Friends of the Great Western Tiers

Kooparoona Niara

Values of the Great Western Tiers

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Contents

1 Introduction

The Great Western Tiers form the northern and eastern escarpment of Tasmania’s Central Plateau, and extend from Western Bluff near Mole Creek in the north-west to Mt Franklin near Lake Sorell in the south-east. The term GWT is generally taken to mean the spectacular columnar dolerite bluffs and cliffs themselves, the deeply incised gorges, the forested slopes below them, and that part of the Central Plateau in proximity to the cliffs.

The Central Plateau is part of the Tasmanian Wilderness World Heritage Area (TWWHA), as are the three forest reserves on the escarpment (Drys Bluff FR, Liffey FR and Meander FR). The western end of the GWT is partly contained in the Mole Creek Karst National Park and a section of that National Park is part of the TWWHA (previously the Marakoopa Cave State Reserve). Approximately the upper third of the escarpment is designated The Great Western Tiers Conservation Area. The remaining forested slopes are in State Forest or private ownership.

The current Intergovernmental Agreement (IGA) between the Commonwealth and Tasmanian governments is designed in part to establish protection in permanent formal reserves of parts of the 570,000ha of forested land identified by the environmental non-government organisations (ENGOs) Environment Tasmania, The Wilderness Society and Australian Conservation Foundation. The land under consideration is all public land and presently classified as State Forest. Much of this is currently available for logging but would cease to be so if formally reserved. On the GWT, the identified land corresponds closely with the parts of the area proposed in 1995 for National Park status which are State Forest.

As part of the IGA process, the Independent Verification Group has assessed to conservation values of the proposed reserves. The new assessment has added further insight into the values of the Great Western Tiers and we will add the relevant details to this document in due course.

The Great Western Tiers are the forested escarpment of Tasmania's Central Plateau.

The Great Western Tiers are the most prominent and accessible natural feature of northern Tasmania, comprising forested slopes, sandstone cliffs, spectacular dolerite cliffs and boulder fields, deeply incised gorges and a multitude of streams, waterfalls, springs and swamps. They dominate the landscape, being visible from an area of at least a quarter of a million hectares.

Of importance are the steep climatic gradients, low to high altitude vegetation sequences, relationship to the Central Plateau and diversity of topography, aspect and geology.

Extensive oldgrowth forests on the slopes and benches are very important as native animal habitat. Suitable habitat is present for all Tasmanian native mammals.

The flatter areas (benches) are important intermediate altitude refuges for plant and animal species which migrate, over thousands of years, up or down the escarpment due to climate change. The perched swamps are each a unique experiment in ecosystem development and are likely to contain valuable fossil records in the deep mud.

The vegetation of the Tiers includes many communities of wet eucalypt forest, dry eucalypt forest, rainforest and subalpine forest, as well as shrublands, sphagnum peatlands, sandstone cliff communities and montane grassland.

The dry eucalypt communities have very high value, because of the poor reservation of this type in the region.

Beautiful stands of King Billy Pine and Pencil Pine are found in the gorges and other sites sheltered from fire. These stands represent the eastern limit of these species and are of very high conservation value. Several gorges also contain the rare hybrid between the two pines *Athrotaxis laxifolia.*

The Mole Creek end of the escarpment is one of Australia's most renowned karst areas, especially for the beauty and variety of the natural cave decorations.

The Tiers are important for the maintenance of adjoining wilderness around Ironstone Mountain and the Wild Dog Tier. Significant wilderness exists within the proposed National Park south of Millers Bluff and on Mt Ironstone.

The Great Western Tiers has "fallen through the cracks" on too many occasions. For example, it has been placed astride two Nature Conservation Regions, despite the fact it is a clearly delineable bio-geographic unit. The value of the escarpment and plateau is as a whole in an earth science sense, a biological sense and a landscape sense. The two are parts of a continuum which needs to be protected in its entirety.

2 Aboriginal Cultural Heritage

The area has a very significant Aboriginal cultural resource. It has a number of very significant and important Aboriginal sites, including prominent sites in the vicinity of the lakes and the various sandstone cliff rock shelters. The full extent of Aboriginal sites is not restricted to those areas. They are located through the entire landscape.

Any future management structure must include the views of local Aborigines and the Tasmanian Aboriginal Land and Sea Council in terms of the management of the Aboriginal cultural resource and may also need to include consultation with local Aborigines and the Tasmanian Aboriginal Centre with regard to Aboriginal rights to the land.

The Tasmanian Aboriginal Land and Sea Council will provide any information on the significance of the Aboriginal cultural resource.

The local Aboriginal community has given the area the name Kooparoona Niara, or "Mountains of the Spirits".

The recent logging of an area adjacent to the Liffey Forest Reserve World Heritage area is an example of sensitive rock shelters not yet being protected and being exposed to potential degradation from logging activities.

Numerous sensitive cultural sites lie in State Forest below the Great Western Tiers Conservation Area.

3 Conservation Values of the Western Region

3.1 World Heritage

The following is extracted from:

Tasmanian Wilderness World Heritage Site, Review and Evaluation of Critical Forest Issues, World Heritage at the Crossroads, Peter Hitchcock, January 2008

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"….It would be naïve to believe that all of those outstanding scenic values could be fully protected within the boundaries of the WHA. Clearly some scenic values extend outside the WHA, including into the State Forests adjacent to the eastern boundary. Never the less, the most effective way of protecting scenic values is to ensure that as far as practicable those areas are included in the WHA.

In this review, where scenic values are at issue, the approach adopted is the conservative one of seeking as far as possible to protect outstanding scenic values by inclusion in the WHA. For example, this is the approach applied to the Great Western Tiers…

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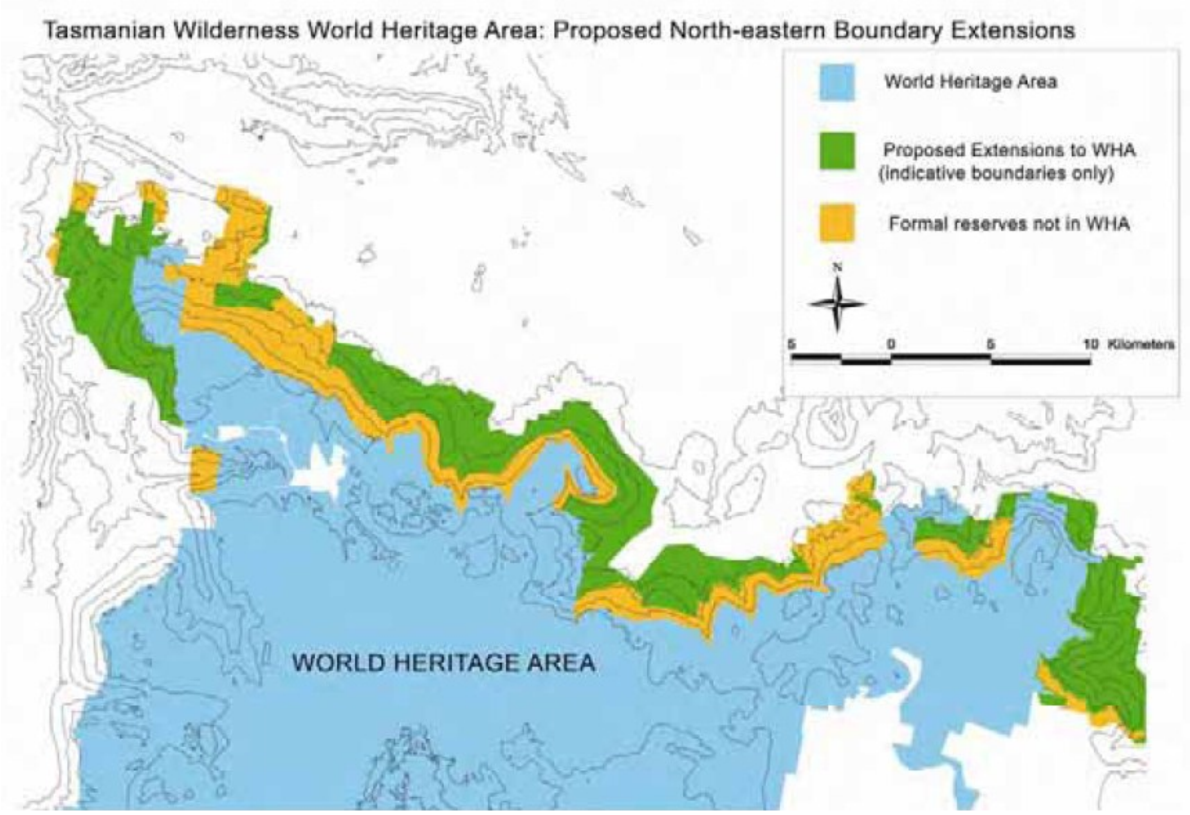
…Great Western Tiers Conservation Area:

Subsequent to the 1989 listing of the TWWHA, a tract of land adjoining the northern boundary of the Western Tiers section of the WHA was protected and gazetted as the Great Western Tiers Conservation Area … This tract of land, which is in several separate parcels, occupies mainly the forested slopes immediately below the cliffed section of the visually spectacular escarpment known as the Great Western Tiers. The cliffed escarpment known as the Great Western Tiers represents the northern edge of the massive dolerite sill that dominates the landscape of central Tasmania including much of the northern half of the World Heritage Area.

The major cliffed escarpment of the Great Western Tiers is an integral part of the outstanding scenic landscape associated with the Tasmanian Wilderness World Heritage Area and represents an important contribution to the scenic integrity of the WHA.

The Great Western Tiers Conservation Area provides protection for a major part of this major scenic escarpment and associated forests but protection is not complete and the lower boundary needs review and improvement as a permanent boundary. An appropriate boundary will need to include State forest areas, a number of which occur on the hillslopes immediately below the Conservation Area. Most of the current boundary of the WHA approximates the top of the cliff line such that at least the westernmost sections of the Conservation Area directly complement the WHA, and would make an important contribution to the scenic integrity of the WHA. As well, the Conservation Area includes a number additional important conservation values including biodiversity conservation (eucalypt forest) and important Aboriginal cultural features. As noted elsewhere in this report, several smaller components of the Mole Creek Karst National Park are intimately associated with if not surrounded by the Great Western Tiers Conservation Area. Together *they therefore represent an integrated package of lands now proposed for inclusion in the WHA.*

The Conservation Area is already field managed by the same management agency responsible for management of the adjoining section of the WHA so no new management arrangements would be needed to implement much of this proposed addition to the WHA.



Recommendation:

It is recommended that:

1. That part of the Great Western Tiers Conservation Area between Mole Creek and Drys Bluff (see diagram above), together with associated area of State Forest and Mole Creek Karst National Park be added to the Tasmanian Wilderness World Heritage Area.

2. A comprehensive definitive delineation is conducted to achieve full protection of the whole of the forested escarpment of the Great Western Tiers and to achieve an appropriate permanent boundary for the World Heritage Area in this region."

…Mole Creek Karst National Park:

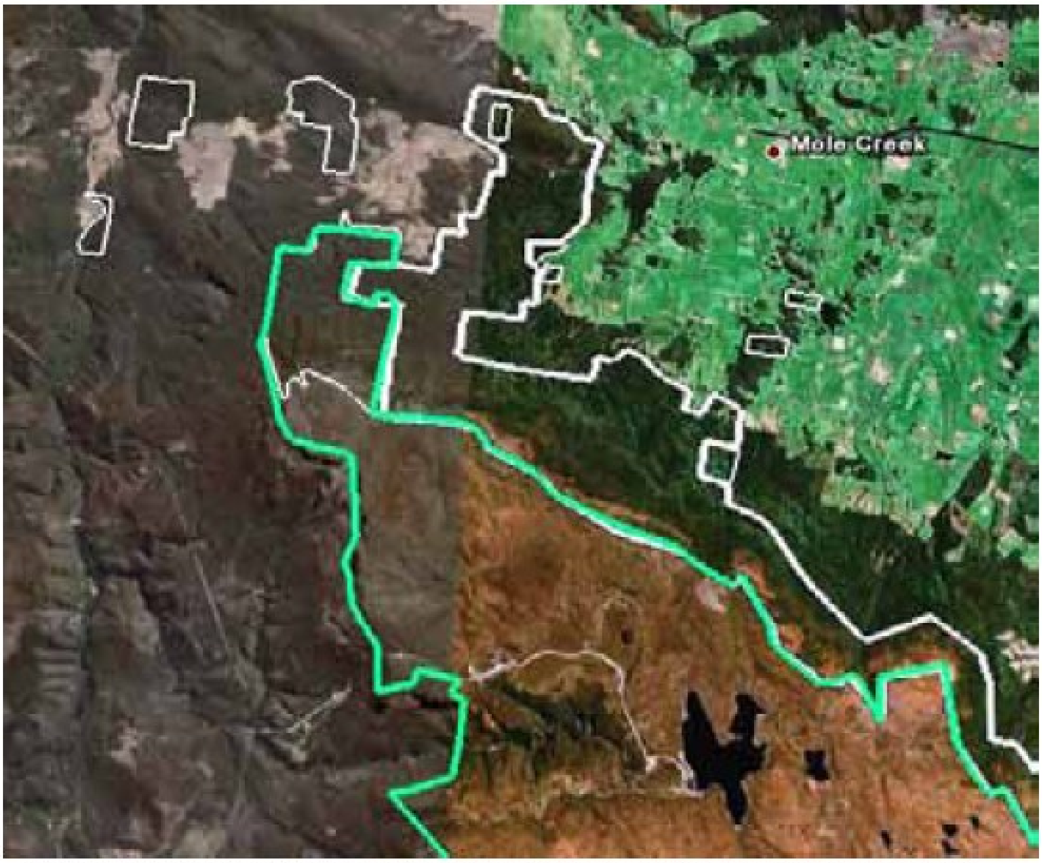
"The Mole Creek Karst National Park was proclaimed on 13th November 1996. This includes the former Marakoopa Cave State Reserve within the WHA and several other former reserves outside the WHA." TWWHA Management Plan (1999).

Mole Creek Karst National Park comprises at least 11 separate land parcels centred on high value cave and karst features. Only the Marakoopa section is within the WHA, The question arises as to whether other parts of Mole Creek Karst National Park should be considered for addition to the WHA, especially given that some are relatively small parcels of land geographically separated from the TWWHA by some kilometres of distance. This question was addressed by reference to two important considerations viz.

■The extent to which the separate reserves represent 'surface windows' to a more extensive underground karst system.

■The values and integrity aspects of lands presently separating the isolated parcels from the current WHA boundary.

There is no fundamental obstacle to smaller, relatively isolated parcels of land being considered for inclusion in a WHA providing they make a meaningful contribution to the value or integrity of the WHA. The attributes and condition of the intervening lands, their conservation significance and management are also relevant.



Sections of Mole Creek Karst National Park relative to existing WHA (green) and Great Tiers Conservation Area (broad white) Green=WHA boundary White (broad) Great Western Tiers Conservation Area, White (narrow) Mole Creek Karst National Park

Heritage Values:

There is an abundance of information that points towards the Mole Creek Caves generally being of high natural heritage value and some parts of particularly outstanding significance. The karst resources of the Tasmanian Wilderness World Heritage Site were specifically cited in the 1988 nomination vide:

"The World Heritage values include:

• karst systems including glacio-karstic features;

• karst geomorphology and karst hydrology;"

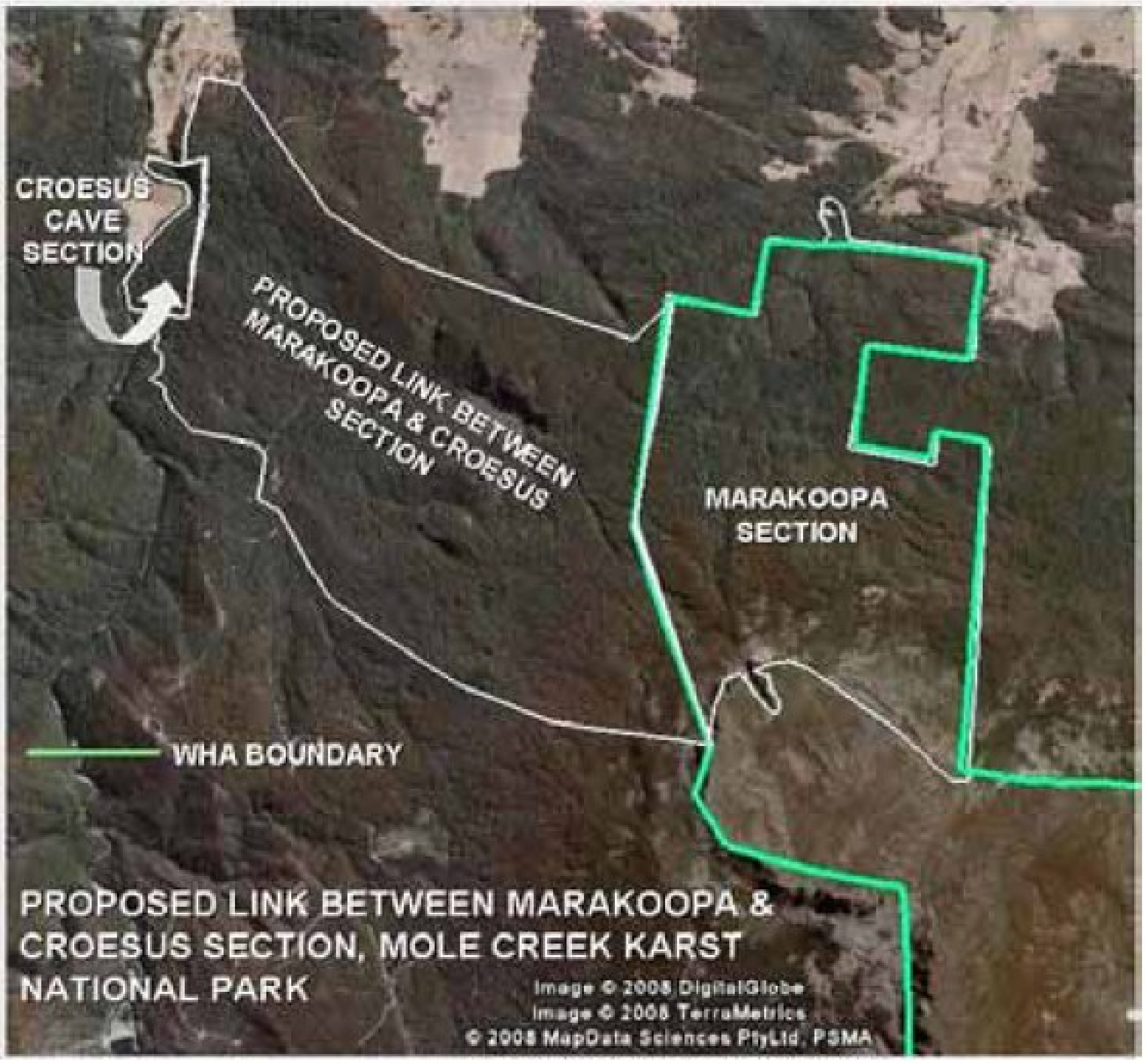
The Marakoopa section of the new Mole Creek Karst National Park is a part of the WHA and was regarded as an important component at the time of nomination. In considering the case for addition of the whole or part of Mole Creek Karst National Park to the WHA, Professor Kevin Kiernan, renowned karst specialist was consulted. The caves of the Mole Creek Karst National Park are many and varied and renowned for their great natural beauty.

Context:

Baldocks Caves, Glow Worm Caves, Sensation Gorge and Westmoreland Falls sections of the national park all adjoin or are embedded in the Great Western Tiers Conservation Area which links directly to the TWWHA. As such, they can be treated as part of a single land entity with direct connectivity to the TWWHA. The King Solomon's and Kubla Khan sections of the park are sizeable areas in a natural forest setting and have important documented conservation values. King Solomon's is open to the public as a managed tourist cave. Indeed, almost all of the surface lands of the various cave sections of the national park are forested, providing a forest conservation bonus. Sassafras, Wet, Cow and Croesus caves are either surrounded by private land or separated from the WHA by State Forest. However, this report presents a proposal, based on recent findings on the location of subterranean karst features that would have the effect of linking Croesus section of the park with the WHA.

All of the above components of the Mole Creek Karst National Park are illustrated in the map below.

Based on both published reports and personal communications it was established that new studies have identified important opportunities for priority protection of a wider area of karst not hitherto protected. In particular, karst connections between the World Heritage listed area previously known as Marakoopa Cave State Reserve (now national park) and the Croesus Cave (also national park) are valuable components of the Mole Creek karst. Accordingly, a tract of forested lands approximating the surface catchments of Mill, Vanishing and Kansas Creeks is recommended for priority protection.



Proposed link between Marakoopa section (in WHA) and Croesus Cave section of Mole Creek Karst National Park:

The link together with Croesus Cave would enhance the value and integrity of the karst values of the WHA and are recommended for addition to the WHA Existing WHA boundary shown in green. (Diagram indicative only) Diagram by OC Consulting

Conclusion:

All of the component areas of Mole Creek Karst National Park are integral parts of the one karst system, subterranean cave connections already confirmed in at least some cases e.g. Marakoopa and Croesus via, appropriately, Vanishing Creek and other connections expected to be confirmed. Several of the smaller component areas adjoin or are surrounded by the Great Western Tiers Conservation Area.(See map above)

A strong case exists for inclusion of all of the component parts of the Mole Creek Karst National Park in the TWWHA. The component parts represent a cave and karst system of outstanding conservation value that collectively form part of the Mole Creek Karst system which is already partly within the WHA. Addition to the WHA would add new values as well as significantly enhance the integrity of the karst resources in the WHA.

The benefits from inclusion of all of Mole Creek Karst National Park would be greatly enhanced by inclusion also of the more extensive new additions to the Great Western Tiers Conservation Area. (See Section 4.2.2. above)

Land Tenure:

National Park: All that part of Mole Creek Karst National Park not already included in the WHA.

State Forest: That part of the proposed link between the Croesus and Marakoopa sections of the national park is State Forest.

Recommendation:

It is recommended that:

1. All those component parts of the Mole Creek Karst National Park not already included in the WHA be added to the WHA. (But see Section 4.2.2. above)

2. Priority be given to protection and inclusion in the World Heritage Area of a tract of karst landscape linking from the Marakoopa section of the national park (in WHA) to the Croesus Cave section of the national park. (Mill-Vanishing- Kansas catchments) …"

The following is extracted from:

Western Tasmania A Place of Outstanding Universal Value. Proposed extensions to the Tasmanian Wilderness World Heritage Area, Geoff Law, September 2009 ***(FOGWT added emphasis)***

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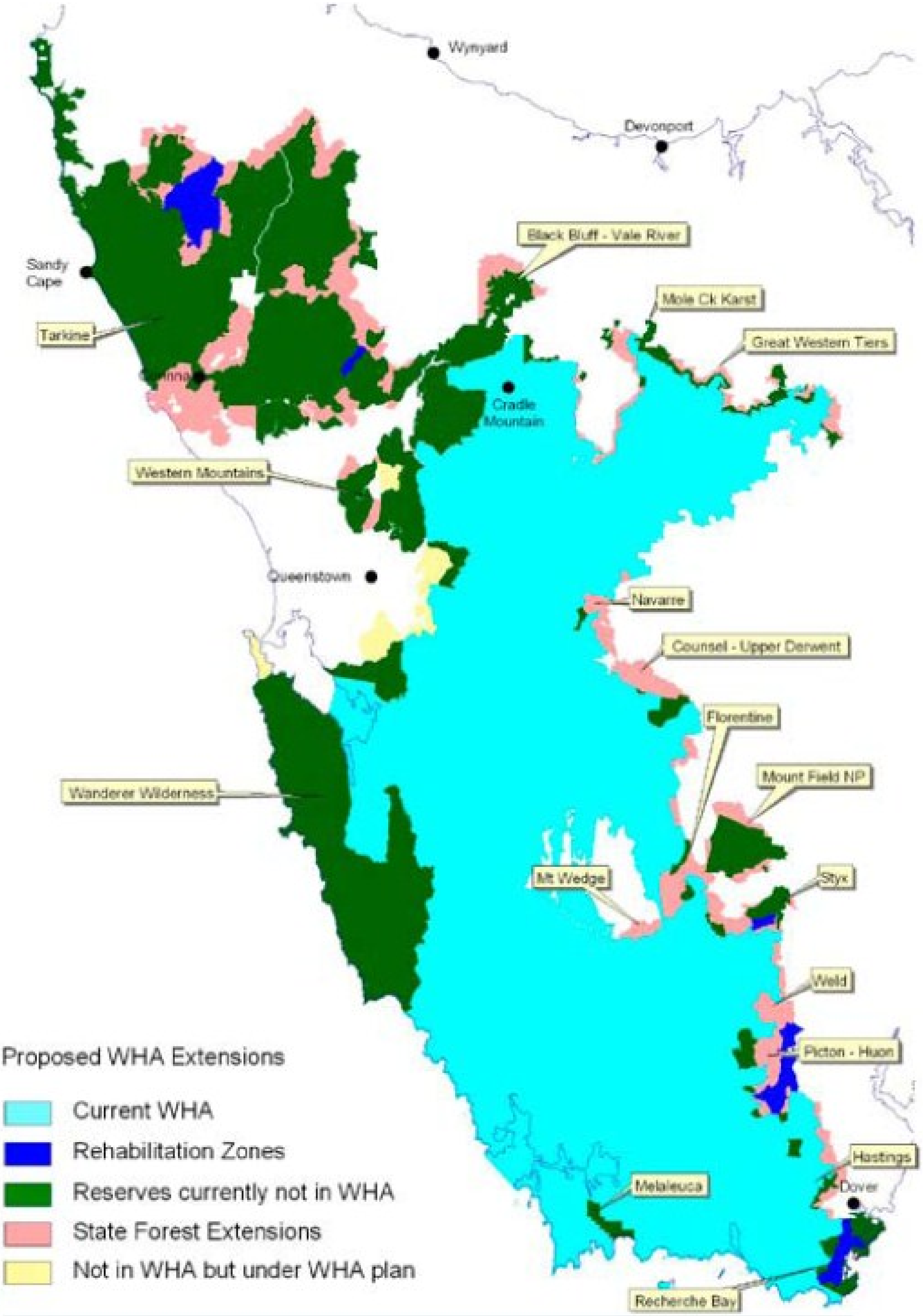
Proposed extensions and buffer zones to the World Heritage Area

Proposed extensions to the TWWHA are shown on the map opposite. They include the Vale of Belvoir/Black Bluff area, ***the Mole Creek karst, the Great Western Tiers****, the tall forest valleys of the south, the Mt Field National Park, reserves in the Recherche Bay area, Melaleuca, the Wanderer Wilderness (Southwest Conservation Area), the Western Mountains (including the Tyndall Range and Mt Murchison) and the Tarkine. Protecting the outstanding universal values and integrity of Western Tasmania in this way would bring the TWWHA to 2.19 million hectares, or 32% of the state.*

In addition, it is proposed that a further 22,000 ha of existing formal conservation reserves be managed as a buffer zone under the Management Plan for the TWWHA, and a further 33,000 ha of State Forest be rehabilitated and managed as a buffer zone. In this rehabilitation forest, no further clearfelling or plantation establishment would occur, though selective small-scale extraction of specialty timbers would be permitted. The land tenure of the proposed extensions and buffer zones is shown in Table 1.



Proposed extensions to the Tasmanian Wilderness World Heritage Area.

page 11…

1. Primitive flora and refugia – including rainforests – whose ancestry goes back to or pre-dates the ancient continent of Gondwana…

…Beautiful forests of deciduous beech, king billy pine and pencil pine drape the glaciated peaks of Mt Murchison, the Tyndall Range, Mt Dundas and Mt Field National Park.[13] Mt Romulus, within the Granite Tor Conservation Area, holds a large, pristine and very remote

stand of king billy pine.8 ***And refugia of conifers and rainforest also occur in moist, rocky gullies and sheltered slopes in the higher parts of the Great Western Tiers.[8] Tasmania's best example of sphagnum rainforest occurs at Mother Cummings Peak, just outside the TWWHA.****13…*

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8. A stronghold of rare, threatened and often unique fauna that occupy a diverse range of ecological niches…

…In a similar plight is the ***white goshawk (Accipiter novaehollandiae)*** *— a raptor of striking appearance. Listed as endangered, it hunts in wet forests of low stem density such as those near the Tasmania's west coast and on* ***the Great Western Tiers.****[37]…*

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9. A unique record of human habitation at extreme southerly latitudes lasting over 35,000 years

…Within the TWWHA there are shelters in the Mersey valley and Lemonthyme containing evidence of Aboriginals occupation during these 12,000 years.15 ***Similar rock shelters and deposits are found outside the TWWHA beneath the sandstone cliffs on the Great Western Tiers.****8 The integrity of some of these sites is threatened by encroaching logging….*

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Drawing on published work of experts over the last 20 years, it is proposed that the Tasmanian Wilderness World Heritage Area be extended to include the following areas of outstanding universal value:

• ***Black Bluff and the Vale River catchment*** *— a scenic highland valley with glaciated peaks, rare natural grasslands, a dramatic waterfall and sensitive karst systems. This proposed extension occurs largely in conservation reserves but does include State Forest on the slopes of Black Bluff. The Tasmanian Land Conservancy has given permission for its land on the Vale of Belvoir to be included in this proposal.50*

• ***Mole Creek Karst*** *— an intricate cave-system containing huge caverns and features of great fragility and beauty. This extension consists of conservation reserve, including part of the Mole Creek National Park, and State Forest adjacent to the TWWHA. No private land has been proposed for the extension.*

• ***The Great Western Tiers and upper Mersey*** *— the imposing northern edge of the World Heritage Area, containing cliffs of dolerite and sandstone, rainforest gullies, waterfalls and Aboriginal heritage. This consists of conservation reserve and State Forest.*

• ***Tall-forest valleys (Navarre, upper Derwent, Counsel, Beech, Florentine, Tyenna, Styx, Mt Wedge, Weld, Huon, Picton).*** *The world's most impressive tracts of tall hardwood forest — including giant trees over 90 metres tall and up to six metres in diameter — occur in the valleys of the Weld, Florentine, Styx, Picton, Huon, Counsel and upper Derwent. These proposed extensions comprise conservation reserve and/or State Forest and include Aboriginal heritage, glacial features, rainforest, waterfalls, cave-systems and habitat of rare and threatened species. Protected in an expanded World Heritage Area, the giant trees of*

Tasmania would stand as a southern counterpart of the World-Heritage-listed Redwoods National Park in the USA.

• ***Mt Field National Park*** *— a microcosm of World Heritage values. Only three kilometres from the TWWHA, this national park (proclaimed in 1916) contains a dramatically glaciated landscape; assemblages of rare alpine plants; deciduous beech and ancient pines; some of Australia's deepest caves (over 370 metres deep); the renowned Russell Falls; tall-eucalypt forest; a tourist road and a network of walking tracks. The extension includes the 15,881-ha national park plus some adjacent State Forest. It provides an outstanding opportunity to present to the public a wide range of World Heritage Value*

• ***Recherche Bay*** *— beaches, coves, lagoons and forests where Europeans and Tasmanian Aboriginal people first interacted and where threatened coastal species occur. This extension consists largely of conservation reserve. The Tasmanian Land Conservancy has given permission for its property at Recherche Bay to be included in this proposal.50*

• ***Melaleuca and Cox Bight*** *— moorlands, beaches, headlands and a lagoon that are an intrinsic part of the Tasmanian wilderness. This 4000-ha conservation area should be incorporated into the WHA in a manner that encourages those people for whom Melaleuca has been home to maintain their links with this isolated outpost. Specifically, members of the King and Willson families who have lived at Melaleuca should be able to continue to use their dwellings and associated infrastructure.*

• ***Wanderer Wilderness*** *(Southwest Conservation Area south of Macquarie Harbour) — a wild coastline, pristine rivers, extensive moorlands, disease-free Tasmanian devils and temperate rainforests. This large extension does not include the shacks, private land, lighthouse and damaged country in the very northern part of this Conservation Area.*

• ***Western Mountains.*** *These are the spectacular ice-sculpted mountains, glacial lakes, ancient conifers and deciduous beech of the West Coast ranges. These extensions consist almost entirely of conservation reserves. They include the ancient Huon pine assemblage at Lake Johnston, the most diverse rainforest in southern Australia, and Tasmania's greatest stand of deciduous beech and king billy pine.*

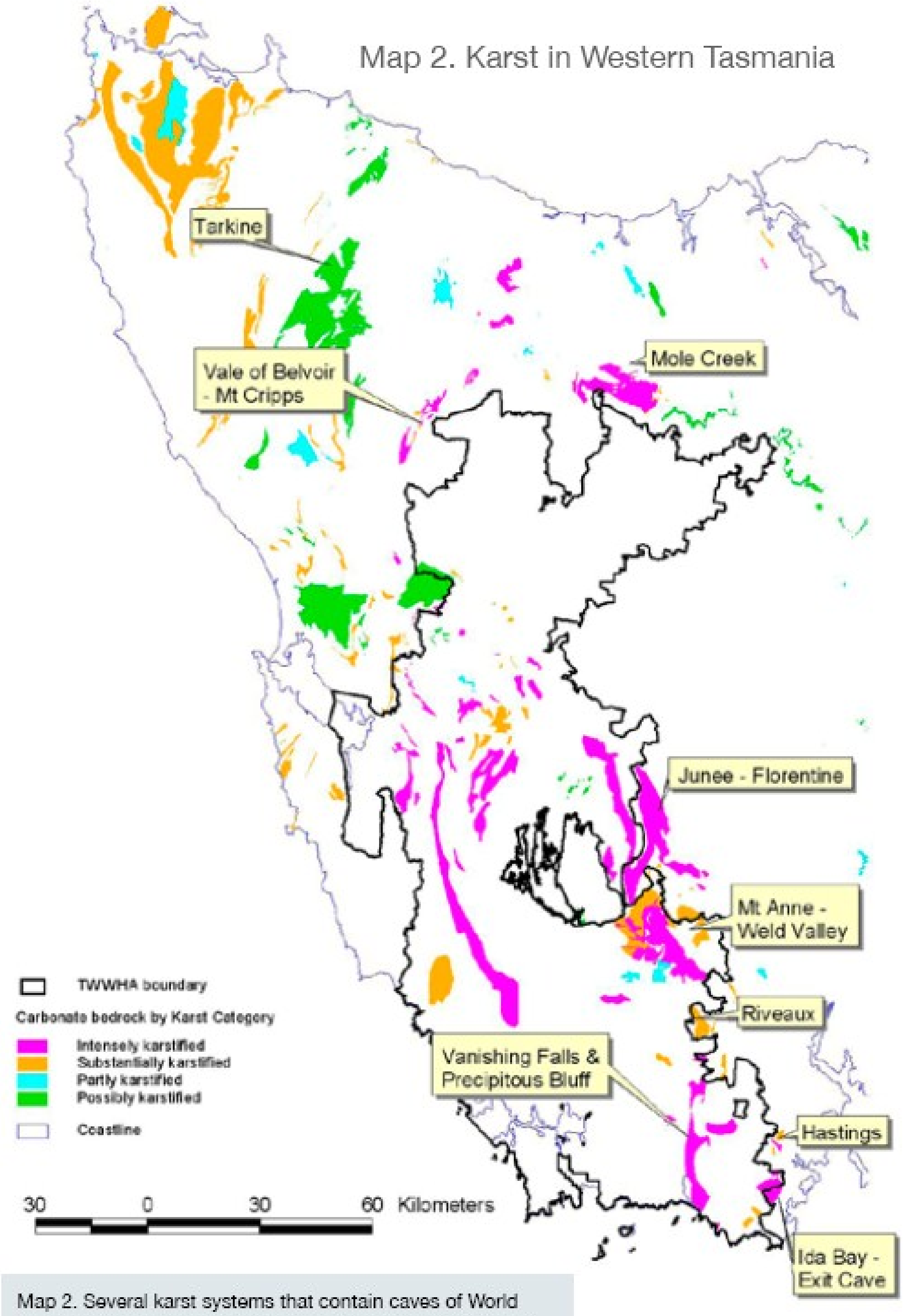
• ***The Tarkine*** *— Australia's greatest temperate rainforest, threatened stands of tall eucalypts, large tracts of moorland, wild rivers, rare magnesite karst, populations of disease-free devils and a dramatic coastline rich in Aboriginal heritage, including petroglyphs and hut-sites. This very large extension contains over 190,000 ha of rainforest and consists largely of conservation reserves and State Forest.*

References

[8]. Department of Parks, Wildlife and Heritage (1990): The Appropriate Boundaries of a World Heritage Area in Western Tasmania. Tasmanian Government, Australia. (Author — Grant Dixon)

[13]. Balmer J., Whinam J., Kelman J., Kirkpatrick J.B. & Lazarus E. (2004) A review of the floristic values of the Tasmanian Wilderness World Heritage Area. Nature Conservation Report 2004/3. Department of Primary Industries Water and Environment, Tasmanian Government, Australia.

[37]. Threatened Species List Department of Primary Industries, Water and Environment, Tasmanian Government, Australia. http://www.dpiw.tas.gov.au/ inter.nsf/WebPages/SJON-58KUJD?open



Map 2. Several karst systems that contain caves of World Heritage value extend beyond the boundaries of the World Heritage Area. Source: Tasmanian Karst Atlas, (Kiernan 1995).

3.2 Forests

Overview

The forest communities range from dry, open sclerophyll forest through various successional stages to tall wet eucalypt forest, closed rainforest and subalpine and alpine forest communities. The forests on the Great Western Tiers are a mosaic of age classes and communities with a relatively small patch size. This is largely a reflection of a varied fire history with intensity modified by aspect and topography. Most of the eucalypt forest is uneven-aged.

The impact of early logging has been to modify forest structure and favour the rain forest species on the wet sites. The retention of many mature trees in logged areas, together with uncut stands of previously inaccessible forest has ensured the maintenance of oldgrowth habitat on the Great Western Tiers.

The presence of larger areas of natural regrowth of many age classes will ensure the maintenance of the eucalypt component for the foreseeable future.

The vegetation of the Great Western Tiers escarpment has been described in general by Jackson (1972) :

"*At the base of the scarp the eucalypt savannah forests of the Midlands Graben consist of open communities of Eucalyptus pauciflora - E. viminalis or E. pauciflora - E. rubida in drier areas (Jackson 1965). Soma savannah of E. ovata or E. rodwayii occur where the drainage is poor in the winter. The ground vegetation of these savannahs is a tussock grassland of Poa billardieri. Themeda australis and Lomandra longifolia may predominate on clayey soils. Corridor forests of E. viminalis - Acacia melanoxylon occur on stream courses, and dry sclerophyll forests occur on low hills of sandy or lateritic soils."*

"On the lower slopes of the scarp the open savannah is replaced by dry sclerophyll forests of the same tree species. These forests increase in density and height as the rainfall increases.

On areas of deep soil and sufficient moisture the ash species E. obliqua may replace the peppermint species E. pauciflora or E. amygdalina partially or completely as the dominant. The macrantherous species E. viminalis, E. rubida or E. ovata remain as associate species. Above 300m altitude these species are replaced by E. dalrympleana as the associate with E. obliqua. Due to increasing rainfall there is a structural transition from dry sclerophyll forest, with low and medium shrub layers of Epacridaceae and Leguminosae, to wet sclerophyll, with well developed tall shrub layers of Olearia argophylla and Pomaderris apetala."

"On the wetter northern and western slopes where the annual rainfall exceeds 1250mm, the climax is a rainforest of Nothofagus cunninghamii - Atherosperma moschatum. This climax is attained only in areas topographically protected from high fire incidence (Jackson 1968). Because of the fairly regular disturbance by fire, most areas carry "Mixed" forest (Gilbert 1958), with a stratum of eucalypts over a substratum of rainforest and wet sclerophyll shrub species such as Acacia dealbata, Prostanthera lasianthos and Olearia argophylla. Near the upper lip of the scarp face (c.1000m) water availability is greatly increased by the "fog drip"

or "cloud stripping" effect of the vegetation on the cloud base so prevalent around the plateau rim. Under these conditions a dwarf "elfin" rainforest or thicket of Nothofagus occurs. Nothofagus cunninghamii extends around the rim of the Western Tiers...."

"Above 450m the subalpine species become increasingly evident. E. obliqua is replaced by E. delegatensis. The E. delegatensis - E. dalrympleanea forest extends up the slope to altitudes of about 1000m or slightly higher in sheltered situations......over much of its range E. delegatensis is growing on a relict solifluction sorted mantle. This surface is covered in many places with large dolerite boulders, though there is commonly a deep yellow-brown soil on solifluction deposits (cf. alpine humus soil) beneath, with a shallow water table. The smaller shrubs have difficulty reaching this reliable supply of water in the summer and the shrub layer is scattered and more xeromorphic on the upper slopes. Bedfordia salicina, Oleria viscosa, O. phlogopappa and Cyathodes parvifolia predominate. With increasing and more reliable precipitation near the cloud base the sub-alpine shrub belt increases in density. Around 910m dense shrubberies of Hakea lissosperma, Orites diversifolia, Lomatia polymorpha and Telopea truncata occur as a fire-determined deflection state of the climax Nothafagus thicket .... Where fire is frequent enough to maintain eucalypts, an open woodland overstory of E. coccifera - E. gunnii or E. archerii occurs."

"At altitudes exceeding 1000m exposure to glazing winds and snow limits tree and shrub forms and only the specialised alpine communities are found. Well-drained areas are occupied by a proteaceous - epacridaceous closed heath or shrubland; while those areas receiving a high precipitation but obtaining some topographic protection from the wind, carry dwarf coniferous forest or coniferous shrubbery. Poorly drained areas carry a complex mosaic of herbfield, bog and bolster moor communities. Cold air drainage "basins" carry tussock grassland, sedgeland or bog communities...."

Rainforest

Kirkpatrick and Moscal (1986) and Duncan (1989) have identified a number of different callidendrous rainforest communities between Western Bluff and Drys Bluff. These are (after Jarman et al 1984):

C1. Dicksonia antarctica - Polystichum proliferum understoreys

(a) Nothofagus cunninghamii - Atherosperma moschatum over Dicksonia antarctica

(Low altitude Myrtle Rainforest)

(b) Nothofagus cunninghamii - Atherosperma moschatum over Olearia argophylla - Dicksonia antarctica - Polystichum proliferum

(Low altitude Myrtle/Musk Rainforest)

C2. Clear understories, sometimes with scattered shrubs

(a) Nothofagus cunninghamii (- Leptospermum lanigerum) over clear understory or Telopea truncata and/or Tasmannia lanceolata

(High altitude Myrtle/Lichen Rainforest)

Of these communities C1b and C2a were considered by Kirkpatrick and Moscal (1986), to be poorly reserved

Wet Eucalypt Forest

The wet eucalypt forests between Western Bluff and Drys Bluff have been described and analysed by Kirkpatrick and Moscal (1986), Kirkpatrick (1988) and Duncan (1989).

The dominant eucalypt species found generally followed those outlined by Jackson (1972). In addition, Duncan (1989) recorded the presence of Eucalyptus regnans dominated forest between the Lobster Rivulet and Western Bluff at lower altitudes and Kirkpatrick and Moscal (1986) recorded E. brookerana on river flats south of Warners Sugarloaf.

Kirkpatrick et al (1988) established a floristic base for the identification of wet eucalypt forest communities and identified the Great Western Tiers as an extremely important area for the reservation of wet eucalypt forest. They recommended the area for reservation to cover 10 communities. This was more than for any other location in the state. Communities identified were:

E. amygdalina - Monotoca glauca - Pomaderris apetala - Dicksonia antarctica wet sclerophyll/mixed forest (AM0)

E. amygdalina - E. viminalis - Lomandra longifolia wet sclerophyll forest (AM1)

E. brookerana/E. obliqua - Bedfordia salicina wet sclerophyll forest (BR11)

E. coccifera - Orites revoluta - Olearia phlogopappa subalpine mixed forest (COC00) ("the centre of its distribution is the Western Tiers")

E. dalrympleana/E. delegatensis - Lomatia tinctoria wet sclerophyll forest (DAL00)

E. dalrympleana - Tasmannia lanceolata - Dicksonia antarctica mixed forest (DAL10)

E. delegatensis - Bedfordia salicina - Lomatia tinctoria wet sclerophyll forest (DEL0000)

E. delegatensis - Acacia melanoxylon - Bedfordia salicina wet sclerophyll forest (DEL0001)

E. delegatensis - Olearia phlogopappa - Olearia viscosa subalpine wet sclerophyll forest (DEL0010)

E. delegatensis - Telopea truncata subalpine wet sclerophyll forest (DEL0011)

E. delegatensis/E. viminalis - Acacia melanoxylon wet sclerophyll forest (DEL0100)

E. delegatensis/E. obliqua - Acaena novae - zelandiae wet sclerophyll forest (DEL0101)

E. delegatensis - Atherosperma moschatum - Olearia argophylla wet sclerophyll/mixed forest (DEL0110)

E. delegatensis - Zieria arborescens - Hydrocotyle sibthorpthioides wet sclerophyll/mixed forest (DEL0111)

E. delegatensis - Nothofagus cunninghamii - Grammitis billiardieri mixed forest (DEL1000)

E. delegatensis - Nothofagus cunninghamii - Gahnia grandis mixed forest (DEL1001)

E. delegatensis - Telopea truncata - Pittosporum bicolor subalpine mixed forest (DEL1100)

E. delegatensis - Hakea lissosperma - Monotoca glauca subalpine mixed forest (DEL1110)

E. obliqua - Olearia lirata - Pultenaea juniperina wet sclerophyll forest (OB010)

E. obliqua -Acacia dealbata - Olearia argophylla wet sclerophyll forest (OB0110)

E. obliqua - Malaleuca squarrosa - Monotoca glauca wet sclerophyll forest (OB0111)

E. obliqua - Nothofagus cunninghamii - Polystichum proliferum - Hymenophyllum flabellatum mixed forest (OB1000)

E. obliqua - Nothofagus cunninghamii - Monotoca glauca mixed forest (OB101)

E. ovata - Acacia dealbata - Pomaderris apetala wet sclerophyll forest (OV01)

E. regnans- Atherosperma moschatum - Acacia dealbata - Olearia argophylla wet sclerophyll/mixed forest (REG101)

E. viminalis - Bedfordia salicina - Pultenaea juniperina wet sclerophyll forest (VIM0011)

E. viminalis - Acacia dealbata - Pomaderris apetala wet sclerophyll forest (VIM0100)

E. viminalis - Acacia dealbata - Dicksonia antarctica wet sclerophyll forest (VIM0101)

E. viminalis - Nothofagus cunninghamii - Atherosperma moschatum - Dicksonia antarctica mixed forest (VIM111)

The communities selected for optimum reservation on the Great Western Tiers were AM0, AM1, COC00, DAL00, DEL0001, DEL0010, DEL0100, DEL0111, VIM0011, VIM111.

Dry Eucalypt Forest

The dry eucalypt forests are largely confined to the low altitude forests west of Projection Bluff, notably on Warners and Archers Sugarloaf and the lower slopes of Quamby Bluff, the forests between Drys Bluff and the Poatina Hwy and most of the Eastern Region.

Dry eucalypt forests from the area between Drys Bluff and Western Bluff are described in Kirkpatrick and Moscal (1986) and identified in Duncan (1989). These studies found dry eucalypt forests dominated by E. obliqua, E. delegatensis, E. viminalis and E. amygdalina.

Cadman (pers comm 1989) reports the presence of E. rodwayi dominated forest at low altitudes in Jackeys Marsh. Recently a small population of E. pauciflora has also been discovered.

Kirkpatrick and Moscal (1986) divided the E. obliqua dry forests into two groupings. The most frequent species in the first group were E. obliqua, E. viminalis, E. amygdalina, Banksia marginata, Acrotriche serrulata, Tetratheca pilosa, Pultenaea juniperina, Lomatia tinctoria, Lomandra longifolia, Diplarrhena, bracken, Pteridium esculentum and Viola sieberana. The most frequent species in the second grouping were E. obliqua, Pultenaea juniperina, Lomatia tinctoria and Pteridium esculentum.

The E. delegatensis dry forests occur mainly above about 650m. Kirkpatrick and Moscal (1986) divided these forests into two groupings. The most frequent species in the first group were E. delegatensis, Bedfordia salicina, Cyathodes parvifolia, Lomatia tinctoria, Senecio linearifolius, Pteridium esculentum, Dianella tasmanica and Ranunculus lappaceus. The most frequent species in the second group were E. delegatensis, Acacia melanoxylon, Bedfordia salicina, Olearia viscosa, Lomatia tinctoria, Pultenaea juniperina, Pteridium esculentum and Microsorium diversifolium.

The E. delegatensis dry forests on the high benches are considered transitional between dry sclerophyll and wet sclerophyll.

Dogs Head Hill is fine example of low altitude dry sclerophyll forest on karst.

Subalpine Forests and Shrub Lands

The cloud forests of the Great Western Tiers described by Jackson (1972) have been found to contain a very rich lichen flora (Moscal pers comm 1989).

Duncan (1989), regarding the vegetation of the Marakoopa Cave State Reserve and the non-allocated Crown land to the east, states:

"Vascular species diversity and endemic species richness tended to increase with altitude, reaching a maximum in subalpine and alpine communities. Low altitude and high altitude rainforests were rich in epiphytic species, bryophytes and lichens. The subalpine forest and scrub and the montane grassland were characterised by particularly interesting species associations, with xerophytic species (eg. Cyathodes spp., Pultenaea juniperina, Richea spp.) co-occuring with rainforest species (eg. Pittosporum bicolor, Nothofagus cunninghamii) which benefitted from orographic stripping of moisture from clouds."

Brown (1988), identified the gorges and high altitude forests of the Great Western Tiers as containing small disjunct, but widely dispersed populations of Athrotaxis selaginoides (King Billy Pine). The sites identified include Lobster Rivulet, Western Creek, "Little Gorge", a high bench below Mother Cummings Peak, Mother Cummings Rivulet, Smoko Creek, below Meander Falls, Staggs Creek, Sales Rivulet, Dunning Rivulet, Burnies Creek, Quamby Bluff and Brumbys Creek. Recently a population has been found on Projection Bluff. These populations are almost certainly post glacial relics.

Kirkpatrick and Moscal (1986) recommended the active conservation of the Dunning Rivulet Gorge as it contains Athrotaxis selaginoides and Athrotaxis cupressoides (Pencil Pine) and the rare hybrid between these species Athrotaxis laxifolia, as do the Meander Gorge, the Western Creek Gorge and the Lobster Gorge.

The Lobster Gorge and the Dunning Rivulet Gorge contain the greatest expanses of Athrotaxis cupressoides forest which extends over a length of about 1.5km in both cases.

The Great Western Tiers escarpment is directly adjacent to the Central Plateau which is the largest contiguous area of alpine vegetation in Australia. Small pockets of alpine vegetation extend off the plateau and down onto exposed high ledges and benches.

In addition to this is the small alpine plateau present on Quamby Bluff. Kirkpatrick and Moscal (1986) noted: *"Quamby Bluff is of particular scientific interest as an outlier of the Central Plateau alpine environment. Many of the scrub quadrats contained unreserved or poorly reserved species..."*

Sphagnum Peatlands

Sphagnum peatlands occur in small pockets at various altitudes on the Great Western Tiers where drainage and soil conditions are suitable. A fairly substantial bog is found at low altitude in Jackeys Marsh and a sphagnum bog occurs on a high bench west of the Lobster Rivulet. Whinam et al (1989) have identified the rainforest - sphagnum mire on the sandstone shelf below Mother Cummings Peak as important and recommended its reservation:

"..Rainforest - Sphagnum mires

Nothofagus cunninghamii, Gahnia grandis and Phyllocladus aspleniifolius are the distinguishing species of the poorly reserved rainforest - Sphagnum community. This is usually found primarily at lower altitudes than the communities listed above, and is typified by peatlands in the west (Little Fisher River, Mother Cummings Peak) and north-west (Netherby Plains). In this community Sphagnum can occur in mats with emergent rainforest species, or as small discrete patches on a humic layer below a rainforest canopy."

"..Mother Cummings Peak

This mire is important for conservation purposes because it is a good example of the poorly reserved rainforest - Sphagnum mire, combined with its smooth surface morphology. It also represents the sandstone shelf geomorphological niche. There are some potential hydrological problems created by the bulldozing of a road upslope from the mire, but these have been mitigated by subsequent action by the Forestry Commission."

This swamp has Athrotaxis selaginoides associated with it.

Sandstone Cliff Vegetation

The sandstone cliffs of the Great Western Tiers between Billopp Bluff and Mother Cummings Peak are a major and imposing geological feature. They provide an extremely rich and diverse variety of habitats.

Kirkpatrick and Moscal (1986) identified the vegetation of the cliffs as quite distinct:

"Group 9 consists of quadrats associated with the shallow soils of sandstone cliffs and their environs. The Quadrats are floristically very distinct with high constancies of the shrubs Gaultheria hispida, Monotoca glauca, Aristotelia peduncularis and Epacris impressa, the graminoid, Dianella tasmanica, the fern, Blechnum chambersii, and the herbs, Stylidium graminifolium and Galium australe. The vegetation type represented by the quadrats in this group has not been recorded in the literature. Although Martin (1940) noted the distinctiveness of the vegetation of the sandstone shelves at the same altitude on Mt. Wellington, there are substantial differences in floristics and dominance between the two areas as well as some significant floristic communalities. The conservation status of this particular vegetation type is unknown. However, the 40% of quadrats with unreserved or poorly reserved species suggests that it may be poor."

Coates (1988) produced a thesis based on studies of cliffs contained within the proposed National Park. This included a detailed description of the geomorphology and vegetation of the cliffs. Coates further stressed the high conservation status of the cliff vegetation:

"Despite their imposing appearance, the sandstone cliffs of the Western Tiers support vegetation which is highly vulnerable to disturbance. Forestry operations and the associated threat of fire and weed invasion (Kirkpatrick and Moscal 1986) as well as removal of the canopy cover, which provides the necessary shade for fern communities, at present threaten the existing plant communities. Sandstone shelves recorded by Martin (1940) on Mt Wellington have since been burnt, with little recovery of the vegetation other than some crevice species. Furthermore, increased recreational use, such as rock climbing, can only degrade the cliff flora."

"The protection of cliff vegetation from these activities is long overdue in Tasmania. The Jackeys Marsh-Quamby Bluff area is included on the Register of the National Estate which,

although not providing protection, does serve to accentuate the cultural and botanical values of features such as the cliffs. Kirkpatrick and Moscal (1986) reported that 40% of the sandstone cliff quadrats in their survey contained unreserved or poorly-reserved species. These species, including Deyeuxia accedens (poorly reserved, endemic) and Poa jugicola (possibly endemic and unreserved) were both recorded on the cliffs during this survey. The vegetation type has not been previously recorded in the literature other than by Kirkpatrick and Moscal (1986), and its reservation status is unknown. The relatively rich flora of these cliffs is unparalleled by sandstone cliffs in the drier parts of the state and there is an urgent need for their conservation."

Grassland

Duncan (1988) recorded the presence of a montane grassland within the Marakoopa Cave State Reserve. The area is important for a number of grassland species most notable of which is Poa jugicola, a species almost certainly confined to the Western Tiers region, and Deyeuxia accedens.

Riparian Vegetation between Warners and Archers Sugarloaf

Kirkpatrick and Moscal (1986) state:

"*Group 12 consists of three quadrats located in lowland riverine vegetation along the Meander River and Jackeys Creek. These quadrats have a fascinating species mix including highland species, such as Podocarpus lawrencii and Athrotaxis cupprossoides, wet forest species, such as Nothofagus cunninghamii, Phebalium squameum, Tasmannia lanceolata, Notelaea ligustrina and Monotoca glauca, dry forest species, such as Exocarpus cupressiformis, Banksia marginata and Bossiaea riparia, and characteristically riverine species, such as Epacris exserta and Leptospermum lanigerum. The nearest analogue to this fascinating community that is recorded in the literature is the riverine vegetation of the middle Douglas River (Duncan 1983). There seems little likelihood that the type of riverine vegetation found in the study area will be found to occur within the present State Reserve system. The best possibility would be within the Alum Cliffs State Reserve. All quadrats in this group contain unreserved plant species. The riverine community is particularly susceptible to severe transformation as a result of the invasion of exotic shrubs and trees, which can always find moist, bare ground for establishment. Thus, it is extremely important to maintain catchments free of the most deleterious of the introduced taxa, such as Ulex, Salix and Rubus, if such communities are to be maintained."*

Other Important Species

Kirkpatrick and Moscal (1986) state:

"The areas that deserve the most attention on the part of authorities concerned with conservation are those containing populations of Epacris exserta and Pernettya lanceolata, as the available information suggests that both these species are in danger and that the study area is the best location for efforts directed towards their preservation. The study area may also be one of the best locations for preservation of the important Tasmanian gene pool of Glycine latrobeana."

Harwood and Edwards (1988) identified Glycine latrobeana and Pomaderris phylicifolia on Warners Sugarloaf.

Kirkpatrick and Moscal (1986) identified a number of areas of extremely high conservation significance outside the Jackeys Marsh - Quamby Bluff area:"..populations of Pernettya lanceolata, Deyeuxia accedens, Deyeuxia benthamiana and the new Poa species, ..."

Duncan (1989) identified a number of poorly conserved species in the Marakoopa Cave State Reserve and on the adjoining non- allocated Crown land. These were Pterostylis decurva, Pimelea cinerea, Hymenthera dentata, Asplenium trichomanes, Drapetes tasmanicus and probably Pernettya lanceolata.

3.3 Fauna

Introduction

The bio-geographical importance of the Great Western Tiers in relation to Tasmanian native fauna should not be underestimated. The diversity of habitats is special. Suitable habitat for all species of native mammals is currently found in the area. (Statham 1981, Kelly and Hunt 1989)

The geographical location of the Great Western Tiers combined with the diversity of microclimates, steep climate gradients, low to high altitude vegetation sequences, diverse topography and proximity to the Central Plateau are most significant. It may be argued that the Great Western Tiers can serve as a central gene pool for all species of Tasmanian native mammals. The region is presently connected to most other parts of Tasmania through habitat which is suitable for the dispersal of most species of native mammal.

Mammals

Excluding Homo sapiens there are 35 species of land mammals native to Tasmania. The Great Western Tiers area is unique in Tasmania with its diversity of fauna, probably containing all 35 species up until recent times.

Extensive oldgrowth forests provide habitat for dependant species.

The Thylacine has been positively identified and recorded as inhabiting the area in the past, but the only evidence of present occupation is some reported sightings.

Two other species have not been positively identified in the area recently, these being the Forester Kangaroo and the Broad-toothed Rat.

Thylacinidae and Dasyurids

1.Thylacine (Tasmanian Tiger) - endangered, wholly protected

Once a common inhabitant, reported sightings in recent years are the only evidence of presence.

2.Sarcophillus harrisi (Tasmanian Devil) - common, wholly protected

Found throughout the Great Western Tiers at all altitudes, including the Plateau. Very important role of preventing potential spread of disease from rotting animal matter, through their carrion feeding nature.The sudden decline in Dasyurid spp numbers in recent years, attributed to Trichonella spirosis, indicates the vulnerability of our native animals in the longer term.

3.Dasyurus maculatus (Spotted Tailed Quoll) - common to sparse, wholly protected, inhabitant throughout the Great Western Tiers.

The distribution of this quoll has been greatly reduced, particularly on the east coast of mainland Australia, where it is becoming so thinly distributed that it will be unable to survive. Tasmania is considered its stronghold.

4.Dasyurus viverrinus (Eastern Quoll) - locally common in Tasmania; rare, possibly extinct in mainland Australia, inhabitant throughout the Great Western Tiers.

5.Antechinus swainsonii swainsonii (Tas sub species) (Dusky Antechinus, Marsupial Mouse) - abundant in suitable habitat, wholly protected, inhabitant throughout the Great Western Tiers.

6.Antechinus minimus minimus (Tas sub species) (Swamp Antechinus, Little Marsupial Mouse) - rare, wholly protected, threatened by destruction of its limited preferred habitat, particularly by too frequent burning.

7.Smithopsis leucopos leucopus (White Footed Dunnart) - wholly protected.

"Probably occur in Great Western Tiers" (Statham 1981)

8.Ornithorhynchus anatis (Platypus) - common but vulnerable, wholly protected, distributed throughout the Great Western Tiers from high altitude tarns on the plateau to lowland streams.

9.Tachyglossus aculeatus (Echidna) - common, secure, wholly protected, widespread throughout the Great Western Tiers.

10.Isoodon obesulus (Southern Brown Bandicoot) - common in suitable habitat, wholly protected, widespread throughout the Great Western Tiers, preferring scrubby habitats or areas of low ground cover.

11.Parameles gunii (Eastern Barred Bandicoot) - locally common (north and eastern Tas), wholly protected, widespread throughout the Great Western Tiers, particularly at lower altitude where habitat forest borders pastureland and extending into open pastureland.

12.Vombatus ursinus tasmaniensis (Tas sub species) (Common Wombat) - common in suitable habitat, partly protected, found throughout the Great Western Tiers, its main habitat being the forested lowland to mountainous areas.

13.Trichosurus vulpecula (Brush Tail Possum) - abundant, partly protected, widespread throughout the Great Western Tiers

14.Pseudocheirus peregrinus (Ringtail Possum) - common, wholly protected, found throughout the Great Western Tiers.

15.Petaurus Breviceps (Sugar Glider) - common, wholly protected, found throughout the Great Western Tiers.

16.Cercartetus nanus (Eastern Pygmy Possum) - threatened, wholly protected, found throughout the Great Western Tiers.

17.Cercartetus lepidus (Little Pygmy Possum) - status unknown, wholly protected, found throughout the Great Western Tiers.

18.Macropus giganteus (Forester Kangaroo) - wholly protected

Ideal suitable habitat is found throughout the Great Western Tiers. Reports of their habitation in the Jackeys Marsh/Meander area have not been confirmed by Parks, Wildlife and Heritage.

19.Macropus rufogriseus (Red Necked Wallaby) - locally abundant, partly protected, found throughout the Great Western Tiers.

20.Thylogale billardierii (Tasmanian Pademelon, Rufous Wallaby) - abundant, partly protected, found throughout the Great Western Tiers.

21.Bettongia gaimardi (Tasmanian Bettong) - wholly protected, is known to inhabit some areas of the Great Western Tiers.

Bettongs are considered the most threatened known species of mammal next to the Thylacine in Tasmania at present. Local high density populations have been seen to diminish rapidly. Their near relative from the mainland is nearly extinct. About 90% of the Bettong habitat is on private land being developed for pasture or with forestry operations underway. Their known western range is adjacent to Western Bluff in the south east Mt Roland area.

22.Potorous tridactylus (Potoroo) - common in remaining habitat areas, wholly protected, found throughout the Great Western Tiers.

There are 8 species of native bats in Tasmania, listed below. All species have been found in the Caveside/South Mole Creek area of the Great Western Tiers (Taylor et al 1986). Apart from this work little is known about these species.

23.Nyctophilus timoriensis (Greater Long Eared Bat) - uncommon, wholly protected.

24.Nyctophilus geoffroyi (Lesser Long Eared Bat) - common, wholly protected.

25.Chalinolobus gouldii (Goulds Wattled Bat) - uncommon, wholly protected.

26.Chalinolobus morio (Chocolate Wattled Bat) - common, wholly protected.

27.Falsistrellis tasmaniensis (Tasmanian Pipistrelle) - uncommon, wholly protected.

28.Eptesicus regulus (King River Eptesicus) - common, wholly protected.

29.Eptesicus vulturnus (Little Forest Eptesicus) - common, wholly protected.

30.Eptesicus sagittulla (Large Forest Eptesicus) - common, wholly protected.

There are five species of native rats in Tasmania, listed below. Some have very restricted habitat. Mastacomys fuscus (Broad-toothed Rat), for example, depends on areas of wet scrub/sedgeland which have been protected from fire for long periods.

There is not a lot known about any of the five species. Suitable habitats for all five species exist in the Great Western Tiers.

31.Hydromys chrysogaster (Water Rat) - common, partly protected.

A local survey in the Great Western Tiers found numbers diminished in most areas due to over-exploitation in the past.

32.Pseudomys higginsi (Long-tailed Mouse (Rat)) -common in limited habitat, wholly protected.

This species is endemic to Tasmania. They inhabit the wetter rainforest areas of the Great Western Tiers, for example, Westmoreland Falls area.

33.Pseudomys novaehollandiae (New Holland Mouse) - common, wholly protected.

34.Mastacomys fuscus (Broad-toothed Rat) - uncommon, wholly protected.

This species is considered vulnerable with insecure status. Nearest recorded location of this species was by Dr Bob Green, Queen Victoria Museum, in 1973 at Maggs Mt in the Cradle Mt area. No attempt to locate this species in the Great Western Tiers has been recorded though suitable habitat exists there.

35.Rattus lutreolus (Swamp Rat) - common, wholly protected.

Birds

Owing to the great number of different habitat types encountered, the region is rich in avifauna (birds), in both species diversity and population density.

As can be expected in an area with such habitat diversity in a relatively compact region, there is much overlap with regard to species types found in the various habitat forms. This makes for a good cross section of species breeding in the area and for the production of offspring from a strong gene pool. The richly forested slopes act as a large corridor, enabling juveniles to freely disperse and offering shelter and food requirements as these individuals seek out suitable unoccupied areas in which to take up residence.

Overall, the Great Western Tiers are home to 70 species of birds, of which 55 species are permanent breeding residents and 15 species are migrant. Of the migrant species, 13 rely on the area as a breeding ground.

Of the species total, 18 are endemic or of subspecific status.

The Great Western Tiers are considered a breeding stronghold for the vulnerable White (Grey) Goshawk (Mooney, pers comm).

A complete list of known bird species for the Great Western Tiers is given below. These are all positive sightings by two local naturalists, who independently arrived at almost the same list for the Liffey and Jackeys Marsh valleys. The exception was the Brown Quail.

(Species marked with an asterisk are Endemic or of Subspecific status.)

Resident Breeding Species

Spotted Pardalote	Pardalotus punctatus
Yellow Rumped Thornbill	Acanthiza chrysorrhoa
Brown Thornbill	Acanthiza pusilla
Tasmanian Thornbill	Acanthiza ewingii *
Superb Blue Fairy Wren	Malurus cyaneus

Scrub Tit	Sericornis magnus *
White Browed Scrub Wren	Sericornis frontalis humilis *
Field Wren	Sericornis fuliginosus
Grey Fantail	Rhipidura fuliginosa
Grey Breasted Silvereye	Zosterops lateralis *
Beautiful Firetail	Emblema bella
Dusky Robin	Melanodryas vittata *
Flame Robin	Petroica phoenicea
Scarlet Robin	Petroica multicolor
Pink Robin	Petroica rodinogaster
Golden Whistler	Pachycephala pectoralis
Olive Whistler	Pachycephala olivacea
Grey Shrike Thrush	Colluricincla harmonica
Yellow Wattle Bird	Anthochaera paradoxa *
Little Wattle Bird	Anthochaera chrysoptera
New Holland Honeyeater	Phylidonyris novaehollandiae
Crescent Honeyeater	Phylidonyris pyrrhoptera
Eastern Spinebill	Acanthorhynchus tenuirostris
Yellow Throated Honeyeater	Lichenostomus flavicollis *
Black Headed Honeyeater	Melithreptus affinis *
Strong Billed Honeyeater	Melithreptus validirostris *
Noisy miner	Manorina melanocephala
Whites Thrush	Zoothera lunulata
Brush Bronzewing	Phaps elegans
Common Bronzewing	Phaps chalcoptera
Spotted Quail Thrush	Cinclosoma punctatum
Brown Quail	Coturnix Ypsilophora
Grey Currawong	Strepera versicolor arguta *
Black Currawong	Strepera fuliginosa *
Richards Pipit	Anthus novaezeelandie
Laughing Kookaburra	Dacelo gigas
Forest Raven	Corvus tasmanicus
Butcher Bird	Cracticus torquatus
Australian Magpie	Gymnorina tibicen

Lewins Rail	Rallus pectoralis
Tasmanian Native Hen	Gallinula mortierii *
Yellow Tailed Black Cockatoo	Calyptorhynchus funereus
Ground Parrot	Pezoporus wallicus
Green Rosella	Platycercus caledonicus *
Eastern Rosella	Platycercus eximius diemenensis *
Southern Boobook	Ninox novaezeelandiae leucopsis
Masked Owl	Tyto novaehollandiae castanops *
Tawny Frogmouth	Podargus Strigoides
Owlet Nightjar	Aegotheles cristatus
White (Grey) Goshawk	Accipiter novaehollandiae
Brown Goshawk	Accipiter fasciatus
Collared Sparrowhawk	Accipiter cirrhocephalus
Brown Falcon	Falco berigora tasmanica *
Peregrine Falcon	Falco peregrinnus macropus
Wedge Tailed Eagle	Aquila audax fleayi *

Breeding Migrants

Striated Pardalote	Pardalotus striatus
Dusky Woodswallow	Artamus cyanopteris
Tree Martin	Cecropis nigricans
Welcome Swallow	Nirundo neoxena
Satin Flycatcher	Myiagra cyanoleuca
Pallid Cuckoo	Cuculus pallidus
Fantailed Cuckoo	Cuculus pyrrhophanus
Shining Bronze Cuckoo	Chrysococcyx lucidus plagosus
Horsfields Bronze Cuckoo	Chrysococcyx basalis
Swift Parrot	Lathamus discolor*
Musk Lorikeet	Glossopsitta concinna
Black Faced Cuckoo Shrike	Coracina novaehollandiae
Swamp Harrier	Circus aeruginosus gouldi

Non Breeding Migrants

Spine Tailed Swift	Hirundapus caudacutus
Japanese Snipe	Gallinago hardwickii

Fish

Native fish which would probably be found in the streams which form part of the Mersey system (for example the Lobster Rivulet) include Galaxias maculatus, Galaxias truttaceus and Prototroctes maraena (Australian Greyling).

Gadopsis marmoraties (River Blackfish), which is endangered on the mainland has been found by Inland Fisheries in the upper reaches of the Meander River. They are also present in the Liffey River. This species needs tree cover and snags to survive.

Reptiles

The list of species given below may be incomplete. Because of the large array of habitat types to be found on the Great Western Tiers it is probable that other lizard species are present in small pockets. The most likely candidates are the Tussock Skink (Leiolopisma entrecasteauxii), Whites Skink (Ergenia whitii) and the Mountain Dragon (Amphibolurus diemensis).

Lizards

1. Leiolopisma metallicum (Metallic Skink)

- Extremely abundant throughout the Great Western Tiers, from the foothills to the Central Plateau.

2. Leiolopisma ocellatum (Ocellated Skink)

- Endemic to Tasmania. Generally restricted to rocky habitats.Common on the Central Plateau but generally only encountered on the scree slopes of the Great Western Tiers at around 700m elevation. Food as for L. metallicum.

3. Leiolopisma pretiosum

- Endemic to Tasmania. Extremely abundant on the Great Western Tiers, mainly in forested areas. Food as for L. metallicum.

4. Tiliqua casuarinae (Slender Bluetongue) - Uncommon, patchy distribution.

5. Tiliqua nigrolutea (Blotched Bluetongue)

- Common in wet and dry eucalypt forest throughout the Great Western Tiers.

6. Drysdalia coronoides (White Lipped Whip Snake)

- Found throughout the Great Western Tiers from foothills to Central Plateau in all habitat types. Locally very abundant in rocky, grassy areas.

7. Austrelaps superbus (Lowlands Copperhead)

- Possibly absent from the area. Appears to favour low lying, open country. High population densities form around marshes, lagoons, dams and river flood plains where their principle food, frogs, are abundant.

8. Notechis ater (Tiger Snake)

- Abundant throughout the Great Western Tiers in all habitat types.

Invertebrates

As far as the authors are aware there has been no comprehensive survey of the invertebrate fauna of the Great Western Tiers.

Observational information (Mesibov and Cadman, pers comm 1989) suggests that the Great Western Tiers is a very important refugium for a number of relict groups, notably Onychophorans (Velvet Worms). All the species in this group of ancient animals are included in the IUCN Red Data Book of rare and endangered animals and conservation measures proposed are for control and monitoring of collection of these animals and encouragement of research including the maintaining of captive populations. These animals are found in large rotting logs on the forest floor.

Another invertebrate species of great scientific interest is Tettigarcta tomentosa (Hairy Cicada). This species is considered a living fossil and is morphologically almost identical to 40 million year old Texan fossils. This species is considered threatened. (Fry and Robinson 1986) A large population of this species has been found in the Bowmans Creek catchment. (Cadman, pers comm)

The upper parts of the catchments of the Great Western Tiers that do not contain trout, because of waterfalls and rapids, contain large populations of the relict species Anaspides tasmaniae (Mountain Shrimp). This species is also listed in the IUCN Red Data Book. This species inspired one of Tasmanias early naturalists to write, as quoted by Frederick R. Schram (Crustacea, Oxford University Press, 1986):

"However, I especially want to 'thank' the Crustacea, for being such a compelling, fascinating group that some days I can hardly wait to get to work in the morning to find out more about them. Geoffrey Smith expressed it well of syncarids in A Naturalist in Tasmania (Clarendon Press, 1909):

Goethe somewhere remarks that the most insignificant natural object is, as it were, a window through which we look into infinity. And certainly when I first saw the Mountain Shrimp walking quietly about in its crystal-clear habitations, as if nothing of any great consequence had happened since its ancestors walked in a sea peopled with strange reptiles, by a shore on which none but cold-blooded creatures splashed among the rank forests of fern-like trees, before ever bird flew or youngling was suckled with milk, for me time was annihilated and the imposing kingdom of man shrunk indeed to a little measure."

Mesibov (pers comm, 1989) considers the Great Western Tiers an ideal locality for the study of Velvet Worms because they are found within a very narrow altitudinal range. The same is probably true of other rare and unusual species.

Numerous species of butterfly are found in the area, the most notable being Neosenica leprea leprea (Leprea Brown). Other butterfly species found in the area include Hesperiidae sp., Graphium macleayanum (Macleay Swallowtail), Heteronympha banksii (Common Brown), Heteronympha penolope panope (Shouldered Brown, alpine variety), Vanessa kershowi (Painted Lady), Vanessa itea (Australian Admiral), Oreixenica spp., Lycaenidae spp.(Blues, Coppers).

The Land Mollusc (Caryodes dufresnii) is known to occur in the area.

Higgs (1994) studied the predatory litter beetles on Warners Sugarloaf. The beetles found are listed in table B.1:

Cave Fauna

The following description of the cave invertebrate fauna appears in Hunter (1983).

"The Mole Creek system is notable for the diversity of its fauna as well as the uniqueness of some of the species represented. To date invertebrate fauna described from the Mole Creek system known only from that locality include the isopod Styloniscus nichollsi Vandel, one species of Harvestman - Monoxyomma sp. n. and flies of the genus Spaerocera. Recorded occurrences of the pseudo scorpion Pseudotyrannochthonius typhlus Dartnall, and the beetle Tasmanotrechus cockerillii Moore indicate only one cave of occurrence outside the Mole Creek system, while more common species such as the Tasmanian Cave Spider Hickmania troglodytes Higg. and Pet., two cave crickets Micropathus cavernicola Rich. and Parvotettix goedei Rich. and the glow-worm Arachnocampa tasmaniensis Ferg. Additionally various specimens of the Acarina, Diploda, Chilopoda, Collembola and Diptera have been collected but are yet to be described."

A recent study of Kubla Khan Cave (Spate 1991) identified 71 invertebrate species.

A comparitively enormous, pale and apparently sightless form of the Tasmanian mountain shrimp, Anaspides tasmaniae (Eberhard et al, 1991), adapted to cave life, is found in several of the caves. Three forms of pale spiders which appear to live on clay banks within the caves and spin no webs are to be found. (D.Hunter, pers. comm)

In addition to the expected invertebrate fauna of the karst system, Glowworms have been found in a small sandstone cave straddling Bowmans Creek (Cadman, pers comm).

Table 1 Predatory litter beetles on Warners Sugarloaf. (after Higgs (1994))

Family	Sub Family/Tribe	Genus/species	
Staphylinidae	Staphylininae	Quedius sp 1,2,3	≤8mm, winged, highly mobile, specialised predator
	Euasthetinae	Protopristus sp 1	≤1mm, blind, deep litter resident, wingless, probably preys on mites
	Proteininae	Anepius koebelei	Gondwanic affinities, 3.5mm, wingless
		Austrorhysus sp1	
	Paederinae	Hypercomma sp 1	highly mobile and specialised predator, ≤5mm
	Oxytelinae	Anotylus sp 1,2	primarily saprophytes, living on dead & decaying plant material
	Osoriinae	Osorius sp 1	saprophyte
	Osoriinae	Holotrochus sp 1	saprophyte
	Osoriinae	Holotrochus "sp 4"	saprophyte, new Tasmanian record, previously found in mid-northern NSW, 3.5mm, deep litter resident with fossorial tibiae
	Scaphidiinae	Scaphisoma sp 1,2	saprophyte, though some feed on slime moulds
	Aleocharinae	sp 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	mainly free living, highly mobile specialised predators, large, ≤6mm
Pselaphidae (predatory on minute invertebrates incl. Collembola)	Euplectini	Euplectops sp 1, 2, 3	all winged
	Brachyglutini	Rybaxis parvidens	
		Rybaxis sp 1, 2, 3	
		Eupines sp 1	
	Pselaphini	Pselaphaulax bryophilus	
		Pselaphaulax sp 1	
		Tyromorphus auricomus	
		T. auricomus grp sp 1	
Scymaenidae (probably mite predators)	Euconnus clarus		
	Euconnus sp 1, 2, 3		
	Euconnus sp 4 cf abundans		
	Euconnus sp 5, 6, 7, 8, 9		

3.4 Landscape

The whole area is highly visible from fore, middle and background views. The visual catchment for the area is very large, of the order of a quarter of a million hectares.

The Great Western Tiers forms the major landscape backdrop to towns and communities from Mole Creek in the west to Hagley in the north and Longford in the east. The area is the major scenic viewfield of Deloraine.

The area is also seen from within the World Heritage Area and major walking destinations outside the WHA, for example Mt Roland and the Alum Cliffs State Reserve.

The area is seen from major tourist roads, the Mole Creek Rd, the Mersey Valley Rd, the Bass Hwy, Midlands Hwy and scenic view points on these roads. In addition the area is seen from the minor tourist roads traversing the base of the Tiers. There are spectacular views from the Lake Highway and Poatina Highway which ascend the Tiers. (The top of the Tiers on the two highways are the highest major road altitudes in Tasmania - Lake Highway at Pine Lake 1210m and Poatina Highway at Starvegut Hill 1185m.)

The Longford Council has zoned the area south of the Liffey River as a scenic buffer area.

Landscape description

Colour: The area is a mosaic of greens and green/blues reflecting the differences between vegetation communities. Particularly apparent is the contrast between rainforest, eucalypt, silver wattle forest and cleared land, the wattle forest in some years providing a magnificent golden floral display, giving a sharp colour contrast. The brown/yellow sandstone and grey dolerite cliff bands also provide colour diversity.

Form: The area is aptly named the Great Western Tiers with steep slopes and benches. The sandstone cliffs are a very dominant landscape feature on the slopes between Mother Cummings peak and Drys Bluff. The steep slopes are dissected by a number of highly visible gorges. The whole length is capped by the imposing grey, columnally jointed dolerite cliffs. The form is complemented by an outlier montain, Quamby Bluff, and the foothills, Warners Sugarloaf and Archers Sugarloaf.

Texture: Textural diversity is provided by the differing age classes of vegetation, the eucalypt overstorey on the older forest sites and the textural contrast provided by the sandstone and dolerite cliffs and the cleared land.

The Tiers are snow capped in winter with drifts lingering into late spring or summer in places.

3.5 Hydrology

The Great Western Tiers contain a multitude of streams. There are about 32 named streams and about 150 unnamed streams apparent within the Western Region on Lands Department 1:25000 maps. There are many small streams both permanent and non permanent not shown on maps.

Of the total number of mapped streams in the Western Region, about 36 flow directly off the Central Plateau. Those streams which do not flow directly off the Plateau originate from springs or from runoff from the slopes of the escarpment. The swamps and lakes of the

Central Plateau provide a most reliable source for the streams originating there, and may also be a source of the water emerging from the springs.

The springs are most frequent around the contacts between the major rock strata. Some areas contain a myriad of small streams originating from springs.

Most of the streams are subject to very high peak or storm flows. A combination of heavy rainfall and snowmelt can result in large surface flows through the forests.

The water from the streams and springs is greatly valued for its high purity by local domestic users. There are many individual domestic take off points within the State Forest or within a few kilometres of the State Forest boundary. Some community supply schemes also draw from the streams.

A number of swamps and bogs exist on poorly drained topographic benches.

3.6 Geology and Geomorphology

The oldest rocks in the immediate area are limestones of the Ordovician Gordon Group in the Mole Creek area. More than 1000m of limestone is present - variously oncolitic, cherty, coraline or micritic. The rock is often fossiliferous, abundandtly so on some horizons. Fossils include stromatolites, brachiopods, corals, bryozoa, gastropods, ostracodes, cephalopods and trilobites. The limestone was deposited in a generally shallow, marine environment (subtidal - supratidal)

Gordon Group limestone is overlain, apparently conformably, in several localities by Silurian sandstone and quartzite.

Folding during the Devonian has produced southeast - trending, gently plunging folds.

Rocks of the Parmeener Supergroup (Carboniferous - Triassic) uncomformably overlie the Ordovician and Silurian rocks, and this surface has some relief.

The Lower Parmeener Super Group has a thickness of upto 600m and outcrops fairly persistently on the lower slopes of the Tiers. It is predominantly marine, but contains two freshwater sequences. The rocks consist of conglomeratic sandstone, quartz sandstone, mudstone and occasional limestone. Erratics (of quartzite, schist and slate) occur, in profusion on some horizons. Carbonaceous shales (plant-bearing) occur higher in the sequence. These virtually flat-lying Permian rocks crop out on the middle to lower escarpment slopes in the form of benches, a result of differential erosion of the various rock units.

A system of sediments deposited under lacustrine or swamp conditions, the Upper Parmeener Supergroups, overlie the Lower Parmeener Supergroup with a conformable/transitional or disconformable contact where they occur at an altitude of 700m. They consist of up to 350m of quartz sandstone, "feldspathic" sandstone and shales. Cross-bedding may occur in the sandstones and plant fragments are common, particularly in the shales. Thin carbonaceous bands are common within the sandstones in the upper part of the sequence. These rocks generally form a pronounced bench and crop out distinctively as cliffs or steep slopes at the edge of this bench.

Jurassic dolerite is a very noticable feature of the Tasmanian landscape generally, and the Great Western Tiers in particular. The dolerite was emplaced as a liquid some 175 million years ago. It rose through the basement rocks into the Parmeener Supergroup rocks and now caps the Tiers/Central Plateau. It is a sill-like intrusion of the order of 300m thick, and is transgressive of the order of 350m stratigraphically. A "hornfelised" contact zone may be observed (up to 10m wide in shaly beds) in sediments adjacent to the dolerite.

The Central Plateau horst was upfaulted commencing about 65 million years ago. Possibly 0.5 to 3.5 km. of cover rock have been lost from the dolerite.

The dolerite has produced a steep escarpment characterised by high, joint-banded columns at the foot of which are talus slopes. Talus and scree at the base of the scarp is up to 150m thick. The strongly developed, near-vertical joints in the dolerite (in addition to cooling features) are probably related to Tertiary fault systems.

Sloane (1986) described the Jurassic dolerite in some detail:

"JURASSIC DOLERITE. The Central Plateau..(is) underlain by Jurassic dolerite, which crops out as cliffs at the head of the upper escarpment slopes........The overlying rocks have been subsequently removed by erosion and the exposed upper surface of the dolerite sheet has itself been eroded. Dolerite also caps Warners Sugarloaf. The position of the lower contact of the dolerite is often mantled by slope deposits, ...The base of the dolerite is approximately accordant at 1000m but at Warners Sugarloaf and on the eastern face of the Tiers the sill is more transgressive in nature and the lower contact is approximately between 700m and 600m.

DOLERITE SCREE. Scree slopes are found immediately at the base of the dolerite cliffs of the upper escarpment....They consist of accumulations of rock fragments up to six metres in diameter with little or no matrix. The dolerite rock fragments have been shed from the cliffs by processes involving ice wedging, frost action and gravity.

DOLERITE TALUS. Mass wasting of the dolerite escarpment of the Tiers ...has produced extensive deposits of dolerite talus. The talus consists of weathered and unweathered dolerite blocks in a yellow-brown to red-brown silty and clayey matrix....Some talus composed of angular blocks of quartz sandstone in a light grey sandy matrix is usually found close to the base of the Triassic sandstone scarps.

.....The scree and talus mantles may obscure the stepped slope profile of the upper escarpment as the deposits often overlie the benches formed by the Triassic sandstones and in some cases, the Permian rocks.

An interesting geomorphological feature of the Great Western Tiers is the deeply incised gorges.

Karst features have developed on the Ordovician limestone and the karst landscape is surrounded by topographically higher areas of non-carbonate rocks with surface drainage. Surface drainage from the surrounding slopes is responsible for much cave development when it enters limestone .The sediment load carried by such streams is also important.

The precise extent to which Pleistocene glacial ice has affected the karst is uncertain, however ice descended the slopes of the Great Western Tiers at some stage and probably invaded the eastern margins of the Mole Creek karst during an early Pleistocene glaciation (Kiernan 1982, 1984). Glaciofluvial fans occur south of Mole Creek, and possible end moraines occur east of Westmorland Creek.

The caves contain a great variety of deposits - including decorations contributing to the spectacular scenery of many of the caves. Karst is described in more detail in the next section.

3.7 Karst

Introduction

The term "karst" is a German word and can be defined as "a terrain with distinctive characteristics of relief and drainage arising from a higher degree of rock solubility in natural waters than is found elsewhere" (Jennings 1971). In practice, karst is normally confined to areas of limestone or dolomite bedrock. The prime significance of karst regions stems from the marked solubility of the carbonate rocks. The solubility results in the normal association of limestone regions with near waterless surface conditions. The paucity of surface water gives rise to a need for maximum information on groundwater resources (Smith 1977). On climatic grounds, one would expect streams in the Mole Creek area to be largely perennial; however, the Mersey River is the only one. All other streams lose sufficient water underground either to abandon reaches of their channels for periods of time or to have permanent underground courses over part of their length (Jennings 1967).

The Mole Creek karst is highly scenic with a variety of karst resources. The limestone belt measures some 26km east to west and up to 10km north to south, along the foot of the Great Western Tiers.

The presence of enormous deposits of limestone in the vicinity of Mole Creek and Chudleigh has been noted since the middle of last century. (Strzclecki 1845, Gould 1860,1861, Johnston 1888) Then, as now, the main interest in these high grade and freely accessible deposits was confined to the scenic beauty of the caves formed in them. (Jennings 1963)

The underground drainage system which has developed has resulted in the formation of cave systems which have been exploited as a tourist attraction and used by speleologists for study and recreation. The limestone areas in the Mole Creek valley represent wonderful examples of karst topography. The Mole Creek karst includes examples of all stages of karst development from youthful to senile.

There are several examples of breaches of surface drainage divides (Jennings 1963, Kiernan 1984, 1989) and other unusual or representative classic karst landforms.

A full understanding of the nature and management of the karst resources is best obtained by the study of the whole range of karst features in which the geomorphology and hydrology are intimately linked and of major importance (Smith 1977, Jennings 1967)

The maintenance of almost all karst resources, namely economic, scientific, educational and recreational, hinges upon the maintenance of natural water flow and chemistry. The karst environment is highly interactive and systemic (Kiernan 1988).

Systems

Mill Creek Area

Kiernan (1984) defines the Mill Creek topographic area as being about 16 sq km. It is drained by Kansas Creek, Vanishing Creek and Mill Creek and contains two large enclosed depressions (uvulas). Drainage resurges into the Mersey River. Altitude ranges in the area from 1,400m to 290m. Kiernan et al (1994) states is an excellent example of a major integrated karst hydrogeological system.

A number of dry valleys occur within the Mill Creek area karst, as do numerous sinkholes of the lower order, especially along the upper margin of the limestone contact, and two very large sinkholes of the higher order which feed Vanishing Creek (Rat Hole) and Croesus Cave. These uvulas are on the topographic bench (400m elevation) above the caves. Rat Hole has now been revealed to be extensive and utterly fundamental to the hydrological and geomorphological study of the western foothills of Western Bluff (Kiernan 1984).

Croesus is a major "restricted access" cave system 2km long, famous for its large and extensive gour pools (rim pools) and other elaborate decorations. The Croesus Cave State Reserve essentially encompasses only the entrances and first few hundred metres of Croesus Cave and Lynds Cave, which is also "restricted access" and over 1km long. The existing reserve does not include the caves' catchments.

Mill Cave (Tailender) is developed on two levels and is directly connected hydrologically with the Rat Hole. The cave contains important clastic deposits and fine speleothems including helictites which are virtually unparallelled elsewhere in Mole Creek for diversity and intricacy (Hunter pers comm).

There are several other caves and major discoveries have been made as recently as 1992 and 1993.

Water tracing has revealed two principal drainage systems; Kansas Creek directly into Lynds Cave and Vanishing Creek into Rat Hole (and Tailender). There is no stream to account for the largest Mill area cave, Croesus, which paradoxically contains the smallest stream. Also, the flow of this stream varies very little with the weather (while the others do), apart from one or two known floods. One implication is that Croesus might be fed by seepage and another is that part of the flow could come from a large body of water via a very restricted conduit. The rare floods may be caused by overspill through higher old routes. Some significant karst development may lie further than the known limits of this and other caves and may involve cave/s of nationally significant depth. (Kiernan et al 1994).

Many questions remain, but the significance of the karst developments is beyond question. There are strong genetic links between the 3 drainage (sub)systems in the Mill Creek area. Recent investigations suggest that interflow between systems under very high discharge conditions now seems inevitable (Kiernan et al 1994). The implication in case of surface disturbance by human activities is serious indeed. Soil stability and the maintenance of forest cover are critical, particularly for the maintenance of the unique gours of the Croesus streamway. The Mill Creek area is deserving of reservation in its own right. The recent discoveries and compilation of data are the evidence for the existence of a major integrated karst drainage system. The highest level of protective management is warranted for this very important complex (Kiernan et al 1994).

Some speculation exists as to human impact on sites in the area - siltation and logging debris in caves and a recent collapse in Croesus, the cause of which is unclear. Recent studies compound evidence that past logging activity has led to water chemistry and sediment flux changes injurious to some of the caves and national estate values generally. (Kiernan et al 1994).

There has also been vandalism and pilfering in Croesus, but better gating and route definition within the cave ensure a better outlook. Overall, integrity of the karst landforms in the Mill area is good.

Loatta (King Solomon) Area.

This block contains Execution Pot and Long Drop (near Marakoopa Cave State Reserve) whose water travels via Lime Pit Cave to resurge above Liena township into the Mersey River. It also contains the tourist cave, King Solomons Cave, and some of its well decorated tributary caves nearby and its resurgence, Soda Creek Cave, an important recreational cave near Liena. Two actively-forming travertine cascades (calcium carbonate deposits outside caves at resurgences) exist at Little Trimmer Cave (in the dry valley below Execution Pot) and at a site 1 km to the north-east (Kiernan 1984).

Kubla Khan and Ghengis Khan Caves are contained within a State Reserve adjoining State Forest in the east of the Loatta Area. Kubla Khan is nationally famous and has over 2 km of passage. It is rated by John Dunkley (1983 pers comm), the then President of the Australian Speleological Federation (ASF), as being among the top 10 caves in the world by various criteria. Kubla Khan contains the largest stalagmite in the Southern Hemisphere (20m). Its neighbour, Ghengis Khan, is also a gated and "restricted access" cave, important for its speleothems, crystal formations and genetic relationship to Kubla Khan.

Marakoopa Cave State Reserve Area

This area extends from the escarpment at Western Bluff to 450m elevation. It contains the catchment of Gillam Creek down to 690m elevation, which feeds several caves downstream, and the majority of the forest catchment of Marakoopa Creek. The western extremity of the area is the catchment for the important vertical and decorated cave systems of Execution Pot and Long Drop. Kansas Creek, which drains into Lynds Cave ("Mill Creek Area"), also rises in this area.

The upper reaches of the Marakoopa Creek gully contains rich humus soil with Nothofagus cunninghamii up to about 20m high. This steep gully descends in a series of cascades over bedrock benches. Marakoopa Creek falls into the spectacular collapse doline of Devils Pot (105m deep). Adjacent to this formation is the large complex doline of Devils Earhole. A cave of the same name is located at the base of the doline - a former inflow cave which contains the uncommon phenomenon known as oolites or cavepearls. The doline also harbours a small rainforest in its ideal microclimate, surrounded by dry sclerophyl forest above.

The significance of the Marakoopa cave system itself is well known. It is a system of major importance which extends far beyond the "tourist" section. It contains good decoration, gypsum formation and glow-worms. The upstream sections are well-known by recreational cavers and include a vertical entrance. There are many other caves in the area, including one of considerable significance discovered in 1984 only metres away from the picnic area (Kiernan 1984).

The Sassafras/Mayberry Divide Area

The area is deeply incised by dry valleys, most of which follow the strike of the limestone beds. There are large areas of unexposed rifts on the ridge top, numerous minor sinkholes on the divide, and at the foot of the Standard Hill a magnificent array of collapse sinkholes of the higher order (Jennings 1963) under which the Mayberry depression (polje) drains eastwards to Sassafras Creek. Recently formed minor dolines in a logged area near Prohibition Cave on adjoining private land clearly post-date the logging (Kiernan 1984). The scarcity of similar fresh sinkholes in the forested country suggests that their formation may have been accentuated by forestry activities.

There are probably more resurgences known along the Sassafras Creek than in any other single area of the Mole Creek karst. At least 20 are known. The largest of these is probably Sassafras Cave but another very large resurgence is just south east of the nose of Standard Hill, and is almost undoubtedly the main flow from the Mayberry Polje. Smaller examples are numerous, most being on the west side of Sassafras Creek. The inflow of My Cave, a well developed adventure cave resurges at Cyclops Cave, within the Baldocks Cave State Reserve.

Deep grikes in the limestone are very common on the divide, with some vertical solution pits and pipes 50mm or more in diameter.

Numerous caves are fed from the divide and catchment above Sassafras Valley, the most important being My Cave, Baldocks Cave, Sassafras Cave and Prohibition Cave. Several entrances, some vertical shafts, have been located by local speleologists, and are are being systematically explored, evaluated and mapped. Rift complexes, subterranean lakes and erratic speleothems are some of the features. Known caves have been extended recently beyond previously known extents, including a well developed complex. (Lichon, 1994).

Stream relationships and hydrology are uncertain between Prohibition Cave and the lower caves. There is speculation in caving circles of a "master cave system" awaiting discovery under the divide. (D.Hunter, pers. comm.)

A small area of presently private freehold land comprising the immediate catchment and environs of Prohibition and Depression caves warrant protection as "Underground National Park" under the private land as in the NSW model, and as proposed in an election promise by the last outgoing Tasmanian Labor Government.

Mole/Lobster Area

The catchment for arguably the most important karst drainage system in terms of the cave resource and hydrological significance is extensive. The water which sinks into Kellys Pot at around 550m near the boundary of State Forest and Crown Land is known to flow eastwards to the Wet Cave (Mole Creek) system under the Mole Creek/Lobster Rivulet surface divide via Herberts Pot (Jennings and James 1967). The other streamsink on Crown Land in that vicinity, Waterworks Cave, drains into the Mole Creek valley below, west of the surface divide. To the east, the water sinking at Westmoreland Cave (below the Falls) also flows to this system. The catchment on this side extends across Parsons Track near to the escarpment.

The entrances of Wet Cave and Honeycomb complex, the most frequented recreational caves in the Mole creek district, are contained in a 100 acre reserve (Wet Cave Reserve) was leased to the Meander Valley Council and sub-leased to a neighbouring farmer until recently and is now returned to the Crown.

Kiernan (1984) claims that the system of caves within the Mole Creek/Lobster Rivulet divide is of a complexity and scale without parallel in Australia. It includes one of the nations longest single caves, a double breach of a surface drainage divide, stream bifurcations and two system endemic invertebrate fauna species. The system resurgence is at Scotts Rising, 3 km south of the Mole Creek township.

Protection of the catchment for this system is vital.

Much of the Mole/Lobster system is under private land but most of the upper catchment for this very important system would be protected by the National Park. The greatest potential for protection of this system system lies either within the Local Government Act, through Council regulations, or better still by declaration of an "underground National Park". As proposed in Kiernan (1984), some grazing on existing cleared land above the underground National Park could be allowed

There exists much need for sensitive land management in other privately owned areas adjoining the Proposed National Park to protect the karst. This may be affected by declaration of Conservation Areas jointly managed by government and private owners under management plans. However, the Mole/Lobster system's significance demands underground National Park status.

Dogs Head Area

The Dogs Head hill itself is an example of a classic residual karst surface landform known as a "hum", possibly the only true hum in Australia (Kiernan 1984). It is roughly conical in form and rises about 270m above the Mersey River.

A number of sinkholes have developed upon the Hill and along the lowest point of the "windgap" between the Hill and Standard Hill. Examples include the collapse doline of the upper entrance to Union Cave on the northern side and alluvial streamsink dolines at the southern foot of Dogs Head Hill. Numerous rifts in the limestone bedrock occur upon the Hill, some of which lead to caves, including Moss Palace and Bone Rift. There are numerous soaks along the course of small streams which descend from Standard Hill, and there are three resurgences, the largest of which is Union Cave, at river level. Two smaller resurgences occur on the south side.

Union Cave is the major subsurface development - 490m of passage including helictites and two sumps. A major discovery was made on the southern side of Dogs Head in 1987 when local cavers found "Moss Palace", a rift cave which contains phytospeleothems, a rare combination of calcite and mosses (Lichon, 1992a&b). This formation is so well developed and fragile that preservation of the hum might well be justified on these grounds alone. Another more recent discovery (Bone Rift) contains extensive bone deposits which await evaluation.

Slopes of 20-45% on the northern side, up to 50% on the southern side and thin residual karst soils mitigate against logging activities on Dogs Head Hill and its catchment on Standard Tier and the windgap. The Dogs Head Hill outlier to the Proposed National Park now includes the full catchment for the Dogs Head system and takes in an area of exceptional scenic value between the Standard Tier and the Mt Roland Protected Area. Logging operations north of the Mersey River, close to this area, threaten the scenic values and at the very least a streamside reserve of 500 metres should be left unlogged.

Mole Creek Karst National Park 2006

In 1996, following the Tasmanian Regional Forests Agreement (RFA) and subsequent public consultation process, a total of 11 geographically discrete former unallocated Crown land blocks and state reserves recognising caves and scenic geomorphic features were rededicated collectively as the Mole Creek Karst National Park, totaling 1,345 ha. An adjacent 68 ha of private land was purchased for a Conservation Area in 2000. The Marakoopa block (formerly the Cave Country Reserve) is the only component in the WHA. Since 1996, some important geographical links between blocks of the MCKNP have been purchased from private land for conservation under the Karst Forests Program (see below). The Great Western Tiers Conservation Area was also declared following the RFA in 1999, commencing with the conservation of the proposed Caveside State Forest, with smaller additions being gradually made over several years. The 22,495 ha GWTCA has increased the area of karst lands dedicated for conservation management (see Mole Creek Base map V2 below) and improved the contiguity of conserved lands over some karst sub-systems. Of particular significance, the GWTCA on the Sassafras/Mayberry divide excludes logging from approximately 1,000 m topographic extent, while the purchase of private land over the lower Mole Creek karst sub-system protects the forests over an especially densely cavernous part of the karst. The area of the formerly proposed Caveside State Forest on the slopes of the escarpment protects much of the karst catchment above the limestone geological contact from logging.

Private Tenure Karst Lands 2011

By December 2011, further private tenure karst lands have passed into both public conservation tenure and private conservation covenants. The Tasmanian Land Conservancy (TLC), in administering the Karst Forests Program and its own revolving land fund, gives the following figures (Rod Pearse TLC, pers. comm., December 2011):

- 376 ha purchased for public land
- 68 ha to be covenanted and resold
- 99 ha of private land covenanted

This land is shown in the attached "Mole Creek Base map V2," excepting for one of the private land blocks not shown for reasons of privacy at the owners' request and the most recent purchase for public land. This land, 60 ha in extent, is currently under contract and is shown separately on the following map.

Further research is required into the security of the several forms of conservation tenure over karst lands and the implications for continuing threats to karst processes, ecosystems and ecological services.

3.8 Climate

General

Coates (1988) contains a concise description of the local climate variables. This study was conducted for the area east of Mother Cummings but is generally applicable to the areas further west:

"Local records for the study area are not available.The nearest weather station is Deloraine and the nearest rainfall station is Meander."

"Weather conditions on the Western Tiers vary by comparison with the above places, due to increased elevation and steeper topography, and the frequent occurrence of mountain mists and fogs (Foresty Commission Tasmania 1984).Precipitation is higher and air temperatures are cooler. Numerical data are presented in Appendix 8 Climate Data

"Average annual precipitation at Meander is 1082mm. The area experiences its wettest period from May to September under the influence of the broad westerly wind band (Forestry Commission Tasmania 1984). Heavy rain may fall at any time throughout the year when it is associated with either a northeasterly or northwesterly air flows around a low pressure system near Bass Strait (Forestry Commission Tasmania 1984). During cold weather, precipitation may fall as snow."

"Over one hundred frosts occur each year (Forestry Commission Tasmania 1984) and below zero minimum temperatures are usual between May and September. Summer conditions are mild to warm although they may reach maxima of up to 35oC (Forestry Commission Tasmania 1984)."

"The prevailing wind is from the northwest quarter and may bring fine or rainy weather to the area. Calm conditions are most common between April and June while strong winds associated with warm north westerlies are most frequent in spring and summer. Wind speed varies locally around the base of the cliffs, which are largely protected by the surrounding forest, or by the indented nature of the formation."

On the western end of the Tiers, the prevailing winds are more westerly to southwesterly than northwesterly.

The Tiers carry snow in winter with drifts lingering into late spring or summer in places. Summer snow on top is common.

During the record Tasmanian freeze in June 1983, the temperature on Drys Bluff fell to -15.3oC.

Climate Gradients - Conservation Significance

Rapid climate change and the potential impact of this human generated problem has been the subject of considerable concern in the last few years. The likely problems created by this phenomenon are not confined to the obvious implications of rising oceans. Climate change may have a profound effect on many plant and animal species.

The diversity of microclimates and the steepness of climate gradients on the Great Western Tiers are two of the more important factors in determining the high conservation significance and the need for secure reservation of the escarpment. All of the escarpment has been mapped (Nix 1987) as having very steep climate gradients.

Professor Henry Nix, the leading expert on biological climate modelling in Australia, had this to say to the Lemonthyme and Southern Forests inquiry (Nix 1987):

"*Any reservation of species and communities that has a currently restricted climatic range must include the provision for a climatic buffer to allow movement of species and communities. This is best achieved where current climatic gradients are very steep, allowing* *movement up a slope, or very broad where "erosion" at the edge will not eliminate the species or community....The slopes of the Western Tiers in the vicinity of Quamby Bluff which is at the junction of Eastern and Western climatic regions has refugia habitats containing species from both regions growing together (Kirkpatrick, 1986). It is likely that the Forth and Mersey valleys also contain refugia sites. In this context, the presence of low to high altitude vegetation sequences from approximately 300m-1400m in the Forth, 800m-1500m in the Mersey and 300m-1300m from Jackeys Marsh to the top of the Western Tiers escarpment, are of prime importance....*".

Futher comment is supplied by Cullen and Kirkpatrick (1988):

"*If the upward shift in vegetation-climate zones proceeds at a faster rate than species can migrate then these species are in danger of being restricted to relict patches stranded in a hostile environment. Slow-growing, poorly dispersed species such as A. Selaginoides and A. cupressoides are at a greater risk than tree species which can mature more rapidly or have long distance dispersal characteristics. Successful upslope migration of Athrotaxis species is most likely to occur where the temperature (altitudinal) gradient is steep and the distance to safe habitats is short. Steep altitudinal gradients occur throughout much o the Central Highlands and on the edge of the Central Plateau.*"

3.9 Recreation

Walking

The proposed National Park area contains many valuable walking tracks and opportunities for untracked exploration. The tracks lead through the various vegetation types. The higher portions of many of these tracks offer outstanding views out over the plains to distant mountains and ocean, along the Tiers, down over the forested slopes and out to the dolerite cliffs, boulder fields and subalpine and alpine forest, scrub and heath. Many offer intimate experiences of mountain streams, streamside riparian vegetation and native conifers. Each track has its own special features.

The **Western Bluff Track l**eads from Erks Loop to the summit of Western Bluff from where spectacular views can be obtained.

Devils Pot/Devils Earhole Track in the Marakoopa Cave State Reserve is a recently opened, restricted access walk up to some deep sinkholes.

The **South Mole Creek Track** was used by the HEC for access to Lake Mackenzie.

Marakoopa Forest Walk is a short nature trail.

Parsons Track leads via two distinct benches to a particularly beautiful small wet valley on the Plateau which gives a spectacular display of Richea scoparia in season. The track has two well kept huts. The upper hut (Haberles Hut) is an old trapper's hut of unusual design which has been renovated. An alternate route from the lower hut (Hills Hut) to the Plateau traverses a bench below the Plateau which has a spectacular Waratah display in season.

Sentinel Rock Track is an alternate route down from Haberles Hut which connects with Parsons Track. It follows a gorge through interesting Sphagnum and King Billy Pine.

Westmoreland Falls Track is one of the most beautiful short rainforest walks available anywhere.

Higgs Track climbs the side of Nells Bluff through rainforest and provides the most direct and well known access to the main alpine lakes in this region (Chudleigh Lakes).

The **Western Creek Track** leads through the deeply incised "Western Gorge" with stands of native conifers, providing a direct route to Lake Ironstone via Whitelys Hut.

Syds Track climbs quickly to the Plateau through the "Little Gorge" with a lovely area of Dwarf Myrtle and King Billy Pine forest and provides a direct route to Mt Ironstone.

The **Mother Cummings Peak Track** climbs from Westrope Road to a valley on the Plateau which connects readily with the track which climbs beside Mother Cummings Rivulet from the south. It also provides the best access to Mother Cummings Peak (northern peak).

Scotts Track leads from the end of Scotts Road up the eastern side of Mother Cummings Summit (southern peak).

Mother Cummings Rivulet Track provides access to Cummings Mountain from the south via a sheltered rainforest gorge which is well known for its King Billy Pine.

The **Smoko Creek Track** leads to the Mt Ironstone trig point. An alternative route runs via Chasm Falls. Shute Falls are also accessible on the way.

Stumps Track is a steep old trappers track which leads off Smoko Creek Track to the Plateau through a "bearded" Myrtle forest. It also provides access to a coal seam under Bastion Bluff.

The **Dell Track** leads off Smoko Creek Track up onto Bastion Bluff via some small tarns.

Stone Hut Track leads past an old trappers shelter to Bastion Bluff or connects with the Cleft Rock Track.

The **Bastion Cascades Track** features rainforest, sandstone cliffs and spectacular waterfalls and is extremely rugged.

The **Split Rock Track** leads from the Apex Hut to Meander Falls via a subalpine plateau below Bastion Bluff. The Shower Cave Falls and the Cleft Rock Falls are accessible from this track. A side track leads up to Lake Meander through a mossy alpine valley below the lake.

The **Meander Falls Track** follows the Meander River through rainforest and is the best known walk in this area.

Dixons Track leads from the Meander Falls Track and follows Staggs Creek to the Plateau.

Staggs Track (Sales Lake Track) leads from the top end of Bessels Road and follows an old trappers track through spectacular dwarf Myrtle forest. It comes onto the Plateau at Sales Lake and provides quick access to Wild Dog Tier.

Johnsons Track also leads from the top end of Bessels Road to the Plateau. It is an old stock route.

Old Powerline Track provides quick access to Johnsons Crag. It features stonework hand laid by the transmission line builders.

Warners Track follows the old Lake Highway. It features old Native Pine bridges and spectacular hand laid stonework, and leads past Adams Peak to Pine Lake.

Fairy Glade Track leads from the Lake Highway to the summit of Quamby Bluff through very old Myrtle forest in the upper portions. It provides easier walking than the northern track which leads from Walking Track Road in Golden Valley.

A further track connects Jackeys Marsh with the summit of Quamby Bluff. This track leads through mixed forest containing some very large Eucalypts.

The **Liffey River Track** connects the Liffey Falls picnic area with the viewing spot on the Lake Highway just below the edge of the Plateau. It follows the Liffey River all the way.

The **Liffey Bluff Track** starts near the bottom of the Liffey River Track and provides a good long climb to the Plateau.

Liffey Falls from top picnic area

Liffey Falls to lower picnic area

The **Drys Bluff Track** is a very long and steep climb to the top of the Bluff from where the views are spectacular.

The **Blackwood Creek Track** leads from the end of Blackwood Creek Road to the Plateau, past some sandstone cliff overhangs.

The **Bradys Lookout Track** ascends to the Plateau from the Poatina Highway.

The Great Western Tiers have been traditionally enjoyed by European settlers as a means of access to the Central Plateau for recreation, fishing and trapping. Styant-Browne (1899) describes an excursion up Higgs Track:"...After winding up the mountain for some distance the top was approached and the track became more steep and rocky, and at length a beautiful peep of scenery was seen from what is called "Nells Lookout". A halt was called and the scene duly admired and photographed, and then a short distance further on another peep of the mountains peaks tempted us to secure a picture of it. After a sharp pinch of a half a mile or so we at length landed on the summit, where a magnificent view of the surrounding country was obtained, though part of it was obscured by mist. The plains lay spread out like a map at our feet and the bright gleams of the sunshine resting on some parts, with the clouds casting grey shadows over others, was very beautiful; the scene stretching from Chudleigh and Deloraine to Port Sorell and Devonport in the far distance. The peculiarity of the Western Tiers is that when you get to the top about 3000 feet high, level plains extend for many miles, watered by lakes of various size, and out of these plains again spring other mountains...."

Jetson (1989) describes early use of the Great Western Tiers for recreation and tourism:"...access tracks up the front of the Tiers. Griffins Track was but one of many which were making the Plateau increasingly accessible to the tourist and angler. In 1894 the Deloraine and District Improvement Society mentioned two tracks, Scott and Dunhams and Warners Track from Jackeys Marsh. Along the latter, anglers could make a day trip from Great Lake. The Deloraine Group persevered with track improvement and by 1897 C.J.L. Smith and John Napper drove the first vehicle to the summit of the Western Tiers. Negotiations were under way for an accommodation house at the northern end of Great Lake to augment the hospitality of Don Brandum. Other tracks ascending the northern face of the Tiers were from Tubbs at Blackwood Creek to the Sandbanks on the north eastern end of the Great Lake, Parsons Track from Caveside and Higgs Track to Lake Lucy

Long...Another past-time was photography and Ilford Dry Plates and Lantern Plates provided a variety of techniques for enthusiasts."

Caving

Mole Creek is one of Australia's most renowned caving areas, especially so for the beauty and state of activity of its cave formations and also the density of subsurface developments over a fairly compact and accessible area. The caves of Mole Creek, because of less recreational pressure to date, are in extraordinarily better condition than mainland caves.

The most famous cave is Kubla Khan. Other famous caves exist within the proposed (1995) National Park area, such as Croesus, Lynds, Execution Pot, Marakoopa, Devils Pot and Devils Earhole, Anastamosis, My Cave, and Baldocks. Other famous caves, which are outside the area but whose catchments are within the area, are Kellys Pot, Herberts Pot and most of the Eldorado/Wet Cave system.

The area offers a wide variety of challenges for cavers of varying degrees of proficiency. Hard, "sporty" caves such as Rat Hole and Soda Creek cave challenge the hardiest. Execution and the Devils system offer the pleasures of multiple-pitch vertical caving and photographers enjoy the delights of caves such as Croesus, Lynds and Marakoopa. Through trips are possible in some systems. Following both "Speleomania", the 1985 Biennial Conference of the Australian Speleological Federation (ASF), and "TasTrog" in 1993, over 200 delegates visited Mole Creek for recreational caving.

Of the nearly 100 known karst localities in Tasmania, Mole Creek is nationally recognised as the richest in major, highly decorated caves, from an ASF survey involving several hundred Australian cavers and speleologists, on the basis of both personal experience and repute (Kiernan 1984).

Educational groups, Scouts, Venturers and Rovers, and city adolescent groups on self esteem programmes are amongst cave resource users. The sport is gaining popularity.

New discoveries are still possible for those willing to undertake the necessary field reconnaisance involved.

The aesthetic values of the caves and the satisfaction of the physical achievements involved are heightened by the fact that the caves are contained in an area of considerable aesthetic value in itself.

3.10 Wilderness

A high quality wilderness core extends north on the Central Plateau to about Forty Lakes Peak/Lake Ironstone. This was assessed by Lesslie, Mackey and Shulmeister (1988) on the basis of four indicators - remoteness from settlement, remoteness from access, aesthetic naturalness and biophysical naturalness. Access to this northern wilderness is from Lake Mackenzie, Western Creek or the Meander Forest Reserve. Higgs Track, the Western Creek Track and Syds Track provide the quickest access. No further shortening of these tracks can be allowed. The remoteness and hence wilderness quality would be improved by blocking off the side roads leading from Westrope Road to Syds Track and the Western Creek Track, allowing them to regenerate into walking tracks over a long period.

Any roading onto the high bench between the Meander Forest Reserve and the top end of Bessels Road would erode the remoteness and hence wilderness quality of the area including core wilderness.

Much smaller wilderness areas, devoid of roads, occur south of Drys Bluff and Bradys Lookout.

4 Conservation Values of the Eastern Region

4.1 Flora

Kirkpatrick, Moscal and Askey-Doran have recently published a study of the flora of the eastern region (April 1994) which partly overlaps previous studies of the western region (Kirkpatrick et al, 1986, 1987, 1988). This study covers the forests of the escarpment and extends onto the Central Plateau over areas proposed for inclusion in the eastern region of the Proposed National Park. This approach illustrates the integral nature of the alpine/subalpine environment of the plateau and the forests of its escarpment. The variety of plant communities in close biological connection is a superlative feature of the Great Western Tiers.

The 27 plant communities identified in the recent study Kirkpatrick et al (1994) add to the 28 wet forest communities, 3 callidendrous rainforest communities, other rainforest communities (athrotaxis, sphagnum, riverine), sandstone cliff communities and dry forest communities already identified in previous studies (see Section 2.2).

The 27 plant communities identified in the recent study, most of which lie in the eastern region, include:

Triglochin procera - Isoetes gunni aquatic herbfield

Eucalyptus pauciflora - Cyathodes parvifolia open forest

Helichrysum hookeri - Pultenacea juniperina alpine shrubland

Richea acerosa - Restio australis alpine heath

Eucalyptus coccifera - Richea scoparia scrub

Orites acicularis - Cryptandra alpina alpine heath

Pentachondra pumila - Pernettya tasmanica grassy mat heath/bolster heath

Orites acicularis/Richea scoparia - Grevillea australis heath

Eucalyptus coccifera/E. urnigera - Cyathodes parvilfola open scrub

Orites revoluta - Richea acerosa open scrub

Eucalyptus coccifera/E. archeri - Orites revoluta open scrub

Orites revoluta - Richea scoparia heath

Nothofagus cunninghamii - Olearia pinifolia open/closed scrub

Nothofagus cunninghamii - Tasmannia lanceolata closed forest

(Eucalyptus delegatensis)/Leptospermum lanigerum - Tasmannia lanceolata open forest

Euvalyptus delegatensis - Poa gunnii open forest

Myriophyllum variifolium - Villarsia reniformis aquatic herbfield

Eucalyptus delegatensis - Bedfordia salicina open forest

Eucalyptus delegatensis - Hakea lissosperma open forest

Eucalyptus dalrympleana - Aceana novae-zelandiae open forest

Eucalyptus delegatensis - Dicksonia antarctica open forest

Eucalyptus delegatensis - Nothofagus cunninghamii open forest

Nothofagus cunninghamii - Atherosperma moschatum closed forest

Eucalyptus viminalis - Notelaea ligustrina open forest

Eucalyptus obliqua - Olearia argophylla open forest

Eucalyptus obliqua - Bedfordia salicina open forest

Eucalyptus amygdalina - E. viminalis open forest

7 wet forest communities (AM0, AM1, DAL00, DAL10, DEL0111, VIM0011, VIM0101) were identified in the eastern region. These communities are described in Section 2.2.

Kirkpatrick et al (1994) describe the vegetation in general terms:

"The most extensive major vegetation types within the Great Western Tiers National Estate listing are Eucalyptus delegatensis forest..., the eastern alpine complex...., Eucalyptus coccifera forest..., inland grassy forest dominated by Eucalyptus amygdalina..., Eucalyptus delegatensis tall forest..., Eucalyptus amygdalina tall forest....The eastern alpine complex is the most concentrated in the listing of any of these vegetation types..., followed by Eucalyptus coccifera forest..., Eucalyptus amygdalina tall forest...., Eucalyptus delegatensis forest..., inland grassy forest... and Eucalyptus delegatensis tall forest..."

"....the plateau is largely covered by Eucalyptus coccifera scrub/forest and alpine vegetation with some small areas of Athrotaxis cupressoides woodland, Eucalyptus delegatensis forest and E. pauciflora forest....The alpine vegetation largely consists of heath on well-drained rocky sites, bolster heath, short alpine herbfield or sedgeland on poorly-drained sites and tussock grassland on moderately to well-drained sites with deep soils. The deeper soils are most common in treeless valleys below the climatic treeline, which is situated at approximately 1350m. E. pauciflora and E. coccifera intergrade with the latter species occurring at higher altitudes, and usually forming the treeline. However, on steep slopes, especially where cliffs are prominent above the treeline, E. delegatensis is the treeline species. In general, E. delegatensis forest tends to occur on more sheltered and less frosty sites than either of E. pauciflora or E. coccifera-dominated communities. Athrotaxis cupressoides woodland is restricted to places, such as block streams and Sphagnum bogs, that are protected from fire....Eucalyptus gunnii woodland/forest is found on the margins of poorly drained flats in the E. coccifera zone....."

"Along the (western) scarp of the Great Western Tiers a narrow belt of Nothofagus cunninghamii scrub/rainforest, interspersed with small areas of Athrotaxis selaginoides rainforest in fire-protected niches, is found on the upper parts of the blockstream below the plateau. E. delegatensis forest is found below this zone, with some small areas of Eucalyptus archeri scrub/forest on shelves. Tall E. delegatensis forest is found below this zone. This vegetation type usually has a broad-leaved shrub or rainforest understory. On the drier aspects of the lower slopes E. obliqua becomes shorter, has a schleromorphic understory, and is often mixed with E. viminalis and E. amygdalina. Within the tall forest belt, rainforest is common in valleys and on south-facing slopes. Where the rainforest has been burned, a seral community dominated by Acacia dealbata is found."

"The eastern scarp of the Great Western Tiers receives considerably less precipitation for any particular altitude than the (western) scarp. Consequently, rainforest and tall eucalypt forest are less common, the typical altitudinal sequence being from E. amygdalina inland grassy forest on the dry lower slopes to E. delegatensis forest on the upper slopes."

Kirkpatrick et al (1994) describe the conservation status of the plant communities:

"The low altitude forests on the interface between wet and dry schlerophyll are the most significant for nature conservation in the unreserved part of the area, with the exception of the grassy forest dominated by E. amigdalina and E. viminalis which occurs in the driest lowland parts of the study area.."

"The most important areas for community conservation in the study area are the treeless subalpine grasslands and wetlands south of Sandbank Tier and Millers Bluff...."

Kirkpatrick et al (1994) describe the flora:

''..The 511 native higher plant species observed in the area constitute almost a third of the native flora of the State, including approximately the same proportion of the Tasmanian endemic plant species...."

Kirkpatrick et al (1994) describe the conservation status of the higher plant species:

"The nationally rare and threatened higher plant taxa found in the study area are concentrated in the alpine/subalpine environments. The most significant species is the nationally vulnerable annual, parasitic herb, Euphrasia scabra...."

"Pernettya lanceolata is also vulnerable at a national level....."

"Epilobium willisii, Viola cunninghamii, Phebalium montanum and Pimelea pygmaea are nationally rare plants with centres of distribution within the alpine areas of the eastern Central Plateau. Eucalyptus archeri and Epacris acuminata are nationally rare species found in the forests of the study area. Only the former species has its centre of distribution on the eastern Central Plateau. Carex raleighii, Danthonia nitens and Festuca plebeia are nationally rare species of montane grassy ecosystems."

"Only a few of the higher plant taxa found in the eastern part of the study area are thought to be unreserved in Tasmania. These are Epilobium billardieranum ssp. hydrophilum, Agrostis australiensis, Veronica serpyllifolia, Carex capillacea and Juncus revolutus. These are found in the (eastern) part of the study area, which is one of the driest subalpine areas in the State. They are predominantly species of grassy ecosystems."

"Most of the rare taxa found in the study area are reserved, and not nationally rare and threatened, but are regarded as rare in Tasmania....Most of the species have the centre of distribution in the alpine and subalpine zones of the Central Plateau. The relative fertility and low rainfall of this area makes it distinct within Tasmania....The most significant of these species is Amphibromus macrorhinus, which is considered to be endangered on a statewide basis. It occurs on an island studded, species rich wetland of high biological and geomorphological importance on Lagoon Plain, north of Lake Sorell.'

4.2 Fauna

The Eastern Region extends the diversity of habitats offered by the Western Region, as evidenced in 5.1 Flora.

The Millers Bluff area is important habitat for Bettongs. (Driessen et al 1990)

Richardson (1990) identified the catchments of the Great Lake, Arthurs Lake and Lake Sorell as areas of high zoological conservation value with respect to aquatic fauna in those lakes. The fauna included native fish (paragalaxias eleotroides, paragalaxias dissimilis, galaxias tanycephalus, paragalaxias mesotes and galaxias auratus), crustaceans (onchotelson brevicaudatus, onchotelson spatulatus, uramphisopus pearsoni, mesacanthotelson setosus and paranaspides lacustris) and molluscs (glacidorbis pawpela and ancylastrum cumingianus).

Podger et al (1990) identified the Gunns Lake area as containing rare and endangered fauna (and flora).

The Great Western Tiers are a stronghold for the White Goshawk, which is classed as rare and its habitat threatened. The Great Western Tiers are also a stronghold for the Tasmanian Wedge Tailed Eagle, which is classed as vulnerable to extinction.

4.3 Wilderness

The Australian Wilderness Inventory (Lesslie et al 1988) identified a significant wilderness area on the Millers Bluff/Mt Franklin massif and in the Tumbledown Creek/Sandbanks Tier area.

Millers Bluff/Mt Franklin Massif

The Millers Bluff/Mt Franklin area includes Stevensons Lookout, Henrys Bluff, Millers Bluff, Molly Yorks Night Cap, Priests Marshes, Lagoon Plain, Mt Franklin, Cradle Hill and Wild Hops Hill, Mountain Creek, and Scrubby Den Rivulet. It is part of the Isis River and Lake River catchments. Escarpment forests extend beyond.

The area is virtually surrounded by escarpment and the Proposed National Park includes most of the escarpment forests and all of the area above the escarpment, both forest and alpine grassland.

This important region, of some 15,500ha in extent, represents the far southeastern extent of the Great Western Tiers and has significant wilderness value.

The connection between this region and the western escarpment has been compromised by logging between Parson and Clerk Mountain and Machlanachan Sugarloaf. This connecting region should be managed as a restoration zone, as defined in TWIG et al (1990).

Alpine area north of Arthurs Lake -Tumbledown Creek/Gunns Lake

Alpine areas of high conservation value adjoin the escarpment of the Eastern Region but do not yet have the protection of World Heritage status afforded to the western Central Plateau. The area north of Arthurs Lake includes the Sandbanks Tier, Starvegut Hill, Buchanan Creek, Tumbledown Creek, Allison Marshes, Gunns Marsh, Gunns Lake and Little Lake. It has been suggested that this area be called the Tumbledown Wilderness.

Mother Lords Plains

Mother Lords Plains is an alpine area partially included in the Central Plateau World Heritage Area. The major portion, which is under HEC tenure, is not included in the World Heritage Area. The Mother Lords Plains are contiguous with the escarpment and with the alpine area north of Arthurs Lake. Also included is the heavily forested top of Cathcart Bluff.

4.4 Species Conservation Status in Eastern Region as at 1995

(adapted from: J.B. Kirkpatrick, A Moscal and M. Askey-Doran, National Estate Values Of The Great Western Tiers, Tasmania-The Flora And Vegetation   Tasmanian Conservation Trust Inc., April 1994)

Species	Type	Status	Figure number (Kirkpatrick et al 1994)
Agrostis australiensis	Grass	r1u	2
Ajuga australis	Herb	r2	3
Amphibromus macrorhinus	Grass	e	7
Australopyrum velutinum	Grass	r2	7
Brachyscome nivalis var.alpina	Herb	r1	9
Carex raleighii	Sedge	r2R	11
Colobanthus affinis	P.herb	r2	12
Craspedia glauca var. gracilis	Herb	r2	13
Danthonia nitens	Grass	r2R	14
Deyeuxia brachyathera	Grass	r2	15
Epacris acuminata	Shrub	r2	19
Epacris petrophila	Shrub	r1	20
Epilobium billardierianum spp. hydrophilum	P.herb	uK	21
Epilobium willisii	P.herb	r2R	22
Eucalyptus archeri	Tree	r2R	23
Euphrasia scabra	A.herb	Ve	24
Festuca plebeia	Grass	r2R	25
Gaultheria depressa	Prshrb	r3	26
Isolepis montivarga	Rush	r2	29
Leucopogon stuartii	Shrub	r2	31
Myosotis australis	Herb	r2	33
Nertera depressa	Shrub	r2	35
Olearia phlogopappa var. subrepanda	Shrub	r2	36
Oreomyrrhis argentea	Herb	r1	37
Oreomyrrhis sessiliflora	Herb	r2	38
Pentapogon quadrifidus var. parviflorus	Grass	r2	39
Pernyetta lanceolata	Shrub	Vv	40
Pimelia pygmaea	Shrub	r1R	41
Poa costiniana	Grass	r2	42
Poa labillardieri var. acris	Grass	r2	43
Phebalium montanum	Tree	r2R	44
Stellaria multiflora	Aherb	r2	46
Stellaria palustris	Aherb	r2	47
Taraxacum aristum	Pherb	Rr2	48
Veronica nivea	Herb	r2	49

Veronica serpyllifolia	Herb	ur2	50
Viola cunninghamii	Herb	r2R	51

Wet Eucalypt Forest Communities	**Status**	**Figure number (Kirkpatrick et al 1994)**
DAL 00	Unreserved	55
DAL 10	Unreserved	56
VIM 0011	Unreserved	58
VIM 0101	Poorly Reserved	59

KEY

e = endangered in Tas.
v = vulnerable in Tas.
R = Rare nationally
U = Unreserved
PE= Tas only endemic with only 1 secure reserve
X = Extinct
K = rare threatened nationally - exact status unknown
r1 = rare in Tas. < 100 x 100km grid
r2 = " " < 20 (10x10km) grid
r3 = " " in very small populations.

Eucalypt. Community Key

DAL 00 E. dalrympleana/ E. delegatensis - Lomatia tinctoria
DAL 10 E. dalrympleana - Tasmanian lanceolata - Dicksonia antartica
VIM 0011 E. viminalis - Bedfordia salicina- Pultenaea juniperina
VIM 0101 E. viminalis - Acacia dealbata - Pomaderris apetela

5 The Northern Plateau

The botany of the World Heritage plateau included in the proposed National Park (both 1995 and 2012) are partly described in Kirkpatrick et al (1994). The eastern alpine complex identified in that study extends to the west of Great Lake.

The northern edge of the Central Plateau encompassed by the proposed National Park contains a large part of the highest altitude areas on the Central Plateau, which is tilted from north to south. Two surfaces (Davies 1959) have been identified in this area, the Higher Plateau Surface (1190 m - 1340 m) which comprises the majority of the area, and the High Monadnocks (1340 m - 1610 m) which in the proposed Park are the Mt Ironstone Massif, the Wild Dog Tier and the Sandbanks Tier Massif.

The Central Plateau terrain is of outstanding geological and geomorphological significance. While the proposed National Park does not contain all the terrain it contains extensive areas of both the erosional and depositional glaciated landscape, a legacy of the last glaciation, as well as areas subjected to peri-glacial processes. This glacial legacy, particularly the lakes and tarns in the southwest of the proposed National Park, was one of the major reasons for the World Heritage listing of the Central Plateau. The Plateau and escarpment edge have been identified as containing a number of individual earth science features of conservation significance eg the slab topples near Nells Bluff, Lake Explorer, Lake Nameless patterned ground, block glacis at Pine Lake and the ice spillover area associated with Lobster Rivulet (Dixon 1991).

The Central Plateau contains the largest contiguous area of treeless high country in Australia (Kirkpatrick 1983). Levels of endemicity and local endemicity are very high (Kirkpatrick and Brown 1984a, b). The vegetation has been classified into a series of communities by various authors eg Jackson (1972) and Kirkpatrick and Dickenson (1984a). Jackson (1972) describes idealised communities on the Central Plateau by altitude and rainfall. The diversity and fragility of much of this vegetation has meant that fire and erosion have had a major impact in the last 100 years (Kirkpatrick and Dickinson 1984b). A new and ominous threat has appeared with the discovery of a cold tolerant Phytophthora which is attacking a number of species (including Pencil Pine) near Pine Lake.

The Northern Plateau Region contains some of the most significant stands of conifers remaining on the eastern half of the Plateau.

Despite the bleak and often inhospitable conditions prevailing on the Central Plateau, several mammals are reasonably abundant there. Amongst the grazing mammals the Bennetts wallaby is often seen, particularly in the early morning and later afternoon, and the presence of wombats, which are mainly nocturnal, can be detected from their square-shaped faecal pellets. The eastern quoll and Tasmanian devil, two of Tasmania’s unique marsupial carnivores, occur on the Plateau. The eastern quoll's diet includes insects, fruit, small mammals and birds. Crayfish are a common dietary item on the Plateau.

Small mammals such as native rats and marsupial mice are more common in the forests on the Tiers than on the Plateau. This is also the case for the arboreal species such as the brushtail possum, ringtail possum and pygmy possum. However, they all can be found on the Plateau in small pockets of suitable habitat.

The platypus is found in many of the numerous lakes which occur throughout the Plateau. Its footprints can sometimes be seen in the snow where it has moved overland from one lake to another.

The northern plateau is well endowed with Lakes and Tarns. These are home to a significant vertebrate and invertebrate fauna. This area contains populations of the rare galaxid Paragalaxias julianus. This species is confined to the Central Plateau. The area is a major stronghold for the Tasmanian mountain shrimp Anaspides tasmaniae, a species of great evolutionary significance.

6 Landslips

Summary of factors involved in landslips

In simple terms, the Tiers and Central Plateau were formed when ancient sandstone was eroded. Volcanic material (dolerite) had previously intruded up into the sandstone. This dolerite is much more resistant to erosion than sandstone. The Tiers formed where the dolerite layer restricted erosion. The Tiers and the Central Plateau are dolerite. Beneath the solid dolerite layer, there is a layer of sandstone. This outcrops as sandstone cliffs at about the middle of the escarpment for about one third of the length of the Tiers. Where there are no obvious cliffs, there is usually sandstone not far below the surface around the mid level of the escarpment. The dolerite has itself weathered forming clay, which mantles the slopes of the escarpment. Often, there are significant flatter areas on the side of the escarpment, known as benches. These are typically above the mid level sandstone stratum and often contain significant areas of quality native forest and sensitive wetlands. It is these areas of forest high on the side of the escarpment that the logging industry has been accessing. In several cases landslips appear to have resulted.

Where the dolerite clay overlies the mid level sandstone stratum, there is high potential for landslip. Landslips sometimes occur naturally in this zone, apparently triggered by infrequent high rainfall events, which result in the clay becoming locally saturated with water and sliding off the sandstone bedrock. There is often considerable subsurface water flow which may not be evident from the surface. During heavy rainfall events, there is also considerable surface flow over the floor of the forest.

Forestry roads often intercept these surface and subsurface flows and channel them down roadside drains into culverts. Where these culverts discharge there is an unnaturally heavy concentration of water flow which can initiate landslips. This was a significant factor in the 1997 landslips at Scotts Road, Meander (Mother Cummings Peak) and at Western Creek (off Westrope Road, east of Syds Track).

Logging, especially clearfall, increases water runoff during rainfall for many years after the logging. Also, as the roots of the logged trees rot, the support they gave to the clay mantle decreases, making the slopes more unstable. Thus, logging in conjunction with roading further increases the risk of landslip. This is evident in some of the landslips on the edge of the Bessels Road logging bench and in the series of landslips east of the Dunning Rivulet.

Another major mechanism for landslips comes where roads are cut through the dolerite clay mantle on slopes. These roads are typically put in to access the native forest on the high benches. By cutting the road through the dolerite mantle, the slope is weakened. This can result in the collapse of the slope above the road in the next high rainfall event. This is evident at Poatina, Bessels Road and Western Creek.

The 1999 slips in the Dunning Rivulet gorge are not as directly related to logging practices. The large slip on the eastern side of the gorge occurred in apparently pristine forest with no related forestry activities.

The slips on the western side of the Dunning gorge, which occurred in 1997 and enlarged in 1999, while not arising directly from a logging or roading area, may have some linkage to the roading and logging on the Bessels Road high bench. If there is a linkage, it would probably be through changes in surface and subsurface water flows. A significant factor in slope stability is the pore water pressure, which can be affected by changes in the water table. These slips are actually below the Bessels Road bench.

Following forest clearance for logging, mass movements including a debris flow occurred on the flanks of Brumby's Creek, above Blackwood Creek, in 2005. A university study (Hunter, 2011a) found evidence that removal of forest cover on the subalpine topographic bench above the slope had altered the long term hydrological regime within the slope's sedimentary deposits, and that subsequent saturation during an abnormally high rainfall period triggered the landslides.

Abnormally prolonged high rainfall conditions that broke the drought in Northern Tasmania over the summer of 2010/11 triggered a series of sudden landslides in slope deposits at Caveside in January 2011 (Hunter, 2011b). A total of 9 landslides occurred over a few days, including a 2.5 km long debris flow that altered the hydrology of the Lobster Rivulet catchment and disrupted local farm water schemes. In this case, slope deposits failed in the absence of modern industrial scale logging activities.

Climate change implications

Greater frequency and magnitude of extreme climatic events is acknowledged with anthropogenic climate change. Studies have suggested that the stability of the Quaternary slope deposits on the Great Western Tiers escarpment is "conditional," that is, disturbance and/or abnormal climatic events can trigger mass movements. Forestry codes of practice written for application under previous climatic regimes are probably redundant. Therefore, logging activities pose risks that could be seen as unacceptable to nature conservation aims, hydrology and local water supplies.

Forestry Tasmania's role

All areas at risk of landslip, taking into account increased risk with anthropogenic climate change, should be mapped by Forestry Tasmania as "Geomorphic Hazard". There is ample information available to allow such mapping. This information includes consultants' reports on the landslips at Western Creek and at Scotts Road, Kiernan's 1984 report on the Poatina landslips, Sloane's 1986 report on landslip hazards on the Western Tiers and Mt Barrow, Pinkard and Klye's 1999 interim report on Dunnings Rivulet erosion and landslide activity, Hunter's (unpublished 2011) report to Blackwood Creek residents on the Brumby's Creek landslide, the experience of the geomorphologists in the Forest Practices Unit and maps which show the typical topography of past landslips.

It is an unavoidable fact that there will be occasional extreme rainfall events which can precipitate massive slope failures especially around the mid level stratum. These cannot be dismissed as isolated incidents. They must be planned for, just as bridges must be built to accommodate 50 yr floods. The appropriate planning approach is to map the landslip areas and stay out of them. It is surprising that Forestry Tasmania has not yet thoroughly mapped these hazards as part of its Management Decision Classification system. Failure to do so is like refusing to accept the problem.

Apart from the recent (1999) slips in the Dunning gorge, and a couple of other small slips, all the landslips in the Huntsman and at Western Creek are apparently associated with logging operations. These include the slips at Bessels Road, Scotts Road and Western Creek. The jury is still out on the cause of the major slip on the western bank of the Dunning Gorge.

The large series of slips between Duncasons and the Dunning which occurred in May 1997 are associated with 35 year old logging. The most easterly slip is of huge proportions and coincides exactly with the old logging road where it once climbed up over the sandstone.

Roading and logging in these landslip hazard areas is irresponsible.

Areas of unprotected forest of special note include Bessels Road, Scotts Road and Nells Bluff (Caveside to Quamby Bluff). Nells Bluff has had landslips in the memory of long term local residents. Its topography indicates that it is landslip prone. The escarpment above Blackwood Creek is also an area of high landslip risk where Forestry Tasmania has ongoing logging aspirations.

Total Disturbance:

Forestry Tasmania must weigh its own activities against the total disturbance of the whole upper Meander catchment. Forestry Tasmania's activities have contributed in a major way to the disturbance. The upper Meander catchment has been grossly over exploited. This includes grazing and burning on the plateau, resulting in loss of much of the peat in the Dunning catchment; clearing of native forest for plantation on North's block; and logging of State Forest, including clearfelling. All these activities lead to increased peak flows during the inevitable extreme rainfall events and are steady sources of siltation.

Further disturbance:

There is an immense amount of landslide debris in the Dunning Gorge waiting to be swept downstream in a future high rainfall event. Any increase in runoff will increase the intensity of future floods. In the face of these circumstances, Forestry Tasmania is contemplating further disturbance of the Huntsman by clearing forest for establishing plantations between Warners Creek and the escarpment, and logging a number of coupes near the Meander Forest Reserve, including clearfelling. The responsible course of action is to cease disturbing the catchment (apart from essential restoration work).

Similarly, Western Creek and Dalebrook catchment has been greatly disturbed due to clearfelling on State Forest, illegal logging on private land on Nells Bluff, large scale plantation establishment on private land and poor roading practices on State Forest leading to landslips and chronic contamination of domestic water supplies. The carting of logs through the Western Creek catchment results in contamination of Western Creek due to the churning of the road surface by the log trucks and subsequent run off into the streams. The responsible course of action for Forestry Tasmania is to withdraw from the Western Creek /Dalebrook catchment.

Gambling with Soil and Water Values:

Following are extracts from two expert reports on the landslips. These reports show that the causes were essentially identified around 1984/1986. Given that the landslips at Western Creek, Scotts Road and Bessels Road in 1997 were similar to those analysed about 10 years earlier, it needs to be asked whether Forestry Tasmania was negligent in failing to take remedial action to prevent the 1997 landslips. Were these roads left open in the vain hope that they would not fail, just so the benches they accessed could be logged?

Kiernan, a geomorphologist with the Forest Practices Unit, wrote in 1984 : ***"...Value judgements need to be made here: a dubiously located and constructed road may survive long enough if there are no heavy rains – it may therefore represent a legitimate gamble in terms of economics, but how legitimate is it to gamble in such a manner with environmental values and in particular with soil and water values?"***

Expert reports on landslips

Kiernan in 1984 studied landslips on the Great Western Tiers. He writes: *"...evidence from the Poatina area gives some indication of the possibilities when roading occurs through these fossil slope deposits..."* The fossil slope deposits are the weathered dolerite material which mantles (covers) the slopes.

Kiernan continues. *"...In the Poatina area the heavy rains of winter and spring 1984 initiated debris avalanching on the new access road to Lake River Unit 1 after the new road formation was cut through a solifluction sheet* (weathered dolerite material) *just below the edge of a lithological bench. Along this road, bedrock sandstone is overlain by angular dolerite boulders in a sandy clay or silty clay matrix which has been derived largely from decomposition of the dolerite...The main Poatina slip was initiated by the failure of a slope of around 30^o above the road. It extends from about 80m upslope down across the road and then steeply downwards as a debris flow...This slope appears to have failed during torrential rain around the third week of September 1984...In addition to the main slide and its associated subsidiary slides, the batters have slumped onto the road in many places. A further slide of particular note has occurred a few hundred meters to the north above a cut on a road at least 20 years old...Among the passive factors involved here are the presence of the sandstone bedrock close to the surface and of a discontinuity within the solifluction material, both providing potential slippage planes. There is also considerable subsurface water flow, seldom evident on the surface, which sometimes emerges with considerable force from the cuttings. The abundance of potentially unstable clays has also been important. Removal of support from the old mantle by excavation of the road formation has undoubtedly been a critical factor, but the 20 year delay which preceded failure of the old road shows that the intense rainfall event was the actual trigger. Some desiccation cracking probably occurred in the doleritic clays during the preceding dry years...Crescentic fractures are present 40m upslope from the headwall of the main slide and a great deal of now destabilised material remains above the road. This, coupled with the possibility of continuing lateral expansion...will make restoration work difficult and expensive. The absence of alternative access routes means that further wet winters could make logging on the whole lithological bench above this point not economically viable."*

Kiernan continues:

"...A similar situation on a small scale has already posed problems for the Forestry Commission. At the MG22 forestry access road in the Mt Punter area of eastern Tasmania, dolerite mantles overlying clays and Triassic bedrock have proven unstable where the slope is steeper than about 15^o. Logging has had to be abandoned in part of the area (Sloane 1978). In cases elsewhere fossil solifluction deposits have posed serious problems for road builders where toe support has been removed or the deposit has been excessively loaded (Weeks 1969, Higginbottom & Fookes 1970). The Mt Punter and Poatina landslips involved removal of support in this manner. Prior stability assessment is required, and this needs to

take into account not only present day slope instability but should also delimit slopes which have previously been mobile and might move again.

That the Western Bluff and Poatina debris avalanches appear to have been initiated during high intensity rainfall events is also important. Such slope failures seldom occur under "average" weather conditions but rather under the impact of the sort of low frequency high magnitude events which are responsible for much geomorphic work (Wolman & Miller 1969; Renwick 1977) . A study of eight small forest catchments in New Zealand found that 98% of slope failures (by volume) and 88% of stream borne sediment was attributable to two large storm events which occupied only 0.12% of a total study time of seven years (O'Loughlin et al 1982). Forest managers and operators need to take considerations of this kind into account. Value judgements need to be made here : a dubiously located and constructed road which is needed for only two or three years may survive long enough if there are no heavy rains - it may therefore represent a legitimate gamble in terms of economics, but how legitimate is it to gamble in such a manner with environmental values and in particularly with soil and water values?

Roading in the vicinity of bench edges or across fossil solifluction deposits poses one hazard, but other risks exist in the process of actual logging. The occurrence of landslides after fire in the Huntsman area (K.Eggins, pers.comm) indicates just how important a vegetation cover may be to slope stability. There is no doubt that depending upon local conditions, clearfelling has promoted landslides in some types of terrain overseas (Gray 1969; Bailey 1971) but the situation has not been documented in Tasmania. Most post logging failures recorded overseas have tended to occur near actively scouring streams ; just below major convex breaks of slope and within drainage- depressions. Most have been shallow debris avalanches or debris flows. Failures near streams are probably brought about because stream incision continually oversteepens the slope and because such sites are more prone to the development of high pore water pressures. The sensitivity of convex slopes probably relates to the thinner regolith on the slope below in comparison to the crest area. On the crest weathering produces "strata" which are parallel to the surface and which conduct moisture faster than the regolith at the break of slope can transmit it (Furbish & Rice 1983).

An important factor in the context of forestry operations lies in the loss of shear strength in the regolith as a result of root decay after cutting (e.g. Fujiwara 1970; Bailey 1971; Burroughs & Thomas 1977; Zeimer 1981a,b; O'Loughlin & Watson 1981; O'Loughlin et al 1982). In one area of New Zealand coarsely textured mantles at angles in excess of about 28^o have been found to be susceptible to failure after clearfelling and apparently remain so from the time root strength had markedly declined 2-3 years after cutting until a substantial cover of new vegetation has established. During this total period of 8-10 years two storm events of sufficient magnitude can be anticipated at that site. The intensity and standard of the construction of the road and the snig track network has a bearing on landslide intensity (O'Loughlin & Pearce 1976; O'Loughlin 1981)

The tendency towards regolith drying which permits the stabilisation of solifluction deposits may be reversed to some extent by logging. Reduced evapotranspiration after forest cutting can significantly increase soil moisture and induce slope failure through higher pore water pressures (Gray 1969; Bailey 1971; Rice 1977). The increase in runoff which tends to follow logging is well documented - Bosch and Hewlett (1982) review 90 experiments nearly all of which showed such an increase. Other examples are provided by Hewlett & Hibbert (1961), Tsykin et al (1982) and Sharma et al (1982). However, in some karst areas the blockage of *sinkholes by debris and eroded soil after forest clearance may reverse the general tendency towards increased peak flow magnitude, storm flow amount and discharge variability which is normally expected after such activities (Gunn 1978). A final but less well demonstrated theory suggests that landslide risk may be increased where tree removal unloads the surface and thereby opens up planes which can be penetrated by moisture (Bishop & Steven 1964) .*

The absence of hard data from Tasmania is unfortunate. Furbish and Rice (1983) point to one possible direction for further work in their use of discriminant analysis of conditions associated with slide and non-slide sites which it might be possible to modify for the Tasmanian context. Field and laboratory studies on the significance of tree roots to mantle sheer strength and the duration of the post logging risk period in relation to storm event return periods might also be beneficial. The fundamental need is for more understanding and the prior identification and mapping of present and former sites of slope instability. Detailed soil, hydrologic and engineering studies of questionable sites would permit objective stability indices to be derived and forest practices to be guided accordingly."

In the same document, Kiernan made specific recommendations with respect to ground surface stability:

"(i) Because landslides which threaten both karst catchments and economic losses are natural phenomena on the Western Tiers and the risk of landslides may be significantly increased by forestry operations, particular care needs to be taken to avoid actions which destabilise slopes; recognition needs to be given to the risks which are associated with the incision of fossil solifluction deposits by road formations, and operations below major convex breaks of slope, in the vicinity of actively scouring streams; and within drainage depressions.

(ii) Sites of previous or potential slope instability should be identified and mapped during the planning stage; streamside reserves should be used to protect water quality and should include minor headwater gullies.

(iii) Consideration should be given to detailed soil, hydrological and engineering studies including the determination of safety factors for particular types of slope; research is also warranted into the significance of post logging root strength decline in Tasmanian tree species and the relationship between this and storm event return periods."

Sloane (1986) conducted a study of potential landslip problems associated with forestry operations on the Great Western Tiers and Mt Barrow. They concluded that *"...Slopes greater than 20^o have a very high potential for failure and should therefore remain undisturbed. Slopes between 15^o and 20^o are potentially unstable and should be treated with caution by modifying operations and careful planning. Slopes between 15^o and 12^o are known to have failed in some cases, particularly where roading has resulted in the excavation of steep embankments, and therefore consideration of this risk should be included in the assessment..."*

In an Appendix to Sloane's 1986 report, Weldon describes a landslide in the vicinity of Billopp Bluff: Presumably this occurred early in 1986:

"A landslide on the slopes of the Great Western Tiers was inspected with APPM representatives and several officers from the Forestry Commission on Wednesday 25 June 1986. A logging road traverses a 'bench' on the slopes of the Great Western Tiers. The

landslide is located on the edge of this bench and is some 60 m north-east of the logging access road.

The landslide is relatively narrow (about 30 m across), affecting a long slope segment (estimated at 120-140 m long). Splash marks on trees adjacent to and within the path of the landslide mass indicate that the landslide was apparently quite fluid at the time of failure.

The surface geology consists of boulders of Jurassic age dolerite in a clayey matrix. These are talus deposits overlying the bedrock. Fragments of sandstone were observed within the landslide mass. Toward the north-western edge of the landslide, a large mass of Triassic age sandstone crops out. Green/blue, highly plastic clays were observed both above and below the sandstone mass.

The headscarp of the landslide is located within a natural drainage path which leads from the bench (variable slopes 4-10 degrees) to the steep slopes (16-22 degrees) of the Tiers. This natural drainage path is now fed with water collected by the roadside table drains. The Forestry and APPM personnel were concerned that this roadside water may have been a trigger for landsliding. This is probably the case. However, because the natural drainage path feeds the head scarp area of the landslide, it may merely have accelerated the occurrence of the landslide. Without the benefit of watershed mapping it is difficult to assess the role that roadside water played in initiating the landslide.

The slope on which the landslide has occurred is potentially unstable. Topographic maps show irregular contours, the slope is steep and landslides have occurred in the past. The geological setting of a dolerite veneer overlying Triassic sandstone is known to be unstable elsewhere in Tasmania.

After discussing the above mentioned points in the field, it was agreed that some guidelines were required to assist the foresters to identify areas where the local conditions were unfavourable with respect to slope stability."

Forestry Tasmania provided a summary of a report by Weldon and Sloane (1997) on the 1997 landslips at Western Creek. It reads: *" Landslide activity has occurred in the Western Creek area following heavy rain in the first week of May 1997. The landslides occur on a section of slope with angles between 28 – 34^{o}. The slope is underlain by colluvium derived mostly from Jurassic age dolerite. The landslide activity extends about 250m along the slope adjacent to an unnamed road above Westrope Road. Evidence for instability extends from about 50m into the forest above this un-named road, down the slope over a distance of about 400m to Westrope Road. Several generations of landslide are present with three principal areas of recent activity.*

The landslide activity occurred at a time of high soil moisture content. Concentrated surface drainage from natural water-courses and from the roadside drainage system was probably a trigger that initiated the landslide activity.

We recommend that the un-named road above Westrope Road be abandoned and rehabilitated over a portion of its length. Excavation plant should be walked over the landslide debris that has over-ridden the road and be used to construct cross drains or grips from the table drain across the road. Log bridges and concrete culverts should be removed and attempts made to revegetate the recently active landslips above and below the road.

We recommend that consideration be given to falling a mature eucalypt tree located on a land bridge between two landslides above Westrope Road. Consideration of this recommendation must take into account safety aspects associated with falling the tree.

A stream that enters onto the landslide is contained by the table drain at Westrope Road and taken to a low point where it is piped under the road into a natural drainage line. This arrangement may be contrary to the current Forest Practices Code but is considered to have less risk of initiating future landslide activity than piping the stream beneath the road at the intercept point.

A separate landslide has occurred in the fill batter on a spur road. Remedial work has been undertaken but a minor failure has occurred in the cut batter. Flattening of the cut batter should remove this failed area. The fill batter should be monitored for future instability."

With regard to these 1997 landslips at Western Creek, Forestry Tasmania appears to have admitted liability for contamination of domestic water supplies. A letter from the Acting Regional Forester in September 1997 states: *"Given the possibility that old forestry roads may have contributed to the particular landslip events, we are prepared to consider making redress for demonstrable additional costs which may have been unavoidably incurred as a result of increased turbidity levels attributable to the landslip events related to the old road. Each individual case would need to be considered on its merits. You are invited to make written application in this regard to Mr. Alan Watson, District Forester of Mersey District."*

Forestry Tasmania provided the summary of a report by Weldon and Sloane (1998) which assessed the landslip on Scotts Road (which leads to coupe HU307 below Mother Cummings Peak). This slip occurred during the heavy rains of May 1997. They summarised: *" A landslide has occurred on the eastern slopes of Mother Cummings Peak. The landslide is located 40m downslope from Scotts Road and is about 140m long and 40m wide. Above the landslide, Scotts Road is located on a narrow but relatively flat bench. A deep table drain has been provided on the upslope side of the roadway. Culverts drain either end of the table drain beneath the road and one discharges onto the slope directly above the landslide. This drainage is considered to have contributed to the landslide movement. The landslide headscarp is likely to be affected by on-going erosion and the headscarp is expected to migrate upslope due to slumping and sloughing in this area..."*

Some atempts have been made at remedial work. This mainly involves directing the road sourced water flow to the base of the slip area, presumably to stop the headwall working back to take out the logging road. The lower part of the slip enlarged in the March 1999 heavy rainfall.

Geology of the Tiers/Central Plateau

Sloane (1986) writes:

"JURASSIC DOLERITE. The Central Plateau..(is) underlain by Jurassic dolerite, which crops out as cliffs at the head of the upper escarpment slopes...The overlying rocks have been subsequently removed by erosion and the exposed upper surface of the dolerite sheet has itself been eroded. Dolerite also caps Warners Sugarloaf. The position of the lower contact of the dolerite is often mantled by slope deposits, ...The base of the dolerite is approximately accordant at 1000m but at Warners Sugarloaf and on the eastern face of the Tiers the sill is more transgressive in nature and the lower contact is approximately between 700m and 600m.

DOLERITE SCREE. Scree slopes are found immediately at the base of the dolerite cliffs of the upper escarpment....They consist of accumulations of rock fragments up to six metres in diameter with little or no matrix. The dolerite rock fragments have been shed from the cliffs by processes involving ice wedging, frost action and gravity.

DOLERITE TALUS. Mass wasting of the dolerite escarpment of the Tiers ...has produced extensive deposits of dolerite talus. The talus consists of weathered and unweathered dolerite blocks in a yellow-brown to red-brown silty and clayey matrix....Some talus composed of angular blocks of quartz sandstone in a light grey sandy matrix is usually found close to the base of the Triassic sandstone scarps.

..The scree and talus mantles may obscure the stepped slope profile of the upper escarpment as the deposits often overlie the benches formed by the Triassic sandstones and in some cases, the Permian rocks."

References

Barbour, RC (2003): Gene flow from introduced *Eucalyptus* plantations into native eucalypt species. PhD Thesis, University of Tasmania.

Brown, M.J.(1989), Distribution and Conservation of King Billy Pine. Tasmanian Forestry Commission.

Cadman, S., N Fitzgerald and Micah Visoiu, (2004) Conservation Values & Management Options for Jackeys Marsh HU303Y (Prepared for Jackeys Marsh Residents Ass.)

Cullen, P. and Kirkpatrick J.B. (1988) The Ecology, Distribution and Conservation of Athrotaxis. Tasmanian Conservation Trust and Department of Geography and Environmental Studies, University of Tasmania.

Coates, F. (1988) The Vegetation of Sandstone Cliffs in the Jackeys Marsh - Quamby Bluff Area. BA Hons Thesis, University of Tasmania.

Davies (1959), High Level Erosion Surfaces and Landscape Development, Australian Geographer 7, 193-203

Department of Parks, Wildlife and Heritage.(June 1990) Appropriate Boundaries of a World Heritage Area in Western Tasmania

Dixon, G. (1991) Earth Resources of the Tasmanian Wilderness World Heritage Area., Department of Parks, Wildlife and Heritage, Occasional Paper no 25.

Driessen, M., Hocking, G., Beukers, P., (1990) Habitat, Conservation Status and Management of the Tasmanian Bettong. Unpublished report to the Tasmanian Department of Parks, Wildlife and Heritage, Hobart.

Duncan, F. (1989) Vegetation of the Proposed Caveside State Forest. Unpublished Report, Tasmanian Forestry Commission.

Eberhard, S.M., Richardson, A.M.M. and Swain,R. (1991) The Invertebrate Cave Fauna of Tasmania. Zoology Department, University of Tasmania.

Law, G., (2009) Western Tasmania, A Place of Outstanding Universal Value

Higgs, Kerryn (1994), Hidden Hunters - A Study of Predatory Litter Beetles (Staphylinidae, Pselaphidae and Scydmaenidae) in Cool Temperate Rainforests of Tasmania and New South Wales. Unpublished Graduate Diploma of Environmental Studies with Honours Thesis, Dept Geography and Environmental Studies, University of Tasmania.

Hitchcock, P., (2008) World Heritage at the Crossroads, A Review and Evaluation of Critical Forest Issues relating to the TWWHA.

Hunter, DL, 2008: Karst drainage relations with catchment land use change, Mole Creek, Tasmania, Australia. Cave and Karst Science, 35 (3), 95-104.

Hunter, DL, 2011a: A report on a landslide near Brumby’s Creek, Great Western Tiers, Tasmania (2nd Edn). Presented at a conference of the Australia and New Zealand Geomorphologists’ Group (ANZGG), Queenstown, Tasmania, 2008.

Hunter, DL: 2011b: Recent changes in the local hydrology, Lobster Rivulet catchment, Mole Creek karst: The landslides of January 2011. Proceedings, Cave and Karst Management in Australasia 19, Ulverstone Tasmania, May 2011.

Jackson (1972) The Lake Country of Tasmania. Royal Society of Tasmania.

Jennings, I.B. (1963) Middlesex. One Mile Geological Map Series K/55-6-45, Geological Survey Explanatory Report, Tasmanian Department of Mines.

Jennings, J.N. (1967) Some Karst Areas of Australia. in Jennings, J. and Mabbcott, J. Landform Studies from Australia and New Guinea. ANU Press (Canberra) p 256-292.

Jennings, J.N. and James, B.N. (1967) Underground Water Movements in the Lobster Rivulet Mole Creek Divide, Tasmania. Aust.J.Sc. 30(3): 108-109

Jetson ,T. (1989) The Roof of Tasmania. A History of the Central Plateau. Pelion Press, Launceston.

Kelly, A. and Hunt, M. (1989) Research Surveys and Records of the Tasmanian Wildlife Park, Mole Creek, 1979 - 1989. Unpublished data.

Kiernan, K. (1981) Man and Karst in Tasmania. ASF Newsletter No 94

Kiernan, K. (1982) Glaciation and Karst in Tasmania - a Review and Speculations. Helictite 29 p 11-16

Kiernan, K. (1984) Land Use in Karst Areas - Forestry Operations and the Mole Creek Caves. Report to the Forestry Commission and National Parks and Wildlife Service Tasmania.

Kiernan, K. (1988) Management of Soluble Rock Landscapes-An Australian Perspective. The Speleological Research Council Ltd, Sydney.

Kiernan, K., Eberhard, R and Shannon, C.H.C. (1994) Further Hydrogeological Investigations of the Mill Creek-Kansas Area, Northern Tasmania. (in) Tasforests Vol. 6. Forestry Tasmania.

Kirkpatrick, J. B, (1983), Treeless Plant Communities of the Tasmanian High Country. Proc. Ecol. Soc. Aust. 12:61-77.

Kirkpatrick, J. B. and Brown, M.J., (1984a), A Numerical Analysis of Tasmanian Higher Plant Endemism. Bot. J. Linn. Soc. Lond. 88:165-182.

Kirkpatrick, J. B. and Brown, M.J., (1984b), The Palaeogeographic Significance of Local Endemism in Tasmanian Higher Plants. Search 15(3-4):112-113.

Kirkpatrick, J. B and Dickinson, K. J. M., (1984a), Vegetation Map of Tasmania 1:500,000. Forestry Commission, Tasmania.

Kirkpatrick, J. B and Dickinson, K. J. M., (1984b), The Impact of Fire on Tasmanian Alpine Vegetation and Soils. Aust J. Bot. 32:613-629.

Kirkpatrick, J.B. and Moscal, A. (1986) Conservation Status of the Vegetation and Flora of the Great Western Tiers Tasmania. Report to the Australian Heritage Commission.

Kirkpatrick, J.B. (1987) The Conservation Status of the Plant Species and Communities of the Central Plateau and Fringing Forest. Report presented to the Lemonthyme and Southern Forests Commission of Inquiry.

Kirkpatrick, J.B., Peacock, R.J., Cullen, P.J. and Neyland, M.G. (1988) The Wet Eucalypt Forests of Tasmania. Tasmanian Conservation Trust.

Kirkpatrick, J.B., Moscal, A. and Askey-Doran, M. (1994) National estate Values of the Great Western Tiers, Tasmania - The Flora and Vegetation, Tasmanian Conservation Trust Inc, April 1994.

Law , G. (2009) Western Tasmania, A Place of Outstanding Universal Value, Proposed extensions to the Tasmanian Wilderness World Heritage Area, Commissioned by Senator Bob Brown

Lesslie, R.G., Mackey, B.G. and Schulmeister, J. (1988) Wilderness Quality in Tasmania. Australian Heritage Commission.

Lichon, M.J. (1992A) The Phototropic Phytospeleothems of Moss Palace, Mole Creek, Tasmania. (in) Helictite 30 (1).

Lichon,M.J. (1992B) The Phototropic Phytospeleothems of Moss Palace. (in) Illuminations 1. Mole Creek Caving Club.

Lichon, M., (1993a): New Caves on Dogs Head Hill, Illuminations 2, Journal of the Mole Creek Caving Club.

Lichon, M., (1993b): Human impacts on processes in karst terranes, with special reference to Tasmania. *Cave Science*, 20 (2), 55-60.

Lichon, M.J. (1994) Sassafras Area Explorations. (in) Illuminations 3, Mole Creek Caving

Nix, Prof H., (1987) Climate and Conservation. Statement to the Lemonthyme and Southern Forests Commission of Inquiry.

Pinkard, G. and Klye, D.G., 1999: Interim Report on Erosion and Landslide Activity, Dunning Rivulet, Meander, March 1999. Tasmania Department of Primary Industries, Water and Environment.

Podger, F., Bayly-Stark, J., Brown, M., Delahunt, A., Kiernan, K., Kirkpatrick, J., Law, G., Ranson, D., Richardson, A., Report of the Panel of Experts of the Conservation Technical Working Group of the Forests and Forest Industry Council, August 1990.

Richardson, A. M., Zoological Conservation Values, in Report of the Panel of Experts of the Conservation Technical Working Group of the Forests and Forest Industry Council, August 1990.

Sloane, D.J., (1986) *Potential Landslide and Erosion Problems, Great Western Tiers and Mt Barrow*, Tasmanian Department of Mines, Unpublished Report.

Statham, H. (1981) Woodchipping and Wildlife. Skyline Magazine (Launceston Walking Club) March 1981: 12 - 17.

Styant-Browne, F. (1899) A Trip to the Westward in a Caravan by the Bishop and the Laird. Handwritten notes accompanied by photographs. Supplied by Rema Jago to Charlie Crowden.

Spate, A., Kubla Khan State Reserve, Pilot Management Study, Department of Parks, Wildlife and Heritage, 1991.

Strauss, SY ((2001): Benefits and risks of biotic exchange between *Eucalyptus* plantations and native Australian forests. Austral Ecology 26, 447-457.

Tasmanian Public Land Use Commission, Inquiry into Tasmanian Crown Land Classifications, Proposed Recommendations Report, August 1995.

Taylor, R. (1988) Ecology and Conservation of the Tasmanian Bettong (Bettongia gaimardi). Report to Kangaroo Monitoring Unit, Australian National Parks and Wildlife Service and National Geographic Society.

Taylor, R. (1989) Fauna Conservation Manual. Tasmanian Forestry Commission.

Taylor, R., O'Neil M.G. and Reardon, T. (1987) Tasmanian Bats: Identification, Distribution and Natural History. Proceedings of the Royal Society of Tasmania 121: 109 - 119.

The Western Tiers Interest Group, Jackeys Marsh Residents Association, Tasmanian Conservation Trust, Wilderness Society, Australian Conservation Foundation, The Great Western Tiers: the Case for Conservation. Proposal for a Great Western Tiers National Park. Deloraine Environment Centre, January 1990.

The Wilderness Society, Western Tasmania Wilderness World Heritage Area Stages 1 and 2, December 1993.

Western Tiers Campaign, "Towards a Great Western Tiers National Park Management Plan, Deloraine Environment Centre Inc, May 1993.

Whinam, J., Eberhard, S., Kirkpatrick, J. and Moscal, T. (1989) Ecology and Conservation of Tasmanian Sphagnum Peatlands. Tasmanian Conservation Trust.