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Submission to Federal Senate Inquiry on *Australia's national parks, conservation reserves and marine protected areas*

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Executive Summary

WWF-Australia welcomes the opportunity to provide a submission to the Federal Senate Environment, Communications, Information Technology and the Arts References Committee inquiry into Australia's national parks, conservation reserves and marine protected areas.

Australia's biodiversity conservation efforts are Globally Significant

Australia has the global privilege of being one of only 17 megadiverse countries on Earth. Our nation harbours up to 10 per cent of the world's biodiversity, 80 per cent of which is native to Australia.

This confers a large responsibility on our society, and through it our governments, to protect this rich important diversity of life. As such, in absolute terms the single biggest contribution that Australia can make to global conservation efforts is to protect our unique diversity of plants, animals and ecosystems.

Summary of Key Findings

The National Reserve System is Australia's premier investment in biodiversity protection

National parks and other protected areas are central to the conservation of Australia's biodiversity. They are the backbone of Australia's effort to protect its full range of ecosystems.

The *National Strategy for the Conservation of Australia's Biological Diversity* recognises that: "central to the conservation of Australia's biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas integrated with the sympathetic management of all other areas, including agricultural and other resource production areas".

Australian, State and Territory Governments have made significant acquisitions to establish the National Reserve System, but opportunities are being lost

Major progress has been made to establish the terrestrial NRS over the past 13 years: between 1991 and 2004, over 31 million hectares have been added. This includes major areas of indigenous lands using innovative mechanisms, such as the Indigenous Protected Areas program. A prime example is the *Ngaanyatjarra Lands - Indigenous protected area* in Western Australia that covers 9.8 million hectares. As of 2004, the NRS covered 80.9 million hectares or 10.5% of Australia (excluding external territories).

However, the National Land and Water Audit found that approximately half of Australia's bioregions are of high priority to consolidate the National Reserve System and that in many bioregions the opportunity for a fully representative system is being lost through the extent of development. [1]

Australia's rank against other wealthy countries is only average

Australia ranks only 16th out of 30 OECD countries in the relative extent of land secured and managed in a national protected area system. Indeed, the only other OECD country that is also considered to be 'megadiverse' – the United States – has reserved 1.5 times more of its relative land area in protected areas than Australia.

The National Reserve System is well recognised as one of the most cost-effective means to protect biodiversity

The report prepared for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) *Setting Biodiversity Priorities* found that efforts to consolidate Australia's National Reserve System is one of the most cost-effective investments that governments can make to secure the nation's biodiversity: an investment of $300-400m would achieve 80% protection of the full range of regional ecosystems, save 14,700 native species and result in collateral benefits of $2,000m.[2]

The *Directions for the National Reserve System* adopts 80% target by 2010-2015

Arguably, the most important target in the *Directions for the National Reserve System – A Partnership Approach*, adopted by the Australian and all State and Territory governments, is that "by 2010-2015, examples of at least 80% of the number of extant regional ecosystems in each IBRA region are to be represented in the NRS."

As of 2002, 67% of Australia's regional ecosystems were represented in national parks and formal reserves, according to the National Land and Water Resources Audit's *Terrestrial Biodiversity Assessment* [3] - which leaves a shortfall of 13%.

The analysis prepared for PMSEIC reported that to meet this target would require the addition of another 22 million hectares to the NRS at a cost of between $300m-$400m.[4]

Australian, State and Territory Governments have failed to provide adequate resources to achieve national policy commitments to establish the National Reserve System

Australia is well behind schedule to fully implement agreed national targets for 2000 and 2005 set out in the *National Biodiversity Strategy* and the *National Objectives and Targets for Biodiversity Conservation, 2001-05.* The national targets set out in the *Directions for the National Reserve System* will also not be met without securing a large increase in funding in NHT2 and NHT3 to achieve these targets.

To acquire the 22 million hectares by between 2010 and 2015, based on an investment of $400m, equates to $80m/yr for 5 years to $40m/yr for 10 years. Under the current NHT2 funding formula with the States and Territories of 1:1, this equates to a required Australian Government investment of $40m/yr for 5 years to $20m/yr for 10 years.

Australian Government funding for land acquisition for the National Reserve System has collapsed under NHT2

The last year of NHT1 (2000/01) saw nearly $20m expended for NRS related land acquisitions. This is the required funding to achieve the national target by 2015.

However, this funding level has not been sustained under NHT2 despite "establishing and effectively managing a comprehensive, adequate and representative system of protected areas" being one of only 10 priority outcome groups for NHT2.

Funding for NRS related land acquisitions has collapsed in the past two financial years – a mere $2.99m in 2003/04 and only $3.87m in 2004/05. This equates to a miniscule 1.2% and 1.3% of total NHT2 annual allocations.

Highly variable and decreased funding levels for NRS related acquisitions has greatly increased uncertainty and risk for potential program partners

This highly variable and decreased funding allocation by the Australian Government has also resulted in high levels of uncertainty for States which seek funding support to acquire new NRS properties through the partnership arrangements under NHT2.

Australian, State and Territory Governments have yet to implement effective strategic responses to the major threats to Australia's national parks

The major direct pervasive threats to Australia's protected areas include invasive species, altered fire regimes, hydrology changes and climate change. Governments have yet to put effective strategic systems in place to deal with the causes and sources of several of these threats, particularly invasive species and climate change. In relation to invasive plants, the failure of governments to implement coherent and strategic measures to deal with invasive garden plants – which account for 7 in 10 of Australia's environmental weeds – has created a high risk of sustained future invasions of many national parks by escaped invasive garden plants. Over 1,000 known weed species (or 12% of total traded species) have advertised for sale by the garden industry, according to the last survey undertaken in the late 1990s.

Climate change is expected to have large impacts on icon national parks and biodiversity values

A 2ºC to 3ºC rise in temperatures may result in the complete loss of freshwater wetlands in Kakadu, which would be inundated with salt water as a result of sea level rise.

The most likely outlook for the Great Barrier Reef is that mass bleaching, leading to the death of corals, will become a more frequent event in Australian coral reefs in coming decades. A 2ºC warming is expected to bleach 95% of the reef leaving it devoid of coral and dominated by seaweed and blue-green algae.

Up to 2ºC global warming would dramatically affect Australia's tropical rainforests. Greater than 2ºC would see a 90% reduction of the core environment, home to 65 vertebrate species in the north Australian wet tropics.

Ninety Australian animals have been specifically identified as being at risk from climate change.

As a consequence, there is an urgent need for an NRS climate change adaptation response plan to be developed.

Need for a science driven process for development of the National Reserve System of Marine Protected Areas

The scientific process to rezone the Great Barrier Reef Marine Park is to be commended. This science driven process should underpin the development of other regional marine plans.

The NRSMPA roll out needs to be accelerated to meet 2012 target

Currently 9 % of Australia's EEZ falls within a marine protected area, but this is concentrated in large MPAs in the Great Barrier Reef and Heard and McDonald Islands. Overall the distribution of MPAs falls short of acheiveing true representation across all ecosystems and habitat types. To achieve the 2012 Convention on Biological Diversity target of a global representative system of MPAs will require an acceleration of the current roll out and an increase in funding, particularly in relation to regional marine plans for northern Australia.

Australian Government has a national leadership role to play in the establishment of the terrestrial and marine National Reserve System

Australia has made steady progress to establish the terrestrial NRS, and the Australian Government is to be particularly commended on its incubating role of the private land trust industry, and innovations to partner with indigenous groups through the Indigenous Protected Areas program.

The Australia Government has a critical leadership role to play in ensuring that nature's safety net is built by 2010-2015. A key role is providing the enabling resources to assist State and Territory governments, private land trusts, land holders and indigenous organisations secure lands within the terrestrial National Reserve System. The above evidence clearly shows that a 10 fold increase in funding is required if the key target under 10 year national reserves plan is to be achieved.

Australia is regarded as a world leader in marine conservation. Significant challenges, however, do lie ahead, that may threaten Australia's record. The Australian Government has thus far been highly successful in protecting the iconic and the remote. A far more difficult challenge is presented with the roll-out of the NRSMPA. Many of the regions that fall into the Nationally Representative System do not have the iconic status of the Great Barrier Reef and certainly all have significantly greater competing uses than occurs in the sub-Antarctic. However, their ecological importance and need for protection is significant. Considerable resourcing, a commitment to CAR criteria and strong political resolve will be required to implement MPAs in these areas.

Summary of Recommendations

Recommendation 1

That the NRM Ministerial Council explicitly recognise the pressing need to establish the National Reserve System and that sufficient funds should be provided by governments to ensure that the targets in the *Directions for the National Reserve System – A National Partnership Approach* are implemented within agreed timeframes.

Recommendation 2

That the Australian Government reaffirm its critical leadership and enabling role in the establishment of the National Reserve System through promoting national planning and providing substantial funding through NHT2 and the proposed NHT3.

Recommendation 3

That for 2005/06 – 2006/07, NHT2 invest a minimum of $20m/yr for NRS related land acquisitions

Recommendation 4

That the proposed NHT3 delivery framework include establishing and effectively managing a comprehensive, adequate and representative system of protected areas as an explicit priority area of activity

Recommendation 5

That the NHT3 delivery framework include a national investment stream with block funding of between $20m/yr-$40m/yr for NRS related land acquisitions to enable the 80% comprehensiveness target under the *Directions for the National Reserve System – A National Partnership Approach* to be achieved by 2010-2015.

Recommendation 6

That the cost sharing arrangements between the Australian Government and other government partners should revert to at least the 2:1 basis as recommended by the HORSCERA inquiry in 1993. Consideration should also be given to the Australian Government assisting with some establishment costs to balance the on-going management costs, particularly in relation to the acquisition of any large reserves in the Northern Territory and South Australia.

Recommendation 7

That State and Territory Governments prohibit the supply of *all* high risk environmental weeds throughout their jurisdictions.

Recommendation 8

That the Australian, State and Territory Governments identify all high and medium risk environmental weeds to determine that have been supplied through the garden industry but have yet to naturalise.

Recommendation 9

That Australian, State and Territory Governments increase funding for feral animal and weed management, with a particular focus on eradication of high risk new or sleeper weeds (such as recently discovered small Orange Hawkweed infestation (on the national Alert List of Environmental Weeds) in Kosciuszko National Park).

Recommendation 10

That the Australian, State and Territory conservation agencies strongly support the rebid for a third Weeds Cooperative Research Centre and provide funding for development of biocontrol agents for serious environmental weeds impacting on national parks.

Recommendation 11

That governments establish a *Darling River Initiative* for the northern MDB to ensure large wetlands receive an additional 500 Gl of environmental flows to restore river health, particularly those in national parks and other conservation reserves.

Recommendation 12

That Parks Australia and the Australian Greenhouse Office undertake detailed studies into the most appropriate protected area acquisition strategies required to enable effective climate adaptation, including the proposed Eastern Australian Great Escarpment Corridor.

Recommendation 13

That Australian, State and Territory governments review progress to implement the 2005 actions under the *National Biodiversity and Climate Change Action Plan*

Recommendation 14

That Australian, State and Territory governments implement the targets of the *National Biodiversity and Climate Change Action Plan* within agreed timeframes, particularly those under Objective 5

Recommendation 15

That the Australian Government maintain the NRS 2:1 funding formula for private conservation organisations

Recommendation 16

That States and Territories allocate additional resources to increase the standard of management across bioregions.

Recommendation 17

1. National Representative System of Marine Protected Areas

WWF recommends that the Australian Government increase resourcing:

- **of the application of the principles of integrated, spatial ecosystem based management as the roll-out of the NRSMPA continues.**
- **to increase the momentum in which the NRSMPA roll-out can occur, not only to meet Australia's international obligations, but also in recognition of the under-representation of large areas of Australia's waters in protected areas.**
- **for the identification of further sites of high conservation value to achieve a comprehensive, adequate and representative system in Australia's EEZ**
- **to build the data/knowledge base where necessary by undertaking scientific research programs. For many of the stakeholders the lack of data is seen as a reason not to protect until the level of knowledge gives reason to apply**

high levels of protection. Resources must be applied to gathering data, but meanwhile the precautionary approach must be applied.

Recommendation 18

2. Great Barrier Reef Marine Park

WWF recommends that the Australian Government increase resourcing:

- **To adequately resource GBRMPA to remain an independent statutory authority while increasing its resources to deal with the increasing severity of threats impacting on the GBR from outside the marine park. These include: coral bleaching, land-based sources of pollution, shipping and illegal fishing.**
- **to review and strengthen the existing Dugong Protection Area network. In the southern GBR, all Zone B Dugong Protection Areas should be upgraded to Zone A status; and a new Zone A network of DPA's should be established in the northern GBR.**
- **to extend the eastern boundary of the Great Barrier Reef Marine Park eastwards to include the Coral Sea reefs and surrounding waters of the Coral Sea.. The extended Park should include a comprehensive network of no-take zones to highly protect the reefs of the Coral Sea.**

Recommendation 19

3. Northern Australia

WWF recommends that the Australian Government increase resourcing:

- **to accelerate the development of the National Representative System of Marine Protected Areas (NRSMPA) in northern Australia**
- **to work collaboratively with the governments of Queensland, Western Australia and the Northern Territory to implement complementary MPAs across Australia's north.**
- **To continue to develop an Indigenous Sea Ranger Program in northern Australia that:**

i) Is developed in liaison with Indigenous communities, Land Councils, State/Territory government departments, non-government organisations;
ii) Is flexible enough to ensure that local Sea Ranger groups develop in a way that is appropriate to them
iii) Provides sustainable funding arrangements with properly paid positions (e.g. at Park Ranger rates) to the Sea Rangers and has a career path.
iv) Incorporates accredited training
v) Has reporting requirements that are accountable but not onerous.

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1. Introduction

WWF-Australia welcomes the opportunity to provide a submission to the Federal Senate Environment, Communications, Information Technology and the Arts References Committee inquiry into Australia's national parks, conservation reserves and marine protected areas.

This submission addresses the terms of reference in two parts: terrestrial followed by marine.

The funding and resources available to meet the objectives of Australia's national parks, other conservation reserves and marine protected areas, with particular reference to:

(a) the values and objectives of Australia's national parks, other conservation reserves and marine protected areas

(b) whether governments are providing sufficient resources to meet those objectives and their management requirements

(c) any threats to the objectives and management of our national parks, other conservation reserves and marine protected areas

(d) the responsibilities of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

(e) the record of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

The submission was prepared by Andreas Glanznig - Senior Policy Adviser, Dr Stuart Blanch – Manager, Northern Australia Program, and Rik Leck – Marine and Coastal Policy Officer.

About WWF-Australia

WWF-Australia is part of the WWF International Network, the world's largest and most experienced independent conservation organisation. It has close to five million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity;
- ensuring that the use of renewable natural resources is sustainable; and
- promoting the reduction of pollution and wasteful consumption.

With over 60,000 supporters, and active projects in Australia and the Oceania region, WWF works to conserve Australia's plants and animals, by ending land clearing, addressing climate change and invasive species, and preserving and protecting our fresh water, marine and land environments.

WWF achieves this by working on the ground with local communities, and in partnership with government and industry, using the best possible science to advocate change and effective conservation policy.

2. Comments Against the Inquiry Terms of Reference (Terrestrial)

The funding and resources available to meet the objectives of Australia's national parks, other conservation reserves and marine protected areas, with particular reference to:

(a) the values and objectives of Australia's national parks, other conservation reserves and marine protected areas

1. **Introduction**
2. **National Values**
3. **Growing Economic Value of National Parks**
4. **Objectives of the National Reserve System**

1. Introduction

National parks and other conservation reserves are effective policy mechanisms to conserve a range ecological, social and economic values. WWF believes that protection of natural assets to maintain national and regional biodiversity values should be the primary objective of Australia's national parks and other conservation reserves.

This position reflects Australia's critically important role in global biodiversity conservation efforts. Australia is one of only 17 megadiverse countries on Earth,[5] and it is estimated to have up to 10 per cent of the world's biodiversity, with possibly the highest rate of endemism.[6] As such, in absolute terms the single biggest contribution that Australia can make to global conservation efforts is to protect our unique diversity of plants, animals and ecosystems.

2. National Values

A comprehensive summary of national terrestrial biodiversity values outlined in the WWF report, *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent,* is at Appendix 1.

3. Growing Economic Value of National Parks

The growing economic value of Australia's national reserves is substantial. For example:

- For the Wet Tropics World Heritage Area, direct expenditure has been estimated at $443m, and with a multiplier effect generates economic activity of $753m (based on an average of two nights accommodation attributable to the visit to a park)[7]
- An assessment of the contribution of Sturt National Park, Kinchega National Park and Mutawintji National Park to regional economic development in western NSW found that the three parks generated $9.6m per year[8]
- The contribution of the Tasmanian parks system to the Tasmanian economy has been estimated at $140m in 1998-99[9]
- Visitors support many accommodation establishments, restaurants and other services near parks. A Queensland study of 42 resort establishments, which identified an average of

95% of their business being dependent on the attractions of parks, revealed a turnover of around $126m a year and employment of at least 3,100 people.[10]

Objectives of the National Reserve System

The *Directions for the National Reserve System – A Partnership Approach* adopted by the NRM Ministerial Council introduces the goal of the NRS:

> The National Reserve System (NRS) represents the collective efforts of the States, Territories, the Commonwealth, non-government organisations and Indigenous landholders to achieve an Australian system of terrestrial protected areas as a major contribution to the conservation of our native biodiversity. It aims to contain samples of all regional ecosystems, their constituent biota and associated conservation values.[11]

Central to the establishment of the NRS is achieving a Comprehensive, Adequate, and Representative (or CAR) system of protected areas.

At present there are three national processes that aim to achieve a CAR National Reserve System: the National Reserve System partnership program, which is supported by the Indigenous Protected Areas initiative under the *National Strategy for the Conservation of Australia's Biological Diversity*; the Regional Forest Agreement Process under the *National Forest Policy Statement*; and the National Reserve System for Marine Protected Areas (NRSMPA) under the *National Oceans Policy*.

Directions for the National Reserve System – A Partnership Approach includes nationally agreed timebound targets, which includes:

> **Progressing comprehensiveness**
> Examples of at least 80% of the number of extant regional ecosystems in each IBRA region are to be represented in the NRS (By 2010-2015)
>
> **Progressing representativeness**
> Examples of at least 80% of the number of extant regional ecosystems in each IBRA subregion ar represented in the NRS by 2010-2020.
>
> **Protecting threatened species and ecosystems**
> As a priority, critically endangered and endangered species are regional ecosystems in each IBRA region are included in the NFR by 2010.
>
> Significant progress is made towards inclusion of vulnerable species and regional ecosystem in each IBRA region in the NRS. (By 2010).[12]

A summary of international and national policy commitments to establish a national reserve system is included in the WWF response to Term of Reference (d).

(b) whether governments are providing sufficient resources to meet those objectives and their management requirements

1. **Introduction**
2. **Relative cost effectiveness of the National Reserve System**
3. **Resource requirements to meet National Reserve System targets**
4. **Australian Government funding trends for the establishment of the National Reserve System**

1. Introduction

The next decade will be a critical period for biodiversity conservation planning in Australia and presents significant opportunities for progressing a comprehensive, adequate and representative NRS.

Natural Resource Management Ministerial Council (2005, pg.8)[13]

The Australian Government has a critical leadership role in the establishment of the nation's biodiversity safety net – the National Reserve System. This role embraces three main areas; first in ensuring robust planning, monitoring and reporting; second, providing enabling funding to catalyse partner investments to acquire lands for the reserve system; and third to develop innovative mechanisms in highly fragmented landscapes or those under indigenous control.

WWF believes that the Australian Government has made major progress in relation to the first and third roles. Indeed, Australia is a world leader in relation to the science and robust planning approaches that underpin its efforts to expand the National Reserve System.

However, while the National Reserve System is one of the most cost effective options to protect key biodiversity assets, the discussion below shows the Australian Government has 'dropped the ball' in relation to its second leadership role – providing enabling funding to establish the NRS. The resultant uncertainty generated from decreasing and variable funding has resulted in a large increase in risk for potential partners. The result is that the enabling conditions to lead Australia's efforts to establish the National Reserve System have been significantly weakened over the past two years.

2. Relative Cost Effectiveness of the National Reserve System

The *National Strategy for the Conservation of Australia's Biological Diversity*, adopted by the Australian and all State and Territory governments in 1996, recognises that:

> central to the conservation of Australia's biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas integrated with the sympathetic management of all other areas, including agricultural and other resource production areas.[14]

As such, the *National Reserve System* has long been recognised as an effective policy instrument to achieve Australia's biodiversity diversity protection objectives, since maintaining rather than repairing high value natural assets is highly cost-effective.

Indeed, the NRM Ministerial Council's *Directions for the National Reserve System – A Partnership Approach* notes that:

> …experience in Australia to date has generally demonstrated that it is seven times more cost effective to conserve intact native ecosystems rather than attempting to re-establish them after they have been cleared or significantly degraded.[15]

This has been further reinforced through a study prepared for the Prime Minister's Science, Engineering and Innovation Council in 2002, *Setting Biodiversity Priorities*, which compared the cost effectiveness of 18 policy options.[16] Based on a decision analysis that involves quantifying the costs and benefits of a particular action, the study calculated that efforts to consolidate Australia's National Reserve System is one of the most cost-effective investments that governments can make to secure the nation's biodiversity: an investment of $300-400m would achieve 80% protection of the full range of regional ecosystems, save 14,700 native species and result in collateral benefits of $2,000m.[17]

The assumptions used in the decision analysis are summarised in the box below.

Consolidate the National Reserve System to achieve comprehensiveness targets: Assumptions applied in the PMSEIC analysis

- 2 IBRA regions are not yet represented in the national reserve system; 33 have less than 5% of their area protected and 15 have been between 6 and 10% protected (Hardy 2001).
- To achieve 80% comprehensiveness (ie 80% protection of the full range of regional ecosystems within and across each IBRA region) within 10 years would take $300-400m, using a mix of public land, purchase of private land and covenanting agreements. (unpublished data from the Draft Strategic Plan for the National Reserve System).
- Based on the increases in area needed, we estimate this would protect about 22 million hectares, or a further 3% of Australia's land area.
- Assuming this would secure a further 3% of Australia's 490,700 species, this would save 14,700 species.
- The collateral benefit would be chiefly in increased tourism and recreation opportunities, especially in the more intensively used areas. Allow an annual enhancement of 3% of the national value; over 10 years that represents $2b.

Table 1: Key Findings from PMSEIC analysis for NRS policy option

Factor	Value
No. of species saved	14,700
Area	22m ha
Cost/ha	$18
Total cost	$350m
No. species saved/$1m	**42**
Collateral benefit	$2,000m
Collateral benefit/total cost	**6**

Comparision of NRS option findings against other options

A summary of the options and calculated biodiversity and collateral returns is reproduced in the table below. The options were also classified as predominantly "repair" items, "maintenance items" or a mix of the two.

	Policy Option	No. species secured/ $1m	Collateral benefit/cost	Maintenance or Repair
A	Prevent broadscale clearing of high ecological value communities in Queensland	26	20	M
B	Prevent broadscale clearing of communities in the MDB that have high multiple ecosystem service value	13	26	M
C	Restore ecological communities which have fallen below 10% back to 10% of their original area, in the 5 IBRA regions that have <30% native vegetation remaining.	25	0.6	R
D	Restore native vegetation in all IBRA sub-regions that have fallen below 10% back to 10% of their original area	13	0.6	R
E	**Consolidate the National Reserve System to achieve comprehensiveness targets**	**42**	**5.7**	**M**
F	Protect the health of rivers that are least disturbed	98	13	M
G	Restore river health to rivers in poor condition	2	0.3	R
H	Ensure environmental flows are at least 15% of sustainable water yield.	1	0.3	R
I	Limit the spread of Phytophthora	35	40	M
J	Eradicate new outbreaks of naturalised plant species with weedy potential	83	1.4	M
K	Biological control of weeds of national significance	16	10	R
L	Mechanical and herbicidal control of weeds (Mimosa example)	7	0.3	R
M	Biological control of vertebrate pests	57	9	R
N	Mechanical control of feral predators (Earth Sanctuary example)	2	0.7	R
O	Strategic revegetation to prevent salinity from further affecting remnant vegetation	19	0.5	R
P	Prevent grazing of 10% of all arid and semi-arid grazing lands	4	1	R
Q	Manage grazing for conservation in threatened grasslands in South East Australia	90	0.8	R+M
R	Implement fire management regimes in native vegetation which promote a diversity of fire patterns	95	9	R+M

The weighted averages of the clear maintenance and repair options in each category (setting aside those that are a mix) are:

	No. species secured/$1m	Collateral benefit/cost
Maintenance (6 items)	39	13.7
Repair (10 items)	6	0.8

The analysis then classified the 18 options into groups according to whether they had high, medium or low values of "species secured/$1m" and "collateral benefit/cost". (High, medium or low was assigned on the basis that the top six options were called "high", the middle six "medium", and the bottom six "low" for each criterion.) The options fell into the following groups (first number in brackets is species secured/$1m, second number is collateral benefit/cost).

COLLATERAL BENEFIT/CSOT	Low <10	Medium 10 - 40	High >40
High >9.05		A clearing (26, 20) B clearing (13, 26) I Phytophthora (35, 40) K biological … weeds (16, 10)	**F protect rivers (98, 13)** M biological … pests (57, 9.1)
Medium 0.65 – 9.05	N mechanical .. pests (2, 0.7) P grazing arid (4, 1.0)		**E reserve system(42, 5.7)** J new weeds(83, 1.4) Q grazing SE (90, 0.8) R fire (95, 9)
Low <0.65	G restore rivers (2, 0.3) H environmental flows (1, 0.3) L mechanical … weeds(7, 0.3)	C restore veg (25, 0.6) D restore veg (13, 0.6) O salinity (19, 0.5)	

SPECIES SECURED/$1m

The analysis shows that consolidating the National Reserve System is the third most cost-effective option of the 18 assessed. This position is further enhanced when it is noted that developing biocontrol agents for feral animals is a high risk venture as evidenced by the limited success to date in developing such agents for foxes, pigs or any feral animal other than rabbits. The most cost effective option, protecting least disturbed rivers, can also be achieved through the NRS option, and indeed the *Directions for the National Reserve System – A Partnership Approach* includes the target:

> The current understanding of freshwater biodiversity in relation to CAR to be reviewed and an agreed approach finalized, which may include future amendments to the NRS Scientific Guidelines, to ensure freshwater ecosystems are appropriately incorporated with the NRS (By 2005).[18]

Given the very high cost-effectiveness of the NRS when compared to other policy instruments, it would be assumed that the Australian Government would strongly resource this program to achieve national biodiversity conservation objectives. The evidence presented below shows this is in fact not the case, and that funding to consolidate the NRS has collapsed under NHT2.

3. Resource requirements to meet National Reserve System targets

The *National Strategy for the Conservation of Australia's Biological Diversity*, adopted by all governments in 1996, included a target that by 2000 Australia "will have completed development of a nationwide system of protected areas on public land, and waters, that are representative of the major ecosystems in each biogeographical region." In part, this timetable reflected the urgency of consolidating the NRS before opportunities to acquire high conservation lands disappeared, particularly in regions under-going high rates of land clearing.

This urgency and concern is reflected in feedback to the 1995 evaluation of the National Reserve Cooperative Program:

> A very common response during the interview held throughout Australia…was that unless representative samples of threatened ecosystems are acquired in the next decade, or less in many cases, the opportunity to do so will be foreclosed.
>
> *Evaluation of the NRS Cooperative Program (1995)*[19]

Unfortunately, while significant progress has been made (outlined in section (e), to date governments have not made the consolidation of the NRS a high enough funding priority, and consequently agreed national targets for establishing the National Reserve System have not been implemented within agreed timeframes. The 2000 national target was not achieved (see box), and neither was the 2005 national target. The *Directions for the National Reserve System – A Partnership Approach* includes realistic targets agreed to by the Australian and all State and Territory government, but similarly many will not be met unless firm commitments are made to providing adequate funds to enable their achievement.

Review Findings on Progress to Establish the National Reserve System

National Strategy for the Conservation of Australia's Biological Diversity

By the year 2000 Australia will have:

(e) completed development of a nationwide system of protected areas on public land, and waters, that are representative of the major ecosystems in each biogeographical region

"As this action will not be achieved by 2000, resources will need to continue to made available after that date...Further work is required to include…freshwater and grassland ecosystems which are currently under-represented"[20]

Australian and New Zealand Environment and Conservation Council (of Commonwealth and State/Territory environment ministers) (2001)

"The representation of major vegetation types within the Australian conservation reserve estate remains poor despite the long-standing recognition of the need to enhance the reservation and protection of these ecosystems."

National State of the Environment Report 2001[21]

National Objectives and Targets for Biodiversity Conservation, 2001-05

Target 1.2.3: By 2005, a representative sample of each bioregion (as specified in the ANZECC action plan) is protected within the National Reserve System or network of Indigenous Protected Areas or as private land managed for conservation under a conservation agreement.

"Despite ongoing progress and enhanced targeting of acquisitions, this target is unlikely to be met by 2005, assuming a target of 15% representation of IBRA in IUCN category protected areas."

Small Steps for Nature: A review of progress towards the National Objectives and Targets for Biological Diversity Conservation 2001-2005[22]

Resource Requirements to Implement the *Directions for the National Reserve System*

One of the most important time-bound targets included in *Directions for the National Reserve System – A Partnership Approach* is that by 2010-2015, examples of at least 80% of the number of extant regional ecosystems in each IBRA region are to be represented in the NRS.

The National Land and Water Resources Audit *Terrestrial Biodiversity Assessment*[23] has developed the baseline for this target: as of 2002 only 67% of Australia's terrestrial regional ecosystems are represented in national parks and formal reserves.

As such, a major national biodiversity conservation challenge is to increase the 2002 baseline of 67% comprehensiveness to 80% comprehensiveness by 2010-2015. The achievement of this target was the focus of the decision analysis, set out in *Setting Biodiversity Priorities*, undertaken for the Prime Minister's Science, Engineering and Innovation Council. As outlined above, it used unpublished data from the Draft Strategic Plan for the National Reserve System to ascertain that an estimated additional 22 million hectares would be needed to achieve this target, or a further 3% of Australia's land area. This would require the investment of $300-400m over 10 years, using a mix of public land, purchase of private land and covenanting agreements.[24] The level of investment now required would be at least at the high end of this estimate due to the land 'boom' of the last five years.

To acquire the 22 million hectares by between 2010 and 2015, based on an investment of $400m, equates to $80m/yr for 5 years to $40m/yr for 10 years. Under the current NHT2 funding formula with the States and Territories of 1:1, this equates to a required Australian Government investment of $40m/yr for 5 years to $20m/yr for 10 years.

Under the previous 2:1 funding formula that existed under NHT1, the Australian Government partnership contribution would be $53.3m/yr over 5 years to $26.7m/yr over 10 years. WWF believes that given the significant establishment and management costs incurred by the States and Territories, that the funding formula needs to be changed back to 2:1, or preferably 3:1 to assist offset these upfront and on-going costs.

The evidence presented below shows that Australian Government partnership funding at the level required to enable the national comprehensiveness target to be achieved by about 2015 has only been achieved once – in the 2001-02 financial year.

4. Australian Government Funding Trends for the National Reserve System Program

There is widespread concern about the current poor levels of Australian Government partnership investment in land acquisitions for the National Reserve System. This is not a function of the NHT2 delivery framework, but rather strategic decisions made about the level of national stream funding for NRS related acquisitions.

Australian Government investment through the Natural Heritage Trust 2 is focussed through 10 priority areas of activity. One of these is Protected Areas whose scope of activity is "establishing and effectively managing a comprehensive, adequate and representative system of protected areas" (Australian Government 2005, pg.7).[25]

Protected areas is also one of 10 National Investment Stream priority outcome groups:

> **Establishing and effectively managing a comprehensive, adequate and representative system of protected areas**
>
> **Outcomes**
>
> 1. A comprehensive, adequate and representative National Reserve System, including support for the Indigenous Protected Areas program, progressed.
> 2. Australia's obligations under the World Heritage Convention to protect and manage Australia's world heritage areas met.
> 3. Establishment of an estate of marine protected areas that represent most of all the marine ecosystems in Commonwealth waters progressed (Australian Government 2005b)[26].

As such, there is ample scope and priority established in the NHT2 delivery framework, but this has not translated to adequate funding investments to achieve the comprehensiveness target set out in the *Directions for the National Reserve System – A Partnership Approach*.

The analysis presented below shows that inadequate funding was also provided under NHT1 to enable target 1.2.3 of the *National Objectives and Targets for Biodiversity Conservation, 2001-2005* to be achieved.

Investment trends for NRS land acquisitions under NHT 1 and NHT 2

Table 2 and Figure 1 show the levels of Australian Government investment for NRS related land acquisitions under the Natural Heritage Trust.

Figure 1: Australian Government investment in NRS related land acquisitions, 1997-2005

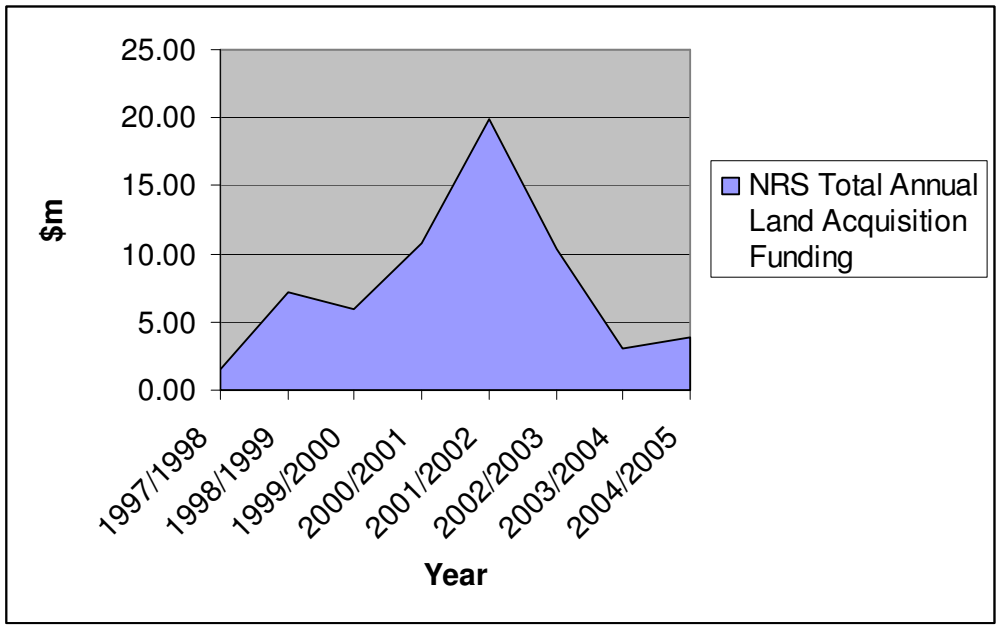


Table 2: Australian Government investment in NRS related land acquisitions, 1997-2005

	NHT 1					NHT2			
	1997/1998	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	TOTAL
	$m	$m	$m	$m	$m	$m	$m	$m	$m
Total Land Acquisition	1.45	7.24	5.94	10.73	19.89	10.38	2.99	3.87	69.44
Protected Areas on Private Land		0.09	0.04	0.15	0.19	0.09	0.28	0.28	1.44

Notes

1. Expenditure figures only - not approvals, which change as projects are withdrawn
2. Excludes Administration costs
3. Does not include declared IPA expenditure figures - approximately $10.5m
4. Land acquisition also includes the purchase and establishment of PPAs - $17.409m in total, including the $1.44m listed as a separate item.

Source: Department of the Environment and Heritage (2006)

This information shows that after a slow build up under NHT1, the level of investment for NRS related land acquisitions has collapsed under NHT2. In 2003/2004 only $2.99 million was expended, while in 2004/2005 only $3.87 million was expended. This is an order of magnitude below the level of investment needed to achieve the comprehensiveness target in the *Directions for the National Reserve System – A Partnership Approach* by 2010-2015. The current investment trends are of major concern to WWF.

Recent Protected Area Investment under the Natural Heritage Trust 2

At a broader level, WWF has analysed the two most recent NHT annual reports to derive actual expenditure for 2003-04 and 2004-05 for progress to establish the NRS, World Heritage management, and to establish Australia's system of marine protected areas.

Table 3 shows relatively consistent funding levels for the national investment stream of between $92.99m to $117.80m.

Table 3: Natural Heritage Trust funding allocations by level of investment ($m)

	Actual expenses ($m)	Actual expenses ($m)	Estimated expenditure ($m)	Estimated expenditure ($m)	Estimated expenditure ($m)
Investment level	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**
National	97.53	117.80	103.73	92.99	100.00
Regional	110.21	145.22	159.55	161.41	154.40
Local	19.76	19.47	20.00	20.00	20.00
Administration	22.48	25.12	26.72	25.60	25.60
Total[a]	**249.98**	**307.61**	**310.00**	**300.00**	**300.00**

[a] Due to rounding, some columns may not add exactly to totals

Sources: Australian Government (2005a, pg. 223[27]; 2005b, pg. 123[28])

The investment levels shown in table 2 to progress the National Reserve System differ from those presented in table 3., particularly for 2003-04. These discrepancies would need to be resolved by the Department of the Environment and Heritage, but possible explanations include that a significant approved project for 2003-04 fell through, that the funding reported against the 'Progress NRS' item includes investments related to establish and manage Indigenous Protected Areas (which do not require land acquisition). It should also be noted that some funding is available to private land trusts for acquisition of high conservation value lands under the non-NHT national biodiversity hotspots program.

Table 4: Breakdown of National Stream Expenditure for NHT Protected Areas Priority Activity

NHT Priority Activity	Outcome	2003-04			2004-05		
		$m	% of National Stream	% of Total NHT	$m	% of National Stream	% of Total NHT
Protected Areas		26.15[a]	26.6	10.5	29.32[a]	24.6	9.5
	Progress NRS	15.50	16.5	6.6	6.93	6.1	2.2
	World Heritage obligations	7.68	8.7	3.1	14.43	12.7	4.7
	Establishment of MPAs	1.32	1.4	0.5	6.59	5.8	2.1

[a] Due to rounding, some columns may not add exactly to totals

For 2003-04, the National Stream expenditure was $93,958,697 (pg.211) to calculate outcome expenditure, rather than National Stream actual expenses of $97,530,000 (pg.223). % of total NHT calculated using total actual expenses of $249.98 m (pg.223)

For 2004-05, the National Stream expenditure was $113,627,399 (pg.109) to calculate outcome expenditure, rather than National Stream actual expenses of $117,800,000 (pg.123). % of total NHT calculated using total actual expenses of $307.61m (pg.123)

Sources: Derived from Australian Government (2005a, pp. 211,223[29]; 2005b, pp. 109,123[30])

A key finding from Tables 3 and 4 is that in 2004-05, only between 1.3-2.2% of NHT funds were invested to progress the NRS under the national investment stream. This highlights that despite progressing the NRS being recognised as one of 10 NHT priority areas, a 10 fold increase in funding is required in order for the Australian Government to provide adequate enabling resources to achieve the key target set out in the 10 year NRS plan – the *Directions for the National Reserve System – A National Partnership Approach*.

Implications for Partnership Agencies and Organisations

The highly variable and rapidly decreasing funding allocations by the Australian Government has also resulted in greatly increased uncertainty for States which seek funding support to acquire new NRS properties.

To accelerate State government participation in the National Reserve System Program and acknowledge the long term management cost for the States, Territories and private land trusts, WWF recommends that the NRSP funding formula should be changed back to $2 Commonwealth for every $1 from State/Territory governments, and the NRSP funding allocation changed to 3 year block funding to provide certainty for Program partners. This funding formulae was a key finding of the House *of Representatives Standing Committee on Environment, Recreation and the Arts* in 1993 into the role of protected areas in protecting biodiversity. It recognised in part, the significant contribution made by State and Territory governments in the management of reserves.

The need for a return to a 2:1 funding formula is vital for jurisdictions with a relatively small tax base and large land areas comprising a multitude of bioregions, particularly Northern Territory and South Australia.

Recommendation 1

That the NRM Ministerial Council explicitly recognise the pressing need to establish the National Reserve System and that sufficient funds should be provided by governments to ensure that the targets in the *Directions for the National Reserve System – A National Partnership Approach* are implemented within agreed timeframes.

Recommendation 2

That the Australian Government reaffirm its critical leadership and enabling role in the establishment of the National Reserve System through promoting national planning and providing substantial funding through NHT2 and the proposed NHT3.

Recommendation 3

That for 2005/06 – 2006/07, NHT2 invest a minimum of $20m/yr for NRS related land acquisitions

Recommendation 4

That the proposed NHT3 delivery framework include establishing and effectively managing a comprehensive, adequate and representative system of protected areas as an explicit priority area of activity

Recommendation 5

That the NHT3 delivery framework include a national investment stream with block funding of between $20m/yr-$40m/yr for NRS related land acquisitions to enable the 80% comprehensiveness target under the *Directions for the National Reserve System – A National Partnership Approach* to be achieved by 2010-2015.

Recommendation 6

That the cost sharing arrangements between the Australian Government and other government partners should revert to at least the 2:1 basis as recommended by the HORSCERA inquiry in 1993. Consideration should also be given to the Australian Government assisting with some establishment costs to balance the on-going management costs, particularly in relation to the acquisition of any large reserves in the Northern Territory and South Australia.

(c) any threats to the objectives and management of our national parks, other conservation reserves and marine protected areas

1. **Introduction**
2. **Invasive Species**
3. **Altered Fire Regimes**
4. **Changed Hydrology**
5. **Climate Change**

1. Introduction

Australia's national parks and conservation reserves are at risk through a number of major threats.

Why is Australian biodiversity vulnerable?

To provide a backdrop for the following discussion on threats to the values and objectives of national parks, it is worth noting the current state and inherent vulnerability of Australia's biodiversity, excerpted from the WWF report, *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent* (Jim Tait, In Press):

> Some of the features of the Australian continent that have contributed to it having exceptional biodiversity are also implicated in its sensitivity to the ecological changes and massive loss of native species that has accompanied the introduction of European land use and exotic biota. These characteristics include being an ancient land mass with weathered, relatively infertile soils, a long period of evolutionary isolation and an extreme climate.
>
> The loss of biodiversity that Australia has experienced in the last two centuries is massive by international standards. Over a hundred species of plants and animals have become extinct (Williams *et al* 2001). Globally two thirds of the mammals that have become extinct since the 1600's are Australian (NLWRA 2002). Despite some recent positive outcomes in threat abatement, recent national assessments of the condition and trend of biodiversity in Australia (SoE 2001, Morgan 2001, NLWRA 2002) indicate that it is more imperiled than ever with greater than a thousand entire regional ecosystems now recognised to be threatened (NLWRA 2002).
>
> Of greatest concern are assessments that indicate that Australian biodiversity loss to date may be moderate in relation to predicted losses in forthcoming decades. This prognosis comes from detailed ecological assessments within Australia and from international overviews considering each continent's susceptibility to global scale drivers of biodiversity loss. Australian experience with bird population declines in response to reduced habitat availability has lead to a substantiated prediction that half of Australia's native land birds will become extinct by the end of this century due to habitat loss and degradation (Recher 1999). Internationally Australia is identified as one of the world's regions most likely to undergo large losses of biodiversity in the next few decades due to inherent susceptibilities of biomes and ecosystems typical of the Australian continent to several of the five key biodiversity threats recognised globally (Sala *et al.* 2000) Table 1. Globally, grassland and Mediterranean ecosystems (which occupy significant areas of Australia) are predicted to experience the greatest change in biodiversity due to their sensitivity to all of the key drivers of biodiversity change (Sala *et al.* 2000).

Table 5: Australian Continent Sensitivity to Global Scale drivers of Biodiversity Change

Ranked Global Scale Drivers of Biodiversity Change (Sala *et al.* 2000)	Australian Continent Sensitivity
1. Land use change	Significant areas of natural ecosystem subject to ongoing land use intensification and mooted for greenfield development.
2. Climate change	Greatest impart in biomes with existing extremes of climate (majority of Australia).
3. Nitrogen deposition & Acid rain	Most significant impact in northern latitude temperate zone and biomes less typically Australian – temperate and boreal forests, artic and alpine.
4. Biotic exchange	Islands most prone to biotic invasions. Greatest impact in biomes such as Mediterranean and southern temperate forests that have been long isolated.
5. Increasing atmospheric carbon dioxide levels	Greatest impact in biomes where plant growth limited by water availability and there is a mixture of plant functional (C_3 and C_4) types (grasslands and savannas – dominant Australian biomes).

WWF-Australia has recently re-analysed the datasets behind the recent Australian Terrestrial Biodiversity Assessment[31] and other national assessments and thematic studies by the National Land and Water Resources Audit and other bodies to, amongst other things, examine key threats to Australia's biodiversity and identified specific conservation priorities. These studies provide a broad analytical capacity to rigorously define Australia's biodiversity conservation priorities. This study, to be published as *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent* (Tait In Press) is due for release in 2006. It found that:

> In the National Land and Water Resources Audit Assessment of Australian Terrestrial Biodiversity (NLWRA 2002a) the general absence of quantitative data necessitated the use of qualitative data to define the range of threatening processes impacting upon key biodiversity assets including:
>
> - wetlands in the Directory of Important Wetlands in Australia (DIWA),
> - riparian zones,
> - threatened species, and
> - threatened ecosystems.
>
> The Audit's use of consistent threat classification within a bioregional framework provided a robust subregional scale analysis. Although the relative impact of different threats was not defined by the Audit assessment, some measure of the relative importance of different threats can be interpreted from their defined continental distribution and the frequency with which they were recorded for specific biodiversity assets within individual IBRA sub-regions.
>
> Based on this approach the dominant top five most extensive and frequently recorded threats across the range of biodiversity assets assessed by the Audit included:
>
> - Grazing pressure,
> - Weeds,
> - Feral animals,
> - Fire regime change, and
> - Habitat fragmentation.

Within the top ten most extensive and frequently recorded threats across the range of biodiversity assets assessed by the Audit other key threats identified included:

- Changed hydrology,
- Vegetation clearing,
- Pollution,
- Salinity,
- Firewood collection,
- Pathogens, and
- 'Other.'

The nature of these threats and their associated impacts and the range of threats recorded in the 'other' category are discussed below.

Table 6: Relative importance of threats defined for Threatened Species and Ecosystems, Riparian Zones, and Directory of Important Wetlands in Australia in terms of continental distribution and number of threatened species records per IBRA subregion (NLWRA 2002a).

Top 3 current threats for national parks in bold

Threatened Species		**Threatened Ecosystems**	**Riparian Zones**	**DIWA wetlands**
Ranked extent of threat (Number subregions recorded)	Ranked extent most frequent* threats (*most species records per subregion)	Ranked extent of threats (Number subregions recorded)	Ranked extent of threats (Number subregions recorded)	Ranked extent of threats (Number subregions recorded)
1. Feral Animals	1. Vegetation Clearing	1. Grazing Pressure	1. Grazing Pressure	1. Grazing Pressure
2. Changed Fire Regimes	2. Grazing Pressure	**2. Feral Animals**	**2. Exotic Weeds**	**2. Exotic Weeds**
3. Grazing Pressure	**3. Feral Animals**	**3. Exotic Weeds**	**3. Feral Animals**	**3. Feral Animals**
4. Exotic Weeds	**4. Changed Fire Regimes**	**4. Changed Fire Regimes**	**4. Changed Hydrology**	**4. Changed Hydrology**
5. Other	5. Increasing Fragmentation	5. Increasing Fragmentation	5. Increasing Fragmentation	5. Pollution
6. Increasing Fragmentation	6. Changed Hydrology	6. Vegetation Clearing	6. Changed Fire Regimes	6. Salinity
7. Vegetation Clearing	**7. Exotic Weeds**	7. Changed Hydrology		
8. Changed Hydrology	8. Pollution	8. Salinity		
9. Pollution	9. Salinity	9. Firewood Collection		
10. Pathogens				
11. Firewood Collection				
12. Salinity				

Source: Tait (In press). *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent*

The report, *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent*, puts this national ranking derived from NLWRA data in context by noting:

> As the term 'Audit' would suggest the National Land and Water Resources Audit assessment of terrestrial biodiversity audited impacts and threats that have been recorded for biodiversity assets. The Audit analysis was therefore constrained by the availability of data by which to quantify biodiversity change. Where only largely qualitative data were available i.e. for weeds and invasive species, this was acknowledged to present constraints in terms of quantifying the threat posed to biodiversity (Morgan 2001, NLWRA 2002a). It was also beyond the scope of the Audit assessment to examine the potential biodiversity impacts associated with emerging though yet largely unrealised threats such as climate change or new invasive species.
>
> In the 2001 State of the Environment Report (Williams *et al* 2001), clearance of native vegetation was identified as the 'single most significant threat to biodiversity', while climate change was identified as a serious threat to biodiversity that needed to be 'adequately managed, better understood and managed' (SoE 2001). Using improved predictive modeling approaches more recent Australian (Williams et al 2003, Krockenberger et al 2004) and international assessments (Malcolm et al 2002, Thomas et al 2004) of the threat posed by climate change now suggest that it is as significant if not a more significant threat to biodiversity than any other (Tait In Press).

Some of the major immediate and emerging threats to Australia's national parks are discussed below.

Need for Effective Strategic Response to Threats

WWF is strongly of the view that the Committee's scope to analysing the funding and resources available to mitigate threats to national parks needs to place due emphasis on the original causes and sources of the threats. This is due to the fact that many threats originally emanate external to the national park or conservation reserve. This includes controls on high risk environmental weeds that are currently being sold by the garden industry and planted in gardens near national parks, but are yet to naturalise and invade, or decisions on water extraction and environmental flows.

This approach will enable the Committee to propose strategic responses aimed at the causes and sources of the threat, rather than unduly limiting the report to tactical level responses, such as controlling weeds or feral animals in national parks.

2. Invasive Species

Invasive Plants

Invasive plants present Australia with an immediate and growing threat. They cost agriculture $4 billion a year in control and lost production costs,[32] and just six of Australia's worst invasive weeds have degraded over 20 million hectares of grazing and natural lands.[33]

Most national park weeds are escaped invasive garden plants

Most weed problems in national parks can be traced back to invasive garden plants that have jumped the fence. For example, the 2004 *NSW State of the Parks* report highlights that the NSW government recognises that "weeds pose one of the most significant threats to biodiversity after land clearing and habitat destruction", and that major park control programs are in place for bitou bush, lantana, blackberry, perennial grasses, Scotch broom, gorse, exotic vines, willows, aquatic weeds, asparagus species, African boxthorn, camphor laurel, glory lily, groundsel bush, olives, ochna, privet and St John's wort. It is instructive to note that most of these serious weeds are escaped invasive garden plants.

Escaped invasive garden plants are *the* major source of weeds in Australia

According to new Weeds CRC research, the garden sector (excluding botanic gardens) has introduced 18,444 or 66% of new plant species into Australia. Of these, 5,587 are 'referenced weeds'[34] (A referenced weed is any plant species with a reference as a weed either in Australia or overseas, of any type, which is listed in the WA Department of Agriculture Plants Database). Of these,1,852 have already escaped and naturalised.

These naturalised invasive garden plants now make up about 70% of Australia's environmental and agricultural weeds. They cost farmers and government agencies $100m's a year in control costs and lost production – for example the cost of just three escaped invasive garden plants are: Paterson's curse costs $30m/yr, lippia costs $38m/yr and rubbervine costs $27m/yr and occupies 700,000 ha.[35] Just one escaped garden plant, lantana, now degrades over 4 million hectares of Australia's environment.[36]

Tomorrow's invasive plants are already here.

About 10 new plant species naturalise each year, and invasive garden plants are set to dominate future naturalisations. New research from the Weeds CRC has calculated that about 3,735 plant species imported into Australia for cultivation as garden plants are referenced weeds *yet* to naturalise in the environment.[37]

This pool of invasive garden plants waiting for the right conditions to jump the garden fence presents a large and unacceptable risk to the Australian environment and agricultural lands. Examples include the ornamental tussock grass, Mexican feathergrass (*Nassella tenuissima*) which will cost agriculture $39m in its early invasion phase,[38] if current efforts to detect and eradicate it fail.

Figure 2: Introduced garden plant species that are referenced weeds

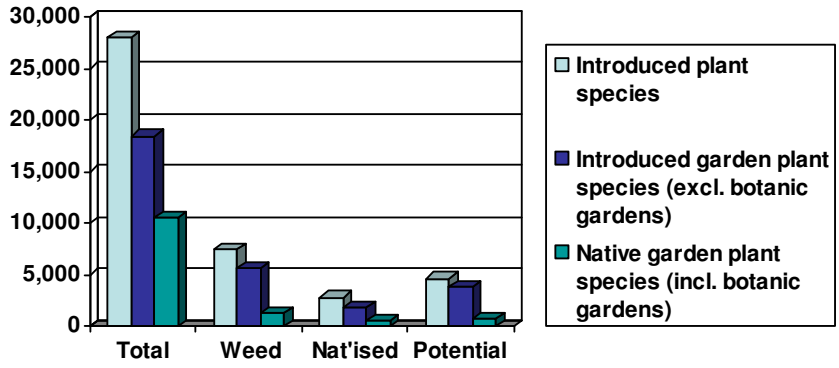


Table 7: Numbers of introduced garden plants that are referenced weeds

	Total	Referenced Weed	Naturalised Referenced Weed	Potential Referenced Weed
Introduced plant species	28,042 [A]	7,396	2,794	4,626
Introduced garden plant species (excl. botanic gardens)	18,444	5,587	1,852	3,735
Native garden plant species (incl. botanic gardens)	10,589	1,198	565 [B]	645 [C]

A includes material in Botanic Gardens only as many of these are known weeds elsewhere.
B and **C** added together do not add up to 1,198 as there are some horticulturally derived hybrid natives that were not considered in the search terms.

A referenced weed is any plant species with a reference as a weed, of any type, which is listed in the WA Department of Agriculture Plants Database

Source: Randall, R. Plants Database, WA Agriculture (2005, unpublished data)

Of major concern is the risk associated with the over 3,700 garden plant species that are known weeds (either overseas or through weed risk assessments undertaken in Australia) that may yet jump the back fence.

Most of tomorrow's major weeds of national parks are growing in gardens right now.

Over a thousand referenced weed species are still for sale through the garden industry

Over 1,000 known weed species (or 12% of total traded species) were advertised for sale by the garden industry in 1998/99, according to the WA Department of Agriculture.[39] This scale of trade in invasive plant species underscores that governments are doing far too little to deal with a major cause of Australia's weed problem – stopping the trade and wide distribution of high-risk invasive garden plants.

Serious environmental weeds for sale – the next wave that may invade national parks

A large number of high-risk environmental weeds that are yet to jump the fence continue to be sold. A good example, is Ceylon hill cherry (*Rhodomyrtus tomentosa*), which is a serious weed in Hawaii and Florida. It is now a prohibited import into Australia, targeted by the Australian Quarantine Inspection Service for eradication as a quarantine weed, *but* not prohibited for sale in NSW nor Queensland and advertised for sale in NSW and Queensland garden centres. Will the NSW and Queensland government wait until this quarantine weed becomes a major problem in their sub-tropical national parks – like Hawaii and Florida - before they ban its sale – too little too late ?

In early 2005 WWF released a landmark CSIRO report, *Jumping the Garden Fence* - the most detailed analysis to date of Australia's invasive garden plant problem.[40] Park managers are in a major battle with invasive weeds, but the report shows that governments still permit the sale of many of the world's and Australia's worst weeds. Just three examples provide a snapshot of this clear and present risk:

1. On the one hand, the Australian Government is spending $100,000s on community awareness and a reporting hotline for 28 national Alert List of environmental weeds – yet 6 of them can still be bought from local garden centres.
2. The World Conservation Union (IUCN) identified 36 plants as part of their *100 World's Worst Invasive Alien Species List* – the majority (20) of them are escaped invasive garden plants and a quarter are still for sale. Despite histories of causing major harm to the environment in other countries, three are still for sale in NSW. This includes a serious weed, Kahili ginger (*Hedychium gardnerianum*) which is a major invader of forests in New Zealand and a problem in South Africa. It has already jumped the garden fence in NSW and is naturalised but surprisingly is not a declared Class 5 noxious weed under the NSW Noxious Weed Act.

Economic benefits of a strong pro-active policy response to reduce risk of new weeds invading national parks.

Invasive species have traditionally been considered to be a 'funding black hole'. This myth has been truly debunked by recent studies on the cost-effectiveness of new strategic investments.

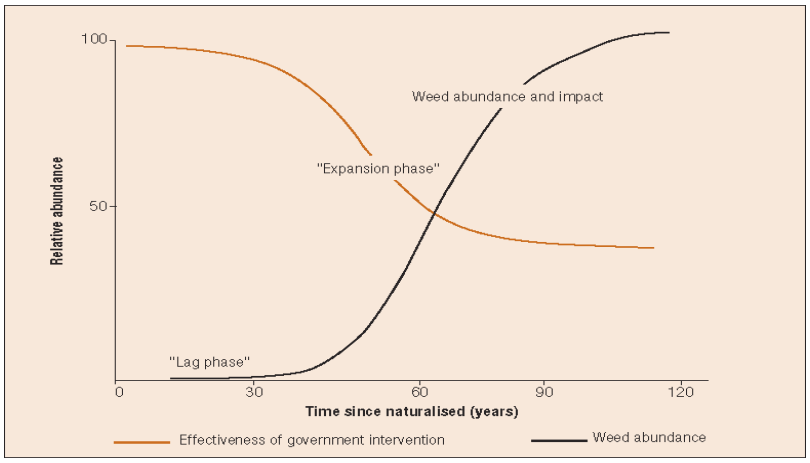
The general economic benefits of implementing this policy package have been calculated in a report to the Prime Minister's Science, Engineering and Innovation Council (PMSEIC). It concluded that limiting the spread of pests, weeds and imported diseases was "one of four areas of investment above all others that are likely to return greatest impact in heading off the diminishing value of Australia's natural systems and biodiversity."[41]

The report also estimated that:

- Eradication of new outbreaks of naturalised plant species with weedy potential would save 6,000 native species and result in a collateral benefit of $100m/yr
- Biological control of weeds of national significance (WONS) would save 1,600 native species and result in a collateral benefit of $1,000m.[42]

A specific example is that the real cost to Queensland of rubbervine (a WONS) in 1995 was estimated at $27m.[43] Yet the research program that delivered the solution cost a mere $0.73m.[44] This is the equivalent to just 10 days expenditure on conventional control.[45]

Figure 3: Early government intervention is the most effective and cheapest intervention strategy



Opportunity for Australia to build an effective weed defence system

Australia has traditionally taken a reactive approach to weed problems, waiting until they became widespread and a huge and costly problem before acting – too little too late. This has changed significantly over the past decade, but policy makers still give inadequate attention to the control of high risk invasion pathways that spread invasive plant species around Australia.

It is time for Australia's post border weed prevention and control measures to be brought up to the same standard as those in place at the national border.

A new approach is needed that prevents weeds and pest animals from entering Australia, restricts the spread of those already here, and enables early detection and eradication of high risk emerging and 'sleeper' invasive species, where this is feasible. Prevention rather than cure is the most effective and cheapest way to control the growing threat posed by weeds.

Action is needed to ensure that Australia has strong nationally-coordinated measures that unify Commonwealth and State efforts, close glaring gaps, and enable new weed problems to be detected early and eradicated before they become widespread and costly.

The revised *National Weed Strategy* provides an opportunity for Australia to consolidate and transform its current national weed defence to become the world leader in weed prevention and control.

The WWF-Australia working paper, *Weed Proofing Australia*, has identified key strategic risks and weaknesses in relation to Australia's current national policy response to weeds, and proposed targets and actions that should be incorporated into the revised National Weeds Strategy to build an effective national weed defence system.[46]

Recommendation 7

That State and Territory Governments prohibit the supply of *all* high risk environmental weeds throughout their jurisdictions.

Recommendation 8

That the Australian, State and Territory Governments identify all high and medium risk environmental weeds to determine that have been supplied through the garden industry but have yet to naturalise.

Recommendation 9

That Australian, State and Territory Governments increase funding for feral animal and weed management, with a particular focus on eradication of high risk new or sleeper weeds (such as recently discovered small Orange Hawkweed infestation (on the national Alert List of Environmental Weeds) in Kosciuszko National Park).

Recommendation 10

That the Australian, State and Territory conservation agencies strongly support the rebid for a third Weeds Cooperative Research Centre and provide funding for development of biocontrol agents for serious environmental weeds impacting on national parks.

Altered Fire Regimes

Each year fire burns between 6 and 14 million hectares of forest worldwide and over 3 million hectares in Australia in the summer of 2002/3. In recent years the devastating impacts of forest fires on people and the environment have been graphically shown on television and in the print media. Often the messages conveyed to decision-makers and the public presents a very simple picture of a complex situation. Examples of misleading messages include:

- Forest fires are caused by the weather (not necessarily true);
- All forest fires are harmful (not true);
- Forest fires are important only when they happen (definitely not true).

Overly simplistic explanations of forest fires tend to encourage decision-makers to support the view that fire fighting is the main solution to harmful forest fires. To date, inadequate attention has been paid to analysing, understanding and addressing the underlying causes of forest fires and, once an area has burnt, to preventing a downward spiral of recurrent fire and forest degradation.
WWF believes that, where fires are a problem, inadequate attention is paid to their underlying causes and to preventing a downward spiral of recurrent catastrophic fires and consequent degradation. Effective and efficient fire strategies are needed on a case-by-case basis, addressing three elements: prevention, response and restoration. Prevention includes social and physical strategies for minimising the risks of destructive fire through education, management and by addressing underlying causes. Responses range from rapid fire-fighting tactics to longer-term management changes in forested landscapes. Restoration is required when repeated mismanagement of the fire regime causes serious ecological damage. Effective management also needs the participation of stakeholders (governmental, NGO, community and private sectors) in planning and implementation.

The effect of forest fires

The immediate impacts of fires can be devastating to human communities as graphically illustrated in and around Sydney and Canberra in early 2003. In the longer term, they can adversely affect the supply of environmental services necessary for the well-being of local communities, threaten the survival of endangered species, simplify the structure and composition of biologically important forest, and provide conditions suitable for entry of invasive species.

In fire-adapted ecosystems, fires can be beneficial and even necessary for maintaining crucial ecosystem functions such as regeneration and nutrient cycling. In many ecosystems, such as some eucalyptus forests, fire is essential in maintaining succession cycles and associated plant and animal communities. Too little fire in these fire-adapted areas can be as ecologically damaging as too much fire in those that are fire sensitive.

The challenge lies in managing both for fires that are beneficial and for fires that are destructive. This is especially relevant as the incidence of fires appears to be on the rise. However it is also important to understand that the role of fire varies between ecosystems. In Australia many of our ecosystems are fire adapted with specific requirements for fires (not the same requirement for each ecosystem).

The impact of fires on the forest depends on the scale (the area burnt), frequency, distribution (or patchiness), intensity and seasonality (the season in which fires occur) of the fires. These elements combine to produce a *fire regime*. A change in any one of these elements, or the balance between them, will impact on a forest's structure and species composition and its capacity to maintain its full complement of biodiversity and ecological services.

Understanding the fire regime of any natural areas is essential to the development of sustainable and balanced fire management policies. Fire is an essential factor in the ecological cycle of many fire-adapted landscapes and in the survival of associated plants and animals. However, we are causing major disturbances to natural fire regimes around the world: sometimes by increasing the rate of fires and by setting fires in forests that would seldom burn under natural conditions; sometimes by suppressing natural fires, causing ecological damage and leading to less frequent but catastrophic fires due to a build-up of flammable material.

Failure to understand the ecological relationship between the forest and its fire regime leads to ill-conceived forest and fire management practices that may result in permanent changes to a forest's structure and species composition. It is for this reason that understanding a fire regime for any given forest is essential to the development of sound forest and fire management strategies. Altering fire regimes can poses a major threat to conservation efforts – pushing ecosystems and species, already threatened by pressures such as habitat loss and pollution, into a more precarious existence.

Causes of forest fires

All forest fires have a direct cause (an ignition source) – either natural (e.g. lightning) or human. Although the proportion of natural fires compared to human-caused fires varies widely between regions and types of forest, overall the vast majority of forest fires can be attributed to the deliberate or accidental actions of people, in Australia towards 90%.
In many cases, harmful forest fires are a symptom of some underlying causes that create the circumstances for damaging unwanted fires. Worldwide these vary across a range of factors but in Australia the reasons lie mainly with the failure to appreciate the nature of fire in our landscapes in both time and space. We have built in places where fires must also be, continue to be careless with fire and attempt to remove fire from where it is ecologically needed at the same time as we continue the spiral of increasingly expensive fire fighting and create balance in some places with prescribed fire. Unfortunately governments and agencies have not demonstrated the awareness or focus on the underlying causes of unwanted fire and willingness to redress the fire management balance.

Making fire management work – Prevention, Response and Restoration

Given that forest fires are shaped by a complex mix of physical, social, political and economic factors it may appear self-evident that effective and efficient fire management strategies must be developed on a case-by-case basis. However, many actors continue to pursue a "one size fits all" strategy that places undue emphasis on fighting forest fires, fails to take into consideration the role of fire regimes and promotes advanced fire-fighting technologies that can only be afforded by the world's richest nations, and probably not even by them in the long term. At the same time, failure to address underlying causes leads to the repeated occurrence of harmful forest fires, and escalating expenditure on fire fighting without reducing long term risks.

WWF and IUCN believe that in order for a fire management strategy to be effective it must address 3 essential elements:

- **Prevention** – many forest fires need not occur, however they will continue to ignite and degrade forests as long as governments fail to focus on both the direct and underlying causes of unwanted fires. In practice this means that governments must develop and implement programmes that influence people to modify the way they use fire, for example through enacting and enforcing laws that focus on prevention of fires and through focussed efforts on changing attitudes towards the use of fire. They must also ensure that laws and policies are fair (e.g. result in equitable sharing of costs and benefits and recognition of community-use rights), and seek out and remove perverse incentives that may encourage harmful fires. Governments, industry and other land managers must also invest in fire management before the event, equipping forest managers with the skills and resources to gain a sound understanding of the role of fire in forest ecosystems and to develop capacity to manage forests and forest fires in an effective manner. It is equally important that protected area managers strive to incorporate local people into planning and management to ensure that those individuals most affected by conservation activities and fires can participate and offer their input into prevention strategies.
- **Response** – being sufficiently prepared and ensuring an appropriate response to forest fires when they occur are key factors in effective and efficient fire management. To achieve this it is essential to have plans and resources in place prior to the fires occurring. Responsible authorities need to have a range of options available, know which fires to suppress and which to allow to burn, have mechanisms for monitoring fire danger and identifying fires which require action, and have clear responsibilities and coordination mechanisms in place. Firefighting resources need to be readily available and appropriate to the local situation, and there should be an ability to scale-up responses to deal with abnormal forest fires. Resources and procedures are also needed for monitoring the extent and impact of fires and using this information to plan for future fire management and control activities. In Australia these elements are reasonably mature and have evolved effectively, perhaps in some respects beyond the point of balanced fire management due to an over emphasis on fire fighting.
- **Restoration** – after forest fires have been extinguished there still remains the need to prevent a spiral of recurrent fire and further degradation in the short-term, and to help re-establish the forest's original structure, biodiversity and productivity, over the long term. Failure to consider appropriate restoration strategies results in vulnerable people living in ever more precarious situations. Nevertheless, the reality is that post-fire restoration is given scarcely any attention by the media, national governments or international organisations.

Time to Act

No blueprint exists for managing harmful wildfires or ensuring that the natural role of fire is sustained. Each situation has unique ecological, social and economic factors that need to be addressed. Sustainable fire management will require engaging a wide variety of stakeholders (government, non-government, community and the private sector) in the planning and implementation of a comprehensive strategy.

Through a Global Fires Partnership, IUCN, TNC and WWF call on governments and international organizations to address the underlying causes of unwanted fires and undertake the following steps to reduce their threat:

1. Involve key stakeholders (especially local communities and land managers) in fire management planning and implementation. Through training and other programs,

assist stakeholders in obtaining the knowledge, skills and resources they need to participate effectively.

2. Promote fire management strategies that mimic natural fire regimes and avoid manipulating natural or well-established fire regimes.
3. Invest in ecologically appropriate restoration of areas adversely affected by fire, fire exclusion, or both.
4. Improve understanding of fire issues by investing in research and analysis of associated costs and benefits.
5. Build awareness among policy-makers, the public and media of the underlying causes of destructive fires as well as the beneficial ecological and social role that fires can play.
6. Put in place reliable fire monitoring and recording systems that provide warning of high fire danger and the occurrence of fires. Include evaluation of the ecological and human impacts of fire and report annually in an internationally consistent manner.

4. Changed Hydrology

Many national parks and other conservation reserves in Australia contain rivers, creeks and wetlands that do not receive adequate volumes and flow patterns of water. In general, protected area managers frequently have little or no direct decision making powers in relation to water management planning. Park management agencies are generally consulted by water resource management agencies when water sharing rules for a catchment or groundwater system are being set, but this has frequently not led to adequate flows being delivered to maintain aquatic ecosystems in a healthy condition (eg, Macquarie Marshes Nature Reserve and Narran Lakes Nature Reserve in NSW, Coorong National Park in South Australia).

Partly to address declining river and wetland health across southern Australia, significant funding has been committed by the Australian Government under the Australian Government Water Fund ($2 B) to assist in implementing the CoAG National Water Initiative Agreement including the return of water flows to over-allocated and over-used rivers and wetlands. States have also contributed funding to assist in returning over-allocated and over-used river and groundwater systems to ecological balance, such as the $100 M NSW Government *RiverBank*.

However, the NWI Agreement does not explicitly require governments and natural resource management organisations to deliver adequate flow volumes and ecologically appropriate flow patterns to national parks and other conservation reserves which contain rivers and wetlands. Whilst there is a requirement for states and territories to protect and restore ‘high conservation value’ aquatic ecosystems, the NWI Agreement does not define these to include *inter alia* aquatic ecosystems in national parks and other conservation reserves.

An example of a water sharing agreement which does explicitly identify the flow volumes of specific rivers and wetlands is the $500 M Living Murray First Step decision. This Agreement identifies Significant Ecological Assets for receiving additional water flows, of which five are large wetlands occurring mainly within national parks or other conservation reserves.

Based on current projections, the Living Murray is predicted to deliver only around half of the 500 Gl to the Murray. There is a growing consensus amongst key stakeholders that the only avenue available to secure the 500 Gl in additional environmental flows under the First Step decision is through purchasing water on the market.

In contrast to the Murray River, no such Agreement exists for the over-allocated and over-used rivers and wetlands in the northern Murray-Darling Basin. A *Darling River Initiative* is required to ensure large wetlands receive adequate flows to restore river health, particularly those in national parks and other conservation reserves.

Maintaining the conservation values of protected areas on wetlands in the Darling catchment is likely to require an additional 500 Gl of environmental flows. Key wetlands with either / or protected areas or Ramsar wetland areas in the Darling catchment are the Macquarie Marshes, Gwydir Wetlands, Narran Lakes, Lower Balonne and Border Rivers.

Recommendation 11

That governments establish a *Darling River Initiative* for the northern MDB to ensure large wetlands receive an additional 500 Gl of environmental flows to restore river health, particularly those in national parks and other conservation reserves.

5. Climate Change

The predictions that WWF, and others, have been making about the impacts of climate change on protected areas are coming true. Most protected area authorities are still not taking this issue seriously: in many countries the immediate pressures on parks and shortages of resources mean there is no time to worry about future impacts, even if they are already becoming manifest. Clearly, protected area agencies and managers need to consider climate change in future plans. But what exactly should they do? WWF suggests that four urgent steps are needed:

PREVENTING CHANGE: the optimum way to reduce the impacts of climate change on protected areas is to dramatically reduce the heat-trapping gases that cause climate change. Carbon dioxide, the main heat trapping gas, is emitted by the burning of fossil fuels (coal, oil and natural gas). If these emissions are not cut deeply and quickly, there will be little chance of saving many protected areas. The power sector is responsible for 37%of those emissions globally and has many opportunities to switch from coal to clean power. To learn more go to www.panda.org/climate.

MANAGING FOR CHANGE: many climate change impacts are exacerbated by other pressures: even climate-related phenomena like coral bleaching and dieback are increased by pollution and mechanical damage. WWF has published a guide to adaptation strategies, *Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems*, the first comprehensive account of how protected areas might be managed in a rapidly changing climate.

PLANNING FOR CHANGE: Protected area agencies need advice—and political support—for planning protected area networks to withstand or adapt to change as much as possible. This needs to be a collaborative, global exercise. WWF proposes that the World Commission on Protected Areas would be one obvious body to coordinate such an effort, perhaps as a task force under its theme on management effectiveness.

LEARNING ABOUT CHANGE: we are still in a transition from theory to observation in terms of climate change impacts on protected areas. Information comes from a very limited number of examples. Along with an urgent need to learn more, we also need a series of controlled exercises in addressing and hopefully mitigating pressures when they arise.

Climate Change Impacts and Prevention Policy Options

In its report[47] to the Asia Pacific Partnership for Clean Energy and Development meeting on 12 January 2006 the Australian Government proposed a doubling of current greenhouse gas emissions by 2050, implying it finds an increase in the long term global average temperature of up to 4^0C acceptable (see Appendix 2) - including a temperature rise of 3^oC occurring before the end of the century.

However, mainstream scientific opinion[48] [49] is of the view that a rise of 2^0C in global average temperature will already have very severe economic, social and environmental consequences, including:

- South-eastern NSW and Victoria and south-western Western Australia becoming hotter, drier and more affected by droughts and bushfires – with similar changes to existing temperature and rainfall patterns occurring in many other countries;
- Droughts, floods, cyclones and severe storms occurring more frequently in Australia generally – with more extreme weather events becoming more frequent in many other countries as well;
- Coastal areas of Australia, Asia and Oceania becoming inundated by rising sea levels;
- Tropical diseases spreading south (in the northern hemisphere – north) into the temperate zone including to Sydney, Perth, Newcastle and Wollongong.

The consequences of little more than a 2^0C rise in global average temperature will destroy infrastructure[50] and buildings[51], destabilise countries and economies, create conflicts[52] and up to 50 million of 'climate refugees'[53], and push a million animals and plants species to the brink of extinction[54]. It follows that the Australian Government's acceptance of a temperature rise of up to 4^0C will lead to even more severe consequences.

The Government claims that its proposal reduces greenhouse gas emissions by 23% by 2050. However, that claim is not based on reductions from today's level of emissions, or from 1990 levels[1], but from "what would otherwise occur over the same period[55]", which is a scenario under which global greenhouse gas emissions more than double by 2050.

What does 3-4ºC mean for Australia?

Global warming is already happening. Global average surface temperatures have risen 0.8°C in the last century[56]. Most of the temperature rise has occurred since the 1970s and five of the hottest years on record have occurred in the last eight years[10]. Already this is causing a number of social, economic and environmental impacts in Australia and overseas[57].

The pathway proposed by the Federal Government is projected to lead to a 3^oC rise in global average surface temperatures in this century and up to 4ºC rise over the course of the next century[2]. Few studies have investigated what the exact impacts of 4^oC will be, however most studies have documented impacts of a 1.4 to 5.8 ^{o}C rise in temperatures, which is the projected range of warming for this century[58].

We have included some of the investigated impacts below, based on recent peer-reviewed scientific reports, but this is only a selection of the effects Australia can expect to experience under such conditions.

[1] 1990 is the baseline for emission reduction targets used under the Kyoto Protocol
[2] based on mid-range results of scientific modelling – IPCC (2001a)

Natural disasters

Under a 3-4ºC temperature increase, the likely intensification of tropical cyclones or their possible movement further south into areas where infrastructure is not designed to cope with them would have significant implications for building design, safety and emergency services.[59]

With roughly 2ºC increase in mean temperature, the intensity of wind speeds during cyclones rises by 5% to 10%[60], and the destructive energy of cyclones increases by up to one third[3].

Projections of increased cyclone energy under a 3-4ºC increase have not yet been made but will be higher, so it should be noted that threshold levels can be crossed that result in step increases in losses according to IAG, which cites a 650% increase in building damages from a 25% increase in peak wind gusts.[61]

With a 1ºC increase in average summer temperatures, the incidence of bushfires increases by up to 28%. Doubling greenhouse gas emissions along a 4°C pathway will result in a 143% increase in catastrophic wildfires.[62]

Northern Victorian river systems will see a much higher frequency of floods which will significantly impact on communities and production in the area.[63]

Australian society will become much more vulnerable to climate-related natural disasters under a 3-4ºC temperature rise, which would bring significant economic costs.

The impact of extreme climatic events in Australia is already very costly. The damages from a combination of drought, flood, and high wind (including cyclones) in Australia, New Zealand and the Pacific Islands have already reached more than a billion dollars per year.[64]

There are an increasing number of communities in Australia exposed to extreme weather-related events such as cyclones, flooding and storm surge. The Insurance Australia Group has already flagged that such communities may not have access to insurance coverage in the future.[65]

Health

Human health is likely to be affected both directly and indirectly by increasing temperatures, the frequency of heat waves and changing patterns of rainfall.

Climatic conditions have wide-ranging impacts on human health, including temperature-related deaths (heatstroke, a particular risk for older Australians), vector-borne diseases, food-borne diseases, water-borne diseases, and respiratory diseases. By the year 2100 up to 15,000 Australians could die every year from heat related illnesses, and the dengue transmission zone could reach as far south as Brisbane and Sydney.[66]

Natural disasters also expose people to physical and mental health risks.[67]

[3] The energy content of wind streams varies with the cube of the wind speed.

Loss of national icon protected area values

Kakadu

A 2ºC to 3ºC rise in temperatures may result in the complete loss of freshwater wetlands in Kakadu, which would be inundated with salt water as a result of sea level rise.[68]

Great Barrier Reef

The most likely outlook for the Great Barrier Reef is that mass bleaching, leading to the death of corals, will become a more frequent event in Australian coral reefs in coming decades[69]. A 2ºC warming is expected to bleach 95% of the reef leaving it devoid of coral and dominated by seaweed and blue-green algae.[70]

In a case study applied to the inshore waters of the central Great Barrier Reef, Australia, the worst case scenarios suggest that reefs will become devoid of significant coral cover and associated biodiversity by 2050.[71]

A 3-4ºC of global warming would have an even more devastating effect on the reef.

Australian Wet Tropics

Up to 2ºC global warming would dramatically affect Australia's tropical rainforests. Greater than 2ºC would see a 90% reduction of the core environment, home to 65 vertebrate species in the north Australian wet tropics.[72]

Australian Alps

Scientists estimate an 18% to 66% reduction in the total area of snow cover by 2030 and a 39% to 96% reduction by 2070 under current climate change projections. [73]

Pests, parasites and pathogens

Projected warming will increase the ability of pests to survive winters and accelerate the development of most of the species that are active in summer.

Cropping, horticulture, livestock and forestry industries in Australia are vulnerable to changes in the incidence of existing pests, parasites and pathogens. The likelihood that such pests, parasites and pathogens – particularly those of tropical or sub-tropical origin – will spread southward, or become established once introduced, increases with climate warming. [74]

Water shortage

A 3-4ºC rise in temperatures would throw Australia into a serious water crisis.

Possible reductions in stream flow across the whole Murray Darling Basin catchments range from 16% to 25% by 2050, and from plus 24% to 48% by 2100.[75] This will result in water shortages, particularly in winter rain-fed systems that are already under stress.

According to the CSIRO, climate change will exacerbate competition between different water users, especially where large diversions to river systems are made for industry and irrigation.[76]

A study of the Macquarie River basin in NSW indicates that a combination of decreased rainfall and higher temperatures and evaporation will lead to flow reductions into the Burrendong Dam of 10% to 30% by 2030, and reduced stream flows if irrigation demand remains constant or increases.[77]

Species extinction

Climate change over the next 50 years is expected to drive one million species - or a quarter of all land animal and plant species around the world - into extinction. Among the more startling findings was that of 24 species of butterfly studied in Australia, all but three would disappear from much of their current range and half would become extinct.[78]

Ninety Australian animals have been specifically identified as being at risk from climate change (see Attachment 3), including the state emblems of Victoria (Leadbeater's possum), South Australia (hairy-nosed wombat), and Queensland (koala). Animals identified as being at risk include mammals, birds, reptiles, frogs, fish and invertebrates from all Australian states and territories.[79]

Of 42 Australian vertebrate species, most with threatened status, 41 would have their range dramatically reduced by climate change while 15 would lose their range completely under a 3ºC warming scenario[80]

Climate change is likely to have a catastrophic effect on the long-term biodiversity values of the Australian Wet Tropics rainforests if temperatures increase by more than 2ºC. A 3.5ºC rise would reduce range sizes to about 10% of their current range, resulting in the extinction of at least 30 endemic vertebrate species. Most upland species, including the lemuroid ringtail possum, would become extinct under a 4ºC rise[81].

What should Australia do to avoid dangerous warming?

Dangerous climate change can be prevented using known commercially available technologies. The greenhouse emissions currently in the atmosphere already commit the planet to some additional level of climate change. However, climate science shows that there is an opportunity to keep average global warming below 2ºC if we ensure that global greenhouse gas emissions peak before 2020, and are quickly reduced in the decades thereafter.[82] This could prevent some of the worst scenarios presented above.

Some new technologies are being researched – such as CCS. However, a suite of solutions already exist in both developed and developing countries that can be implemented immediately to reduce global emissions while ensuring people have access to the energy and other services they want and need. Using the technologies we have available today also buys time while new technologies are developed.

The three pillars for solving climate change are; (a) smart and efficient technologies that can provide the same services using a fraction of the resource, (b) sources of energy that cause little or no pollution such as renewables like wind power, and (c) technologies that stop unavoidable pollution from reaching the atmosphere.

These are outlined in the Australian Climate Group (ACG) report, *Climate Change: Solutions for Australia report*, recommending a 60 per cent cut in emissions by 2050, released in 2004.[83]

The ACG proposes the following set of solutions to lower the risk that climate change will reach a dangerous level:

1. **REDUCE:** Australia's political leaders must work with business and the community to take immediate action to cut our greenhouse gas emissions by 60% by 2050.
2. **TRADE:** Establish market mechanisms to trade greenhouse gas emissions, providing the business sector with a powerful tool to meet reduction targets.
3. **ACT:** All Australians to take responsibility for their own role in reducing greenhouse gas emissions by using energy more wisely.
4. **ADAPT:** Put in place measures to minimise the impacts of climate change, from building improvements to deal with more intense storms, to investing in new agricultural industries which require less fresh water.
5. **INNOVATE:** New business opportunities must be developed and implemented as the rest of the world moves to low carbon energy futures.
6. **LEAD:** A leadership role must be taken to identify and implement solutions to reduce the impacts of human-induced climate change. As one of the wealthiest and best-educated nations in our region, we can share our innovations and technologies with nations of the Asia Pacific.

Managing for Climate Change

The *National Biodiversity and Climate Change Action Plan* recognizes the need to create networks of protected areas that form the core areas of linked and integrated natural areas that encompass different climatic gradients.

This is consistent with the Durban Action Plan, target 5 states:

> All protected areas are linked into wider ecological / environmental systems or resource management and protection on land and sea by the time of the next World Parks Congress.[84]

An example of a important cross bioregional response that would enable more effective adaptation to climate change is in the box below.

Protected Areas Will Play a Critical Role in a Climate Change Adaptation Strategy

Large protected areas integrated with surrounding lands through corridors will play a critical role in enabling Australia's species to migrate in the face of climate change.

One proposal, presented by G. Worboys, is for the establishment of an *Eastern Australian Great Escarpment Corridor* running 2,800 km between Cairns, Queensland and the NSW-Victorian border near Eden. [85] The Corridor could comprise extensive areas of inter-connected natural lands that cover a range of altitudinal gradients to facilitate adaptation to climate change. The Corridor contains some of the world's most important forests, including The Wet Tropics of Queensland World Heritage Area, and the Central Eastern Rainforest Reserves World Heritage Area.

The Great Escarpment is still mostly undisturbed along many sections of its length, and still offers many opportunities for the retention of continuous, unfragmented natural bushland. A number of protected areas have already been established along the Great Escarpment, however, many of the natural areas in public ownership are still unprotected.

To increase the resilience of protected areas, there will also be a need for more intensive management of protected areas to deal with projected increased impacts from pervasive threats, particularly invasive species and altered fire regimes. WWF has published a guide to adaptation strategies, *Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems*, the first comprehensive account of how protected areas might be managed in a rapidly changing climate.

Recommendation 12

That Parks Australia and the Australian Greenhouse Office undertake detailed studies into the most appropriate protected area acquisition strategies required to enable effective climate adaptation, including the proposed Eastern Australian Great Escarpment Corridor.

Recommendation 13

That Australian, State and Territory governments review progress to implement the 2005 actions under the *National Biodiversity and Climate Change Action Plan*

Recommendation 14

That Australian, State and Territory governments implement the targets of the *National Biodiversity and Climate Change Action Plan* within agreed timeframes, particularly those under Objective 5

(d) the responsibilities of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

A number of national policy commitments set specific requirements for establishing the national protected area system and subsequently called the National Reserve System. These are summarised in Table 8.

Table 8: Australian government and national commitments to establishing the National Reserve System

WSSD Plan of Implementation	Achieving by 2010 a significant reduction in the current rate of loss of biological diversity
Convention on Biological Diversity (1992) (Ratified 1993 by the Australian Government)	Article 8(a) Each Contracting Party shall, as far as possible and as appropriate: (a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity
Convention on Biological Diversity Programme of Work on Protected Areas (2004) **Decision VII/28**	Adopts the programme of work on protected areas…with the objective of the establishment and maintenance by 2010 for terrestrial…areas of comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas that collectively, *inter alia* through a global network contribute to achieving the three objectives of the Convention and the 2010 target to significantly reduce the current rate of biodiversity loss.[86]
National Strategy for the Conservation of Australia's Biological Diversity (Adopted in 1996 by the Commonwealth and all State and Territory Governments)	By the year 2000 Australia will have: (e) completed development of a nationwide system of protected areas on public land, and waters, that are representative of the major ecosystems in each biogeographical region By the year 2005 Australia will have: (b) implemented management plans for the protected area network Action 1.4.1 Undertake a 10-year Commonwealth, State and Territory cooperative program, which includes the provision of adequate resources, to ensure that the terrestrial and marine protected area systems are comprehensive, adequate and representative. Action 1.4.2 Undertake a 10-year Commonwealth, State and Territory cooperative program to: (a) develop management plans for all protected areas.
National Objectives and Targets for Biodiversity Conservation, 2001-05 (Adopted in 2001 by the Commonwealth all State and Territory Governments except those of the Northern Territory, Queensland and Tasmania)	Target 1.2.2 By 2001, ANZECC has developed an action plan for the National Reserve System which includes targets for the protection and restoration of terrestrial ecosystems on indigenous-owned estates and private land. Target 1.2.3 By 2005, a representative sample of each bioregion (as specified in the ANZECC action plan) is protected within the National Reserve System or network of Indigenous Protected Areas or as private land managed for conservation under a conservation agreement.

Directions for the National Reserve System – A Partnership Approach	There are a total of 38 agreed national targets, four of the most significant are below. By 2010-2015, examples of at least 80% of the number of extant regional ecosystems in each IBRA region are to be represented in the NRS. Examples of at least 80% of the number of extant regional ecosystems in each IBRA subregion are represented in the NRS by 2010-2020. As a priority, critically endangered and endangered species and regional ecosystems in each IBRA subregion are included in the NRS by 2010. By 2010, significant progress is made towards inclusion of vulnerable species and regional ecosystems in each IBRA region in the NRS.

The House of Representatives Standing Committee on Environment, Recreation and the Arts enquiry into *Biodiversity – The Role of Protected Areas* in 1993 also recommended:

> 'that, in setting up a core protected area system nationwide, the Commonwealth set as a minimum target the representation of at least 80% of bioregional ecosystems in core protected areas by the turn of the century.'

(e) the record of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

1. **Introduction**
2. **National Trends in Establishment of the National Reserve System**
3. **Extent of Australia's Terrestrial Protected Areas Compared to Other OECD Countries**

1. Introduction

WWF analysis shows that major progress has been made over the past 13 years to 2004. It shows that over 31 million hectares have been added to the National Reserve System. Australia's performance against other wealthy OECD countries shows that the extent of Australia's protected area system is at best average, with the other OECD country considered to be megadiverse – the United States – having 1.5 times of its land area in the protected area system.

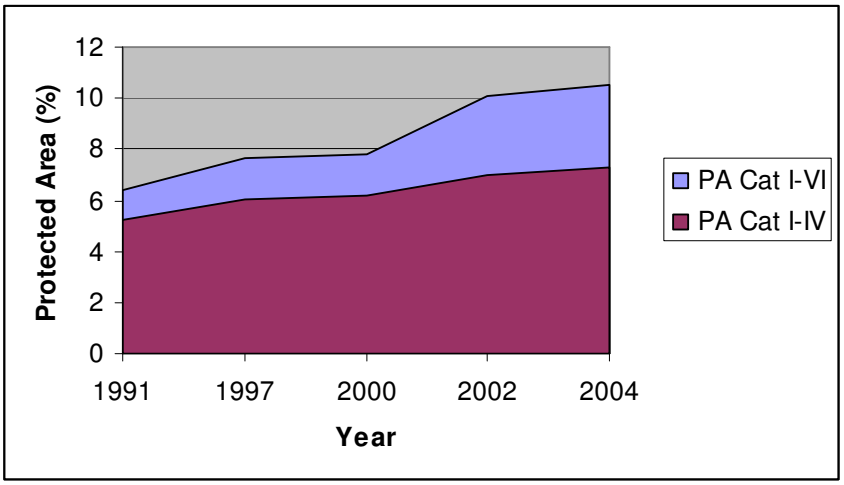
This record of achievement also reinforces that the outstanding target to acquire 22 million hectares to achieve 80% comprehensiveness in the National Reserve System is eminently achievable.

2. National Trends in Establishment of the National Reserve System

Australia has made significant progress to establishing a National Reserve System since the initiative's inception in the early 1990s.

For the 13 year period from 1991-2004, the area of terrestrial protected areas added across Australia totalled 31.383 million ha or 4.08% of Australia's land mass. Of this amount, 15.637 million ha or 2.03% was IUCN protected area category I-IV (Glanznig and Sattler In Press). The growth in Australia's terrestrial protected area estate is graphically shown at Figure 4 below.

Figure 4: National Extent of Protected Areas, 1991-2004



Source: Glanznig and Sattler (In Press)

Co-funding through the Natural Heritage Trust National Reserve System Program has contributed 6.336 million ha of this total (Department of the Environment and Heritage 2006). While the IPA program has contributed to the establishment of almost 14 million hectares to the National Reserve System.

The findings of a national taskforce into protected areas, reported in a report to PMSEIC estimated that an additional 22 million ha were still needed to establish a comprehensive, adequate and representative National Reserve System.[87] The 31.4 million ha added to the protected areas estate over the 13 year period, 1991-2004 shows that this is an achievable target, if properly resourced.

Aquatic (freshwater) ecosystems

The following comments are made in relation to the adequacy of funding and resources available to protect aquatic ecosystems in national parks and other conservations reserves on land.

Aquatic ecosystems are defined here to include rivers, creeks, wetlands, swamps, floodplains, estuaries, mound springs, groundwater dependent ecosystems, and fresh and saline lakes.

In general, aquatic ecosystems are under-represented in the National Reserve System.[88]

In southern and eastern Australia, aquatic ecosystems in mountainous areas and on unproductive coastal sandy soils are often well represented in the NRS, but very poorly represented in the agricultural zone. For example, 17.5% of wetlands on the coast occur within NSW National Parks and Wildlife reserves, but only 2.4% west of the Dividing Range.[89]

The NRS Guidelines need to be amended to ensure a comprehensive, adequate and representative approach to incorporating aquatic ecosystems within the NRS.[90]

For example, WWF-Australia has calculated that only approximately 7.2%[4] of the almost three million kilometres of rivers and creeks in Australia occur within the National Reserve System.

Of the 16.1 M ha of listed nationally important wetlands in Australia, approximately 55% or 8.87 M ha[5] occurs within the NRS.

3. Extent of Australian Terrestrial Protected Areas Compared to Other OECD Countries

A comparison of OECD countries from the World Database on Protected Areas (WDPA) Version 6, shows for the IUCN protected area categories I-VI, Australia is ranked 16th out of 30 in terms of the per cent land area reserved (10.1%): the top three countries are Austria (36.4%), Germany (32.7) and Switzerland (28.7%). Corresponding figures for other

[4] Of the 2.96 million kilometres of rivers and creeks in Australia (at a scale of 1:250 000), 214 035 km occurs within protected areas. Calculated using the AUSLIG 1:250 K drainages layer (Geoscience Australia, 2003) and the Collaborative Australian Protected Areas Database (2002) (DEH, 2002)

[5] Calculated by WWF using a spatial database of nationally important wetlands (DEH, 2005) and the Collaborative Australian Protected Areas Database (2002) (DEH, 2002). Note that this calculation excludes wetlands within the Great Barrier Reef Marine Park.

significant countries are: USA (United States of America) (16.0% - rank 10th), Canada (6.3% - rank 21st) and New Zealand (24.0% - rank 5th).

This World Database on Protected Areas includes the caveat that it is based on 2002 data. Based on CAPAD 2002, at that time Australia's terrestrial protected area system constitutes 10.1% of total land area for the IUCN protected area categories I-VI (June 2002 approx.); figures from CAPAD 2004 indicate a figure of 10.5%. However, for the purposes of international comparison this section of the report uses primarily data available up to August 2003 – see sources below.

In addition, Australia is ranked equal 16th for categories I-V (7.1%): the top three countries are again Austria (32.3%), Germany (29.3) and Switzerland (28.7%). For these categories we also have USA (8.6% - rank 12th), Canada (5.2% - rank 18th) and New Zealand (23.7% - rank 4th).

However, Australia ranks highly for categories I-II, namely 3rd at 6.7% after New Zealand (7.2%) and the Slovak Republic (7.0%). For these categories we also have USA (5.8% - rank 4th) and Canada (4.6% - rank 6th).

Australia is in many ways unique and cannot be straightforwardly compared to other countries or other OECD countries. Many European OECD countries are relatively small and have high population densities. They have been developed over many centuries; and well before conservation reserves were created. As such, they typically have a large percentage of their reserves in the higher categories (V-VI). Australia, by contrast, is relatively recently developed and is arguably more comparable to OECD countries of continental scale, such as USA and Canada.

As an OECD country, Australia is characterised by (i) large continental scale, (ii) low population density, (iii) large proportion of arid and semi-arid land and (iv) relatively short history of European settlement. The most comparable country is probably Canada, to which Australia compares favourably with modestly greater percentages of land areas in each of the IUCN categories I-II (6.7% vs 4.6%) , I-V (7.1% vs 5.2%), and I-VI (10.1% vs 6.3%) . The absolute areas of land are quite similar in both countries. Canada of course has a much colder climate and a large extent of Arctic and sub-arctic lands absent in Australia. The second most comparable country is the USA (but with much higher population and much lower proportion of arid and semi-arid land). In comparison to the USA, Australia is deficient in categories I-V (7.1% vs 8.6%) and very much deficient in categories I-VI (10.1% vs 16.0%). This finding is significant since the United States is the only other OECD country considered to be megadiverse.

Australia has obvious social and historical connections to its near neighbour New Zealand. In comparison to New Zealand, Australia is very deficient in categories I-V (7.1 vs 23.7%) and I-VI (10.1 vs 24.0%) , but is also has a small deficiency in categories I-II (6.7% vs 7.2%).

Table 9: Comparison of OECD Country Protection of Natural Areas, 2003 for IUCN reserve Categories I-VI. Countries are ranked by percentage of total area in reserve categories I-VI.

Rank (IUCN 1-6)	Country	Total Area (000 ha)	Protected Area Extent, (IUCN 1-2) (000 ha)[1]	Protected Area Extent, (IUCN 1-5) (000 ha)[1]	Protected Area Extent, (IUCN 1-6) (000 ha)[1]	Per cent of Total Land Area (IUCN 1-2, 1-5, 1-6)[6]		
1	Austria	8,386	47.4	2,712.6	3,049.6	0.6	32.3	36.4
2	Germany	35,698	129.5	10,444.6	11,660.7	0.4	29.3	32.7
3	Switzerland	4,129	16.9	1,185.1	1,185.1	0.4	28.7	28.7
4	Denmark	4309	10.7	933.1	1,093.6	0.2	21.7	25.4
5	New Zealand	27,053	1,934.6	6,414.6	6,485.0	7.2	23.7	24.0
6	Netherlands	4,084	41.6	175.2	950.4	1.0	4.3	23.3
7	Poland	32,325	522.5	3,698.8	7,314.6	1.6	11.4	22.6
8	Slovak Republic	4,901	344.4	1,096.7	0	7.0	22.4	22.4
9	Luxembourg	259	0	37	44	0.0	14.3	17.0
10	United States of America	936,352	54,317.5	80,450.6	149,796.9	5.8	8.6	16.0
11	Czech Republic	7,886	85.6	1247.0	1,254.3	1.1	15.8	15.9
12	Japan	37,780	637.8	3,123.4	5,334.0	1.7	8.3	14.1
13	France[2]	55,150	258.9	6186.8	6,186.0	0.5	11.2	11.2
14	Italy	30,127	468.1	2,190.7	3,376.5	1.6	7.3	11.2
15	United Kingdom	24,488	0.0	136.3	2,551.5	0.0	0.6	10.4
16	Australia[7]	768,827	51398.2	54,803.2	77462.0	6.7	7.1	10.1
17	Spain	50,599	160.4	4,058.8	4,663.9	0.3	8.0	9.2
18	Hungary	9,303	224.0	820.6	829.9	2.4	8.8	8.9
19	Finland	33,815	998.8	1,059.8	2,964.7	3.0	3.1	8.8
20	Sweden	44,996	1,743.1	3189.0	0	3.9	7.1	7.1
21	Canada	997,061	45,636.2	52,070.9	62,879.1	4.6	5.2	6.3
22	Norway	32,388	1,529.2	1,952.5	1972.7	4.7	6.0	6.1
23	Portugal	9,198	31.9	398.7	469.9	0.3	4.3	5.1
24	Mexico	195,820	1188.9	1,205.3	9901.7	0.6	0.6	5.1
25	Iceland	10,300	177.0	475.8	0	1.7	4.6	4.6
26	Korea, Rep	9,926	0.0	350.1	353.9	0.0	3.5	3.6
27	Turkey	77,482	380.0	571.2	2754.0	0.5	0.7	3.6
28	Belgium	3,051	0.0	83.1	104.8	0.0	2.7	3.4
29	Greece	13,196	79.2	239.0	427.2	0.6	1.8	3.2
30	Ireland	7,028	53.5	69.4	159.4	0.8	1.0	2.3

Notes

1 Protected Areas (IUCN Management Categories 1-5)
2 Data for France include French Guiana and Guadeloupe
3 Marine and littoral protected areas are excluded from these totals
4 For inclusion in this dataset, protected areas must be specifically designated by a national government and also be larger than 1,000 hectares
5 Data on European Communities not available
6 Underlined figure indicates that more than 50% of the total protected area is in IUCN Management Category 6.
7 Data from CAPAD 2002 provided to World Database on Protected Areas Consortium

Sources: United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC). World Database on Protected Areas (WDPA) Version 6. Compiled by the World Database on Protected Areas Consortium. Cambridge, UK, August 2003. Contained on the World Resources Institute Earthtrends: the environmental information portal (http://earthtrends.wri.org)
Department of the Environment and Heritage. 2003. Collaborative Australian Protected Areas Database 2002. DEH: Canberra. (http://www.deh.gov.au/parks/nrs/capad/2002/index.html). Cited in Glanznig, A. and Sattler, P. In Press. *Building Nature's Safety Net: An Evaluation of Australia's Terrestrial Protected Area System* (1991-2004).

Support for the Private Conservation Trusts

A critical achievement of the National Reserve System program has been to nuture the growth of private conservation trusts by enabling community donations to be significantly leveraged through the 2:1 funding formula in place.

Recommendation 15

That the Australian Government maintain the NRS 2:1 funding formula for private conservation organisations

5. Management of Protected Areas

The Australian Terrestrial Biodiversity Assessment determined that the standard of protected area management was fair for 53% of the bioregions assessed.[91]

Recommendation 16

That States and Territories allocate additional resources to increase the standard of management across bioregions.

3. Comments Against the Inquiry Terms of Reference (Marine)

The funding and resources available to meet the objectives of Australia's national parks, other conservation reserves and marine protected areas, with particular reference to:

(a) the values and objectives of Australia's national parks, other conservation reserves and marine protected areas

At approximately 16.1 million km^2 Australia's Ocean Territory is one of the largest marine jurisdictions in the world containing globally significant marine biodiversity. All major groups of marine organisms are represented, and also very high endemism particularly in southern temperate waters. Some features include:

- the world's largest areas and highest species diversity of tropical and temperate seagrasses
- largest areas of coral reefs
- highest mangrove species diversity and third largest area of mangrove

Australia's tropical environments are located within the global epicentre of marine biodiversity and contain biodiversity/species threatened in neighbouring regions. While Australia's mid-water, outer shelf and deepwater offshore marine environments are less well understood, they include significant biodiversity values. Intensive surveys have recorded only 5% of the Australia's ocean's physical terrain, and less than 2% of its life and habitats. [6]

The values of Australia's current Marine Protected Areas (MPAs) system in Commonwealth waters are highly significant as demonstrated by the recent rezoning of the Great Barrier Reef Marine Park and the establishment of the Heard and MacDonald MPA, both of which have rightly been acknowledged as globally significant conservation achievements. However, Australia's National Representative System of MPAs (NRSMPA) is strongly skewed towards these tropical and sub-Antarctic habitats and still falls far short of a truly Comprehensive, Adequate and Representative (CAR) system based on nationally consistent targets, processes and outcomes.

The Department of Environment and Heritage describes the objectives of the NRSMPA as:

"The primary goal of the NRSMPA is to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.

The following secondary goals are designed to be compatible with the primary goal

- To promote the development of marine protected areas within the framework of integrated ecosystem management

[6] Edyvane KS, 2005, Current Status of the National, Representative System of Marine Protected Areas (NRSMPA), accessed www.mccn.org.au on 18.02.06.

- To provide a formal management framework for a broad spectrum of human activities, including recreation, tourism, shipping and the use or extraction of resources, the impacts of which are compatible with the primary goal
- To provide scientific reference sites
- To provide for the special needs of rare, threatened or depleted species and threatened ecological communities
- To provide for the conservation of special groups of organisms, e.g. species with complex habitat requirements or mobile or migratory species, or species vulnerable to disturbance which may depend on reservation for their conservation
- To protect areas of high conservation value including those containing high species diversity, natural refuges for flora and fauna and centres of endemism
- To provide for the recreational, aesthetic and cultural needs of indigenous and non-indigenous people.

The goals of the NRSMPA relate primarily to the conservation of biodiversity and sustainable and equitable management of human usage. However, the marine protected areas that make up the NRSMPA may also protect and manage many other important geological, archaeological, historical and cultural attributes."[7]

[7] Department of Environment and Heritage, '*About the National Representative System of Marine Protected Areas (NRSMPA)'* accessed at www.deh.gov.au on 17.02.06

(b) whether governments are providing sufficient resources to meet those objectives and their management requirements

As described in the above sections on progress towards achieving an overall national reserve system, WWF Australia maintains that the objectives outlined above for the NRSMPA will not be met unless firm commitments are made to providing adequate funds to enable their achievement. WWF has been supportive of the commitment made through NRSMPA and by the Australian Government to build a CAR system of MPAs and has been actively engaged in the processes to date. However without significant additional resourcing, it appears unlikely that the NRSMPA will meet the 2012 global target at the current rate of roll-out. Both the South-east Regional Marine Plan and the Northern Regional Marine Plan have now both significantly exceeded their original timelines for completion and WWF recommends increased resourcing to increase the momentum in which the NRSMPA roll-out can occur, not only to meet Australia's international obligations, but also in recognition of the under-representation of large areas of Australia's waters in protected areas.

Recommendation 17

1. National Representative System of Marine Protected Areas

WWF recommends that the Australian Government increase resourcing:

- **of the application of the principles of integrated, spatial ecosystem based management as the roll-out of the NRSMPA continues.**
- **to increase the momentum in which the NRSMPA roll-out can occur, not only to meet Australia's international obligations, but also in recognition of the under-representation of large areas of Australia's waters in protected areas.**
- **for the identification of further sites of high conservation value to achieve a comprehensive, adequate and representative system in Australia's EEZ**
- **to build the data/knowledge base where necessary by undertaking scientific research programs. For many of the stakeholders the lack of data is seen as a reason not to protect until the level of knowledge gives reason to apply high levels of protection. Resources must be applied to gathering data, but meanwhile the precautionary approach must be applied.**

Recommendation 18

2. Great Barrier Reef Marine Park

WWF recommends that the Australian Government increase resourcing:

- **To adequately resource GBRMPA to remain an independent statutory authority while increasing its resources to deal with the increasing severity of threats impacting on the GBR from outside the marine park. These include: coral bleaching, land-based sources of pollution, shipping and illegal fishing.**
- **to review and strengthen the existing Dugong Protection Area network. In the southern GBR, all Zone B Dugong Protection Areas should be upgraded**

to Zone A status; and a new Zone A network of DPA's should be established in the northern GBR.

- **to extend the eastern boundary of the Great Barrier Reef Marine Park eastwards to include the Coral Sea reefs and surrounding waters of the Coral Sea.. The extended Park should include a comprehensive network of no-take zones to highly protect the reefs of the Coral Sea.**

Recommendation 19

3. Northern Australia

WWF recommends that the Australian Government increase resourcing:

- **to accelerate the development of the National Representative System of Marine Protected Areas (NRSMPA) in northern Australia**
- **to work collaboratively with the governments of Queensland, Western Australia and the Northern Territory to implement complementary MPAs across Australia's north.**
- **To continue to develop an Indigenous Sea Ranger Program in northern Australia that:**

vi) Is developed in liaison with Indigenous communities, Land Councils, State/Territory government departments, non-government organisations;

vii) Is flexible enough to ensure that local Sea Ranger groups develop in a way that is appropriate to them

viii) Provides sustainable funding arrangements with properly paid positions (e.g. at Park Ranger rates) to the Sea Rangers and has a career path.

ix) Incorporates accredited training

x) Has reporting requirements that are accountable but not onerous.

(c) any threats to the objectives and management of our national parks, other conservation reserves and marine protected areas

Well-designed, enforced and adequately resourced MPAs can play a vital role in protecting building the resilience of marine environments. However, management of activities and impacts that occur outside MPAs must also be recognised as priorities for government. An example of this is the Great Barrier Reef Marine Park which, while possessing the world's largest network of strictly protected areas, faces an uncertain future primarily due to the impacts of land-based sources of pollution and also due to coral bleaching. A comprehensive list of threats for Australia's marine jurisdiction is beyond the scope of this document however WWF recommends that accompanying the creation and management of MPAs must be a comprehensive analysis of the impacts and future trends that will affect the integrity of ecosystem within MPA, and mitigation plans developed.

(d) the responsibilities of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

In recognition of the importance of maintaining healthy marine ecosystem system for biodiversity conservation and sustainable resource management, governments, including Australia, committed to establishing representative networks of MPAs worldwide by 2012 at both the World Summit on Sustainable Development (2003) and the Conference of Parties to the Convention on Biodiversity (2004). The target of 2012 was set in recognition of the under-representation of marine habitats in the global protected area system - particularly in comparison to terrestrial protected areas, and due to the acknowledgement of the urgent need for greater protection of the world's oceans in the face of increasing threats.

Australia's NRSMPA is an important contribution towards meeting these international goals as well as building a national system. At present, approximately 9% of Australia's EEZ (including the Antarctic EEZ) is contained within MPAs, ranking in the top five countries globally in terms of proportion of area protected. However much of this protection is directed at tropical and sub-Antarctic waters, and linked with a few extremely large Marine Protected Areas. Of particular note, is the Great Barrier Reef Marine Park, which is an outstanding global example of the application of a science-based process to deliver a network of fully protected zones within the larger park, and which is the world's largest Marine Protected Area. The concentration of protection in a few bioregions results in the overall system falling short of acheiving the overall Representation needed to meet international and national commitments by 2012.

(e) the record of governments with regard to the creation and management of national parks, other conservation reserves and marine protected areas

Australia is regarded as a world leader in marine conservation and, as evidenced in Australia's hosting of the first International Marine Protected Areas Congress, the expertise of Australia's MPA practitioners is keenly sought after. Significant challenges do lie ahead, that may threaten Australia's record. The Australian Government has thus far been highly successful in protecting the iconic and the remote. A far more difficult challenge is presented with the roll-out of the NRSMPA. Many of the regions that fall into the Nationally Representative System do not have the iconic status of the Great Barrier Reef and certainly all have significantly greater competing uses than occurs in the sub-Antarctic. However, their ecological importance and need for protection is significant. Considerable resourcing, a commitment to CAR criteria and strong political resolve will be required to implement MPAs in these areas.

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4. Conclusions

This submission shows that significant progress has been made to establish the terrestrial and progressively the marine National Reserve System, though significant challenges remain to ensure adequate funding is invested to consolidate the NRS and ensure effective management.

A key challenge is ensuring that the Australian, States and Territories provide adequate funding to achieve the 2010-2015 80% comprehensive target set out in the Directions for the National Reserve System. The performance over the past 13 years shows that the target is achievable with a major increase in funding by the Australian Government to progress the NRS to catalyse stronger investment by State/Territory governments and private conservation trusts.

Appendix 1: National Terrestrial Biodiversity Values

Excerpt from *Conserving Australia's Terrestrial Biodiversity: Priorities for a Living Continent* (Jim Tait In Press)

Definition of Biodiversity 'Value'

The identification of assets with National biodiversity values is by its very nature, a value laden task. While there are a range of accepted objective methods for describing biodiversity, evaluation remains a subjective exercise influenced by the intended end application of the evaluator. There are ecologic, economic, social and intrinsic values associated with biodiversity and the *value of biodiversity* in an economic or use sense (what may be termed *utility value*) is quite distinct from *biodiversity value* from the perspective of ecosystem, species and genetic diversity conservation (hereafter referred to as *conservation value*). Definitions are confounded by the lack of exclusivity between these two types of values i.e. certain species and ecosystems are the focus for conservation activities because of the economic or use values that can be identified for them.

In recent times there has been a call "*to move the biodiversity conservation debate on past biodiversity as lists of species, or lists of ecosystems, to a focus on biological processes and the resulting ecosystems services that benefit humans"* (Morton *et al* 2002), although the same authors recognise that there are "*ethical and aesthetic reasons.. to conserve as wide a range as possible of species and ecosystems"*. The call for an increased focus on ecosystem services is being made to foster improved recognition of the enormous though largely unvalued economic contribution that biodiversity makes to society and the economy through a range of ecosystem services and goods (see Figure 4). It is argued that an increased recognition of the economic value of Australian biodiversity in regard to ecosystem services such as pollination (estimated value to Australian agriculture $1.2 billion p.a.), or as one of the primary attractions of Australia's growing $16 billion (2000-01) tourism industry, will convince Governments of the imperative and greater cost effectiveness of investing in the maintenance of natural systems and biodiversity in comparison to the greater costs associated with repair or replacement (Morton *et al* 2002).

Ecosystem services

The products of natural systems that benefit people

Goods	*Ecological processes*	*Life-fulfilling*
timber	pollination	tourism
pasture	climate regulation	recreation
fish	pest control	aesthetic beauty
plant breeding material	genetic resources	lifestyle
	habitat	inspiration
	shade and shelter	sense of place
	erosion prevention	national identity
	soil fertility	ethical value
	water regulation	scientific discovery
	waste breakdown	

Figure 4 Ecosystem Services provided by Australian biodiversity from Morton et al (2002).

In practice the quantification of the economic value of biodiversity and associated ecosystem services is still in its infancy and has been identified as one of the highest national biodiversity conservation research priorities (BDAC 2001). Nonetheless existing estimates of the collateral economic benefits associated with various national biodiversity conservation options (Possingham *et al* 2002), make a convincing prospectus for pursuing investment in biodiversity conservation.

The importance of utility values associated with biodiversity and ecosystem services are well recognised by ecologists although the process linkages by which they are delivered not so. The improved definition of the utility values of biodiversity is primarily a requirement for arguing the case for conservation where there are competing natural resource use demands operating in management paradigms where the ethical dimensions associated with biodiversity conservation have limited currency. While such initiatives are critically important they essentially lie outside the scope of this report which is focussed on defining conservation priorities rather than the prima face case for conservation.

The following discussion of biodiversity values focuses primarily on conservation value. The case is made that the conservation of species and ecosystems remains a prudent step toward ensuring that the ecosystem services and utility values associated with such species and ecosystems are also conserved. However, the proposition that there needs to be a shift in focus beyond species and ecosystems to an increased consideration of ecosystem processes (Morton *et al* 2002) is supported, as these processes not only underpin the services and goods valued by humans but also priority needs, effective opportunities and appropriate approaches toward improved species and ecosystem conservation.

Biodiversity Conservation Value

Attributes used for biodiversity conservation evaluation ('conservation value') most commonly compare the complement of species and ecosystems found within an area to other areas. The rationale underpinning this type of evaluation is that the task of a biodiversity conservationist is analogous to a life 'stamp collector' in which the ultimate goal is to ensure that a comprehensive, adequate and representative (CAR) sample of the diversity of life is conserved for future generations and the intrinsic values associated with ongoing evolutionary processes.

These attributes include species and or ecosystem diversity or richness, rarity, and uniqueness or endemicity. Another attribute developed and applied relatively more recently is irreplacability (Ferrier *et al* 2000, NLWRA 2002a). This provides a measure of the degree to which the species complement of an area can be substituted for by other areas. Irreplacability integrates values associated with high species richness and endemicity.

Other attributes used for biodiversity conservation evaluation consider the conservation status of species or ecosystems within an area i.e., the number or percentage of species or ecosystems that are threatened or the functional value of an area as a refuge for endemic or threatened species and ecosystems.

Some specific ecosystem types are considered to have particularly high biodiversity values and their occurrence within an area may also be used to indicate biodiversity conservation value. For example wetland ecosystems in Australia are generally recognised to have high biodiversity values due to the juxtaposition of terrestrial and aquatic ecosystem elements, periodically high primary productivity and refugial functions in a dry continent.

The application of biodiversity evaluation attributes is both scale and data dependent. Consistent assessment frameworks and comparable data availability is necessary to underpin valid biodiversity conservation prioritisation between regions or areas. Nationally this is seldom possible for most taxa or at the ecosystem level.

In the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002a) conducted by the National Land and Water Resources Audit *(Audit*), the attributes described above were applied quantitatively or qualitatively to define national biodiversity conservation values at the resolution of IBRA (Interim Biogeographic Regionalisation of Australia) bioregions and/or subregions. Quantitative analyses were limited to taxa with better national data coverage i.e. birds Figure 6, mammals Figure 7, eucalypts Figure 10 and acacias Figure 11. The Audit's biodiversity assessment and its assessment of *Landscape Health in Australia* (Morgan 2001), also quantified the number (and where possible percentage) of threatened ecosystems Figure 16 and the number of threatened plants Figure 14 and animals Figure 15 within IBRA subregions.

Given national data constraints, a more qualitative assessment of biodiversity values was also undertaken by each jurisdiction identifying any known special biodiversity values associated with rarity, diversity, endemicity, threatened status, refugia and wetlands in relation to landscape, ecosystems, species and genetic values for each IBRA subregion. Data used to identify these values ranged from quantitative assessments to expert opinion.

Outputs from these various analyses (discussed below) provide a basis for ensuring conservation programs target areas with biodiversity values of national significance. The rationale underpinning such strategies varies in relation to identified values but generally seeks to maximise biodiversity conservation returns for invested resources in terms of:

- the number of species/ecosystems conserved within and/or supported by an area (relates to richness/diversity attributes)
- securing unique assemblages of species/ecosystems (relates to endemism, irreplacability and sometimes rarity attributes)
- ensuring functional refugial areas are protected (relates to refugia, and sometimes rarity, wetlands and number/% of threatened species attributes)
- securing threatened species/ecosystems (relates to number and/or % of threatened species, refugia and sometimes rarity attributes).

Biodiversity value however defined is only one consideration in the development of strategic conservation programs. Considerations of resource condition and trend provide a three dimensional decision matrix in which areas with lower biodiversity 'value' may sometimes be deemed to be better conservation investment options. This concept is discussed further below and in Section 1.4 *Biodiversity Conservation Approaches.*

Centres of Species Richness, Endemism and Irreplacability

Centres of species diversity and to a lesser extent endemism, are reasonably well recognised for better known components of the Australian biota (Table 1) including vascular plants (Boden and Given 1995, Crisp et al 2001, NLWRA 2002a) and vertebrate fauna including mammals (NLWRA 2002), birds (Stattersfield *et al* 1998), reptiles (Cogger *et al* 1981), amphibians (Tyler *et al* 1981) and freshwater fish (Unmack 2001). Areas of species richness have been defined in some earlier national assessments (i.e. SoE 1996) using 1° grids Table 2. Findings of the Audit biodiversity assessment regarding centres of species richness, endemism and refugia reinforce previous work but take definitions further due to a more comprehensive national mammal, bird, eucalypt and acacia database developed for the assessment and the use of IBRA subregions as a biogeographic based assessment framework. The Audit assessment also undertook some innovative analyses to define areas of high 'irreplacability' in terms of their eucalypt and acacia species complement.

A lack of national data coverage has generally limited the definition of centres of species diversity and endemism for non-vascular plants and invertebrate taxa other than for more charismatic invertebrate groups such as butterflies and freshwater crayfish (Whiting *et al* 2000).

Patterns of species richness and endemism defined for a range of taxa at the national level highlight key areas with national biodiversity conservation values. These include well known biodiversity icons such as Cape York, the Wet Tropics of north Queensland and the sub tropics of south east Queensland and northern New South Wales which show concordance in patterns of species richness and endemism across many taxa. Factors driving the cross taxa concordance for these centres are various but include

a combination of higher rainfall, more stable climatic regimes and the resulting refugial function of areas in evolutionary time.

However, there are also distinct divergences in observed centres of species richness and endemism between some taxa and between centres of species richness and endemism within taxa. This is often readily related to the habitat and life history requirements of taxa i.e. amphibians which are dependent upon aquatic environments have low species richness in the arid interior while reptiles which are very successful in such environments exhibit their highest species diversity in central Australia. Similarly there are marked distinctions in subregions identified as having high species richness and endemicity values for eucalypts versus acacias Figure 10 and Figure 11.

Amphibians and Reptiles

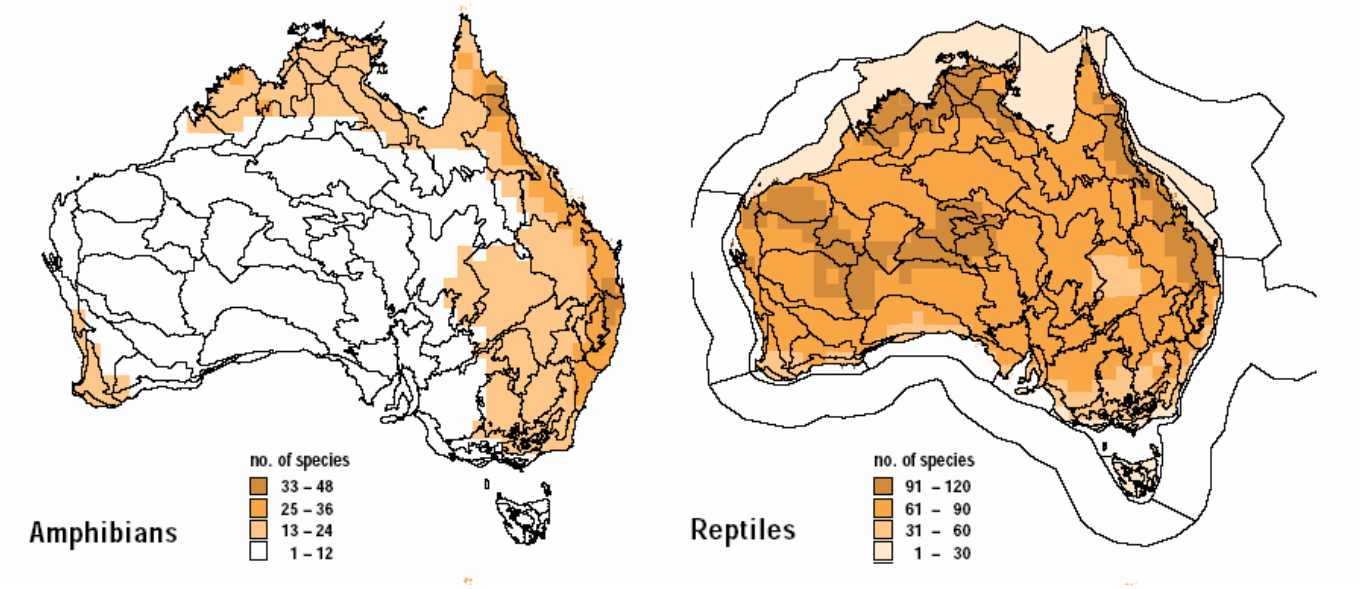


Figure 5 Patterns of Species Richness for Australian Amphibians and Reptiles from SoE (1996).

Divergence in patterns of species richness and endemism within taxa highlight the sometimes disparate drivers behind species richness or endemicity, for example isolated and harsh environments often limit species richness but can drive endemism. The south west of Western Australia is an example of such an area having only moderate species richness for vascular plants Figure 8, but outstanding levels of vascular plant endemicity Figure 9. The key take home message in terms of the definition of conservation value is that cross taxa convergence in defined centres of species richness and endemism is as much an exception as a rule, highlighting the need for taxa specific studies to define biodiversity values related to centres of species richness and endemism.

Definition of patterns of species richness and endemism are also scale dependent and the finer resolution provided by assessment at the IBRA subregion level identifies finer scale patterns of richness and endemism not identified at the bioregional level. In some instances localised hot spots of combined acacia and eucalypt endemicity defined at a subregional level dissipate when the broader assessment framework provided by bioregions is used Figure 13 . This highlights the benefits of continuing progress toward finer scale biogeographic assessment frameworks. The use of such assessment frameworks for biodiversity values (cf grids) enables identified values to be linked back to particular suites of landform and regional ecosystems. Previously less recognised areas of endemism and species richness defined for eucalypt and acacia species by the Audit using this approach include subregions of the North Kimberly, Coolgardie, Einasleigh uplands and Brigalow Belt Bioregions.

Birds

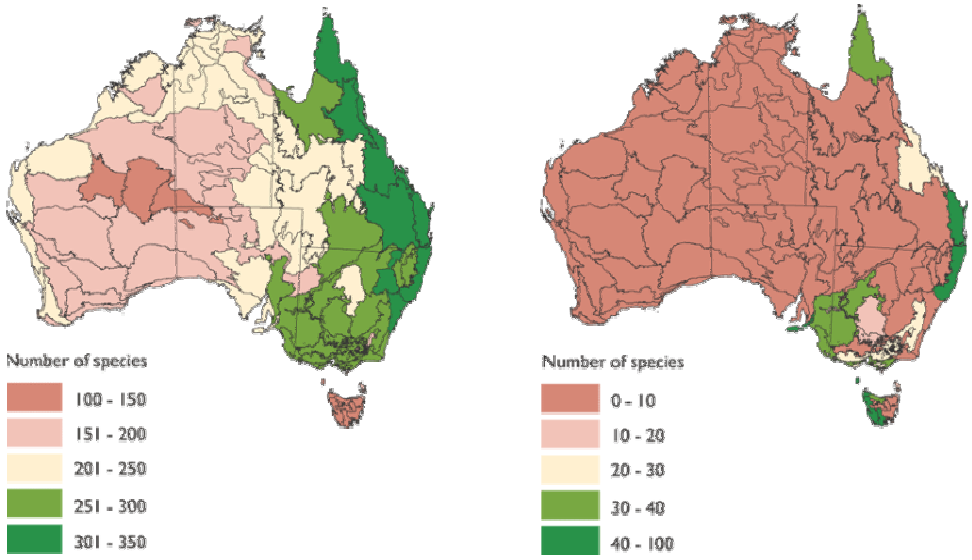


Figure 6 Total number of resident bird species per subregion (left) and number of threatened bird species per subregion (right) from NLWRA (2002a).

Table 2 Non-exhaustive List of Centres of Australian Species Richness and Endemism

Global 200 Ecoregion (Component IBRA Bio region)	**Taxa and Value Richness (R) and Endemism (E)**
90. Northern Australia	
Cape York	Mammals (E and R), Birds (E and R), Reptiles (R), Amphibians (R) Freshwater fish (R) Vascular plants (E and R)
Gulf Plains	Birds (E and R), Freshwater fish (R)
Victorian Bonaparte	Mammals (R), Reptiles (R), Freshwater fish (R)
Darwin Coastal	Mammals (R), Reptiles (R), Freshwater fish (R), Vascular plants (E and R)
Pine Creek	Mammals (R), Reptiles (R), Freshwater fish (R)
Arnhem Plateau	Mammals (R), Reptiles (R), Vascular plants (E and R)
Arnhem Coast	Mammals (R), Reptiles (R), Freshwater fish (R), Vascular plants (E and R)
North Kimberly	Mammals (R and E), Reptiles (R), Acacia and Eucalypt species (E).
17. Qld Tropical Forests	
Wet Tropics	Mammals (E and R), Birds (E and R), Reptiles (R), Amphibians (R), Freshwater fish (R), Vascular plants (E and R)
64. Eastern Australian Temperate Forests	
South East Queensland	Mammals (E and R), Birds (E and R), Reptiles (R), Amphibians (R), Vascular plants (E and R)
NSW North Coast	Mammals (R and E), Birds (E and R), Amphibians (R), Vascular plants (E and R), Acacia and Eucalypt species (R)
New England Tableland	Mammals (R), Vascular plants (E
Sydney Basin	Mammals (R), Birds (R), Vascular plants (E and R), Acacia and Eucalypt species (R and E)
NSW South Western Slopes	Birds (R), Acacia and Eucalypt species (R)
South East Highlands	Mammals (R)
Australian Alps	Vascular plants (E)
Victoria Midlands	Birds (R),
Victoria Volcanic Plain	Mammals (R)
Tasmanian Bioregions	Birds (E), Vascular plants (E and R), Freshwater fish (E)
120. Southern Australia Mallee and Woodlands	
Murray Darling Depression	Birds (R), Freshwater fish (E)
Naracoorte Coastal Plain	Mammals (R)
Eyre Yorke Block	Mammals (R)
Kanmantoo	Vascular plants (E and R)
129. Central Ranges and Western Deserts	Freshwater fish (E)
Great Sandy Desert	Mammals (R), Reptiles (R)
Finke	Vascular plants (R), Reptiles (R)
MacDonnell Ranges	Vascular plants (R), Reptiles (R)
Central Ranges	Vascular plants (R),Reptiles (R)
Gibson Desert	Reptiles (R)
128. Carnarvon Xeric Scrub	
Carnarvon	Mammals (R), Reptiles (R), Freshwater fish (E)
Pilbara	Mammals (R), Reptiles (R), Freshwater fish (E),

119. South Western Australia Forests & Scrub	
Geraldton Sand Plains	Birds (E), Vascular plants (E), Acacia and Eucalypt species (R and E)
Avon Wheatbelt	Birds (E), Vascular plants (E), Acacia and Eucalypt species (R)
Swan Coastal Plain	Birds (E), Vascular plants (E), Freshwater fish (E)
Jarrah Forest	Birds (E), Vascular plants (E), Freshwater fish (E)
Coolgardie	Birds (E), Vascular plants (E) Acacia and Eucalypt species (R and E)
Mallee	Birds (E), Vascular plants (E) Acacia and Eucalypt species (R and E)
Esperance Plains	Birds (E), Vascular plants (E), Acacia and Eucalypt species (R), Freshwater fish (E)
Warren	Birds (E), Vascular plants (E), Freshwater fish (E)

Table 2. Continued

Bioregions outside Global 200 Ecoregions Component IBRA Bio region	**Taxa and Value Richness (R) and Endemism (E)**
Einasleigh Uplands	Mammals (R, and E), Birds (E and R), Reptiles (R), Amphibians (R)
Brigalow Belt North	Mammals (R and E), Birds (E and R), Reptiles (R)
Brigalow Belt South	Mammals (R and E), Reptiles (R), Acacia and Eucalypt species (R and E)
Mulga Lands	Birds (R),
Darling Riverine Plains	Birds (R),
Riverina	Birds (R), Freshwater fish (E)
Flinders Lofty Block	Mammals (R)
Great Victoria Desert	Reptiles (R)
Gascoyne	Reptiles (R)
Murchison	Reptiles (R)

In considering species richness it is important to recognise that it is not richness per se' that defines conservation values or priorities but more the rarity, uniqueness and 'irreplacability' of the species complement found within a particular region that have higher values in comparison to common species. Audit assessments of irreplacability for acacia and eucalypt species define subregions of associated high conservation value additional to regions identified on the basis of high species richness or endemicity - Figure 10 and Figure 11.

If data constraints can be overcome, assessment of irreplacability for a range of other taxa would also be likely to define associated high conservation values in regions not currently assessed to have high values on the basis of species richness or endemism. This is a prudent consideration for conservation planners who use species richness and endemism as a primary focus.

Mammals

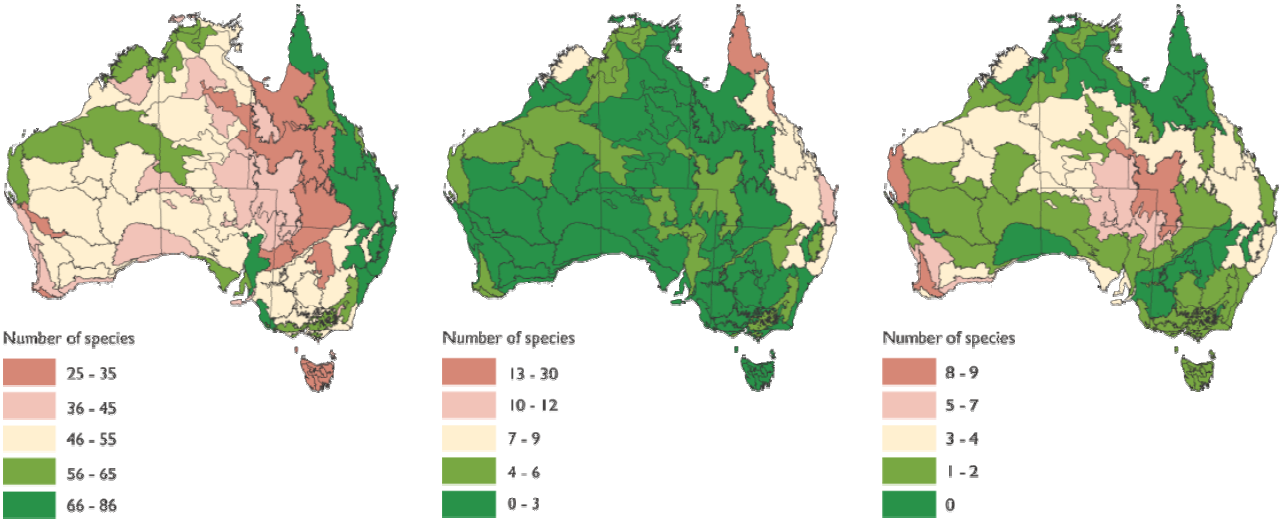


Figure 7 Original diversity (number of species) of bioregion mammal fauna (left), number of endemic* species (*confined to 5 or less bioregions) within original bioregion mammal fauna (centre) and Bioregions with high relictual* faunal value (*Number of retained species in each bioregion that have contracted from more than 50% of the bioregions originally occupied) from NLWRA (2002a).

Flora

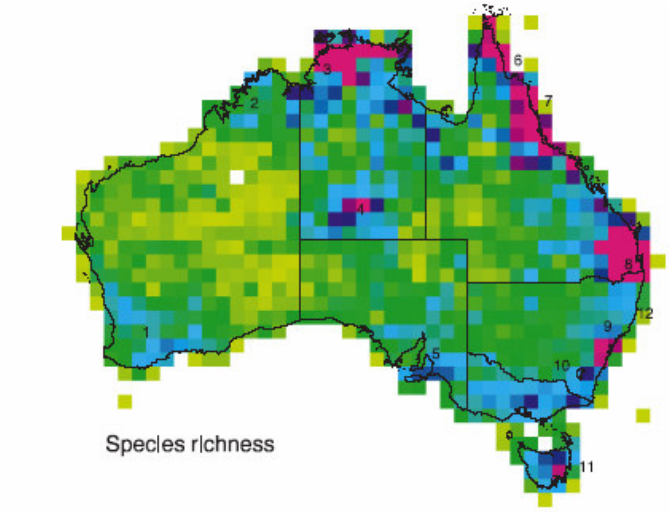


Figure 8 Vascular Plant species richness from Crisp *et al* (2001).

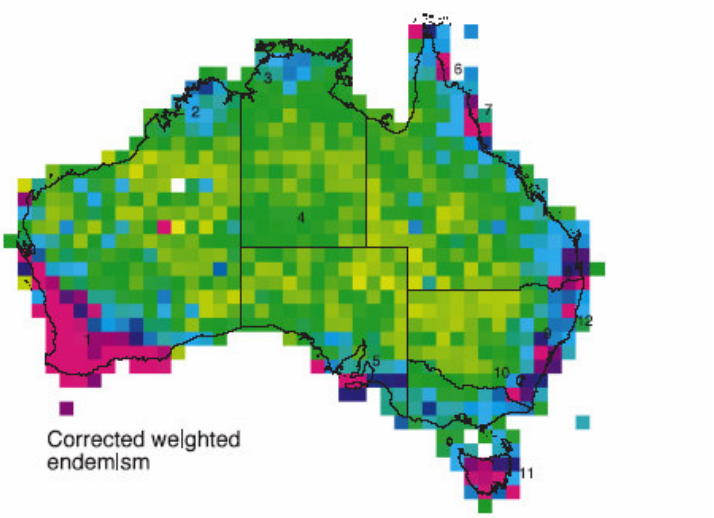


Figure: Vascular Plant species endemism (corrected weighted) from Crisp *et al* (2001).

Table: Centres of vascular plant species richness and endemism from Crisp *et al* (2001).

Centre	Species richness	1–4-cell endemism	Weighted endemism	Corrected weighted endemism	Boden & Given (1995) Plant diversity and endemism
1. South-west Western Australia	?	+(double centre)	+(double centre)	++	++
2. North Kimberley	?	?	?	+	+
3. Kakadu–Alligator Rivers	++	+	+	+	+
4. Central Australian Ranges	+	–	?	–	+
5. Adelaide–Kangaroo Island	+	+	+	+	–
6. Iron Range–McIlwraith Range (Cape York Peninsula)	++	+	+	+	+
7. Wet Tropics	++	++	++	++	++
8. Border Ranges (McPherson–Macleay)	++	++	++	+	+
9. Sydney Sandstone	+	+	+	+	+
10. Australian Alps	?	?	?	+	+
11. Tasmania	+	+	+	++	+
12. New England–Dorrigo	–	?	?	+	–

+, Centre; ++, major centre; ?, weak or doubtful centre; –, no centre distinct from background.

Eucalypts

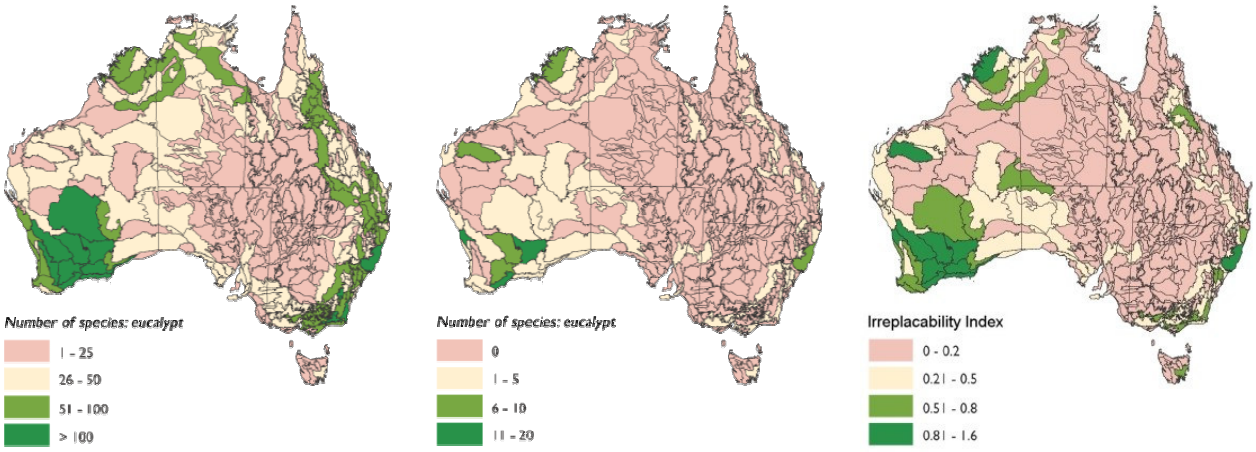


Figure 10 Number of Eucalypt species per subregion (left), number of endemic Eucalypt species per subregion (centre) and irreplacability index for Eucalypt species complement per subregion (Right) from NLWRA 2002a.

Acacias

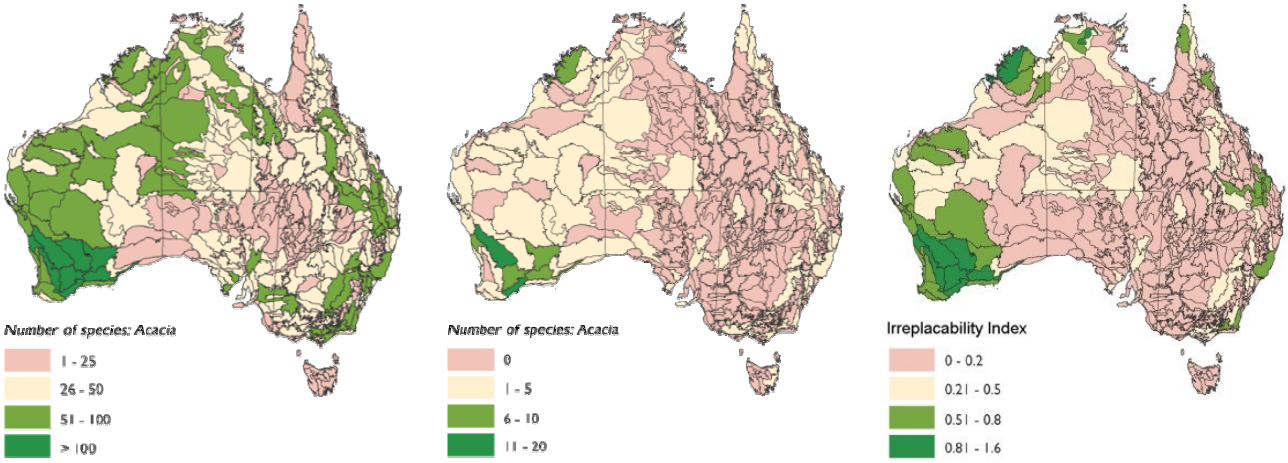


Figure 11 Number of Acacia species per subregion (left), number of endemic Acacia species per subregion (centre) and irreplacability index for Acacia species complement per subregion (right) from NLWRA 2002a.

Eucalypts and Acacias Combined

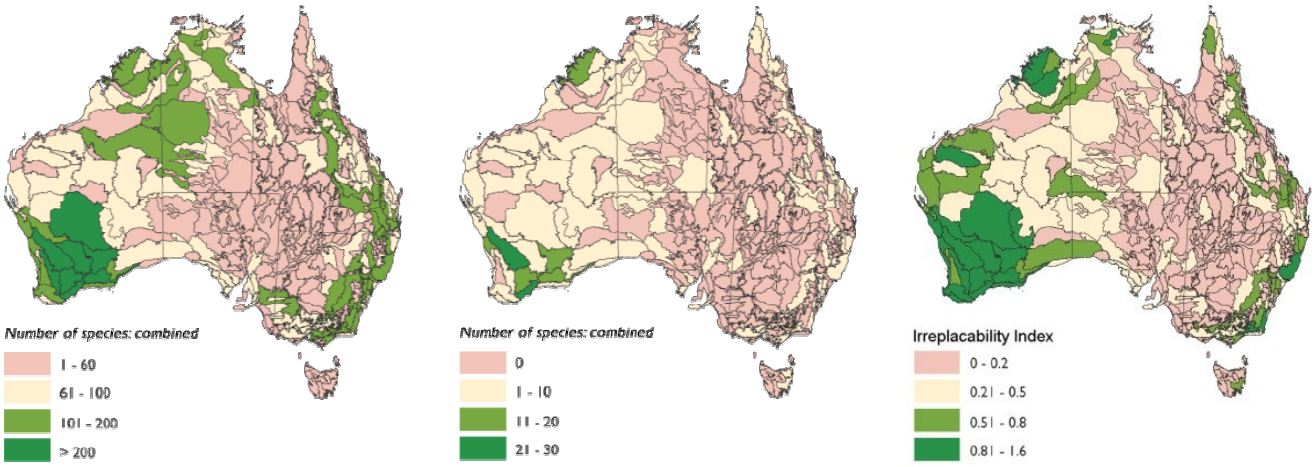


Figure 12 Number of combined Eucalypt and Acacia species per subregion (left), combined number of endemic Eucalypt and Acacia species per subregion (centre) and irreplacability index for combined Eucalypt and Acacia species complement per subregion (right) from NLWRA 2002.

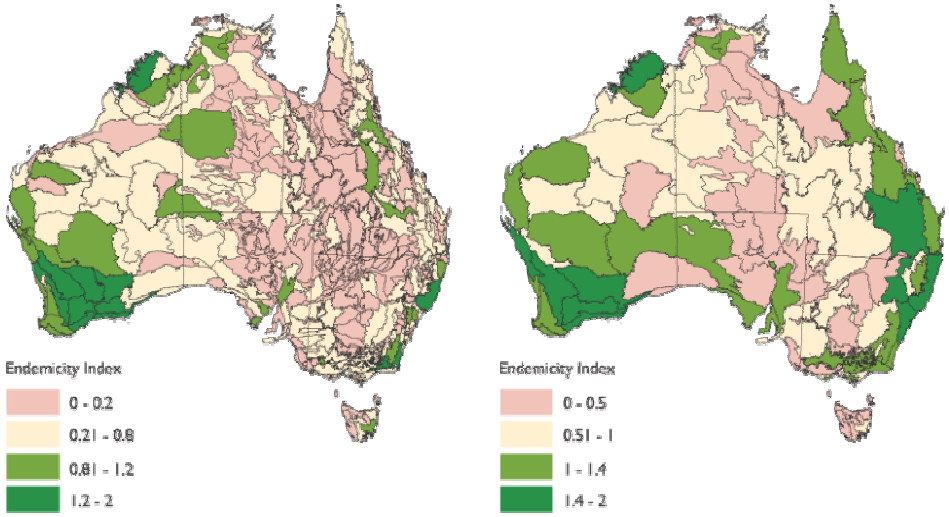


Figure 13 Endemicity index for combined data of acacias and eucalypts in subregion (left) and bioregion (right) from NLWRA (2002a).

Refugia

Biodiversity refugia are areas in which organisms persist when environmental stresses impact populations in broader areas of their current or historical range. In Australia at least three forms of refugia may be defined including those that operate in evolutionary time often in the face of interglacial climate change, seasonal or periodic refugia associated with stresses such as droughts and fire and historical refugial

associated with areas that have not been as exposed to land use impacts and ecological changes wrought by European settlement (Morton, Short and Pearce 1995).

The biodiversity conservation value of refugia are readily apparent as they are in effect areas in which biodiversity has already been effectively conserved to some degree and are also often areas of associated high species richness and endemism. The maintenance of refugia in the Australian landscape is essential for the conservation of biodiversity.

A preliminary list of biodiversity refugia in arid and semi-arid Australian has been compiled by Morton, Short and Pearce (1995). These authors identified nine types of refugia including:

1. Islands
2. Mound Springs
3. Caves
4. Wetlands
5. Gorges
6. Mountain ranges
7. Ecological refuges
8. Refuges from Exotic animals
9. Refuges from Land Clearing

These types of refugia were identified Australia-wide in the Audit's more qualitative compilation of refugia values for each of Australia's subregions undertaken as part of the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002). Many of the refugia defined by both these studies have not yet been targeted by specific conservation initiatives.

An innovative approach used to define contemporary land use and ecological impact refugia was demonstrated by the Audit assessment of the relictual mammal fauna values of bioregions Figure 7. Bioregional refugia which retained the highest numbers of mammal species that have become extinct in more than half of the bioregions they originally occupied were identified in the Channel Country, Carnarvon and Jarrah Forest Bioregions. This analysis represents a shift away from the recognition of biodiversity values on the basis of historical species distribution patterns and introduces consideration of the current status of species in relation to threats and recent patterns of attrition (discussed further below). . Areas thus defined present strategic conservation priorities.

The high conservation values of refugia and the increased importance allocated to their management as a strategic biodiversity conservation response to the pervasive threat posed by global climate change (NTGMCCIB 2003) underpin their priority as a focus for national biodiversity conservation initiatives.

Threatened Species and Ecosystems

Threatened species and ecosystems are a high priority for conservation programs seeking to avert the loss of threatened elements of Australia's biodiversity. Conservation approaches and specific needs associated with threatened species and ecosystems are discussed in sections 1.4, 2.4 and 3.4. Areas that contain threatened species and ecosystems have high conservation values in terms of the opportunities presented for their conservation.

One approach used to define national biodiversity values associated with the location of threatened species is to intersect threatened species distributional data with an assessment framework such as the IBRA subregions to define the number of threatened species within a particular area or subregion Figure 14 and Figure 15.

Care needs to be exercised in interpreting threatened species abundance patterns defined for combined or individual taxa which in some instances will converge due to the unified effect of land degradation or other pressures within a particular subregion and in other instances will diverge reflecting underlying distinctions

in patterns of species richness within or between taxa. Even within a single taxa, concentrations of threatened species within subregions can be indicative of two widely disparate conservation contexts, one associated with highly stressed subregions with a threatened species complement (i.e. Avon Wheat Belt) and the other being unstressed subregions which are functioning as a refugial centre for species primarily threatened by population impacts external to the subregion (i.e. some Cape York subregions). Obviously the conservation 'value' associated with these two subregional contexts is quite different.

Threatened Flora

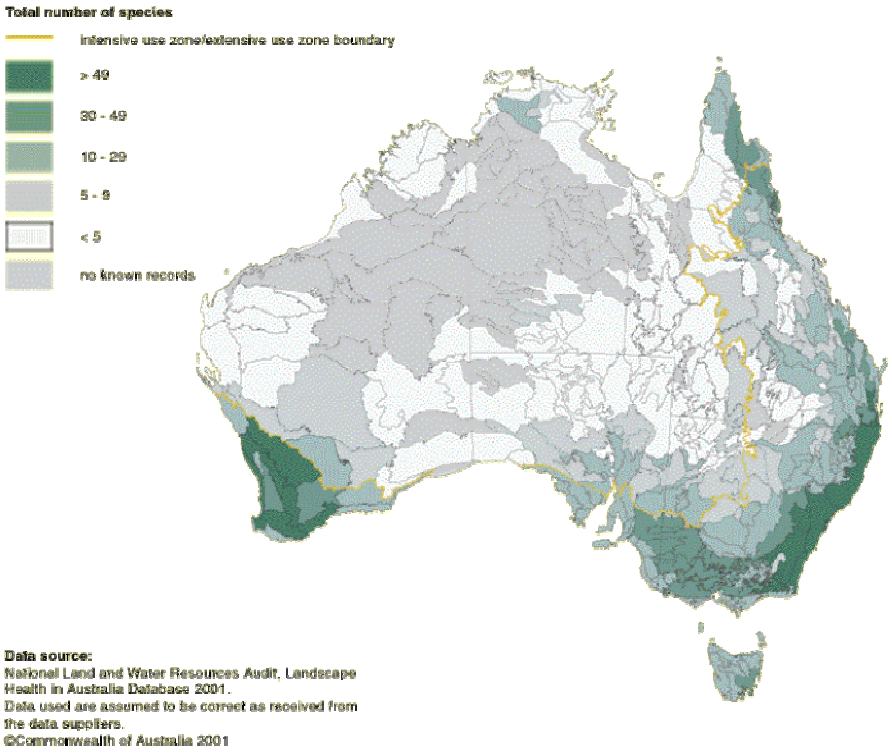


Figure 14 Known and predicted number of threatened plants per subregion from Morgan (2001).

Threatened Fauna

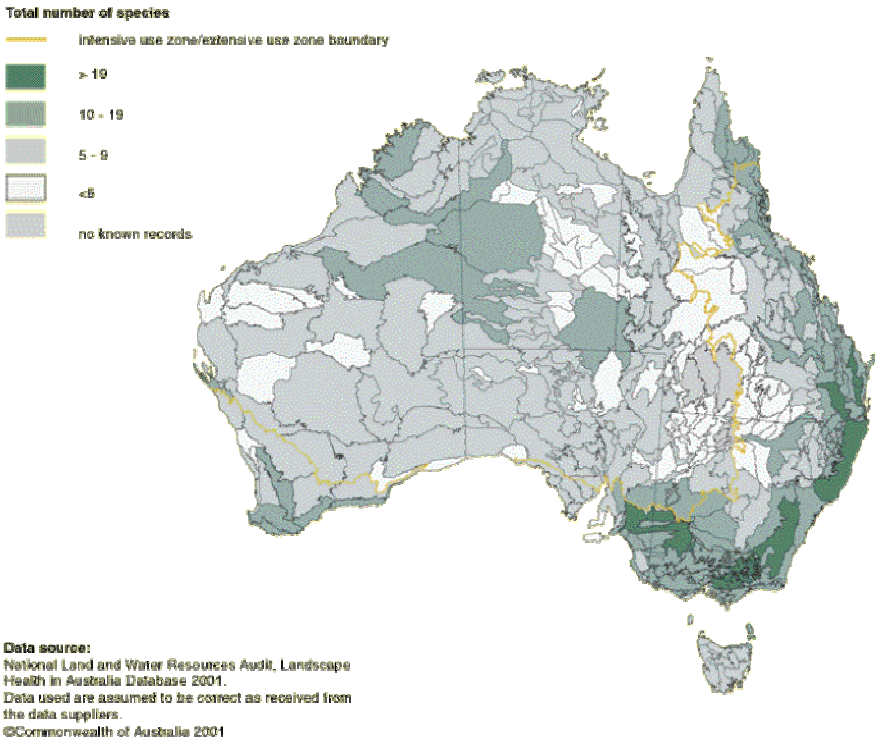


Figure 15 Known and predicted number of threatened animals per subregion from Morgan (2001).

The ability to define patterns of threatened ecosystems nationally depends on having consistent approaches for the definition of regional ecosystems and the determination of conservation status. Neither of these conditions has yet been established nationally. Acknowledging these limitations the analysis produced by the Audit terrestrial biodiversity assessment (NLWRA 2002a) currently provides the best national overview of regional ecosystem conservation status Figure 16. The distribution of subregions with high percentages of threatened regional ecosystems broadly reflects Audit assessments of landscape stress (Figure 33 section 1.4) and appears largely driven by land use intensity (Figure 20 section 1.3). On this basis potential discrepancies in bioregional ecosystem status (i.e. the Avon Wheat Belt in south west Western Australia and the Tasmanian Midlands) may provide a focus for improving the comparability of assessment methods.

The biodiversity value associated with areas with high percentages of threatened ecosystems and/or species warrants careful consideration. In many instances such attributes are indicative of potentially costly conservation challenges rather than conservation value per se' and from a cost effectiveness perspective it could be argued that areas with low levels of threatened ecosystems or species in fact provide greater conservation value. Application of the attribute will ultimately be case specific. Generally the value of threatened ecosystem and species relates to the economics of limited (and diminishing) resources which have higher values than abundant resources. When considering specific types of conservation initiatives such as Bushcare restoration activities and private nature refuges, areas with high levels of threatened ecosystems and species may be used to identify where investments potentially provide the highest value returns in terms of biodiversity conservation outcomes.

Threatened Ecosystems

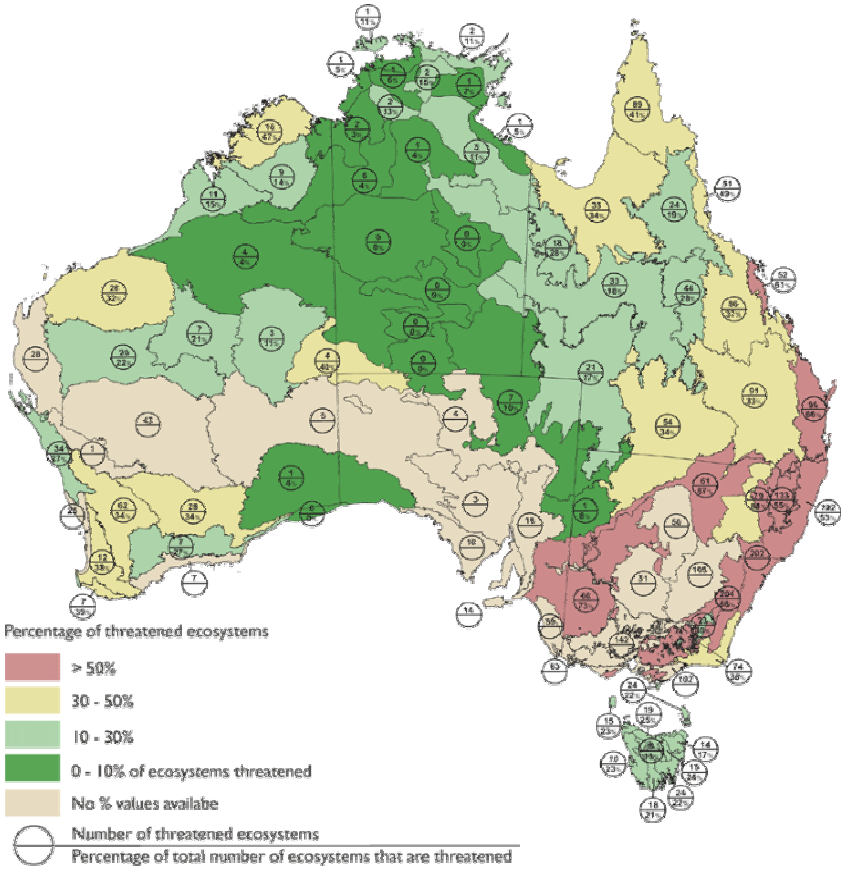


Figure 16 Number and percentage of threatened ecosystems and other ecological communities identified across bioregions from NLWRA (2002a).

Conservation Application of Value Definitions

Biodiversity Hotspots

To use defined biodiversity 'values' in a management or conservation planning context also generally requires definition of threats facing a region's biodiversity and associated biophysical condition trends (see section 1.4). This is the approach used for the definition of so called biodiversity 'hotspots' (DEH 2003) where recognised areas of species endemism or richness are exposed to high levels of existing or immanent threats Figure 17.

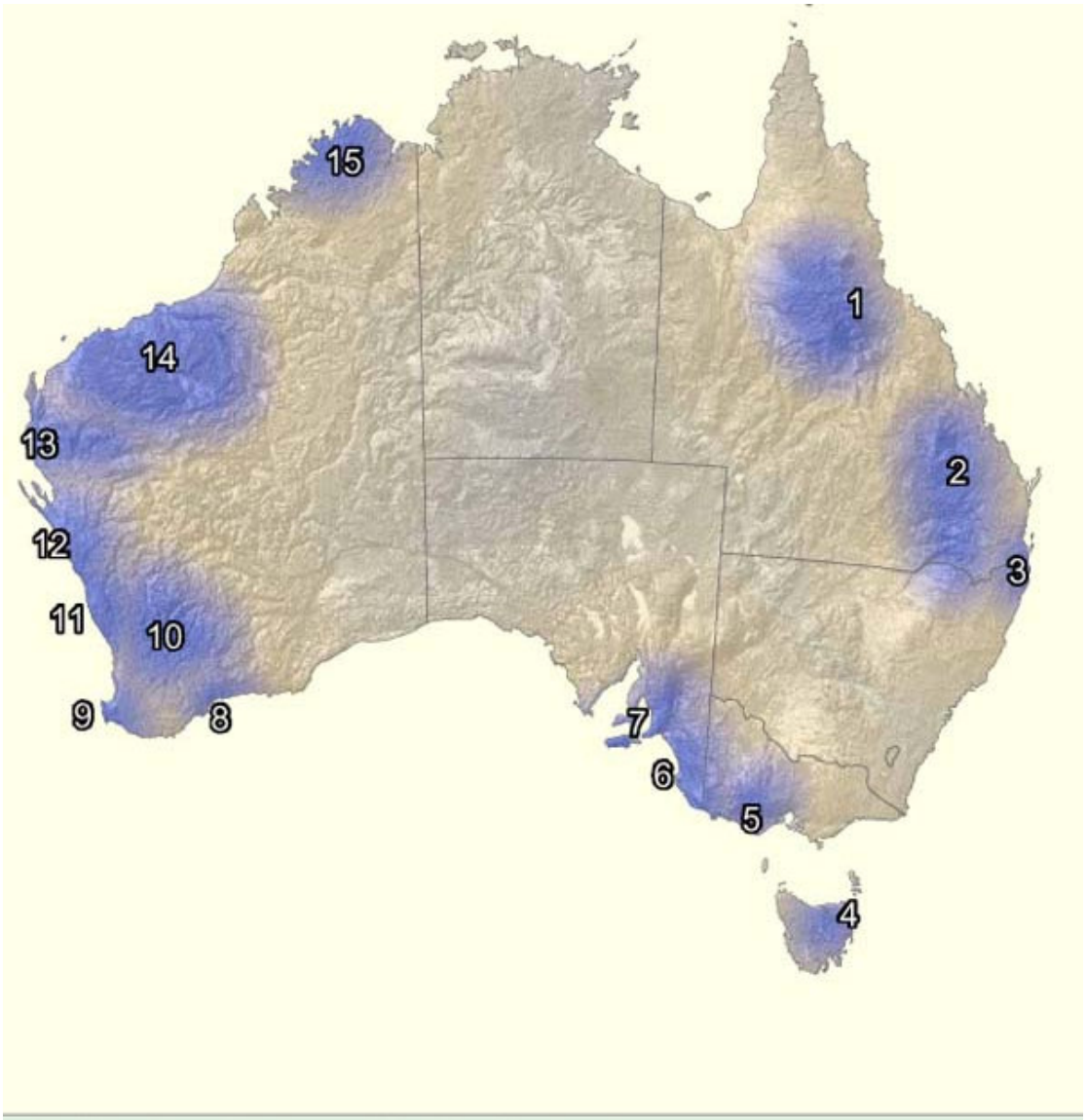


Figure 17 Biodiversity 'Hotspots' from DEH (2003).

The Audit also conducted an analysis semi-analogous to the hotspot approach by intersecting subregional areas within defined high irreplacability indices for Acacia and Eucalypt species with classifications of landscape health (Morgan 2001) which provide an indication of landscape scale threats to biodiversity Figure 18.

While most of the subregions with high irreplacability values for Acacia and Eucalypt species and high landscape stress are included in recent definitions of Australia's biodiversity 'hotspots' (DEH 2003) several are not including subregions within the NSW South Western slopes, South East Coastal Plains and Victorian Midlands bioregions Figure 18. Potentially more important is the delineation of areas with both

high biodiversity value (in terms of species irreplacability) and lower levels of defined landscape stress, which could be considered to identify areas that in contrast may be termed biodiversity 'coolspots'.

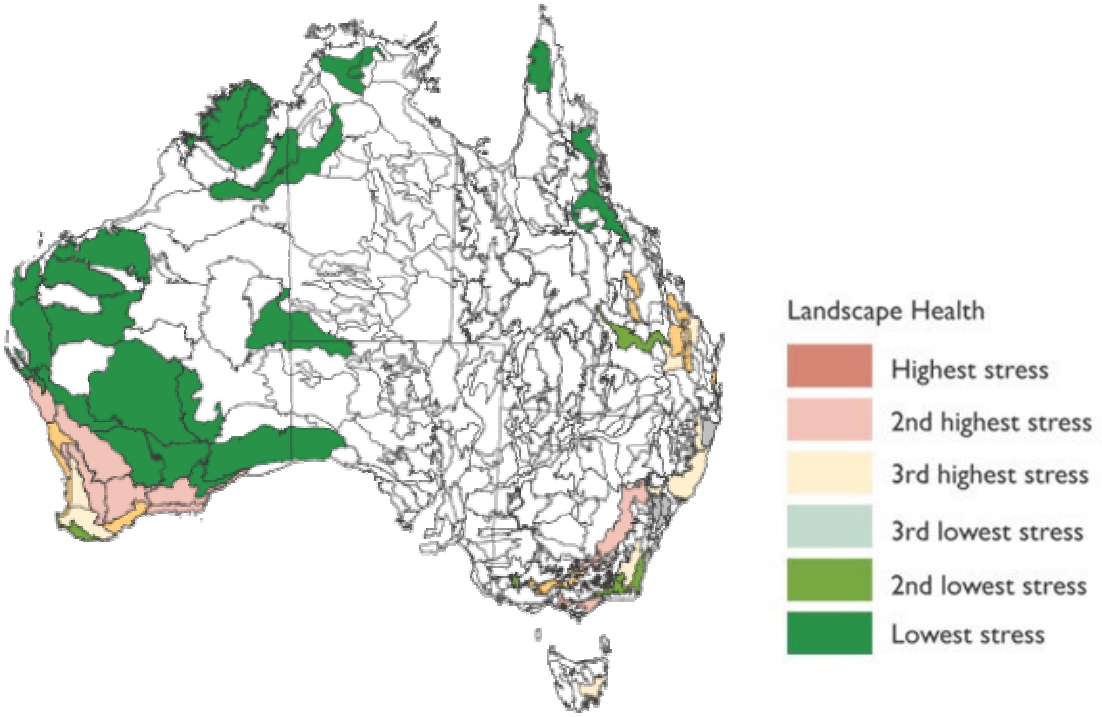


Figure 18 Subregions with high irreplacability indices for combined Acacia and Eucalypt species data and subregion landscape health classification (from NLWRA 2002).

While 'hotspot' definition is appropriate for identifying areas requiring immediate conservation intervention, priority setting based more on considerations of the cost effectiveness and returns of investment in preventative, protective biodiversity management may benefit by targeting 'coolspots'.

Biodiversity Value in Broader Conservation Context

Ultimately comparative definitions of biodiversity value are a relative and subjective exercise which are not an end in themselves but provide tools for guiding strategic conservation efforts. The merit of targeting areas of high biodiversity conservation value will depend upon the type of conservation approach being pursued (see section 1.4) but can include identifying immediate 'tactical' priorities associated with 'hotspots' or longer term strategic priorities associated with securing cost effective investment in protective management of diverse or endemic species assemblages (~'coolspots'). Biodiversity value defined in terms of threatened species and ecosystems define where resource intensive habitat restoration conservation approaches may be justified.

Importantly it needs to be remembered that areas of high biodiversity value, or what might be considered 'conservation jewels' don't exist as islands. Such areas are affected by threats and are dependent upon ecosystem processes that operate at a range of scales from site to global. If conservation programs only target areas of nationally high value or 'jewels' to the exclusion of the broader continental or global biodiversity landscape they will ultimately be doomed to failure.

The salient message that emerges from attempts to define biodiversity value is that it occurs at all scales and is stratified across the full diversity of the continent's landscapes and is just as much defined by the ecosystem and evolutionary processes that create it as the species and ecosystem expressions of it. This understanding needs to guide our approaches to conserving it.

Appendix 2: Outline of the Government's greenhouse plan

The ABARE report[8] provides the following graph in which the outcomes of the government's technology plans are shown (figure 2, lowest line). By 2050 this would result in a doubling of greenhouse gas (GHG) emissions from about 8 gigatonnes carbon equivalent (GTCe) in 2000 to over 16 GTCe in 2050. The government has proposed that this represents a good outcome since it is less than emissions under a possible 'reference scenario'[9].

Figure 2: Global emissions (reproduced from ABARE, 2006, fig. 12)

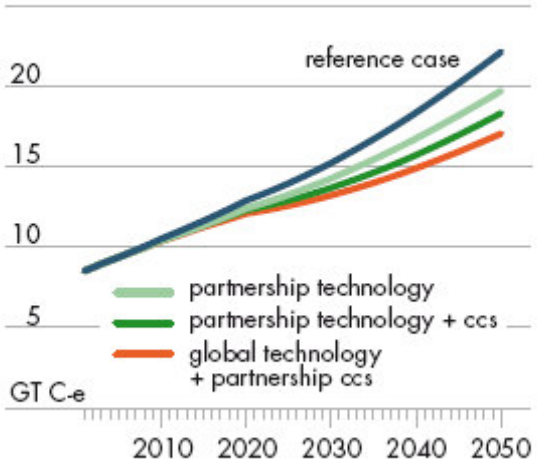
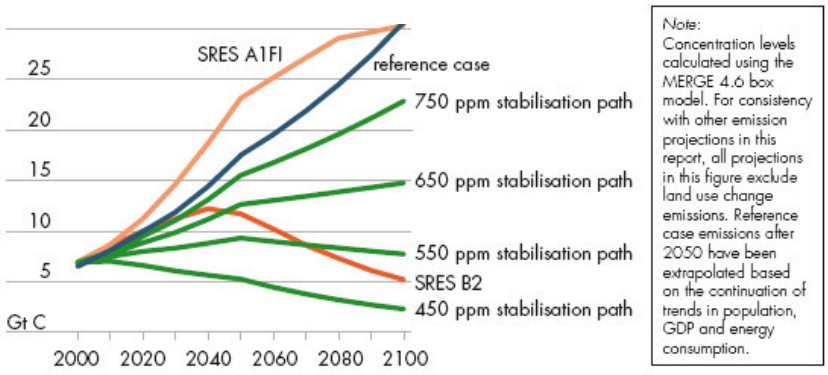


Figure 3 shows how the *annual* emissions levels shown in the 'global technology and partnership' line in figure 2 would result in *cumulative* GHG concentrations in the atmosphere best expressed by the 750 ppm stabilisation line. We note, however, that emissions are still increasing in 2100, so that there is no long-term stabilisation of emissions or temperature envisaged, thus the labels as are misleading as they stand.

[8] ABARE (2006)

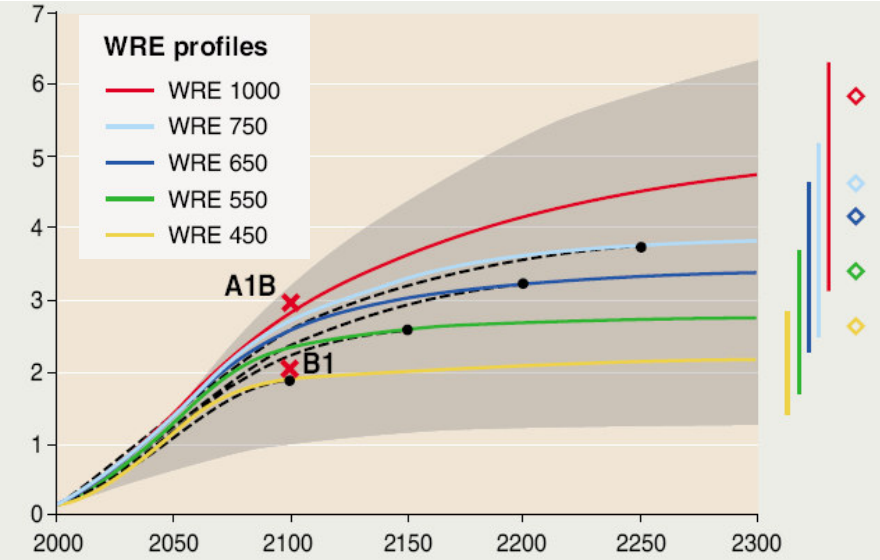
[9] " I can indicate to you today ladies and gentlemen that the Australian Bureau of Agricultural and Resource Economics will later today release a report showing that with concerted and comprehensive effort the adoption and diffusion of cleaner technologies does have the potential to reduce greenhouse gas emissions in partner countries by almost 20 per cent below what would otherwise be the case by the year 2050. The spillover to the rest of the world could lead to a global cumulative reduction in emissions of some 13 per cent below what would otherwise occur over the same period. If this were to be borne out, such a result would be significant given that global energy consumption is expected to grow from nine billion tonnes of oil equivalent in 2001 to about 21 billion tonnes of oil equivalent in 2050. On this basis the adoption of new technologies are therefore a credible and essential part of any suite of measures needed to address global emissions growth." (Howard, 2006)

Figure 3: Reference case emissions and possible atmospheric carbon dioxide stabilization pathways (reproduced from ABARE, 2006, fig. 4)



With global GHG concentrations of *at least* 750ppm, it is possible to refer to the scientific literature to identify a corresponding global warming temperature[10].

Figure 4: Global mean temperature change (ºC) (reproduced from from IPCC, 2001c)



As shown in the figure 4 above, the estimated temperature increase for an emissions pathway that stabilizes CO_2 concentrations at 750 ppm ranges from 2.5º to over 5º above 1990 levels by 2300 (light blue vertical bar); the light blue line shows a mid-range estimate (using a model with a climate sensitivity of about 2.5ºC) of a 3.8º increase over 1990 levels by 2300, or about 4.4 degrees over pre-industrial.

It should also be noted that the 750ppm line in figure 4 of the ABARE report covers CO_2 concentrations only; it does not include many of the other greenhouse gases (figure 12 of their report does include these other gases). The temperature increases shown in figure 4 are based on projections for non-CO_2 gases that raise the *equivalent* CO_2 concentration to about 900 ppm.

Based on these considerations, a mid-range estimate for the warming expected in this century in the ABARE scenario is approximately 3°C.

[10] IPCC (2001c)

Appendix 3: Australian animal species at risk from climate change

Mammals
Antilopine wallaroo
Banded hare wallaby
Black-footed rock wallaby
Bridled nailtail wallaby
Broad-toothed rat
Brush-tailed bettong
Central rock rat
Coppery brushtail possum
Dibbler
Dusky hopping mouse
Eastern barred bandicoot
Eastern quoll
Ghost bat
Golden bandicoot
Greater bilby
Heath mouse
Heath rat
Herbert river possum
Kowari
Leadbeater's possum
Lemuroid ringtail possum
Long-footed potoroo
Lumholtz tree kangaroo
Mitchell's hopping mouse
Mountain pygmy possum
Mulgara
New holland mouse
Northern hairy-nosed wombat
Pebble-mound mouse
Plains rat
Quokka
Red-tailed phascogale
Rufous hare wallaby
Sandhill dunnart
Shark bay mouse
Smoky mouse
Swamp antechinus
Western barred bandicoot
Western mouse
Western quoll

Amphibians
Northern corroboree frog
Sharp-snouted day frog
Southern bell frog
Southern corroboree frog
Spotted frog
Spotted tree frog
Sunset frog
White-bellied frog
Yellow-bellied frog

Birds
Alexandra's parrot
Black-breasted button quail
Black-eared miner
Carpentarian grasswren
Forty-spotted pardalote
Golden-shouldered parrot
Gouldian finch
Ground parrot
Helmeted honeyeater
Hooded plover
Little tern
Mallee emu-wren
Malleefowl
Night parrot
Noisy scrub bird
Orange bellied parrot
Pink robin
Plains wanderer
Red goshawk
Red-lored whistler
Red-tailed black cockatoo
Regent honey eater
Regent parrot
Rufous bristlebird
Slender-billed thornbill
Sooty owl
Southern cassowary
Swift parrot
Western whipbird

Reptiles

Broad-headed snake
Legless lizard
Pink-tailed legless lizard
She-oak skink
Striped legless lizard
Swamp skink

Fish
Australian grayling
Swan galaxias
Trout cod

Invertebrates
Giant Gippsland earthworm
Ulysses butterfly

Source: Reynolds, 2002

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