How much Rainforest is in Tasmania? A Better Answer to a Difficult Question

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Abstract

The progressive production of large-scale photo-interpreted maps has resulted in revisions to rainforest area estimates in Tasmania. All rainforest areas in Tasmania are now covered by maps produced from detailed interpretation of colour aerial photographs at scales from 1:15 000 to 1:42 000. A composite map that retains the boundaries of some 10 000 mapped rainforest patches has been reproduced at a scale of 1:500 000. This new map, The Rainforest Map of Tasmania, *indicates a rainforest area of 563 100 ha that is significantly less, particularly in the Tasmanian Wilderness World Heritage Area, than indicated on previously published maps. It also shows that the level of reservation of tall rainforest is much less than for low rainforest.*

Introduction

How much rainforest is in Tasmania? This question has been asked many times over the last three decades but answers have differed widely according to the rainforest definition and the accuracy and scale of the available mapping. Rainforest estimates have usually been based on a combination of large-scale (e.g. 1:23 760), photo-interpreted (PI) forest-type maps where they exist and on less accurate, small-scale (e.g. 1:250 000 and 1:500 000) vegetation maps for the remaining area. The progressive production of large-scale forest-type mapping has therefore resulted in revisions to the estimated area of rainforest. While this fluctuation has been inevitable, it has been a source of frustration to those interested in rainforest management.

In 1988, the Mapping Branch of the Forestry Commission commenced a project to photo-interpret the vegetation of western Tasmania and hence fill the last major gap in large-scale forest-type mapping. The project was funded under the National Rainforest Conservation Program (NRCP) and assisted by the Department of Environment and Planning and the Department of Parks, Wildlife and Heritage. (These departments have subsequently merged to form the Department of Environment and Land Management.) By using 1:42 000 photographs instead of the usual scale of 1:20 000, the project was completed in less than three years. The interpreted patches of vegetation have been plotted onto 1:25 000 base maps where available and 1:50 000 maps for the remaining area. The patches have been digitised and coded onto an ARC/INFO Geographic Information System (GIS). Although there is no intention at this stage to produce high quality paper maps, computer-generated overlays of the mapped data are available.

The rainforest patches mapped during the NRCP project were combined with existing computer-stored rainforest mapping to produce the most accurate estimate of the amount and distribution of rainforest yet assembled. The boundaries of rainforest patches are retained at 1:25 000 and reproduced on a 1:500 000 map titled *The Rainforest Map of Tasmania* which is currently being prepared for publication. This map will be a useful resource for those concerned with the reservation status and management of rainforest.

This paper examines the development of previous rainforest mapping and describes

the main features of the new map. A comparison of *The Rainforest Map of Tasmania* and earlier maps is also given, followed by a discussion of the potential for new mapping.

The development of large-scale forest-type maps for rainforest

The Tasmanian Forestry Commission commenced production of forest-type maps, initially at scales of 1:15 840 and 1:23 760, in the late 1940s (Walker and Candy 1982). Emphasis was given to eucalypt forests which were stratified into height and density classes. Vegetation with an overstorey of eucalypts and an understorey of rainforest trees was mapped as rainforest where the eucalypt crowns covered less than 5% of the stand. Rainforest was broadly identified as myrtle (*Nothofagus cunninghamii* (Hook.) Oerst.) forest and denoted as 'MM'.

Nothofagus cunninghamii is present, and usually the dominant tree, in most Tasmanian rainforest communities. Exceptions include open-montane rainforests (*sensu* Jarman *et al.* 1984), which are dominated by pencil pine (*Athrotaxis cupressoides* D.Don), and some callidendrous communities in eastern Tasmania (Neyland 1992).

From 1952, the codes used for mapping rainforest areas were:

M = myrtle representing at least 50% of the canopy;

T = associated species, for example leatherwood (*Eucryphia lucida* (Labill.) Baill.), sassafras (*Atherosperma moschatum* Labill.) and celery-top pine (*Phyllocladus asplenifolius* (Labill.) Hook.f.);

S = scrub.

There was difficulty in identifying the associated species. Taller understorey species were denoted as T and lower ones as S. Relative abundance was indicated by priority in order, for example MT, TM, MS and TS.

In 1964, the system was developed so that rainforest was mapped according to three height classes based on the dominant myrtle trees. This was done to improve estimates of timber merchantability. The classes were:

M1 = average height more than 37 m;

M2 = average height from 24–37 m;

M3 = average height less than 24 m.

However, the height classes were inappropriate because there was virtually no M1 forest. The addition of height classes meant that a very large number of codes were used to describe rainforest on aerial photographs, for example STM3, M2TS. In fact, over 100 codes were possible although the majority had little meaning to most users and could be summarised adequately into two broad classes: tall rainforest on better quality sites, and low rainforest on poorer quality sites.

By 1986, dissatisfaction with the rainforest typing lead to a formal simplification of the two classes into:

M+ = rainforest usually taller than 25 m, with a sparse understorey which often includes manferns (*Dicksonia antarctica* Labill.); usually on more fertile sites.

M- = rainforest from 8 m to usually less than 25 m tall, with a dense understorey which mingles with the canopy trees resulting in a fine textured appearance on aerial photographs; usually on sites of low to moderate fertility.

Under the new guidelines, the use of the code T was confined to stands where particular species could be positively identified (Brouder 1988). This is frequently the case for species such as silver wattle (*Acacia dealbata* Link) and blackwood (*Acacia melanoxylon* R.Br.) which were denoted as T(W) and T(B) respectively, but rarely the case for rainforest species such as celery-top pine or King Billy pine (*Athrotaxis selaginoides* D.Don) which may be coded as T(C) and T(K) respectively.

The specification of the lower height limit of 8 m for rainforest was made so that the Forestry Commission mapping would be consistent with the rainforest definition of Jarman and Brown (1983). Prior to 1986, no minimum height for rainforest was specified but, by convention, vegetation less than 15 m was excluded.

Unfortunately the rainforest types of Jarman *et al.* (1984, 1991) are not readily interpreted from aerial photographs. The main problem is the distinction between callidendrous and thamnic types. Both types can be similar in height but thamnic rainforest has a shrubby understorey while callidendrous rainforest usually has an open understorey. The M+ class includes most callidendrous and the taller thamnic types whereas lower callidendrous, thamnic and all implicate forests are included as M-. Open-montane rainforest, dominated by pencil pine, is not classed as rainforest under Forestry Commission mapping specifications because it is frequently less than 8 m tall and often occurs as scattered woodlands rather than as forest. The area of open-montane rainforest has been estimated at 8900 ha (Kirkpatrick and Brown 1991).

In June 1988, vegetation mapping of western and south-western Tasmania commenced using 1:42 000 colour photography taken in the previous summer. The specifications for the interpretation of the 1:42 000 photography were less stringent than for standard 1:20 000 photography. For example, the minimum patch size for standard photography of 3 ha was increased to 10 ha for the 1:42 000 photography.

Small-scale maps of rainforest

The first published vegetation map of Tasmania was by Davies (1964), although a highly generalised map had appeared in Stephens (1941). The map by Davies was based on photographic interpretation and prepared at a scale of eight miles to the inch (approximately 1:506 880) but was published at a scale of 1:2 400 000. The value of the map was diminished by its use of very broad categories which resulted in the 'rainforest' category including mixed forest (vegetation with a rainforest understorey and a eucalypt overstorey) and wet sclerophyll forest. Nevertheless, it did indicate some of the broad characteristics of the distribution of vegetation in Tasmania. The combined area of 'rainforest' mapped by Davies was approximately 2 582 000 ha (McCuaig 1982).

The next comprehensive small-scale map which showed rainforest, and other forest types, in Tasmania was prepared for the 1974 Forestry and Wood-based Industries Development (FORWOOD) Conference. The area of rainforest was estimated at 456 000 ha (Australian Forestry Council 1974) but subsequently revised to 464 000 ha, and the latter figure was used and quoted by land managers (e.g. Quick 1983) for the next decade. The Tasmanian FORWOOD map was produced from a low density point sample (0.25 miles between points) of large-scale forest-type maps where they existed, and aerial photographs at scales of 1:31 680 and 1:15 000 for areas without forest-type maps. It was compiled at a scale of 1:250 000 but was never published. Vegetation less than 15 m tall was excluded from the map.

Kirkpatrick and Dickinson (1984) produced a 1:500 000 map entitled *Vegetation of Tasmania* which showed the general distribution of 48 vegetation types. The map was compiled from large-scale forest-type maps, where available, and from aerial photographs and ground surveys. It was assembled at a scale of 1:250 000 and then generalised at a scale of 1:500 000. The authors emphasised the distribution of alpine and rainforest mapping units (J. Kirkpatrick, pers. comm.). Thus, an area that might have been 70% rainforest with smaller incorporated areas of other vegetation types would be mapped as rainforest at the final scale. The *Vegetation of Tasmania* was subsequently converted to digital form on the Forestry Commission's GIS and, together with the land tenure map, has been the standard reference source for information on the reservation status of particular vegetation

types. Four of the vegetation types on the *Vegetation of Tasmania* relate to rainforest and are shown in Table 1.

The data from the *Vegetation of Tasmania* can be combined in several ways to give a total area of rainforest in Tasmania but a common approach (e.g. Working Group for Rainforest Conservation 1987; Hickey 1990; Balmer and Whinam 1991) has been to combine codes 12, 13 and 15 to give an area of 765 100 ha. An alternative, and more conservative, estimate of 656 200 ha results if only code 12 is considered as rainforest (see Figure 1). This estimate has been modified to 551 700 ha by Kellog (1992) in a worldwide assessment of 'coastal temperate rainforest'.

Table 1. Rainforest vegetation types from Vegetation of Tasmania *(Kirkpatrick and Dickinson 1984).*

Vegetation type	Code	Area (ha)
Rainforest – central alpine mosaic	10	1 320
Rainforest	12	656 210
Recently burnt rainforest	13	56 350
Rainforest – wet scrub	15	52 540

The large difference in rainforest area between the FORWOOD map and the *Vegetation of Tasmania* was attributed by Miller (1984) as being due to a difference in the demarcation between rainforest and eucalypt forest for the two maps. While the FORWOOD map had used a maximum

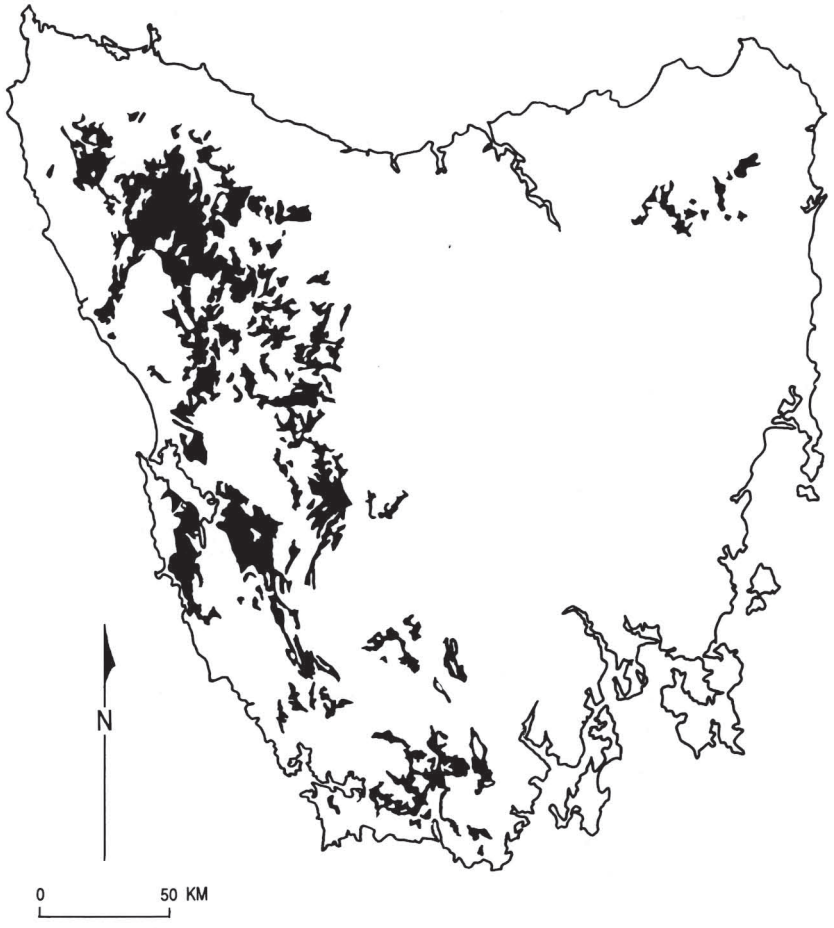

Figure 1. Distribution of rainforest (code 12) from Kirkpatrick and Dickinson (1984).

eucalypt (solid crown) cover of 5% to demarcate rainforest, the legend of the Kirkpatrick and Dickinson map indicates that 10% projective crown cover was used. However, the resolution of both maps is such that the difference in mapping using either demarcation limit would be barely discernible. A much more probable reason for the large differences in area is the different lower height limits used. Whereas the FORWOOD map only included vegetation greater than 15 m tall because this was deemed the potentially commercial forest, the *Vegetation of Tasmania* included rainforest to 8 m tall. Consequently, the *Vegetation of Tasmania* includes large areas of low implicate rainforest not included in the FORWOOD map.

Another map, which is available only as a 1:500 000 computer-drafted plot and which has been used to estimate the extent and reservation status of Tasmania's rainforest, was compiled by the Working Group for Forest Conservation to carry out its task of assessing the conservation status of Tasmania's forest types (Working Group for Forest Conservation 1990). This map was prepared (B. Smith, pers. comm.) from 1:100 000 maps of rainforest (Hickey *et al.* 1988), wet eucalypt forest (Wells 1989) and dry sclerophyll forest (Williams 1989) and is referred to as *Forests of Tasmania* (Forestry Commission 1990). Only patches of each forest type greater than 100 ha were mapped. Smaller patches were amalgamated if they were at least 10 ha in size and within 250 m of a larger or similar sized patch. The patches were compiled from PI maps where available while the *Vegetation of Tasmania* was used for western and south-western Tasmania for areas without forest-type maps. The *Forests of Tasmania* estimates the rainforest area to be 605 000 ha.

In 1991, a 1:500 000 map was published entitled *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* (Forestry Commission 1991). This map was compiled from the 1:100 000 mapping of Brown (1988) for King Billy pine, Peterson (1990) for Huon pine (*Lagarostrobos franklinii* (Hook.f.) Quinn) and Robertson and Duncan (1991) for deciduous beech (*Nothofagus gunnii* (Hook.f.) Oerst.). The map does not depict rainforest without these species and therefore only includes about 74 000 ha of vegetation, including 17 000 ha of fire-killed stands.

In 1991, Kirkpatrick and Brown prepared a 1:500 000 computer-drafted plot entitled *Forest Vegetation of Tasmania* as part of their analysis of the reservation status of Tasmanian forests (Kirkpatrick and Brown 1991). Much of the forest area was derived from *Forests of Tasmania* after modifying it using satellite data to account for recent land clearance. Map data from *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* was also included plus information on the distribution of pencil pine (Cullen and Kirkpatrick 1988; Kirkpatrick and Brown 1991). Vegetation information for areas not covered by these sources was derived from the *Vegetation of Tasmania* and from the personal knowledge of the authors. The resultant map depicts the distribution of 39 forest communities including the five rainforest communities shown in Table 2. The estimated area of rainforest from this map is about 602 000 ha.

Table 2. Rainforest vegetation types from Forest Vegetation of Tasmania *(Kirkpatrick and Brown 1991).*

Forest community	Area (ha)
Nothofagus cunninghamii	539 000
Athrotaxis selaginoides (live and dead)	46 300
Athrotaxis cupressoides	800
Athrotaxis cupressoides – Nothofagus gunnii	8 100
Lagarostrobos franklinii (live and dead)	8 000
Total	602 200

The Rainforest Map of Tasmania

In 1992, it became possible to use the Forestry Commission GIS to plot an accurate map of all rainforest patches containing M types and with less than 5% eucalypt crown cover in Tasmania (Figure 2). All rainforest patches mapped prior to 1986 were converted to the

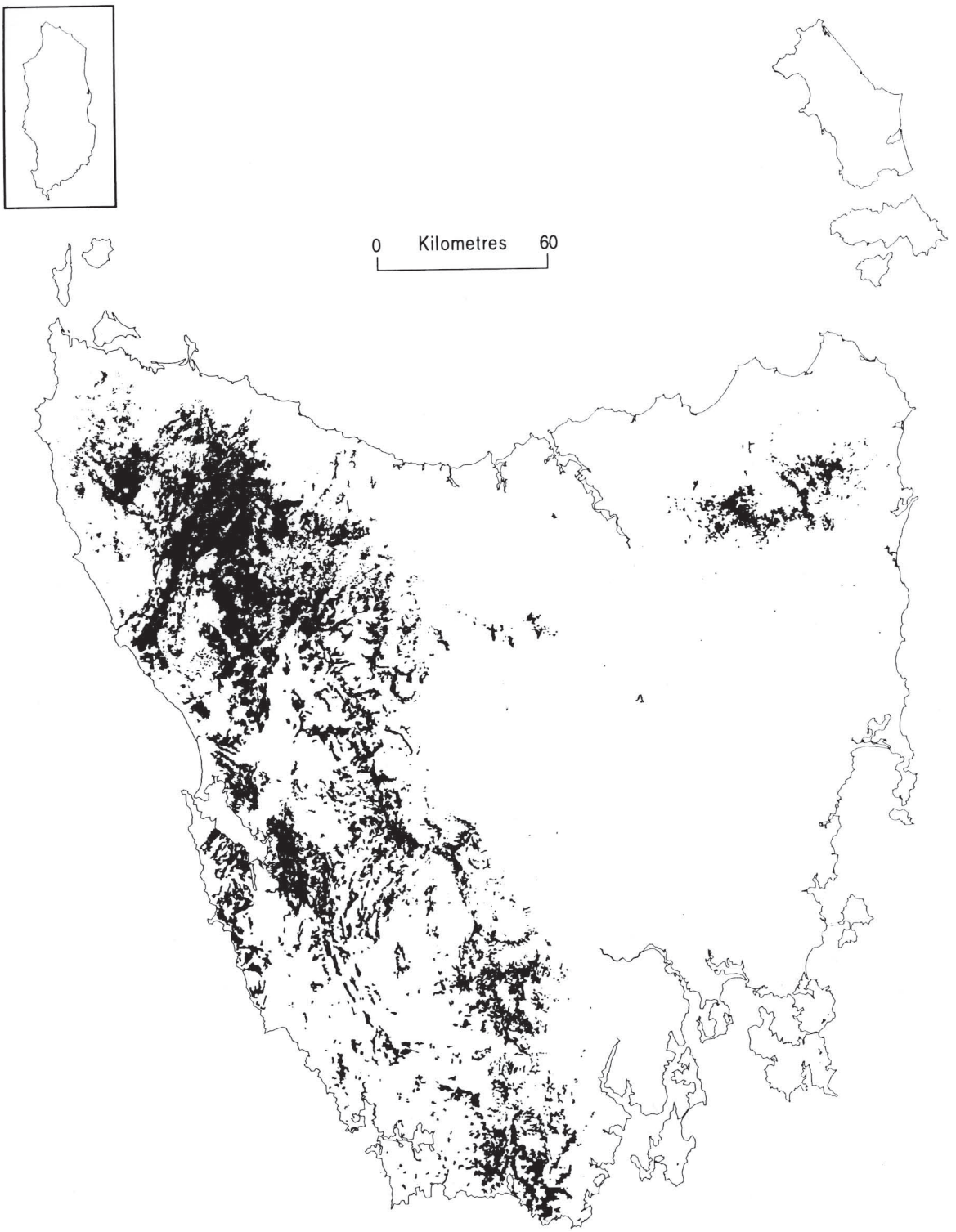

Figure 2. The Rainforest Map of Tasmania. *The map includes all photo-interpreted forest patches which contain myrtle* (Nothofagus cunninghamii) *and which have less than five per cent eucalypt crown cover.*

Table 3. The area and tenure of M+ (tall) rainforest and M- (low) rainforest in Tasmania.

	M+		M-		Total (ha)
	ha	%	ha	%	
TWWHA	23 853	14	162 464	41	186 317
State Reserves[1]	982	1	2 320	1	3 302
Forest Reserves[1]	1 963	1	3 061	1	5 024
Crown land in Conservation Areas[2]	4 203	2	30 369	8	34 572
Protected Areas, other Crown Reserves	446	0	1 299	0	1 745
State forests	76 230	45	117 035	30	193 265
Non-allocated Crown Land	46 775	27	57 797	15	104 572
Land vested in the Hydro-Electric Commission	710	0	3 929	1	4 639
Private property	15 109	9	14 574	4	29 683
Total	170 271	100	392 848	100	563 120

[1] Outside the TWWHA (Tasmanian Wilderness World Heritage Area).
[2] Where the Department of Environment and Land Management is the managing authority.

M+/M- system by alteration of existing programs for computer storage of condensed photo-interpreted data. Appendix 1 is a list of common rainforest PI types classified into either M+ or M-. The final product was a very accurate map of rainforest which showed patches as small as 3 ha and a total area of rainforest (excluding the open-montane type) of 563 120 ha. The map includes approximately 10 000 patches, with the largest single patch being over 65 000 ha (in the Savage River area). Figure 3 shows the scale and date of the photography used to compile the map. Although some of the photography, for example in eastern Tasmania, is up to 26 years old, the map is considered to be current because there has been little human or natural disturbance to the rainforest since that time. Table 3 shows the area and tenure of M+ (tall) and M- (low) rainforest as indicated by *The Rainforest Map of Tasmania*. Tenures were determined from edition 5 of the 1:500 000 *Land Map* (Department of Environment and Planning 1992). The table shows that about 30% of Tasmania's rainforest is greater than 24 m tall. There is a disproportionate level of reservation between the two rainforest height classes, with about 43% of M- rainforest but only 16% of the M+ type being in formal reserves (i.e. World Heritage Area, State Reserves or Forest Reserves).

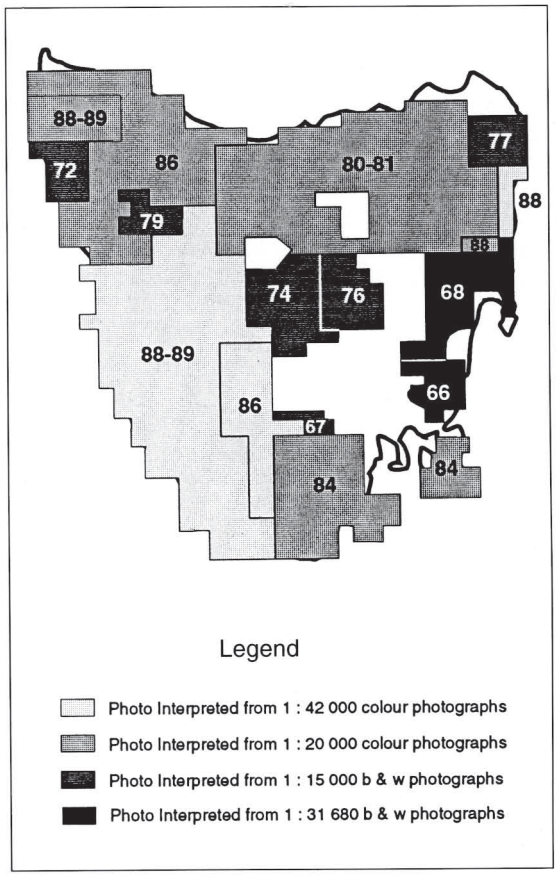

Figure 3. Date of photography for PI maps used to compile The Rainforest Map of Tasmania. *Numbers on the map represent the year of photography.*

Table 4. A comparison of the extent and tenure of rainforest from Map 1, The Rainforest Map of Tasmania, *and Map 2,* Vegetation of Tasmania *(codes 12, 13 and 14).*

	Map 1		Map 2	
	ha	%	ha	%
TWWHA	186 512	33	333 956	44
State Reserves[1]	3 303	1	4 007	1
Forest Reserves[1]	5 027	1	4 651	1
Crown land in Conservation Areas[2]	34 573	6	58 266	8
Protected Areas	1 745	0	12 602	2
State forests	193 265	34	183 691	24
Non-allocated Crown Land	104 374	19	130 061	17
Land vested in the Hydro-Electric Commission	4 639	1	5 893	1
Private property	29 682	5	32 063	4
Total area	563 120	100	765 100	100

[1] Outside the TWWHA (Tasmanian Wilderness World Heritage Area).
[2] Where the Department of Environment and Land Management is the managing authority.

Comparison with previously published maps of rainforest

The Rainforest Map of Tasmania was compared with Kirkpatrick and Dickinson's *Vegetation of Tasmania* and *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* to check the recent information with that previously available. The extent and tenure of Tasmania's rainforest according to *The Rainforest Map of Tasmania* is shown in Table 4 together with that derived from the *Vegetation of Tasmania*.

The Rainforest Map of Tasmania has a total rainforest area of 563 120 ha, some 202 000 ha less than that indicated on the *Vegetation of Tasmania*. The most striking difference was the much reduced area of rainforest shown in the Tasmanian Wilderness World Heritage Area (TWWHA), with a consequent marked effect on the reservation status of rainforest.

The large discrepancy between the two estimates was of concern so further checks were made to investigate reasons for the large differences in area. The TWWHA was used to compare the two maps because:

- this was where the greatest differences were;
- large-scale forest-type maps of rainforest for other areas had been available and used for some years without serious anomalies being reported;
- there had been no significant human or natural disturbance to rainforest in the TWWHA which could contribute to the difference between the two estimates.

The comparison showed that about 37% of the rainforest shown on the new map was not mapped as rainforest in 1984. Furthermore, only 34% of the rainforest mapped in 1984 was also shown as rainforest on the new map.

A further analysis was made by comparing the PI-typing on individual 1:25 000 sheets with the rainforest shown on the *Vegetation of Tasmania*. There are approximately sixty 1:25 000 map sheets which cover the TWWHA. Five of these were randomly selected for the comparison. The results are summarised in Table 5 which indicates that about 40% of the rainforest for the five map sheets shown on the *Vegetation of Tasmania* was confirmed as rainforest by recent PI mapping, with substantial areas being reclassified as scrub (22%), mature eucalypt forest (16%) and non-forest (11%). Only 6% was indicated as mixed forest (forest with a

Table 5. Breakdown of rainforest as mapped on the Vegetation of Tasmania *by vegetation classes derived from photo-interpretation of 1988 colour aerial photography (sedgelands, heaths and grasslands = PI-types Vz, W, Wg, Wm, Wr and water; Scrub = PI-type S; Secondary species = PI-types TS, ST and T(W)). Unless otherwise specified, all figures are given in hectares.*

Map sheet	Sedgelands, heaths and grasslands	Scrub	Secondary species	Regrowth eucalypt forest	Mature eucalypt forest	Mixed forest	Rainforest	Total
Cathedral	482	409	23	142	1 313	168	1 406	3 943
McCall	372	2 491	600	21	873	245	6 624	11 226
Melaleuca	849	596	13	7	424	21	86	1 996
Majors	599	1 953	125	55	991	866	3 595	8 184
Spires	871	1 161	0	180	1 097	395	1 061	4 765
Total area	3 173	6 610	761	405	4 698	1 695	12 772	30 114
Proportion of total	10%	22%	3%	1%	16%	6%	42%	100%

Table 6. Breakdown of rainforest interpreted from 1:42 000 colour aerial photography by vegetation classes derived from the Vegetation of Tasmania. *Unless otherwise specified, all figures are given in hectares.*

Map sheet	Alpine complexes	Rainforest	Burnt rainforest	Buttongrass moorland	Scrub	*Eucalyptus delegatensis* forest	*E. nitida* forest	Montane grassy forest	Total
Cathedral	640	1 406	0	234	0	680	0	0	2 960
McCall	28	6 525	0	132	256	0	1 079	0	8 020
Melaleuca	0	86	0	84	0	0	0	0	170
Majors	100	3 588	6	87	105	330	0	0	4 216
Spires	4	1 061	0	371	0	24	108	9	1 577
Total	772	12 666	6	908	361	1 034	1 187	9	16 943
Proportion of total	5%	75%	0%	5%	2%	6%	7%	0%	100%

eucalypt overstorey and a rainforest understorey) on the recent PI mapping.

The rainforest shown on the same five map sheets was compared with the vegetation codes of Kirkpatrick and Dickinson (1984) and results are shown in Table 6. About three-quarters of the rainforest shown on the recent mapping was also indicated as rainforest in 1984, with relatively small amounts being apparently mistyped as other vegetation types.

A comparison of *The Rainforest Map of Tasmania* with *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* also indicated a low level of agreement. Only about half the live Huon pine shown on the latter map was included in rainforest patches shown on the former map. This can be attributed partially to much of the Huon pine occurring as riverine stands that were too narrow to be mapped as rainforest on *The Rainforest Map of Tasmania*. Only about one-third of the live King Billy

pine shown on *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* is co-incident with patches shown on *The Rainforest Map of Tasmania*. Possible explanations are that:

- much of the King Billy pine occurs as woodlands at high altitudes rather than as forest;
- myrtle is absent from some high altitude King Billy pine communities;
- *The Distribution of Huon Pine, King Billy Pine and Deciduous Beech in Tasmania* overestimates the extent of King Billy pine.

The relative importance of these explanations has not been investigated.

The new map indicates that 35% of myrtle rainforest is reserved in the TWWHA, or in State Reserves or Forest Reserves outside the TWWHA. This is 11% less than the proportion estimated as reserved from the *Vegetation of Tasmania*. Based on the new map, another 14% of rainforest is in the Recommended Areas for Protection (Working Group for Forest Conservation 1991) which are protected from logging under the Forests and Forest Industry Strategy (FFIC 1990). A further 16% is classed as Deferred Forest under the *Public Land (Administration and Forests) Act 1991* while 28% of rainforest is on the Register of Multiple Use Forests and is potentially available for wood production. The status of rainforest land under the Forests and Forest Industry Strategy is shown in Table 7.

Table 7. Status of rainforest under the Forests and Forest Industry Strategy. (RAPs = Recommended Areas for Protection).

	ha	%
Multiple-use forests	157 100	28
Deferred forests	89 200	16
RAPs	81 000	14
Other crown land	206 100	37
Private property	29 700	5
Total	563 100	100

The potential for new sources of rainforest mapping

The Rainforest Map of Tasmania is not planned to be substantially revised for many years because most rainforest areas have been recently mapped and, apart from major wildfires, it is unlikely that their current extent will alter significantly. Minor revisions resulting from timber harvesting will occur and be recorded by using small format aerial photography to update existing PI maps. Other minor revisions will result from the retyping of forests such as the areas in eastern Tasmania which were typed in the 1960s. Detailed vegetation mapping of some areas in the TWWHA is being undertaken (e.g. Kirkpatrick and Mackie 1991) which may also result in revised estimates of rainforest area.

It is possible that future mapping of rainforest will make some use of satellite imagery. LANDSAT data have been used to map rainforest, with about 70% accuracy in north-eastern Tasmania (Ahmed *et al.* 1987) although the technique was hampered by the shading effect of mountainous terrain and by difficulty in distinguishing rainforest from pine plantations. LANDSAT data have also been used to map vegetation including rainforest in the Picton Valley (Elton *et al.* 1990) but again the accuracy of rainforest mapping was only about 70%. As the rainforest area of Tasmania is now comprehensively mapped from aerial photographs, there seems little point in remapping it from less accurate LANDSAT data in the near future. However, satellite imagery could be useful in updating existing PI data following large wildfires in remote areas.

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Appendix

A selection of PI (photo-interpreted) rainforest types commonly used prior to 1986, and now classed as M+ or M-. (M = mature myrtle forest, S = Scrub, T = Secondary species, T(W) = Wattle, W = Wasteland, 1 = average height more than 37 m, 2 = average height from 24–37 m, 3 = average height less than 24 m)

New PI-type	Old PI-type
M+ (Rainforest with *Nothofagus cunninghamii* on better quality sites)	M1, M2, M2S, M2ST, M2T, M2TS, MST, MT, MTS
M- (Rainforest with *Nothofagus cunninghamii* on poorer quality sites)	M3, M3S, M3ST, M3T, M3TS SM, SM2, SM2T, SM3, SM3T, SM2T, ST(W)M3, STM2, STM3, SWM, TM2S, TM3S, WM, WMS