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Chapter 2

PHYSICAL ENVIRONMENT

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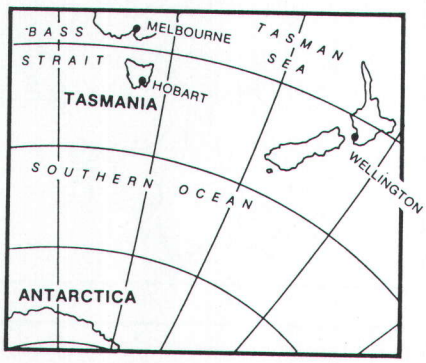
PHYSICAL ENVIRONMENT

2.1 LOCATION AND AREA

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 40° 38′ to 43° 39′ south latitude and from 144° 36′ to 148° 23′ east longitude. 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 latitude, 158° 53′ east longitude and is bounded by 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.

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

2.1 Area of Islands

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

area, compared with the other States. The distinctive feature of the island is not so much the height of the mountains — few exceed 1 500 metres — but rather the frequency with which they occur making Tasmania 'probably the most thoroughly mountainous island on the globe'.

2.2 CLIMATE

(The following section was prepared by the Bureau of Meteorology)

Since Tasmania lies between 40° and 43½° south of the Equator 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 averages about 8° Celsius, rising to about 12° Celsius further inland, indicating a slight continental effect.

The combination of mountainous terrain in the western half of the State and prevailing westerly winds produce a marked west-east variation of climate, and especially of rainfall.

Summers are mild and characterised by greatly lengthened days. The sun reaches a maximum elevation of 70–73° in mid-summer, giving 15 hours of daylight in the north and 15½ hours in the south. In mid-winter, the sun's elevation does not exceed 20–23°, and the shortest day consists of 9¼ hours of daylight in the north, falling to slightly under nine hours in the south.

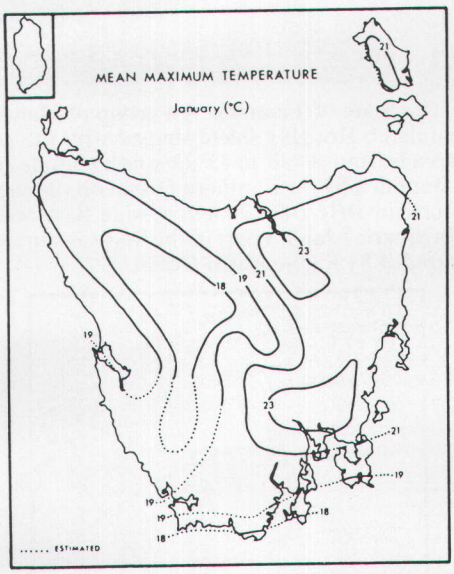
In winter, westerly winds reach their greatest strength and persistence, causing a distinct maximum in rainfall distribution in the west and north-west. In the east and south-east, rainfall is more evenly distributed throughout the year. In comparison with those areas of Europe and North America which are at similar latitudes Tasmania enjoys a very temperate climate. This is due to the stabilizing effect of surrounding oceans whose temperatures change only 3–5° throughout the year. The higher proportion of ocean to land area confers a similar benefit on the Southern Hemisphere as a whole.

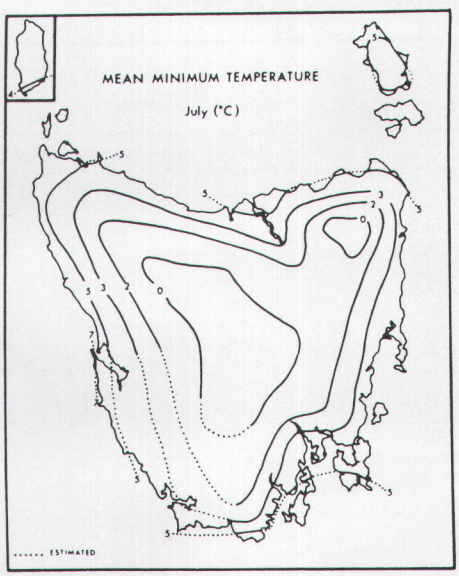
2.2.1 Winds

The prevailing winds over most of the Island are north-west to south-west, with greatest strength and persistence during late winter. Speed and direction vary with the eastward passage of high and low pressure systems. In the summer months, when westerlies are weak, afternoon sea-breezes become the predominant wind in coastal areas. Occasional periods of north-east to south-east winds occur. The highest average wind speeds are associated with extensive deep depressions over ocean areas south of Tasmania.

2.2.2 Temperature

Tasmania only occasionally experiences the extremes of temperature common to the other States. High temperatures recorded in the east and south-east of Tasmania generally occur on the last day of a warm spell during which a dry air mass of mainland 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 temperatures ever recorded in Tasmania are 40.8°C at Bushy Park in December 1945 and at Hobart in January 1976. The lowest temperature recorded was -13.0°C at Shannon, Butlers Gorge and Tarraleah in June 1983.





The recorded extremes of temperature for Hobart are 40.8°C in January 1976 and -2.8°C in June 1972 and July 1981. Readings above 38°C or below -1°C are rare, the mean maximum temperature in summer being 21°C and the mean minimum in winter, 4.8°C.

The average number of hours of sunshine a year ranges from about 2 500 hours in the northern Midlands to less than 1 750 hours on the West Coast and western highlands, this area having the least amount of sunshine in Australia. Hobart averages 2 100 hours per year and Launceston around 2 400.

In January, daily averages of sunshine range 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 three hours on the East Coast and to considerably less on the West Coast and highlands.

2.2.3 Rainfall

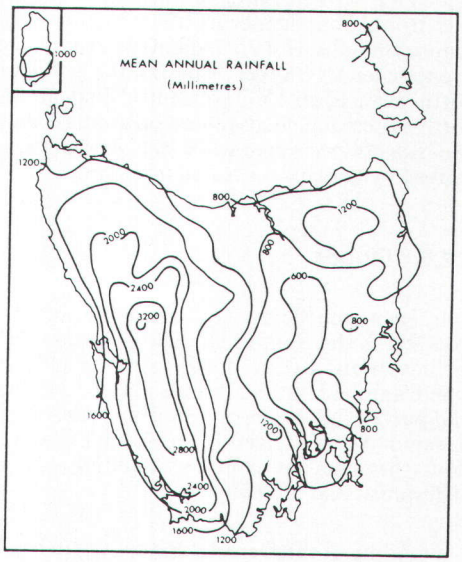
As Tasmania's position is on the northern edge of the 'Roaring Forties' (a westerly air-stream), its exposure to this stream and the mountainous nature of the terrain are the controlling influences on the amount, distribution and reliability of the State's rainfall.

In the west, average annual rainfall ranges from about 1 500 mm on the coast to 3 500 mm at Lake Margaret; in the north-east, from 500 mm on the coast to 1 300 on the highlands; while rainfall in the north-west ranges from 1 000 mm near the coast to 1 600 mm in the higher inland areas.

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 well above 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 from late autumn to spring. 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.

There is a strong gradation in rainfall from west to east, because of topography, with a distinct rain shadow east of the Central Plateau. Parts of the Midlands average less than 500 mm per year. Totals in the east and south-east are higher (over 800 mm on exposed slopes).

Rainfall is least 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.



2.2 Rainfall in Districts

District	*1983*	*1984*	*1985*	*Average(a)*
Northern	762	944	913	994
King Island	863	707	784	933
Central Plateau	836	1 154	1 097	989
Midlands	423	525	625	550
Derwent Valley	674	805	662	687
South-East	876	848	934	759
East Coast	747	818	823	817
West Coast	2 026	2 507	2 014	2 332
Flinders Island	688	635	893	740

(a) Long-term annual average based on 73 years of record.

2.2.4 Snow, Hail and Thunderstorms

Snow and hail can be experienced over the highlands at any time of the year. Heaviest snowfalls occur, as a rule, in late winter and spring, and less frequently in June and July. Extensive snow below 150 metres occurs, on the average, less than once every two years, 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 possible in any month. Hail storms are a big risk to fruit

crops in the Huon Valley and on the Tasman Peninsula, and sometimes cause extensive damage.

Thunderstorms are most common in the west and about the North Coast and are usually associated with the lifting of warm moist air by a cold front. Thunderstorms occur mainly in the summer months. Hobart and Launceston average five to seven storms per year, and the north and north-west, 10 to 15. The Central Plateau and north-eastern highlands report, on average, about five storms per year, while the Midlands, as gauged by Oatlands, has less than three.

2.2.5 Floods

In Tasmania the river system most affected by flooding is the South Esk. The Esk catchment includes most of the north-eastern highlands, where annual rainfall averages about 1 300 mm, and part of the Western Tiers where run-off can be rapid. As many rivers in the South Esk system flow through flat country, flooding can be widespread and disruptive.

Flooding of the Derwent River system can be extensive but is less frequent than in the South Esk. The most severe flood on record in the Derwent occurred in April 1960 with the peak discharge flow recorded as 3 400 cumecs (cubic metres per second) at Macquarie Plains. However, it is most unlikely that flooding of this severity will again occur on the Derwent due to the completion of the four dams across the River since 1960 by the Hydro-Electric Commission.

Flooding of rivers in the west and south of the State can be of greater frequency than in the Derwent and Esk systems but because of mountainous terrain and lack of population these pass mostly unnoticed. Similarly, the short, fast-flowing rivers of the East Coast flood and fall rapidly, but can cause damage and disruption of road systems.

In the north and north-west of Tasmania many rivers have their catchments along the northern edge of the Central Plateau and can flood quickly.

Central Hobart was centimetres from flood emergency

Central Hobart was 10 centimetres from emergency evacuation early on the eighteenth of December 1985 as the worst floods in 25 years hit the south-east of the State.

At 5 am the Hobart Rivulet, measured at the twin culverts at the Campbell Street intersection, rose to 1.2 metres — the highest level for more than 15 years.

Evacuations in the city centre under the central business district flood action plan start when the water level at the culverts reaches 1.3 metres.

The Hobart City Engineer, Mr Graeme Howard, was reported as saying that the major city rivulets had coped well with the deluge but there had been widespread flooding.

2.2.6 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. But it is colder on average.

2.3 Capital Cities Climatic Data

	Sydney	*Melbourne*	*Brisbane*	*Perth*	*Adelaide*	*Hobart*	*Darwin*	*Canberra*
Temperature (°C) —								
Mean daily maximum	21.4	19.9	25.4	23.2	22.4	**16.8**	32.3	19.3
Mean daily minimum	13.6	9.9	15.5	13.1	11.8	**8.2**	23.2	6.2
Extreme maximum	45.3	45.6	43.2	44.7	47.6	**40.8**	40.5	42.2
Extreme minimum	2.1	-2.8	2.3	1.2	0.0	**-2.8**	10.4	-10.0
Mean daily hours of sunshine	6.7	5.7	7.5	7.9	6.9	**5.8**	8.5	7.2
Rainfall —								
Mean annual (mm)	1 215	661	1 157	879	531	**626**	1 536	639
Mean annual days of rain	148	143	123	120	120	**160**	97	110
Wind — Average (km/hr)	11.6	12.3	10.8	15.6	12.5	**11.7**	9.2	5.8

2.4 Hobart Climatic Data, 1985

Month	Shade temperature				Mean daily hours of sunshine (a)	Rainfall	
	Mean maxima (a)	Mean minima (a)	Extremes (b)			1985	Long-term average (a)
			Maximum	Minimum			
	°C	°C	°C	°C	hours	mm	mm
January	21.5	11.7	40.8	4.5	7.9	61	47
February	21.6	11.9	40.2	3.4	7.0	38	40
March	20.0	10.7	37.3	1.8	6.3	39	48
April	17.1	8.8	30.6	0.6	5.1	65	53
May	14.3	6.8	25.5	-1.6	4.2	36	49
June	11.8	5.1	20.6	-2.8	3.9	44	57
July	11.5	4.4	21.0	-2.8	4.3	61	53
August	12.9	5.1	24.5	-1.8	5.0	22	52
September	14.9	6.3	28.2	-0.6	5.8	38	53
October	16.9	7.6	33.4	0.0	6.3	58	63
November	18.5	9.1	36.8	1.6	7.0	47	56
December	20.2	10.6	40.7	3.3	7.3	206	57
Total for year	16.2	8.2	40.8	-2.8	5.8	716	626

(a) Long-term average. *(b)* Specific extreme temperatures since records kept.

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 1 400 mm (at The Springs and The Gap) while at Fern Tree the annual average is 1 140 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 1 104 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.

2.2.7 Seasonal Temperatures

2.5 Temperatures at Selected Stations, Tasmania, 1985

Station	*Summer (Dec–Feb)*		*Autumn (Mar–May)*		*Winter (June–Aug)*		*Spring (Sept–Nov)*	
	Mean maximum	*Mean minimum*	*Mean maximum*	*Mean minimum*	*Mean maximum*	*Mean minimum*	*Mean maximum*	*Mean minimum*
Hobart	19.6	10.9	18.0	9.7	12.5	4.7	16.4	8.6
Launceston Airport	21.4	8.5	18.4	8.0	11.1	2.5	16.6	6.2
Devonport	19.8	10.3	18.6	9.7	12.3	3.3	16.7	7.5
St Helens	20.7	10.6	19.1	9.5	14.4	2.4	17.5	8.0
Queenstown	18.5	6.4	18.6	6.3	11.9	2.8	17.0	4.6

2.2.8 Monthly Weather Review 1985

January

With average monthly minimum and maximum temperatures below normal, January was relatively cool and wet; rainfall was well above normal in the south-west although below normal elsewhere.

February

In most districts rainfall was well below average; temperatures too were below normal. Combined with January and December, the summer was one of the coldest for the State since 1964–65.

March

East to north-easterly winds produced generally above average temperatures throughout the State. Rainfall was above average in eastern and central districts but well below normal on the West Coast.

April

Easterly winds again produced above normal temperatures and above average rainfall on the East Coast.

May

North to north-westerly airstreams again produced above normal temperatures. Rainfall in the north of the State was well above average but was below normal in most other districts.

June

Rainfall was close to normal except in eastern and central districts which had about half their usual falls. Temperatures were cool with most of the State below normal.

July

Most of the north, central and eastern parts of the State received less rain than usual, while the south-west received above average falls. Early in the month temperatures were above average and slightly below normal thereafter. High winds and heavy rains occurred at the end of the month.

August

Temperatures overall were slightly above average. Most of Tasmania had rainfall totals below average due to a general lack of strong frontal activity. North-westerlies dominated the weather.

September

Lack of rain resulted in some areas recording their lowest September rainfall totals ever. Above average maximum temperatures occurred except in the south-east. Minimum temperatures were also above average apart from the north-west.

October

Maximum and minimum temperatures were generally above average. Some parts of the State received above average rainfall although much of Tasmania had another drier than average month.

November

Less than average westerly weather affected the State. Rainfall in the south and west was generally below average.

December

Heavy rainfalls persisted throughout the State causing some flooding in the south. Hobart recorded its wettest December since 1916.

2.3 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 (and virtually unexplored) 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.

2.3.1 Mountains, Lakes and Rivers

With six mountains exceeding 1 500 metres, 28 above 1 220 and a substantial part of the Central Plateau above 900 metres, Tasmania is truely an island of mountains. The tallest is Mt Ossa (1 617 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.

2.6 Mountains and Lakes

Mountains	*Height (metres)*
Mt Ossa	1 617
Legges Tor	1 573
Barn Bluff	1 559
Mt Pelion West	1 554
Cradle Mountain	1 545
Stacks Bluff	1 527
Mt Gould	1 491
Mt Jerusalem	1 491
Mt Olympus	1 447
Frenchmans Cap	1 443
Mt Ironstone	1 443
Lakes	*Area (square kilometres)*
Lake Gordon *(a)*	272
Lake Pedder *(b)*	241
Great Lake *(c)*	170
Arthurs Lake *(c)*	64
Lake Sorell	52
Lake King William *(a)*	41
Lake Echo *(c)*	41
Lake Mackintosh *(a)*	29
Lake St Clair	28
Lake Pieman *(a)*	22
Lake Rowallan *(a)*	9
Lake Roseberry *(a)*	7
Lake Barrington *(a)*	7
Lake Cerhena *(a)*	4
Lake Murchison *(a)*	4

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

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 Huon River takes the waters of the south-west from the Gordon and Franklin Rivers at Lake Pedder. 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.

2.7 Rivers

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

2.3.2 Physiographic Regions

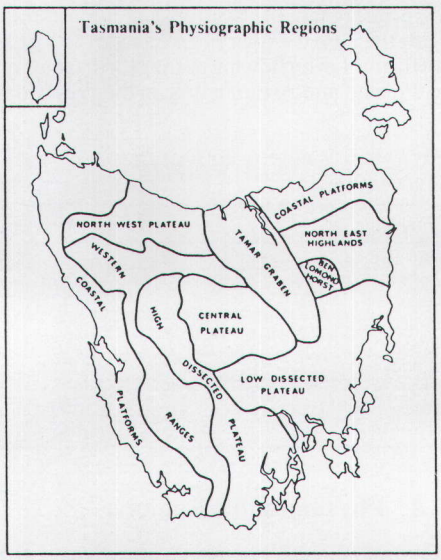
Central Plateau: The main feature is a relatively undissected, dolerite-capped plateau sloping generally south-eastward from an average level of 1 065 metres in the north to 610 metres in the south, and drained almost wholly by the Derwent system. The northern and eastern boundaries of the Plateau are the Great Western Tiers (paradoxically named since they lie in the central north of the island). This is known as the 'lake country' of the island and is one of the chief sources of hydro-electric power.

High Dissected Plateau: West of Lake St Clair, dolerite caps steeply-tilted sediments and the plateau is much dissected; it comprises a series of peaks and broken ridges. The coastlands in the extreme south of the region are rugged but in the D'Entrecasteaux Channel and Huon River areas, narrow coastal belts have been devoted to specialised agriculture.

Western Ranges: The high dissected plateau is bounded by a series of mountain ranges running parallel to the West Coast and in this region are located the State's principal mines. The south of the region is virtually uninhabited.

Western Coastal Platforms: Throughout almost the entire length of the West Coast, an uplifted and much dissected peneplain slopes westward from about 275 metres altitude, ending abruptly in cliffs more than 30 metres high. In the

south of this region, superhumid button grass plains predominate, and the area is uninhabited. On the coastal plain south of the Arthur River however, dairy cattle are wintered on agistment runs, while north of the river dairying begins to appear and swamps have been drained to allow farming.



The above regions derive from a classification by J.L. Davies, M.A., PhD., University of Tasmania

North-West Plateau: North of the Western Ranges lies a plateau averaging nearly 610 metres altitude which is important mainly for forestry; the coastlands derive mainly from basalt, giving rise to intensive mixed farming based on dairying, potatoes and crops for canning and freezing, such as peas and beans.

Tamar Graben: This graben (rift valley) is the largest plain and the leading agricultural and pastoral district in the State; it ends in the drowned inlets of the Tamar and Mersey estuaries and of Port Sorell, in the north.

North-East Coastal Platforms: This region consists of undulating lowland but the soils are acidic and the land is used only for grazing.

North-East Highlands and Ben Lomond Horst: This region comprises mostly uplifted remnants of old fold mountains dominated by the 1 525 metre dolerite-capped plateau horst of Ben Lomond, an outlier of the Central Plateau. Here agriculture is largely confined to small basalt-derived basins. Some minerals are worked.

Low Dissected Plateau: In the south-east lies a low dissected dolerite plateau averaging perhaps 365 metres and used mainly for grazing. The northern coastlands of this region are narrow and also devoted to sheep, but the southern coastland is important for its specialised agriculture. At the extreme south of the region is the drowned estuary of the Derwent and the Tasman and Forestier Peninsulas.

2.4 SOILS

(The following article by K.D. Nicolls and G.M. Dimmock is taken from 'Atlas of Tasmania', published by the Lands and Surveys Department, Hobart in 1965.)

Nearly all Tasmanian soils are moderately to strongly leached, because of the generally humid climate. Most are acid, at least in the surface horizons, some very strongly so. Podzolic soils of various kinds are the most extensive, while on basalt in the north of the State, the strongly leached krasnozems are widespread. Moderately leached soils are almost restricted to basic igneous rocks, in the relatively dry valleys of the centre and south-east; in some of these small amounts of free carbonate produced in rock weathering remain in the deeper horizons. Elsewhere, low to moderate leaching is associated with youth of the parent materials, as in the calcareous coastal sands, but this is only in restricted localities.

In keeping with relatively high rainfall and low temperatures, Tasmanian soils tend to be high in organic matter. In a survey of 264 samples of various soils throughout the State, the median value for organic matter in the surface four inches was close to nine per cent.

Restricted drainage, in association with button grass, *Mesomelaena sphaerocephalus*, produces moor podzol peats at low elevations on the valley floors of the south-west. Together with low temperature on the Central and smaller plateaux, it is responsible for the development of the moor peats. Restricted drainage also accounts for the acid swamp soils and fen soils in the north-west and on King and Flinders Islands, and for the organic soils occupying narrow strips of alluvium along the flood plains of rivers in the eastern half of the State. Nevertheless, Tasmanian peats are usually shallow. The depth of soil with organic matter content exceeding 20 per cent is usually no more than 12 inches, and peats more than 24 inches deep are rare.

Within any one climatic zone the pattern of parent material largely determines the distribution of soils, the soil boundaries closely following rock boundaries. This is so particularly with the basic igneous rocks, basalt and dolerite, the soils of which are distinct from those on more siliceous parent materials. Consequently where soil surveys have not been made, the geological map is the best indicator of the likely soil pattern.

Examples of the influence of age of the soil surface upon soil development may be seen in river terraces and in successive drifts of wind-blown sand along some parts of west-facing coastlines. In the Midlands Graben the highest (oldest) river terraces have lateritic podzolic soils, lower terraces have meadow podzolic and solodized-solonetz soils and the present flood plains have organic alluvial soils. On the coastal sand drifts, the oldest surfaces farthest inland have strongly leached groundwater podzols and podzols, the intermediate dunes have less leached terra rossa soils, and the young drifts near the beaches have the slightly leached calcareous coastal sands.

Fertility

Like other Australian soils, by world standards Tasmanian soils are not fertile. But on the average, Tasmania is well watered, and its soils can be made highly productive if adequately fertilised. The need for nitrogen has been met mainly by growing legumes, but there is an increasing place for nitrogen fertilisers with special crops and high producing pastures such as those used in dairying. Though in areas of intensive farming, superphosphate has been in continuous use for at least three to four decades, phosphorus is still generally required. The majority of agricultural soils in Tasmania apparently have low reserves of usable potassium, and as greater demands are put upon them, the need for applied potassium will increase. Already lack of potassium limits pasture production on sandy soils and those exploited by long cropping, particularly the lateritic podzolic soils and some of the meadow podzolics. Molybdenum is the most widely required of the trace elements, especially in the lateritic podzolic soils, the krasnozems, and many of the yellow podzolic. Copper is commonly required on the groundwater podzols, podzols and calcareous coastal sands, for stock health as well as for pasture production. Soils of these last three groups, together with some krasnozems and yellow podzolic soils, commonly fail to supply enough cobalt to stock grazing on them, and cobalt supplementation by pasture topdressing or by other means is necessary.

2.5 VEGETATION

(This section is based on an article contributed by Dr Winifred M. Curtis to the 1969 Tasmanian Year Book.)

Tasmania's rugged topography and diversity of soil and climate result in a wide range of habitats for plants. There are some 1 200 species of native flowering plants of which about 200 are *endemic*, i.e. peculiar to the State. This flora, while closely related to that of the Australian mainland, has also a very strong affinity with the floras of other southern lands, namely New Zealand and southern South America.

Except on the mountain summits, the climate of Tasmania is favourable for the development of forest, both temperate rain forest in areas having an annual rainfall of about 1 500mm or more, and sclerophyll (eucalypt) forest in the drier parts. There are, however, considerable areas of sedge-moor and heath associated with particular types of soils; these are sometimes increased by the effects of repeated fires. Conditions for the growth of plants often change abruptly, particularly in mountainous country dissected by gullies, and juxtaposition of forest, sedge-moor and subalpine communities produces a mosaic-like pattern.

2.5.1 Temperate Rain Forest

Myrtle and Sassafras

In areas of high rainfall and suitable soils, temperate rain forests are found from sea level to an altitude of about 1 000 metres, and corridors extend into many of the deep sheltered gullies in eucalypt forests. The characteristic trees, myrtle (*Nothofagus cunninghamii*) and sassafras (*Atherosperma moschatum*), cast a deep shade and undergrowth is often reduced to a surface cover of liverworts, mosses and lichens with scattered areas of ferns. Corridor forests at low altitudes develop as fern gullies in which other species of trees appear. Often musk (*Olearia argophylla*), with sassafras, are the dominant trees forming a canopy above the tree ferns.

'Pines' and Blackwood

While myrtle and sassafras are characteristic and widespread throughout Tasmania's rain forests, other species are locally abundant. King Billy pine (*Athrotaxis selaginoides*) and pencil pine (*A. cupressoides*) are trees of 15 to 30 metres in height. They may be associated with myrtle or they may form pure stands on slopes of the central plateau in high-rainfall areas, e.g. at Cradle Valley. Huon pine (*Dacrydium franklinii*),

a fine timber tree characteristic of the banks of rivers near the west coast and of lakes on the central plateau, is no longer plentiful. Blackwood (*Acacia melanoxylon*) reaches its greatest development in the swampy soils of the north-west.

Celery-top and Leatherwood

Where soils are acid and poor in mineral nutriments and the canopy of the rainforest becomes broken, other trees and also tall shrubs appear. Celery-top (*Phyllocladus aspleniifolius*) is widespread and leatherwood (*Eucryphia lucida*) locally abundant. The latter sometimes grows to a height of 30 metres although more usually 7–12 metres. In late summer, the flowers make a spectacular display; they are white, about 3.5 cm in diameter and resemble wild roses. There are some six species of leatherwood, two endemic in Tasmania, one in the Australian mainland and three in Chile.

'Laurels', Waratahs and Heaths

The tall shrubs of these forests include a number of endemics, many characterised by showy flowers or by bright fleshy fruits. Native laurel (*Anopterus glandulosus*) is a handsome shrub bearing large terminal racemes of white flowers. The waratah family (*Proteaccae*) and heath family (*Epacridaceae*) are well represented. From the latter family, two endemic species are of particular interest. Pandani or giant grass tree (*Richea pandanifolia*) has leaves one to two metres long, parallel-veined, hard, rigid and drooping, borne at the summit of a trunk which may be six to nine metres high. Climbing heath (*Prionotes cerinthoides*) is a climber not infrequent on the trunks of myrtle where it may reach a height of 12 metres above the ground. It forms pendant sprays of small evergreen leaves and crimson bell-like flowers. In the character of both leaf and flower, climbing heath differs somewhat from other representatives of the heath family but it resembles another monotype genus (*Lebetanthus*) which is endemic in southern South America.

Impenetrable Scrub

Locally in poor acid soils where the water table is at or very near the surface an almost impenetrable scrub develops, the density of which is notorious. About five species are mainly concerned. Woolly teatree (*Leptospermum lanigerum*) forms dense stands of trees having slender, very tough trunks up to 15 metres high. The sedges appropriately called 'cutting grass', grow in clumps which are often more than two metres in height and breadth. *Bauera rubioides* (family Cunoniaceae) has innumerable thin, wiry, intertangled branches often spreading over other shrubs to a height of 3 metres or more. The most unusual growth form is horizontal scrub. This is a small evergreen tree making a closely packed understorey in the forest or forming pure stands in gullies. The trees sometimes grow erect with trunks up to 13 metres high but, typically, slender saplings arch towards the ground and many erect branches arise from the almost horizontal trunks. The branches in turn bend over, interlacing with each other and with branches from adjoining trees. In this way, dense platforms develop at varying heights above the ground.

2.5.2 Mixed Forest

Where rain forest gives way to sclerophyll forest, there is an ecotone of mixed forest, the extent and character of which are largely determined by the incidence of fires. Eucalypts are able to establish in open ground cleared by fire; at altitudes below about 750 metres swamp or stringy gum (*Eucalyptus regnans*), stringy bark (*E. obliqua*) and gum-topped stringy bark (*E. delegatensis*) tower above an understorey of trees and tall shrubs from the rain forest. In this understorey tree ferns are often abundant, their trunks clothed with epiphytes among which filmy ferns (Hymenophyllaceae) are prominent and *Tmesipteris* locally frequent. At higher altitudes, eucalypts characteristic of montane and subalpine communities are found in the ecotone and myrtle may be reduced to a bushy scrub below Tasmanian snow-gum (*E. coccifera*), urn gum (*E. urnigera*), yellow gum (*E. subcrenlata*) or cider gum (*E. gunnii*).

2.5.3 Subalpine Vegetation

Subalpine Communities

The subalpine communities of the mountains form a complex pattern determined by the varied habitats. Endemic conifers often form quite extensive forests; here pencil pine is usually dominant. In some of the moister environments, stands of myrtle extend to the tree line. A second species of myrtle (tanglefoot), forms dense thickets on very exposed slopes. Tanglefoot is an endemic species and Tasmania's only native deciduous tree; its leaves brighten the slopes in autumn by changing colour from green to vivid golden-bronze or red before they fall.

Subalpine Moorland

The term subalpine moorland is used to include a number of communities such as shrubberies, the assemblages characteristic of

screes and mountain-top detritus, herbfields, swamps and bogs. Some shrubberies comprise conifers reaching a height of two to two and a half metres, others consist of lower-growing plants, including the prostrate conifers *Podocarpus alpina* and *Microcachrys tetragona*, and with daisies, waratahs and heaths well represented. The plants of the heath community make a colourful display in summer and early autumn. The flowers of *Richea* (family Epacridaceae) are of particular interest; they are characterised by the corolla, the petals being joined to form a more or less conical cap which does not open when the stamens are mature but splits transversely near the base and falls in its entirety. *Richea scorparia*, which is abundant in the shrubberies, has flower buds ranging in colour from white to apricot, brick red, or deep crimson. The genus comprises some ten species of which only one occurs outside Tasmania, on mountains of the south-east of the Australian continent.

Micro-shrubbery

An interesting plant community, which may be termed a micro-shrubbery, develops on mountain-top detritus (worn rock material), on the margins of shallow pools and on gentle slopes where snow often lies for up to six months of the year. Five species of cushion plant are concerned. These plants are perennial, ever-green and much-branched with the main branches prostrate but sending up short, erect shoots that grow to an even height. The erect shoots are very densely packed; they bear stiff, closely imbricated leaves and adventitious roots. As growth continues, the lower leaves die and the debris, together with roots and with silt washed into the interstices, help to consolidate the mass. A plant spreads to form a mound which may be one and a half metres or more in diameter, the surface flat or rounded and so firm as not to yield underfoot. The species involved are: *Abrotanella forsterioides* (Compositae family), which is able to grow at lower altitudes and in drier situations than the rest; *Pterygopappus lawrencii* (Compositae), distinguished by the sage-green colour of its leaves; *Dracophyllum minimum* (Epacridaceae); *Donatia novae-zelandiae* (Donatiaceae); *Phyllachne colensoi* (Stylidiaceae). This plant community closely resembles those found in comparable habitats in New Zealand and in the Magellanic moorland of South America. The species of *Donatia* and of *Phyllachne* are common to Tasmania and New Zealand.

As the cushion plants spread and adjoin, they form a mosaic which has a continuous level or undulating surface. These plants serve as seed beds for others; the white-flowered *Drosera arcturi* is often conspicuous and the endemic plantain, *Plantago gunnii*, is confined to this habitat. But a cushion plant does not continue to expand to an indefinite size; after a time it dies in the centre allowing the establishment of plants such as the fern *Gleichenia alpina, Calorophus minor* (syn. *Hypolaena lateriflora*, family Restionaceae), *Astelia alpina* (pine-apple grass, family Liliaceae) and also various shrubby species. One result of this method of growth is that the flow of water in the area is interrupted and conditons then favour the development of bog or swamp. In water-logged soils, *Astelia alpina* is locally frequent, often forming extensive mats which are firm underfoot. The leaves of this plant are closely tufted, lanceolate or ensiform and up to 30 cm long; they are very stiff and are held erect showing the lower surface which is silvery white and contrasts with the grey-green upper surface.

2.5.4 Button-Grass Plains

Extensive tracts of country in climatic conditions suitable for the development of temperate rain forest or mixed forest carry sedge-moors which are given the descriptive name 'Button-grass plains'. The characteristic plant is button-grass (*Gymnoschoenus sphaerocephalus*) which grows in tussocks consisting of hard, narrow leaves, one to two metres long, and of slender spreading flower-stalks terminating in small spherical heads of flowers and fruits. This plant community is typical of wet infertile soils that are acid, podsolized and having a surface accumulation of peat. Reaching their greatest development on flat valley floors in areas of high rainfall, the tussocks extend from sea level and spread over hills until they give way to more drought-resistant or cold-tolerant plants of montane and subalpine regions. However, the boundaries of this community are not strictly limited by the nature of the soil and may be extended as a result of repeated fires. While button-grass is a characteristic and conspicuous plant, other monocotyledons, particularly representatives of the Restionaceae, are abundant and sometimes dominant. The yellow-flowered species of *Xyris* (family Xyridaceae) and mauve-flowered *Patersonia fragilis* (family Iridaceae) are widespread and, between the tussocks, small herbaceous plants are locally frequent. Where the soil becomes better drained, woody shrubs appear.

2.5.5 Sclerophyll Forests

Principal Growth

The sclerophyll forests dominated by *Eucalyptus* extend through a wide range of habitats from the margins of rain forests to exposed mountain plateaux and the relatively dry areas of the

midlands. In the dry regions, the forest becomes almost a savannah woodland with scattered trees of cabbage gum (*Eucalyptus panciflora*) and a ground cover of grasses or low shrubs. Between the extremes there are considerable areas of rather open forest. Some 26 species of *Eucalyptus* occur in the State of which about half are endemic. Many of these species are highly variable and the forests show a complex pattern in which variants of one species give way to those of another, in response to slight changes in conditions, e.g. different soil-type or different aspect. Near Hobart a pattern is well shown on the low but much dissected foothills of Mt Wellington. Here the sunny north-facing slopes carry the glaucous species silver peppermint (*E. tasmanica*) or Risdon peppermint (*E. risdoni*) while the south-facing slopes carry the non-glaucous species such as stringy bark and white gum (*E. riminalis*). In the open forests, subdominant trees include species of she-oaks, *Casuarina*, which often forms societies on dry slopes, the semi-parasitic native cherry (*Exocarpos cupressiformis*) and wattles such as *Acacia mearnsii. Banksia marginata* and silver wattle (*Acacia dealbata*) are widespread. Many low-growing shrubs contribute to a colourful show of flowers in spring, representatives of the pea family, heaths, daisies and boronias being the most conspicuous.

Blue Gum

Blue gum (*Eucalyptus globulus*) which has been chosen as Tasmania's floral emblem is, of all Australian eucalypts, the species that has been most widely introduced overseas. The tree has been established throughout the Mediterranean region and in highlands of the tropics in many parts of Africa and India; it is widespread in California and in parts of Chile, Argentina and New Zealand. In many of these regions, the tree has become of considerable economic importance as timber, as a material for paper pulp production, and for fuel and oil. Blue gum is locally abundant in southern and eastern Tasmania; in well-drained soils and in sheltered valleys, it reaches a height of about 60 metres. The tree also occurs in restricted areas near the west and south coast, but, apart from local occurrences in southern Victoria, is native to Tasmania.

2.5.6 Coastal Heath Vegetation

On coasts, mainly in the north-west and north-east of the State, areas of infertile soils support only a heath vegetation of stunted trees and low shrubs. This community, like the sedge-moor, may extend beyond the infertile soils as a consequence of recurrent fires. Two species of grass tree (*Xanthorrhoea australis* and *X. minor*) are locally frequent. These are bizarre plants producing a large number of rigid, persistent, narrow-linear leaves, often half to one and a half metres long and tufted at the top of a stout stem. In *X. australis* the stem may form a trunk up to half a metre high. The flowering stems are erect, typically solitary, and, again in the larger species *X. australis*, from one to two metres high, having the upper half very densely crowded with small bracteate sessile flowers that form a narrow-cylindrical spike. The flowers are white but after they have withered, the dark brown fruiting spikes are long-persistent. The genus is confined to Australia and has been classified in several ways.

2.5.7 Tasmanian Fungi

by *Edward Gall*

When most people think of fungi, they usually think of the mushrooms and toadstools that are commonly found growing on the floor of the forest. Although mushrooms and toadstools are beautiful and varied in form and colour, they comprise only a part of a very diverse group of fascinating organisms present in all natural Tasmanian environments.

Fungi are non-vascular plants that do not possess chlorophyll. They obtain their nourishment either as a saprophyte from dead material or as a parasite on living organisms. The main part of the plant body is the mycelium, an interwoven network of microscopic white threads usually found either under leaves and bark or penetrating through earth and tree trunks. When circumstances are favourable, reproductive spore bearing sporophores develop on the mycelium. These fruiting bodies are the mushrooms, toadstools and brackets that are familiar to everyone.

In Tasmania there has been little study of fungi by either amateurs or professionals. While some isolated groups have been researched, the gaps in our knowledge remain very broad. It is therefore difficult to be conclusive on the nature of all Tasmanian fungi. It is even difficult to determine the proportion of endemic species.

Eygelsheim (1981) estimates that there are over 1 000 species of true toadstools and mushrooms (family *Agaricaceae*) in Tasmania. Many species have apparently been introduced and are associated with agricultural practices and exotic forestry species.

All of the major groups of fungi are represented in Tasmania. Common types of fungi include: the gill fungi (e.g. *Hygrophorus spp.*); the pore fungi (e.g. *Tyromyces bulcherimus*); the jelly fungi (e.g. *Tremella fuciformis*); the cup fungi (e.g. *Aleuris spp.*); the coral fungi (e.g. *Clavulinopsis miniatus*); the puffballs (e.g. *Lycoperdon*

spp.); morels (e.g. *Morchella elata*); and the sponge fungi (e.g. *Fuligo septica*).

There are many brightly coloured, showy fungi in Tasmania such as *Amanita muscaria* and *Russula spp*. One of the most characteristic is the 'myrtle oranges' (*Cyttaria gunnii*) which, as the common name suggests, looks like bunches of oranges hanging in myrtle rainforests.

Although Tasmanian fungi can be found with sporophores at any time of the year, the time when they are most conspicuous and abundant is autumn, particularly after a warm, wet summer. The greatest diversity of species is found in the wet lowland forests, particularly rainforest.

As in most parts of the world, there are edible, halucinagenic and poisonous species. The Tasmanian aboriginals used many species for food including blackfellow's bread, a large species found growing in cavities. Most of the names used by the aboriginals have been lost. As there has not been any subsequent development of a peasant or subsistence culture closely dependent on the natural environment, there are few species with a common name. Where there is a common name, it is often based on European folk-lore and usually applied inconsistently for various species.

There are few native species of direct economic importance other than the field mushroom (*Agaricus campestris*) and the horse mushroom (*A. arvensis*) which are gathered directly from pasture-land for home use. Several introduced species are cultivated for the fresh vegetable market and other species are used in cheese production and brewing. However, the indirect economic importance of fungi for forests and soils is great.

In all established Tasmanian forests there is an amount of forest litter (shed leaves, bark and branchlets) that lies on the forest floor. Given sufficient time, the litter is almost completely digested by fungi and bacteria. In the dry sclerophyll forests, due to the reduced rate of fungal activity caused by the lack of moisture, there is a net accumulation of litter and a consequent potential high fire risk. However, in a rainforest the rate of fungal digestion of litter is close to equilibrium with the rate of litter accumulation, with a consequent low fire risk. In wet sclerophyll forests where conditions are intermediate between these two extremes, there is typically a slow net accumulation of litter and an intermediate frequency of fires.

In the decomposition of organic matter, an important effect is the release of nutrients in a form useful for other species. Another important effect is that of soil conditioning by the humus that has resulted from the breakdown of organic matter.

An interesting phenomenon is the succession of fungal species in the forest litter. The fresh litter is invaded by the fast growing 'sugar fungi' (often from the class *Phycomycetes*) which use the readily available, easily digestible organic molecules such as sugars and proteins as their main source of energy. Having exhausted these resources, there is then an invasion of the 'cellulose fungi' (often from the class *Ascomycetes*) which digest more stable molecules such as cellulose. Finally there is the development of the mycelia of the slow growing 'lignin fungi' (often from the class *Basidiomycetes*) which digest the most stable and hardest to break down molecules such as lignin and the phenolic compounds.

In the litter there is also an 'antibiotic war' in progress. Many of the fungi release antibiotics into the surrounding medium to inhibit or reduce the growth of other fungi and bacteria. This gives rise to a direct competitive advantage against other species. It is from such fungi that many of the antibiotics currently used on humans and in animal husbandry are produced. The potential for Tasmanian fungi in this field remains unresearched.

Many species of native plants have established symbiotic relationships with fungi. In one of these relationships called a mycorrhiza, the fungus provides nitrogen and other nutrients to plant roots in exchange for all or part of its nourishment. The orchids form the best example, and two of the orchids, the potato orchid (*Gastrodia sesamoides*) and the hyacinth orchid (*Dipodium punctatum*) use the relationship so well to their advantage that they have lost their photosynthetic functions. The large tuberous rhizomes of the potato orchid were one of the few sources of dietary starch available to Tasmanian aboriginals. Recent findings imply that the *Eucalyptus spp.*, the main economic forestry species in Tasmania, may also have a mycorrhizal relationship with various species of fungi.

Possibly the most interesting symbiosis of fungi is with algae. In Tasmania, some fungi from the class *Ascomycetes* associate with a single species of either a green alga or a blue-green alga to form an association that acts as a single plant called a lichen. The fungus depends on organic material from the alga and in return supplies a moist environment and basic minerals from the substrate. Lichens are tolerant of extreme illumination and nearly complete desiccation.

Bratt (1976) estimates that there may be up to 500 species of lichens in Tasmania although only half of that number are currently listed. There are some endemic species such as *Lichina tasmanica*. The species are found in all environments from rocks on the highest mountains to the littoral salt-spray zone. They may grow on rocks, soil or as epiphytes on either living or dead wood. The form of the lichen may be: a crust on rocks and soil; a leaf-like thallus on rocks and tree trunks; a spongy matt on soil; a crown-like structure on stems or rocks and soil; or as long pendulous threads. The species found on rocks may be coloured either white, grey, brown, red, yellow or green. Most of those found in forests are yellow or green in colour. Lichens are a major group of the epiphytes that live in rainforests and often their diversity is greater than that of the woody species.

Another peculiar group that is found in Tasmania's wetter forests is the slime moulds. For most of the vegetative part of their unusual life these organisms live as single-celled animal-like amoebae. In suitable circumstances the amoebae are drawn together and fuse to form an acellular multinucleate plasmodium or 'slug'. The slug can slowly stream over the forest floor and logs, responding as an organised organism to stimuli. Eventually in the sexual phase the slug forms stalks up to several centimetres high that terminate in brightly coloured spore capsules that can be extremely ornate.

While this article has dealt with the more conspicuous common groups of fungi, it should be kept in mind that many fungi do not form large sporophores and so remain undetected to all but microscopic analysis. The impact of these on any environment may be as great or greater than the easily identified species.

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2.6 ENVIRONMENTAL MANAGEMENT AND CONTROL

2.6.1 National Parks and Reserves

The value of Tasmania's impressive scenic beauty was already appreciated as far back as 1885 when the first reserve, covering 120 ha around Russell Falls, was created by proclamation.

The Tasmanian Scenery Preservation Board was created by an Act of 1915 and became the vanguard of Australia's heritage authorities.

On August 29, 1916, Freycinet National Park, Mt Field National Park, St Columbia Falls and the convict sites of Port Arthur, Isle of the Dead and the foreshore of Point Puer were among the first proclamations, followed by Gunns Plains Caves, south of Ulverstone, in 1918.

The care of Tasmania's built and natural heritage became the responsibility of a permanent Government department when, in November 1971, Tasmania's National Parks and Wildlife Service was formed.

Tasmania's cultural and natural riches draw some 306 000 visitors annually who contribute significantly to the State's economy.

The Department of Tourism's visitor survey shows that national parks, State reserves and historic sites were high on the list of priorities; 58 per cent of visitors wanted to visit historic sites while 22 per cent were keen to go bushwalking.

Prime Minister Joseph Lyons' home at Stanley, Tasmania. *(Tasmanian Government Stills)*

Commonwealth Law Courts *(Australian Information Service)*

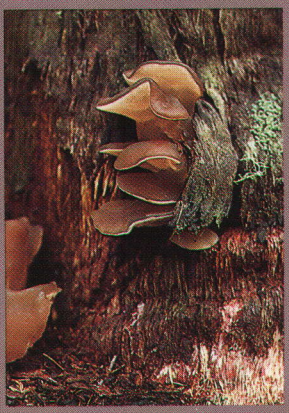
Paxillus infundibuliformis

Amanita muscaria

Tremella fuciformis

Clavulinopsis miniatus

Heterotextus sp.



Pseudohydnum gelatinosum

Bertrondia astrogala

Russula sp.

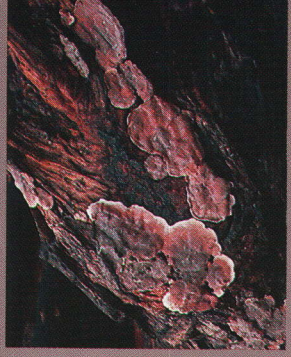
Hygrophorus sp.

Amanita sp.

Cyttaria gunnii

Fuligo septica

Tasmanian fungi



Stereum illudens

Hygrophorus sp.

Hypholoma fasciculare

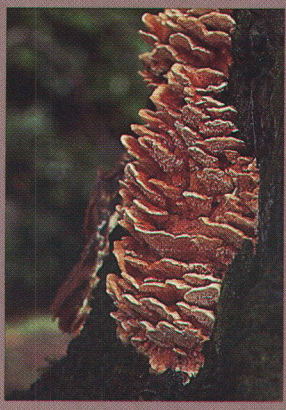
Morchella elata

Ramaria sp.

Phylloporus sp.

Clavicorona pyxidata

Clavulinopsis amoena



Irpex sp.

Alpine lichen

Tyromyces bulcherimus

Agaricus sp.

Photographs by Elizabeth Holloway

Winter at Mt Weld

(Edward Gall)

Tasmania's first national park board, then known as the Scenery Preservation Board, at Russell Falls in February 1917

The combination of modern conservation techniques and old skills which have been revived has already been internationally recognised when the Pacific Area Travel Association presented the Heritage Award to Tasmania for the conservation and development of the Port Arthur historic site.

This $9m project was jointly funded by the Commonwealth and State Governments but, unless further funding is forthcoming, this project will cease at its currently scheduled completion date early in 1986te is now among its attractions.

Gravelled and timber walkways have been constructed over sections of the old penal settlement with metal signs featuring graphic aspects and explanatory material concerning convict life.

The ruins of the 'new' penitentiary are presently undergoing urgently needed stabilisation works and in the future, the island will be the subject of archaeological and conservation studies.

A colour brochure, which acts as a site guide, has been produced and a private jetty on the island, which will allow public access, has been bought.

Further up the Gordon River, tenders have been let for the construction of a large, new jetty and walkway near Sir John Falls jetty, which will allow passengers to disembark from tourist vessels to an easy, low gradient and smooth gravel track to the scenic amphitheatre and pool at the foot of the falls.

But apart from the historical aspect, the NPWS is also active in the protection of endangered wildlife. Protection can only be achieved with the co-operation and assistance of the public and the most recent example of such a co-operation approach took place on the North-West Coast.

Counts over recent years at Lillico Beach had shown that over 100 penguins a year were killed in this area by cars. With the invaluable help of volunteers, NPWS rangers erected a chain wire fence to prevent the birds wandering onto the highway, which reduced the death toll significantly.

Another example of such co-operation is occurring in the far north-west, where Three Hummock Island is being developed as a Nature Reserve, with valuable assistance offered annually by the Smithton Rotary Club. The Club has provided volunteer labour to help restore the collapsing wharf. Sheep are pastured on the island to keep the grass to a level which will support populations of Cape Barren geese and forester kangaroo.

The orange-bellied parrot, which has its breeding place in the south-west, is an endangered species, of which only a couple of hundred are to be found. King Island is a resting place for the bird on its migration from the mainland. It is primarily for this reason that the Sea Elephant Wildlife Sanctuary was proclaimed on the east coast of the island as it maintains the natural habitat for this endangered species of parrot.

Whale strandings, which have occurred at Ocean Beach, Macquarie Harbour and Perkins

Bay near Stanley, are always sad events. Wildlife officers have been able to develop and refine successful techniques to return marooned mammals, with the help of volunteers, to deeper water.

The internationally acclaimed overland walking track between Cradle Mountain and Lake St Clair, which takes between five and 10 days to walk from end to end, has attracted many overseas back-packers.

The Cradle Mountain-Lake St Clair National Park covers more than 130 000 ha of wild alpine and rugged mountain country in the heart of Tasmania's Central Highlands.

At both Cradle Mountain and Lake St Clair, the NPWS has established and maintains tourist facilities.

The South-West World Heritage Area comprises Tasmania's three largest national parks —Cradle Mountain-Lake St Clair (131 915 ha), Franklin-Lower Gordon Wild Rivers (181 075) and the South-West (442 240).

The area contains unique flora and fauna, provides spectacular mountain scenery, rainforests, rivers and deep gorges.

Many facilities, such as caravan parks, a camping area, visitor centres, picnic areas and boat ramps, among others, are planned for the area.

2.6.2 Pollution Control

Environmental Impact Studies

Public authorities in Tasmania are required to undertake environmental impact studies before proceeding with any development which may have a significant effect on the environment. During the 12 months to June 1985, 16 environmental impact statements were submitted to the Department of Environment for assessment:

Upgrading of Bass Highway from Penguin to Blythe River;
Sewage treatment plant, Wynyard;
Woodwaste disposal site, APPM Ltd., Long Reach;
Quarry, Blue Gate Road, Margate;
Power Station, Currie, King Island;
Link Road from Murchison Highway to Cradle Mountain Tourist Road;
Alluvial gold mining at Lisle;
Coal mine near Royal George;
A deep water sewage outfall from the Blackmans Bay treatment plant;
Chairlift at the Nut, Stanley;
Alluvial gold mining at Lisle;
Rubicon River improvement scheme;
Tasmanian woodchip exports beyond 1988;
Bellerive By-pass;
Dam near Bothwell;
Installation of coal-fired boiler at a vegetable processing factory, Scottsdale.

In addition, licence applications, transfers or change of operation for 114 scheduled premises were examined and their likely environmental impact assessed by the Department. These premises included refuse disposal sites, sewerage treatment plants, fish processing plants, meat processing works, mines, quarries, loam, sand and clay pits, and abattoirs. Also 11 mines, 22 quarries, 22 gravel, clay, loam and sand pits, together with refuse disposal sites, were inspected and advice given regarding rehabilitation, or rehabilitation reports prepared.

Prosecutions

During the year 17 successful prosecutions were carried out under the *Environment Protection Act*. These covered breaches of licence conditions, the operation of scheduled premises without a licence, emission of pollutants and smoking vehicles; fines of up to $1 250 plus costs were imposed.

Emission Control Exemptions

Provision is made under the *Environment Protection Act* 1973 for the Minister to grant exemptions from the emission controls of Sections 15, 16, or 17 in respect of a specified act or course of action. This is the mechanism by which an industry or operator which is not immediately able to comply with emission controls is enabled to continue operation. There has been a constant decrease in the mass flow of polluting emissions permitted in the course of exempted acts. In April 1985 there were 65 exemptions in force, involving 57 premises. The premises involved were:

Municipal sewage treatment plants	22
Septic tank installations	2
Exemptions to permit fire-fighting training	4
Exemptions for premises awaiting amplification of municipal sewage treatment works to treat their effluents	3
Exemptions current but not actually required (e.g. operation ceased)	4
Abattoirs providing substantial, although incomplete, treatment of effluents	3
Mines where, despite pH control and tailings dams, emission standards are slightly exceeded for some substances	4

Primary metallurgical works in substantial compliance with the standards, but having one or more acts exempted	5
Foundry unable to comply a few days per year	1
Waste burning	2
Paper mill in substantial compliance, but having one or more acts exempted	1
Miscellaneous	6

Litter Control

A total of 120 contravention notices were issued during the year ended 30 June 1985; 10 were issued by police officers, 91 by officers and voluntary authorised officers and 19 reported by municipalities.

A total of 32 prosecutions under the *Litter Act* were initiated during the year. Of these 22 proceeded to conviction and the balance were either withdrawn, dismissed or adjourned sine die. From the convictions, a total of $1 055 in fines and $317 in costs were realised.

During the 12 months, a total of 43 persons were appointed authorised officers under the *Litter Act* 1973. Of these 29 were municipal appointments, 11 Crown employees in government agencies, and three volunteers.

The most recent litter control initiative is the launching in 1984 of a litter reduction campaign, aimed at promoting and generating public concern about the need for litter control and involving the community in a variety of litter reduction activities. The campaign has maintained a high profile through advertising, radio and television interviews, distributing promotional material such as car litter bags, stickers and posters, staging exhibitions and displays and speaking at schools, service clubs, youth and other community organisations.

The campaign is administered by the Litter Control Council, membership of which comprises representatives of those organisations directly responsible for litter control in the State. With a budget of $74 000 provided by the Litter Research Association, and support from media organisations, the major projects have included, a statewide roadside clean-up campaign using hired and volunteer labour, maintaining and upgrading litter stations on the Arthur Highway and the establishment of a Youth Litter Co-ordinating Committee.

Water Pollution

The Department of the Environment undertakes a program of monitoring some of the State's rivers and waterways; the Derwent, Tamar, Mersey Rivers, Lisle Creek, Barilla Bay, Port Cygnet Bay, Emu and Cam Rivers, Cooee Creek, Hospital Bay and Buttons Creek, as well as the site of a bark dump on the East Tamar. During the year eight instances of oil spillages were reported resulting in two prosecutions.

2.7 REFERENCES

Davies, J.L. (ed), *Atlas of Tasmania*, Lands and Surveys Department, Hobart, 1965.

Director of Environmental Control, *Report for the Year 1984–85*, Government Printer, Hobart.

Monthly Weather Review, Tasmania, Bureau of Meteorology, Hobart.

APPENDIX

CLIMATE

Annual Rainfall at Representative Stations, Tasmania (Millimetres)

Station	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*Long-term average (a)*
Avoca	474	563	395	484	546	596	560
Beaconsfield	961	927	706	711	912	896	955
Burnie (APPM)	964	985	749	n.a.	887	856	1 014
Campbell Town PO	400	553	387	422	503	590	550
Cressy Research	546	599	456	522	n.a.	n.a.	642
Franklin	902	842	630	817	828	740	897
Hobart (Weather Bureau)	464	548	399	598	596	716	626
Hobart (Airport)	385	482	335	472	504	625	553
Kettering	n.a.	856	663	997	997	n.a.	881
Launceston (Airport)	597	652	423	488	656	688	708
Lilydale	1 015	1 047	690	786	1 060	n.a.	978
Lymington	713	767	578	856	796	n.a.	790
Maydena	1 401	1 314	1 008	1 026	1 251	n.a.	1 234
New Norfolk	479	559	396	357	484	n.a.	553
Oatlands	439	576	361	480	535	656	563
Queenstown	2 800	2 423	2 263	2 164	2 734	2 041	2 531
Ringarooma	1 175	1 206	882	1 110	1 278	1 218	1 236
Savage River	2 003	1 857	1 578	1 528	1 969	n.a.	1 982
Smithton	1 094	1 124	814	919	1 088	952	1 109
St Helens	639	675	574	797	901	869	780
St Marys	837	1 038	654	1 128	1 266	1 137	1 026
Swansea	458	604	418	585	615	685	614
Triabunna	478	614	375	612	600	750	659
Ulverstone	913	923	763	769	998	n.a.	965

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

NATIONAL PARKS

National Parks, State Reserves, etc. at 30 September 1985

Name	*Area (ha)*	Location	*Description*
	National Parks		
Asbestos Range	4 281	North coast	Coastal heathland
Ben Lomond	16 526	Central north	Mountainous, ski fields
Cradle Mountain-Lake St Clair	131 920	West central	Mountainous, lake
Franklin-Lower Gordon Wild Rivers	181 075	South-west	Wilderness, rivers
Freycinet	10 010	East coast	Coastal, red granite
Hartz Mountains	6 470	South	Mountainous, scenic
Maria Island	9 672	East coast	Wildlife, convict station
Mount Field	16 257	Central south	Mountainous, skifields
Mount William	13 805	North east	Coastal, wildlife
Rocky Cape	3 070	North west	Coastal heath, banksia
Southwest	442 240	South west	Rugged wilderness
Strzelecki	4 215	Flinders Island	Mountainous, coastal
Walls of Jerusalem	11 510	West central	Elevated plateau, scenic
Total National Parks	851 051		

National Parks, State Reserves, etc. at 30 September 1985 *continued*

Name	*Area (ha)*	*Location*	*Description*
		State Reserves	
Alum Cliffs	1 540	Mole Creek	Scenic gorge and cliffs
Baldock Cave	43	Mole Creek	Caves, sclerophyll forest
Bradys Lookout	1	West Tamar	River, scenic
Brown Mountain—Remarkable Cave	61	Tasman Peninsula	Coastal, scenic
Cape Pillar	3 200	Tasman Peninsula	Coastal, heath
Cape Raoul	2 089	Tasman Peninsula	Coastal cliffs
Croesus Cave	47	Mole Creek	Caves
Derwent Cliffs	5	New Norfolk	Scenic
Devils Gullet	146	North central	Scenic gorge
Eaglehawk Neck—Taranna	25	Tasman Peninsula	Coastal, scenic
Eugenana	1	North west	Stratified cave deposit
Exit Cave	441	South	Australia's largest cave, glow worms
Fairy Glade	39	Central north	Scenic fern glade
Ferndene	35	North	Scenic fern glade
Fluted Cape	530	Bruny Island	Coastal, sclerophyll forest
Forth Falls	55	North central	Waterfall
Gunns Plains Cave	10	North west	Caves
Hastings Caves	61	South	Caves, thermal pool
Hellyer Gorge	569	North west	Scenic rainforest
Henty Glacial Moraine	1	West	Geological feature
Holwell Gorge	121	Central north	Scenic gorge
Ida Bay	425	South East	Scenic reserve, railway
Junee Cave	20	Central south	Cave
Kentford Forest	37	King Island	Relict eucalypt forest
King Solomon Cave	164	Mole Creek	Caves
Kubla Khan Cave	160	Mole Creek	Caves
Labillardiere	2 332	Bruny Island	Coastal heath
Liffey Falls	101	North central	Scenic waterfall
Lookout Rock	2	East coast	Coastal, scenic
Marakoopa Cave	790	Mole Creek	Caves
Marriotts Falls	121	South central	Waterfall
Mount Arthur	4	Tasman Peninsula	Scenic lookout
Mount Barrow	459	North east	Mountain
Mount Barrow Falls	81	North east	Waterfall
Mount Montgomery	299	North west	Scenic
Murchison Highway	452	West	Scenic road, rain forests
Notley Gorge	11	North	Scenic fern gully
Palmers Hill Lookout	1	Tasman Peninsula	Scenic
Pieman River	3 328	West coast	Scenic river
Point Puer—Crescent Bay	53	Tasman Peninsula	Scenic coast
Port Davey	17	South west	Scenic coast
Roger River	174	North west	Scenic rainforest
St Columbia Falls	314	North east	Waterfall
St Marys Pass	273	North east	Scenic
St Patricks Head	150	North east	Scenic
Steppes	48	Central	Homestead, dry sclerophyll forest
Stewarts Bay	78	Tasman Peninsula	Scenic foreshore
Tasman Arch	138	Tasman Peninsula	Coastal, scenic
Tessellated Pavement	4	Forestier Peninsula	Scenic, geological feature
The Nut	59	North west	Scenic, landmark
Thermal Springs	1	Central north	Geological feature
Trowutta Caves	66	North west	Caves, limestone
Waterfall Creek	24	Bruny Island	Scenic forest
Zeehan—Renison Bell	110	West	Scenic forest
Total State Reserves	19 316		
		Historic Sites	
Batchelors Grave	Small	Taroona	Historic grave
Callington Mill	Small	Oatlands	Historic mill
Coal Mines	214	Tasman Peninsula	Convict mine
Currie Lightkeepers Residence	1	King Island	Historic building
161 Davey Street	Small	Hobart	Historic home
D'Entrecasteaux Monument	Small	South	Historic monument
D'Entrecasteaux Watering Place	1	South	Site of early landing

National Parks, State Reserves, etc. at 30 September 1985 *continued*

Name	*Area (ha)*	*Location*	*Description*
		Historic Sites continued	
Entally House	38	Central north	Historic home
Female Factory	Small	Hobart	Historic prison site
George III Monument	10	South	Memorial to ship wreck, flora
Highfield	4	Stanley	Van Diemen's Land Co. house
Kangaroo Bluff	3	Bellerive	Historic fort
Lyons Cottage	Small	Stanley	Historic cottage
Mt Direction	180	East Tamar	Early semaphore station
Old Trinity Church—Criminal Courts	Small	Hobart	Historic building
Oyster Cove	30	South	Aboriginal station
Port Arthur	115	Tasman Peninsula	Convict settlement
Richmond Gaol	1	Richmond	Convict gaol
Risdon Cove	3	Hobart, east	Site of first settlement
Ritchies Mill	Small	Launceston	Old water mill
Ross Female Convict Station	1	Ross	Convict station site
Sarah Island	6	Macquarie Harbour	Site of convict station
Shot Tower	3	Taroona	Historic tower
Strahan Customs House	Small	West coast	Historic building
Sydney Cove	53	Furneaux	Historic shipwreck
Tasman Monument	Small	Tasman Peninsula	Monument to discoverer
Toll House	Small	New Norfolk	Historic building
Waubadebars Grave	Small	Bicheno	Aboriginal grave
Wybalenna	126	Flinders Island	Aboriginal station
York Town	2	North Tamar	Site of early settlement
		Nature Reserves	
Albatross Island	33	Bass Strait	Seabird breeding
Bass Pyramid	Small	Bass Strait	Seal breeding
Betsy Island	181	South east	Scientific reference
Big Green Island	270	Furneaux	Cape Barren Geese
Black Pyramid Rock	40	North west	Seabird rock
Chappell Islands	1 350	Furneaux	Cape Barren Geese
Coal River Gorge	209	South	Scenic
Curtis Island	149	Bass Strait	Ecological reference
Diamond Island	5	East coast	Penguin rookery
Dismal Swamp	100	North west	Blackwood forest
East Kangaroo Island	200	Furneaux	Cape Barren Geese
East Risdon	44	Hobart, east	Rare eucalypts
Foster Island	48	North east	Bird islands
George Rocks	5	North east	Bird islands
Green Island	5	D'Entrecasteaux Channel	Ecological reference
Green Point	22	South east	Research station
Hippolyte Rocks	5	South east	Seal breeding
Hospital Creek	22	South east	Rare endemic plant
Ile des Phoques	7	East coast	Seal breeding
Isabella Island	25	Flinders	Cape Barren Goose breeding
Judgment Rocks	Small	Bass Strait	Seal breeding
Lavinia	4 622	King Island	Heath, dunes
Lime Bay	1 310	Tasman Peninsula	Dry sclerophyll forest
Low Islets	8	Furneaux	Australian pelicans
Macquarie Island	12 785	Sub Antarctic	Research, wildlife
Moriarty Rocks	3	Bass Strait	Seal breeding
Native Point	127	East Tamar	Relict forest
North East Islet	Small	Bass Strait	Seal breeding
Penguin Islet	4	Bass Strait	Seabird breeding
Reid Rocks	Small	Bass Strait	Seal breeding
Rodondo Island	80	Bass Strait	Ecological reference
Tenth Island	1	Bass Strait	Seal breeding
The Doughboys	20	Bass Strait	Seabird breeding
Three Hummock Island	7 284	North west	Sclerophyll forest, heath
Three Sisters—Goat Island	37	North west	Seagull rookery
Truchanas	406	South west	Huon Pine forest
West Moncoeur Island	10	Bass Strait	Seal breeding, ecological reference
Wright Rock	9	Bass Strait	Seal breeding
Total Nature Reserves	29 426		

National Parks, State Reserves, etc. at 30 September 1985 *continued*

Name	*Area (ha)*	*Location*	*Description*
		Aboriginal Sites	
Mount Cameron West	530	West coast	Aboriginal rock-carvings
Sundown Point	132	West coast	Aboriginal rock-carvings
Trial Harbour	1	West coast	Aboriginal rock-carvings
West Point	580	West coast	Aboriginal occupation site
Total Aboriginal Sites	1 242		
		Game Reserves	
Actaeon Islands	9	South	Muttonbird rookeries
Bird Island	65	Bass Strait	Muttonbird rookeries
Bruny Island Neck	1 450	South	Lagoons, coastal heath
Lake Tiberius	983	Midlands	Waterfowl lagoon
Little Dog Island	50	Furneaux	Muttonbird rookeries
New Year Island	112	King Island	Muttonbird rookeries
Petrel Island	50	Bass Strait	Muttonbird rookeries
Stack Island	30	Hunter Group	Muttonbird rookeries
Steep Island	30	Hunter Group	Muttonbird rookeries
Total Game Reserves	2 779		
		Conservation Areas	
Wildlife sanctuaries under National Parks and Wildlife Service Management and acquired areas —			
Asbestos Range	68	North coast	Coastal heathland
Brigg Islet	Small	Furneaux	Bird island
Cat Island	30	Furneaux	Bird island
Central Plateau	23 250	Central north	Alpine vegetation
Chalky Island	36	Furneaux	Bird island
Cockle Creek	41	South	In Southwest Conservation Area
Cradle Mountain—Camp ground	63	North central	Camping and caravan park
Cradle Mountain—Lake St Clair	1	Derwent Bridge	To be added to a National Park
Egg Islands	128	Huon	Estuarine, wetland
Gull Island	32	Furneaux	Bird island
Holwell Gorge	4	North	To be added to a State Reserve
Lackrana	220	Flinders Island	Cape Barren Goose refuge
Lake Sorell	198	Central	Sclerophyll forest
Lavinia	258	King Island	To be added to a Nature Reserve
Liffey Falls	7	North central	To be added to a Scenic Reserve
Logan Lagoon	2 256	Flinders Island	Wetland, marsh
Medeas Cove	81	North east	Estuarine, marsh
Mile Island	8	Furneaux	Bird island
Moulting Lagoon	512	East coast	Brackish lagoon
Mt William	94	North east	To be added to a National Park
Night Island	10	Furneaux	Bird island
Oakleigh Creek	756	North central	Nothofagus forest
Oyster Rocks	10	Furneaux	Bird islands
Pieman River	129	North west	To be added to a State Reserve
Port Arthur	12	Tasman Peninsula	To be added to an Historic Site
Port Cygnet	81	South	Foreshore, marsh
Reef Island	10	Furneaux	Bird island
Risdon Cove	70	Hobart	To be added to an Historic Site
Seal Rocks	127	King Island	To become a State Reserve
South Esk River	142	North Midlands	River, scenic
Tamar River	4 600	North	Estuarine, waterfall
Tathams Lagoon	13	King Island	Freshwater lagoon
Wright and Egg Islands	10	Bass Strait	Bird islands
Wybalenna Island	3	Furneaux	Bird island
Total Conservation Areas	33 260		
		Muttonbird Reserves	
Babel Island	445	Furneaux	Muttonbird hunting ground
Great Dog Island	377	Furneaux	Muttonbird hunting ground
Hunter Island	7 365	North west	Muttonbird hunting ground
Little Green Island	89	Furneaux	Muttonbird hunting ground
Outer and Inner Sister Islands	1 012	Furneaux	Muttonbird hunting ground
Total Muttonbird Reserves	9 288		

National Parks, State Reserves, etc. at 30 September 1985 *continued*

Name	*Area (ha)*	*Location*	*Description*
Wildlife Sanctuaries Under Joint Management With Other Authorities			
Badger Corner	333	Flinders Island	Foreshore and marine
Ben Lomond	2 665	North east	Wet sclerophyll forest
Burnie Fernglade	44	North west	Fern gully
Cape Contrariety	4	South east	Muttonbird rookery
Cape Direction	5	South east	Muttonbird rookery
Cape Portland	663	North east	Waterfowl habitat
Carr Villa	62	Launceston	Modified sclerophyll forest
Chauncy Vale	357	East central	Dry sclerophyll forest
Deal Island	1 623	Bass Strait	Island, grassland
Deloraine	2	North central	Riverine, waterfowl
Derwent River	1 568	South east	Estuarine, river, marsh
Four Mile Creek	607	North	Estuarine, flats
Fulton Park	34	North	Scout camp
Glenorchy Water Reserve	712	Hobart, west	Dry sclerophyll forest
Goose Island	97	Furneaux	Seabirds
Grimes Lagoon	173	Midlands	Freshwater lagoon, birds
Goulds Lagoon	8	Hobart, north	Brackish lagoon, birds
Henry Somerset Orchid	39	North	Orchid flora
Kingston Golf Course	61	Kingston	Dry sclerophyll forest
Lake Dulverton	217	Oatlands	Freshwater lagoon, birds
Launceston Golf Course	61	Launceston	Dry sclerophyll forest
Paterson Island	16	North central	Modified sclerophyll forest
Patriarchs	101	Flinders	Cape Barren Geese
Pipers River	162	North east	Riverine
Punchbowl	24	Launceston	Modified sclerophyll forest
Reekara	2 428	King Island	Heathland tea tree
Sandspit River	550	East coast	Estuarine, marsh, birds
Scottsdale, NE Park	16	North east	Modified wet sclerophyll forest
Sea Elephant River	1 186	King Island	Coastal dunes, heath
Southport Lagoon	3 556	South east	Coastal lagoon
Southwest	777 151	South west	Scenic wilderness
St Clair Lagoon	255	South central	Lagoon
The Lea	150	South	Scout camp
Tooms Lake	22 663	East central	Lake, dry sclerophyll forest
Wayatinah Lagoon	1 809	South central	Storage reservoir
Woodstock Lagoon	20	North	Waterfowl habitat
Total Wildlife Sanctuaries Under Joint Management With Other Authorities	819 421		

NOTE: Sclerophyll forest: The term *sclerophyll* means 'hard leaved'. Most Australian forests are dominated by trees (usually eucalypts) and shrubs which have thick, hard leaves — an adaption to the dry Australian environment.