PROOF OF EVIDENCE

On behalf of: The Environment Association (TEA) Inc.
PO Box 261 Deloraine 7304

To be submitted to: Forest Practices Tribunal
GPO Box 2036 Hobart 7001

Private Timber Reserve POR 1698 Appeal
Meander Valley Council v. Forest Practices Authority and EE & IC Porter J & M Hawkes v. Forest Practices Authority and EE & IC Porter N Hoffmann v. Forest Practices Authority and EE & IC Porter PA Elkin v. Forest Practices Authority and EE & IC Porter J Leis v. Forest Practices Authority and EE & IC Porter J King v. Forest Practices Authority and EE & IC Porter

5 March 2006

Prepared by: phill Parsons MAIH
199 Samuel St
Elizabeth Town

Experience:

Certificate in Horticulture.

I manage a botanical institution and provide arboricultural advice to local government.

An interest in the subject of climate change for some 8 years.

My interest in nature is lifelong.

ADDITIONAL EVIDENCE

"The IPCC Third Assessment Report (2001 a,b) concludes that Australia is significantly vulnerable to the changes in temperature and rainfall predicted over the next decades to 100 years. Natural resources and conservation are two of the key sectors identified as likely to be affected strongly. Climate change will add to the existing substantial pressures on these sectors. Until recently, it was expected that the effects of climate change on species and communities would not be detectable for at least another couple of decades. However, over the last few years, evidence has accumulated which indicates that the relatively modest warming experienced so far has *already* had measurable impacts on the distributions, physiology, and life cycles of a range of plants and animals." *Climate change impacts on biodiversity in Australia' Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee,1 –2 October 2002*

Change to the Basis of Calculations in The Environment Asssociation's Rebuttal

It has recently come to my attention that greenhouse gases [GHG] are now at an equivalent of 425 parts per million [ppm] by volume in carbon dioxide equivalents [CO2eq] in the biosphere [1.].

[CO2 379ppm + methane at 40ppm C02eq + nitrous oxide at 6 ppm = 425ppm CO2eq]

The calculations I made in my rebuttal [insert doc title] were based on a 401ppm CO2eq.

Therefore the CO2eq that I estimated for 2070 should be 515ppm in the biosphere, not 490ppm, the basis for my comments in rebuttal.

However, the current rate of growth in GHG's is now running at an average of 3.42ppm CO2 eq. This is the rate of growth since the measure of 401 in 1998.

This rate of growth is a path to 650ppm CO2 eq by 2070.

The changes in energy production forecast by the recent Asia Pacific Partnership on Clean Development and Climate Conference are such, that, were they achieved it would result in at least retaining the rate of growth of CO2 emissions from fossil fuel use.

Growth in total energy produced is predicted to rise from a current level of 9 to 21Gt pa by 2050. [Australian Bureau of Agricultural and Resource Economics research report 06.1 technological development and economic growth]

Notes on the rate of growth of GHG's: Positive feedbacks may increase the rate of atmospheric CO_2 accumulation. Rates of growth of atmospheric CH_4 is partly dependent on release from natural stores that is governed by the degree of warming and thus may exceed the current rate.

<u>Recent New Evidence of impacts comes to my attention</u>

In February 2005 the UK Meteorological Office hosted the Avoiding Dangerous Climate Change Conference [ADCC] in Exeter, UK, the papers being recently published.

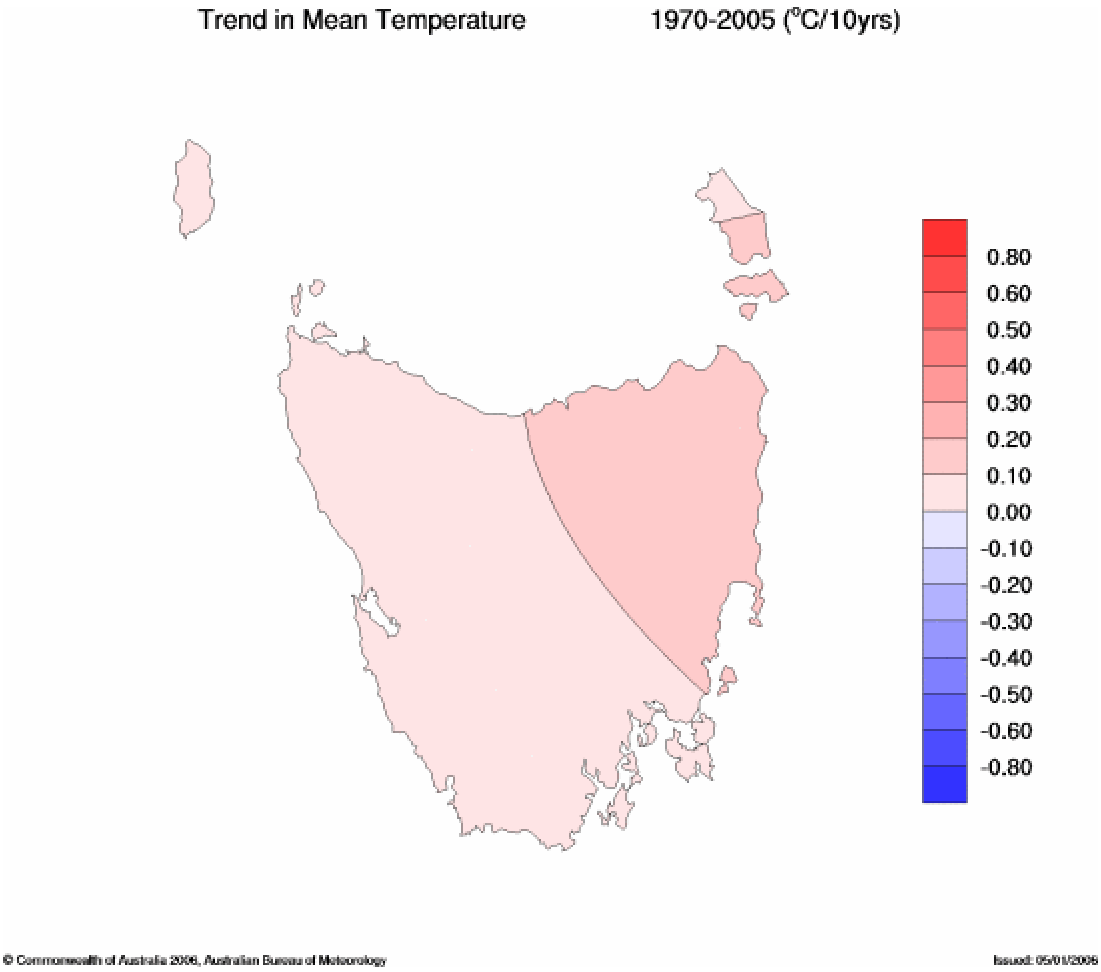
The conference concluded that if GHG's rose to a level above 400ppm CO_2 eq it would mean that a 2dC warming was likely somewhere late this century.

Dr Malte Meinshausen's presentation to the conference, ranking a range of probabilities from very unlikely to very likely, indicated that rising to 550ppm CO_2 eq level increased the chance of an even greater warming. [2.]

He gave a range of possibilities of which 2dC was considered likely, the risk running at 75%, with a growth of GHG to a stable level of 550ppm CO_2eq. His risk assessments change with different levels of GHG's accumulating in the atmosphere.

<u>Relation to CSIRO prediction of range of warming for 2030</u>

Figure 1.

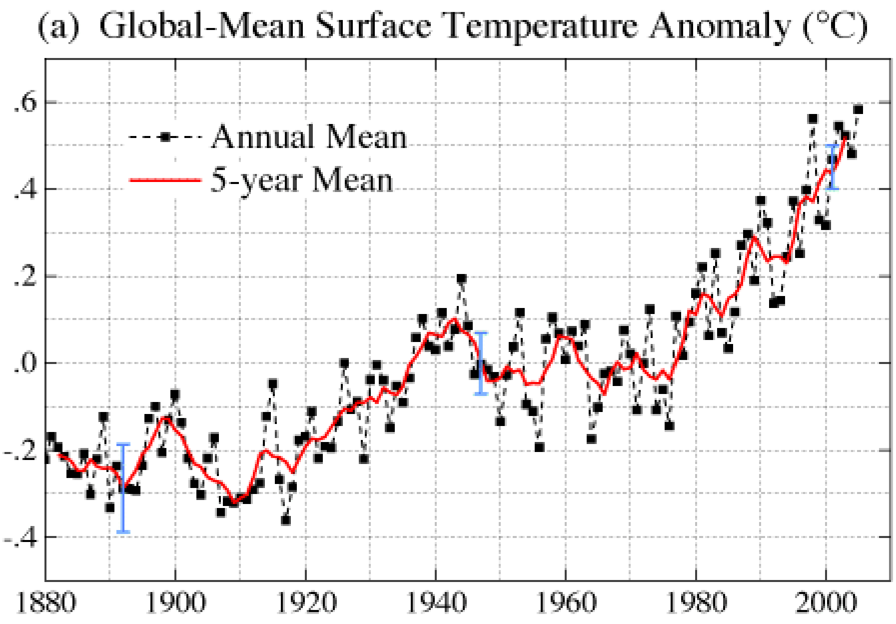


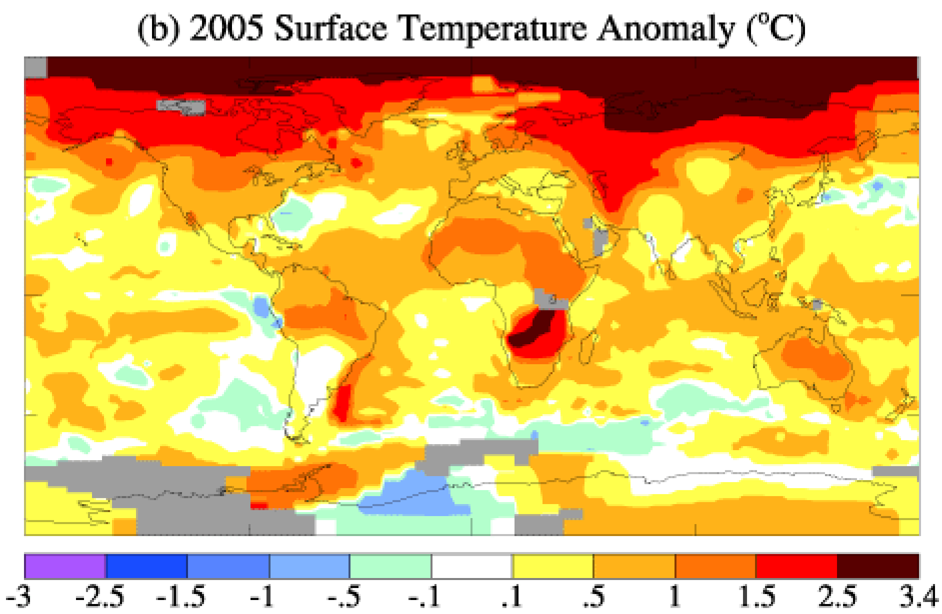
From 1910 to 2005 the trend was in the band +0.00 to 0.10dC for the area of northern Tasmania. [Source BoM http://www.bom.gov.au/cgi-bin/silo/reg/cli_chg/trendmaps.cgi]. Rising to the next band, as shown above, in the last 35 years indicates an increasing rate of warming.

CSIRO predicts a range of temperature increases for Australia including northern Tasmania [4.]

Place	2030	Mean	2070	Mean
Nth Coast	0.4 – 2.0		1.0 – 6.0	
Sth Coast and Tas	0.3 – 1.7	1.0	0.8 – 5.2	3.0
Inland	0.4 – 2.2		1.0 – 6.8	

The Earth has a global temperature increase of 0.6dC. since 1900. [5 year mean]





[Top] Global annual surface temperature relative to 1951-1980 mean based on surface air measurements at meteorological stations and ship and satellite measurements for sea surface temperature. Error bars are estimated 2σ (95% confidence) uncertainty. [Bottom] Temperature anomaly for 2005 calendar year. Gray areas indicate a lack of station data within 1200km

Goddard Institute for Space Studies Surface Temperature Analysis Global Temperature Trends: 2005 Summation http://data.giss.nasa.gov/gistemp/2005/

- The minimum temperature increase predicted for northern Tasmania by 2030 is 0.3dC. [CSIRO 2001]. Figure 1 indicates we are close to this change already, being in the 0.2 to 0.3dC band.

- The top of CSIRO's possible range to 2030 is 1.7dC. [CSIRO 2001].

- The mean of that range is 1.0dC by 2030.

- Reaching this mean would be a warming of a further +-0.8dC in the 25 year period from the 1970 – 2005 period covered by Figure 1.

Mienshausen shows a warming of 1.0dC in his range of probabilities as 'very likely' to occur globally at about the same time. [See Fig 2. page 7][Risk range 90% with GHG stabilizing at 550ppm CO2 eq]

The rate of change and the total increase in temperature for northern Tasmania may vary from the global average.

- If northern Tasmania warmed by 1.0dC by 2030 the rate would average at 0.32dC per decade.

- Were that warming trend to continue to the 3.0dC mean in 2070 [CSIRO 2001] the rise would average of +-0.5dC per decade.

The probability of this degree of warming increases with GHG rising above a level of 550ppm CO2 eq, driven by the increase in radiative warming of the GHG's.

An outline of the implications for this are set out in **Table 1b: Impacts of rate of temperature change on Ecosystems** on page 5.

Impacts on ecosystems and species

A threshold proposed by Leeh,am and van Vilet of a temperature change that does not impact adversely on species and ecosystems is 0.05dC per decade. [3.]

Table 1b: Impacts of rate of temperature change on Unique and Threatened Ecosystems [from the ADCC conference papers]

Rate of Temp-erature rise above pre-industrial	Population scenario	Impacts to unique and threatened ecosystems	Region affected	Source
0.6C over 20th century; now 0.17+/-		Fastest rise of millennium	Globe	IPCC 2001
0.05C/decade		Proposed threshold to protect ecosystems		Leemans & van Vilet 2005
0.1C/decade		Threshold above which	Globe	Vellinga &

		ecosystems are damaged		Swart 1991
0.1C/decade		50% of ecosystems can adapt; forest ecosystems impacted first	Globe	Leemans & Eickhout 2003
General remark		Warming may require migration rates much faster than those in post-glacial times & therefore has potential to reduce biodiversity through selection for mobile/opportunistic species		Malcolm et al 2002; using 7 climate scenarios from GFDL and HadCM2
General remark		ecosystem response lags behind equilibrium, hence vulnerability to pests, diseases, fire is high, this is worse for higher rates of change	Globe	IPCC 2001, Leemans & Eickhout 2003
0.3C/decade		30% ecosystems can adapt; ecosystem response lags behind equilibrium, vulnerability to pests, diseases, fire is high	Globe	Leemans & Eickhout 2003
0.4C/decade		All ecosystems rapidly deteriorate, disturbance regimes, low biodiversity, aggressive opportunistic species dominate globe: resulting in release of carbon to the atmosphere	Globe	Leemans & Eickhout 2003; Neilson 1993
0.46C/decade		Current rate in Arctic (1977 – 2003)		**Folkestad 2005**

I have highlighted Leehmans predictions in the above table in yellow.

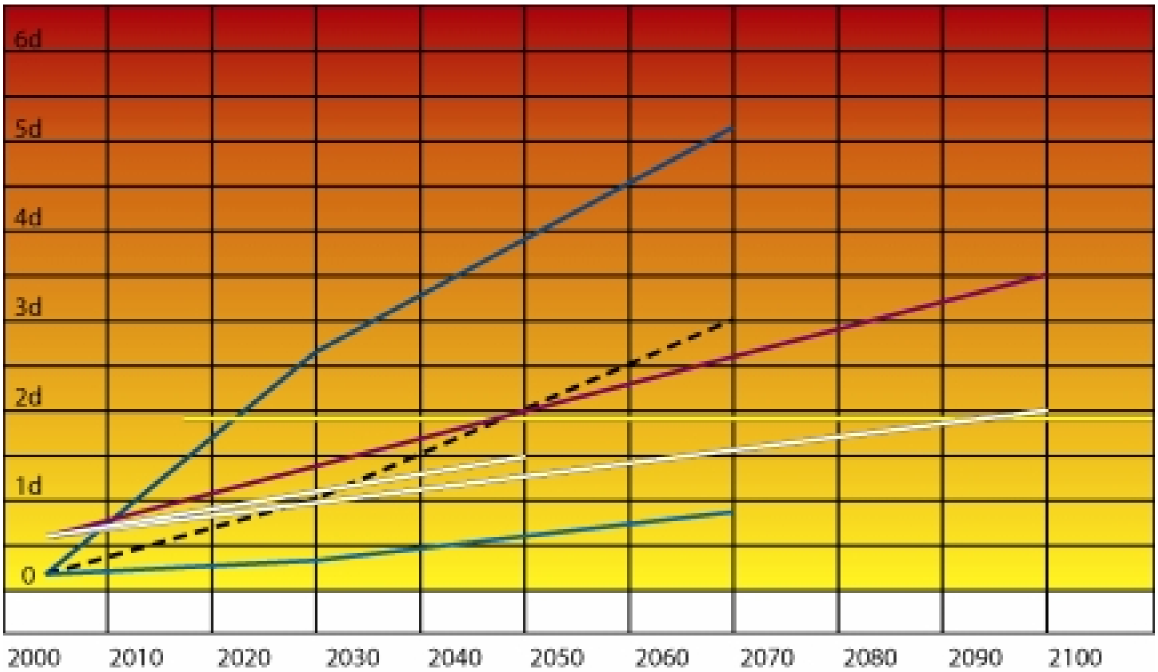
Over the last 5 decades the temperature has warmed at the equivalent of approximately 20% more than Leehmans proposed threshold rate to protect ecosystems [3.], with the current rate at over 3 times the proposed threshold at about 0.17dC globally. [see above Table].

Changes in ecosystems due to global warming are being measured. [3.]

If by 2030 the temperature rises by 1.0dC., the mean of the CSIRO range and in the range of probability of very likely in Mienshausen [see Fig.2 on p7.], the rate of warming of 0.3dC is predicted to impact on unique and threatened ecosystems such that only 30% of ecosystems can adapt, ecosystem response will lag behind equilibrium, vulnerability to pests and diseases will increase and the fire risk become high.[Leemans & Eickhout 2003] [see Table 1b above]

At a rate of 0.1dC, one third of the average rate to reach the mean CSIRO predicts for 2030 for Tasmania, forest ecosystems are predicted to be impacted first. [see above Table]

Figure 2. Graph showing the decade where predicted temperature rises past the point where the risks to many unique and threatened ecosystems eventuates.



The shading to red in Fig 2. above represents the change from a 'risk to some unique and threatened species' to a 'risk to many' as temperatures rise. Above 2dC [yellow line] is the temperature where risk to many unique and threatened species eventuates. [see Table 1a] [shading from Intergovernmental Panel on Climate Change Risks to Unique and Threatened Ecosystems Scale of Risk].

Mienhausen **[a]** a short white line shows ‘very likely’ warming and **[b]** a longer white line shows the ‘likely’ outcome for the globe [both predicated on a GHG stabilization at 550ppm].

Blue lines show the CSIRO range from present for Tasmania, mean is the black dotted line.

The Purple line is an estimate of current path following ABARE reports conclusions on energy growth and extrapolating current GHG growth rates to 730ppm by 2100.

Conclusions re Fig 2.:

[a] That about 2100, on a GHG stabilization path of 550ppmCO2eq, the temperature at which the ‘risk to many unique and threatened ecosystems’ eventuates in globally is ranked as likely to begin. [4.]

[b] On the current GHG growth path of 730ppm by 2100, the ‘risk to many’, I estimate to eventuate at about the same time as the mean of the CSIRO 2001 predictions, about 2050, given that the purple line represents the rate at which those temperature changes occur.

An example of impacts on forest ecosystems

Currently the lodgepole pine [Pinus contorta] forests of Canada are being attacked by mountain pine beetle [Dendroctonous ponderosa] to a degree that has never been experienced before, killing pines at an altitude higher than has been recorded. These atttacks cause epidemic levels of mortality.

The following is extracted from a Washington Post report published in the Duluth News Tribune 03FEB06.

> <u>Climate change catches up with Canada’s forests</u>
>
> *Scientists fear the mountain pine beetle will cross the Rocky Mountains and sweep across the northern continent into areas where it used to be killed by severe cold but where winters now are comparatively mild. Officials in neighboring Alberta are setting fires and traps and felling thousands of trees in an attempt to keep the beetle at bay.*
>
> *"This is an all-out battle," said David Coutts, Alberta's minister of sustainable resource development. The Canadian Forest Service calls it the largest known insect infestation in North American history.*
>
> *"It's pretty gut-wrenching," said Allan Carroll, a research scientist at the Pacific Forestry Centre in Victoria, B.C., whose studies tracked a lock step between warmer winters and the spread of the beetle. "People say climate change is something for our kids to worry about. No. It's now."*

"It's a rapid warming" that is increasing the beetles' range, Carroll said. "All the data show there are significant changes over widespread areas that are going to cause us considerable amount of grief. Not only is it coming, it's here."

"We are seeing this pine beetle do things that have never been recorded before," said Michael Pelchat, a forestry officer in Quesnel, as he followed moose tracks in the snow to examine a 100-year-old pine killed in one season by the beetle. "They are attacking younger trees, and attacking timber in altitudes they have never been before."

Winters in Canada have warmed by 4dC, removing cold as a natural control over this forestry pest. The beetle is reported as currently killing more pines than wildfires and logging combined.

A similar even has happened with white spruce [Picea glauca] forests in Alaska, the spruce beetle [*Dendroctonus rufipennis*] killing over 38 million trees since 1987. Dendochronolical records show that this is the warmest period in the last 400 years and it is the largest outbreak of spruce beetle.

What may follow in the path of the dead spruce forest is likely to be a mix of grasses, and more hardwood trees like birch, alder and aspens

Past 2dC global warming

"A 3d C change in mean annual temperature corresponds to a shift in isotherms of approximately 300–400 km in latitude (in the temperate zone) or 500 m in altitude. Species' geographic ranges are therefore expected to move upwards in altitude or towards the poles in response to shifting climate zones, in those species capable of moving range relatively rapidly." *Climate change impacts on biodiversity in Australia' Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee,1 –2 October 2002*

Appendix 1 is a table summarizing some of the impacts of changes in temperature as presented to the ADCC conference. [Table 1a]

Increases in temperature past the 2dC. point will take the impacts from the zone of 'threats to some unique and threatened ecosystems' into the zone of 'threats for many unique and threatened ecosystems'. [2.].

Meinshausen predicts this as a 'likely' probability by 2100 if GHG is stabilized at 550ppm CO_2 eq.

GHG growth is currently trending towards 730ppm by 2100 with no international agreement aiming at stabilizing the level. This equates to a level of 550ppm by about 2045.

Even if the growth in GHG's is arrested and the concomitant warming caused by that initiating action levels out at 2dC., all ecosystems are now very likely to face the changes that a warming of a further 1.4dC globally will bring.

An average rate of 0.14dC per decade will add to pressures on the capacity of species to adapt to this warming.

The species that are dependant on and inhabit the systems being impacted adversely by the rate and degree of change summarized in Tables 1a and 1b will face added pressures to their survival.

Those that are threatened [Rare, Vulnerable and Endangered.] are already exhibiting the least resilience to pressures on habitat through their recognized status. Warming will bring further pressure on those species dependant on the status quo remaining.

Forest dependent species appear to be at a higher order of risk due to impacts occurring at lower rates of warming. [Leemans & Eickhout 2003]

Comments on 'Land Capability' for PTR 1698

Whilst the underlying geological capacity of the land to provide a physical and chemical base upon which vegetation may grow will remain, climatic factors will also influence the population of the particular species that will have this area within their distributional range.

The mean annual temperature will rise and the mean average rainfall will alter, as mentioned on page 12, over the period of the next century or so [4.], the time it would take for another replacement forest to grow in areas not converted to plantation. These two critical parameters for ecosystems will change on all sites, including that subject to this PTR application.

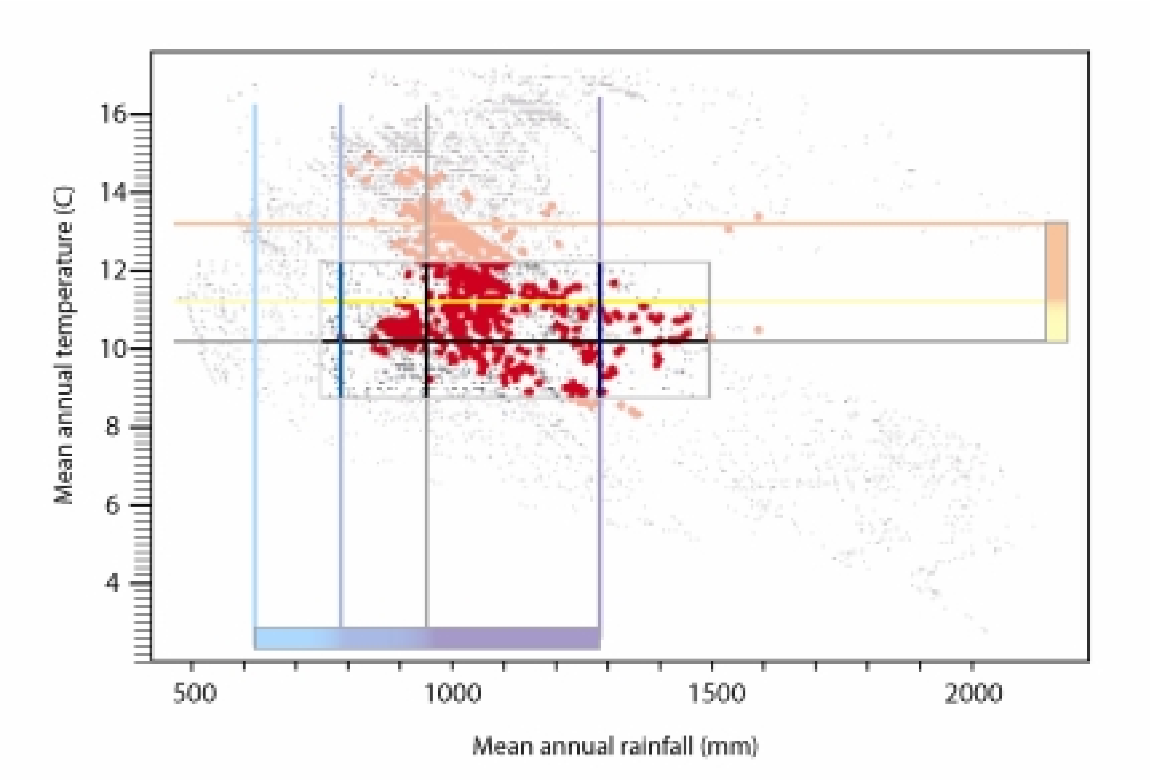
Examples of the CSIRO predicted changes in temperature and rainfall for 2 of the species present on the subject land are shown in Figures 3 and 4

The degree that the subject land is likely to sustain the existing ecosystems and their dependant species currently present would appear to be partly dependant upon limiting to low, both the size of the area disturbed and the level of that disturbance to low, to allow natural processes to function through this period where the resilience of more than just 'some' unique and threatened ecosystems and species capacity to adapt will be severely tested.

Also influencing the level of risks is the rate at which warming occurs, affecting the degree of adaptation to the changed temperature regime and thus resilience. It appears that this rate will be between 6 and 10 times above the proposed threshold where adverse impacts would be avoided.

Figure 3. shows the distribution of Eucalyptus obliqua in south eastern NSW [Lat. 34.5 and 37dS. Long 149 and 151d E] [Source CSIRO Forest and Forest Products Division http://www.ffp.csiro.au/nfm/mdp/bbproj/oblclim.htm] with the mean of projected temperature changes [4.] as a background. Red dots indicate presence, black dots indicate a climatic condition with an absence of that species.

Highlighted in the rectangle is the current distribution of E. obliqua in Tasmania. The upper temperature limit in Tasmania may be limited by the current sea level. The limits are taken from the MAT for Devonport and Tarraleah [BoM] and the MAR from Woodhouse. [5.]



Legend Fig 3.

2005 MAR and MAT for Deloraine [BoM station 000911] are shown in black. Predictions shown as;

2070Maximum decrease,
2070 50% of MAR decrease,
2070 Maximum MAR increase.
Mean of 2030 Increase,
Mean of 2070 increase. [4.]

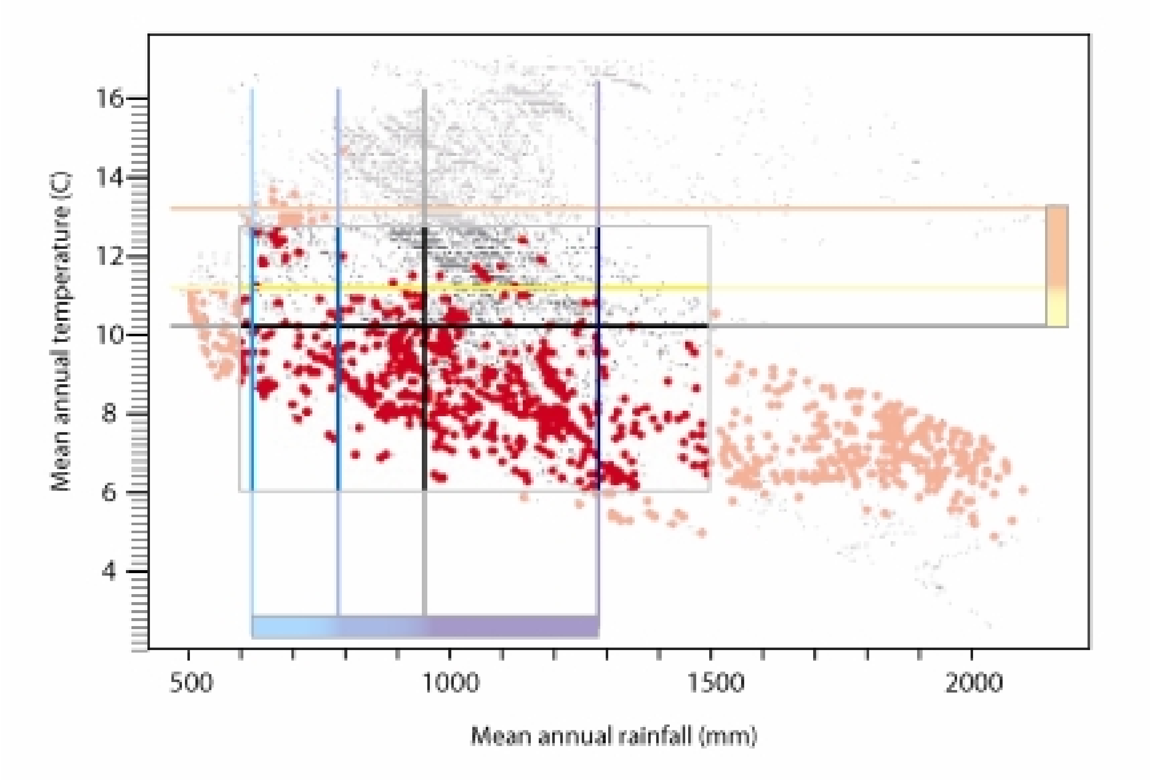
Conclusion re Fig 3: **[a]** E. obliqua provenances from SENSW are currently exhibiting a limited capacity to inhabit sites around Deloraine given a predicted temperature increase by the mean for 2030 by CSIRO [4.]

[b]E. obliqua provenances from SENSW are not currently exhibiting a capacity to inhabit sites around Deloraine given a predicted temperature increase and a rainfall decrease by the mean for both in 2070 by CSIRO [4.]

Figure 4. shows the distribution of Eucalyptus pauciflora in south eastern NSW [Lat. 34.75 to 37.25 S. Long 148 to 150.4 E] [Source CSIRO Forest and Forest Products

Division http://www.ffp.csiro.au/nfm/mdp/bbproj/pauclim.htm] with projected climate changes [4.] as a background. Red dots indicate presence, black dots indicate a climatic condition with an absence of that species.

Highlighted in the rectangle is the current distribution of E. pauciflora in Tasmania. The upper temperature limit in Tasmania may be limited by the current sea level. The limits are taken from the MAT for Swansea and Miena [BoM] and the MAR from Woodhouse. [5.]



Legend Fig 4.

2005 MAR and MAT for Deloraine [BoM station 000911] are shown in black. Predictions shown as;

2070Maximum decrease,
2070 50% of MAR decrease,
2070 Maximum MAR increase.
Mean of 2030 Increase,
Mean of 2070 increase. [4.]

Conclusion re Fig 4.: [a] E. pauciflora provenances from SENSW are currently exhibiting a limited capacity to inhabit sites around Deloraine given a predicted temperature increase and a rainfall decrease by the mean for both in 2070 by CSIRO [4.] **[b]** At the maximum predicted rainfall decrease this species does not currently exhibit a capacity to inhabit sites in SE NSW.

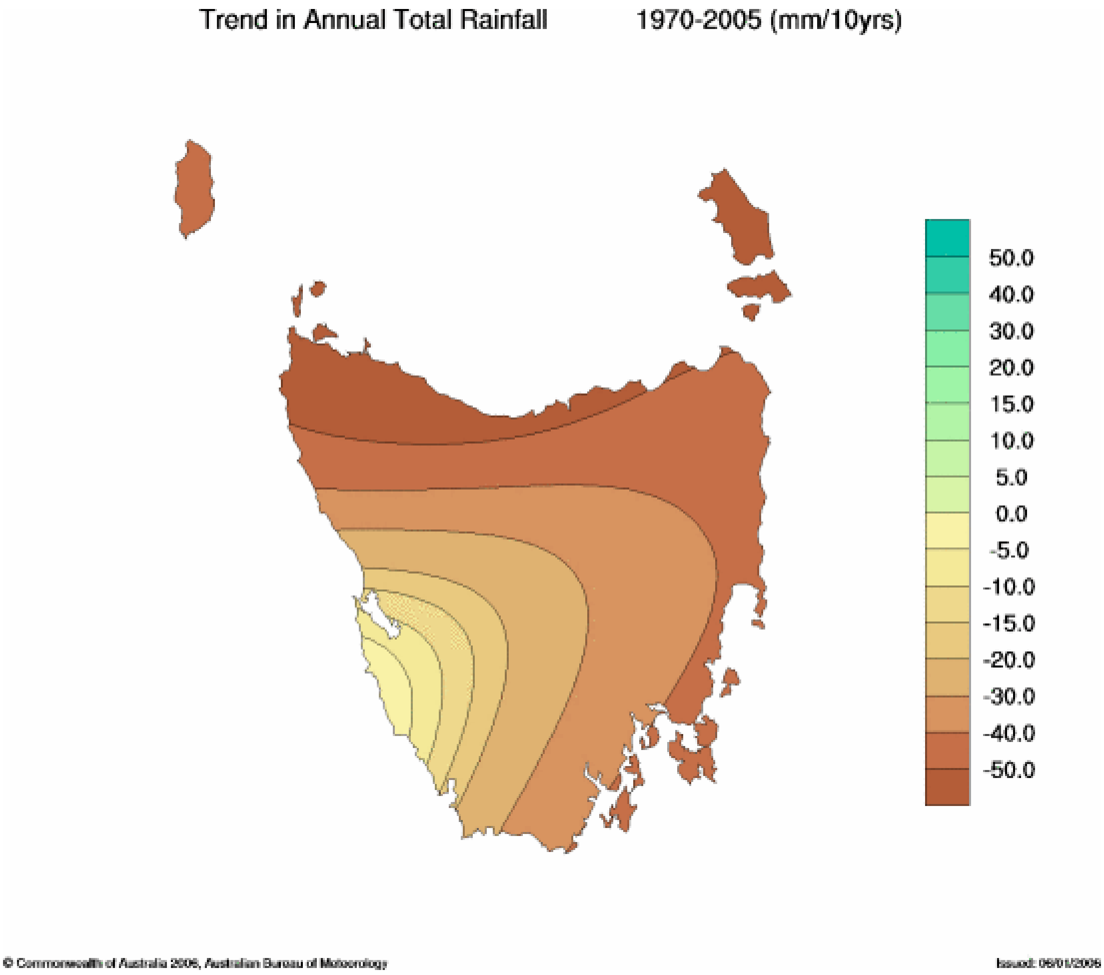
By 2070 rainfall is predicted to change by +-35%. for Deloraine, a range between 620mm and 1280mm MAR [4.] from the current 950mm MAR.

The range of MAT rises are shown in CSIRO predictions on page 3.

Water availability decreases between 80 and 220mm pa. [4.]

Trends are for a decline in rainfall aligned with the increase in temperature. Rainfall has exhibited an increasing rate. [see Figs 1. and 5.]

Figure 5.



The current trend is shown above, from 1900 to 2005 the trend lies in the band of -05 to -10mm. [Source BoM http://www.bom.gov.au/cgibin/silo/reg/cli_chg/trendmaps.cgi]. Falling by 6 bands, as shown above, in the last 35 years indicates an increasing rate of drying.

Impacts on the subject land

"As well as changes in vegetation composition in temperate forests, it is likely that changes in structure, productivity and foliage quality will have flow-on effects to other components of biodiversity. Additionally, likely increases in fire frequency and intensity will have also have impacts." *Climate change impacts on biodiversity in Australia' Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee,1 –2 October 2002*

A change to drier and warmer tolerant plant species as a response to warming and drying of the climate appears to be the most likely response.

Those species dependant on higher levels of soil moisture are most likely to have a reduced range and population density as their tolerances for available moisture cease to be present on areas of the subject land.

Likely candidates to replace the wetter preferring species of Eucalyptus are E. pauciflora and E. amygdalina, because they are currently present. Of course this is limited to the period where the climatic factors remain within their range of tolerances, either as exhibited or selected for.

E. pauciflora is a tree of lesser stature than many of the other eucalypt trees found in the area, growing to only 20m. With a reduced rainfall it may appear as dominant in woodland and not as an integral part of a complex forest community, presenting as it appears it the drier areas of its distributional range in Tasmania.

In my experience E. amygdalina growing on dry rocky sites presents as a shorter tree with a lower population density

All eucalypts growing on sites with reduced available moisture will grow more slowly.

I would expect the trend to be toward increased areas of open canopy and heights to reduce as replacement trees attempt to mature in the changing climatic conditions.

- Woodland habitat with a grassy understorey and grassland should increase its extent.

- The open canopy tall forest currently present on this winter wet summer dry site should reduce its extent.

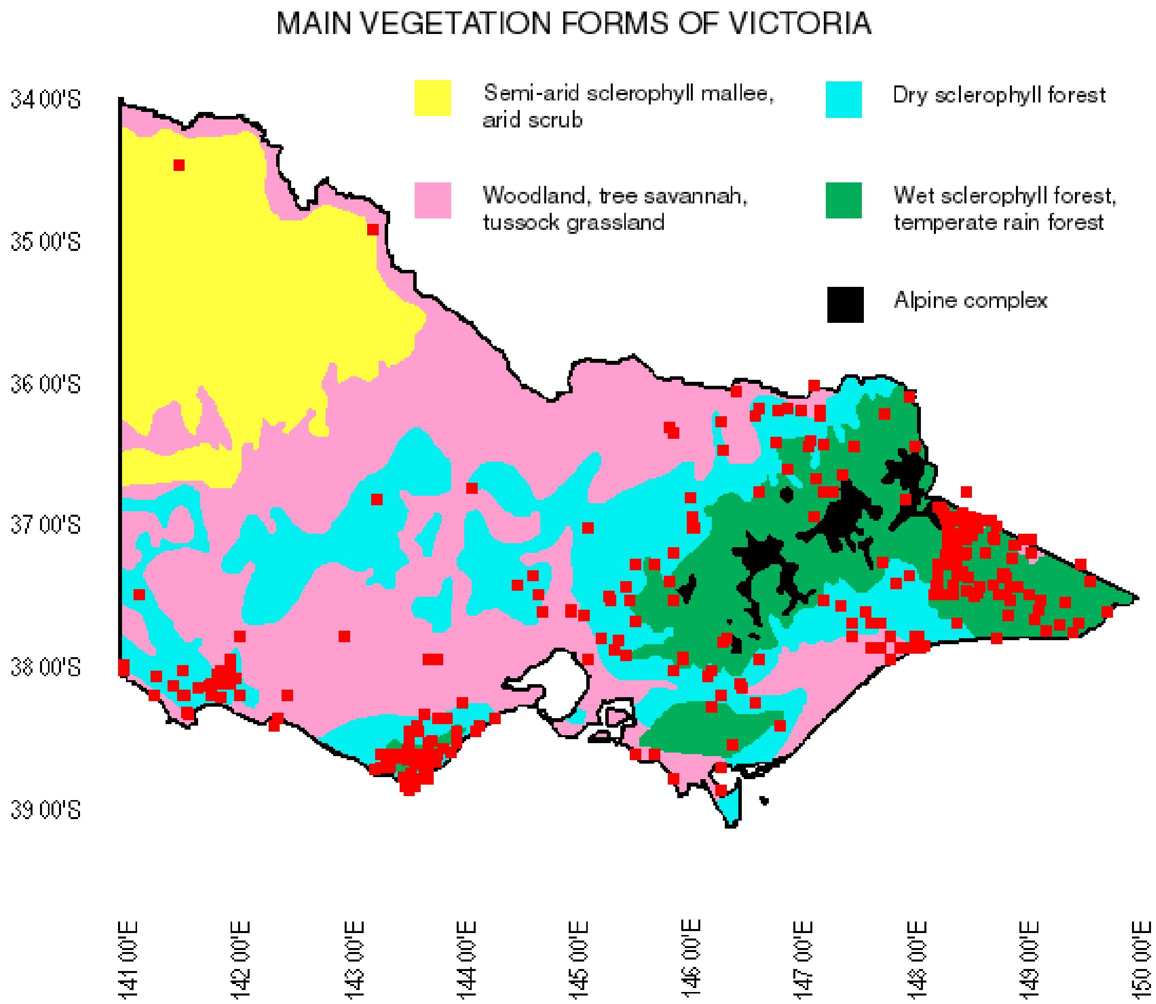
- Because of the relatively level topography and the current drainage patterns on part of the subject land, some areas of moisture dependant vegetation will remain but be reduced in length and width.

Such changes will affect significantly the areas of different habitats on the site

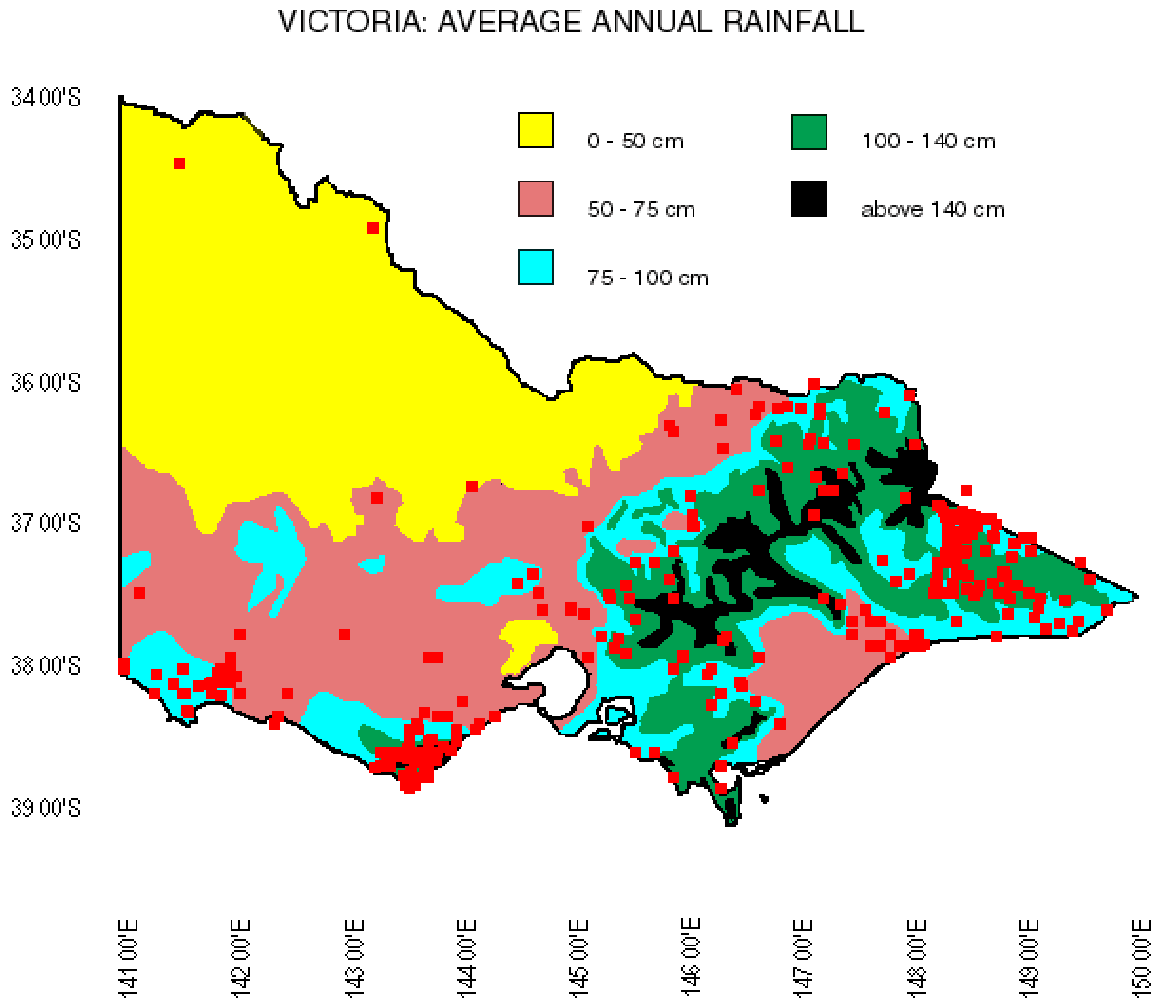
I use the distribution maps of known occurrences for Victoria taken from a number of collections to show both the main vegetation forms and the rainfall zones against the exhibited population density for the spotted tail quoll [Dasyurus maculatus], a species that is listed as threatened and known to me to be present in Reedy Marsh in 2003 and the eastern quoll [Dasyurus viverrrinus].

The Victorian distributions of these 2 species of Dasyurus were selected to compare the stated Tasmanian distributions with a large area with both wet/cool and warm/dry vegetation forms, such as those that could be expected to increase in extent with a warming climate.

Map 1. Distribution of Dasyurus maculatus in Victoria showing main vegetation forms [all records]



Map2. Distribution of Dasyurus maculatus in Victoria against bands of average annual rainfall [all records]



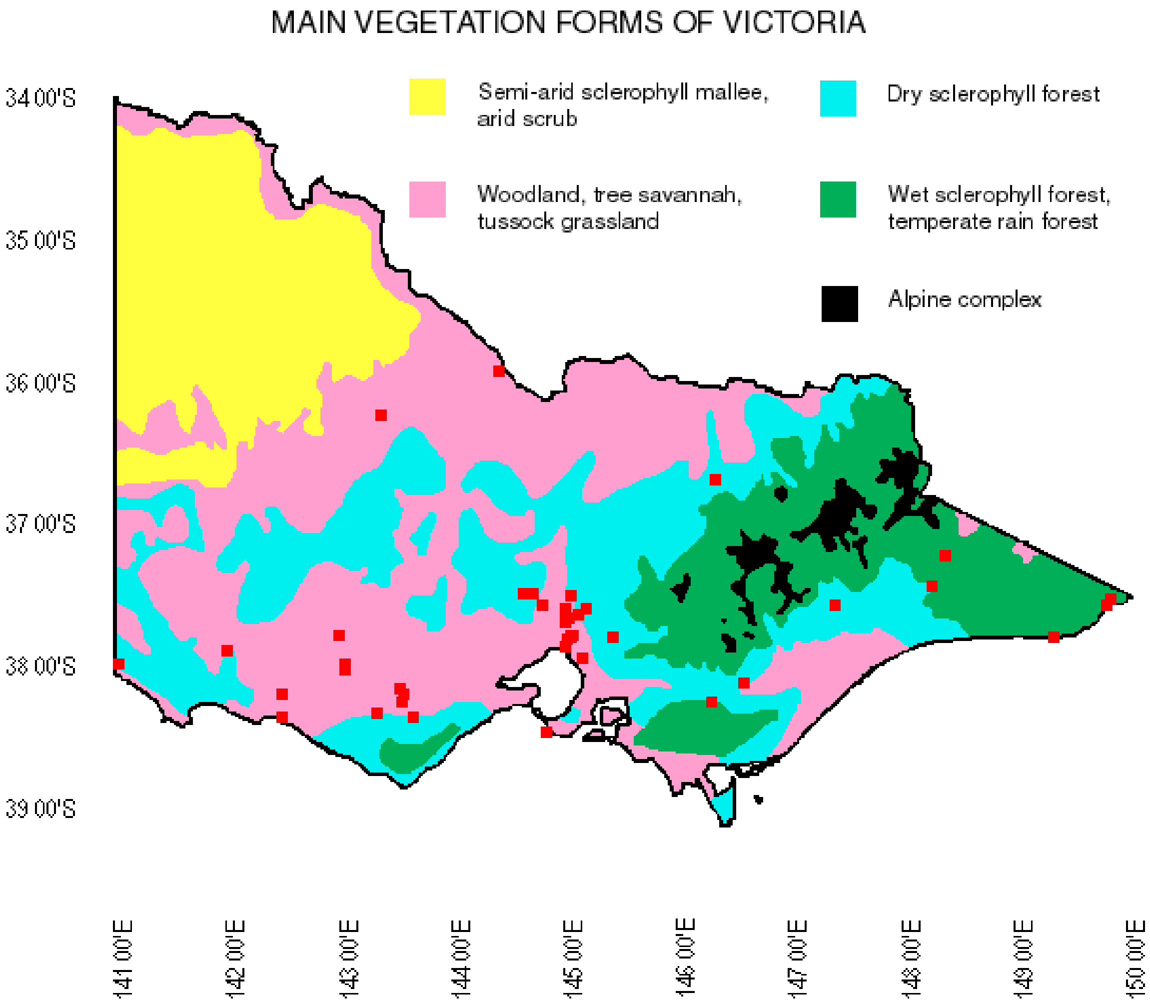
Conclusions re Maps 1 and 2: The population density distribution exhibited by the collection records for the species appears to correlate with the vegetation forms related to higher rainfall similar to the stated preferred habitats for Tasmania.

This species does not show high population density in drier habitats as exhibited by the collection records [rainfall below 500mm pa and a lower density in the range up to 750mm pa] and D. maculatus shows a preference for habitats with a range of 750 to 1400mm pa.

A drier environment appears to reduce the population density.

Distribution of D. maculatus has remained consistent between 1890 and 1999 except for 2 collections widely spaced geographically and occurring between 1970 and 1999 in the rainfall zone below 500mm, one @ 141.5dE. and 34.5dS and the other @ 143dE and 35dS.

Map 3. Distribution of Dasyurus viverrinus in Victoria showing main vegetation forms [all records]. Status: Extinct [No collections recorded since1940]



Victorian Museum Maps for the Distribution of Dasyurus maculautus and Dasuyurus viverrens in main vegetation forms and rainfall [http://flyaqis.mov.vic.gov.au/cgi-bin/bio_vic_remap_mm?/usr/local/apache/htdocs/tmp/17566.dist@viczoo.gif@Dasyuruszxqmaculatus@bio_mammapfly]

Faunal specimen records are from the Museum's collections, the Victorian Government Wildlife Atlas, Parks Victoria and several private collections and cover from the last 150 years to now.

Conclusions re Maps 3: The former distribution of Dasyurus viverrinus appears to have a strong correlation with the areas of greatest intensification of human activity although other factors such as body size may also have mitigated against its survival when competing with introduced predators such as foxes [Vulpes vulpes].

There is a high probability that its lower population density contributed to its extinction.

The population density distribution exhibited by the collection records for the species appears to correlate with vegetation forms similar to the stated preferred habitats for Tasmania.

Actions to increase resilience of existing natural systems

"Many, but not all, existing conservation programs are based, implicitly or explicitly, on the notion that what we want to conserve is 'exactly what we have now, where it is now'— a static view of biodiversity. While this notion is not consistent with a far more dynamic biogeographic or evolutionary perspective (10,000s of years), it is broadly consistent with the shorter-term anthropomorphic perspective (1–10s of years). Hence it has maintained currency. However, future climate change is very likely to result in a pattern of shifting mosaics of ecosystems in more human time scales (10– 100 years), thereby undermining this static notion of biodiversity. To be effective, future conservation programs will have to acknowledge and accommodate this dynamic view of biodiversity. "*Climate change impacts on biodiversity in Australia' Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee,1 –2 October 2002*

1. Ecosystems with any degree of biophysical naturalness should not be disturbed in a way that affects their resilience.

Because of the rate and degree of climate change predicted to occur with a degree of certainty all activities causing disturbance, such as logging in such ecosystems, should be restricted to practices known to have little or no impact on the threatened species inhabiting such ecosystems.

"The most apparent strategy for improving forest resilience to climate change is to promote overall ecosystem health. As discussed earlier, a variety of present non cl-mate threats to forest systems exist, namely conversion, fragmentation, and degradation. Identifying and targeting for action the reduction of priority threats in a particular forest system will go far in ensuring that forest structure, composition, and function that increase a forest's resilience are maintained." A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems World Wildlife Fund AUGUST 2003

Techniques of logging that reduce the multi age structure and its complexity and affect the diversity and population of all species present should not be allowed in native forest that is the habitat of those species.

The potential for hollow formation in forests used for timber production should be managed to ensure levels replicate the norms found in unlogged conservation areas because these hollows are the places where some degree of shelter from higher diurnal temperature can occur and so is important for nocturnally active species during a period of warming and probable drying.

Property boundaries, for the purposes of sustaining ecosystems through a period of stress, are not relevant, the landscape must be managed as an interacting whole.

"Primary forests have been shown to be particularly resilient to climate change (Franklin et al., 1991). Mature trees are better able to weather large-scale disturbances than recently established forests

(Brubaker, 1986), thereby providing arefuge for species reproduction once favorable climatic conditions return (Noss, 2000). While shifts in composition along environmental gradients are still expected in established forests (Franklin et al., 1991), the effects are expected to be much slower, thereby giving species more time to adapt."

2. Ecosystems with threatened species present, and especially containing breeding habitat, should not be disturbed.

The larger and more complex an ecosystem, measured by its degree of biophysical naturalness, indicates a greater importance as a refuge for species during this coming period of perturbation. It needs to be allowed to function naturally to be resilient.

Smaller areas in close proximity to each other or to large areas are also important because they can act in concert.

"Maintaining the natural diversity of species and functional groups in forests is a sound overall strategy for enhancing both resistance and resilience to climate change. Several recent studies have demonstrated increased tolerance to environ-mental extremes and recovery potential as species richness increases. Species diversity in turn promotes the "redundancy" or number of species present in critical functional groups. Functional groups include various kinds of producers, pollinators, seed dispersers, predators, parasites, decomposers, and so on. Thus, it is not just species diversity that matters, but also species composition. Both may enhance the stability of a forest ecosystem. Efforts to identify keystone species and functional groups will help forest managers maintain natural patterns of abundance and distribution." (Noss, 2000)

3. The edges of current plant communities distributions should be managed to allow for any natural relocation of those species, especially in sites with complex distributions that are poorly represented in IBRA regional reserve systems.

"The fossil record provides evidence that species have adapted to changing climates by shifting their ranges. Protected areas established to conserve a particular species may not contain appropriate habitat in the next few decades. Overlaying a climate change scenario upon existing protected areas and other management units will give managers an indication of where a given habitat will occur to enable revision of management boundaries. However, given the rather crude estimation of climate change impacts within particular locales as well as the largely unknown change in ecosystem dynamics that will occur, it is prudent to give forest systems the maxi-mum allowance of habitat in which to migrate (Noss, 2000). Attention should be given in the design of protected area networks to the need for north-south as well as altitudinal migration opportunities. The solution in this case does not rely solely on a reorientation of protected area boundaries, but also to a paradigm shift where decision making regarding land uses takes place on a large, biogeographic scale to include potential habitat outside reserves " (Hilbert, In Press).

4. Corridors to allow movement of plant species to new areas of suitable habitat should be planned immediately and established within the next decade.

These would most likely be altitudinal for temperature and may be site specific for rainfall/available moisture in particular regions.

"The fixed boundaries of protected areas are not well suited to a dynamic environment unless individual areas are extremely large. With changing climate, buffer zones might provide suitable conditions for shifting of populations to lands bordering reserves as conditions inside reserves become unsuitable (Noss, 2000). Buffer zones increase the patch size of the interior of the protected area and overlapping buffers provide migratory possibilities for some species (Sekula, 2000). Buffer zones must be large, and managers of protected areas and surrounding lands must demonstrate considerable flexibility by adjusting land management activities across the landscape in response to changing habitat suitability. A specific case for a buffer zone surrounding tropical montane cloud forests can be made based on research that shows the upwind effects to deforestation of lowland forests causes a raising of the cloud base." Lawton et al., 2001).

5. Plantations should only be planted on land previously cleared [no degree of biophysical naturalness], that are not undergoing natural regeneration or in a corridor as recommended above.

Some short term gains in carbon sequestration can be made through the use of plants. However this must be combined with a serious program to reduce other sources of CO2 emissions to prevent plants failing to act as stores of carbon if the volume of respiration becomes greater than the volume of photosynthesis.

6. Planning for human intervention to overcome distributional discontinuities for plant species, as a result of global warming, should be increased.

Where corridors for plants cannot be established or available sites are likely to disappear due to the changes in climate, seed stores holding sufficient material from a wide range of sites will be needed if revegetation is to occur later, if the climate is stabilized at parameters suitable for the species stored as germplasm and/or in ex-situ living collections, as part of a process of attempting to recover ecosystems.

Recommendations for the subject land

"Preserving currently intact natural habitat is and will continue to be the cheapest and most effective biodiversity conservation action. "*Climate change impacts on biodiversity in Australia' Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee,1 –2 October 2002*

The subject land,

- has higher degrees of biophysical naturalness, ranging from 3 to 5, and
- provides habitat for 7 threatened fauna species and contains 6 threatened vegetation communities subject land, and
- has a number of plant communities that are poorly represented in regional reserve systems and with edges that are likely to change with global warming, and
- has been inadequately studied and assessed as a strategic whole, and
- has areas that are naturally regenerating that may be important in allowing for movement of plant species to new areas of suitable habitat, and
- is a relatively large area in close proximity to other forested areas.

For all those reasons the land should is not suitable to be a PTR.

The land should be managed to protect it ecosystems predominantly for conservation purposes.

Conversion to plantation should only occur on land previously cleared and not undergoing natural regeneration.

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