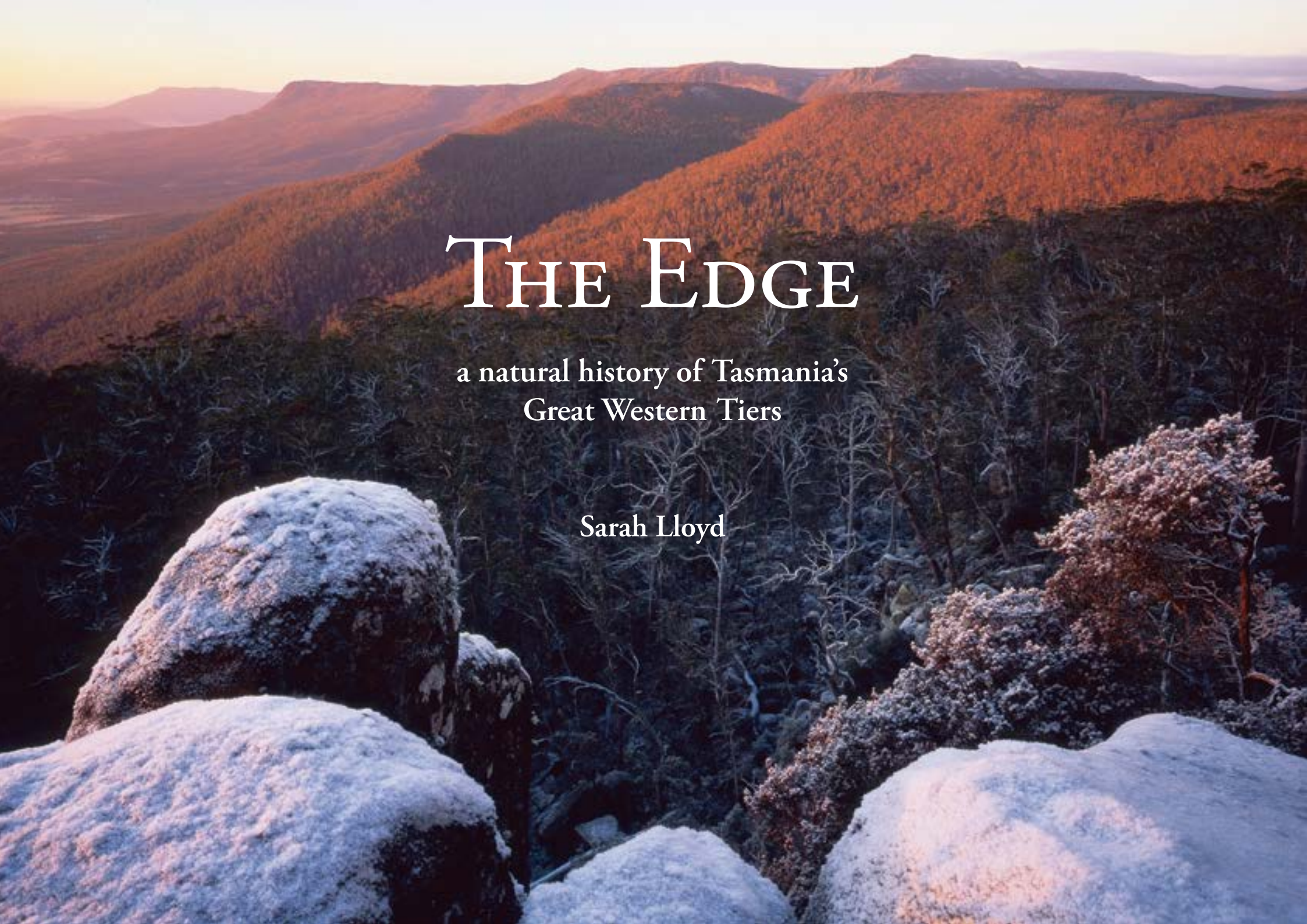


The Edge

a natural history of Tasmania's Great Western Tiers

Sarah Lloyd

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Dennis Harding

Sarah Lloyd
Foreword by Tom May

First published in 2012 by
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Pages i, iii & vi Dennis Harding; Pages v, 5, 7 & 44 Laurie Goldsworthy
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Front cover: The Great Western Tiers - Rob Blakers
Back cover: native bee on forest flaxlily (*Dianella tasmanica*); orange everlasting (*Xerochrysum subundulatum*)

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The Great Western Tiers by nunarng



Dennis Harding

Quamby Bluff amd Drys Bluff

In the morning glory of the Great Western Tiers
There is more to the eye than you see
As a power and strength portrays in the mind
The depth of a past history.

My people wandered the many tracks
When they set out each day to explore
Her natural living pantry
From plateau to forest floor.

They saw birds on the wing, all colours
Native animals abounded there too.
Insects and reptiles trod leafy floors
Of Mother Natures natural zoo.

Foot weary from each long journey
And feeling all overwhelmed
My people would then turn homeward
To their haven, their Spiritual Realm.

Tangible whispers would often be heard
As stories our people would say
And the secrets they shared right from the heart
In her bosom forever to stay.

As the mantle of evening lowers her shade
All audible sounds fade with light
Majestic in silence, protecting her own
The Great Western Tiers sighs ... goodnight.

nunarng

BACKGROUND NOTE



Ritters Crag, Jackeys Marsh

The residents of Jackeys Marsh, Western Creek, Mole Creek and other areas along the base of the Great Western Tiers have fought for over 30 years for the protection of the biodiversity and other natural values of the escarpment and to have these values recognised in the wider community.

The first Environmental Impact Statement on forest harvesting in Tasmania, completed in 1982, on the first Jackeys Marsh forest coupes, determined that clear fell harvesting was unlikely to have any significant impact. As a reaction the Jackeys Marsh Forest Festival was born. The first festival, in 1983, attracted academics, scientists, naturalists and conservationists who came together to explore and highlight the significance of the environmental values of the valley.

In the mid 1980s the valley of Jackeys Marsh was nominated and eventually listed on the Interim Register of the National Estate. As a consequence the Deloraine Environment Centre and the Forest Action Network applied for funding to undertake the first assessments of the natural values of the area and to compile a book and displays to promote these values. At approximately the same time it became evident that the Mole Creek karst was also under threat from forestry activities. The increased awareness of the plight of the forests at Jackeys Marsh, the Mole Creek karst and the Great Western Tiers lead to further studies. During the Helsham enquiry of 1989 it was identified that the Great Western Tiers is topped by the longest dolerite sill in the world and has the second steepest climate gradient in Australia. It is also the catchment for a karst system that is not only among the most spectacularly decorated in Australia but also contains deposits which are helping to unravel the history of the Earth's changing climate.

In 1989 the Central Plateau Conservation Area on top of the Tiers was inscribed on the World Heritage list, together with the Liffey Falls State Reserve and the Cave Country Reserve. In 1996 several small existing cave reserves were collectively rededicated as the Mole Creek Karst National Park. Subsequent years saw more areas added to the World Heritage list, so that by 2013 most of the Great Western Tiers escarpment and adjoining plateau had become part of the Tasmanian Wilderness World Heritage Area. The Mole Creek Karst National Park was extended in 2013. Much of this protection has been achieved through the persistence of local residents supported by national and international experts.

Over successive years the natural and cultural values of the Great Western Tiers have been explored, documented and analysed by scientists, local residents, field naturalist groups, bush walking and caving clubs and students. Much remains unexplored and undocumented. This informative book is one more step along the way to promoting the amazing wealth of natural diversity found on both the escarpment and the plateau above this magnificent land form.

We are grateful to the Jani Haenke Charitable Trust, established to support various organisations including those dedicated to the conservation and preservation of the environment, for providing funds for the printing of this book in 2012.

Rosemary Norwood and Deborah Hunter

FOREWORD



Laurie Goldsworthy

Tumbledown Creek

I first saw the Great Western Tiers in the autumn of 1992 when I spent a memorable couple of months in Tasmania, based at a bush hut at Jackeys Marsh. I pottered around in the myrtle beech gullies in the shadow of Quamby Bluff and used the Marsh as a base for travels further afield. I was staggered by the wonderful diversity of fungi in Tasmanian forests and marvelled at the extent of Cool Temperate Rainforest, restricted to tiny pockets elsewhere in Australia. Subsequently, through Fungimap (Australia's fungi mapping scheme), I was fortunate to meet Sarah Lloyd and I have enjoyed regular trips back to Tasmania to collaborate with Sarah and the Central North Field Naturalists on expeditions and activities to promote understanding and conservation of fungi.

I am always impressed by the broad approach that field naturalists take to nature-organisms large and small are observed in the wild, and their myriad interactions spark wonder and further investigation. Sarah's writing and images in *The Edge* exemplify this approach to natural history, with documentation of not only the birds, mammals, lizards, frogs and flowering plants of the Great Western Tiers, but also a celebration of the beetles, moths, flies, wasps, fungi, lichens, mosses, liverworts and other less obvious organisms.

Not only will readers benefit from Sarah's detective work in putting names on many of the smaller organisms featured in *The Edge*, but there is much of interest to read about behaviour, life-cycles and habitat requirements, all based on careful and often first-hand observation. *The Edge* also draws attention to interconnections, such as the diversity of insects attracted to prickly box; the springtails that feed on slime moulds; and the pardalote's fondness for psyllids and lerp.

The Edge is an impressive addition to Sarah's previous works in a similar vein, including *Life in the Shadows* (about her home on Black Sugarloaf) and *The Blue Tier – a natural history*, all evoking a sense of the specialness of each place and the diversity of life to be found there.

From much of central north Tasmania the Great Western Tiers are a dominant feature of the landscape; but what is obvious may also be overlooked. The Tiers are not just a bookend for the Central Plateau but an integral part of the landscape and biodiversity systems of the region. Climate change is likely to cause shifts in the areas suitable for individual species. The extra-ordinary steepness of the Tiers is a natural laboratory to monitor species responses over climate gradients, and an escape route if shifts become necessary.

The Edge highlights the conservation value of the Great Western Tiers. Protecting and cherishing large, relatively intact areas of natural habitats may seem a luxury; but the stark reality is that such habitats are becoming rarer across the planet, especially with the pace of habitat destruction. The Tiers are a place of impressive scenic beauty as well as unique landscape features such as the Mole Creek Karst. In addition, the Tiers are home to endangered species and habitats, such as sphagnum bogs, and provide extensive healthy forest that ensures common species stay that way.

The Edge provides a unique perspective on the Great Western Tiers and the life found there; at scales varying from the grand vistas of the Tiers themselves to the tiniest 'dot snail' crawling on a fern. Sarah's meticulous documentation of the fascinating natural history of the Tiers will considerably deepen the understanding and appreciation of nature by those who live in or visit the region.

Dr Tom May
Principal Research Scientist (mycology)
President Fungimap Inc. 2005-2018

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AUTHOR'S PREFACE



The Great Western Tiers dominate the skyline of central north Tasmania and form a dynamic background to the towns and agricultural landscape of the region. At times they have a remarkable clarity against a brilliant blue sky; at times mist and fog swirl around the foothills or they disappear from view in a blanket of heavy cloud. The extent and duration of winter snowfalls provide a talking point for new and long term residents who compare this year's with last year's – and those of long ago. Smoke-filled autumn days caused by forestry 'regeneration' burns kindle more heated discussions.

A naturalist likes nothing more than to have a reason to delve a little deeper and this was presented when the Friends of Jackeys Marsh commissioned me to write a book about the natural history of the Great Western Tiers in November 2010.

I have lived near the Tiers for over three decades, conducted bird surveys on farmland at their base and on the forested escarpment and visited many sites to look at the flora, fauna and fungi. But despite my familiarity with the Tiers this has been a daunting task. The area is extensive, geologically complex and encompasses a variety of vegetation communities abounding with different species. Furthermore, there are undoubtedly as many views as to why the Tiers are special as there are people for whom the mountains form the backdrop to their daily lives.

My first task was to become acquainted with those places with which I was less familiar and in this I was accompanied by my partner, Ron Nagorcka, who shares my love of natural history. We experienced the exhilaration of cave exploration with local speleologist (cave expert), Deb Hunter; explored Sensation Gorge and the intriguing Dogs Head Hill *hum*. At the top of Cluan Tiers we looked at the extensive sphagnum swamp surrounded by huge tree stumps with 'steps' indicating centuries old tree harvesting ascending the trunks for over seven metres. We had numerous outings to Rats Castle, Pine Lake, Lake McKenzie and Great Lake.

At the same time as exploring the Tiers I was reading A *Great Western Tiers National Park – an extended proposal* (Goldsworthy 1995). This excellent summary of the geology, flora and fauna of the Tiers compiled by Laurie Goldsworthy provided a starting point for The Edge.

Tasmania has been occupied by human beings for approximately 40 000 years. But it was during the last two centuries that much of it has been Europeanised, something that is especially evident on the plains to the north and east of the Tiers. I considered it important to convey in the book a sense of the indigenous landscape and how it was perceived by the first British settlers. For this I quote from two sources, George Augustus Robinson and James Bischoff.

George Augustus Robinson is a controversial figure because of his role in the tragic events that led to the Indigenous Tasmanians being exiled to Flinders Island. Nevertheless, the cruel irony is that Robinson was one of the very few British settlers who had anything like a close relationship with the Aboriginal people. His diary, documented in *Friendly Missions* (Plomley 2008, indicated by GAR in the text), is replete with acute observations. For instance, he describes how Aboriginal people used fungi as a fuel and food source, thus providing some of the few ethno mycological records of their kind in Australia. And as Aboriginal scholar, Greg Lehman, writes in his review of *Friendly Missions* ('Pleading Robinson' *in* Australian Humanities Review Issue 49, Nov 2010):

> *'Buried within Robinson's ostentatious prose and amateur naturalism is a patchwork of observation and interpretation that constitutes most of what is known of the cosmology and lifestyle of an ancient society in the midst of devastating change.'*

My use of Robinson's quotes in no way is meant to excuse his activities or his character. Instead, I have used them to remind readers that the Great Western Tiers have been occupied by Aboriginal people for tens of thousands of years. Their natural history needs to be seen with this in mind.

'They are at home in the woods; the whole country with few exceptions affords them concealment ... They can perceive the smallest trace, much less the footmarks of white men. They can trace small animals. They can also do with small fires, the smoke of which is scarcely perceptable. They will collect small dry sticks for this purpose. They can subsist on roots and small animals and they know the passes and are well acquainted with the topography of the country.'
(GAR 14 December 1831, Arthurs Lake)

In 1832 James Bischoff wrote *Sketch of the history of Van Diemen's Land* (indicated by Bischoff 1832). Bischoff himself never visited Tasmania so his work is a compilation of others' observations. It gives some idea of the abundance of wildlife, especially birds (many of which were shot and eaten by the settlers), and presents an insight into how the British viewed Tasmania, their appallingly racist attitudes, and the over-exploitation of the natural resources that began at that time.

I have written books about the natural history of other locations in Tasmania including *Munginabitta's Country* near Port Sorrell, the Tarkine, Quamby Bluff and the Blue Tier. I embark on these books in anticipation that I will inevitably see species new to me. But at the end of each project I invariably find myself disturbed that these special areas are not permanently protected. They are clearly crucial to the long term viability of Tasmania's flora and fauna and at a time when much of the ecology of the planet is under threat, they are important to the citizens of the world. Above all, they have an intrinsic right to exist.

Specialists in such esoteric fields as snails, bryophytes, millipedes and flies may be seen in the general community as rather odd. But to the author of a book about natural history their expertise is invaluable. I am constantly inspired by the passion and dedication a relatively small number of people have for their chosen subjects and ever grateful for their willingness to share the information they have gleaned from their careful and often painstaking efforts. They are the unsung heroes whose work has increased our collective knowledge of the species that occur in Tasmania.

Soon after I started writing Tom Thekathyil gave me *Mosses and other bryophytes: an illustrated glossary* (Malcolm 2008), a book that quickly became a favourite. Its fascinating information about the evolution of the first plants to colonise the land got me started on a Gondwanan theme. I conferred with Tom when writing about bryophytes and have included some of his exquisite micrographs of liverwort lobules, elaters and spores on page 31.

Kevin Bonham identified the snails. As far as he is aware the tiny undescribed snail *Pedicamista* sp. 'Chisholm' I saw near Marakoopa Cave has never been photographed alive before despite being widespread in Tasmania's wet forest and rainforest. Kevin also proffered his opinion about the possible impact of the introduced carnivorous snail photographed in Honeycomb Cave.

I used the website compiled by 'multipede' expert Bob Mesibov to identify the millipede Polydesmidae 'sip-ins'; my record at Marakoopa extended its range by about 15 km. Fly enthusiast, Tony Daley, identified my fly photographs and provided ecological information about the species depicted in the book. Phil Collier helped with plant identification.

Chrissy Borzak sent me her honours thesis that investigated the diet of the Black Currawong and its importance to the dispersal of plant species in the highlands. Andrew Hingston, who conducted numerous bird surveys at Jackeys Marsh in the early 1990s, sent me his paper on pollination ecology.

Deb Hunter assisted with the chapters on geology and landforms, the Mole Creek karst and cave fauna. Sean Cadman assisted with the chapter on vegetation. Shayne Breen was consulted about Aboriginal occupation and early European land use. Russell Warman from Environment Tasmania provided the basis for the map.

I am very grateful to Dennis Harding, Laurie Goldsworthy, Geoff Fenton, Tom Thekathyil, Richard Cooper, Deb Hunter, Danilo Harms, Lesley Nicklason and Rob Blakers for allowing me to use their images. And to Auntie Phyllis Pitchford who wrote the poem *The Great Western Tiers* for the book.

Draft copies of The Edge were printed with financial assistance from the Central North Field Naturalists Inc. They were sent to Phil Collier, Robin Garnett, Nicholas Sheehy, Deb Hunter and Rosemary Norwood who provided valuable suggestions. Ron Nagorcka and Felicity Nagorcka proof read the text. Rosemary Norwood coordinated the project. I thank them all.

I especially thank Ron Nagorcka for his support and encouragement.

Sarah Lloyd, January 2012

'… in 1819, the emigration of free settlers from England first commenced. That may indeed be considered the period from which its [Tasmania's] prosperity took its rise; since then the beneficial effects of industry and capital have been displayed; Englishmen are now established on lands which had recently been the range of the kangaroo, and the hunting ground of the wretched savage, who, without domicile, wandered about in precarious search of food; forests are now brought under cultivation and stocked with herds of cattle and flocks of sheep.'
(Bischoff 1832)



INTRODUCTION



Cluan Tier, Drys Bluff and Liffey Bluff

The Great Western Tiers are a series of mountains that form the northern and eastern edge of Tasmania's Central Plateau. The mountains extend from Western Bluff (1420 m) south of Mole Creek to Millers Bluff (1 210 m) overlooking the Macquarie River valley 25 km west of Campbell Town. Between Western and Millers Bluff are Mt Ironstone (which at 1443 metres is the highest mountain of the Tiers) and numerous other bluffs and small mountains including Mother Cummings Peak, Projection Bluff, Liffey Bluff, Drys Bluff, Billopp Bluff, Parson and Clerk Mountains and Molly Yorks Night Cap. South of Deloraine is the distinctive monolith, Quamby Bluff, with Cluan Tiers, a series of low hills, to its northeast.

Towering cliffs and columns of Jurassic dolerite characteristic of so many of Tasmania's mountains are the most visible geological features of the Tiers. Fossil-bearing mudstone occurs around Golden Valley and sandstone cliffs between Mother Cummings Peak and Drys Bluff and in the Jackeys Marsh - Quamby Bluff area support a unique vegetation community with many rare and endemic plants, i.e. plants that are found nowhere else in the world. An extensive plain of 510 million-year-old Ordovician limestone in the vicinity of Mole Creek and Chudleigh features formations typical of karst areas including underground drainage systems, sinkholes and spectacular caves with unique troglobytic (i.e. cave dwelling) fauna. Over 180 named and unnamed permanent and ephemeral streams flow from the central plateau and eventually join the major waterways in the central north of Tasmania including the Mersey, Meander and Macquarie Rivers.

The local Aboriginal community has named the Great Western Tiers *kooparoona niara* 'mountains of the spirits'.

HUMAN HABITATION

The Great Western Tiers are spiritually and culturally significant for Tasmanian Aboriginal people. Prior to European colonisation, the Pallitorre people and other groups traversed the escarpment in different seasons. Bountiful native animals provided the basis for their diet; a rich variety of plants and fungi were used for food and medicines; and many types of sedges, grasses and other plant material were fashioned into tools, ropes, baskets, shelters and watercraft. Groups gathered on the plateau in late summer to seek out the intoxicating substance they procured from the endemic cider gums (*Eucalyptus gunnii* and *E. archeri*).

European colonisation of Tasmania severely disrupted age-old links between the mountains and the Aboriginal People. The British settlers had a different view of the landscape; their very survival depended on the exploitation on an unprecedented scale of Tasmania's natural resources. They cut the forests and used the timber for their homes, fences and firewood. They surrounded their homes with gardens of European plants. They stocked their farms with cattle and sheep that soon roamed wild across much of the island and they grew crops for the colonies on the northern plain in the deep fertile soils washed down over millennia from the Great Western Tiers.

In the 1940s and 1950s Tasmania experienced a period of hydro-industrialisation. On the plateau Lake Mackenzie and the largest permanent freshwater lake in Australia, the Great Lake, were dammed. The building of the dams and associated infrastructure created employment for European immigrants who added greatly to the cultural diversity of Tasmania. However, the impressive engineering feats left permanent scars on the delicate terrain of the high country.

Forestry activities also provided employment, particularly for local people in the small towns at the base of the Tiers. In the early days mature trees suitable for milling, hydro poles or railway sleepers were carefully chosen and the remaining forest was left intact. When the export woodchip industry began in the early 1960s tree harvesting took on a different scale. For the past 50 years industrial-scale forestry has scarred the landscape and large tracts of forest have been cleared and replaced with plantations of pines and eucalypts not native to Tasmania.

A FUTURE IN CONSERVATION

Much of the Great Western Tiers and adjoining plateau are now included in the Tasmanian Wilderness World Heritage Area (TWWHA). Some significant areas on the lower slopes and at the far eastern end remain as production forest.

The Mole Creek Karst is registered as a site of national significance in the Tasmanian Geoconservation Database and some of the karst and its catchment has been added to the TWWHA in 2013 and 2023. Despite this national and international recognition of its aboriginal, historical, cultural and natural importance, its protection is piecemeal.

Some threatened old-growth forest communities are included in Conservation Areas, National Parks or formal and informal reserves across the karst, but mining is still possible outside national park blocks and forestry still threatens some catchments. In some cases, reservation status protects only the entrance passages of "limited access" caves valued by speleologists. Indeed, the majority of the karst is in private hands where economic interests of agriculture and tree farming dominate over conservation. An idiosyncrasy of Tasmanian law means some caves extend from entrances in National Park into centre-of-the-earth private land tenure, where they are unprotected.

Mole Creek's "show" caves are famous mainstream tourism drawcards while undeveloped caves attract many cavers annually. Variation in tenure, hence degree of protection denies the landscape connectivity of karst, is nonsensical and is inconsistent with government commitment to protection of the TWWHA. Only a minority of the karst has national park status. Not all of the National Park is covered by the TWWHA and much of the TWWHA is Conservation Area, denying the level of protection required for World Heritage properties.

The prevailing view that Tasmania's economic growth should take precedence over the protection of the natural environment is slowly changing. Many people now recognise that Tasmania's future lies in the preservation of its flora and fauna and natural features of world significance.

The Tiers attract local, interstate and international visitors. Some come to see the early colonial architecture in the small historic townships at the base of the escarpment. But undoubtedly the biggest attractions are the natural ones: the pristine forests with their plethora of plants and animals, impressive waterfalls, spectacular limestone caves, glaciated high country and craggy mountains that edge the Tiers.

Species mentioned in the book that are listed as rare, threatened or endangered under the Commonwealth's Environmental Protection and Biodiversity Control Act (EPBC 1999) or Tasmania's Threatened Species protection Act (TSPA 1995) are indicated in red text boxes.

Nomenclature of scientific plant names follows Baker M.L. & Duretto, M.F. (2011). Common names of plants are those suggested by Wapstra et al (2005). Common names of birds are those in Christidis and Boles (2008).



blue damselfly (*Austrolestes* sp.)



matted brooklime (*Gratiola nana*)

GEOLOGICAL TIME-SCALE

Era	Period	Geology and climate	Life on Earth
Cainozoic / Quaternary	Holocene (present) 10 000 years	Climate more or less as at present.	Biotas as at present. Rise and expansion of human civilisations causing many birds, especially those on islands, to decline.
Cainozoic / Quaternary	Pleistocene 2 mya	Repeated glaciations and changing sea levels as polar ice caps expand and contract. Tas is one of few S. Hemisphere countries glaciated.	Aborigines arrive in Australia between 50 000 to 120 000 ybp. Extinction of most megafauna and many birds.
Cainozoic / Tertiary	Pliocene 5.2 mya	Lower latitudes warm; higher latitudes cool further. Australia drifts to lower latitudes, cools and dries.	Rainforests continue to decline and eucalypts & grasslands spread.
Cainozoic / Tertiary	Miocene 23.3 mya	Climate continues to dry and cool. Australia 'crashes' into southeast Asia.	Lush forests proliferate during middle Miocene; by late Miocene rainforests decline and grasslands spread.
Cainozoic / Tertiary	Oligocene 35.4 mya	Climate cools and dries; Fossil deposits in Tas, SA & Qld contain diverse vertebrate faunas that indicate forest communities.	Most land masses covered in forests. Kangaroos, possums and other modern families present by end of Oligocene.
Cainozoic / Tertiary	Eocene 56.5 mya	Global climate mild and humid.	Rainforest covers most of southern Australia. Oldest marsupials, bats, frogs and snakes in Australia. Mammals and birds diversify on all continents after decline of dinosaurs.
Cainozoic / Tertiary	Palaeocene 65 mya	Mild climate worldwide; shallow continental seas disappear.	Mammals diversify on all continents; first primitive primates; many modern birds appear.
Mesozoic	Cretaceous 145.6 mya	Warm tropical and sub tropical climate. Gondwana fragments; much of Australia covered in shallow seas; Seas surrounding Australia start to assume modern configurations.	Numerous giant aquatic reptiles, Flowering plants spread rapidly, conifers and cycads decline. Dinosaurs dominate. Australia's oldest birds appear. Australia's oldest mammal is platypus-like. Exchange of plants between Australia and lands to the north.
Mesozoic	Jurassic 210 mya	West Gondwana (Laurasia) splits from East Gondwana; outflows of basalt; climate warm and wet.	Conifers & ferns abundant; first birds, lizards and salamanders appear. Tiny mammals diversify.
Mesozoic	Triassic 245 mya	Gondwana starts to split. Australia in high latitude humid belt; climate warm and wet. Coal deposits in Tasmania.	Mammal-like reptiles present everywhere. Lots of insects, primitive amphibians & reptiles.
Palaeozoic	Permian 290 mya	Glaciers cover parts of Gondwana. Cold climate warms through period; widespread aridity.	Climate becomes temperate with swamp forests. Insects, fish and amphibians present; trilobites extinct, major period of extinction.
Palaeozoic	Carboniferous 362.5 mya	Gondwana drifts towards south pole. Major glaciation in second half of period.	Coal swamps in tropical areas dominated by mosses & ferns. Seed ferns replace club mosses. Fishes & amphibians proliferate, reptiles appear in Northern Hemisphere.
Palaeozoic	Devonian 408.5 mya	Australian section of Gondwana in northern hemisphere.	Thick vegetation of tree-like club mosses & ferns spread from margins of water to swampy areas; seas full of fish. First amphibians venture on to land.
Palaeozoic	Silurian 439 mya	Shallows seas still extensive. 'Australia' straddles equator.	Life colonises land. Land plants evolve from seaweeds. Jawless fish in freshwater; first jawed fish in seas; first coral reefs form.
Palaeozoic	Ordovician 510 mya	Continents covered in shallow seas. Climate moderate until glaciation at end of period.	Graptolites, nautiloids, trilobites, brachiopods, bivalves, crinoids and other sea life abound; first jawless fish.
Palaeozoic	Cambrian 570 mya	Continental land masses including 'Australia' in equatorial belt and covered by shallow seas.	Seas teeming with life: jellyfish, sea anemones, sponges, trilobites, brachiopods and molluscs.
Precambrian	Proterozoic 2000 mya	Large land masses form.	Oxygen becomes abundant. Multi cellular organisms (algae, fungi & invertebrates) develop from single celled organisms. Jellyfish, primitive worms & sponges appear in oceans.
Precambrian	Archaean 4500 mya	Solar System develops; formation of Earth's crust, atmosphere and oceans.	Life evolves from spontaneously formed organic compounds about 3.5 billion years ago. Bacteria produce oxygen that forms ozone layer that shields Earth from UV radiation.

Table adapted from: Archer, M. et al (1991); Rich, P. V. et al (1990) & Podulka, S. et al (2004)

denotes major extinction events mya = million years ago

GEOLOGY AND LANDFORMS



Mother Cummings Peak

There are few places on Earth where the journey of the ancient supercontinent, Gondwana, with its cargo of evolving plants and animals is as richly illustrated as it is in the Great Western Tiers. On the top of the Tiers on a warm summer's day a visitor may enjoy a host of sensual experiences: the deliciously spicy aromas of the highland daisy bushes, the background drone of pollinating insects, the sculpted land that evokes recent glaciers and the rugged terrain that was shaped by cataclysmic events eons ago.

The most conspicuous aspect of the Tiers is the Jurassic dolerite that forms the cliffs of the escarpment. But around it and below are the remnants of earlier ages. During the Ordovician period, around 450-500 million years ago, the portion of the Earth's crust now known as Tasmania was near the equator in the northern hemisphere. It was a small part of an enormous plain covered by a warm shallow sea bubbling with primeval life (the Mole Creek karst, described in more detail on page 50, is composed of fossilised and compacted remains of this ancient life). Australia, South Africa, South America, Antarctica, New Guinea, New Zealand and Madagascar formed the vast supercontinent, Gondwana. And it was on its way South.

In the 300 million years between the Ordovician and Jurassic Periods Gondwana drifted slowly towards the southern polar region. During the late Carboniferous-Permian, sedimentary rocks of the Lower Parmeener Supergroup mostly of marine origin but with two freshwater sequences were deposited. The rocks consist of conglomerate sandstone, quartz sandstone, mudstone, and some limestone; some layers have a profusion of quartzite, schist and slate and Carboniferous plant-bearing shale. A further layer of Upper Parmeener Supergroup was deposited under swamp conditions. It overlies the Lower Parmeener Supergroup. This stratum has quartz sandstone, feldspathic sandstone, siltstone, mudstone and shales. Thin carbonaceous bands occur within the sandstones and plant fragments are common in the shales.

The Jurassic Period was one of great upheavals with violent earthquakes and frequent volcanic eruptions. The Earth's upper mantle melted accompanied by massive magma flows, events that are believed to be related to the onset of the breakup of Gondwana when the eastern part (Australia, India, New Zealand, New Guinea, Madagascar and Antarctica) split from the west (Africa and South America). Over one million or so years pulses of liquid magma rose and intruded into the Earth's crust as small dykes or large sills up to 300 metres thick. The Jurassic upheavals elevated the relatively flat plain of Carboniferous – Permian sediments in central Tasmania by approximately 600 metres. Over millennia the magma cooled and solidified to form a sill of dark-coloured rock, dolerite; the central plateau is believed to be the largest such sill in the world.

As the older rocks overlying the dolerite intrusion eroded, the dolerite 'cap' of the Central Plateau remained. Its edge, which forms distinctive erosion-resistant cliffs at the top of the escarpment, is clearly visible from below. Precipitous dolerite cliffs and columns and deeply incised gorges characterise much of the escarpment of the Great Western Tiers. Tasmania, South Africa and Antarctica are the only places on Earth where dolerite is such a significant feature of the landscape.

Differential erosion of the Parmeener Supergroup strata beneath the dolerite sill has resulted in distinctive topographic benches, the familiar 'tiers' of the escarpment's profile between the plateau and the lowlands.

'The country round those lakes [Great and Arthurs] consists of extensive plains, and the scenery is very picturesque ... a clear expanse of water for the foreground, and then the plains with their little hills and rocky points interspersed with clumps of trees and the green appearance of the herbage, and the tiers of hills seen in the distance of a sombre appearance and in some parts near the mountains thick forests and on the tops of the mountains the jutting rock, all form together a beautiful landscape.'
(GAR 6 December 1831, Great Lake)



Laurie Goldsworthy

pool on the Western Creek track

Most of the high altitude topographic benches have been obscured by the fallen dolerite that forms fanned rock screes. The scree slopes are most evident at the base of the dolerite columns of the upper escarpment. They are composed of huge rock fragments up to six metres in diameter dislodged through the actions of frost, ice wedging and gravity. There are also areas of dolerite taluvium below the escarpment. This consists of talus (i.e. a sloping mass of coarse rock fragments) along with colluvium (i.e. fine debris washed downhill) resulting in dolerite blocks embedded in a yellow-brown to red-brown silt and clay matrix internally drained by pipe-like watercourses.

The steep slopes between the topographic benches are covered in weathered sediments of the Parmeener Supergroup. During favourable climatic periods they are stabilised by vegetation growth. But the steep slope sediments are prone to mass movements (landslides) when they are saturated during abnormally prolonged wet conditions. Overwhelmingly, erosion forces that shape the land occur during occasional periods of climatic abnormality. These occurrences are predicted to increase in severity and frequency due to anthropogenic climate change.

GLACIATION

In the last three million years, the Earth's climate cycled between cold glacial periods and warm interglacials and the sea levels rose and fell correspondingly. On at least six separate occasions glaciers formed on the mountains in the Cradle Mountain-Lake St Clair National Park and the western end of the central plateau and smaller ice caps formed on other high peaks. During the penultimate glaciation an ice sheet 160 metres thick covered Mole Creek. The most recent glaciation occurred approximately 18 000 years ago.

The central plateau is the most glaciated landscape in Australia with the most extensive ice-braided plain. Ice scouring has resulted in low rocky hills interspersed with hundreds of small lakes, many aligned along major joints. Highly visible glacial features on quartzite, dolerite and flat sedimentary bedrock have important scientific value. Periglacial processes at the margins of ice-sheets and ice-caps contributed to the geomorphic features that are evident today.

Boulder streams are one such feature. These rivers of rocks formed during periods of glaciation. They are not the direct result of glacial action, but formed adjacent to the glaciers by water that seeped into cracks in the dolerite. The water subsequently froze and expanded, enlarging the cracks and eventually splitting the rocks apart. In some places these rivers of rocks have developed a patina of lichens and in sheltered gaps between the rocks fire-sensitive pencil pines and plum pines have taken root. Some block streams are still moving because ice under the rocks lubricates the 'river' causing a downhill flow of about one millimetre each year.



fossilised coral, Honeycomb Cave

'I proposed therefore to cross the mountains by the pass … as being the way the natives frequently went … Proceeded to ascend the western mountains. The way to the pass was by a ridge of hills to the westward of Drys Bluff, up the Penny Royal Creek [Liffey River] … came to some perpendicular rocks composed of sandstone.'

(GAR 12 December 1831)



Mount Parmeener with a u-shaped glacial valley on its upper flank

ESCARPMENT

Vegetation



unnamed bluff east of Billopp Bluff

Depending on the time of day and the play of the light, the escarpment of the Great Western Tiers has that hazy blue of distant forests. But there are subtle colour changes when seen at close range.

The geographical extent of the Great Western Tiers and its steep climatic gradient, believed to be one of the steepest in Australia particularly between Drys, Projection and Quamby Bluffs, gives rise to a mosaic of different plant communities that meld and change depending on altitude, soil type, rockiness and the frequency, intensity and extent of fires and other disturbances–either human or natural. Aspect can have a marked influence at a very local level. For instance, wet forests and rainforests grow in sheltered gullies and on shaded slopes that in the winter may receive very little direct sunlight, whereas on the opposite side of the valley dry forests grow on sunny north facing hillsides and other exposed areas.

In contrast, human disturbance to the original vegetation can be sharply delineated. The change in colour from the yellow green of eucalypts to the bluish green of silver wattle (*Acacia dealbata*) indicates past activity. Silver wattle quickly colonises bare ground and protects the seedlings of plants that germinate at a slower rate. On a different scale, huge rectangular chunks of forest, especially at the base of the Tiers, have been removed and the areas cleared, bulldozed and burnt before being replanted with seedlings of shining gum (*Eucalyptus nitens*) or radiata pine (*Pinus radiata*).

OPEN WOODLANDS

Open woodlands with widely spaced trees grow at the base of the escarpment at the south eastern end of the Tiers. The dominant trees are cabbage gum (*E. pauciflora* subsp. *pauciflora*) and white gum (*E. viminalis*) except on drier sites where cabbage gum grows with candlebark (*E. rubida*). Communities of black gum (*E. ovata* var. *ovata*) or the endemic swamp peppermint (*E. rodwayi*) occur where the drainage is poor in winter. Beneath the trees in suitable soils are tussock grasslands of *Poa* species. In areas with clay soils the species include kangaroo grass (*Themeda australis*) and sagg (*Lomandra longifolia*).

Corridor forests of white gum and blackwood (*Acacia melanoxylon*) occur along watercourses.

DRY SCLEROPHYLL FORESTS

On the lower slopes the woodlands give way to dry sclerophyll forests of cabbage gum and white gum. They have a low to medium understorey of heaths and beardheaths in the Epacridaceae family, and many leguminous plants in the pea (Fabaceae) family. They often have a rich variety of orchids, grasses and small herbaceous plants.

WET SCLEROPHYLL FORESTS

The forests increase in density and height as the rainfall increases.

On areas with deep soil and sufficient moisture stringybark (*E. obliqua*) partially or completely replaces cabbage gum and swamp peppermint as the dominant species and grows with swamp gum, white gum and candlebark. Above 300 metres mountain white gum (*E. dalrympleana* subsp. *dalrympleana*) and stringybark are the dominant eucalypts. The structure (i.e. layers) of the vegetation changes with increasing rainfall. Beneath the canopy of the wet forests small trees including musk (*Olearia argophylla*) and dogwood (*Pomaderris apetala*) form a well-developed mid layer of vegetation.

The Great Western Tiers has been identified as extremely important for the preservation of wet eucalypt forests. Ten wet forest communities with a different combination of eucalypt species and associated understory plants grow mostly on the mid slopes of the Tiers. This is more than any other location in Tasmania. Of particular interest are the communities dominated by giant ash (*E. regnans*) between Lobster Rivulet and Western Bluff and the brookers gum (*E. brookeriana*) dominated forest on river flats south of Warners Sugarloaf and at Cluan Tiers.

SUB-ALPINE FORESTS

Above 450 metres the subalpine species start to dominate and stringybark gradually gives way to gumtopped stringybark (*E. delegatensis* subsp. *tasmaniensis*). Forests of gumtopped stringybark and



mountain white gum extend up the slope to an altitude of about 1000 metres or slightly higher in sheltered situations. Over much of its range gumtopped stringybark grows on ancient weathered sediments that slowly moved downslope during periglacial freeze-and-thaw processes. The surface is strewn with large dolerite boulders and a deep yellow-brown soil overlies the weathered sediments. On wetter sites the endemic blanketleaf (*Bedfordia salicina*), viscid daisybush (*Olearia viscosa*), mountain dusty daisybush (*Olearia phlogopappa* var. *subrepanda*) and mountain pinkberry (*Leptecophylla juniperina* subsp. *parvifolia*) predominate in the understorey. On the upper slopes where the small shrubs have difficulty reaching the shallow water table in summer, the plants are scattered and have evolved to cope with the dry conditions.

With increasing and more reliable precipitation near the cloud base the shrub layer increases in density. At around 910 metres where fire has eliminated the myrtle beech that would otherwise predominate there are impenetrable shrubberies of mountain needlebush (*Hakea lissosperma*), variable orites (*Orites diversifolius*), mountain guitarplant (*Lomatia polymorpha*) and waratah (*Telopea truncata*). Where fire is frequent enough to maintain eucalypts, open woodlands of snow peppermint (*E. coccifera*) and alpine cider gum (*E. archeri*) occur.

ALPINE PLANTS

Only the hardiest plants can withstand the icy winds and frequent snowfalls that occur above 1000 metres. Shrubby plants in the Proteaceae and Epacridaceae families grow on well drained sites and dwarf coniferous shrubberies persist in sheltered areas with higher rainfall. Poorly drained areas contain a complex mosaic of herbfield, sphagnum bog and bolster heath (cushion plant) communities. Cold air drainage 'basins' carry tussock grassland, sedgeland and bog communities dominated by *Sphagnum* moss.

SANDSTONE CLIFF VEGETATION

The sandstone cliffs between Billops Bluff and Mother Cummings Peak have a distinct vegetation community that includes copperleaf snowberry (*Gaulthiera hispida*), goldey wood (*Monotoca glauca*), the endemic heartberry (*Aristotelia peduncularis*), common heath (*Epacris impressa*), forest flaxlily (*Dianella tasmanica*), lance waterfern (*Blechnum chambersii*), narrowleaf triggerplant (*Stylidium graminifolium*) and tangled bedstraw (*Galium australe*). A similar vegetation community with additional species including forest bentgrass (*Deyeuxia frigida*) and the endemic bluff snowgrass (*Poa jugicola*), grows on the sandstone cliffs in the Jackeys Marsh-Quamby Bluff area. Despite being different to sandstone communities in drier parts of Tasmania, these vegetation communities remain unreserved and are particularly vulnerable to disturbance from forestry activities, fire and weed invasion. The removal of the canopy which provides shade for the ferns further threatens the plant communities.

RAINFOREST

Rainforest of myrtle beech (*Nothofagus cunninghamii*) and sassafras (*Atherosperma moschatum*) occur in deep fire-protected gorges where the annual rainfall exceeds 1250 mm. Areas exposed to regular fires have a shrubby understorey of wet forest species such as silver wattle, christmas bush (*Prostanthera lasianthos*) and musk. A poorly reserved rainforest community of myrtle beech with a musk understorey grows on the escarpment and on the southern slopes of Quamby Bluff. Along the upper edge of the escarpment at about 1000 metres persistent low clouds and mist provide enough moisture for the proliferation of dwarf 'elfin' rainforest or thickets of myrtle beech.

Patches of King Billy Pine (*Athrotaxis selaginoides*) persist in gullies and deeply incised gorges that are sheltered from the ravages of wildfires such as at Western Creek, Lobster Rivulet, Mother Cummings Rivulet, Quamby Bluff and Projection Bluff. At Dunning Rivulet Gorge King Billy pine grows alongside pencil pine (*A. cupressoides*) with which it hybridises to form the rare hybrid pencil pine (*A. laxifolia*). These three species also occur at Pine Lake, Meander Gorge, Western Creek Gorge, Lobster Gorge and at the top of Cluan Tiers.

The rugged terrain and steepness of the Great Western Tiers have protected much of the escarpment vegetation from exploitation. However, many important forest communities remain unreserved. These occur particularly on fertile soils that are suitable for agricultural activities at the drier south eastern end and those at low altitudes that are easily accessible.

The flora and fauna in the different vegetation communities are described in more detail on the following pages.



Laurie Goldsworthy

Low shrubs, sphagnum moss and cushion plants grow in poorly drained soil at Lagoon Plain.

The eucalypt forests of the Great Western Tiers cross a significant part of the central north of Tasmania. They encompass dry and wet vegetation communities reflecting the gradual change in precipitation from the wetter western end to the drier east. Their mosaic of plant communities supports birds that favour wet forests as well as the dry forest species that are more common in the east of Tasmania. In short, the forests of the Great Western Tiers are vital to the health and long-term viability of most of Tasmania's terrestrial birds.

The forests of the Tiers that have not been substantially altered by fire, clearing or grazing are structurally diverse i.e. they have several layers of vegetation. This means that many different bird species are able to co-exist in the forests. For instance, ground-foraging birds such as Superb Fairy-wrens, Beautiful Firetails, robins and bronzewings search for invertebrates and seeds amongst the grasses, sedges, orchids and small herbaceous plants that grow between rocks, rotting logs, fallen limbs and leaf litter on the forest floor. Whistlers, shrike-thrushes and thornbills find shelter from inclement weather, refuge from predators and places to forage and nest in the dense shrubby understorey and mid-storey vegetation, especially where there are some prickly plants that provide extra protection from cats and aggressive birds. Nectar feeding species such as parrots and honeyeaters forage on the nectar-rich flowers of eucalypts, banksias and other understorey plants. Insectivorous species such as pardalotes search for insects and spiders that hide in the canopy foliage of the eucalypts.

Eucalypts that have lived for many hundreds of years have cavities of different sizes that provide breeding sites for large and small hollow-dependent species. Eucalypts take about eighty years to form hollows suitable for small birds such as Striated Pardalotes and well over a century to form cavities large enough for Masked Owls and Yellow-tailed Black-Cockatoos. These trees are essentially irreplaceable in our lifetime. Their dead stags and emergent branches provide elevated lookout sites where raptors can scan the landscape for prey - or where smaller birds can keep an eye out for predators.



Dusky Robin

The abundance of species that inhabit the forests is especially noticeable during the warmer months when many plants are in flower, insects are active and migratory birds return from the Australian mainland to join Tasmania's resident species. The Blue-winged Parrot, Striated Pardalote, Dusky Woodswallow, Welcome Swallow, Black-faced Cuckoo-shrike, Satin Flycatcher, four species of cuckoo and the endangered Swift Parrot cross Bass Strait twice each year to breed in Tasmania. Many return to the same location–some to the same nesting hollow–year after year.

The Great Western Tiers provide an important stepping stone in the landscape for the migratory birds that fly from the Australian mainland to breed in the south of Tasmania. Their altitudinal range allows species to move upslope from foothill forests to breed and forage on the plateau in spring and summer. Their mosaic of wet and dry vegetation communities accommodates those species that breed in wet forest gullies or rainforest but move to adjacent drier areas in autumn and winter. Cleared farmland at the base of the Tiers, especially where some patches of native vegetation have been retained, provides foraging and breeding sites for Superb Fairy-wrens, Grey Fantails, Grey Shrike-thrushes, Brown Thornbills and other adaptable species.

Agricultural activities on the plain to the north and east of the Tiers are becoming more intensive and continuing the fragmentation and degradation of remnant bushland within the region. There is growing awareness of the importance of the preservation of biodiversity for its own sake and for the health of farms, and many landowners are now protecting degraded bush and riparian areas or planting native shelterbelts. The health and long term viability of these areas rely on healthy bird populations. The extensive forests of the Great Western Tiers are home to a reservoir of species that can reinhabit the rural landscape.

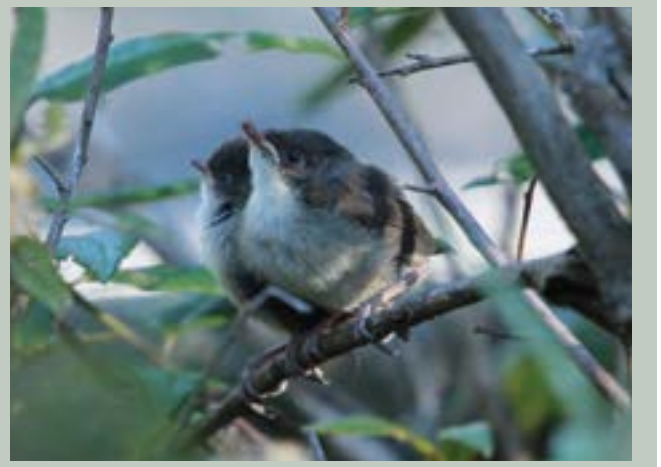
Birds are dependent on other species for all their living requirements such as food, shelter, nest sites and nesting material. Because of this they are often referred to as indicator species–their presence in an area indicates the presence of other species on which they depend. As different bird species target different areas to forage and nest, many species are able to co-exist in an area with little competition for resources. Thus, the bird-rich forests of the Great Western Tiers are also rich in other species.

On sunny mornings after the winter solstice when the days get noticeably longer, the forests of the Tiers resound with bird song. This is particularly evident in the hour before sunrise during the breeding season when male birds join in a bout of concentrated singing known as the dawn chorus. They sing to advertise their breeding territories to rival males and to attract a mate. The birds remain vocal throughout the morning, but they are seldom conspicuous. Most are cryptically coloured in shades of browns and greens and they keep well hidden in the understorey or canopy foliage. Some have greyish brown plumage and perch on dead branches with a similar hue. They can be frustratingly difficult to see.

'The road is extremely hilly and the country all the way to the Mersey is principally a succession of hills and dells, densely wooded. It is very romantic, the road or track winding round the acclivity of the hills and overhung in many parts by stately ferns and other trees.'

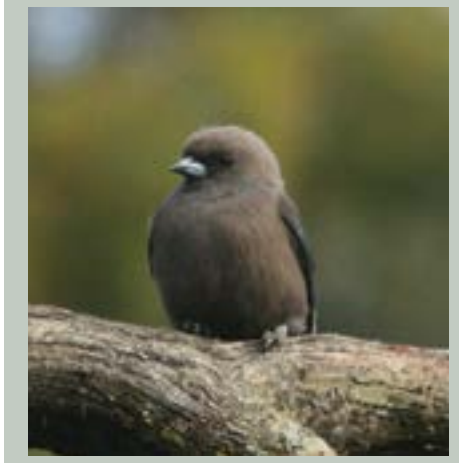
(GAR 9 April 1832 Mole Creek)





Small family groups of Superb Fairy-wrens are frequently seen in the Tiers. They forage on cleared land adjoining dense understorey vegetation where they can shelter from inclement weather, hide from predators and breed, roost and preen in safety.





Dusky Woodswallows return from the Australian mainland each spring to traditional breeding sites in the drier eucalypt forests of the Tiers. They build a flimsy nest often between the shedding bark and trunk of 'degraded' eucalypts.

Dusky Woodswallows are not related to swallows but, along with magpies, currawongs and butcherbirds, are members of an ancient Gondwanan family, the Artamidae.

Woodswallows, like many Australian birds, sometimes breed cooperatively.

Co-operative breeding seems to be altruistic behaviour that improves the chances of survival of the species rather than individual birds. It involves non-breeding birds assisting related (and sometimes unrelated) breeding pairs to rear their offspring. 'Helpers at the nest' are birds from a previous season's brood or from a brood reared earlier in the same season. They assist the parent birds by bringing food to the nestlings.

Not only are Dusky Woodswallows co-operative breeders but they breed colonially and crèche their newly fledged young. Crèching is not that unusual in the bird world but Dusky Woodswallows, unlike other birds that crèche (e.g. swans, galahs and penguins), will feed not only their own young, but all other birds in the crèche.

'The pigeons are by far the most beautiful birds in the island; they are called bronze winged pigeons. They are more like the partridge than the pigeon, and much more delicious to eat. The wings are beautifully variegated with gold-coloured feathers. They are wild, though easily shot off the stubble, where they feed in large quantities. There are small kinds of pigeons, and a beautiful species of dove, whose cooing is a melancholy tone.

The birds that may be called game are very numerous, with the exception of the emu or native ostrich, they very much resemble the latter bird, and are nearly as large. They leave the mountains to feed in the plains, and are sometimes caught by the kangaroo dogs. They are exceedingly swift, and, like the ostrich, have no power to raise themselves from the earth.

The quail of which there are three kinds, are far more numerous, in many parts of the island, than the partridge in England. They are much larger than the quail of any other country, and afford to the sportsman capital shooting.' (Bischoff 1823)



Brush Bronzewing

'The country is very fine, teeming with beautiful natural productions, both in the animal and vegetable kingdom … John [Gould, famous British ornithologist] is acquiring a vast fund of information in the ornithological department … We got here just in the right season, and I assure you he has already shown himself a great enemy to the feathered tribe, having shot a great many beautiful birds and robbed various others of their nests and eggs.'

(Elizabeth Gould, 8 October 1830, Hobart Town *In* Datta 1997)



Black-headed Honeyeater

Tasmania, like most other islands, has a very special bird fauna with a high percentage of endemic bird species, i.e. birds that are found nowhere else in the world. (In comparison, Victoria has no endemics and South Australia has just one). All but two of these endemic species, the Orange-bellied Parrot and Forty-spotted Pardalote, breed in or visit the forests of the Tiers.

The endemic honeyeaters include the Yellow Wattlebird, Yellow-throated Honeyeater, Black-headed Honeyeater and Strong-billed Honeyeater. They are a particularly interesting group of birds because they, along with the Grey Currawong and Grey Shrike-thrush, fill the bark-foraging niche that in other parts of Australia is filled by treecreepers and sittellas, birds that are absent in Tasmania.

Unlike most honeyeater species that feed noisily on the blossom of eucalypts and other flowering plants, Tasmania's endemic honeyeaters spend most of their foraging time searching for insects and other invertebrates that live on the bark, trunks, branches and foliage of eucalypts. They only occasionally feed on nectar.

The largest and most nectarivorous of Tasmania's endemic honeyeaters is the Yellow Wattlebird. Like other honeyeaters it has a brush-tipped tongue for lapping the nectar from flowers of eucalypts, banksias and other flowering plants. It also eats insects and spiders, especially those that hide under the bark of eucalypts. The Yellow Wattlebird is an altitudinal migrant that is sometimes seen on the plateau in summer. In cooler months large flocks move to lower altitude forests in the Tiers and they sometimes visit home gardens to feed on the flowers of introduced or native plants.

The Yellow-throated Honeyeater occurs in all vegetation types except the darkest rainforests. It is a more generalist feeder than the smaller Black-headed and Strong-billed Honeyeaters and searches for invertebrates by probing the bark on the lower limbs and trunks of eucalypts. It is a vociferous bird with an extensive repertoire. During winter it emits a loud 'tonk tonk' but once spring approaches this is heard less often and a melodious warble predominates. Its harsh raspy call indicates an altercation with other birds that invade its breeding or feeding territory or it warns other birds of the presence of people.

Black-headed and Strong-billed Honeyeaters are much less conspicuous than the other two endemic honeyeaters. They are easily overlooked because they spend most of their time foraging out of view in the upper canopy of eucalypts and only occasionally descend to the understorey to feed or collect nesting material. They play an extremely important role in the forests because of the high numbers of insects they consume.

The Black-headed Honeyeater inhabits the drier forests of the Tiers. It has short claws for gripping small twigs and leaf stalks, long wings for manoeuvrable flight and a short bill for pecking insects off the surface of foliage and upper branches.

The Strong-billed Honeyeater (also known as 'bark-bird') is a gully dweller that rarely leaves the wet eucalypt forests. It has highly curved claws and long feet which it uses to perch acrobatically on vertical surfaces or hang from small branches while searching noisily for insects and spiders under shedding bark. When it does descend to the understorey, it is invariably to search for invertebrates that shelter in the ribbons of bark that have fallen off the eucalypts, or to collect the seeds of the native clematis (*Clematis aristata*) that it sometimes uses to line its nest.

The endemic honeyeaters prefer to forage on the large surface area provided by mature trees rather than smaller seedling eucalypts. They also need dense understory or mid storey vegetation in which to nest, shelter and roost. The Yellow-throated Honeyeater, for instance, usually nests in saggs, ferns or shrubs within one metre of the ground.

'This man during his long and lingering illness had invariably refused to take any sustenance save a bird - of which species of food all aborigines are exceedingly fond' (GAR 11 July 1829, Bruny Island)





The plumage, bill, eye ring and feet of the immature Strong-billed Honeyeater (left) will gradually change colour as it matures.



Yellow-throated Honeyeater

'The feathered tribes of Van Diemen's Land are numerous. The sea and other waterfowl consist of gulls of various kinds, boobies, noddies, shags, gornets [gannets], cormorants, pelicans, black swans (very abundant), the musk-duck, and all kinds of the duck tribe. The land birds, generally speaking, are all of them curious and beautiful. The numbers of various kinds of parrots and parroquets, clothed in the most beautiful plumage, are almost beyond description. The cockatoos are as great destroyers of corn, during the seed time and harvest, as crows are in England.' (Bischoff 1832)



At close to 50 cm the endemic Yellow Wattlebird is Australia's largest honeyeater. Its guttural call is variously described as like the sound of someone vomiting, gurgling or a cork being extracted from a bottle.

Their fleshy pendulous wattles can be up to 52 mm long. They are usually orange/yellow with a pale yellow or white base and bright orange tips. They become engorged and their colour brightens during the breeding season. Juvenile birds have rudimentary wattles that attain full length when the birds are six months old.

The Yellow Wattlebird was a mystery to the early naturalists. In 1800 the French taxonomist, François Marie Daudin described it as a type of crow and assigned it the name *Corvus paradoxa*. Its current genus name *Anthochaera* comes from the Greek words *anthos*: a flower and *chaera*: to enjoy. It refers to the birds' nectar loving habits. Its Greek species name *paradoxa* means 'incredible, unexpected'.

For many decades the Yellow Wattlebird was regarded as a game bird and there was a three week open season with a bag limit of fifteen birds per day. Flocks congregating in and around flowering eucalypts were easy targets and so many were slaughtered during the open season that it was feared they may become extinct. In 1902 they were fully protected.

Yellow Wattlebirds were subsequently returned to the list of game species and 187 hunting licences were issued in 1963. There has not been an open season since 1972.



The long down-curved bill of the Eastern Spinebill is perfectly shaped to search the flowers of waratah (*Telopea truncata*), mountain correa (*Correa lawrenciana*) and common heath (*Epacris impressa*). While probing the flowers for nectar their heads become covered with pollen. This is transferred to the next flower they visit. Thus the nectarivorous honeyeaters are important pollinators of some native plants.



Unlike the mostly sedentary endemic honeyeaters, Eastern Spinebills and Crescent Honeyeaters are highly nomadic birds that move seasonally between alpine and sub-alpine areas and lowland forests and coastal heathlands in search of nectar-rich flowers. They are particularly attracted to red or yellow flowers such as those of banksias, waratah and correa.

The climatic gradient and altitudinal extent of the Great Western Tiers (which in the Meander area ranges from 300 metres at base of the Tiers to over 1250 metres at the top of the plateau) means that there is a succession of flowering and therefore sustenance for the nectar feeding nomads over many months.

Crescent Honeyeaters are garrulous birds that keep in constant vocal contact with other birds while staying well hidden in dense vegetation. They nest in the understorey and particularly favour areas with cutting grass (*Gahnia grandis*). Chicks remain hidden in the understorey while being fed by their parents.

New Holland Honeyeaters are pugnacious birds that tend to defend a rich nectar source and dominate home gardens.



Crescent Honeyeater



New Holland Honeyeater



Green Rosella



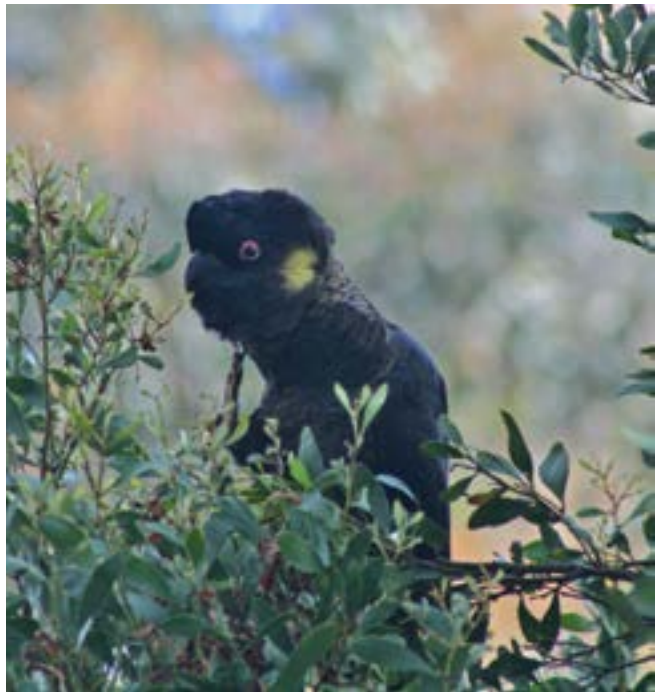
Swift Parrot

Flocks of the endemic Green Rosella occur throughout Tasmania wherever there are trees. They have a distinctive undulating flight accompanied by a 'cussik-cussik' call and a beautiful bell-like song when perched.

Rosellas of various hues occur in the southeast, southwest and northern parts of the Australian mainland. All rosellas have distinctive cheek patches and mottled plumage on their back. The females and juveniles are duller green.

Green Rosellas feed on a wide variety of plant material. Depending on the season they eat the seeds of grasses, understorey shrubs and trees and the woody capsules of eucalypts. They also eat nectar, buds, flowers and fruit. At certain times of the year they eat the ripe spores of treeferns causing the ground beneath to become littered with fragments of fern fronds.

In contrast, another of Tasmania's endemic parrots, the Swift Parrot, is a specialist feeder that is now highly endangered. As recently as a decade ago it was a frequent visitor to the forests of Jackeys Marsh and elsewhere in the Tiers especially when the swamp gums (*E. ovata*) were in flower.



Yellow-tailed Black-Cockatoo

The breeding habitat of Swift Parrots is concentrated in the south and south east of the island with occasional sites in the north. They are fast flying birds whose breeding is closely correlated with a rich source of high energy nectar provided by blue gum (*E. globulus*) or swamp gum. The trees sometimes flower poorly and may only provide enough nectar to sustain breeding three years out of every ten.

After breeding or in the years they don't breed Swift Parrots roam widely throughout the island in search of suitable food. All forests are important to their long term survival.

Swift Parrots are known as 'breeding endemics' because they breed only in Tasmania but spend the winter on the Australian mainland. Like other migratory species they have to withstand alterations to both their breeding and over-wintering habitats. Throughout the country native vegetation is being clearing, fragmented and degraded for urban and industrial development and forestry and agricultural activities. This is having an impact on many species.

The screeching calls and slow flapping flight of Yellow-tailed Black-Cockatoos make them among the most conspicuous birds in the Tiers. Flocks of black cockys descend on silver wattles to rip apart the rusty-brown galls that disfigure their branches and trunks. The galls are caused by the rust fungus *Uromycladium tepperianum*. Within them is a feast of invertebrates including moths, beetles and native wasps. Black Cockatoos also use their strong bills to tear at rotting logs on the forest floor to access moth and beetle larvae.

Cockatoos and parrots are cavity nesters. Hollows large enough for cockatoos take hundreds of years to form. As forests age or are harvested old growth trees with suitable breeding sites become increasingly rare. They are also being removed from the rural landscape to make way for large-scale pivot irrigators. To add to the problem, other cavity nesters such as Galahs, Sulphur-crested Cockatoos, Laughing Kookaburras, Starlings and native bees aggressively compete for hollows.

The Swift Parrot is listed as Endangered
(TSPA 1995 & EPBC 1999)



Four species of robin, the endemic Dusky Robin, the red breasted Scarlet and Flame Robins and the Pink Robin inhabit the forests of the Tiers. They have slightly different habitat requirements although the Scarlet, Flame and Dusky Robins often coexist in an area. The Pink Robin prefers rainforest and wet forest gullies.

Like other birds robins defend a breeding territory during spring and summer. The size of their territory will depend on the quality of the site. Several hectares may be large enough to supply the birds' needs at a particularly rich site but at poorer sites they may have to defend a territory of over twenty hectares. They range over a wider area in the non breeding season.

Robins have a characteristic way of foraging: they sit and watch the ground from a fence, thistle, bracken fern or other low perch before dropping to the ground to collect their invertebrate prey.

The endemic Dusky Robin (page 8) lacks the brightly coloured breast of male Scarlet, Flame and Pink Robins but it can be confused with the females or young Flame or Pink Robins. The female Scarlet Robin has a faint reddish wash on her breast.

Dusky Robins have a mournful song and a quiet friendly disposition. They will often sit on a stump or other perch close to gardeners or forest workers and feed on insects disturbed by their activities.

Like the red-breasted robins the Dusky Robin has declined in recent decades, something that has been attributed to the fragmentation and modification of its habitat.

More intensive farming practices are taking their toll on robins and other birds. When the land was first cleared tree stumps that were a favourite perching place for Dusky Robins (they were called 'stump robins' by early homesteaders) were left in the paddocks. In most areas they are now removed to make way for crops and large irrigators.



Scarlet Robins
Top: adult male
Left: female
Right: juvenile



In late July and early August the soft trilling contact calls of migratory Striated Pardalotes herald their spring arrival in the forests of the Great Western Tiers. As regular as clockwork flocks of tiny birds return from their winter sojourn along the Great Dividing Range in Queensland and New South Wales to join their resident kin, the beautifully coloured 'diamondbird' or Spotted Pardalote and, in the south and southeast, the highly endangered Forty-spotted Pardalote.

Pardalotes, at just 8-10 cm long, are among the smallest forest birds and although extremely difficult to see as they search for invertebrates amongst the canopy foliage of eucalypts, their incessant contact calls and mating songs indicate their presence. They have stubby, partially notched bills for pecking psyllid insects and an associated exudate called lerp off the surfaces of leaves. They fill a very specialised feeding niche, a specialization that has driven one species to the edge of extinction.

In Tasmania the three coexisting pardalote select slightly different habitats: Forty-spotteds prefer relatively unmodified forests, spotteds cope with some disturbance while striated pardalotes show no preference. Competition for resources is further reduced because they hunt in different regions of the trees and use different foraging techniques.

Spotteds are the smallest and lightest pardalote. They have more rounded wings, are more agile and hover more while foraging. The longer Striated Pardalotes prefer to forage higher in the canopy, often stretching to reach leaf extremities while perching on twigs. Forty-spots employ similar foraging methods to the Striateds which harass them where they co-occur.

Forty-spotted Pardalotes were once locally common in the north and east of Tasmania and there are records from the central plateau. They are now restricted to coastal south-eastern regions, particularly Maria and Bruny Islands.

Competitive interactions with large honeyeaters are energetically costly for pardalotes and may have driven them to nest in cavities. Spotteds excavate a tunnel in loose soil, sometimes inconveniently in piles of topsoil, gravel or compost. Forty-spotteds nest in hollows in trunks, branches, stumps, fence posts or fallen wood and occasionally in wall crevices or banks. Striateds usually nest in tree hollows but steep banks, particularly river banks, ceiling cavities and even tractor exhaust pipes can prove suitable. Successful nesting sites are reused in consecutive years with generations of Striateds returning to the same cavities for over 50 years.

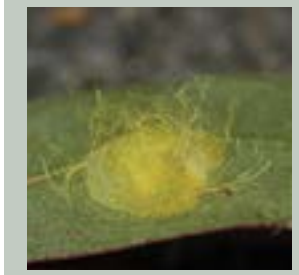


A male Spotted Pardalote with strips of bark for its nest.



Striated Pardalote

Birds with narrow feeding niches are disadvantaged by their specialisation. Lerp-forming psyllids are found only on eucalypts and outbreaks of lerps are seasonal and unpredictable. Nomadic pardalotes must travel long distances in search of food. The clearing and fragmentation of lerp rich forests has contributed to the decline of one pardalote species in Tasmania. The further loss of eucalypt forests may threaten the long-term viability of the two remaining species.



Psyllids are sap-sucking insects in the Order Hemiptera. They exude a sugary substance that hardens to form a protective covering called lerp.

Pardalotes have evolved stubby, partially notched bills for pecking psyllid insects and the associated lerp off the surfaces of leaves.

As lerp are mostly associated with eucalypt leaves pardalotes are rarely seen where these trees don't occur. By targeting psyllids, which sometimes form large infestations, pardalotes rid eucalypts of insects that can cause defoliation, tree decline and eventual death, particularly if trees are stressed by other factors such as drought.

Lerp are a carbohydrate-rich, high-energy food defended aggressively by honeyeaters, especially when little else is flowering.

In healthy eucalypt forests there is a range of bird species–the bird assemblage–that **should** be present. They include fairy-wrens, scrubwrens, robins, thornbills, silvereyes, fantails, whistlers, pardalotes, bronzewings and honeyeaters; the so-called common birds.

All these birds have important ecological roles: they consume copious quantities of insects, and they help to pollinate plants and disperse the seeds. But are they still common?

In 1997 the Tasmanian and Commonwealth Governments signed the Regional Forest Agreement that attempted to protect under-reserved vegetation communities in a Comprehensive, Adequate and Representative (CAR) reserve system. However, there is growing concern that the conservation emphasis on the reservation of threatened vegetation communities or rare and threatened plants, rather than looking at the whole biota, may be having an adverse impact on those bird species hitherto regarded as common.

Threatened vegetation communities are not necessarily rich in bird species. Conversely, there are many healthy forests supporting numerous bird species that have no formal protection. They have structurally complex (i.e. layered) vegetation that provides birds with places to forage, shelter from inclement weather and predators, and safe nesting sites. Birds are not concerned whether plants are rare or threatened, they simply need them to be present.

There is no doubt that the extensive areas of intact, healthy eucalypt forests of the Great Western Tiers are crucial to the long term viability of many of Tasmania's birds. They are not only important to species such as Wedge-tailed Eagle and Grey Goshawk that are known to be declining, but also to the common species that are, in turn, vital to the health of the forests.

Bird surveys are indicating that species that have long been regarded as common have declined dramatically in recent decades. Two endemic species that are of particular concern include the once widespread Dusky Robin (photo p. 8), and the Strong-billed Honeyeater (photo p.10), a bird that favours gullies in wet forests.



Grey Fantail



Beautiful Firetail



Brown Thornbill



Silvereye



This juvenile Fan-tailed Cuckoo is more than twice the size of its Tasmanian Scrubwren foster parent.

'Tasmania may be said to be entirely without singing birds, [Author's note: this was a common misconception of British settlers.] although the parroquets sing admirably when taught and rendered tame. The tribes of small birds are various, but very unlike the birds seen in England. The crows are similar to those in England, with the exception of white eyes. There are two kinds of magpies, the one completely black, the other like ours but differently marked: neither is so mischievous or destructive.' (Bischoff 1832)

The Great Western Tiers provide habitat for the four migratory cuckoos that return to Tasmania from the Australian mainland each spring. Two species, the Pallid Cuckoo and Fan-tailed Cuckoo, sing incessantly while perching conspicuously on power lines or fences. The Fan-tailed Cuckoo sings a mournful trill; the Pallid Cuckoo sings a series of ascending microtones. Shining Bronze-cuckoos also sing repeatedly but they stay well hidden in dense wet vegetation. Horsfield's Bronze-cuckoos are found in the drier woodlands at the eastern end of the Tiers.

All four cuckoos are brood parasites; they lay their eggs in the nests of smaller forest birds (including thornbills, fairy-wrens, scrubwrens or honeyeaters) and leave the rearing of their young to the foster parents.

At the beginning of the breeding season a female cuckoo locates the nest of a host by watching the smaller birds collecting and transporting nesting material. After locating a suitable nest, the cuckoo waits until the host bird has started laying. Before incubation begins and when the host bird is absent, she lays her own egg (this can take less than ten seconds) directly into the nest. She then leaves.

Not long after hatching the nestling cuckoo removes all other eggs from the nest and the host birds feed and raise the youngster as if it were their own.

While often maligned for relinquishing their parental duties, cuckoos are ecologically important because they are among the few birds that consume hairy caterpillars that can reach pest status if left unchecked.

Most other birds find hairy caterpillars repugnant, not only because of the hairs, but because they contain a concentration of toxic substances the caterpillars ingest from their food plant. The cuckoos have strategies that overcome these problems. Before swallowing their prey cuckoos bash the caterpillars to rid them of their gut contents. They consume the hairy caterpillar whose hairs form a felted mat that lines the birds' stomach. These are eventually expelled in a pellet.



Fan-tailed Cuckoo



Shining Bronze-Cuckoo

There are limited foraging opportunities for birds in the rainforests of the Tiers. This is because Tasmania's cool temperate rainforests do not have the plethora of succulent fruits and invertebrates found in their tropical counterparts.

The endemic heartberry (*Aristotelia peduncularis*) is one of a handful of fruit-bearing plants in this habitat. Its latin species name *peduncularis* comes from the word peduncle, a botanical term that refers to the stalk of a flower (and thus the fruit). The genus name *Aristotelia* is in honour of Greek philosopher Aristotle (384-322 BC) for his work on plants and their classification.



heartberry (*Aristotelia peduncularis*)



Tasmanian Thornbill



Scrubtit

Three endemic species, the Scrubtit, Tasmanian Thornbill and Tasmanian Scrubwren are small brown birds that are easily confused. The best way to tell them apart is to observe where and how they forage.

The Tasmanian Thornbill is the smallest of the three. It forages for tiny invertebrates on the branches, trunks and foliage of understorey shrubs and small trees.

Small family groups of Tasmanian Scrubwren usually forage on the ground, logs or in low shrubs. They typically feed by flinging leaves aside with their bill and eating any insects they uncover. They have a range of melodious songs and a harsh scolding call directed at intruders in their territory.

Tasmanian Thornbills and Tasmanian Scrubwrens are frequently seen in wet eucalypt forests or in damp vegetation within drier forests.

In contrast, the Scrubtit is rarely seen away from dense wet vegetation in rainforest, wet sclerophyll forest or teatree or paperbark swamps. Its creamy-yellow throat, down-curved bill and large white spot on its 'shoulder' makes it the most distinctive of the three small brown birds. It searches for invertebrates (insects and spiders) by ascending tree trunks in a manner reminiscent of treecreepers.



Tasmanian Scrubwren



Bassian Thrush belong to the large cosmopolitan thrush family, Muscicapidae, whose members (including the European Blackbird) are medium-sized ground-dwelling songbirds with melodious songs and speckled, spotted or scaly plumage.

Over the years the Bassian thrush has been known by various names including mountain, scaly, ground and more recently, White's Thrush. 'Mountain', 'scaly' and 'ground' describe its patterning or habitat, while 'White's' is a name now reserved for an almost identical bird that dwells in the coniferous forests of Siberia and eastern Asia. The most recent appellation 'Bassian' alludes to the Bassian bioclimatic region that covers Tasmania, southern Victoria and the wetter regions of the Great Dividing Range–the area that largely corresponds with the birds' distribution.

The Bassian Thrush is about the same size and shape as the European blackbird. Its Latin name '*lunulata*' which means 'marked with little moons' aptly describes the crescent-shaped markings that cover much of its body. This subtle patterning camouflages the bird as it forages and shelters in the dappled shadows of its preferred habitat of ferny gullies and rainforests. Rather than flying away when disturbed the Bassian thrush will take a few steps, fly to a low perch or simply freeze.

The Bassian Thrush's beautiful fluty song, whose complex phrasing is similar to the familiar song of the blackbird, is rarely heard during the day unless it is dark and overcast. Instead, it is more likely to be heard in the twilight hours of sunrise or sunset in winter and early spring. The bird also emits a contact or warning call described as a high-pitched 'seet'. Like the warning calls of many other songbirds this sound seems to have ventriloqual qualities. This is a desirable attribute in a call that is designed to warn other birds of the presence of danger while not giving away the bird's location to a possible predator.

The Bassian Thrush is considered a specialist feeder of earthworms. It will also forage on other ground dwelling invertebrates including beetles. When foraging it will often stop and listen with its head cocked to one side. It will also stomp on the ground with its pink fleshy legs, an action that may simulate rainfall and bring worms to the surface so they are easy to capture.



Pink Robin (male)

Pink Robins breed in rainforest or in gullies within wet eucalypt forests. They often move into adjacent drier forests in autumn when they have finished breeding.

The Pink Robin is an inquisitive bird that will often greet an intruder in its territory with a sharp 'tic' call. Its song is described as a rapid trill or soft warble.

Like many bird species the male is brightly coloured while the female is uniformly brown, ensuring she is inconspicuous as she sits on the nest to incubate the eggs.

Pink Robins build a cup-shaped nest in the fork of a small tree. The nest is made of strips of bark, lined with treefern fibre and decorated on the outside with flakes of lichen.



Pink Robin (sub-adult male)



Pink Robin (female)



Grey Goshawk

Few people could fail to be impressed by the sight of the Tasmanian sub-species of the Wedge-tailed Eagle as it soars over farmland or rides the thermals high above the escarpment of the Great Western Tiers. The pure white form of the Grey Goshawk is equally beautiful. Sadly, these raptors, as well as the White-bellied Sea-eagle, are seen much less frequently than they were decades ago and all three species are classified as Endangered. Their demise is attributed to the clearing of their forest habitat, persecution, poisoning, and collisions with power lines, vehicles, fences or wind turbines. Eagles are particularly vulnerable to disturbance, especially during the early stages of egg laying.

Top level predators including raptors, owls and carnivorous marsupials (Tasmanian Devils and quolls) have crucial roles in the ecosystem. They keep populations healthy by targeting weak, deformed and old individuals. In areas where there is an absence of native prey they help to control populations of introduced species by taking significant numbers of starlings, sparrows, rabbits, rats and mice. They also clean up carcasses.

In the past two hundred years Tasmania's environment has been altered significantly. The Thylacine (Tasmanian Tiger) is presumed extinct and other top predators are now classified as Endangered, Rare or Vulnerable. While it is extremely difficult to assess the likely impact of the decline or loss of these animals, an overseas example gives cause for great concern.

In North America carnivorous predators high in the food chain such as wolves and coyotes have disappeared from some areas. This has happened either inadvertently or through active management that encourages the proliferation of deer which provide a source of game for recreational hunters. It has long been thought that this has had very little impact on the ecosystem. However, long term monitoring reveals a different story.

The loss of wolves, coyotes and grizzly bears results in an increase in their herbivorous prey species: moose, elk or deer. Their increase puts grazing pressure on woody plants and suppresses the establishment and growth of seedlings. Because the plant community influences the distribution and abundance of birds, mammals and insects and affects litter production and soil nutrients, the loss of predatory animals affects the whole ecosystem.

In Tasmania pademelons seemed to have increased in recent years. There are probably several reasons for this but an increase in the extent of rich pasture land where they feed adjacent to bush remnants where they shelter during the day is undoubtedly a contributing factor. The decline of predatory species may also be having an impact. Increasing numbers of pademelons puts added pressure on native vegetation. This may lead to the loss of invertebrates and threatened plants, and the loss and/or degradation of the roosting, nesting and foraging sites of native birds.



Wedge-tailed Eagle

Diurnal and nocturnal birds of prey including eagles, falcons, hawks and owls are known as raptors (L. *rapere* = to seize). They have extremely sharp eyesight and watch for their prey of small mammals, birds, reptiles or fish from a perch or while soaring. They grasp their prey with their powerful talons and rip the animals apart with their strong hooked bills.



Most birds are very particular about where they build their nests and the nesting material they use. The Satin Flycatcher, for example, builds a small rounded cup-shaped nest usually on a dead horizontal forked branch 5 – 15 metres above the ground. The neat nest, built of bark strips with flakes of lichen, is lined on the inside with rootlets, bark, grass, plant fibres, flowers or hair. Spiders' web is used to bind the nesting material and to attach it to the branch. The nest is so well camouflaged that it closely resembles a knot on the dead branch on which it is built.

Wedge-tailed Eagles nest in sheltered forests with a minimum area of 10 hectares. They build massive stick nests lined with fresh foliage in the forked branches of old growth trees that are greater than 27 metres high. The nests are usually located in east facing gullies sheltered from cold south westerly winds. Long term pairs often alternate between several nests in their traditional territories.



Masked Owl

Four species of nocturnal birds inhabit the forests of the Tiers. They range in size from the tiny owlet nightjar to the large endemic subspecies of the Masked Owl. Most nocturnal species are rarely seen, so it is virtually impossible to assess the long term viability of their populations. However, the Masked Owl is now listed as Endangered, probably because of the clearing and fragmentation of its breeding and foraging habitat.

The two medium-sized nocturnal species, the Southern Boobook and Tawny Frogmouth, are the most widespread and commonly encountered. The Southern Boobook has a distinctive 'mopoke' call; the Tawny Frogmouth has a rhythmical repetitive 'oom'.

Nocturnal birds are consummate hunters and have evolved several remarkable characteristics that enable them to function in complete darkness.

Some owls are able to find prey using their extremely acute hearing. They have large ear openings located asymmetrically near the facial disc and flaps of skin on each side of their head. These features direct sound to their inner ear, amplify the sound and assist the birds to determine its direction.

Diurnal birds have acute vision because they need to capture prey items that are often extremely small and cryptic, and they must negotiate obstacles as they fly quickly through their territory. The vision of nocturnal birds is even more remarkable. Owls and frogmouths have large forward facing eyes giving them a great field of binocular vision. This enables them to detect the tiniest movements and to judge distance extremely accurately.

The flight of nocturnal birds is almost silent. This is achieved by slow flapping and soft velvety feathers.

Listed raptors and nocturnal birds:

Wedge-tailed Eagle : Endangered (TSPA 1995 & EPBC 1999)

Grey Goshawk: Endangered (TSPA 1995)

Masked Owl : Endangered (TSPA 1995) & Vulnerable (EPBC 1999)

White-bellied Sea-Eagle: Vulnerable (TSPA 1995)



Tawny Frogmouths have a habit of perching on fence posts or other such structures where they wait for insects, especially moths, attracted by headlights or house lights.

A forest of rictal bristles fringes their upper bill. Rictal bristles are stiff modified feathers common on birds that feed on insects. (see also Grey Fantail on page 16) It was once thought that they assisted in the capture of food in flight, but studies have found that they form a barrier that protects the face and eyes from flying insects and other debris.

During the day Tawny Frogmouths are extremely cryptic birds. When they roost they adopt a branch-like posture and closely resemble a broken limb. Their beautifully patterned plumage in various shades of grey and brown adds to their disguise.

Rotting logs, leaves and twigs provide substrates for numerous fungal species. Fungi (along with bacteria and invertebrates) are the main decomposers in the ecosystem and assist in the decay and recycling of nutrients locked up in plant material.

Fungi play an important role in converting the indigestible cellulose in wood into substances on which invertebrates can feed.



Stereum ostrea

One of the crucially important but often overlooked attributes of the Great Western Tiers is the abundance of coarse woody debris and other organic material that remains on the forest floor.

Most eucalypt species regularly shed limbs and small branches. This, along with dead wood from other plant species, is known as coarse woody debris. Leaves and bark are other vital components of the organic material that accumulates on the forest floor.

Many invertebrates have muted colours and cryptically patterned bodies that enable them to hide in this organic material and to escape the prying eyes of predatory birds and reptiles. However, a significant numbers of invertebrates that are eventually taken by birds from the canopy foliage, bark or the air, spend at least part of their lives on the forest floor in this material.

Coarse woody debris provides nesting and sheltering sites for ground nesting birds. Robins and fairy-wrens use logs as lookout sites to survey the landscape for predators or to scan the ground for prey. Logs are important foraging places for snakes and velvet worms and basking sites for reptiles. Small animals use logs as pathways. Crevices and hollows are dwelling places for ants, skinks, dunnarts, echidnas, devils and quolls.

Logs are substrates for mosses, liverworts, lichens, fungi and slime moulds. Bryophyte-covered logs are important germination sites, especially in wet forests. A large proportion of the carbon locked up in temperate forests is in coarse woody debris. Unlike in tropical forests, where this material decomposes rapidly and carbon dioxide is released into the atmosphere, in moist temperate forests dead plant material decays slowly so this carbon-rich dead biomass lasts much longer.

Forest waste or biodiversity hotspots?







Logs provide nesting and sheltering sites for birds such as Painted Button-quail, basking and foraging sites for reptiles such as tiger snakes and pathways for pademelons and other small animals.



wood scorpion (*Cercophonius squama*) live in old logs and wood piles



spider wasp (Family: Pompilidae) near its nest entrance in an old stump



collembolon *Acanthanura* sp. feeding on slime mould plasmodium



mite (Order: Acarina)



millipede Polydesmidae 'sip-ins' with slime mould *Lycogala epidendrum*



longhorn beetle ovipositing into dead wood

Tasmania has a rich beetle fauna with almost 500 species (including rare endemic stag beetles) associated with dead wood. Beetle larvae tunnel into wood and thereby provide a conduit for bacteria, fungi and other invertebrates. Wood inhabiting larvae are important food for the Yellow-tailed Black-Cockatoo.

The moist interiors of decaying logs are vital for millipedes, mites, spiders, earthworms, flatworms, snails, collembola (springtails), scorpions, ants and a multitude of other invertebrates.



brown tree frog (*Litoria ewingi*)

Frogs are extremely vulnerable to drying out. To prevent this several species bury themselves deep in the ground, others hide in rock piles, under bark or at the base of saggs, rushes or sedges.

The high moisture content of logs makes them especially important habitats and as vital refuges during and after fires.

There is a growing recognition worldwide that the loss of coarse woody debris from forests and woodlands is a major threat to the conservation of biological diversity. In Europe, a third of forest dwelling species rely on logs, branches and dying trees for their survival. Forests with old and dead trees are often much healthier and more resistant to diseases, pests and climate change than young forests.

Logs are regarded as so important to the maintenance of the diversity of life in forest ecosystems that in Victoria, New South Wales and Queensland the loss of coarse woody debris '*as a result of the removal of forest and woodland waste left after timber harvesting, collection of firewood, burning on site, mulching on site, and the removal of fallen branches and litter as general tidying up*' was listed as a potentially threatening process in 2003.

Logs, fallen branches, leaf litter and other organic material are vital components of healthy terrestrial (and aquatic) ecosystems. When left to break down (rather than being cleaned up or burnt) they release a bounty of nutrients. Most nutrients used by a plant during its life are returned to the soil as it decays. This decay is hastened by fungi, bacteria and invertebrates.





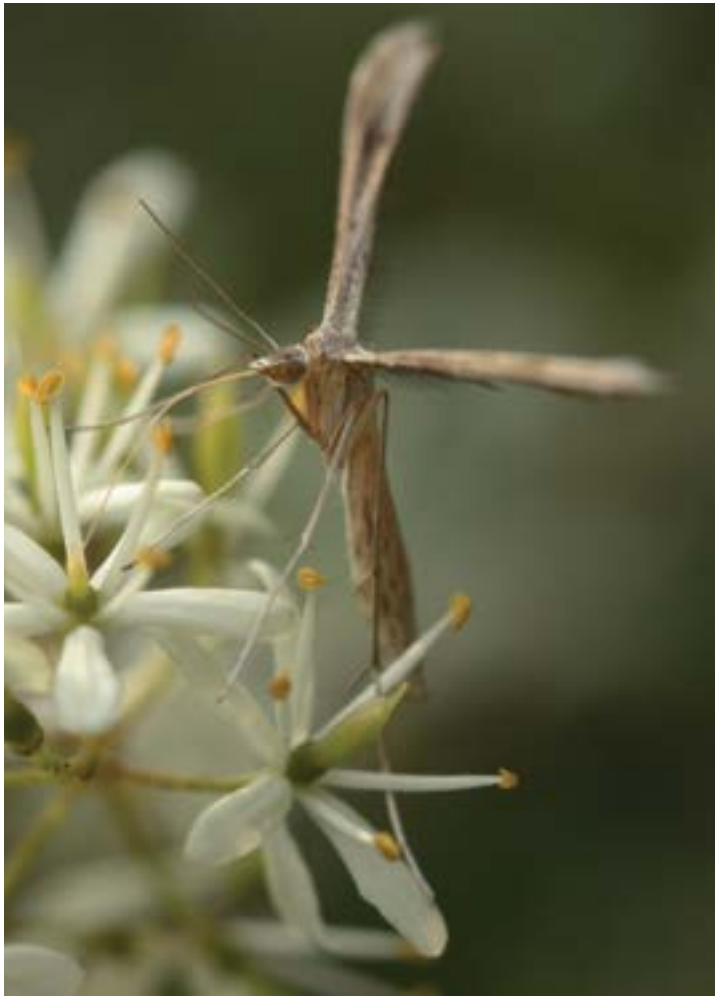
garden spider (*Eriophora transmarina*) with fly



jewel beetle (*Castiarina australasiae*)



grasshopper (Family: Acrididae)



plume moth (Family: Pterophoridae)



longhorn beetle



bristle fly (Family: Tachinidae)



long-nosed lycid beetle (*Porrostoma rhipidius*)

Prickly box (*Bursaria spinosa*) is a small tree. It is common on partially cleared farmland at the foot of the Tiers and in the understorey of eucalypt forests on the Great Western Tiers escarpment. Along with other common prickly plants such as prickly beauty (*Pultanaea juniperina*) and native currant (*Coprosma quadrifida*) it provides safe sheltering and nesting sites for numerous small birds.

Prickly box is relatively inconspicuous until its white, sweet-smelling flowers appear in spring and summer. Its blossom, laden with pollen and nectar, attracts honeybees (*Apis mellifera*) making it a valuable plant for apiarists.

But it is not only honeybees that visit the plant. Hordes of native insects including bees, flies, grasshoppers, longhorn beetles, jewel beetles, wasps, butterflies, moths and ants also feed on its pollen and nectar.



longhorn beetle



scorpion fly (*Mecoptera* sp.)



parasitic wasp (*Gasteruptid* sp.)



parasitic wasp (Family: Ichneumonidae)



metallic fly (Family: Dolichopodidae)



fly (*Odontomyia* sp.)



orange longhorn beetle



bullant (*Myrmecia forficata*)

The adult and larval stages of insects often have a completely different food source. For instance, adult longhorn and jewel beetles forage on pollen and nectar. But they lay their eggs in living and dead trees and when the eggs hatch the larvae feed on bark, sap and/or wood and assist in its decomposition.

Gasteruptid wasps are kleptoparasites (Gk *kleptes* = a thief). They take advantage of the nectar and pollen collected by native bees. The adult wasps deposit their eggs so that their larvae have a food source when they hatch. The newly hatched larvae first consume the eggs or larvae of the bees before further developing on the collected pollen and nectar.

Female scorpion flies feed on nectar; the males feed on nectar and soft bodied insects.

The Great Western Tiers provides habitat for many of the ancient and endemic species that make up Tasmania's unique invertebrate fauna. They are abundant in aquatic and terrestrial ecosystems where they are crucial players in the web of life. They pollinate plants and disperse seeds; they regulate the populations of plants, vertebrates and invertebrates; they recycle nutrients from dung, dead and live animals and plants; and they are food for countless animals including mammals, birds, reptiles and other invertebrates.



donnysa skipper (*Hesperilla donnysa*)

Springs, pools, slow flowing streams and fast flowing rivers are inhabited by a variety of invertebrates. As in terrestrial ecosystems their food source is provided by fungi, algae and other aquatic plants, and the leaves, woody debris and animals that fall into the waterways. Aquatic invertebrates include caddisflies, stoneflies and mountain shrimp (*Anaspides tasmaniae*). Familiar terrestrial invertebrates such as dragonflies, damselflies and mosquitoes have an aquatic larval stage and many aquatic invertebrates such as snails, spiders and beetles, have terrestrial counterparts.

Among the most curious of the terrestrial invertebrates that inhabit the wet forests of the Tiers are velvet worms whose fossilised marine ancestors have been found in sediments dating back to the Cambrian Period 550 million years ago. There are two extant families: one is found in tropical regions and the other in the southern countries that once formed the supercontinent, Gondwana.



Nicodamus bicolor

Velvet worms have segmented bodies and numerous pairs of stubby legs. They live in dark damp places where their strategy for defence and the capture of food (small invertebrates) is to immobilise predators and prey with a stream of slime squirted from modified limbs below the antennae.

Almost all the multi-legged animals (millipedes, centipedes, pauropods and velvet worms) that occur in the Tiers are endemic. Most lack the waxy layer that protects against desiccation so they are most often found in damp places where they feed principally on detritus.

Millipedes are soil-dwelling invertebrates that migrate vertically in response to changing soil moisture. In summer when the soil surface dries out they move deeper into the soil and migrate upwards to the surface when the soil is waterlogged.

Insects belong to the largest and most diverse group of invertebrates. They first appeared on Earth about 400 million years ago but their rapid evolution is closely associated with the rise of flowering plants that (along with birds and mammals) started to appear on Earth in the late Cretaceous Period.

The success and spread of flowering plants, which was mirrored by a decline in the cycads, ferns and conifers that dominated the Jurassic vegetation, is attributed to three main factors. Firstly, their seeds are formed in structures that protect them against damage and desiccation. Secondly, their seeds are completely enclosed by fruits; and thirdly, they enlist animals, particularly insects and birds, to assist in pollination and seed dispersal.



weevil on forest flaxlily (*Dianella tasmanica*)

Pollen is a rich source of food for numerous animals as it provides carbohydrates, fats, proteins, vitamins and minerals. It is produced in enormous quantities (one ragwort plant can release eight billion grains of pollen in one day), far more than is needed to pollinate the flowers. The excess pollen adheres to the hairy bodies of the insects, birds or mammals that visit the flowers to feed. They transport it from one plant to the next and fertilisation is achieved.

The endemic Tasmanian hairy Cicada (*Tettigarcta tomentosa*) is among the most fascinating of insects that lives in the Tiers. It belongs to a family with six genera. Five of these are known only from northern hemisphere Mesozoic and Tertiary fossils; the sixth is represented by two living species in Australia.

The endemic Tasmanian hairy cicada lives at the margins of rainforest, wet eucalypt forests and snowgum woodlands. It shuns daylight and is most likely to be seen at dusk and in the colder months. It lays its eggs in the living branches of eucalypts and the nymphs feed on the roots of eucalypts and possibly other species.

Unlike other cicadas, which are among the most familiar of insects because of their loud songs that fill the summer air, the Tasmanian hairy cicada is silent.

However, it is likely that they produce extremely low intensity vibrations that are transmitted through the substrate on which they settle and attract potential mates within close proximity.



Geoff Fenton

Tasmanian hairy cicada (*Tettigarcta tomemtosa*)

Approximately one third of all animal species and two fifths of all insects are beetles. They occur in just about every habitat and eat a variety of foods including plants, carcasses, dung, other insects, fungi and soil organisms.

Their hard outer covering (elytra) forms a first line of defence and protects their membraneous underwings. If this is breached some species use repellent chemicals to deter predators.





leaf beetle (*Paropsisterna bimaculata*)



Tasmanian velvet grasshopper (*Tasmanalpina clavata*)

Numerous grasshopper species inhabit the grassy woodlands, forests and alpine areas of the Great Western Tiers.

One of the most brightly coloured is the Tasmanian velvet grasshopper, an endemic species with a metallic blue body and vivid red and orange legs.

This grasshopper is also known as talus hopper because it lives in rocky places such as scree and talus slopes or boulder streams.

Bees have been critical to the success of flowering plants because they are the only insects that feed their larvae exclusively protein-rich pollen. Thus, they are completely dependent on flowering plants and they pollinate flowers while collecting food for their young.

Unlike their European counterparts, the honey bee and bumble bee, most Australian bees are stingless and they do not make honey or wax. Most are solitary animals that live in the ground or in tunnels made by other insects in dead twigs, rotten logs or stumps.



native bee on blanketleaf (*Bedfordia salicina*)



Macleay's Swallowtail (*Graphium macleayanus*)

The long proboscis of butterflies and moths allows them access to the nectar of flowers with long corolla tubes such as pimelea species. They also feed on the nectar rich flowers of banksias, teatrees, eucalypts and many other plants. Their larvae (i.e. caterpillars) feed on plant material and are often associated with specific host plants. Caterpillars of the beautiful green Macleay's Swallowtail, for example, feed on sassafras.

Tasmania has over 1400 species of moth. Many are cryptically coloured and beautifully patterned to ensure they remain out of sight of predatory animals such as birds, reptiles, bats, small mammals, spiders and wasps.

On the central plateau the pencil pine moth (*Dirce aesiodora*) is found in association with pencil pines.

Numerous species of fly feed on nectar and pollen. The nectar they ingest gives them the energy they need to sustain flight and the pollen they consume is a rich source of protein they need to produce their eggs. They are particularly important pollinators on the central plateau above 700 metres.

The larvae (i.e. maggots) of many flies feed on and hasten the decay of dung, rotting plants or decomposing animals. Some fly larvae are predators of aphids and other soft bodied insects and others are parasites on grasshoppers or the larvae of moths, butterflies and sawflies. The bristle flies (Tachinidae) are a huge group that are parasitic on moths, grasshoppers and soil-dwelling larvae of scarab beetles that feed on pasture plants or tree roots.



Left: *Scaptia* species closely resemble their relatives, the much reviled march flies. But unlike their blood sucking kin, adult *Scaptia* sp. feed exclusively on nectar while their larvae are predators of snails and insects. Scaptia species have a Gondwanan distribution with related species occurring in New Zealand, South Africa and South America.



Right: adult robber flies (Family: Asilidae) are large flies that are predatory on other insects.

Their larvae feed on soil organisms and rotting vegetation.



Left: *Sphenella rucifeps* is a member of a group called 'fruit flies' (Tephritidae) with a world wide distribution.

Fruit flies is a misnomer for this species. *S. rucifeps* is not associated with fruit but lays its eggs in the flower heads and stems of members of the daisy (Asteraceae) family, particularly fireweed (*Senecio*) species.

Hymenoptera (ants, bees and wasps) are arguably the most ecologically important of all the insects. They, along with Coleoptera (beetles) Lepidoptera (moths and butterflies) and Diptera (flies), are one of four mega-diverse orders of insects. They pollinate flowers, collect seeds, rid the environment of dead and dying animals and control populations of other invertebrates.

Ants have a number of different ecological roles. Adult ants have a liquid diet of nectar or the sweet exudate from scale insects or aphids. They are often seen dragging dead invertebrates back to their nests to feed to their larvae. Thus they assist in keeping areas free of dead and decomposing bodies and in regulating the populations of other insects. Ants collect seeds, especially those of acacia species that have a special oil-rich ant attracting structure called an elaiosome that is eaten by the larvae. The activities of ants influence the composition and distribution of plant communities.

Most ants in Tasmania nests in logs, stumps or in the ground; some nest in hollow plant stems.

Jack jumpers (*Myrmecia pilosula* complex) make conspicuous mounds that they decorate with small stones, seeds, twigs, charcoal, bone fragments, snail shells and/or the scats of native animals. This outer layer not only prevents evaporation but warms rapidly and acts like a solar collector. The nests are usually built and oriented to receive maximum sun. Additional heat comes from decomposing plant material and the metabolism of the ants within the mound. Their complex system of chambers enables adults to move their larvae where the climate is optimum for their development.



Bullants or inchmen (*Myrmecia forficata*) locked in combat on top of a lichen covered stump.

There are over 10 000 species of native wasps in Australia. They prey on or parasitise insects or spiders and are therefore extremely important in controlling invertebrate populations. Different species of wasp target different hosts. e.g. Ichneumonid wasps usually lay their eggs in or alongside the developing larvae of moths or butterflies, or less frequently, in spiders or their eggs sacs. Other species prey on or parasitise the eggs or larval stages of lacewings, flies, beetles, grasshoppers and crickets or other wasps.



tiny parasitic wasp ovipositing into an old log

Wolf spiders (*Lycosa godeffroyi*) are agile, strong and fast. They search by night for ground-dwelling insects which they overpower with their superior strength and speed. Their eyes–all eight of them–are set high on their striped carapace. Their extreme sensitivity to polarised light means they can return to their burrows after a bout of nocturnal hunting by recognising local landmarks.

Wolf spiders live in underground burrows, either in the vacated tunnels of cicadas or moth larvae or in a tunnel they have dug themselves with their fangs. The 20-25 cm burrow, located near roots or rocks to prevent collapse, has a silk-lined entrance with a small wall of grass or leaves to divert rain water and prevent it from flooding the chamber.



wolf spider in heathland on the Central Plateau

Freshwater crustaceans such as isopods and amphipods are abundant in the streams and lakes of the central plateau and lowland areas. Phreatoicidean isopods (distant relatives of pill bugs, slaters and woodlice) first appeared in the marine fossil record about 325 million years ago in the Carboniferous Period. By the Triassic Period (approximately 225 million years ago) they had invaded the freshwater habitats of Gondwana and subsequently became extinct in the oceans. Fossil evidence and present day distribution patterns indicate that isopods evolved many different species before the fragmentation of Gondwana.

Many species of isopods have very restricted distributions. For instance, there are five species endemic to the Great Lake of which two are found only in one or two bays where they feed on algal beds on the bottom of the lake.



amphipod

Many herbivorous insects are extremely well camouflaged. The stick insect (right), with its cryptic colouring and stick-like appearance, usually escapes detection.

Female stick insects lay 3 mm elliptical eggs that are simply dropped to the ground while they feed high in the canopy foliage of eucalypts. The eggs have a small knob called a capitullum; they closely resemble plant seeds, especially those of acacia species that have ant-attracting structures called elaiosomes.

Because of this resemblance, ants collect stick insect eggs and take them to their underground nests. The eggs, which take between one and three years to hatch, are protected from predation and fire in the ants' chambers.



stick insect (*Ctenomorphodes chronus*)

RAINFOREST



Liffey Falls

Cool temperate rainforest thrives in the mist-filled valleys such as those at Liffey Falls and Meander Falls. They also persist in the moist gullies, sheltered hillsides and on the upper edge of the escarpment of the Tiers that experiences frequent low cloud.

The rainforests are dominated by myrtle beech (*Nothofagus cunninghamii*), a descendent of the southern beeches (*Nothofagus* spp.) that originated in Antarctica in the Early Cretaceous Period. The southern beeches radiated from Antarctica and reached South America, Australia, New Zealand, New Caledonia and New Guinea where their descendents still occur.

Species rich rainforest flourished in the warm wet climate of the late Cretaceous. But as Gondwana continued to fragment and Australia moved north conditions became drier and more seasonal and the rainforests contracted. Cool temperate rainforests of Gondwanan origin are now restricted to the wettest parts of Tasmania and as small isolated pockets in sheltered river valleys in Victoria.

The co-dominant trees in the rainforest of the Tiers are sassafras (*Atherosperma moschatum*) and blackwood (*Acacia melanoxylon*) whose dense canopy foliage creates a dark damp environment. Few flowering plants can tolerate such conditions but they are ideal for the proliferation of cryptogams, plants such as algae, ferns, bryophytes (mosses, liverworts and hornworts), fungi and lichens that reproduce by spores rather than seeds.

Algae were the first cryptogams to appear on Earth. They are simple green plants that do not have stems, leaves and roots. They have no sterile layer of cells surrounding and protecting their reproductive organs so they are mostly restricted to aquatic habitats.

BRYOPHYTES

The rainforests of the Tiers are particularly rich in bryophytes, a term used for three unrelated groups of plants: the mosses, liverworts and hornworts. They are thought to have evolved from a group of green algae about 400 million years ago and although they represent separate evolutionary lines, they are lumped together because they developed similar adaptations to increase their reproductive success and to overcome the problems of desiccation.

Firstly, they produce their sperms and eggs in separate sacs called antheridia (male) and archegonia (female); secondly, they retain the fertilized eggs inside the archegonia where the embryos grow into spore-bearing structures called sporophytes. (see page 32) Thirdly, and most importantly, they enclose their spores in a rot resistant, waterproof, UV shielding carotenoid polymer called sporopollenin. It was this last adaptation that enabled them to colonise the land.

Sporopollenin is a waxy polymer that is deposited in the outer walls of the spores of bryophytes. It provides an extremely effective shield against UV radiation, especially the short wavelength radiation that is particularly damaging to cells. Bryophytes are able to respond to fluctuating levels of UV radiation by adjusting the amount of sporopollenin they deposit in the walls of their spores.

Unlike flowering plants most bryophytes do not have a transport system for conducting water. In addition, the leaves of most bryophytes lack a thick waxy covering that in flowering plants reduces water loss. Their extremely thin leaves (usually only one cell thick) are able to absorb water directly from rain or moisture-laden air. They lack true roots but attach to the substrate (e.g. logs, trees, rocks or soil) by hair-like rhizoids through which they can take in water and minerals.

Bryophytes usually reach peak abundance in wet habitats where logs, exposed roots, trunks, rocks and soil are blanketed in a rich variety of liverworts and mosses that in some habitats can number over two hundred species. The Mole Creek limestone also has a rich flora of mosses and liverworts. And although there are few bryophytes that are restricted to limestone, the bryophyte flora often has more species in greater abundance than in adjacent areas with a different geology.

Bryophytes also occur in arid environments and even in predominantly wet areas they can become desiccated during prolonged dry periods. Their ability to absorb water through their leaves means

they can rehydrate as soon as moisture becomes available; they can transform quickly from a crisp to a photosynthesizing green plant. This ability, along with the relatively large amount of water they can hold on their leaves by surface tension, makes them crucial in maintaining a stable humid atmosphere in wet forests. Soil colonising species help to reduce evaporation and prevent erosion.

Fossil evidence from the Devonian Period reveals that the first plants to colonise the land resemble today's liverworts. There are two groups, leafy liverworts and thallose liverworts.

Leafy liverworts have small thin leaves and are often mistaken for mosses. They evolved in Gondwana and dominate the southern hemisphere liverwort flora.

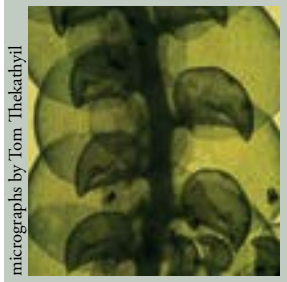
New Zealand, with 600 described species, is the centre of southern hemisphere leafy liverwort diversity with Tasmania, New Zealand's Gondwanan sibling, a close second. The liverworts that occur in Tasmania and New Zealand include primitive endemic families that inhabited Gondwana before it fragmented, as well as genera that evolved after the fragmentation. The primitive families are believed to hold the key to the understanding of the evolution of liverworts.

Some leafy liverworts synthesize compounds called monoterpenoids. Some are aromatic with fragrances reminiscent of lemons, peppermint, camphor and parsnips. Others have bitter, sweet, peppery or nauseating flavours that probably evolved to defend the plants against animals such as grazing snails and insects. Sesquiterpenoids are also common. They are poisonous and are known to cause dermatitis, especially in forest workers in daily contact with trees covered in liverworts.



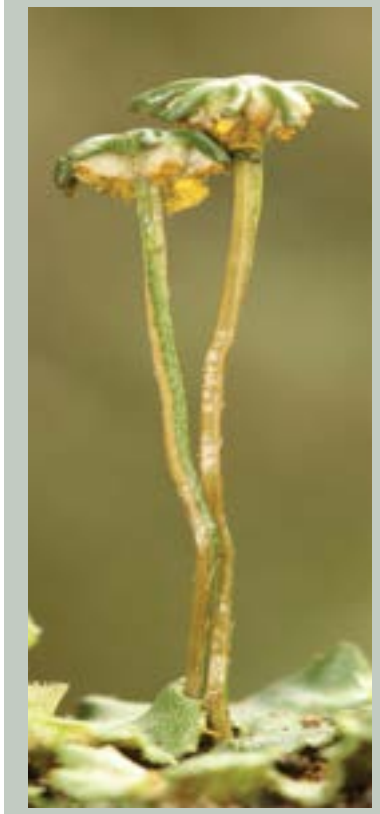
Despite their superficial resemblance to mosses liverworts differ in several ways. Some of these differences are visible to the naked eye while others such as the oil bodies in their leaves or the elaters in their capsules, require a powerful microscope.

Elaters (left) are spiral-form structures that occur only in some leafy liverworts where they act like springs and help to eject spores. They change shape with changing humidity: as the air dries out inside the capsule increasing tension is placed on the elater. When the tension is released the capsule bursts open and the spores are ejected.



Many liverworts have small structures called lobules on the underside of their leaves. Lobules are also known as water sacs as it was once thought their function was to provide a reservoir of water during dry spells. However, not only do the lobules have tiny openings, they are too small to be a back up water supply. They are now thought to house nitrogen-fixing cyanobacteria and tiny protozoa which are likely to provide nutrients to their hosts.

micrographs by Tom Thekathyil



Thallose liverworts have thick leathery leaves. They are thought to have evolved in Laurasia and they now dominate the northern hemisphere flora.

There are relatively few thallose liverworts in the southern hemisphere. One of the most familiar in Tasmania is *Marchantia berteroana*, (left) a species that often grows with potted plants. Its thick leathery leaves lie flat on the surface (usually soil) from where it can access water and nutrients.

Liverworts synthesize bibenzyls, compounds that are absent from the other bryophytes and are found elsewhere in nature in only a few flowering plants. One bibenzyl, lunularic acid, inhibits the growth of the thallus (plant tissue) and the germination of the gemmae (seed-like growths). During cool seasons the production of lunularic acid slows down and the thallus grows quickly; in the warmer months production of lunularic acid rises and the thallus becomes dormant, thus avoiding desiccation.



In some species of thallose liverworts small cups develop on the upper surface of the leaves. These cups contain small disc-shaped 'seeds' called gemmae. Raindrops falling on the cups dislodge and expel the 'seeds' giving the plants a means to reproduce vegetatively.



the thallose liverwort *Hymenophyton flabellatum* and various moss species cover a 'mossy' log at Marakoopa



liverwort sporophytes



moss sporophytes



hornwort sporophytes

Mosses superficially resemble leafy liverworts and the most obvious (visible) difference is in their fertile structures called sporophytes.

The dark, globular-shaped capsules of liverworts mature close to the plant and before the translucent stalks begin to lengthen. When the stalks lengthen they lift the capsules above the plant. The capsules split open into a star-shaped structures and the spores are ejected. The stalk is unable to make its own food and it therefore lasts only for hours or several days at the most.

The sporophytes of moss have a stalk (seta) that is usually brown and solid with long lasting capsules. As the stalk slowly lengthens it raises the capsule above the plant. The capsule matures only once the stalk has stopped growing.

Hornwort sporophytes are needle-shaped structures that open by one or two vertical slits. If conditions are favourable they continue to grow and shed mature spores from the tip and produce new spores at the base.

MOSSES

There are three main groups of moss. The 'true' mosses are the most widespread and species rich with about 9000 species; the granite mosses, about 100 of them, are restricted to granite and the third group, the sphagnum mosses, have a cosmopolitan distribution and are usually associated with bogs (see page 49).

Over two-thirds of mosses synthesise biflavonoids, compounds that are rare or absent in liverworts or hornworts. They protect against fungal invasion and browsing insects.

HORNWORTS

Hornworts resemble thalloid liverworts but there are several fundamental differences in cell structure and composition. There are only about 200 species worldwide.

INVERTEBRATES ON CRYPTOGAMS

Beetles, flies, collembola, mites, spiders, snails and a host of other invertebrates rest, feed and hunt on mosses, liverworts and ferns.

The tiny (2mm) snail pictured below is an undescribed snail in the Punctidae family. Members of this family are often referred to as 'dot snails' because of their size. This species is widespread in Tasmania and occurs mainly on trees and shrubs in wet forests.



longhorn beetle on fern



Pedicamista sp. 'Chisholm'



Austroleria sp.

Ferns are the largest and most obvious of the cryptogams and are a conspicuous element of the vegetation throughout the Tiers. Like flowering plants but unlike most other cryptogams, they have a vascular system and lignin which gives them structural strength. Ferns flourish where conditions are permanently humid so they are abundant in rainforest and wet forests where they range from tiny filmy ferns that are only one cell thick to ten metre tall treeferns (*Dicksonia antarctica*). Drier areas are not devoid of ferns; the familiar native bracken fern (*Pteridium esculentum*) is prevalent in the forests of the Great Western Tiers.

Ferns first appeared on Earth about 400 million years ago. However, Australia's fossil record dates them back only as far as the Carboniferous period (340 million years ago) when ancient ferns and tree-like club mosses dominated the planet.

Fern diversity rose during the Triassic and Jurassic Periods and, along with conifers and cycads, they constituted the main food of giant plant-eating reptiles. They were at their most diverse in the mid Cretaceous; their decline by the end of the Cretaceous coincided with the rise of the flowering plants.

Treeferns are particularly abundant in Tasmania where they readily colonise bare ground. Their ability to spread can be attributed to the massive amount of spores–around 800 million–produced by one plant in just one year.

In very wet places treefern trunks become festooned with filmy ferns, liverworts and mosses.

Tasmanian Thornbills, Scrubtits, Silvereyes, Pink Robins and tiny pygmy possums use treefern fibre to line their nests.



pygmy possums

'The natives eat the fern root baked in the ashes, and in preparing it they cut it into short pieces and eat it with the roasted kangaroo skins.'

(GAR 24 June 1831, Ringarooma River)

'They had made themselves a shelter with the leaves of the ferntree which were quite green.'

(GAR 11 July 1834, Mt Van Dyke)

'… passed through a myrtle or green forest overgrown with espalier shrub and other small trees, the stinkwood, sassafras &c, through which we forced our way with some difficulty, sometimes crawling for yards upon the entwined branches and sometimes upon our hands and knees on the ground beneath them. Those forests are in general wet with mucid substance on the branches and moss, and leeches also is in abundance.'

(GAR 27 April 1832, Hampshire Hills)



common fork fern (*Tmesipteris obliqua*)



bushy clubmoss (*Lycopodium deuterodensum*)

Fork ferns (Psilotaceae) and clubmosses (Lycopodiaceae) have long been classified as fern allies rather than true ferns. Since the 1990s there has been much debate about their evolutionary relationships and it is now generally accepted that fork ferns are more closely related to true ferns than to the first vascular plants and that ferns and seed plants are more closely related to each other than either is to the clubmosses.

Fork ferns such as *Tmesipteris* spp. could be the most morphologically primitive of all living vascular plants. They are epiphytic, usually on treeferns, and they have no true roots. They absorb water and nutrients via a branched rhizome that is buried deep in the treefern. Their gametophytes lack chlorophyll and grow underground in association with a mycorrhizal fungus.

Clubmosses such as *Lycopodium* spp. are ancient plants whose fossilised ancestors have been found in Devonian and Carboniferous rocks. Modern clubmosses are small compared to their giant predecessors whose remains form the major part of present day coal deposits.

Clubmosses have a unique leaf called a microphyll which is simple (not divided like fern fronds), entire and with a single vein. Unlike the leaves of most ferns and seed plants microphylls are always sessile (i.e. without stalks). Their single sporangium is located on the upper surface of the microphyll or in its axis. The sporangia of ferns, in contrast, are usually found on the under surface of the leaves.



dolerite is substrate for numerous species of crustose lichens



Baeomyces heteromorphus

Lichens chemically and physically break down the minerals in rocks and contribute to the formation of soils.

They are pioneer organisms that colonise bare soil and help to prevent erosion and moisture loss. They can provide favourable conditions necessary for the establishment of a succession of 'higher' plants.



Tasmania is the centre of distribution of *Cladia* species, lichens that are characterised by perforations in their thallus.

The coral lichen (*Cladia retipora*) is common in coastal and alpine areas.

Lichens are common in most habitats of the Tiers. Leafy lichens are particularly abundant in the forests that are subjected to frequent mist and fog.

Lichens are organisms composed of at least two–and sometimes three–different components: a mycobiont and one (or two) photobionts. The photobiont, a green alga or a blue-green alga (cyanobacteria)–or both, contains chlorophyll and provides the lichen with sugars through photosynthesis. The mycobiont (always a fungus) provides the alga with some nutrients and protection from harsh conditions. Lichens that contain cyanobacteria are able to capture and fix atmospheric nitrogen.

Lichens are able to thrive in some of the most inhospitable environments on Earth. Their composite nature enables them to withstand conditions not tolerated by their individual components. For example, fungi usually inhabit areas rich in organic matter and algae usually live in aquatic or moist terrestrial environments. Together they can survive extreme humidity, aridity and light intensity.

Lichens are poikilohydric, which means they can survive prolonged periods without water. In a severely desiccated state, lichens become virtually dormant and metabolic processes are suspended. This enables them to tolerate extremes of temperature, radiation and drought.

A range of substances found within the lichen body also helps them to survive the adverse conditions of arid, salty and high altitude environments. For instance, the white appearance of some lichens indicates the presence of a thin layer of calcium oxalate crystals that may deflect the amount of light reaching the organism and thereby help them to survive places with high light intensity. Some lichens contain brightly coloured pigments which masks the green colour of the algae and protects it from exposure to too much light.

Lichens obtain carbon dioxide, oxygen and inorganic nutrients from air or water in the form of mist, fog, dew, rain or runoff. This makes them particularly vulnerable to air pollution. In rainforests where there is a high turnover of large leafy lichens their decomposition adds nutrients to the soil.

Many Tasmanian lichens originated on Gondwana and have closely related species in New Zealand and South America.

Although extremely hardy, lichens, like other organisms, are vulnerable to changes in their habitats. Some are restricted to certain substrates or vegetation types and changes in microclimate or light intensity can adversely affect some species. A diverse lichen flora grows on old growth trees because of the many different habitat niches provided by upper and lower branches, twigs and trunks. Stock trampling destroys ground-dwelling lichens and fires can eliminate most species from an area.



Peltigera dolichorhiza



Cladonia sp.

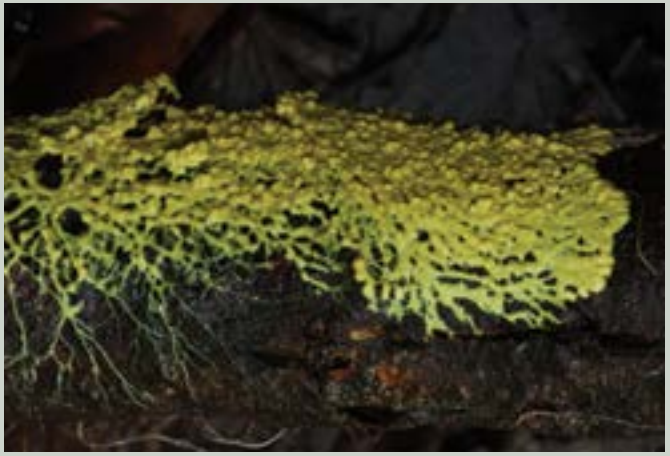
Slime moulds are abundant on decaying logs and leaf litter in the forests of the Tiers.

'Slime mould' is not a term that elicits a favourable response in most people. But the acellular slime moulds (the myxomycetes) are truly remarkable organisms because they share qualities with both animals and fungi. In the early stage of their life they are single cell amoeba that feed and move about, and then several amoebae combine to form a mobile feeding stage called a plasmodium. This eventually transforms into reproductive (spore bearing) structures called sporophores.

Slime moulds were once placed in the same kingdom as fungi but they are now placed in their own kingdom: the Protoctista. They are abundant in temperate forest ecosystems where they are found on living and dead trees, rotting logs and stumps, leaf litter, herbivore dung and bryophytes.

Acellular slime moulds have two different trophic (feeding) stages. The spores germinate into individual, soil-dwelling, single-nucleus amoebae. (The word amoeba comes from the Greek *amoiba*: to change. It alludes to their ever-changing shape, a result of the expansion and retraction of temporary protrusions on their body called pseudopodia.) The amoebae feed on bacteria and other organic matter, and then divide in two–thus their population increases. Two compatible amoebae fuse to form a zygote, a process that involves the fusion of the protoplasm and the fusion of the nuclei. The diploid zygote feeds, grows and undergoes repeated nuclear division to develop into the plasmodium (pl. plasmodia).

Slime moulds are food for collembola (springtails) and other invertebrates.



Slime mould plasmodia are a single cell with multiple nuclei encased in a thin membrane. They can move through extremely small openings of a few micrometres so they are able to exploit the microhabitats within decaying wood where they feed on fungal hyphae and spores, bacteria, yeast, algae and cyanobacteria. Eventually they move to the surface of the substrate where they form their fruiting bodies known as sporophores. The transformation is probably triggered by exhaustion of the food supply and/or changes in moisture, temperature and pH. Wind disperses the spores in most species although the numerous invertebrates that feed on slime moulds undoubtedly also play a part.

If conditions are unfavourable plasmodia have the ability to transform to a hard structure (sclerotium) and revert to a plasmodium when favourable conditions return. Similarly, amoeboid cells have the ability to change to microcysts and back again. Sclerotia and microcysts can remain viable for long periods, a strategy that probably ensures their survival in arid and other hostile habitats.



dog vomit slime mould (*Fuligo septica*)

One of the largest slime moulds, the bright yellow *Fuligo septica,* appears in spring and summer on old logs, stumps or live vegetation. It is sometimes bright pink or orange. The common name of *F. septica,* 'dog vomit slime mould', evocatively describes its size and consistency when it first appears. It slowly hardens as its spores mature.

The sporophores (fruiting bodies) of most slime moulds are only millimetres high. Some are exquisitely patterned or iridescent.



Badhamia utricularis



Lamproderma echinulatum



Stemonitis sp.



Lycogala sp.



Physarum viride



Ceratiomyxa fruticulosa



Oligonema verrucosum



Physarum album

There are many hundreds, perhaps thousands, of species of fungi in the Great Western Tiers. Many different species can be seen during autumn and winter in the publicly accessible rainforests at Meander and Liffey Falls.

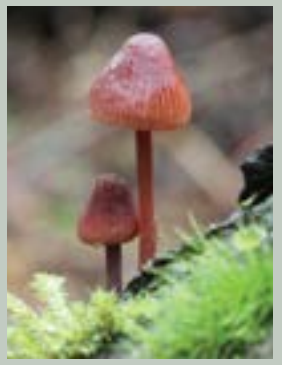
Fungi come in a kaleidoscope of colours and are particularly conspicuous in rainforests, wet forests and in damp shady places within drier areas. But fungi are abundant and carry out crucial ecological roles in every ecosystem. Without fungi rotting organic material would pile up around us and the world as we know it would cease to exist. Fungi, along with bacteria and invertebrates, are nature's recyclers.

It is difficult to appreciate fully the role of organisms that are mostly unseen. Fungi are always present in the environment but their main growing part, a mass of invisible microscopic, thread-like structures called hyphae, grow in the soil or organic material. Most fungi only produce their visible reproductive structures such as the familiar mushrooms, toadstools, corals, puffballs, jellies, discs and earthstars, after a period of favourable weather.

Fungi lack chlorophyll so unlike green plants they are unable to photosynthesize i.e. build energy-rich carbohydrates from carbon dioxide and water using energy from the sun. Instead they obtain their nutrients in other ways; there are three life modes: saprotrophic, mycorrhizal and parasitic.



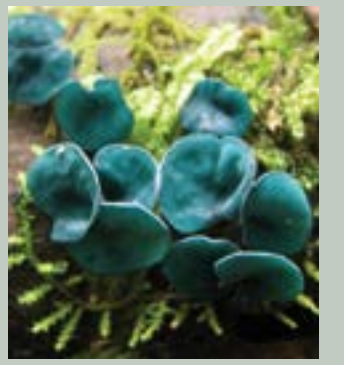
rhubarb bolete
Boletellus obscurecoccineus



Mycena sp.



Marasmius sp.



Chlorociboria sp.

Saprotrophic fungi obtain nutrients from dead organic matter. Their hyphae contain a cocktail of powerful enzymes that are potent enough to break down the flesh, bones and dung of animals and the cellulose, pectin and lignin that would otherwise remain locked up in plant cells. The work of decomposing fungi converts this material into substances that can be used by other organisms.

Saprotrophic fungi come in an enormous variety of colours and shapes.

Mycena species are small, delicate gilled fungi with bell-shaped or conical caps. They grow on wood and leaf litter in all forest types but are particularly abundant in wet habitats.

In contrast, the boletes (some of which are mycorrhizal) are usually robust and often brightly coloured. Their fertile (spore bearing) surface is not a series of gills, but is composed of a mass of minute tubes.



One of the most bizarre saprotrophic fungi is the anemone stinkhorn (*Aseroe rubra*). It resembles an egg when it first appears. As it grows red 'arms' covered in a brown, slimy, foul-smelling spore mass radiate from the stem. The putrid odour attracts flies that become covered with spores as they feed. The spores are dispersed by the flies when they move on.

'In our way the natives showed me a dead tree where there was native bread [Laccocephalum mylittae] growing; I saw no signs myself; they smelt the wood and said the plant was a long way in the ground ... Came to a dead tree and the native women went to look for bread fruit: if they pass where this plant is they find it out by smelling it.' (GAR 26 October 1831, headwaters Prosser River)

'Various are the fungus that the natives eat, and all are known to them by different qualities which they possess, and all are known by different names.' (GAR 2 July 1831, Cape Portland)

Mycorrhizal fungi have a two way symbiotic (mutually beneficial) relationship with living plants. Fossils from Aberdeenshire in northern Scotland provide evidence that fungus-plant interactions date back at least to the early Devonian. (Some researchers put their origin as early as 600 million years ago.) It is believed that when plants first colonised the land about 400 million years ago they had two options: they could either develop their own extensive fine root systems or they could enter into a relationship with fungi and thereby increase their ability to obtain nutrients and water from the soil via the fungal hyphae.



Cortinarius sp.

Members of the saltbush family (Chenopodiaceae), cabbage family (Brassicaceae), sedges (Cyperaceae and Restionaceae) and rushes (Juncaceae) opted for the first strategy and rarely form associations with fungi. However, the vast majority–approximately 80 to 90% of plants–including ferns, liverworts, club mosses and most families of vascular plants form symbiotic partnerships with fungi.

The transfer of nutrients between fungi and plants takes place in modified roots. Fungi get carbon compounds and probably also amino acids and vitamins from plants. They are also provided with a habitat that is relatively free from other soil microorganisms. Plants are supplied with water, phosphorus, calcium, potassium and nitrogen via the fungal hyphae. These associations are particularly important in Australia's nutrient deficient soils and they help to protect plant communities against environmental stresses such as disease and drought.

Many of the mycorrhizal fungi belong to families that produce large fruiting bodies including *Russula*, *Cortinarius* and *Amanita* species.

'When in the company of the aborigines on their hunting excursion I observed them knock off the fungus from the gum tree, which they eat. I requested a piece; it is a vegetable substance, has the appearance of wood and is of a sweet flavour, not unlike mushroom ... There is another sort of fungus belonging to the same tree but which they do not eat ... There is also another sort of fungus belonging to the sheoak tree resembling sponge, of which they also eat.'

(GAR 30 May 1829, Bruny Island)



Australian honey fungus (*Armillaria luteobubalina*)

Parasitic fungi get their nutrients from living plants or animals without necessarily adversely affecting their host. For example, the beech orange (*Cytarria gunnii*) which causes galls to grow on the twigs, limbs or trunks of myrtle beech, sometimes disfigures but never kills the trees.

In contrast, some parasitic fungi, such as the native honey fungus (*Armillaria luteobubalina*), a common forest species, can become pathogenic and cause harm and death to its host. Healthy ecosystems are able to withstand invasion by parasitic fungi but they can wreak havoc in habitats under stress.

The scientific study of fungi in Australia has not kept pace with the study of plants and animals. Tens of thousands of species remain unnamed and the distribution and frequency of occurrence of even the common species has remained unknown until recently. Some fungi are widespread and are found in both Tasmania's wet forests and the dry eucalypt woodlands of Western Australia. Other species are restricted to certain habitats or are found in association with particular plants. For instance, there are several species that grow only with myrtle beech, making Tasmania's cool temperate rainforests, including those on the Great Western Tiers, crucial for their survival.

Fungal diversity is considerably reduced in altered environments such as cleared farmland, eucalypt plantations and where chemical fertilisers and pesticides are used.

'Despite popular belief to the contrary, there is only one practical way of distinguishing between edible and poisonous toadstools. The experimental method is sure, but the result may not profit a man.'

(John Ramsbottom,
Poisonous Fungi
in Money 2002)



strawberry bracket fungus (*Aurantioporus pulcherrimus*)



steel-blue rozites (*Cortinarius metallicus*)

Some fungal species have a Gondwanan distribution reflecting Australia's past connection to other southern hemisphere countries. Many of these Gondwanan fungi are found in the forests of the Great Western Tiers.

The bright red strawberry bracket fungus (*Aurantioporus pulcherrimus*) grows on the trunks of myrtle beech in Tasmania. It also occurs in New Zealand and southern Brazil. Interestingly, it is also found on *Eucalyptus pauciflora* in alpine areas on the Australian mainland.

A group of *Cortinarius* sp. (formerly known as *Rozites*) have a distinct ring or annulus on their stem. They are believed to have co-evolved with Gondwanan plants such as myrtle beech.

The tiny bright blue fungus known as pixie's parasols (*Mycena interrupta*) grows on sodden wood in south-east Australia, New Zealand and Chile.

Mycena austrororida, with its distinctive glutinous stipe, has been recorded from New Zealand, Argentina and Chile.

Forest cup (*Plectania campylospora*) is found in New Zealand and southern Asia including Sri Lanka.

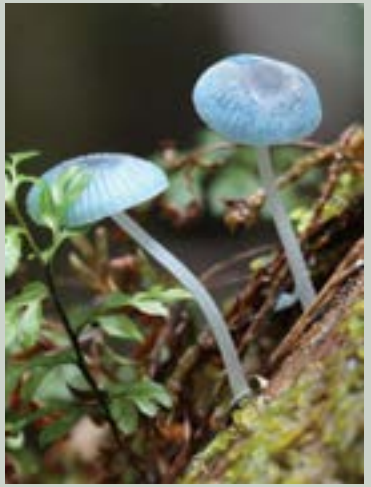
The beech orange (*Cytarria gunnii*), has spherical fruits resembling orange golf balls that appear on galls of myrtle beech in spring and summer. Other *Nothofagus* species in northern Australia, New Zealand and South America have associated *Cytarria* species.



forest cup (*Plectania campylospora*)



beech orange (*Cytarria gunnii*)



pixie's parasols (*Mycena interrupta*)



Austral dripping bonnet (*M. austrororida*)

TRUFFLES AND SMALL MARSUPIALS

It is estimated that Australia has over one thousand species of mycorrhizal truffle-like (i.e. underground fruiting) fungi. They are particularly abundant in eucalypt forests where they form an important year round nutritional food source for potoroos, bettongs and bandicoots. In winter when conditions are cool and moist the animals are more often found digging for truffles in open forests. During summer when conditions are warm and dry they move to riparian areas or shaded gullies. Their movement between habitats may mirror the occurrence of truffles during different seasons.



southern brown bandicoot

The animals are attracted to the strong odours of the mycorrhizal truffles. They dig up and eat the fungi and void the indigestible spores often far from the host plant. Thus, there is a three way association between marsupials, truffles and host plants.

When digging for truffles (and other foods including invertebrates and roots) the small animals mix organic material in the upper soil layer with the lower mineral layer. This improves the soil's overall health and its ability to retain moisture. The small depressions in the soil that result from the animals' scratching are nutrient-rich germination sites.

'A most fortunate circumstance happened to me this afternoon: having requested one of the natives to put me some fungus in a box for the purpose of getting a light when in the bush, I put it in my knapsack. It, however, was on fire and in the course of the day two hours afterwards having occasion to go to my tent, I perceived clouds of smoke issuing from my knapsack, in which I had two pounds of gunpowder. Many things in the knapsack was burnt, but fortunately the gunpowder did not ignite. For this I am truly thankful. Had I been travelling and the pack ignited, the consequence must have been fatal.' (GAR 24 June 1834, Boobyalla River)

FUNGI AND INVERTEBRATES

Fungi provide sustenance for a range of invertebrates including snails, mites, gnats, collembola, beetles, moths and nematodes. Some are generalists that feed on any of the fungal parts; others are specialists that feed on just the hyphae or spores.

Sun flies (*Tapeigaster* species) are large flies and one of the more conspicuous invertebrates associated with fungi. During late summer after rain has stimulated the appearance of fungal fruits, territorial males sit on top of the fungi while the females lay their eggs in the gills or pores beneath.

Fungi provide a food source for the developing grubs of many log-inhabiting invertebrates, especially weevils (Family Curculionidae). The adult beetles bore into dead or dying trees and deposit eggs inside the tunnels. Before laying eggs, the tunnel walls are inoculated with mycelium and fungal spores that are carried in a special body cavity called a mycetangium. Fungi soon cover the walls of the tunnel and the exuded yeast (called ambrosia) provide food for the beetle larvae.



sun fly (*Tapeigaster brunneifrons*)



Stenocarpha hamiltoni on bolete



Left: The fly *Diplogeomyza hardyi tasmanica* (Heleomyzidae) on anemone stinkhorn (*Aseroe rubra*) is an endemic subspecies restricted to Tasmania's wet forests. It is mainly seen in the winter months which suggests it is very tolerant of cold weather.

The biology of this fly has not been studied but based on the biology of other closely related heleomyzid flies such as *Tapeigaster brunneifrons* (above left), it probably breeds in fungi.

In recent decades several fungal species have been implicated in the worldwide decline and extinction of many frog species and in the skin ulcerations found in Tasmanian platypus.

The fungus responsible for frog declines is a member of the usually innocuous group of fungi known as chytrid fungi (*Chytridiomycota*).

There are approximately one thousand species of chytrid fungi. They are ubiquitous in aquatic and terrestrial ecosystems where they are mostly saprotrophic and live on plant and animal remains.

The fungus affecting frogs, *Batrachochytrium dendrobatidis* or *Bd*, has been present in Australia since about 1978 and was confirmed in Tasmania in 2006. It was found in frogs inhabiting a small lake on Mother Cummings Peak.

Some frog species seem to harbour the disease but remain unaffected but it causes the decline of other species.

Bd is thought to have originated in an African frog species that was widely used in laboratory experiments and was a favourite with the pet trade.

'Based on this study toad [and frog] disappearance seems to be caused by the following chain of events: global warming, decreased rainfall at high elevations, UV-B damage (perhaps intensified by ozone thinning), and finally, fungal infection. These types of complicated interactions between climate change and animal health offer a much more compelling explanation for the epidemic of amphibian disappearance than any single factor.' (Money 2002)

The fungus *Mucor amphibiorum* is causing ulcerations in Tasmanian platypus but not in animals on the Australian mainland. Affected platypus develop ulcers on their bodies that result in a loss of body fluids, secondary infections and an inability to control their body temperature. The disease was first recorded in the Elizabeth River at Campbell Town in 1982. By 1991 more infected animals were found in the South Esk and Meander Rivers and in Brumbys Creek at Cressy.



Platypus (*Ornithorhynchus anatinus*)

Surveys in 2001 indicated that the disease is centered around the Meander River. It has also been found in the Liffey catchment. Both rivers flow off the Great Western Tiers.

The waterways most affected are surrounded by land that has been substantially altered by clearing and farming.



southern banjo frog

Seven of the eleven species of frog that occur in Tasmania are found in the Great Western Tiers. Some, such as the brown tree frog (*Litoria ewingi*) are common throughout the Tiers, while other species occur in the grassy woodlands at the base of the escarpment. There are representatives from two families: the Hylidae (tree frogs) and the Myobatrachidae (marsh frogs and froglets).

Amphibians (Gk *amphi* = both; *bios* = lives) typically have an aquatic stage where tadpoles develop from eggs laid in water where they eat algae and other aquatic vegetation. This is followed by the terrestrial stage of adult frogs that are carnivorous and eat just about any moving animal that is smaller than itself.

There are two species in the Tiers that do not have this typical pattern. The Tasmanian smooth froglet (*Geocrinia laevis*) and southern toadlet (*Pseudophryne semimarmorata*) are autumn breeding frogs that lay their eggs on land subject to inundation. Once the eggs are flooded the tadpoles hatch and start their life in water.

Most frogs (apart from one species that lives in South America) don't drink. Instead they are unique among vertebrate animals in having a permeable skin through which they absorb and lose water. This makes them particularly susceptible to desiccation and as a result smooth skin frogs rarely venture far from water. Warty skinned frogs, whose granular skin has a larger surface area and therefore a larger area through which water can be absorbed, can live away from water.

Most frogs are quite cryptic and are detected by their distinctive calls. The bleating sounds reminiscent of a lost lamb heard on the central plateau and at lower altitudes are emitted by the small endemic Tasmanian froglet (*Crinia tasmaniensis*).

The banjo frog or 'pobblebonk', the only specialised burrower in Tasmania, occurs in the agricultural areas and towns at the base of the Tiers and is often found by residents while digging their gardens. As soon as the weather warms in spring, banjo frogs gather at dams and other large water bodies. Each male frog sings a one note 'bonk' to which the other males respond. The silent females are presumably attracted to the male with the best 'bonk'.

The spectacular green and gold frog (*Litoria raniformis*) occurs in some of the towns at the base of the Tiers such as Westbury, Deloraine and Caveside. This species has declined in recent years. Its future is largely dependent on the retention of vegetated swamps and dams and the health of the waterways that drain off the Great Western Tiers.



green and gold frog

Unlike birds that are vocal, highly visible and active during the day, most of Tasmania's terrestrial mammals are silent and nocturnal. Although this makes it difficult to assess the health and size of their populations, there is little doubt that the extensive forested escarpment of the Great Western Tiers is extremely important for their long-term survival. This is especially the case for Eastern Quoll, Eastern Barred Bandicoot, Southern Bettong and Tasmanian Pademelon that were once widespread but have declined or been extirpated from the Australian mainland.

There are several factors leading to the loss of species on the mainland. Since European settlement the animals have lost their habitats through broad scale clearing or modification and fragmentation of the original vegetation. And they have succumbed to predation by introduced species, especially cats and foxes.

Habitat modification, introduced predators and, more recently, the devil facial tumour disease, are having an impact on the viability of populations of Tasmanian mammals.

Spotted-tailed and Eastern Quolls are carnivorous marsupials. Spotted-tailed Quolls are solitary animals that roam over an extensive home range, especially in wet forests and rainforest. They hunt for birds, reptiles, mammals and insects.

The rat-like Swamp and Dusky Antechinus feed on lizards, spiders and other invertebrates. Live animals are rarely seen but adult males that die from stress after their annual mating frenzy are sometimes found where suitable habitat of dense vegetation persists.

Tasmanian Devil is Endangered (TSPA 1995 & EPBC 1999)
The Spotted-tailed Quoll is Rare (TSPA 1995) & Vulnerable (EPBC 1999)



Richard Cooper

Tasmanian devil 'captured' on night vision camera at Jackeys Marsh

'The devil … is very properly named, if it is meant as a designation for the most forbidding and ugly of the animal creation. It is as great a destroyer of young lambs as the hyena, and, generally speaking, is as large as a middle sized dog. The head resembles that of an otter in shape, but it is out of proportion to the rest of the body; the mouth is furnished with three rows of double teeth … it is generally found in the clefts of rocks continuous to the mountains, or on stony hills … the head appears to be full of scabs, as though the animal was diseased …'
(Bischoff 1832)

'We saw several large stringy bark trees which the natives had ascended to search for possums. One tree was at least ninety feet in altitude and large in circumference and notches had been made in the tree at the distance of about four feet from each other. They make these notches by bruising the bark with a stone. A rope made from the long wiry grass is put around the tree, by which means they pull themselves up, shifting it in proportion as they ascend.'
(GAR 3 September 1830, Hampshire Hills)



Short-beaked Echidnas forage during the day for insect larvae, beetles, ants and worms. They have feet modified for digging, strong muscular shoulders and a powerful beak. They use specialized nerve endings at the tip of their snout to detect minute electrical currents produced by their moving prey.

The three extant Monotremes (the other two are the platypus and the Long-beaked echidna of Papua New Guinea) are egg laying mammals that suckle their young. Their ancestry can be traced to the early Cretaceous.



Bennetts wallaby



'The native cat ... infests the hen roosts, and is a great destroyer of all kinds of poultry. They are found in hollow trees and under dead timber …' (Bischoff 1832)



northern snow skink (*Niveoscincus greeni*)

Nine of the eighteen lizard species and all three snake species that occur in Tasmania live in the forests of the Great Western Tiers or the rocky terrain of the Central Plateau.

Tasmania's climate is not favourable for animals that function best in warmer regions. But its reptiles are well adapted to the cool conditions. The seven species of snow skinks (*Niveoscincus* species), six of which are endemic, are an interesting group of medium-sized reptiles that have specialised to inhabit slightly different niches.

The endemic northern snow skink (*Niveoscincus greeni*) is one of three endemic skinks that live in Tasmania's alpine and sub-alpine areas where it inhabits the rocky outcrops. At well visited sites such as at Pine Lake it becomes so accustomed to a constant stream of people passing on the boardwalk that it allows visitors to observe its remarkable agility as it negotiates the vertical and overhanging faces of the dolerite boulders. In areas where northern snow skinks co-occur with southern snow skinks (*N. microlepidotus*), the northern species occupies the boulder fields while its southern cousin keeps to areas of heath.

Northern snow skinks feed mostly on invertebrates including grasshoppers, flies, beetles and winged bullants. Like the other alpine skinks (the third is the mountain skink *N. orocryptus*, a relatively newly described species from several mountains in the southwest) it also take plant material: it has been observed eating the berries of mountain plumpine (*Podocarpus lawrencei*) and to take nectar from the flowers of scoparia (*Richea scoparia*).



Richea species (Family Epacridaceae) have an unusual adaptation to Tasmania's alpine conditions. Their corollas are ovoid or conical in shape and the lobes do not open like normal petals but form an operculum, a lid-like structure that encloses the reproductive parts of the plant.

The operculum provides protection from the cold, but it prevents entry to the stamens by pollinating insects. However, the opercula, especially the mature dark-coloured ones, are full of deliciously sweet nectar. Various animals including the endemic Black Currawong and southern snow skink, have been observed removing the opercula to obtain the nectar, thus exposing pollen-bearing stamens to pollinators.



mountain dragon (*Rankinia diemensis*)



metallic skink (*Niveoscincus metallicus*)

The metallic skink (*N. metallicus*) is widespread throughout Tasmania. It is extremely variable. Some are a uniform colour, some are speckled and the animals found in the south of the island are heavily striped. Metallic skinks seldom climb and so are almost always encountered on the ground. The endemic tree skink (*N. pretiosus*) is very similar in appearance to the metallic skink. It too is found throughout Tasmania but it is an arboreal species and most likely to be seen basking on logs or climbing tree trunks. The ocellated skink (*N. ocellatus*) is grey or grey brown with a pattern of dark wavy lines. It is always found in rocky habitats.

The largest skinks in Tasmania are the cryptic and rarely seen endemic casuarina skink (*Cyclodomorphus casuarinae*) and the familiar and widespread blotched bluetongue (*Tiliqua nigrolutea*).

The casuarina skink tends to keep to areas with a dense cover of vegetation. When threatened it will adopt a snake-like pose by pressing its feet against its body and flicking its tongue with mouth agape. Adult casuarina skinks can reach 150mm in length and like the other skinks they are very variable in colour, ranging from plain grey to rich bronze.

All terrestrial reptiles are ectotherms (Gk *ectos* = outside; *therme* = heat). They regulate their temperature by basking in the sun or seeking shady areas and perform most efficiently when their body temperature is between 25° and 35°C. In contrast, endothermic animals (Gk *endon* = within) such as mammals and birds are less dependent on ambient temperatures. Instead they use the heat energy derived from the 'burning' (or digestion) of their food and regulate their body temperature by metabolic processes such as dilation and contraction of blood vessels, sweating, panting or shivering.

Endothermic animals can be active on days too cold for ectotherms. However, they require a large intake of energy and must eat every day. In contrast, ectothermic reptiles need only about 10% of the food ingested by a similar sized bird or mammal. Snakes, for example, need to eat only once every few weeks.



ocellated skink (*N. ocellatus*)



casuarina skink (*Cyclodomorphus casuarinae*)



blotched bluetongue (*Tiliqua nigrolutea*)

THE HIGH PLATEAU



Laurie Goldsworthy

Pencil pines, high plateau

Western Bluff, Nells Bluff, Mother Cummings Peak, Projection Bluff, Liffey Bluff, Drys Bluff, Billopp Bluff and Millers Bluff are among the conspicuous landmarks that form the northern edge of the central highlands. They, along with other bluffs and Ironstone Mountain which sits south of the edge and is not visible from the northern plain, constitute the high plateau.



bluebell (*Wahlenbergia* sp.)

On the treeless plains the low growing plants form a colourful patchwork of slow-growing evergreen shrubs interspersed with rushes, herbs, grasses and orchids. Colourful lilies, everlasting daisies and perennial herbs must flower and set seed in the limited growing season of just a few months.



sky lily (*Herpolirion novae-zelandiae*)

CLIMATE AND VEGETATION

The island of Tasmania, at latitude 40°-43° south, lies at the northern edge of the southern wind system known as the 'Roaring Forties'. It has a mild maritime climate without the continental influences and seasonal extremes experienced by countries at similar latitudes in the northern hemisphere. Low and high pressure systems cross the island driven by moisture laden westerly winds. This results in the weather alternating between wet, wild and windy and dry, still and cloudless. There is a strong precipitation gradient from west to east with the eastern parts of the island receiving approximately one third of the rain that falls in the west. The west and south west of the island bear the brunt of the weather systems but the central plateau also experiences much buffeting and precipitation. Rain, snow, sleet and frequent mists and fogs are more common in the winter months but rarely does a summer pass without at least a smattering of snow in the highlands.

The central plateau is not only cold, wet and windswept but its atmosphere is thinner and sunlight more intense than at lower altitudes. This does not necessarily warm the thin air, but it can raise the temperature at ground level, especially in areas with rocky terrain. The plants and animals of alpine and sub-alpine habitats have evolved to cope with these harsh climatic conditions.

Some of the richest plant communities in Tasmania occur at high altitudes. Approximately half the species in these alpine and sub-alpine regions are endemic. The remaining species belong to genera that occur throughout the southern temperate regions or to genera with a cosmopolitan distribution.

The snow peppermint (*E. coccifera*) is the dominant tree in the sub-alpine woodlands on rocky sites. It grows alongside other high altitude endemics including the cider gum (*E. gunnii*) and alpine cider gum (*E. archeri*).





carpet frillyheath (*Pentacondra pumila*)



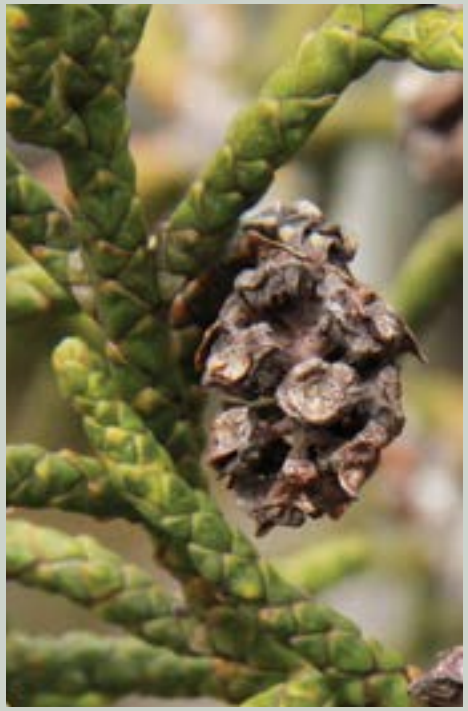
spreading cheeseberry (*Cyathodes straminea*)

Most of the shrubs that grow in the highlands have small, hard, thick leathery leaves and some have ground-hugging wind pruned forms. Many have both fruits and flower buds concurrently; the buds form during one growing season and are ready to burst into flower as soon as the weather warms the following spring.

Left: spider with insect in snowgentian (*Gentianella* sp.)

'… but what interested me most were the numerous cider trees which skirted this extensive plain and which were the first I had seen. Most of these trees had been tapped by the natives. This they had effected by perforating a hole in the tree a short distance above the ground by means of sharp stones and then making a hole at the bottom of the tree into which the liquid is conveyed and from which they extract it, sometimes if the hole is small by sucking it through a reed or twisted bark. In some of those holes I noticed upwards of a quart of this juice … It is exceedingly sweet and well flavoured and in this respect resembles the flavour of cider. Some that has been dried in the sun has an apple taste. The tree in appearance resembles the blue gum, but the leaf when closely inspected has a different form and the bark is more of a dark blue colour. The tree grows to a large size; the wood appears brittle.'

(GAR 28 November 1831, north of Lake Echo)



pencil pine (*Athrotaxis cupressoides*)



scaly everlasting (*Ozothamnus hookeri*)

Gnarled old pencil pines (*Athrotaxis cupressoides*), some believed to be over one thousand years old, grow on the central plateau at Lake Mackenzie and Pine Lake. They also grow in deep fire-protected gorges on the escarpment of the Tiers. Their tiny scale-like leaves pressed close to their branchlets help to reduce heat and moisture loss making them the most frost resistant woody plant in Australia. Interestingly, the scaly everlasting (*Ozothamnus hookeri*) has evolved a similar strategy for surviving the harsh conditions. It too has scale-like leaves but it also has a dense covering of hairs that may act as a screen against the intense ultra-violet light of the high country.

The pencil pine is a descendent of the primitive Gymnosperms (Gk *gymnos* = naked; *sperma* = seeds) that were abundant during the Jurassic Period.

Tasmania has seven species of Gymnosperms, six of which are endemic. The two pine species that occur in the Great Western Tiers, the pencil pine and king billy pine (*A. selaginoides*), were once placed in the Taxodiaceae family whose members are confined to the northern hemisphere and include those giants of the pacific coast of the USA, the coast redwood (*Sequoia sempervirens*). They have recently been moved to the Cupressaceae family.

'Proceeded over some stony and rocky hills for about three quarters of a mile and then came to a large marsh. Here was abundance of kangaroo, boomer etc. This marsh led to another of large extent. On the borders of this marsh the mellifluent cider tree had planted itself in the foreground in front of the forest. Those trees have invariably selected exposed and bleak situations on the borders of open plains, and are seldom met with in the interstices of the forest. I have met with them in the highest mountains. The melliferous property of this tree subjects it not only to the attack of the natives who have made incisions in the tree and dug holes at the bottom for the liquid to drain into, but likewise to the cockatoo and other animals who have attacked it and tore holes in the bark. Ants are also seen in swarms feeding on the honey.'

(GAR 4 December 1831, south of Great Lake)

Two endemic cider gums occur on the central plateau: the cider gum (*Eucalyptus gunnii*) and the alpine cider gum (*E. archeri*). They get their name from the sweet sap that oozes from their trunks and ferments when it comes in contact with natural yeasts in the air. In good years, when there are copious flows, the sap is sought after by birds, insects and marsupials. It was highly prized by Aboriginal people as evidenced by the numerous trees on Projection Bluff that were tapped for their seasonal bounty.

The cider gums are a tricky group of eucalypts with an array of genetic and morphological variations so small that only a handful of dedicated specialists and enthusiasts can tell one sub-species from the next.

The most extreme form of the tree, the Miena cider gum (*E. gunnii* subsp. *divaricata*), is one of Tasmania's rarest plants. It survives in a niche few other plants can tolerate: the frost hollows on the swampy margins of the highland dolerite plains. One of the remaining populations grows on private land at Shannon Lagoon just east of Miena.

In the early 1980s much of the population of the Miena Cider Gum was alive and thriving; three decades later most of the mature trees are dead. The reasons for the drastic decline are probably many and varied. The Miena Cider gum can survive extremely cold conditions and it tolerates the wet. But the prolonged drought of the last two decades of the 20th century coincides with its demise. As well as the drought there was a concurrent 1.5°C rise in temperature that may have tipped the balance for a plant already on the edge.

Because the Miena cider gum is so closely related to other endemic eucalypts on the plateau, it readily interbreeds. The remaining populations are small and fragmented and unlikely to be pollinated efficiently. The several scattered populations of stunted dying seedlings under the grey gnarled skeletal remains of the parent trees suggest that inbreeding is already taking its toll.

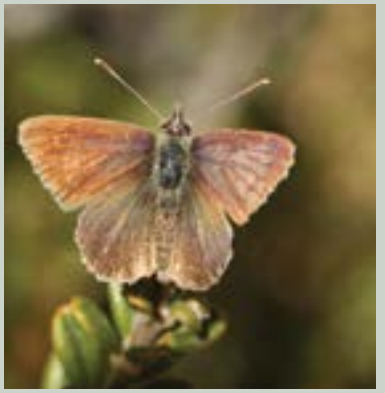
The alpine cider gum (*E. archeri*) is endemic to the northeast mountains and the high rainfall northern end of the Great Lake on the high plateau. This small tree grows in poorly-drained, shallow peaty soils of rocky outcrops or scree slopes below dolerite escarpments at eleven hundred to twelve hundred metres above sea level.

The changing climate is expected to lead to the decline and extinction of species already existing at the edge of their range. Conversely, adaptable species are able to thrive in a variety of different habitats and to cope with subtle and not so subtle changes to the landscape.

Miena cider gum: Endangered (TSPA 1995 & EPBC 1999)

'Came to a river which had its source in the mountains and ran into Lake Arthur … the natives went away to hunt and returned with six kangaroo. Said the kangaroo was as numerous as sheep. The cider tree grew along the banks of this river and the melliferous substance was oozing out of the trees at our encampment.'

(GAR 13 December 1831, Tumbledown Creek)





mountain blue (*Neolucia hobartensis*)

In stark contrast to the extreme habitat preference, shrinking gene pool and fast disappearance of the Miena cider gum, the mountain blue butterfly thrives in the same inhospitable environment.

This small butterfly with a 16mm wingspan is reputed to be the most alpine adapted butterfly in Australia. It occurs in alpine heathland and sub-alpine eucalypt woodlands on the Australian mainland. In Tasmania it also occurs at elevations as low as 300 metres.

On warm autumn days it basks in the sun on low vegetation. During days of inclement weather it retreats to sheltered rocky sites or the interior of dense shrubs.

Like most butterfly species the patterns and colours of the upper wings are very different to those on the lower wing surface and they perform different functions.

The upper wings of butterflies are often brightly coloured for sexual signalling and for temperature regulation. The lower wing surface has colours that provide camouflage when the butterfly is at rest. In the case of the mountain blue, the fine patterns match the grey lichens and dead twigs that are a common feature of its habitat.

The common silver xenica is another butterfly species found in the highlands.



common silver xenica
(*Oreixenica lathoniella*)

Conditions on the plateau are challenging for birds. They must time their breeding so that there is an abundance of invertebrate food when they are feeding their developing chicks. But food is only plentiful in the warmer months when the flowering plants attract myriad insects.

Flame Robins breed on the central plateau and in the wet eucalypt forests of the Great Western Tiers. Once breeding has ceased they move to lowland areas where small flocks congregate on cleared farmland at the base of the Tiers such as at Jackeys Marsh and Meander. In winter many move to warmer coastal areas or migrate to the Australian mainland.

In the 1980s the Flame Robin was described as 'the most common robin in Tasmania'. But in the past twenty years their population has experienced a rapid decline and they now qualify as 'Near Threatened' in the International Union for the Conservation of Nature (IUCN) Red List Criteria.

As with most species in decline there are probably several contributing factors. Wildfire and forestry operations create small cleared areas that are favoured as breeding habitat. However, these areas become unsuitable once they regenerate. 'Rough' pastures used to provide ideal foraging sites during winter and the robins would perch conspicuously on thistles and bracken fern before fluttering to the ground to snatch their insect food. Rough pasture has all but disappeared. Much of it has been over grazed, or it has been cultivated, irrigated and planted with crops of poppies or eucalypts. The increased use of pesticides and herbicides contaminates ground-dwelling invertebrate prey. Climate change may also be a factor in their decline.



Flame Robin



One of the most evocative sounds of Tasmania's high country is the trumpeting song of the endemic Black Currawong (left), a bird that is patchily distributed throughout Tasmania, but with a core breeding range that corresponds with the forests of the Great Western Tiers.

The Black Currawong has a varied diet, a factor that may account for its ability to cope year round in conditions too harsh for many other species. Remains of insects, small crustaceans, lizards, carrion, seeds and fruit are frequently encountered in the regurgitated pellets they deposit on tree stumps, logs or the ground.





The Australasian Pipit is a migratory bird that spends summer on the plateau or on cleared farmland at the base of the Tiers.



cushion plants



Tasmanian waxberry
(*Gaultheri tasmanica*)



bolster plantain
(*Plantago gunnii*)



alpine sundew
(*Drosera arcturi*)

Cushion plants (also known as bolster heaths) thrive in poorly-drained, permanently wet sites on the central plateau.

In a remarkable example of convergent evolution (a process whereby different species develop similar characteristics to cope with a similar lifestyle), over three hundred plant species worldwide have evolved a cushion-like growth form to withstand the harsh climatic conditions of sub-alpine, alpine, arctic and subantarctic habitats.

Each cushion plant is a mound of closely packed stems that grow at the same rate. The resulting smooth, rounded form allows a high rate of absorption of solar radiation so that below the green surface of tiny leaves the interior retains a fairly constant temperature. It is also aerodynamically suited to minimise transpiration loss and to ameliorate the damaging effects of ice-laden winds.

Cushion plants are usually composed of several different plant species resulting in a colourful mosaic in various shades of green. On the central plateau *Abrontanella* species (members of the daisy (Asteraceae) family) are often interspersed with the sage-blue cushion plant, *Pterygopappus lawrencei*.

Other plants that don't form cushions including the Tasmanian snow berry (*Gaultheria tasmanica*) and alpine sundew (*Drosera arcturi*) add splashes of colour to the cushions. The small hairy Tasmanian endemic, bolster plantain (*Plantago gunnii*), is an epiphytic species on cushion plants.

Sundews (*Drosera* spp.), like bladderworts (page 49), live in areas with nutrient deficient soils. They are carnivorous plants, but they have a very different method of capturing their prey to other carnivorous species.

The leaves of sundews are covered with glands that glisten with droplets of a sticky sweet secretion.

Insects possibly mistake the shiny droplets for nectar and are attracted to the plants. They adhere to the glue-like substance and the more they struggle the more they are ensnared.

Gradually (usually overnight) the tentacles bend and envelop the insect and an acidic fluid dissolves all but the exoskeleton and wings. Nutrients are absorbed through the leaf and help fuel plant growth.



fly on sundew



southern pyrgomorph (*Monistria concinna*) with mites

Peat bog (also known as sphagnum peatland) dominated by *Sphagnum* species occurs in small pockets at low altitudes such as in Jackeys Marsh and in suitably saturated sinkholes at Mole Creek. Elsewhere in the Tiers there is a significant peat bog on a high bench west of Lobster Rivulet and another above 800 metres on the Cluan Tier. An important example of a rainforest/sphagnum community grows on a sandstone shelf below Mother Cummings Peak. Here myrtle beech, cutting grass (*Gahnia grandis*) and the endemic celerytop pine (*Phyllocladus aspleniifolius*) emerge through mats of *Sphagnum*.

Because *Sphagnum* peatlands grow in waterlogged soils usually at elevated sites, they regulate the release of water from highland areas and control its flow downstream. The peat bogs of the Tiers grow at the headwaters of many of the small creeks and streams that flow into important waterways in northern Tasmania. Therefore, the vulnerability of these highland vegetation communities to changing climatic conditions and other disturbances has implications for the supply of water to a significant part of Tasmania.

In contrast to Australia's peat bogs which occur as isolated fragments mostly in alpine and sub alpine areas, northern hemisphere peatlands occur as vast expanses of permafrost in the high latitudes and cover about 1% of the world's land surface. In the 12 000 years since the last ice-age, about a quarter of all the carbon in the world's soils has been stored in the northern hemisphere permafrost.

Most peatlands in Australia get their water from runoff and grow in moderately fertile soils in permanently wet areas along streams or in other poorly drained places usually above 600 metres. (Peatlands in the northern hemisphere are deficient in minerals because they get most of their water from rain or snow.)

There are numerous similar looking *Sphagnum* species worldwide. The mature plants lack any root-like structures such as the rhizoids found in other moss species. They have large water-storage cells alongside the normal cells in their leaves and they have a stalk with large leafy tufts that hang (and act) like a mop.

Sphagnum mosses can influence their environment by secreting potent growth inhibitors that prevent the germination of the seeds of plants that could potentially shade out the moss. However, in very wet areas *sphagnum* gradually forms hummocks that are suitable germination sites for plants that are unable to cope with waterlogged soils. When these plants grow they eventually shade the *Sphagnum* and the hummocks collapse.

Bacteria and fungi that usually break down organic matter are unable to tolerate the toxic phenols in the cell walls of *Sphagnum* moss or the acidic, oxygen-depleted waterlogged soils where they grow. Consequently as the old plants die they pile up as peat. *Sphagnum* peatlands develop over hundreds–sometimes thousands–of years. Their acidic nature helps to preserve pollen and spores that blow into the water. Thus, peat bogs hold within them clues to past climates and vegetation communities.

Sphagnum bogs are extremely vulnerable to disturbance. Palatable sedges and woody plants growing in the bogs attract cattle and other hard hoofed herbivores whose trampling creates massive breaches in the delicate drainage system. They can take many decades to recover from this or the devastation of wildfires.

In the northern hemisphere peat has long been exploited for its remarkable properties and is used as a fuel and in the nursery industry. In Tasmania there were attempts to mine peat in the mid 1980s but the industry never eventuated.





The fertile structures (sporophytes) of sphagnum moss in these photos are quite different to the sporophytes of other mosses and more closely resemble those of liverworts (see page 32). They are virtually unknown on plants on the Australian mainland and only occasionally occur in Tasmania. They have a different method of dispersing their spores to other bryophytes, a method sometimes described as 'pop-gun dehiscence'.

The capsules of sphagnum mosses sit on top of translucent stems. The capsule is spherical when moist but as it matures and dries its sides pull in and it becomes cylindrical. This change of shape compresses a pocket of air that sits under the spores inside the capsule. It also bends and cracks the outer surface of the capsule thus weakening a seam-like junction around the 'lid'.

By the time the capsules are completely dry their lids are under enormous pressure (up to 5 atmospheres). This causes them to split apart at the seams and eject the spores high into the air.



Utricularia sp.

Bladderworts (*Utricularia* sp.) are carnivorous plants of wet areas. Except for their flower stalks, most of the plant consists of numerous tiny bladders that lie under the soil or water.

Each submerged bladder is closed by an inward-opening hinged door. The door is surrounded by long branched hairs that guide passing animals (e.g. minute water amoebae and insects) to the short trigger hairs. Until a passing animal triggers the trap the bladder walls are concave and compressed because glands that occur on the inside of the bladder expel water to the outside. Once the trap is triggered the bladder walls suddenly spring outwards. This increases the volume inside the bladder and produces a partial vacuum that sucks in water and prey (calculated to take just 27 thousandths of a second). The lid closes and digestion takes place.

Because of its restricted geographic range and the many threats to its long term survival **Alpine Sphagnum bogs and Associated Fens** is listed as an endangered ecological community (EPBC 1999). The same community, called **Sphagnum peatland** in Tasmania, is listed as Rare (TSPA 1995).

THE MOLE CREEK KARST



Dogs Head Hill

The Mole Creek limestone is composed of the remains of primitive life forms (including graptolites, trilobites and nautiloids) that flourished in the warm shallow sea that covered much of the supercontinent, Gondwana, during the Ordovician Period.

Graptolites, trilobites and nautiloids were among the first animals to appear on Earth. Graptolites first appeared in the middle Cambrian but were extinct by the Lower Carboniferous. They were colonially living plankton-like organisms that, like modern day insects, had chitinous exoskeletons. Trilobites, of which there were thousands of species, were beetle-like creatures with features resembling living arthropods. They ranged in size from tiny 0.5mm planktonic forms to species that were nearly one metre long but most were between three and ten centimetres in length. Nautiloids, of which there is still a living species, the paper nautilis, were ancestral Cephalopods related to present day octopus, cuttlefish and squid.

The 1 000 metre thick limestone deposit of the Mole Creek area is composed of these ancient animals cemented together in a matrix of compacted mud and sand. It lies on top of sandstones and conglomerates that also originated during the Ordovician. The rocks folded into a series of synclines and anticlines, probably during the middle Devonian. Following subsequent uplift and erosion, the limestone now outcrops to the surface over an area of approximately 26 km east to west and 10 km north to south. Its full extent is difficult to determine because the eastern edge is partly covered by more recent soil and glacial deposits and the southern edge on the slopes of the Great Western Tiers is covered by marine and freshwater sediments laid down during the Permian and Triassic Periods. These sediments are mostly obscured by huge blocks and scree that have fallen off the Jurassic dolerite of the central plateau.

'Karst' is an internationally used term given to terrain that develops distinctive characteristics because of the solubility of the rocks (e.g. limestone or dolomite) in natural waters. (The term is the German form of the Slavic words 'kras' or 'krs', meaning a bleak waterless place because streams may take underground courses and therefore water is scarce or absent on the surface.) The rate of solubility of karst rocks varies greatly and will depend on factors such as climate, the rate of water flow, the material present in the flowing water, the composition of the limestone and its inherent solubility, the presence or absence of soil cover and the type and amount of vegetation cover.

The Mole Creek karst has an ambience typical of old or well-developed karst landscapes. Unlike much of Tasmania where creeks, streams and small rivers criss-cross the landscape, there is little surface water. Instead waterways rush underground through passages and caves gouged out over millennia by glacial meltwater laden with tonnes of rocks, gravel and silt.

The interplay between surface and subterranean can be complex and seasonally variable. It may best be appreciated by following the passage of watercourses such as Marakoopa and Gillam Creeks that rise on the escarpment of the Tiers north of Western Bluff. They flow on the surface for part of their journey until they reach the limestone 'contact' and disappear from view. A row of sinkholes (also called dolines) that can mark the presence of underground streams, suggests that they run north then east to join Sassafras Creek which flows around the eastern end of Standard Hill before joining the Mersey River.

The combined waters of Marakoopa basin, a large enclosed depression (polje), normally drain east underground to join Sassafras Creek. Occasionally, during periods of exceptionally prolonged heavy rain, the capacity of the underground conduits is exceeded. Consequently, Overflow Creek cascades temporarily through a spectacular ravine called Sensation Gorge that was cut through Standard Tier during glacial times.

Between Standard Hill and the Mersey River is Dogs Head Hill, a classic residual karst feature of national significance. Dogs Head Hill is a hum, a conical hill that remains after the erosion of the surrounding landscape. It is believed to be the only hum in Australia as they most often develop in the wet tropics.

Looking west from Mole Creek the distant cone-shaped hill is clearly visible. But its fascinating features can be seen only during a closer inspection. Unlike most hills that rise from surrounding ground, there is a moat-like approach to Dogs Head Hill caused by the subsidence. Where the creeks that flow from Standard Hill skirt the western side of the hum there is a group of ponors, deep water filled dolines connected to the karst aquifer. On the eastern end there is a small stream or a gushing torrent (depending on how much rain there's been) that disappears under the hill. On the southern side in the windgap between Dogs Head Hill and Standard Hill there is a series of small and large dry or water filled sinkholes.

Over four hundred and seventy cave entrances, as well as dolines (sinkholes) and other features including twelve distinct underground drainage subsystems, have so far been documented in the Mole Creek karst. Many caves have stunning formations. Two are publicly accessible: the spectacular Marakoopa Cave (from the aboriginal word meaning 'handsome') has active streams while the smaller King Solomon's Cave, though equally beautiful, is no longer hydrologically active. Most of the caves, many named to honour kings and rulers of ancient times such as Croesus, Kubla Khan and Genghis Khan, are not normally available to the public to protect formations and fauna of world significance.

The Mole Creek caves feature spectacular deposits known collectively as speleothems. These develop when seepage water that is acidified by passing through soil, dissolves the calcium carbonate in the limestone and redeposits it in the caves in forms such as stalactites, stalagmites, helictites, shawls, rim pools, cave corals and crystalline floors of flowstone. The well-known stalactites and stalagmites are secondary mineral deposits of calcite that are formed at a rate of about 30 to 50 mm per 1000 years by slowly dripping mineral-saturated seepage water. They are cylindrical or conical in shape and range in size from delicate straws to massive structures. Speleothems can be translucent, opaque or richly coloured in earthy shades of red, orange or yellow. Their colour depends on the amount and type of minerals and impurities in the bedrock and organic contributions such as lignins and tannins from the vegetation above.

Speleothems, particularly stalagmites that build up on cave floors from rainwater dripping from the ceiling, are like barometers of past climatic events; they have embedded within them a record of mean temperature, surface vegetation and climatic variations such as the termination of periods of glaciation. A stalagmite just 23 cm long can potentially give a continuous record of the changing climate over 800 000 years using oxygen isotope and other analyses. Climatic information can be gleaned from Antarctic ice cores, but ice cores are much more difficult and expensive to obtain and they must be several kilometres long to yield equivalent information. Speleothems have other advantages: Antarctica ice cores or marine sediments are difficult to date past about 40 000 years which is the limit of radio carbon dating.

Some speleothems have a greenish hue. At Dogs Head Hill there have been relatively recent discoveries of phytospeleothems, structures that have not been documented previously from temperate Australia. They are intriguing formations, a combination of a mineral (calcite) and living mosses that can form only in places such as cave entrances or under 'skylights' where enough light penetrates for the mosses to photosynthesize. The unusual combination of organic and inorganic causes the structures to have erratic forms. Gravity usually controls the growth orientation of speleothems but in the case of the phytospeleothems it is the moss that controls the growth as it must orient itself to the light source so it can photosynthesize.





Deb Hunter

Croesus Cave

Spiders, mites, millipedes, pseudoscorpions, beetles, springtails, flatworms and a host of other invertebrates, numbering about 150 species, live in the caves. But the caves are not crawling with wildlife and no species is abundant, especially compared to animal densities on the surface. Some cave animals are relict species, (i.e. species that were once widely distributed but now occur very locally) and endemic to very small geographic areas. Many have evolved in isolated cave systems while their closely-related surface dwelling counterparts became locally extinct or migrated to areas with more favourable conditions. Most cave animals have adapted to occupy specialised niches: some inhabit the nooks and crannies near the cave entrances and occasionally venture outside; others dwell deep underground where total darkness prevails. There are three categories of cave animals.

Troglobites are totally dependent on cave environments and are unable to live outside. They include several species of cave harvestmen (*Hickmanoxyomma* spp.) and several species of cave beetles in the family Carabidae.

Trogloxenes spend part of their lives in caves and venture outside to fulfil some of their living requirements. Cave crickets (*Micropanthus* spp.), for example, leave the caves during favourable weather to feed on mosses or dead and injured invertebrates.

Troglophiles spend all their lives underground, but not necessarily in caves. The endemic Tasmanian cave spider (*Hickmannia troglodytes*), the largest spider in Tasmania, can dwell in other cool, dark, damp, sheltered places (e.g. railway tunnels, hollow logs, hollow stumps and under buildings) provided there is enough space for them to construct their large horizontal sheet webs that can be up to one metre across.

Mole Creek Cave Pseudoscorpion - Rare (TSPA 1995)

Tasmanian cave spiders begin their reproductive cycle in late winter to early spring. Courting and mating are highly ritualised and can last for over five hours. Courting starts with much leg beating after which the male, to ensure his own safety, grasps and immobilises his mate using a specialized curve on his second leg which matches the cheliceral (fang) region of the female. Mating is followed by construction of egg-sacs.

The egg-sacs of Tasmanian cave spiders have two layers, a rigid inner layer that encases the egg mass and an outer layer of silk. This two walled arrangement may perform a similar function to double glazing, insulating the eggs and young from fluctuations in temperature and humidity.

Tasmanian cave spiderlings don't emerge from the egg-sacs until eight to ten months after the eggs are laid. This contrasts with most spiders that have incubation periods of four to eight weeks. The extended period spent in conditions that are not conducive to incubation may be the reason for the unusual architecture of the egg-sac and the suspected anti-fungal and antibacterial properties of the silk.



Lesley Nicklason



Danilo Harms

Pseudoscorpions, or 'false scorpions' are named because their large pincers give them a superficial resemblance to true scorpions to which they are only distantly related.

The Mole Creek Cave Pseudoscorpion (*Pseudotyrannochthonius typhlus*) belongs to a large family (Chthoniidae) of cosmopolitan species. Like many cave dwellers it has evolved characteristics as a result of their cave-dwelling existence: their body has no colour, their eyes are reduced or absent and their legs are long and spindly.

Pseudotyrannochthonius is a relict genus that originated in Gondwana. There are ten known Australian species of which six are cave dwellers. Two species are found in Tasmania: one at Hastings Cave in the south and the other in the Mole Creek Caves. The species is not abundant and so far only twelve animals have been found in just ten caves.



Mountain shrimp (*Anaspides tasmaniae*) live in alpine pools and underground streams where they feed mainly on detritus. They are very variable in colour, the alpine animals are usually much darker than their unpigmented cave dwelling counterparts.

Mountain shrimps are believed to be the ancestors of modern crustaceans such as yabbies and shrimps. Fossils of almost identical animals have been found in Triassic sediments.



Glow-worms (*Arachnocampa tasmaniensis*) are probably the best known cave dwellers although they too are able to live in other dark places such as rainforest gullies or railway cuttings.

Glow worms are maggots, i.e. the larval stage of a fly. When seen in the light the animals are unspectacular but in the darkness of their dwelling places their remarkable displays, a result of their bioluminescent rear ends, are seen to best effect.

Although many insects are able to produce silk, glow worms are among the very few species that use it to capture prey. This prey-capturing strategy is similar to that of spiders and is reflected in their genus name *Arachnocampa* (Gk: *arakhne* = spider).

Glow worms drop lines of mucus-studded silken threads from their tubular dwelling places that are also made of silk and mucus. Their glowing bodies attract their food, tiny insects, to their silken snares. These insects include flies, caddisflies, mayflies, moths and stoneflies that have either flown into the cave or have metamorphosed from larvae washed in by the underground streams.

Adult glow-worms are even less spectacular than their luminous young. They closely resemble fungus gnats and their only function is to mate after which they soon die.



Biological oases such as those in the dolines (sinkholes) near Dogs Head Hill occur across the karst. Thus, within the dry sclerophyll forests, these wet karst features provide protection from fire and desiccation to ferns, bryophytes and pockets of rainforest. The dolines represent biological refuges where conditions are sufficiently moist to support 'ecological islands' on sites otherwise hostile to such ecosystems.

Tasmania does not have any cave-dwelling bats but there are several vertebrates that use the caves. Tiny tracks in freshly deposited mud indicate that small mammals, possibly water rats (*Hydromys chrysogaster*), swamp rats (*Rattus lutreolus*) or introduced rats (*Rattus* spp.) venture into the caves.

Platypuses frequent underground streams where they feed on aquatic invertebrates. In the total darkness of a cave platypuses use electrosensors on their bills to detect minute electrical currents generated by one of their favourite foods, the mountain shrimp.

Several bird species, including the Welcome Swallow, Southern Boobook and Australian Owlet Nightjar have been recorded nesting or roosting in the caves.





Small introduced snails (*Oxychilus* sp.), only 10mm long, have been recorded feeding on owl droppings in Honeycomb Cave. The snail is an introduced carnivorous animal that originated in Europe.

What impact it will have on the cave fauna is difficult to determine. As a carnivorous species it may compete with other cave fauna for the limited supply of animals that enter the caves; or it may be a more direct threat and forage on the eggs of other cave animals. This species is known to eat amphipods, aphids, grasshoppers and smaller snails.

A CASE FOR CONSERVATION



Millers Bluff

It is almost impossible to envisage the landscape of the Great Western Tiers after the cessation of the last ice-age 10 000 years ago. But as the climate ameliorated the region would have become suitable for human habitation.

Tasmania's First Peoples lived a sophisticated subsistence lifestyle using their acute skills of observation, strength and perseverance. They moved seasonally between the plateau and the lowlands, travelling to the coast during the 'egging season' and walking to the Gog Range north of the Tiers to gather ochre for ceremonial purposes. They were joined by groups from other regions when the cider gums in the high country oozed their intoxicating liquor.

The arrival of the first British settlers changed this forever as their own needs for shelter and food became paramount. Towns were established around the most productive waterways; the areas richest in native fauna and flora. Trees were harvested for fencing, building, heating and cooking. Wheat for the colonies was grown around Westbury on deep fertile soil washed down by the waterways that drain off the Great Western Tiers.

The sheer scale of the exploitation that occurred in Tasmania in the five years between 1827 and 1831 was massive. Over one million pounds (616 metric tonnes) of wool and over 80 000 hundredweight (4064 metric tonnes) of bark from black wattle were exported to the 'mother country'. By 1830 there were one million hard-hoofed animals (mostly sheep) on the island.

The newly arrived colonisers yearned for the sights and sounds of their homeland. They imported birds - sparrows, blackbirds, starlings and goldfinches - in an attempt to overcome their homesickness. The birds adapted quickly to their new country, they spread far and wide and infiltrated the habitats of the native species. The land was just as rapidly changing to suit their needs. Pastures were created; oaks, elms, willows and pines replaced eucalypts and other native plants; and hedgerows of gorse and hawthorn provided perfect roosting and nesting sites for the foreigners.

The families of wealthy or titled Britons were granted large parcels of land - up to 60 000 hectares in some cases - around Longford, Cressy, Perth and Deloraine, some of which extended to the lower slopes of the Tiers. Sheep grazing and wheat growing were the main agricultural pursuits. They were also given grazing leases on the Central Plateau which continued until the 1980s. Fires lit on peat soils to encourage green pick for the sheep caused massive erosion. This is exacerbated to this day by heavy rains.

Smaller grants of land on the margins of the larger leases were given to poorer folk at Blackwood Creek, Cluan Tiers, Liffey, Jackeys Marsh, Western Creek, Mole Creek and Caveside. In the late 1800s sawmills (most of which continued operating until the 1950s) were established along the base of the Tiers to process the valuable timber growing on more marginal country; this also cleared the land for farming.

Some people supplemented their meagre livelihood by trapping. The fur trade provided a valuable source of income and possum fur especially was highly prized. In one year alone the pelts of nearly one million possums left Tasmania for Europe.

'Limestone is in great abundance, in fact little else is to be met with. It is to be regretted it is not more convenient to the coast where it could be shipped to the settled districts. For strength and durability it is superior to the Dorking or stone lime of England. Government would do well to examine a road or means of conveyance.'
(GAR 15 July 1834, Mole Creek)



Tiny (~15mm tall) fairy lanterns (*Thismia rodwayi*) have been found in wet forests with a deep layer of leaf litter at Cluan Tiers, Archers and Warners Sugarloaf and Meander. It is listed as rare (TSPA 1995).

Industrial-scale clear-fell timber harvesting began in the 1970s. Trees unsuitable for saw logs were processed into wood chips for the pulp and paper market. They proved such a profitable use of the forest that trees suitable for sawmilling became merely a by-product of the industry. Large cleared areas vulnerable to landslips scarred the landscape. Logging roads provided access to arsonists who, in 1983, started a fire that wiped out alpine and riverine rainforest and caused massive erosion adjacent to Dunnings Rivulet. Three decades later this once magnificent rainforest gorge has not fully recovered.

During the 1990s government policy encouraged the clearing of the lower slopes of the Great Western Tiers for tree plantations on both private and public land.

A proposal for a Great Western Tiers National Park was first published in 1990 by the Great Western Tiers National Park Campaign (formerly The Western Tiers Interest Group). It encompassed the western region between Western Bluff and the Poatina Highway. The proposal came from local residents who were passionate about the preservation of the majestic species-rich forests that surrounded them – one of the reasons many had left their city lives on the Australian mainland to settle along the base of the Tiers in the 1970s and thereafter. They were supported in their campaign by long term residents, farmers, bushwalkers, academics and scientists in various fields of expertise who recognised the importance of the region for its landscape and biological values as well as its Aboriginal and western cultural heritage. In 1992 the Great Western Tiers National Park proposal was launched by British botanist, Dr David Bellamy. In 1990 the Tasmanian Department of Parks, Wildlife and Heritage recommended that most of this western region be included in the World Heritage area. The Wilderness Society made a similar recommendation in 1993. In 1995 an extended National Park proposal was launched, extending further east as far as Lake Sorell, taking in the drier forests of that end of the Great Western Tiers as well as parts of the adjoining central plateau.

By 2013 most of the area covered by the National Park proposal was inscribed on the World Heritage list, and the Mole Creek Karst National Park had been created at the western end. However, most of the World Heritage Great Western Tiers escarpment and adjoining plateau are classified by the Tasmanian government as Conservation Areas, a tenure which allows resource extraction, contrary to the management requirements of World Heritage. These areas should have National Park status, as recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

In 2021 the Aboriginal Lands Council of Tasmania formally requested the Tasmanian government to create an Aboriginal owned and managed National Park covering substantial areas of kooparoona niara (Great Western Tiers).

The IUCN recommends that a national park should have a natural landscape of great beauty with one or several ecosystems and/or geomorphological sites with special scientific, educational and recreational interest. It should not be altered substantially by modern human activities and the highest competent authority of the country should enforce the preservation of ecological, geomorphological or aesthetic features of the national park. Moreover, the area should be accessible to visitors for inspiration and educational, cultural and recreational purposes.

The Great Western Tiers clearly qualifies as a National Park under the IUCN guidelines. Its extent, its location in the landscape and its wealth of rare, threatened and endemic species, many with links to Gondwana, make it of utmost importance to the long term survival of much of Tasmania's natural heritage.



Skipper butterfly on kangaroo grass (*Themeda triandra*) in open grassy woodlands at the drier eastern end of the Tiers.

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There are few places on Earth where the journey of the ancient supercontinent, Gondwana, with its cargo of evolving plants and animals, is as richly illustrated as it is in the Great Western Tiers.

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Sarah Lloyd is a Tasmanian naturalist, writer and photographer. She has had an interest in natural history since early childhood and now writes regularly for local publications about birds, fungi, the interactions between plants and animals, and other aspects of the natural world.

Other books by Sarah include *Life in the Shadows*, a natural history of her home at Black Sugarloaf, *Rhythms of the Tarkine: a natural history adventure, The Blue Tier - a natural history*, and her collection of natural history stories, *The silent cicada and other natural sounds*. Her most recent work, *Munginabitta's Country - flora and fauna at Panatana and Marshalls Hill*, was published in 2011 by the Six Rivers Aboriginal Corporation, Devonport.

'*The Edge* provides a unique perspective on the Great Western Tiers and the life found there; at scales varying from the grand vistas of the Tiers themselves to the tiniest 'dot snail' crawling on a fern. Sarah's meticulous documentation of the fascinating natural history of the Tiers will considerably deepen the understanding and appreciation of nature by those who live in or visit the region.'

–from the foreword by Tom May

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