FROM SEA TO SUMMIT:

ALTITUDINAL VEGETATION ZONES ON MT. TARANAKI

TARANAKI, NEW ZEALAND

Arborists manage amenity trees within urban environments, applying a range of professional skills to ensure their care and conservation. Wild trees, within natural living ecosystems, equally require attention and protection – and provide fascinating reminders to us of Nature's complexity. Here's an insight into Mt Taranaki's natural trees and plants within an ever-changing landscape – shaped by environmental influences and species succession.

The biodiversity of Mt Taranaki

Egmont National Park (Te Papakura O Taranaki), centrally located in the Taranaki region of New Zealand's North Island, contains over 650 different types of native vascular plants*. Collectively, they form a complex inter-connected mosaic of species comprising lichens, mosses and liverworts, ferns, epiphytes and lianes, grasses and herbs, shrubs and trees. Some of these plants are locally endemic and unique to the area. The dual drivers of altitude and succession drive the dispersal and distribution of species.

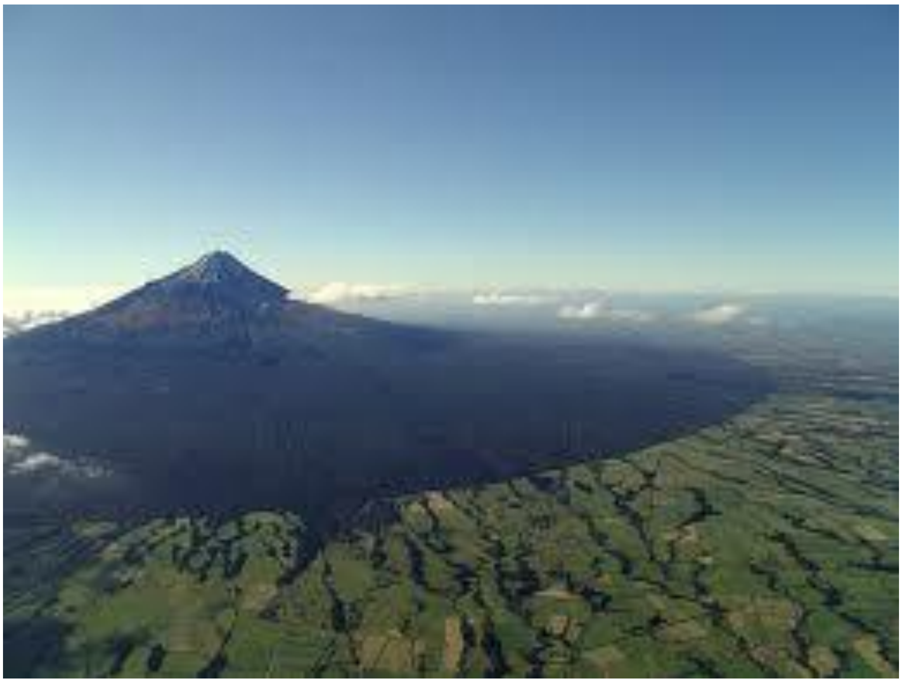

Photo 1: Mt Taranaki and its ringplain
A biodiverse natural environment, beyond surrounding modified farmland, covering a protected area of 341.7km^2 (131.9mi^2).

The stratovolcano Mt. Taranaki (correctly referred to as Taranaki Maunga in Maori) stands at 2,518m asl, forming the central high point of an area rich in botanical diversity. The andesite peak is surrounded by an extensive apron of volcanic clastic conglomerates, breccia and tephra† deposits – termed the ringplain – which decreases in height and extends from the summit for many kilometres in all directions. Protected in perpetuity since 1881, an area of 9.6km (six miles) radius from the summit plus recent additions (see Photo 1) provides a sanctuary for plants, animals, birds and insects living within unique associations. The mountain and its environs cover all vegetation type classifications, from alpine to almost sea level.

Laid upon the summit cone and ringplain is a mantle of vegetation influenced by radiating drainage patterns, deposited/eroded material and soil types and changeable seasonal temperatures (see Photo 2). Additionally, the occurrence of plants has been significantly modified over time as a result of land clearance, animal predation, human interference plus, across millennia since the mountain's inception over 70,000 years ago, catastrophic volcanic events. In places, the treeline plus typically expected natural plant distributions have been disrupted, eradicated and succeeded by eruptive discharges and emissions, creating altered vegetation patterns. Collectively these factors, with many site-specific variations, have resulted in the overall vegetation cover seen today.

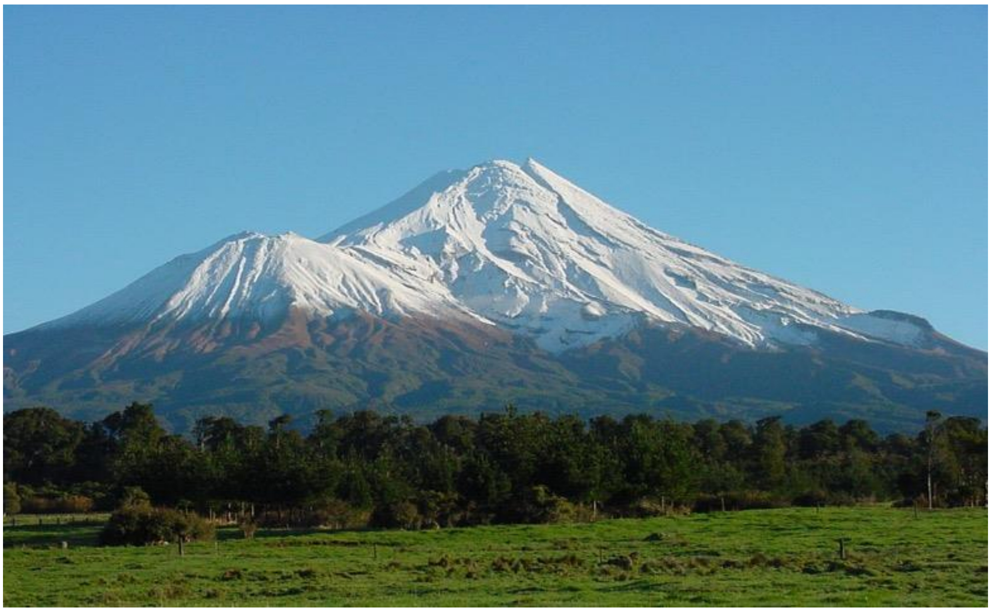

Photo 2: Mt. Taranaki, 2,518m, with the subsidiary cone of Fantham's Peak (Panitahi) standing alongside at 1,966m, from the south-east
Lowland forest covers the surrounding ringplain, ascending into montane forest, scrubland, tussock grassland, alpine herbfields, summit rock zones and snowfields.

A glance at the mountain clearly indicates the vegetation changing with altitude. Conditions for plant growth transform with height, creating a marked transition in vegetation zones from sea level to summit.

The tall trees of the lowland forest recede into the stunted canopy of the montane forest, which continues upward into sub-alpine scrub. Beyond the scrub lie tussock grasslands, herbfields and mossfields. Above 1,650m asl, at the limit of growth, plant cover is patchy and inconsistent, with exposed rock and scoria the dominant feature.

Overall, a botanical exploration of the mountain and the ringplain provides a fascinating insight into a range of plants adapted to their own environmental niche. The vegetative zones found on the mountain – see Photo 3 – are described here in a series of overviews, moving upward from sea level to the summit.

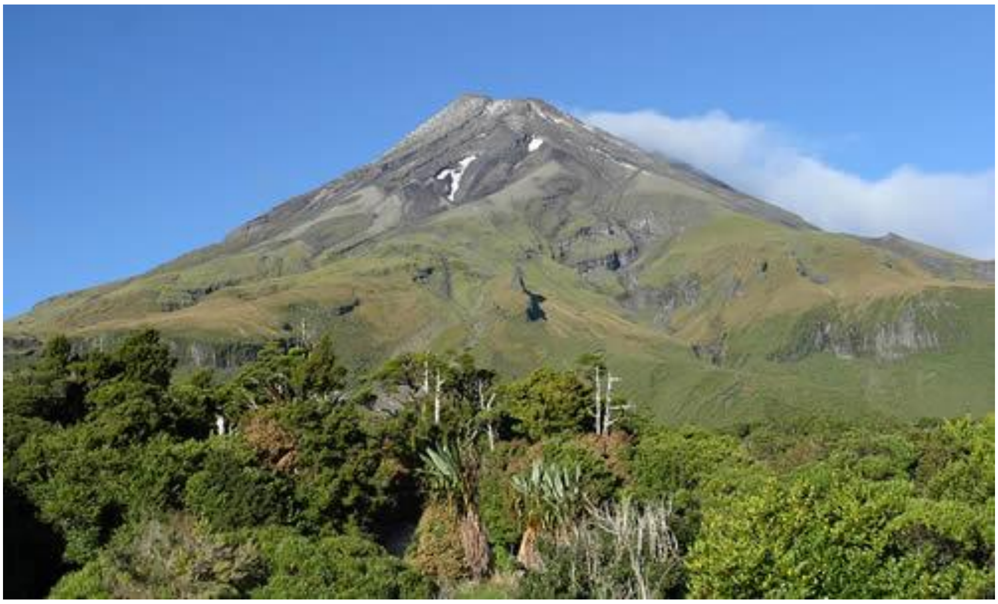

Photo 3: Mt Taranaki vegetation zones influenced by increasing altitude and correspondingly tougher growing conditions
Trees give way to shrubs, then grasses, with herbs and lichens at the highest rocks.

Lowland forest

The vegetation zone described as lowland forest, clothing the lower skirting slopes up to 750m asl, covers over half the 34,000ha park. Botanically there are nine identifiable variants to this forest zone, but essentially a rimu-rata/kamahi mix is the dominant type. The lowland forest area is where a few species of tall forest trees form the upper canopy, emerging through an intricate under-storey of ferns, shrubs and small trees.

Rimu (*Dacrydium cupressinum*) shares this low elevation forest canopy with many other native trees, in particular northern rata (*Metrosideros robusta*) and kamahi (*Weinmannia racemosa*). The natural composition of the rimu/rata/kamahi mix is variable – with either tree being dominant within an area – depending upon the influences of varying soil, drainage and exposure.

Photo 4: the lowland forest, home of giants
Long-lived colossal northern rata (*left*) and rimu (*right*) emerge above the lowland forest canopy.

Many trees exceed 700-800 years old and are ecological sentinels within the forest (see Photo 4).

Regardless of the combination the overall matrix of the forest comprises these large spreading trees. Together with kahikatea (*Dacrycarpus dacrydioides*), mahoe (*Melicytus ramiflorus*) and tawa (*Beilschmiedia tawa*) with associated smaller trees and shrubs they form a plant community recognisable as lowland forest.

Interestingly, just like rimu (and, indeed, many of New Zealand's native trees) both northern rata and kamahi adapt their form and appearance to their growing environment and as they develop through the aging stages of their lives. The variability in appearance noticeable with these trees is most apparent in differing leaf shapes and bark patterns. Rimu, rata and kamahi are all long-lived, with many specimens over 400-500 years old. Numerous emergent rimu and rata exceed 800 years in age.

Montane forest

The montane forest occurs between approximately 750-1,200m asl. The treeline varies depending upon the influence of soil types, nutrients, drainage and disturbance resulting from past eruptive events. As in the lowland areas, the matrix of distinct montane vegetation communities within the montane zone is complicated and interconnected. A noteworthy absentee, typically found throughout the mountains of the central North Island, is beech (*Nothofagus* spp.) – which pollen records show existed on Mt Taranaki approximately 14,000 years ago, until eruptions expunged it completely. Given the slow regenerative establishment of *Nothofagus* once disturbed, the isolation from other seed sources and the propensity of faster growing species to quickly colonise open ground, it may be many years before beech return to the maunga, if at all.

The montane forest zone on Mt. Taranaki is commonly referred to as 'goblin forest' – a descriptive non-botanical term that alludes to the stunted tree growth festooned with mosses and lichens so striking to any observer. Kamahi dominates the canopy (see Photo 5). Trees here are typically shorter in stature – a characteristic especially noticeable where the effect of increasing altitude and exposure to wind has restricted growth and shaped the canopy.

The moss-carpeted fern-covered undergrowth and shrubby understorey is relatively open – a feature noted by early explorers and travellers, who found it relatively easier to negotiate (compared to dense thicket) when moving through the forest. Hundreds of bryophyte and pteridophyte species clothe every surface, on stems and branches or as extensive groundcover drifts – including, occasionally, two epiphytic species of the rare and ancient genus *Tmesipteris*, a spore-bearing plant pre-dating the fern – fork fern (*Tmesipteris elongata*) and chain fern (*Tmesipteris tannensis*).

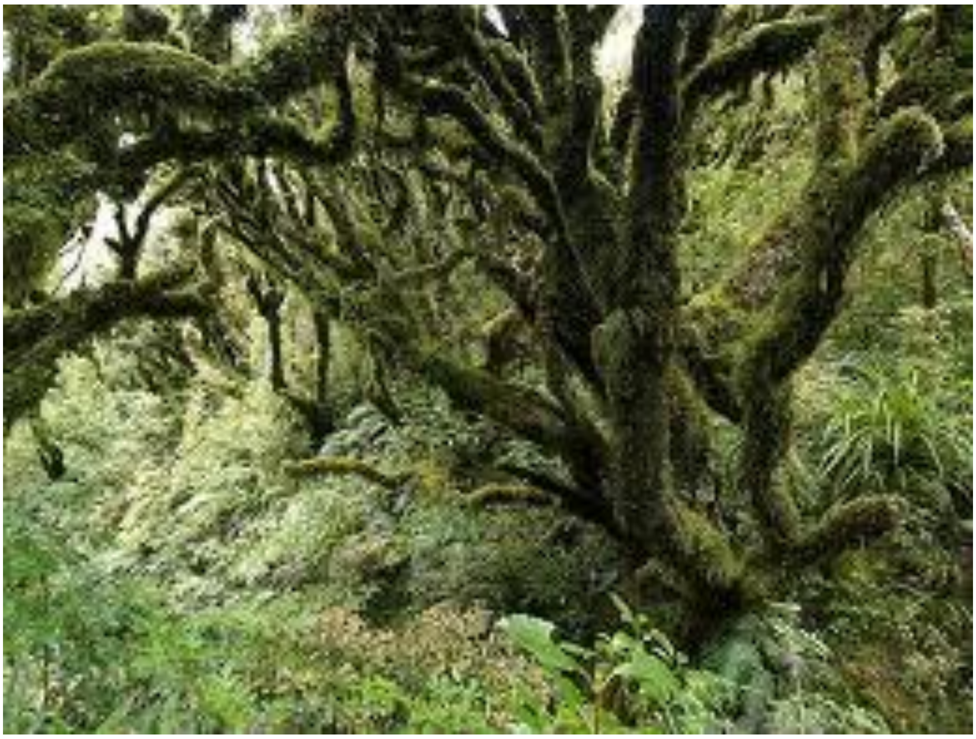

Photo 5: montane goblin forest surrounding the mountain's middle slopes
Kamahi – wind-shorn and festooned with ferns, mosses and lichens, create a fairytale-like forest – where the effects of temperature, wind and precipitation (from fog, rain, sleet and snow) maintain a canopy that rarely exceeds 12m in height.

Stunted wind-shorn kaikawaka (*Libocedrus bidwillii*) and mountain totara (*Podocarpus cunninghamii* syn. *hallii*) are mixed within the continuous canopies, becoming more frequent with increasing altitude (see Photo 6).

Photo 6: maturing and surviving kaikawaka and mountain totara
Within and surrounding the goblin forest of kamahi, regenerating cypresses and podocarps, some over 400 hundred years old, are the survivors of previous eruptive events. Even at this age such wind-sculpted trees in the montane forest may be less than 10m high.

Many trees are massive in their trunks but squat, twisted and gnarled, having begun life as perching epiphytes on fallen logs or within the upper canopy. Evidence of previous ash and tephra deposits can be seen in areas of exposed earth. The deformed remnants of old mountain totara and mountain cypress that pre-date previous cataclysmic lahars and pyroclastic flows[‡] throughout the 1600-1800's – some dead, some alive – are everywhere amongst the forest. Younger, smaller, surviving trees (though, actually 300-400 years old) existing from the time of former eruptive events, are only now fully closing the wrecked canopy, due to their slow growth and development. When viewed from above, looking down and across the mountain's middle slopes, the extent of damage to the montane forest cover from devastating pyroclastic blasts and debris-slides is evident. Good examples of goblin forest and associated mountain cypress and podocarps are easy to find – particularly around the North Egmont, Stratford Mountain House or Dawson Falls areas.

Grotesque tree forms, smothering filmy ferns (*Hymenophyllum* spp.), perched epiphytes and scrambling lianes are characteristic of montane (goblin) forest and are partly the result of the cooler, wetter environment. Rainfall in this zone may be up to 6,500mm per annum. Temperatures frequently fall below freezing anytime throughout spring to autumn and snow lies for lengthy periods during winter. The mountain cabbage tree, or toii (*Cordyline indivisa*) is seen at clearings within the tree cover or along the edge of tracks, where its bold foliage thrusts into the light beyond the shaded forest canopy (see Photo 7).

Photo 7: the broad sword-like leaves of toii, an iconic species
Mountain cabbage tree (toii), a frost/ice/snow-tolerant plant, is only found where temperatures are cooler and precipitation is high.

Some other interesting influences on plant growth are less obvious, however. In particular transpiration – the process by which plants allow the controlled loss of water vapour and gases through their leaves – is affected by the frequent cloud cover and shrouding mist. Low transpiration rates are believed to reduce nutrient uptake which, in turn, slows the growth cycle to very small annual increments. Additionally, the nutrients released from the decomposing leaf litter are flushed by regular rainfall into the soil, where the moisture percolates downwards, leaching them away, thereby limiting their availability to plants. Add to this factors such as temperature and wind and it is not surprising that many of the trees in this zone, whilst often very aged, are small in size.

Sub-alpine scrub and shrubland zone

This zone lies generally between 1,000-1,500m. The sub-alpine scrub and shrubland canopy is dominated by leatherwood (*Brachyglottis rotundifolia*) in association with mountain five-finger (*Pseudopanax colensoi*), haumakaroa (*Pseudopanax simplex*), inaka (*Dracophyllum longifolium*), *Hebe* “Egmontiana” and *Coprosma pseudocuneata.*

The dominance and distribution of the plants within this complex depends, as is so often the case, upon biophysical variables such as moisture availability, nutrient levels and wind exposure – combined with the effect of disturbance due to ongoing erosion and gradual slippage plus past volcanic activity. Leatherwood forms the main tightly packed canopy, but wherever slips occur inaka is usually most prolific as a coloniser, followed successively by leatherwood and its associates, as the area becomes stabilised (a process that may takes decades).

This is the zone of transition between the montane forest and the truly alpine tussock grassland and herbfields (see Photo 8). Some trees occur here – but look markedly different to their forest counterparts at lower elevations, where growth conditions are more sheltered. Accordingly, some stunted wind-shaped kaikawaka emerge through the leatherwood at the lower levels of the sub-alpine layer. So too mountain totara and broadleaf are found randomly and appear sculpted and shrub-like. However, with increasing altitude, the trees disappear. The canopy of the shrub matrix becomes more compact and the leatherwood gives way to mountain tauhinu (*Cassinia vauvilliersii*), mountain tutu (*Coriaria pteridoides*), mountain box (*Hebe odora*), weeping matipo (*Myrsine divaricata*) and inaka.

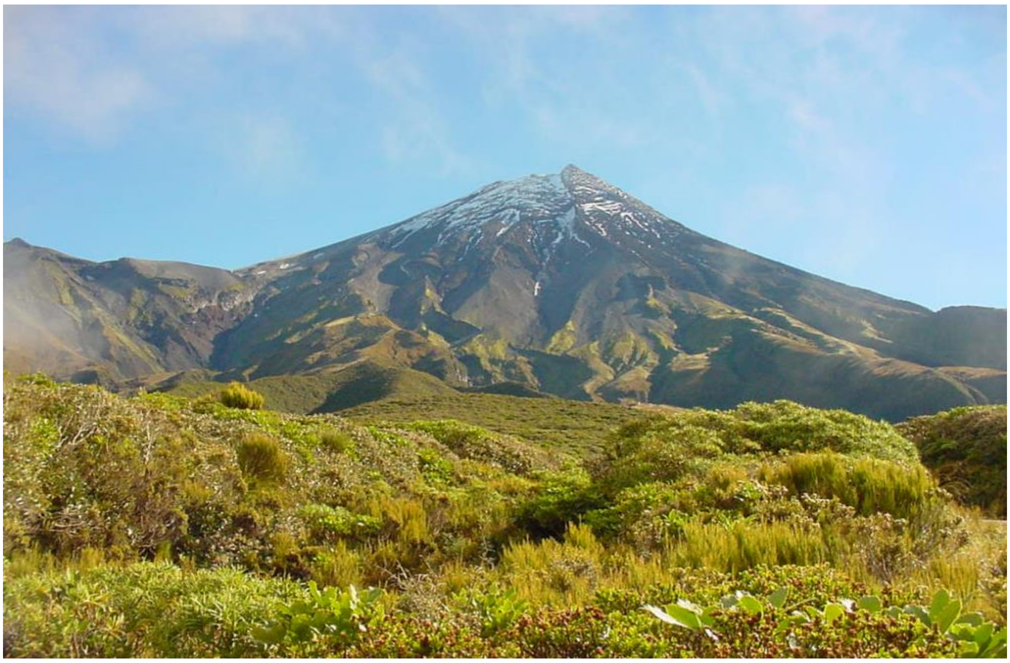

Photo 8: the sub-alpine scrub and shrubland zone
Taranaki Maunga's summit is hidden beyond view, across the crater from the Shark's Tooth (2,510m) at centre right, seen from the south-east, near The Plateau, above Dawson Falls. Leatherwood, hebe and inaka dominate the sub-alpine scrub and shrubland plant matrix before merging, at higher elevations, into tussockland.

The upper edge of the zone undulates at varying altitudes. In places it is breached by landslides, creating the circumstances plant colonisers need to begin the slow process of re-vegetation all over again, thereby changing the species composition. Tussock grasses and herbs from the higher levels make inroads wherever the land is broken or exposed. At the shrubland zone's extremity a shrub-tussock mix fades into almost pure tussockland, as altitude increases and drainage decreases.

In the upper alpine area plants become smaller in stature, hugging the ground or sheltering in crevices. Gone are the forest giants – this is the zone where life exists in miniature and, although some plants are obvious, others are not. Whist adapted to extremes these high-level plants are clinging to survival in a harsh environment of fierce winds, sub-zero cold, baking heat and shifting unstable ground. There's no shortage of precipitation – the north face of Mt Taranaki receives over 7,500mm of rainfall annually. What's important is finding secure shelter and holding on to it.

Once above the treeline and sub-alpine scrub, heading towards the top, the views open to a different world where temperature, exposure, moisture and erosion totally define the type and extent of plant growth.

Sub-alpine and alpine tussocklands

Beyond the scrub, above 1,400m, the vegetation is dominated by alpine grasses (see Photo 9). Referred to as 'tussockland' grasses occupy a zone of approximately 200m vertical altitude. Large swathes of red tussock (*Chionochloa rubra*) interspersed with silver tussock (*Poa laevis*) shroud the slopes.

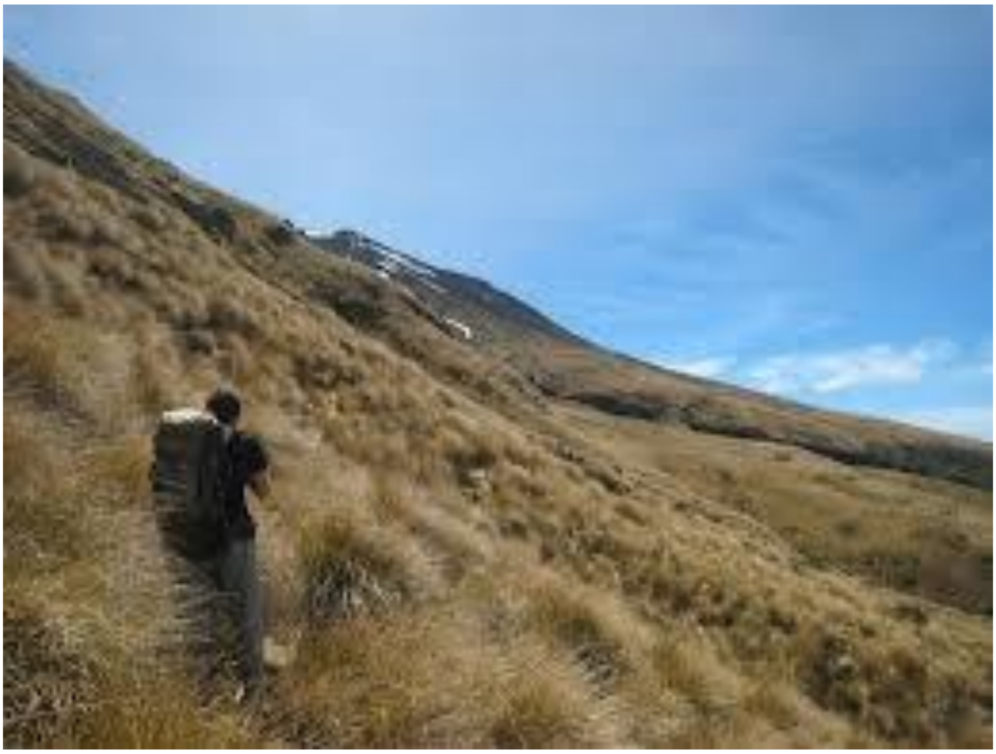

Photo 9: extensive tussock grasslands clothe the upper mountain slopes
Red and silver tussock dominate, interspersed with flowering herbs.

At the lower margins the grass is interlaced with scrub species – including mountain hebe (*Hebe odora*), mountain tauhinu (*Cassinia vauvilliersii*), inaka (*Dracophyllum *longifolium*) and semi-prostrate coprosma (*Coprosma depressa)*. Throughout the central belt of the zone the tussockland is particularly dense where conditions are most favourable – in such areas every centimetre of ground is taken, with no room for other species to gain a foothold. The upper margin is characterised by more scattered spacing, fragmenting into the alpine herbfield zone as drainage and the environment alters again.

Showy flowering plants such as golden-flowered buttercup (*Ranunculus nivicola*) and large-leaved ourisia (*Ourisia macrocarpa* var. *macrocarpa*) are commonly seen here. Their blooms are spectacular between November and February, thrusting through the tussock clumps or alongside tracks and streams at every level from the forest to the herbfields.

Searching at the lower levels of the tussockland zone often reveals the green-hooded orchid (*Pterostylis banksii* var. *patens*). Its subtle colouring makes it easy to miss, but once seen it may be surprising to note how many there are concealed amongst the grass. The male and female reproductive parts are contained within the hood. They cross-fertilise, providing the spring-loaded 'exchange' mechanism is triggered. Its flower is sensitive to insects which, once they land on the petals, are instantly flicked upwards and inside the tensioned flower – temporarily trapped as unwitting pollinators, until the deed is done and they are released as the flower relaxes. Not a bad trick for a little flower.

Alpine herbfields

This is the zone where, in summer, you find it hard to place your boots without stepping on some innocent flower. In mid-late January the herbfield is alive with colour *en-masse*. It's a zone of some confusion (or at least uncertainty) amongst botanists – where many of the plants are both unique and/or closely related to similar species in other alpine areas of the North and South Island. See Photo 10.

Mountain daisies (*Celmisia gracilenta, C. glandulosa* var. *latifolia* and *C. spectabilis*), everlasting daisy (*Helichrysum alpinum*), anisotome (*Anisotome aromatica*) and forstera (*Forstera bidwillii* var. *densifolia*) carpet the stones. Anisotome is a member of the carrot family and its crushed leaves emit a strong fragrance.

The careful observer will see other dwarf shrubs and plants – namely creeping coprosma (*Coprosma pumila*), snowberry (*Gaultheria depressa* var. *novae-zelandiae*), blue tussock (*Poa colensoi*), club moss (*Lycopodium fastigiatum*) and a sprawling clump moss (*Racomitrium lanuginosum* var. *pruinosum*).


Photo 10: flowering alpine herbs
(*Left*) one of three mountain daisies (*Celmisia spectabilis*), which carpet the stony ground – and (*right*) the dwarf shrub snowberry (*Gaultheria depressa* var. *novae-zelandiae*) – find refuge by growing low and flattened to the exposed slopes.

Much of the species composition is due to variation in topography and drainage, but on a site-by-site basis, within small distances. A detailed examination of different slopes, hollows and streams will demonstrate the capacity of plants to establish in ideal (or the best available) circumstances.

In places the herbfield includes a montage of moss species, sometimes to the extent that the vegetation becomes almost exclusively what is known as mossfield. Here, the mosses *Racomitrium lanuginosum* var. *pruinosum*, *R. ptycophyllum* and *R. crispulum* are evident in large distinctive hummocks. Amazingly these plants were first seen (by Europeans) by the noted naturalist Joseph banks in 1770 when, from aboard James Cook's ship the Endeavour, he recorded "… *many white lumps in companies of fifty or sixty together, which probably were stones or tufts of grass, but bore much resemblance to flocks of sheep*". Good telescope. The description has stuck – and now *Racomitrium* species are generally referred to as 'vegetable sheep'.

The spread, presence or absence of species through the herbfield-mossfield zone varies according to seasonal change and, also, the sporadic impact of erosion. Where fragile slopes have moved the ground is re-colonised by pioneers (usually mountain tutu (*Coriaria plumosa* and/or *C. pteridoides*) are the first to arrive) and the composition of plants reverts to a new cycle of adaptation and establishment.

Alpine gravelfields, stonefields, boulderfields, rocklands, snowfields and icefields

We're really at the top now. Above 1,650m there's a lot of bare ground. The size of rock pieces – called substrate – determines the type of zone as either gravelfield, stonefield or boulderfield. Where residual lava is found the term is rockland. As with so many things, the seemingly barren landscape is actually a complex mix of vegetation affected by a range of physical and climatic factors such as slope angle, stability, exposure and duration of snow cover.

Plants numbers are thinning out now, but they certainly exist. Blue tussock (*Poa colensoi*) reaches about 1,900m, along with the anisotome, daisies and forstera. Above 2,000m vascular species (that is, ‘higher’ plants, which are anatomically endowed with flowering parts) are infrequent and confined to sheltered depressions. Mountain grass (*Poa novae-zealandiae*) and dwarf sedge (*Carex pyrenaica* var. *cephalotes*) are found abundantly.

The distinction of being the vascular plant which is found highest on the mountain is taken by a minute cushion plant – an as yet un-named *Colobanthus* species, growing at over 2,400m (see Photo 11).

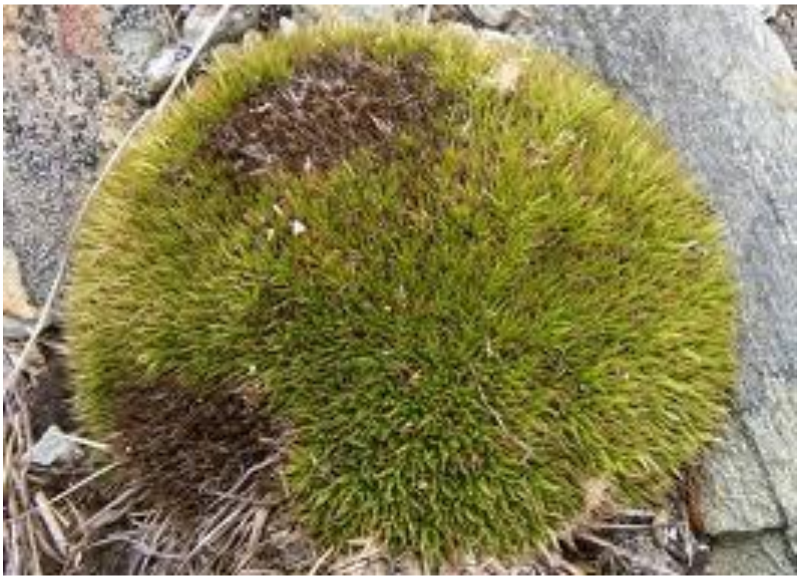

Photo 11: plant king of the mountain
The tiny pin-cushion plant – an un-named *Colobanthus* species – grows in the severest alpine conditions, near the mountain’s summit.

Stonefields and boulderfields are scree areas prone to slippage. Living conditions are hard and impermanent. Despite this a range of plants adhere to the rock and occupy the voids between them. Along with daisies and red-stemmed willowherb (*Epilobium glabellum*) there are colonies of the mountain fern (*Polystichum cystostegia*). The towering cliffs of Warwick Castle and Humphries Castle plus many of the ravines are examples of shifting scree sites.

Rockland ranges from the vertical cliffs of old eroding lava extrusions to the more intact newer flows like Minirapa (a prominent geophysical feature on the north-facing slopes). Lichens (*Rhizocarpon* and *Stereocaulon* spp.) and mosses (*Racomitrium*, *Andreaea* and *Grimmia* spp.) cover the rock surfaces.

Photo 12: the uppermost substrate of the mountain
Looking down and across to the Shark's Tooth, with permanent snow in the crater, from the main (true) summit. Seasonal and diurnal temperatures range from sub-zero to baking heat. Wind erodes loose surfaces shattered by the freeze-thaw cycle. Rock material is constantly shifting down the steep slopes. Only alga and lichen exist here in the rockland-snowfield/icefield zone.

Above 2,500m you will be lucky to see much, other than a few minute lichens growing in rock fissures. The snowfield and icefield of the summit cone and crater are naked of plants (see Photo 12). Clarkson advises the only plant recorded at this altitude is a single-celled alga, called *Chlamydomonas-something-or-other* …… which is very weird, but you'll know it when you see it because it causes red staining on the snow in winter.

References

For further information, two great references are:

- *Vegetation of Egmont National Park, New Zealand*, 1986 by Bruce D. Clarkson (whom I acknowledge as a prime reference for these notes).

- *A Field Guide to the Alpine Plants of New Zealand*, 1986, by John Salmon.

* Vascular plants include: lichens; club mosses, liverworts (bryophytes); ferns (pteridophytes); conifers (gymnosperms); and flowering plants (angiosperms) – all of which have differentiated cells and distinct anatomical structures.

† The material termed ‘clastic’ refers to broken fragments or sediment from pre-existing rock which has been transported from its place of origin by extrusion or ejection; ‘conglomerates’ and ‘breccia’ comprise coarse-grained, rounded to sub-angular sedimentary rock fragments larger than 2mm dia., set in a matrix of finer particles; ‘tephra’ includes volcanic dust, ash, cinders, scoria and pumice ejected during eruptions and air-blasted from a crater or vent.

‡ lahar: fast-flowing destructive debris/mud flow, containing a slurry of ash/mud/rock/water, typically following the path of streams/rivers; pyroclastic flow: fast-moving current of super-heated volcanic gas and volcanic dust (at temperatures of 1,000°C/1,500°F), travelling at speeds of 100-700km/h, vented from fissures and lines of weakness anywhere on the cone.

Amended and revised by the author, from an original version published by the Taranaki Alpine Club (2005).