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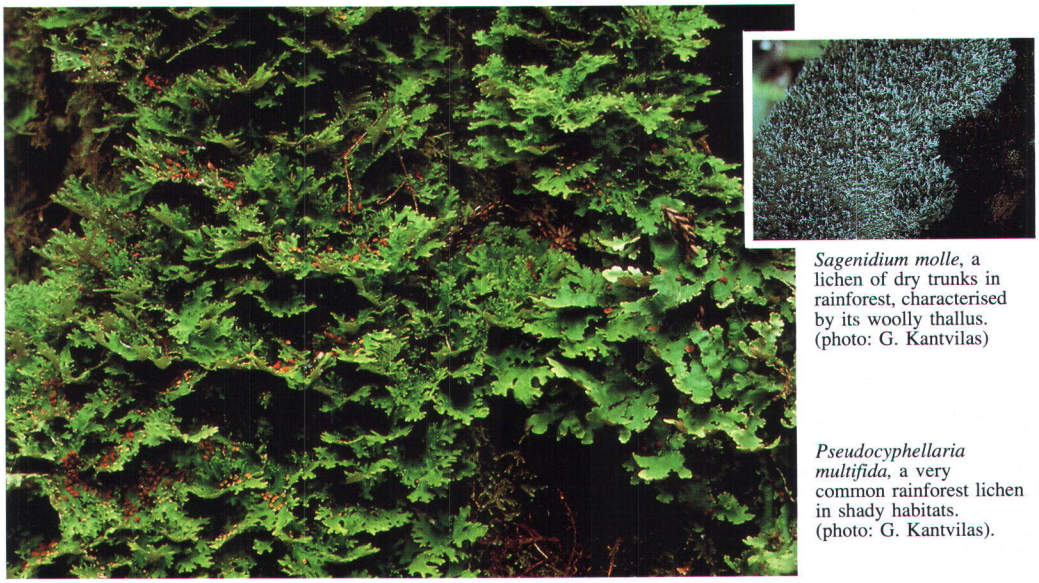
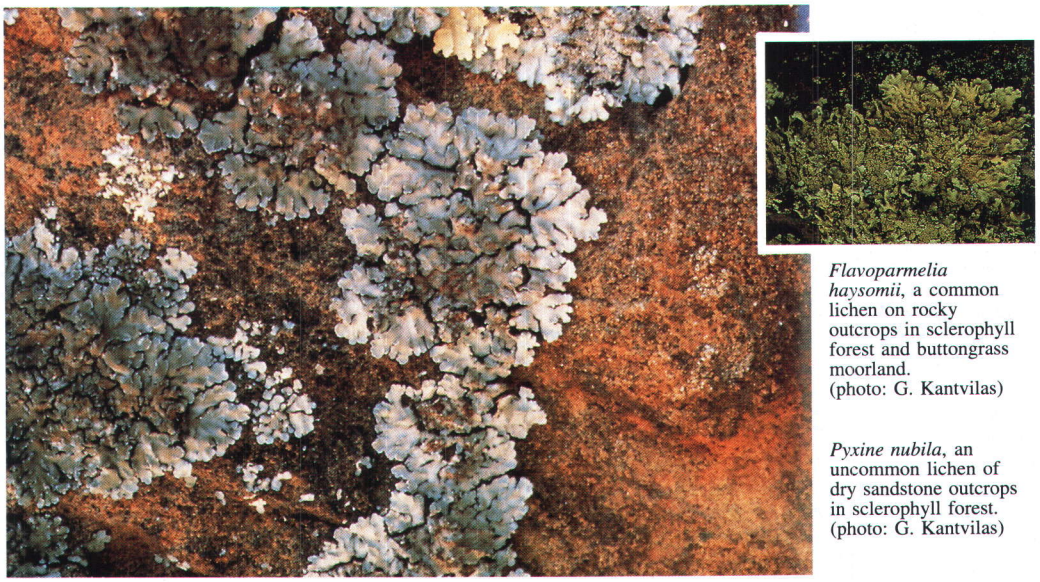
Chapter 2

PHYSICAL ENVIRONMENT



Sagenidium molle, a lichen of dry trunks in rainforest, characterised by its woolly thallus. (photo: G. Kantvilas)

Pseudocyphellaria multifida, a very common rainforest lichen in shady habitats. (photo: G. Kantvilas).



Flavoparmelia haysomii, a common lichen on rocky outcrops in sclerophyll forest and buttongrass moorland. (photo: G. Kantvilas)

Pyxine nubila, an uncommon lichen of dry sandstone outcrops in sclerophyll forest. (photo: G. Kantvilas)

Lichens occupy an important position in the flora of Tasmania; they are the most diverse group of plants present in Tasmanian rainforest. An article in this chapter by Dr G. Kantvilas gives a description of the distribution of lichens in Tasmania.

Cladonia ecmocyna, an alpine species confined to the highest peaks. (photo: G. Kantvilas)

Placopsis sp., common on alpine rocks, especially along roadsides. (photo: G. Kantvilas)

Pseudocyphellaria glabra, a common rainforest lichen. (photo: G. Kantvilas)

Pseudocyphellaria colensoi, a large foliose lichen of the upper parts of tree trunks in rainforest. (photo: J. Jarman)

Menegazzia platytrema, a lichen of the rainforest canopy and sunny trunks in eucalypt forest and scrub. (photo: J. Jarman)

Hypogymnia tasmanica, a common lichen on canopy branches in rainforest. (photo: G. Kantvilas)

Xanthoria ligulata, common on coastal rocks. (photo: G. Kantvilas)

Caloplaca sp., typical of coastal rocks above the high-tide water mark; also found on concrete and on sandstone walls. (photo: G. Kantvilas)

Chapter 2

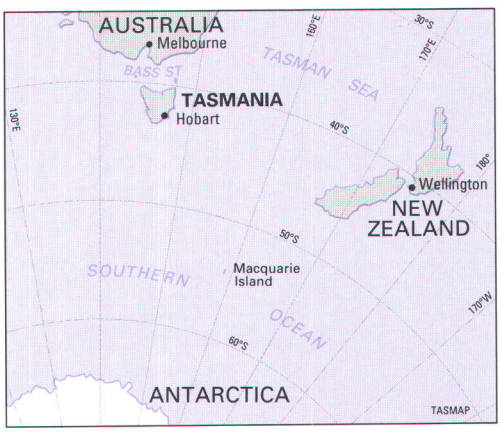
PHYSICAL ENVIRONMENT

The State of Tasmania is a group of islands lying south of the south-east corner of the Australian mainland. Roughly shield-shaped with the greatest breadth in the north, the Tasmanian mainland extends from latitude 40°38′ south to 43°39′ south, and from longitude 144°36′ east to 148°23′ east. The coastline is bounded by the Southern Ocean on the south and west and the Tasman Sea on the east, while the approximately 240 kilometres wide Bass Strait separates the island from the Australian mainland. Macquarie Island, a part of the State, is situated at 54°38′ south, 158°53′ east in the Southern Ocean.

The area of the whole State, including the lesser islands, is 68 331 square kilometres or about 0.9 per cent of the total area of Australia (7 686 900 square kilometres); it is just under one-third the size of Victoria, the smallest mainland State, and is less than half the size of England and Wales.

2.1 AREA OF ISLANDS

Island	*Area (square kilometres)*
Badger	10
Bruny	362
Cape Barren	445
Clarke	113
Flinders	1 374
Hunter	74
King	1 099
Macquarie	123
Maria	101
Prime Seal	10
Robbins	101
Schouten	34
Three Hummock	70
Vansittart	6
Total islands	3 922
Mainland Tasmania	64 409
Total Tasmania	68 331



Mainland Australia, extending north of the Tropic of Capricorn, and with much of its area in the zone of the sub-tropical anti-cyclones, is basically a warm, dry continent. Tasmania is in the temperate zone and practically the whole island is well watered with no marked seasonal concentration; there are no deserts or drought areas as found extensively on the adjacent mainland. Being south of latitude 40°, it is on the edge of the wind belt commonly known as

the Roaring Forties and, with South America, the nearest land mass to the west, Tasmania's weather is subject at times to strong winds and heavy rain about the south and west coastal areas. Its insular position provides protection against temperature extremes—the variation between summer and winter mean temperatures in coastal towns rarely exceeds 8° Celsius.

Apart from the Great Dividing Range in the east, continental Australia is predominantly a land of low plateaux and plains with little relief. In contrast, Tasmania could legitimately be called the island of mountains, since it has the largest proportion of high country to its total area, compared with the other States.

2.1 PHYSIOGRAPHY

Tasmania, a mere 296 kilometres from north to south and 315 kilometres from east to west, has a wide variety of mountains, plateaux and plains, of rivers, lakes, and tarns, of forest, moorland and grassland, of towns, farms and uninhabited country.

The temperate maritime climate partly explains Tasmania being called the most English of all States but other factors operate to heighten the comparison—the pattern of agricultural settlement with orchards, hedges and hopfields; the lake country; the early freestone architecture still common in the east and south-east and the roadsides and villages dotted with oaks, elms and poplars.

With eight mountains exceeding 1500 metres, 28 above 1220 and a substantial part of the Central Plateau above 900 metres, Tasmania is truly an island of mountains. The tallest is Mt Ossa (1617 metres) located with a group of mountains, including Cradle Mountain, to the north-east of Queenstown and west of the highland lake country on the Central Plateau containing Lake St Clair, Australia's deepest natural freshwater lake.

Although the rivers are short, Tasmania is virtually criss-crossed by a network of rivers and lake systems. In the south, the Derwent flows from the Central Highlands past Hobart, providing one of the world's best harbours, to the sea at Storm Bay. The Gordon River takes the waters of Lake Gordon and Lake Pedder and is joined by the Franklin River before flowing into Macquarie Harbour in the west. The Huon River drains eastwards from its headwaters at Scotts Peak Dam on Lake Pedder, reaching the sea in D'Entrecasteaux Channel south of Hobart. The State's longest river is the South Esk in the North flowing from the north-east to join the North Esk at Launceston to create the Tamar. Other rivers include the Mersey, Forth and Leven flowing to the North Coast and the Pieman and Arthur rivers on the West Coast.

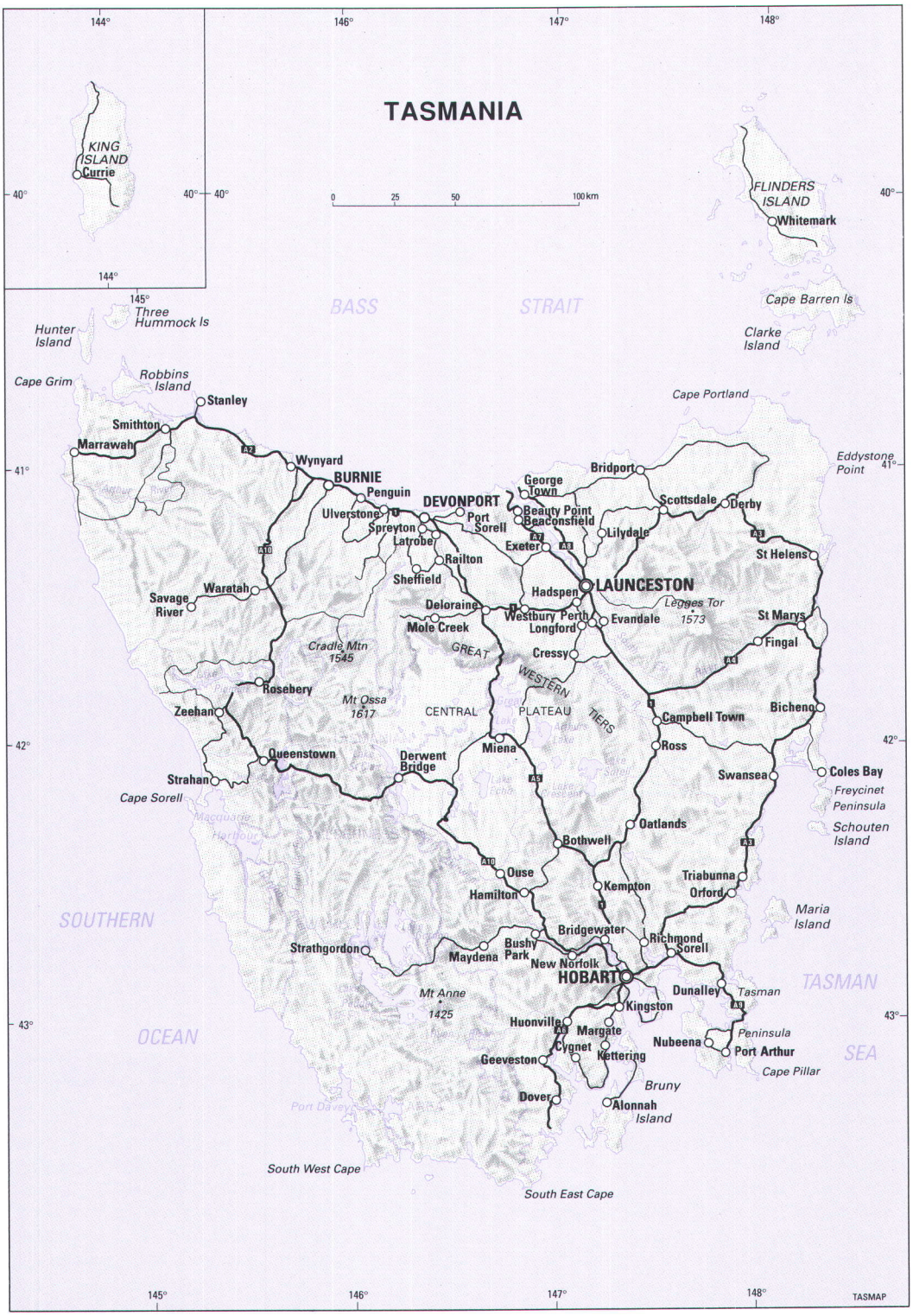
2.2 MOUNTAINS, LAKES AND RIVERS

Mountains	*Height (metres)*
Mt Ossa	1 617
Legges Tor	1 573
Barn Bluff	1 559
Mt Pelion West	1 560
Cradle Mountain	1 545
Stacks Bluff	1 527
Mount Massif	1 514
Mount Geryon	1 510

Lakes	*Area (square kilometres)*
Lake Gordon (a)	272
Lake Pedder (b)	241
Great Lake (c)	170
Arthurs Lake (c)	64
Lake Burbury (a)	53
Lake Sorell (c)	52
Lake King William (a)	41
Lake Echo (c)	41
Lake Mackintosh (a)	29
Lake St Clair (c)	28
Lake Pieman (a)	22
Lake Rowallan (a)	9
Lake Rosebery (a)	7
Lake Barrington (a)	7
Lake Cethana (a)	4
Lake Murchison (a)	4

Rivers	*Length (kilometres)*
South Esk	201
Gordon	185
Derwent	182
Huon	170
Mersey	146
Franklin	118
Arthur	113
Pieman	100
North Esk	82

(a) Man-made.
(b) Man-made - inundated the smaller natural Lake Pedder.
(c) Natural lake enlarged by dam(s).


TASMANIA
KING ISLAND
Currie
FLINDERS ISLAND
Whitemark
0 25 50 100 km
144°
146°
147°
148°
40°
41°
42°
43°
145°
BASS STRAIT
Three Hummock Is
Hunter Island
Cape Barren Is
Clarke Island
Cape Grim
Robbins Island
Cape Portland
Eddystone Point
Stanley
Smithton
Marrawah
Wynyard
BURNIE
Penguin
Ulverstone
Spreyton
Latrobe
DEVONPORT
Port Sorell
George Town
Beauty Point
Beaconsfield
Bridport
Scottsdale
Derby
Lilydale
Exeter
Railton
Sheffield
St Helens
LAUNCESTON
Hadspen
Deloraine
Westbury
Perth
Longford
Evandale
Legges Tor 1573
St Marys
Fingal
Mole Creek
Cradle Mtn 1545
GREAT WESTERN TIERS
Cressy
Waratah
Savage River
Rosebery
Zeehan
Mt Ossa 1617
CENTRAL PLATEAU
Campbell Town
Bicheno
Ross
Queenstown
Derwent Bridge
Miena
Swansea
Coles Bay
Freycinet Peninsula
Schouten Island
Strahan
Cape Sorell
Oatlands
Bothwell
Ouse
Hamilton
Kempton
Triabunna
Orford
Maria Island
SOUTHERN OCEAN
Strathgordon
Maydena
Bushy Park
Bridgewater
Richmond
Sorell
New Norfolk
HOBART
Dunalley
Tasman Peninsula
TASMAN SEA
Mt Anne 1425
Kingston
Huonville
Margate
Cygnet
Kettering
Nubeena
Port Arthur
Cape Pillar
Geeveston
Dover
Bruny Island
South West Cape
South East Cape
TASMAP

LICHENS

(This article was contributed by Dr Gintaras Kantvilas, Tasmanian Herbarium, Tasmanian Museum and Art Gallery.)

A general account of Tasmania's vegetation by Dr Winifred Curtis was published in the 1990 Tasmanian Year Book. The contribution below deals specifically with lichens, a group of non-vascular plants, or cryptogams, which occupy an important position in the flora of Tasmania.

What is a lichen?

Lichens are complex organisms comprised of two separate plants, a fungus and an alga. These two components co-exist in a mutually beneficial association, termed *symbiosis*, and form a new, self-sufficient plant body called a *thallus*, in which the alga produces food for the fungus by photosynthesis, in exchange for other nutrients from the fungus. Aspects of the relationship between the fungus and the alga are not yet fully understood, but the extent to which lichens have colonised the earth demonstrates the success of this remarkable group of plants. Today approximately 13 500 species of lichens are known, with representatives on all continents, even in the harshest environments.

In Tasmania, lichens occur in virtually all terrestrial habitats from the intertidal zone to the summits of the highest mountains. They colonise rocks, soil, wood, bark, charcoal and living leaves, as well as a range of man-made materials such as bitumen, glass, rubber, concrete and paint.

Types of lichens

Lichens adopt a wide variety of growth forms, including shrubby types (*fruticose*), flat leafy types (*foliose*), and thin, tightly adnate types (*crustose*). In addition to their general appearance, lichens are classified according to microscopic characters based on the anatomy of the thallus, their fruiting bodies and spores. Chemical composition may also be used to distinguish closely-related species.

Today approximately 700 named lichen species are known from Tasmania. However, many groups, particularly in the crustose lichens, remain poorly known, and significant additions to the flora continue to be made as research continues. Thus the diversity of the Tasmanian lichen flora is likely to comprise in the order of one thousand species.

Relationships of the flora

Only about five per cent of the lichen flora is endemic to Tasmania, in sharp contrast to the flowering plants and conifers of which about 20 per cent are endemic. Instead the flora displays similarities to that of other world regions with a similar geographical location, climate or geological origin, to the extent that the same or at least closely related species often occupy similar habitats in many areas of the world.

The flora of wetter western or highland parts of Tasmania is most similar to that of New Zealand and southern Chile, and reflects the historical conjunction of these lands in the supercontinent of Gondwana, more than eighty million years ago. In contrast, the drier eastern parts of Tasmania display floristic relationships with mainland Australia, reflecting similarities in climate and more recent land connections during periods of lower sea-level.

The general antiquity and slow evolutionary change of lichens, and the relatively efficient dispersal of many species, means that floristic similarities with more distant regions are also evident. Thus the Tasmanian flora includes many cosmopolitan lichens and shares some species with tropical regions.

Lichens of the major vegetation types

(i) Rainforest

Lichens are the most diverse group of plants present in Tasmanian rainforest. Most are epiphytic and occur on bark, wood, mosses and liverworts, or on leaves. Within a seemingly uniform patch of rainforest there are many different microhabitats, each supporting a characteristic suite of lichens, to the extent that a single tree is analogous to an entire landscape of vegetation, complete with its own diverse topography. For example, more than seventy different species have been recorded from a single Huon Pine tree.

Lichens on twigs are predominantly crustose, although the fruticose Old Mans Beard (*Usnea* spp.) may be abundant in the forest canopy. Whilst appearing as little more than greyish smudges, twig species may be remarkably diverse. Most, such as the common *Coccotrema cucurbitula*, occur along the upper

surface of the twig, but others such as *Opegrapha viridis* and *Porina hyperleptalia*, visible only under magnification, are confined to a narrow band along the underside.

Lichens on branches are usually brightly coloured. The crustose species, *Pertusaria truncata*, is commonly dominant, but grey foliose lichens from the genera *Hypogymnia*, *Menegazzia* and *Parmelia* are present also. In contrast, upper trunks of trees are usually dominated by green foliose lichens from the genera *Pseudocyphellaria*, *Psoroma* and *Nephroma*. These species contain blue-green algae, enabling them to fix atmospheric nitrogen and so provide an important source of nutrient for the whole forest. Similar lichens also occur on the lower trunks of trees with smooth bark such as Sassafras and Leatherwood. The most common lichens are typically *Pseudocyphellaria glabra*, *P. multifida* and *Psoroma microphyllizans*, while seemingly bare areas of bark often support inconspicuous crustose lichens, for example, from the genera *Pyrenula, Arthothelium* and *Thelotrema*.

The lower trunks of the oldest forest trees, especially Myrtle, frequently develop distinct wet-dry sides, due to the leaning of the tree, position of overhead branches and pathways of runnels of water. Wet sides are dominated by mosses and liverworts and by the fruticose, tufted lichen genus *Sphaerophorus*. Whilst some species of this genus, for example, *S. tener* and *S. melanocarpus*, are ubiquitous, others are confined to particular forest types. Thus *S. ramulifer* and *S. insignis* occur mainly in tall, well-formed forest communities, while *S. imshaugii* and *S. scrobiculatus* are confined mainly to the scrubby, tangled rainforests of the South-West.

The dry fissured sides of old trees are commonly rich in small, inconspicuous crustose species, the most common being *Lecanactis abietina* and *Chaenotheca brunneola*. These lichens also occur in similar habitats in Northern Hemisphere forests. *Sagenidium molle*, a species with a grey, woolly thallus, is another characteristic species of dry trunks and provides a substrate for semi-parasitic lichens such as the microscopic, endemic *Arthonia sagenidii*.

Two further noteworthy Tasmanian endemic lichens from rainforest are the species of *Roccellinastrum*. *R. lagarostrobi* has a woolly, tufted thallus and occurs on the leafy shoots of Huon Pine, while its close relative *R. flavescens* grows on the leaves of Pencil Pine.

(ii) Sclerophyll (eucalypt) forests

Despite their often massive size, eucalypts are usually poor hosts for lichens, except in some highland woodlands. Their bark is unstable or may be shed seasonally, and is unsuitable for most species, although lichens may occur on dead branches or on buttresses. Typical lichens occurring on eucalypts include *Neophyllis melacarpa*, *Cladia schizopora* and *Cladonia rigida*. Fallen logs may support grey foliose species of *Hypogymnia*, whilst *Thysanothecium scutellatum* and the crustose species of *Hypocenomyce* occur on charcoal.

In sclerophyll forest, most epiphytic lichens are found on understorey trees. In wetter sites, trees with fibrous bark such as Musk (*Olearia argophylla*) or Dolly Bush (*Cassinia aculeata*) may support abundant lichens, including the blackish gelatinous-like species of *Collema* and *Leptogium*, and many attractive foliose species from the genera *Nephroma*, *Sticta* and *Pseudocyphellaria*, and the family Pannariaceae.

Trees with smooth bark such as Dogwood (*Pomaderris apetala*) and *Acacia* species are excellent hosts for crustose lichens, for example, *Phlyctis subuncinata* and *Pertusaria gibberosa*, which form speckled greyish mosaics on trunks. In more open forests, several grey foliose species such as *Parmelina pseudorelicina* and *Menegazzia subpertusa*, the latter with conspicuous holes in its upper surface, become abundant.

In most sclerophyll forests, the richest habitats for lichens are rocks and soil. The former are usually dominated by the green foliose genus *Xanthoparmelia* which, with almost fifty species, is the largest lichen genus in Tasmania. Other common and conspicuous lichens on rocks include *Flavoparmelia haysomii* (yellowish), *Pseudocyphellaria neglecta* (brown) and *Rimelia reticulata* (grey).

On soil, the fruticose genera *Cladia* and *Cladonia* are usually abundant. The latter can have a wide range of attractive forms, including goblet-shaped thalli, such as *Cladonia pyxidata*, and antler-shaped ones, such as *C. corniculata*. *Heterodea muelleri* is a particularly striking soil species which has become uncommon in Tasmania as grazing and clearing have altered its dry woodland habitat.

(iii) Buttongrass moorland

Lichens are often a conspicuous component of buttongrass moorland and may constitute the dominant ground cover in some communities. Most species occur on soil where the major genera include *Cladonia, Cladia* and *Siphula.* Lichens are also found on large rock outcrops which usually provide some protection from the frequent fires which occur in this vegetation. A large number of species are present, with the apices of the rocks crowned with *Parmelia signifera* and tufts of *Usnea torulosa.* Crustose lichens, apparent only by their small black fruiting bodies, also occur on small pebbles exposed by erosion. Epiphytic lichens, for example, species of *Menegazzia, Hypogymnia* and *Usnea*, and small crustose lichens such as *Mycoblastus* and *Lecidea* species, occur on occasional, emergent shrubs such as *Banksia.*

The Tasmanian moorland lichen flora shares several species with other cold, treeless, Southern Hemisphere regions such as the subantarctic islands, for example *Fuscidea absolodes, Knightiella splachnirima* and *Lithographa subantarctica.* It also shows floristic and ecological similarities to the moorlands of Europe with which it shares almost one quarter of its lichen species.

(iv) Alpine vegetation

Although lichens are well developed in Tasmania's alpine vegetation, relatively few species are restricted to high altitudes and most montane species also occur in the wet lowlands. Of the truly alpine lichens, a significant number have bipolar distributions, occurring in Antarctic and Arctic regions as well as on intervening high mountains. These include *Alectoria nigricans, Coelocaulon aculeatum, Pseudephebe pubescens, Thamnolia vermicularis* and several species of the black foliose genus *Umbilicaria,* sometimes called Rock Tripe.

Other alpine lichens, more typical of the Southern Hemisphere include the Coral Lichens, *Cladia fuliginosa* and *C. moniliformis*, the genus *Siphula*, especially *S. decumbens* which forms extensive pale grey carpets, the genus *Placopsis* which forms neatly lobed rosettes on rocks, and the genus *Neuropogon*, a relative of Old Mans Beard restricted to highest peaks. The genus *Cladonia* is also common, with two vividly red-fruited species, *C. murrayi* and *C. subdigitata*, being particularly attractive.

As with the flowering plants, there is a marked difference between the lichen floras of the dolerite mountains of central and eastern Tasmania and the mainly Precambrian peaks of the South-West. The latter support a remarkable flora rich in characteristically Tasmanian species such as *Pycnothelia caliginosa, Pertusaria gymnospora, Siphula jamesii* and the endemic *Siphulella coralloidea.*

(v) Coastal areas

The major groups of lichens found on coastal rocks display a distinctive coloured zonation which is repeated throughout the world. *Lichina confinis,* a black fruticose species, is often common just below the water line. Within the splash zone, species of the crustose genus *Verrucaria* form a black band, whilst above this is an orange zone of *Caloplaca.* Higher and extending inland is a rich zone of mainly brightly coloured species including grey crustose lichens from the genera *Ochrolechia* and *Buellia.* Foliose and fruticose lichens include the orange species, *Xanthoria ligulata* and *Teloschistes spinosus*, greenish *Xanthoparmelia* species, olive *Neofuscelia* and grey species of *Heterodermia* and the family Parmeliaceae.

(vi) Settled areas

Although not as diverse as in native vegetation, lichens may also be abundant in settled areas, especially where air pollution is minimal. Garden trees and old fences can be abundantly clad in the green foliose species, *Flavoparmelia rutidota*, the grey species *Punctelia subrudecta* and *Physcia adscendens*, and crustose lichens such as the powdery, yellow species of *Candelariella.* In pastures, the bright orange *Xanthoria parietina* and flattened green fruticose species of *Ramalina* are common on Poplars and Elms.

Lichens also grow on bitumen paths or on roofing tiles with the olive species *Neofuscelia pulla* and greenish *Xanthoparmelia* species often common. Old sandstone walls can also be valuable sites of lichen diversity in the city.

In the 200 years of European colonisation, substantial areas of Tasmania have been irrevocably altered, resulting in local extinctions of many species. Nevertheless, other lichen species have managed to establish or survive, preserving an element of native vegetation in the altered environment and providing an important source of floristic diversity.

2.2 FOREST MANAGEMENT

(The following section was prepared by the Forestry Commission Tasmania.)

Of the total forest area of 3 649 000 hectares, 38 per cent is in State Forest, 36 per cent is privately owned, 14 per cent is Crown Land and 11 per cent is in Crown Reserves.

The need for permanent reservation of land for timber production was first given statutory recognition with the *Waste Lands Act* 1881. A program of acquisition of land suitable for dedication as State Forest has seen the gazetted area reach 1 624 003 hectares at 30 June 1991.

State Forests: Tenure by the Forestry Commission under the *Forestry Act*, 1920.

Forest reserves: Areas provided for recreational, scientific, environmental and aesthetic purposes established within State Forests.

Crown Land: Unallocated land with tenure by the Department of Environment and Planning, management by the Department of Parks, Wildlife and Heritage; wood production and sale controlled by the Forestry Commission.

Crown Reserves: Principally National Parks and State Reserves administered under the *National Parks and Wildlife Act* 1970.

HEC: Land vested in the Hydro-Electric Commission.

The Forestry Commission has statutary responsibility to implement the Government's forest policy, foster private forestry in the State, and manage the State Forests, Timber Reserves and timber on Crown Land.

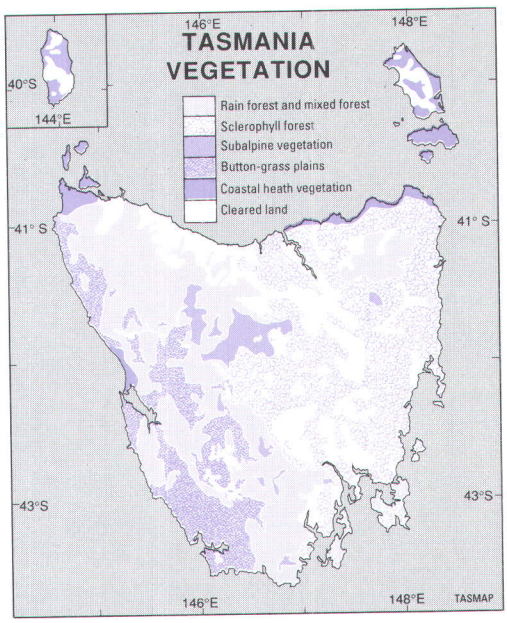
Timbers

Hardwoods: The most valuable eucalypts for commercial use are those which belong to the 'ash' group; stringy-bark (*Eucalyptus obliqua*), gum top stringybark or alpine ash (*Eucalyptus delegatensis*) and swamp gum or mountain ash (*Eucalyptus regnans*). In the south and south-east Tasmanian blue gum (*Eucalyptus globulus*) occurs in high quality forests. In areas where the annual rainfall is below 760 mm the more important eucalypts are black peppermint (*Eucalyptus amygdalina*), swamp or black gum (*Eucalyptus ovata*), white gum (*Eucalyptus viminalis*), stringybark (*Eucalyptus obliqua*) and white peppermint (*Eucalyptus pulchella*).

Softwoods: Some of Tasmania's native forests contain softwood timbers, including King Billy pine, Huon pine and celery top pine. They are very slow growing and in short supply. Although they are of high commercial value, most of these stands are now permanently reserved from timber harvesting.

Plantations

Fast-grown softwood plantations have been established in State Forest initially to fill an expected eucalypt sawlog scarcity. In addition, these softwood plantations yield a long-fibred pulp for paper production. Softwood plantations cover less than 2.4 per cent of State Forest area and radiata pine (*Pinus radiata*) is the principal species planted. An increasing area of native hardwood plantations has been established in recent years due to the availability of Commonwealth funds for various afforestation projects. In 1991 Tasmanian State Forest plantations comprised 39 329 hectares of softwoods and 4263 hectares of hardwoods. Most softwood plantations are in the Fingal, Scottsdale, Devonport and Burnie districts, while hardwoods are distributed more widely.



2.3 NATIONAL PARKS

(The following section was contributed by the Department of Parks, Wildlife and Heritage.)

It was during the 19th century that land in Tasmania was first set aside because of its beauty. Early Lands Department maps and charts were marked with 'reserve for scenic purposes'. These reservations were made of all places under the *Waste Lands Act 1863* and subsequently under the *Crown Lands Act*. By 1899 Tasmania had twelve reserves: six scenery reserves, three cave reserves, two falls reserves and a fernery reserve.

Our First National Parks—the Scenery Preservation Board

The establishment of the early reserves was linked with the feeling that Tasmania's scenic viewpoints were of tourism value. In 1885 an area of 300 acres was reserved at Russell Falls. This was later extended to 27 000 acres in 1915. However, national park status had to wait until the Government passed more comprehensive scenery preservation legislation in 1915, and with this the establishment of the Scenery Preservation Board.

In 1916 Mt Field and Freycinet became Tasmania's first national parks, and in 1922 a scenic reserve and wildlife sanctuary were established within the land from Cradle Mountain to Lake St Clair. The Scenery Preservation Board now had a total area of 223 000 acres in its care.

The Scenery Preservation Board was responsible for the protection of flora and the preservation of scenery and, after the late 1950s, the control of roadside advertising boards. It was not responsible for the protection of fauna.

Animals and Birds Protection Board

Prior to 1928 fauna was protected by the Crown Lands and Police Departments. In view of the economic value of the trade in the furs of native animals and the need to safeguard against over exploitation of this resource the *Animals and Birds Protection Act* was passed in 1928.

The Act created a Board to administer it and to represent all interests concerned with native fauna. The Police Department enforced the Act.

The work of this Board included publishing leaflets and posters with advice on the correct method of pegging animal skins to dry to get the best product and hence the best return.

Wildlife sanctuaries were proclaimed and applications to declare wildlife sanctuaries investigated. The Board monitored and guarded significant wildlife habitats. Efforts were made to protect the dwindling gannet population on Cat Island (Furneaux Group) and studies showed the importance of Moulting Lagoon as a major black swan breeding ground.

Other work included the publishing of posters to educate the public on the value of native birds as Nature's 'pest controllers'.

In 1961 the Board received a boost to its resources in the form of a third vehicle—a far cry from today's fleet of vehicles and other sophisticated equipment.

Lake Pedder

But new troubles were arising. While there was increasing support for the reservation of South-West Tasmania, the conservation-versus-development debate flared again with the proposal to flood Lake Pedder.

Public feeling on this issue ran high. The Legislative Council set up a Select Committee, which was ultimately unable to save Lake Pedder but which revealed that Tasmania lacked qualified officers in the fields of park management and wildlife conservation. It recommended a new system of managing the natural environment and particularly the establishment of a professional park service.

The National Parks and Wildlife Service

The National Parks and Wildlife Service commenced operations on 1 November 1971 under the *National Parks and Wildlife Act* of 1970. This Act repealed the *Scenery Preservation Act* of 1915 and the *Animals and Birds Protection Act* of 1928. The Act made new provisions for the establishment and management of national parks and other reserves and the conservation of flora and fauna. Under the Act, a Director was appointed. The Director's role included responsibility for the development of land for conservation purposes, managing reserved land, preparing management plans, carrying out re-

search and other activities relating to the conservation of flora and fauna, providing education facilities and enforcing regulations under the Act.

Despite the limited resources it had to carry out its large task the Service got off to a vigorous start under the directorship of Mr Peter Murrell, who worked in this role until his retirement in 1990. The early years were hectic ones with the establishment and consolidation of the role of the Service, the declaration of new national parks and reserves and a rapid growth in staff and expertise. In 1971 the Service's staff was 59, by 1974 it was 109.

The early years of the Service saw the creation of the Mt William, Maria Island and Asbestos Range National Parks and the proclamation of Macquarie Island as a nature reserve. The establishment of the Mt William National Park provided a secure habitat for the endangered forester kangaroo. Another endangered animal whose management was secured during this time was the Cape Barren goose.

In 1975 Aboriginal heritage became protected under the *Aboriginal Relics Act*. This was followed by the formation of an Archaeology Section to survey and protect Aboriginal heritage. In the same year the use of snares to take brushtail possums was forbidden and in the following year the impressive mountain of Precipitous Bluff was saved from proposed limestone mining and included in the Southwest National Park.

These developments in conservation mirrored the growing worldwide community feeling for conservation of the environment. Locally, the conservation movement was growing and becoming increasingly active. The conservation-versus-development debate was on the boil again; this time the most significant issue was undoubtedly the proposed Lower Gordon hydro-electric power scheme, publicly announced in 1979, which would have flooded the Franklin River. This issue came to dominate not just Tasmanian but Australian politics. During this debate the Service was sometimes at odds with the Government of the day, other Government instrumentalities and the conservation movement. However, out of this controversy came the Franklin-Lower Gordon Wild Rivers National Park which was proclaimed in 1981. This was followed by World Heritage listing of the three large western wilderness national parks in 1982. In 1982 the federal *Historic Shipwrecks Act* came into force in Tasmanian waters.

Further Changes

In 1987 the National Parks and Wildlife Service was amalgamated with the Department of Lands to form the Department of Lands, Parks and Wildlife. This Department was altered again in 1989 to create the Department of Environment and Planning and the Department of Parks, Wildlife and Heritage. This latter Department today manages not just land reserved under the *National Parks and Wildlife Act* but also under the *Crown Lands Act* of 1976, as well as providing for the conservation of wildlife and of Aboriginal and historic heritage. Approximately 300 people are employed by the Department, which has as its symbol the Tasmanian devil.

2.3.1 World Heritage Nomination

The Tasmanian Wilderness World Heritage Area comprises 1.37 million hectares of essentially wild, natural country in central and south-western Tasmania. It was jointly nominated for World Heritage listing by the Commonwealth and State governments in September 1989 and inscribed on the World Heritage list by the World Heritage Committee of UNESCO in December 1989.

Part of the World Heritage Area (the Cradle Mountain-Lake St Clair, Southwest and Franklin-Gordon Wild Rivers National Parks) was originally recognised by the World Heritage Committee in 1982. The 1989 listing enlarged the original area by approximately 600 000 hectares. It also includes the Lemonthyme area; the Walls of Jerusalem National Park and Central Plateau Conservation Area; the majority of the Central Plateau Protected Area west and north of Great Lake; Marakoopa Cave, Devils Gullet and Exit Cave state reserves; the three forest reserves of Meander, Liffey and Drys Bluff; the area north of Lake Gordon including the Denison and King William Ranges; the western strip of the southern forests stretching from Wayatinah to South Cape Bay including the upper reaches of the Weld, Huon and Picton Rivers; Hartz Mountains National Park; and in the west: the Broken Hills, south-east Macquarie Harbour, Sarah Island Historic Site, Birchs Inlet to Spero River, Governor River, Eldon Ranges and north to Sophia River.

The World Heritage Area now contains values not protected within the original area; notably areas of very tall eucalypt forest, extensive cave systems, a core breeding area for the endangered orange-bellied parrot and ice-age Aboriginal cave-art sites.

The integrity of the original nomination has been greatly enhanced by the inclusion of important alpine and sub-alpine areas, karst and glacial features. These and other values were identified by the numerous reports to the Commission of Inquiry into the Lemonthyme and Southern Forests, established by the Commonwealth Government in 1988 to investigate and report on the World Heritage qualities of this area.

The Tasmanian Wilderness World Heritage Area is subject to a joint Commonwealth/State management arrangement. This consists of the Ministerial Council, chaired by the Premier which approves expenditure and management plans and is supported by a Standing Committee of officials from both governments. The Council also receives advice from a Consultative Committee which has an independent chairperson and comprises 15 members nominated by both governments as representatives of different interests. A joint rolling program of recurrent and capital funding for World Heritage Area management has been agreed with Commonwealth funds guaranteed until 1994.

Day-to-day management of the World Heritage Area is carried out by the Tasmanian Department of Parks, Wildlife and Heritage. Field bases are located at Cradle Mountain, Lake St Clair, Strahan, Queenstown, Mt Field, Liawenee, Marakoopa and Hastings caves.

Preparation of a management plan for the entire World Heritage Area commenced in December 1989 with the launch of the most extensive program of public participation ever undertaken for reserve planning in Tasmania. Selected research programs are carried out to gain information for planning and management.

World Heritage Area management activities include providing visitors with information, interpretation and assistance, search and rescue, fire prevention and suppression, providing and maintaining a range of visitor facilities, walking track upgrading and maintenance, rehabilitation, environmental monitoring and exotic species control.

2.4 CLIMATE

(The following section was contributed by the Bureau of Meteorology.)

Since Tasmania lies between latitudes 40°S and 43.5°S and is an island with no point more than 115 kilometres from the sea, its climate is classified as temperate maritime. On the coast the daily temperature range is about 7°C but inland the range is almost doubled, indicating a slight continental effect.

Prevailing westerly winds produce a marked west-east variation of cloudiness and rainfall, but the variation of temperature is governed more by elevation and distance from the coast.

Summers are mild and are characterised by greatly lengthened days. The sun reaches a maximum elevation of 70°–73° in mid-summer, giving about 15 hours of daylight. In mid-winter, the sun's elevation does not exceed 20°–23° and the shortest day consists of about nine hours of daylight.

In winter and early spring, westerly winds reach their greatest strength and persistence, causing a distinct increase in rainfall in the west and north-west. In the east and south-east, rainfall is more evenly distributed throughout the

year. In comparison with those areas of Europe and North America which are at similar latitudes, Tasmania enjoys a very temperate climate. This is due to the stabilising effect of surrounding oceans whose temperatures change by some 6°C or 7°C throughout the year. The higher proportion of ocean to land area confers a similar benefit on the Southern Hemisphere as a whole.

2.4.1 Winds

The prevailing airstream over Tasmania, the Roaring Forties, is westerly with actual winds varying from northwest to southwest. The greatest strength and persistence of winds occurs during late winter and early spring, but the speed and direction vary with the eastward passage of high and low pressure systems. In the summer months, when the westerlies are weak, afternoon sea breezes become the predominant wind in coastal areas. Periods of more humid north-easterly winds are most likely in the summer and early autumn.

Winds of gale force (34 knots) or greater are more likely to come from the western quarter as deep lows pass just to the south of Tasmania.

2.4.2 Temperature

Temperature decreases with height at an average rate of about 0.7°C per 100 metres. Thus, in a mountainous island like Tasmania the isotherms (lines joining points of equal temperature on a map) will be much influenced by topography. Greater cloud cover over the western half further decreases day-time temperatures in the west, while the Föhn effect warms and dries the westerly airstream as it descends to the eastern areas.

The incidence of frost (air temperature of 0°C or less) is markedly affected by elevation and distance from the coast. Widespread severe frosts are experienced in winter on the Central Plateau and in inland valleys. Inland centres below 300 metres are frost-free only in summer although the north coast, the east and south-east have few frosts from early October until late April. Above 300 metres there is no frost-free month.

Tasmania only occasionally experiences the hot days common in the mainland Australian States. High temperatures in the east and south-east of Tasmania generally occur on the last day of a warm spell during which a dry airmass of continental origin is advected over the State from a direction between north and north-west. Some cooling in the lower air layers over the waters of Bass Strait prevents the northern coast from reaching the higher temperatures that are experienced in the south under these conditions. The highest temperature recorded in Tasmania is 40.8°C, at Bushy Park in December 1945 and at Hobart in January 1976. The lowest temperature recorded is –13.0°C at Shannon, Tarraleah and Butlers Gorge in June 1983.

2.4.3 Rainfall

Rainfall over Tasmania is largely governed by the interaction of airstream and topography. Since the prevailing winds are westerly the higher annual totals are recorded in western highland areas, but there are parts of the north-east which very efficiently intercept the less frequent bursts of humid north-easterly winds. In the west, annual totals vary from 1500 to 3500 mm, whereas in the eastern half the range is from 50 to 1500 mm.

2.3 TEMPERATURES AT SELECTED STATIONS, TASMANIA, 1991 (°C)

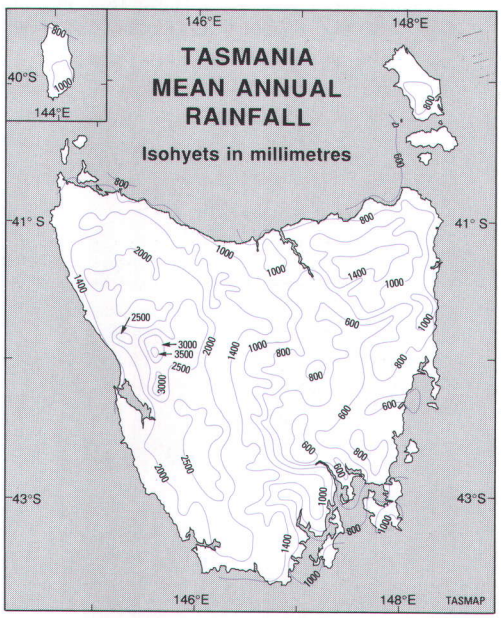
	Summer (Dec-Feb)		*Autumn (Mar-May)*		*Winter (June-Aug)*		*Spring (Sep-Nov)*	
Station	*Mean max.*	*Mean min.*	*Mean max.*	*Mean min.*	*Mean max.*	*Mean min.*	*Mean max.*	*Mean min.*
Hobart	21.6	11.7	17.4	8.7	12.8	6.0	17.3	8.1
Launceston Airport	22.3	9.9	17.6	5.7	12.0	3.2	16.7	5.5
Devonport	20.7	11.5	17.7	7.7	13.0	5.2	16.1	7.0
St Helens	23.4	12.0	19.3	7.1	14.9	4.0	19.1	6.5
Queenstown	19.3	8.4	16.0	5.5	12.1	3.7	15.2	5.2

Extreme three to five day rainfalls occur most often on the West Coast in late June, when the westerlies are increasing in strength and persistence, and the sea temperature is higher than the land temperature. In the north, short periods of extreme precipitation occur when wind flow is sustained for up to two days from the north-east, usually in mid to late autumn. The high moisture content of such streams from over the relatively warm waters of the Tasman Sea results in heavier, if less prolonged, rainfall than is produced in the westerly streams.

Rainfall is less reliable in the east, south-east, Midlands and Derwent Valley. Highest rainfall in these areas tends to occur in autumn and spring, under the influence of small cyclonic depressions off the East Coast.

Effective rainfall is the amount necessary to compensate for evaporation, begin germination and maintain plant growth above the wilting point. Average rainfall is sufficient for this purpose from May until September.

From October to January the chance of receiving effective rainfall lessens, except in the west and north-west, where the probability remains mostly better than 50 per cent. Over much of the eastern half, the chance of receiving at least effective rainfall during the summer months is very small.



2.4.4 Snow, Hail and Thunderstorms

Snow can be experienced over the highlands, above approximately the 900 metre level, at any time of the year. Heaviest snowfalls tend to occur in July and August. Extensive snow below 150 metres occurs, on average, less than once every two years, and is associated with an unusually vigorous outbreak of cold air from Antarctic regions. There is no permanent snowline, but patches of snow often remain on the highest peaks until December.

Hail is most likely in spring, though it is possible in any month. Large hail is usually associated with severe thunderstorms and is more likely in the warmer months. It does particular damage to fruit crops in the Huon Valley and Tasman Peninsula if it occurs in late spring.

Thunderstorms are most common in the north and west of the State and are mostly asociated with the lifting of warm moist air by a cold front. The north and west report ten to fifteen storms per year on average whilst the Midlands,

2.4 ANNUAL RAINFALL, TASMANIA (mm)

Station	*1989*	*1990*	*1991*	*Long-term average (a)*
Bicheno	723	572	633	688
Burnie	1 215	810	1 004	997
Bushy Park	439	575	595	582
Butlers Gorge	1 117	1 709	1 738	1 677
Campbell Town	480	501	487	544
Devonport	1 033	774	963	901
Glenorchy	574	717	704	717
Hobart Airport	469	473	440	522
Hobart Bureau	492	621	571	626
Launceston Airport	615	588	618	695
Launceston	742	648	645	685
Maydena	778	1 184	1 201	1 208
Oatlands	492	539	478	561
Queenstown	2 012	2 398	2 702	2 519
Scottsdale	1 186	871	1 079	1 077
Southport	782	917	975	988
Smithton	1 111	992	1 184	1 104
Strahan	1 542	1 896	1 338	1 647
Strathgordon	1 717	2 495	2 698	2 489
St Helens	865	549	743	784
Swansea	564	425	434	611
Waddamana	603	874	795	813

(a) Number of years of record used to calculate the long-term average varies from station to station.

as gauged from Oatlands, has fewer than three. Severe thunderstorms are more likely during the period November to March and may produce isolated instances of flash flooding or large hail. Tornadoes are rare, most occurring in the central north.

2.4.5 Floods

In Tasmania, floods tend to be seasonal, being more frequent in winter when catchments are saturated, than in summer. The major rivers in the Tamar River basin: the South Esk, Macquarie, Meander and the North Esk Rivers, converge in the north of the state near Launceston, where the combined catchment area is nearly 9000 square kilometres. Many rivers in this system flow through flat country and consequently floods can be widespread and disruptive. Launceston and Longford, the two major urban areas in the basin and many small rural townships are affected by major floods such as those which occurred in 1929 and 1969.

The Derwent River, with a catchment area of 7750 square kilometres at New Norfolk, drains the central part of the State. Minor floods do not occur with the same regularity as in the South Esk due to the Hydro-Electric Commission's storages, but these have little effect during major floods such as the one which flooded New Norfolk in 1960.

The Huon River, which has a catchment area of 2100 square kilometres at Judbury, rises very quickly during floods. Major floods, the most recent of which was in 1975, affect the main township of Huonville in the catchment.

Although heavily regulated by the Hydro-Electric Commission power generation schemes and the Forth and Mersey Rivers (with catchment areas of 1100 and 1600 square kilometres respectively), major flooding is still possible. The most recent major flood in 1970 affected urban areas in the catchments.

Many of the smaller rivers in the north and north-west of the State have their headwaters in the Western Tiers and are subject to flash flooding. The short, fast-flowing rivers of the north-east and east of the State rise and fall rapidly but can be quite damaging. Flooding of rivers in the west and south of the State goes largely unnoticed because they pass through rugged, sparsely populated regions.

2.4.6 Humidity and Evaporation

The mean relative humidity at both 9 a.m. and 3 p.m. exceeds 50 per cent at all stations in all months of the year. Relative humidity is generally higher in the morning than in the afternoon, and higher in coastal areas than inland. Days of high temperature combined with uncomfortably high humidity are rare. In the east, south-east and Fingal Valley, warm dry winds from a westerly or north-westerly direction may occasionally have a relative humidity as low as 10 per cent. These type of winds invariably result from air descending from just above mountainous terrain into lowland valleys or plains.

Evaporation depends mainly on wind strength, the moisture deficit of the airstream and on sunshine.

In the northern Midlands the annual evaporation is nearly 1500 mm due largely to the prevalence of winds coming from the Western Tiers, which become warmer and drier in their descent, thus increasing evaporation. Monthly evaporation at Launceston Airport has ranged as high as 270 mm in summer but drops to be-

2.5 CAPITAL CITIES CLIMATIC AVERAGES

	Hobart	*Melbourne*	*Sydney*	*Brisbane*	*Darwin*	*Adelaide*	*Canberra*	*Perth*
Temperature (°C) -								
Mean daily maximum	16.8	19.7	21.5	25.5	31.9	22.1	19.4	23.3
Mean daily minimum	8.2	10.0	13.6	15.7	23.2	12.0	6.3	13.1
Extreme maximum	40.8	45.6	45.3	43.2	38.9	47.6	42.2	46.2
Extreme minimum	-2.8	-2.7	2.1	2.3	10.4	0.0	-10.0	1.6
Mean daily hours of sunshine	5.8	5.5	6.7	7.5	8.5	6.9	7.2	8.1
Rainfall -								
Mean annual (mm)	626	659	1 226	1 150	1 814	552	629	870
Mean annual days of rain	159	147	137	120	111	121	108	119
Wind - Average (km/hr)	11.6	10.8	12.9	10.3	9.2	12.5	5.8	12.5

tween 25 mm and 40 mm in winter. This area of high evaporation extends southward to the lower Derwent and Huon areas. The lowest evaporation rate occurs in the Central Plateau, West Coast Ranges and Southwest area, where annual evaporation may fall to less than 750 mm. This is due to the high moisture content of the prevailing westerlies and the high average cloud cover. In these areas the monthly evaporation rate may range from about 125 mm in January to only 12 mm in June and July. Another area of low evaporation (below 1000 mm per year) is located in the north-eastern highlands.

2.4.7. Droughts and Bushfires

Although Tasmania has the highest average annual rainfall of any state in Australia, drought conditions are not unknown. Unlike the remainder of Australia, droughts in this State tend to be localised and of relatively short duration and are related to peoples' expectations of normal rainfall. The most severe effects are usually felt over a period of only a few months, but serious rainfall deficiencies can extend over a period of two or three years. The most severe long-term droughts occurred during the periods 1888-89, 1897-98, 1918-20, 1933-34, 1945-46, 1949-52, 1967-69, 1972-73, 1979-82 and 1987-88.

Serious bushfires occurred in 1897-98, 1914, 1934, 1940, 1967 and 1981. The bushfires of 7 February 1967 were the most severe in the State's history, causing 62 deaths and damage to property estimated at the time to be in excess of $25 million. The worst fires on the West Coast occurred during February 1981 when fuels were exceptionally dry for that district. Property damage around Zeehan was estimated to be near $5 million.

2.4.8 Sunshine

The average number of hours a year of sunshine ranges from about 2500 hours in the northern Midlands to less than 1750 hours on the West C oast and western highlands; these areas having the least amount of sunshine in Australia. Hobart averages 2100 hours per year and Launceston around 2400.

In January, the daily average of sunshine ranges from nine hours per day between the Midlands and Launceston to six hours per day on the west and south coasts. In mid-winter, average daily sunshine is down to a maximum of four hours on the east coast and considerably less on the west coast and highlands.

2.4.9 Hobart's Climate

Hobart is not the wettest Australian capital city; in fact it has the lowest mean annual rainfall of all capitals except Adelaide.

2.7 HOBART CLIMATIC DATA

Month	*Temperature (°C)*								*Sunshine (Daily hours)*		*Rainfall (mm)*	
	Maxima				*Minima*							
	Long-term (a)	*Mean 1991*	*Extreme (a)*	*Extreme 1991*	*Long-term (a)*	*Mean 1991*	*Extreme (a)*	*Extreme 1991*	*Long-term average (a)*	*Mean 1991*	*Long-term average (a)*	*Total 1991*
January	21.5	22.8	40.8	39.6	11.7	12.8	4.5	8.1	7.9	8.3	48	69
February	21.6	21.7	40.2	34.0	11.9	11.1	3.4	7.0	7.2	8.6	40	15
March	20.1	19.9	37.3	35.6	10.7	10.1	1.8	5.6	6.3	6.3	47	49
April	17.2	16.9	30.6	22.7	8.9	8.8	0.6	4.1	5.1	5.3	52	24
May	14.3	15.1	25.5	18.9	6.9	7.3	-1.6	3.8	4.2	4.9	49	5
June	11.9	13.8	20.6	18.0	5.2	7.0	-2.8	3.0	3.9	3.9	56	42
July	11.5	12.2	21.0	15.1	4.5	5.8	-2.8	0.0	4.4	4.4	54	31
August	12.9	12.5	24.5	17.4	5.1	5.0	-1.8	0.6	5.0	5.3	52	103
September	15.0	15.1	31.0	20.0	6.3	6.5	-0.6	2.1	5.9	6.4	52	41
October	16.9	18.4	34.6	29.1	7.7	8.5	0.0	3.7	6.4	8.1	64	63
November	18.5	18.4	36.8	33.6	9.1	9.1	1.6	3.7	6.9	7.1	55	43
December	20.2	19.4	40.7	26.5	10.7	11.2	3.3	6.9	7.3	6.1	57	86
Annual	16.8	17.2	40.8	39.6	8.2	8.6	-2.8	0.0	5.9	6.2	626	571

(a) Figures taken over all periods of records.

Temperatures: Mean maximum temperature exceeds 21°C in January and February. On average there are two or three days per year with maximum temperatures greater than 32°C. Minimum temperatures below -1°C are rare.

Rainfall: There is a strong gradient of rainfall to the immediate west of Hobart caused by the bulk of Mt Wellington. On the south-eastern slopes of the mountain the annual rainfall reaches 1400 mm (at The Springs and The Gap) while at Fern Tree the annual average is 1140 mm. The rainfall decreases to about 600 mm in the city area, the annual average being 626 mm at the Regional Office of the Bureau of Meteorology. Some eastern shore suburbs receive as little as 500 mm of rain per annum.

Monthly totals are fairly uniform. The wettest 12 months on record at the Bureau's Hobart Office yielded 1104 mm (to December 1916) and the driest, 320 mm (to November 1943).

Fog: Fogs occur in the city about six times per year in the cooler months but are more frequent over and near the Derwent River, down which they are often carried on a light north-west wind. Fog frequency is far less than that for either Launceston or Melbourne.

Wind: The main wind direction is north-west, induced by the orientation of the Derwent Valley. Next in importance is the sea-breeze (from south or south-east) during summer months. The strongest wind gust experienced in Hobart was 150 km/hr recorded during a storm in September 1965.

Snow and Hail: Snow below 300 metres occurs, on the average, less than once per year. Falls lying in the centre of the city, almost at sea level, have occasionally been recorded. Snow generally lies on Mt Wellington during winter and early spring months, but it is rare between November and March. Hail occurs about four times a year mainly between September and November.

Frost: The average annual frequency of days of frost is 28, mostly from June to August. Cold air drainage is found in the hilly suburbs and frosts are common on the valley floors.

Sunshine and Cloud: No marked seasonal or diurnal variation of cloud amount occurs. However, there is a clear-cut seasonal variation in monthly average hours of sunshine with variations of 235 hours in January to 112 hours in June.

2.4.10 Monthly Weather Review, 1991

January: Monthly rainfall totals were close to average in the south-western half of the State and above, to well above, average in the remainder. Temperatures were slightly above average along the east and south-east coasts during the day, and over almost all of the north-eastern half of the State overnight. On 3 January several new record high January daily maximum temperatures were established in the State.

February: Record or near record low monthly rainfall totals and below average mean daily temperatures throughout most of the State were the major characteristics of February's weather. Several significant bushfires occurred across the State, including on King Island.

March: Rainfall improved during March with most of the State receiving near average or above average monthly totals. Temperatures were cooler than average which to some extent continued the trend set in February, especially in the western half of the State.

April: A pronounced westerly airflow, apparent towards the end of March, continued to control much of Tasmania's weather during April. This situation produced near average rainfall totals about most of the western half of the State, but below average rainfall in the remainder. Temperatures throughout tended to be below the long term averages for the month.

May: The strength of the zonal westerly airflow declined during the first half of the month and gave way to a more meridional circulation pattern which persisted until the end of the month. The resultant rainfall in many areas of Tasmania was amongst the lowest on record with several centres in the north, east and south-east registering totals for the month of less than 10 mm. Temperatures were mostly near normal.

June: In contrast to the previous month, rainfall during June was average or above average, and record monthly totals were registered at some stations in the north and west. Mean daily temperatures were also average or above and several new temperature records were set in the State.

July: Near average rainfall totals were recorded throughout the State during July while temperatures, although initially continuing the above-average trend set in June, fell during the last week of the month to values which were well below the long term daily means.

August: Although most of the State received rainfall which was well above the long-term average for August, some parts of the east coast, Midlands and south-east registered totals which were nearer to their long-term averages. New record August rainfall totals were set at some stations in the north-west, west coast and Flinders Island. Wind gusts in excess of 100 km/h, associated with the passage of a cold front, damaged public buildings and unroofed about 20 houses in the Burnie area on the 5th. Another windstorm with gusts to 135 km/h disrupted power and caused structural damage to buildings on King Island on the 13th.

September: Rainfall and temperatures were close to average throughout most of the State. Several hailstorms affected the northern part of the State during the month. Hailstones, some as large as golf balls, were observed in the Launceston suburb of Trevallyn on the 11th, and on the 19th another storm swept along the Bass Highway between Deloraine and Westbury blanketing the area with hail before crossing the Tamar River. On the 29th strong winds with gusts near 100 km/h damaged houses in Hobart and caused a number of boats to drag or break their moorings in the Cygnet and Dunalley areas.

October: Although westerlies dominated the weather pattern for most of the month the resulting rainfall distribution was somewhat unusual with most totals being well below average in the northern half, but close to average in the remainder. Temperatures were generally slightly above the long-term average.

November: A series of low pressure systems which moved across Tasmania in a southeasterly direction produced above average rainfall in the western half of the State and average rainfall in the remainder. Maximum temperatures were generally within one degree of average. A November record maximum temperature of 31°C was set at Scottsdale, exceeding the previous value by 1.6°C.

December: The first half of the month was marked by a number of anticyclones which moved rapidly past the State. In the latter half of the month Tasmania's weather was influenced by a series of low pressure systems, one of which produced heavy rain which flooded areas of Launceston on the 19th. During this event unofficial reports indicated that 11 mm of rain fell in 10 minutes at Invermay and 25 mm in 40 minutes at the Town Hall.

2.5 ENVIRONMENTAL MANAGEMENT

(The following is based on information supplied by the Tasmanian Department of Environment & Planning.)

Tasmania's 'natural environment' extends above, below and beyond the State's landmass boundaries to the ozone layer 25 kilometres above; below, to the bottom of the deepest water tables; as far as noise carries as well as beyond the low-water mark as far as the coast of Victoria and the continental shelf. It also includes every plant and animal as well as the State's non-living resources. The State's works, its buildings and other structures, form its 'touched environment' and the way of life of its society forms its 'cultural environment'.

Changes, which started with the coming of the Aborigines and accelerated rapidly with European settlement, namely, large scale clearing of land for agriculture, extensive grazing, forestry, mining and settlements have extended human impact to almost every part of the State.

The quality of the Tasmanian environment has profound effects upon the good health and well-being of all Tasmanians. Two substantial sectors of the Tasmanian economy, agriculture and tourism, rely on a high quality of natural environment. The future of Tasmania's society and its economy will be increasingly dependent upon the quality of its natural environment.

An important factor in determining the effect of our activities on the environment is the specific nature of the receiving environment. Tasmania is a mountainous island and is dominated by westerly winds. Despite these prevalent winds, inversion layers frequently form in the valley regions of the State, including the Derwent and Tamar valleys, and influence dispersion of air pollutants.

In the mining areas of the west, average annual rainfall of 2000 - 2600 mm is common and mining districts in the north-east of the State also experience high rainfall. This has a significant influence on water pollution problems arising from the mining operations in those areas.

Marine currents and sedimentary drift around the Tasmanian coast are strongly influenced by the big swell which almost continuously approaches the island from the south-west. Diffraction of this swell in Bass Strait, combined with the effect of prevalent north-westerly winds, produces a distinct on-shore movement along the north coast with consequent impairment of dispersion of any effluents discharged into this coastal region.

The State's population is becoming increasingly urbanised and this, combined with rising per capita consumption and industry, will inevitably raise living standards and this process will require greater control of community and industrial waste disposal.

2.5.1 Pollution Control

Recent Legislation

The *Environment Protection (Sea Dumping) Act 1987* gives effect to the provisions of the London Dumping Convention in relation to the waters of Tasmania by regulating, among other matters, the dumping into the sea, and the incineration at sea, of wastes as well as the dumping into the sea of certain other objects capable and likely to cause pollution. It makes provision for the granting of permits for the disposal of wastes at sea provided environmental requirements are satisfied.

The *Pollution of Waters by Oil and Noxious Substances Act 1987* gives effect to Annex 1 (Oil pollution) and Annex 2 (Noxious Liquid Substances Carried in Bulk) of the *International Convention for the Prevention of Pollution from Ships 1973-78*. Where an oil spill occurs and a response plan is devised, the Minister for Environment and Planning is able to make certain declarations which permit the State to incur clean-up costs. These costs would subsequently be recovered from the polluter or, if this is not possible, through the National Plan for combat of oil spills.

The *Chlorofluorocarbons and Other Ozone Depleting Substances Control Act 1988* imposes strict controls on chemicals which are known to have a major impact on ozone depletion. The chemicals which are controlled under this legislation are chlorofluorocarbon 11 (CFC11), CFC12, CFC113, CFC114, CFC115, HCFC22, Halon 1211, Halon 1301, Halon 2402 and methyl chloroform. It was the first Act of its kind in Australia and one of the first in the world.

Pollution Incidents

During 1990-91, 1236 telephone inquiries were received by the Department of Environment and Planning, as well as a number of written complaints. Of these, 970 were public complaints, 112 were Incident Reports, and 154 were inquiries about hazardous waste disposal.

Complaints were also received concerning primary industry (industries such as food processors, fish farms, poultry, mills and abattoirs), and light industry (industries such as laundrettes, mixed businesses and small factories).

Complaints about local councils were generally related to discharges or odours from sewage treatment plants or waste disposal sites. Complaints about vehicles, which refer to all cars and trucks, generally concerned exhaust system noise and air pollution in about equal numbers.

Ozone Monitoring

The Bureau of Meteorology operates the national ozone monitoring network and recent data indicate a small decrease in stratospheric ozone over Australia during the past 10 years. The Bureau continues to play a key role in international monitoring arrangements and provides the basis for advice to government and general information to community interests.

2.5.2 Environmental Planning

Environmental Impact Assessment

During 1990-91, changes in assessment procedures were brought about by amendments to the *Environment Protection Act 1973* contained in the *Revenue Measures Legislation (Miscellaneous Amendment) Act 1990*. These changes involved:

- the introduction of fees for the assessment of licence applications;
- the introduction of the option of registering, rather than licensing, small developments; and
- changes to the schedule in the Act which determines the nature and size of developments which require a licence.

Baseline Air Pollution Station

The Baseline Air Pollution station at Cape Grim in Tasmania provides the focus for Australia's participation in the World Meteorological Organisation's Background Air Pollution Monitoring Network (BAPMON). The station is funded and managed by the Bureau of Meteorology and its scientific program is supervised jointly by the Bureau and CSIRO.

Registration has, effectively, introduced another level of assessment. The first decision which must now be made is whether to register or licence a premises. Registration involves a simpler set of procedures and is applied to developments which are not likely to pose an on-going environmental risk. After initial assessment it is not expected that registered premises will be subject to regular inspection or monitoring.

Licence Applications for Scheduled Premises

Scheduled premises are those defined in the *Environment Protection Act* as requiring a licence to operate from the Director of Environmental Control. All applications for licences, or variations to existing licences, are subject to environmental impact assessment.

Non-scheduled Premises

The Department is requested to comment on, or carry out assessments on, a wide variety and number of non-scheduled developments. As there is no formal basis for the assessment of non-scheduled developments, there is no clear-cut distinction between developments forwarded for comment and those which might be considered as formal assessments. Thus the assessment procedure followed is essentially the same.

Ministerial Exemptions

The *Environment Protection Act*, through sections 15, 16 and 17 prohibits the emission of pollutants into the air, water or onto the land, from both fixed and moving sources. The Act provides for the Minister for Environment and Planning to exempt a person from the need to comply with these provisions. It is Government policy that no new exemptions will be granted under these sections and that all existing exemptions will be reviewed annually and may only remain valid until 30 June 1994. The number of Ministerial exemptions as at 30 June 1989 was 53, compared to 47 exemptions as at 30 June 1990.

Performance Improvement Program

All operators of industrial and municipal facilities which hold a ministerial exemption under the above sections of the *Environment Protection Act* are required to participate in the Performance Improvement Program. This requires that a program of upgrading works is undertaken in a time frame to eliminate the need for the exemption and as such to bring the facility emissions into compliance with the Act. The operators participating in the program were outlined in the 1988–89 annual report for the Department of Environment.

Individual Premises Review

The larger industrial and municipal facilities in the State are required to prepare an Environmental Management Plan (EMP) for their operations. The EMP contains details of the production process, plant emissions, pollution controls and self-monitoring programs and becomes a major operating licence condition for the facility.

Industry Group Review Program

This program reviews specific industry groups statewide through site inspections, preparation of environmental status reports and, where appropriate, the production of environmental management handbooks. The industry groups reviewed during 1989–90 were sawmilling and timber processing, the poultry industry and the quarrying industry.

2.6 BIBLIOGRAPHY

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