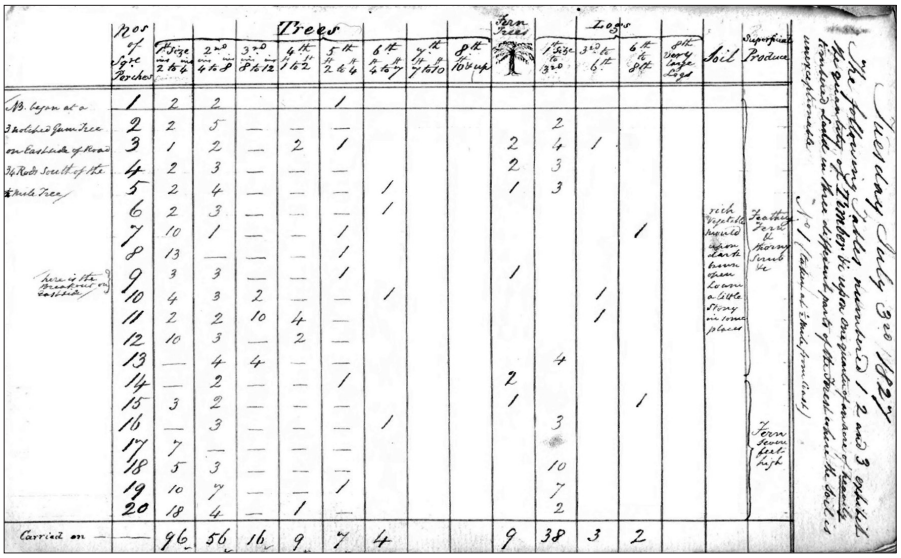

Figure 2: One of Henry Hellyer's three quarter-acre plot sheets showing the number of stems per acre in the Emu Bay mixed forest.
Source: Journal of Henry Hellyer, 3 July to August 1827, Rare/Special Collection, University of Tasmania Library, R12

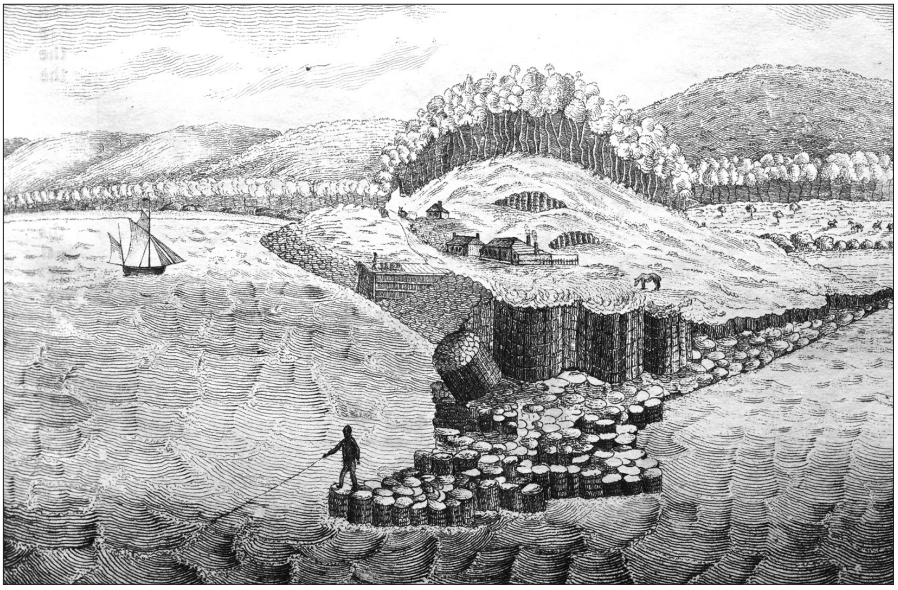

Figure 3: Drawing by Henry Hellyer of Emu Bay showing the fire-climax mixed forest on the rounded ridge in the centre. This is the forest through which he built a track to reach Surrey Hills from the coast.
Source: Ross, *The Van Diemen's Land anniversary and Hobart-Town almanack for the year 1831*.

It is highly likely that before European settlement, Aborigines abandoned the Emu Bay forests and the northern approach to Surrey Hills and instead travelled to Surrey Hills from the west coast. Robinson saw and travelled on Aboriginal tracks through rainforest from the west coast to Surrey Hills, for example their track over Mount Norfolk.[34] When Hellyer cut a track from Emu Bay to the VDL Co. grazing lands thirty kilometres inland in 1827, he couldn't find any aboriginal tracks to follow (Figure 3). Instead he had to clear a track through a dense mixed forest with many obstacles in the form of large fallen trunks in the way.[35]

Understanding landscape change and fire driven succession—the development of successional models

Following Gilbert's discovery of the major role that fire plays in influencing forest patterns, scientific interest in fire-induced forest succession grew. Botanist Bill Jackson observed that only 53 per cent of

the potential rainforest area in western Tasmania was actually occupied by rainforest.[36] The rest was a mosaic of fire-induced and highly flammable disclimax communities—sedgeland, scrub and eucalypt forest. The same can be said for Surrey Hills, where constant burning maintained open communities.[37] Jackson dedicated his early scientific endeavours to finding out why temperate rainforest was restricted in such a favourable climate. In 1968 he published a seminal paper on the ecology of western Tasmania in which he documented a series of interactions between vegetation, soils and landscape fire that produced a complex mosaic of vegetation communities.[38] He argued that if fire frequency was more or less constant the nature of the vegetation would not change appreciably. When fire frequency increased, vegetation changed along a floristic continuum from rainforest towards sedgeland, and flammability increased. Jackson defined this process of vegetation shift as 'ecological drift.'

Ten years later, forester Tony Mount suggested a different fire ecology model based on the interpretation of data collected from numerous study plots in the tall wet forests in southern Tasmania. He proposed that the accumulation of fuel determines fixed 'fire cycles' and therefore stability in the vegetation. Instead of arbitrary fire frequency driving changes, Mount proposed a more static model—one where fuel accumulation in each vegetation type determined fire frequency. He assumed ignition sources were frequent enough to maintain the vegetation because he believed that the presence of fuel alone did not guarantee a fire. This model therefore predicts that rainforest is not limited by fire but by other environmental variables.[39]

Both models agree on the central role of fire in forest dynamics, particularly the rainforest boundary, under present-day climates. The difference between the two is their predicted outcome. Arguments among academics—at times emotional—have raged over the merits of each model. Until recently, the consensus strongly favoured Jackson.[40] Recent work in western Tasmania, however, suggests that rainforest boundaries may be more stable than Jackson suggested and this may lead to a new model.[41]

Another forester, Bob Ellis, studied an area with vegetation similar to Surrey Hills in Tasmania's north-eastern highlands in the 1980s. He presented a detailed explanation of the successional processes and documented the expansion of rainforest into areas previously

dominated by eucalypts, and of eucalypts into grassland that occupied former rainforest areas. He attributed this expansion to local differences in frequency and severity of fires since about 1835 when Aborigines were removed from the area.[42] Again, the present climate in that area would allow rainforest to dominate the whole area and '…that it doesn't is almost certainly attributable to aboriginal burning practices'.[43]

How did Aborigines use fire to manage the Tasmanian landscape?

Whilst fire was an important part of Aboriginal land management practices, first hand accounts from Europeans of their burning practices are few. There are no accounts of Aborigines living a traditional lifestyle and seen lighting fires; no records which detail timing and reasons for their burning. Robinson, who travelled throughout Tasmania between 1829 and 1834 with displaced Aborigines accompanying him, did record them hunting, and noted that they 'had set the bush on fire.'[44]

There are accounts of recent Aboriginal burning, or of burnt-out country. One of the most reliable and extensive is from Robinson. For example on the north-eastern coast: 'This part of the country has been fresh burnt by the natives…All the country fifteen miles inland from the coast had been burnt'.[45] And up in the highlands on the Central Plateau near Lake Echo: '…the whole of this country has been frequently burnt by the natives and was a fine hunting ground for them.'[46]

The Aboriginal occupation of Surrey Hills is known from many observations of burnt ground, native huts and face-to-face contacts. For example, Hellyer wrote:

> We now approached the high forest tier of woody mountains [heading north from Belmont Plains on Surrey Hills], near which we came upon a marshy country…We found here two native huts, and marks of many fire-places in the neighbourhood, as if the spot had been lately occupied by a large body of natives. In one of the huts I saw a drawing of the moon, done with charcoal, upon the inside of one of the slabs of bark which formed the hut…[47]

Surrey Hills formed part of the territory of the northern tribal group of people. This tribe had at least four known bands of 50–75 people giving it an estimated population of 200–300 people.[48] The Surrey Hills area also appears to have been a meeting point for a number of

major routes in the region that linked the area to the west coast, to the north coast, and west and south via Middlesex Plains, near Cradle Mountain.[49]

How long Aborigines have occupied Surrey Hills is not known exactly, but major changes in Tasmania's archaeological record show an expansion of settlement in relatively recent years from about 3–4,000 years before present.[50] Archaeologist Harry Lourandos believed that regular Aboriginal burning opened up the interior forests on the north coast as part of territorial expansion.[51] It has been suggested that artefacts of chert tools show evidence of colonisation of previously unoccupied or seldom visited regions, including the forested hinterland of the north-western coast.[52] Studies on significant chert quarries found on the western boundary of Surrey Hills suggest exploitation for raw material by at least 3,500 years before present.[53] A stone tool recovered below the foundations of a VDL Co. outstation, and in an *in situ* deposit of charcoal, has been dated as 3,370 ± 90 years before present.[54]

The first grassland on Surrey Hills that Hellyer walked on he described as being like a 'neglected old park; a thousand or fifteen hundred acres in a patch, without a tree…grass run to seed.'[55] In April 1827, Joseph Fossey, Hellyer's assistant surveyor with the VDL Co., travelled through Surrey Hills for the first time and was entranced with the country he saw. Much of it was 'so admirably laid out by nature, that it assumes very much the appearance of a nobleman's domain.'[56]

Hellyer and Fossey could be excused for having a Eurocentric view influenced by Lancelot 'Capability' Brown,[57] where any grassed area was compared to a manicured English garden. In those days the term 'park' was used to describe beautiful and natural places. However, Hellyer and Fossey didn't realise that it was Aboriginal husbandry that had created those hunting grounds and the open areas that made it easier to travel through. They followed Aboriginal tracks through Surrey Hills and discovered many other grasslands. It was their manager who first appreciated Aboriginal influence on Surrey Hills:

> It has always been a matter of some doubt whether the forests in this island are encroaching on the clear grounds, or the clear grounds on the forest: an attentive examination of the Hampshire Hills establishes the very important fact, that the forest by the process of fire, is undergoing a gradual destruction, and that useful grass is taking its place. I am of

> the opinion that compared with the old settlements, these plains are of very recent date, and that almost every season is adding something to their extent. The middle of the clear ground near the banks of the river seems the oldest formation, towards the outskirts the burnt forest in some parts thickly strews the ground as yet undecayed, and in one place the destruction of the forest has been so recent, that the fern tree still survives the loss of that shelter which first managed its growth.[58]

Historian Bill Gammage introduced a very plausible theory that Aborigines transformed the landscape through planned cycles. On rainforest areas such as Surrey Hills, he suggests that they operated on cycles of at least 900 years.[59] Using Hellyer's description of the mixed forest south of Emu Bay, Gammage estimated the eucalypts to be at least 350 years old. Generally speaking, the stands of mixed forests are even-aged, representing a stand induced by wildfire. Gilbert, however, found stands of various ages throughout the Florentine valley. So it is with Hellyer's forest. There were at least two age cohorts of eucalypts—those rotting on the ground and those living which grew from the seeds of the latter. Given the size of those rotting on the ground we can assume they had attained a similar age to those standing. Before Aborigines, the original community was rainforest which was converted to grassland by repeated Aboriginal burning. How long was it grassland? Aboriginal artefacts were found on the surface of grassland in the Central Highlands of Tasmania that was created from rainforest just 300 years ago.[60] Ellis measured remnant eucalypts that had regenerated on newly-established grassland at Paradise Plains as 170–190 years old.[61] Botanist and ecologist Truda Howard carried out some research on a small grassland on Surrey Hills surrounded by rainforest and mixed forest.[62] She found the presence of very narrow charcoal bands in the soil, which suggested that the grassland was maintained by fire. She believed the grassland had been stable for a long time, as there was no evidence of tree charcoal in the soil. Unfortunately she didn't determine the age of the seeds or charcoal and so we cannot know for certain how old the grassland was. The current overwhelming archaeological evidence in the north-west shows, however, that the grasslands on Surrey Hills are probably relatively recent in age (some 3–4,000 years old) and may have been recently recycled.

It is plausible that a full cycle created by the Aborigines from

rainforest back to rainforest was at least 540 years (190 + 350 years). At Emu Bay it could be at least 890 years (190 + 350 + 350) because of the two age cohorts of eucalypts.

Research on cave sites in the upland valleys in the south-west of Tasmania showed that the principle food supply was wallaby (with wombat) that was found in large concentrations amongst a patchwork of discrete zones of *Poa* grasses growing in rich alluvial and limestone soils.[63] The wallaby has a small home range (up to 15 hectares) and the Aborigines had a strategy of hunting a specific prey within a distinct ecological patch structure—this predictable resource, one of selective foraging, could cause over exploitation. So as to conserve it, the Aborigines did not spend much time at each patch but moved on to the next, not waiting nor wanting to hunt for medium or small animals as this was too costly in body energy. Instead they preferred the more economic wallaby that possessed long bones (femur and tibia) that yielded marrow, a carbohydrate substitute necessary for the metabolism of a high protein diet.[64]

Nature's wars—the battleground on Surrey Hills

The changes on Surrey Hills after European settlement and the removal of Aborigines give us clues on the importance of fires in maintaining the colonised landscape. Aborigines removed rainforest. In its place they created hunting grounds and an environment more favourable for human occupation. The boundaries between rainforest, eucalypt and grassland were sharp and relatively stable. Without human management they became unstable. An understorey of rainforest species invaded the eucalypt stands; eucalypts, tea tree and shrubs invaded the treeless grass plains. Fifty years after the removal of Aborigines from most of Tasmania:

> …many open plains, especially in the north, which were formerly known as favourite haunts of the blacks subsequently became overgrown with forest through the discontinuance of these annual burnings…[65]

This instability led to war—Nature's war. Without fire, each plant community had the opportunity to expand and each utilised its own survival mechanisms, inherited long ago, before persistent fire arrived. No longer was fire the arbiter of which community occupied what space.[66]

Studies of annual rings[67] and Hellyer's report of his travels through Surrey Hills show that large areas of fire-climax mixed forest were not present in 1827 on Surrey Hills. This is mainly because in montane areas of Tasmania such as Surrey Hills and the north-eastern highlands, a different eucalypt species, *E. delegatensis*, dominates, and it suffers from 'claustrophobia'.[68] It prefers to be few in number and grows best as open woodland and it also likes an open understorey of grass and shrubs. This is called a dry forest.

Mixed forests on Surrey Hills are represented by extensive areas of a eucalypt-rainforest scrub characterised by pepper tree (*Tasmannia lanceolata*) with an understorey age of between 50 and 130 years.[69] It replaces wet sclerophyll vegetation in montane country, and is present in similar plateau forest areas in Tasmania. A 1903 vegetation map of Surrey Hills shows that this community occurred over an estimated 8,000 hectares as 'Stringy bark [*E. delegatensis*] forest with thick pepper tree'.[70]

Tree ring counts in the north-eastern highlands show a dramatic expansion of rainforest understorey species in eucalypt forests after burning by Aborigines ceased.[71] A similar expansion occurred on Surrey Hills. 150-year-old eucalypt forests logged in the early 1970s supported a dense 50–80 year old rainforest scrub understorey.[72] In places where this occurs, the eucalypts prematurely decline and eventually die. Ellis was first to identify and study the causes of the premature decline of *E. delegatensis* that accompanied the development of a rainforest understorey, and he called this phenomenon 'alpine dieback'.[73] Studies on Surrey Hills showed that where the rainforest understorey is older than 70 years, dieback is noticeable.[74] Although the eucalypts continue producing seed, it is impossible for them to germinate under the dense rainforest understorey because of insufficient light. Eventually, without fire and when the overstorey of eucalypts dies, rainforest scrub is left to grow into rainforest proper and dominate. Thus *E. delegatensis* had a symbiotic relationship with the fire-stick in order to dominate the rainforest. It requires more frequent burning than the fire-climax mixed forests to sustain it.

Without regular and persistent fire to kill eucalypt seedlings, eucalypts take advantage of this to invade the grasslands. They encourage the proliferation on the forest margins of shrub species normally found as transients in gaps within rainforest. These 'gap-

phase' shrubs rarely become established, but thrive under a canopy of eucalypts. They suppress the vigour of the grass tussocks. Individual eucalypts, normally susceptible to the exposure on cold open grasslands through cold-induced photoinhibition,[75] regenerate under the cover of the shrubs. Examples of this can be seen where expansion of eucalypts is limited to the canopy-shaded sides of the forest (eastern and south-western sides). Eventually, eucalypts shade the grasslands and in the continued absence of fire rainforest can then replace the eucalypts.

Frequent firing of around 5–10 years on soils of high fertility, such as those on Surrey Hills, eventually reduces forests to grasslands. There is an example of this during European occupation adjacent to the Emu Bay Railway line through Surrey Hills. Aerial photos in 1946 show a one kilometre swathe of grasslands on both sides of the railway line following logging, clearing and constant burning of the original rainforest from 1876.

Native grass, too, is a fierce competitor which doesn't like to give in to the expansion of trees. Trees cannot gain a hold on frost flats. A lot of the grasslands on Surrey Hills occupy such sites. Studies on the Central Plateau at different altitudes found that open areas were colder and had wetter surface soils than the adjoining forests.[76]

Gammage believed the Aborigines burnt the grasslands in deliberately spaced cycles because excessive firing would eventually reduce the nutrients in the soil and thus the vitality of the grass swards—vital for the feeding marsupials they hunted.[77] I agree that the plains were recycled, but for different reasons. There are examples on Surrey Hills of woodlands with a grassy understorey adjoining the plains. These are areas that were formerly grasslands but where the eucalypts have regenerated with reduced burning. It is as though the eucalypts 'followed' the Aborigines as they burnt into the rainforest to create new grasslands. As the climate was favourable to rainforest, it was very difficult for the Aborigines to continually manipulate the same area. They accepted that the boundaries were dynamic and forever changing. To maintain grasslands in areas that were reverting to rainforest via eucalypt succession, took more effort for less return than using a succession of hotter fires in summer to convert rainforest directly to grassland.

Conclusion

The climate in western Tasmania during the Holocene was conducive to supporting widespread rainforest. However, a mosaic of eucalypt forests and woodlands, grasslands, sedgelands and scrublands has persisted with the rainforests. Fire has been the only mechanism to remove rainforest. The only reliable way to achieve this has been by human actions.

The existence of non-climax mixed forests in a rainforest landscape reinforces the presence of fire. Similarly, the requirement of *E. delegatensis* forests and woodlands to have a rainforest-free understorey in a rainforest landscape reinforces the presence of fire.

The extensive tracts of grasslands on Surrey Hills that Hellyer discovered were neither naturally occurring features of the landscape nor neglected old parks in need of British care. They were cultural artefacts; Aboriginal hunting grounds created over many generations by fire stick farming. By colonising the rainforests, the Aborigines allowed themselves to live off an area for millennia that, in its natural or climax rainforest state, offered no appeal to humans.

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Notes

1 Hellyer, H., 1827, 'Report of Mr Henry Hellyer, dated Circular Head 13 March 1827', reprinted in Bischoff, J., 1967, *Sketch of Van Diemen's Land and an Account of the Van Diemen's Land Company*, facsimile edition by the Libraries Board of South Australia, Adelaide, from the 1832 original, pp. 164–78, quote from pp. 168, 169 and 170.

2 Pink, K., 2000, *Campsite to City: a history of Burnie 1827-2000* (Burnie: Burnie City Council), p 2.

3 Quote is attributed to Lieutenant-Governor George Arthur in Pink, *Campsite to City*, p 3.

4 Hellyer, 'Report', pp. 166–67.

5 Duncan, F., 1990, 'Eucalypts in Tasmania's changing landscape', *Tasforests* 2(2), pp. 151–165; Jackson, W. D., 1999, 'Palaeohistory of vegetation change: the last 2 million years', in Reid, J. B., Hill, R. S., Brown, M. J. and Hovenden, M. J. (ed.), *Vegetation of Tasmania*, Flora of Australia Supplementary Series No. 8 (Hobart: University of Tasmania, Forestry Tasmania, CRC for Sustainable Production Forestry), pp. 81–87; Macphail, M. K., 1980, 'Regeneration processes in Tasmanian forests', *Search* 11, pp. 184–190; Macphail, M. K., 1981, 'A history of fire in the forest', in Kirkpatrick, J. B. (ed.), *Fire and forest management in Tasmania* (Hobart: Conservation Trust), pp. 15–22.

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10 See Cosgrove, R., Allen, J. and Marshall, B., 1990, 'Palaeoecology and Pleistocene human occupation in south central Tasmania', *Antiquity* 64, pp. 59–78; Cosgrove, R., 1985, 'New evidence for early Holocene aboriginal occupation in northeast Tasmania', *Archaeology in Oceania* 30, pp. 83–104.

11 Cosgrove *et al.*, 'Palaeoecology and Pleistocene human occupation'; Flood, J., 1990, *The riches of ancient Australia* (St Lucia: University of Queensland Press); Jones, R. 1995, 'Tasmanian Archaeology: Establishing the Sequence', *Annual Review of Anthropology* 24, pp. 423–446.

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13 Jones, R., 1977, 'Man as an element of continental fauna: the case of the sundering of the Bassian Bridge', in Allen, J., Golson, J. and Jones, R. (ed.), *Sunda and Sahul*, (London: Academic Press), pp. 317–386; Jones, R., 1978, 'Why did the Tasmanians stop eating fish?', in Gould, R. A. (ed.), *Explorations in archaeology* (Albuquerque: University of New Mexico Press), pp. 11–47.

14 Pyne, S. J., 1990, 'Firestick history', *The Journal of American History* 76(4), pp. 1132–1141, quote from p. 1132.

15 Jones, R., 1969, 'Fire-stick farming', *Australian Natural History* 16, pp. 224–228.

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17 Peron, M. F., 1809, *A voyage of discovery to the Southern Hemisphere 1801–4*, quoted in Jones, 'The geographical background'.

18 Hiatt, B., 1968, 'The food quest and the economy of the Tasmanian Aborigines', *Oceania* 33, pp. 190–219, quote from p. 219.

19 McIntosh, P. D., Laffan, M. D. and Hewitt, A. E., 2005, 'The role of fire and nutrient loss in the genesis of the forest soils of Tasmania and southern New Zealand', *Forest Ecology and Management* 220, pp. 185–215; McIntosh, P. D., Price, D. M., Eberhard, R. and Slee, A. J., 2009, 'Late Quaternary erosion events in lowland and mid-altitude Tasmania in relation to climate change and first human arrival', *Quaternary Science Reviews* 28, pp. 850–872.

20 McIntosh *et al.* 'The role of fire and nutrient loss'.

21 Australian Newsprint Mills operated a pulp and paper mill on the Derwent River just outside Hobart and in 1932 were granted a large concession area in the Florentine and Styx Valleys as a source of their wood fibre. They were responsible for the regeneration of these forests after harvesting. By 1955 there was much concern about the lack of knowledge on regeneration requirements in the lowland wet eucalypt forests. Natural regeneration was relied upon without any active management. Through this Fellowship, ANM sought to understand the regeneration requirements of these forests.

22 Gilbert, J. M., 1958, 'Eucalypt-rainforest relationships and the regeneration of the eucalypts', report of work carried out under the first Australian Newsprint Mills Forestry Fellowship, 1955–58 (Hobart: ANM), 122 pp.

23 Gilbert, 'Eucalypt-rainforest relationships'.

24 Recent dendrochronological work in Tasmania's southern forests has confirmed this as the oldest age of *E. regnans*. See Wood, S. W., Hua, Q., Allen K. J. &

Bowman, D. M. J. S., 2010, 'Age and growth of a fire prone Tasmanian temperate old-growth forest stand dominated by *Eucalyptus regnans*, the world's tallest angiosperm', *Forest Ecology and Management* 260(4), pp. 438–447.

25 Strictly speaking, these forests are also found to a limited extent in Victoria. They are confined to very favourable sites—a narrow fringe in south-east facing gullies and upper slopes (see Gilbert, 'Eucalypt-rainforest relationships').

26 Hellyer, H., 1827, Hellyer Diary (Journal No. 7), University of Tasmania Archives (R12), Hobart, p. 18.

27 Hellyer Diary, pp. 13–14.

28 Plomley, N. J. B. (ed.), 2008, *Friendly Mission: The Tasmanian journals and papers of George Augustus Robinson 1829-1834*, second edition (Hobart), p. 194. This book is a record primarily of Robinson's field journals during his expeditions throughout Tasmania.

29 Curr, E., VDL 5 Outward Dispatch No 70, 10 November 1827, paragraph 24.

30 Hellyer, 'Report of Mr Henry Hellyer', pp. 1–8. Hellyer recorded the number of trees and fallen logs in diameter classes on three quarter of an acre plots. He also calculated the standing and fallen volumes per acre as well as the number of man ferns (Tasmanian tree ferns). Comments were provided on the soils and structure of the understorey.

31 Gilbert, 'Eucalypt-rainforest relationships', Tables 1.8, 1.9 and 1.10 (between pages 22 and 24). Three transects of varying size were measured by Gilbert. He only recorded the number of eucalypts, myrtle and sassafras trees in diameter classes and thus his numbers are lower than Hellyer's.

32 Hellyer, H., 1832, Map of the Van Diemens Land Company's proposed eastern locations, Van Diemens (*sic*) Land, Plan 21 Wellington, Central Plan Office, Department of Primary Industries, Parks, Water and the Environment, Hobart.

33 Curr, E., VDL 5 Outward Dispatch No 70, 10 November 1827, paragraph 25.

34 Plomley, *Friendly Mission,* p. 903.

35 A detailed account of the hardships endured in building this road during the winter of 1827 are described in Rollins, B., 2002, 'Life in a lost Tasmanian rainforest, winter 1827', in Dargavel, J., Gaughwin, D. and Libbis, B. (ed.), *Australia's ever-changing forests V: Proceedings of the 5th National Conference on Australian Forest History* (Canberra: CRES, ANU), pp. 146–162.

36 Jackson, W. D., 1968, 'Fire, air, water and earth—an elemental ecology of Tasmania', *Proceedings of the Ecological Society of Tasmania* 3, pp. 9–16.

37 It must be highlighted at this point that the soils in western Tasmania, as a whole, differ from those at Surrey Hills. The former mainly consist of Cambrian quartz conglomerates and other siliceous, acid soils of lower nutrients formed from Precambrian quartzite; whereas the latter are deep fertile loams found on a basaltic plateau formed from Tertiary lava flows. The *Poa* grasslands found by Hellyer on Surrey Hills generally favour more fertile sites.

38 Jackson, 'Fire, air, water and earth'.

39 Mount, A. B., 1979, 'Natural regeneration processes in Tasmanian forests', *Search* 10, pp. 180–186.

40 See Henderson, W. and Wilkins, C. W., 1975, 'The interaction of bushfires and vegetation', *Search* 16, pp. 130–133; Macphail, M. K., 1980, 'Regeneration processes in Tasmanian forests', *Search* 11, pp. 184–190; Bowman, D. M. J. S. and Jackson, W. D., 1981, 'Vegetation succession in southwest Tasmania', *Search* 12, pp. 358–362; Brown, M. J. and Podger, F. D., 1982, 'On the apparent anomaly between observed and predicted percentages of vegetation types in South West Tasmania', *Australian Journal of Ecology* 7, pp. 203–205; Mount, A. B., 1982, 'Fire cycles in south-west Tasmania', *Search* 13, pp. 174–175; Hill, R. S. and Read, J., 1984, 'Post-fire regeneration of rainforest and mixed forest in Western Tasmania' *Australian Journal of Botany* 32(5), pp. 481–493; Podger, F. D., Bird, T. and Brown, M. J., 1989, 'Human activity, fire and change in the forest at Hogsback Plain, Southern Tasmania', in Frawley, K. J. and Semple, N., *Australia's Ever Changing Forests* (Canberra: Department of Geography and Oceanography, ADFA), pp. 119–140.

41 David Bowman, University of Tasmania, personal communication.

42 Ellis, R. C., 1985, 'The relationships among eucalypt forest, grassland and rainforest in a highland area in north-eastern Tasmania', *Australian Journal of Ecology* 10, pp. 297–314.

43 Ellis, R. C., 1984, 'Aboriginal influences on vegetation in the northeast highlands' *Tasmanian Naturalist* 76, pp. 7–8.

44 Plomley, *Friendly Mission,* p. 839.

45 Plomley, *Friendly Mission,* p. 412

46 Plomley, *Friendly Mission,* p. 545

47 Hellyer, 'Report of Mr Henry Hellyer', pp. 170–171.

48 McConnell, A., 1999, 'A review of the aboriginal archaeology of the Parrawe area, northern Tasmania', unpublished report to North Forests Burnie. Rhys Jones predicted that the total Aboriginal population in Tasmania at the time of European settlement was 4–6,000; see Jones, R., 1974, 'Tasmanian Tribes', in Tindale, N. B. (ed.), *Aboriginal tribes of Australia* (Berkeley: University of California), pp. 317–354.

49 McConnell, 'A review of the aboriginal archaeology'.

50 Mulvaney, J. and Kamminga, J., 1999, *Prehistory of Australia* (Sydney: Allen & Unwin); Brimfield, B., 2010, *Long trek south: a search for the history of the Palaeolithic Tasmanians* (Mowbray, Tas: the author).

51 Lourandos, H., 1988, 'Seals, sedentism and change in the Bass Strait', in Meehan, B. and Jones, R. (ed.), *Archaeology with ethnography: an Australian perspective* (Canberra: Department of Prehistory, RSPS), pp. 277–285.

52 Cosgrove, R., 1990, *The archaeological resources of Tasmanian forests: past Aboriginal land use of forested environments,* Occasional Paper 27 (Hobart: National Parks and Wildlife Service).

53 Hartzell, L., 1992, *Preliminary report on Phase 2 archaeological investigations in the Surrey Hills, northwest Tasmania,* Report to Dept Archaeology, Latrobe University, Department Parks, Wildlife & Heritage, Tasmanian Forest Research Council, Tasmanian Aboriginal Lands Council and the Tasmanian Forestry Commission, Hobart; Hartzell, L., 1993, *Preliminary report on Phase 3 archaeological investigations in the Surrey Hills, northwest Tasmania, Test excavations at the brecciated chert quarry Site TASI 5354, (SQ N9/W13.5),* Report to Dept Archaeology, Latrobe University, Department Parks, Wildlife & Heritage, Tasmanian Forest Research Council, Tasmanian Aboriginal Lands Council and the Tasmanian Forestry Commission, Hobart.

54 Murray, T., 1993, 'The childhood of William Lanne: contact archaeology and aboriginality in Tasmania', *Antiquity* 67, pp. 504–519.

55 Hellyer, 'Report of Mr Henry Hellyer', p. 168.

56 Fossey, J., 1827, 'Report of Mr Joseph Fossey, dated Circular Head 26 May 1827', reprinted in Bischoff, J., 1967, *Sketch of Van Diemen's Land and an Account of the Van Diemen's Land Company*, facsimile edition by the Libraries Board of South Australia, Adelaide, from the 1832 original, p. 179. Joseph Fossey set out from Launceston early in April 1827 to find a land route to Surrey Hills. Later under his supervision this track was formed for seventy miles (113 km) and met the one from Emu Bay in February 1828.

57 Lancelot 'Capability' Brown was an eighteenth century landscape architect recognised as England's greatest gardener. He was responsible for over 170 gardens surrounding the finest country houses and estates in Britain. He would characteristically tell his landed clients that their estates had great 'capability' for landscape improvement.

58 Curr, E., VDL 5 Outward Dispatch No 70, 10 November 1827, paragraph 31.

59 Gammage, B., 2006, 'Landscape transformed', in Lake, M. (ed.), *Memory, monuments and museums: the past in the present* (Melbourne: Melbourne University Press), pp. 153–165.

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61 Ellis, R. C., 1985, 'The relationships among eucalypt forest, grassland and rainforest in a highland area in north-eastern Tasmania', *Australian Journal of Ecology* 10, pp. 297–314.

62 Howard, T. M., 1972, 'Buried viable seed in three related vegetation types', unpublished report to Associated Forest Holdings Pty Ltd.

63 Brimfield, *Long trek south*. He described them as 'ecologically tethered' to these grasslands.

64 Cosgrove *et al.,* 'Palaeoecology and Pleistocene human occupation'; Cosgrove, R. and Allen, J., 2001, 'Prey choice and hunting strategies in the late Pleistocene: evidence from south west Tasmania', in Anderson, A., Lilley, I. and O'Connor, S. (ed.), *Histories of old ages: essays in honour of Rhys Jones* (Canberra: Pandanus Books, Research School of Pacific and Asian Studies, ANU), pp. 397–429; Brimfield, *Long trek south*.

65 Walker, J. B., 1897, 'Tribal divisions of the Aboriginals of Tasmania', *Papers and proceedings of the Royal Society of Tasmania,* pp. 176–187.

66 Bob Ellis provides a much more detailed and scientific explanation of this process based on studies in the north-eastern highlands of Tasmania; see Ellis, R. C., 1986, 'The relationship between sub-alpine grassland and forest communities in northern Tasmania', in Barlow, B. A. (ed.), *Flora and fauna of alpine Australasia: ages and origins* (Canberra: CSIRO & Aust Systematic Botany Soc.), pp. 243–248.

67 Orme, R. K., 1971, 'The regeneration of commercial eucalypt forests on Surrey Hills, NW Tasmania', unpublished Master of Science Thesis, University of Tasmania, Hobart.

68 *E. delegatensis* also occurs in the montane areas of Victoria and New South Wales. In those States it prefers a forest habitat. The Tasmanian subspecies is physiologically and morphologically different from the mainland forms, and was once regarded as a separate species. It is more fire resistant as an adult and can persist as a suppressed seedling in dry forests for up to 30 years; see Forestry Tasmania, 2001, *Eucalyptus delegatensis forests,* Native Forest Silviculture Technical Bulletin No. 2 (Hobart).

69 The dating was carried out by Keith Orme as part of his M.Sc. study on Surrey Hills; Orme, 'The regeneration of commercial eucalypt forests'.

70 At the start of the twentieth century, the VDL Co. engaged the surveyor Henry Percival Winter Sams to sub-divide Surrey Hills into blocks for sale. He produced a valuable survey plan in 1903 showing the detailed distribution of the vegetation communities at that time. It now provides an important record for the study of vegetation change and dynamics on Surrey Hills.

71 Ellis, R. C., 1985, 'The relationships among eucalypt forest, grassland and rainforest in a highland area in north-eastern Tasmania' *Australian Journal of Ecology* 10, pp. 297–314.

72 Orme, 'The regeneration of commercial eucalypt forests'.

73 Ellis, R. C., 1964, 'Dieback of alpine ash in north eastern Tasmania' *Australian Forestry* 28(2), pp. 75–90.

74 Orme, 'The regeneration of commercial eucalypt forests'.

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76 Fensham, R. J. and Kirkpatrick, J. B., 1992, 'The eucalypt forest-grassland/grassy woodland boundary in Central Tasmania', *Australian Journal of Botany* 40, pp. 123–138.

77 Gammage, B., 2006, 'Landscape transformed'.