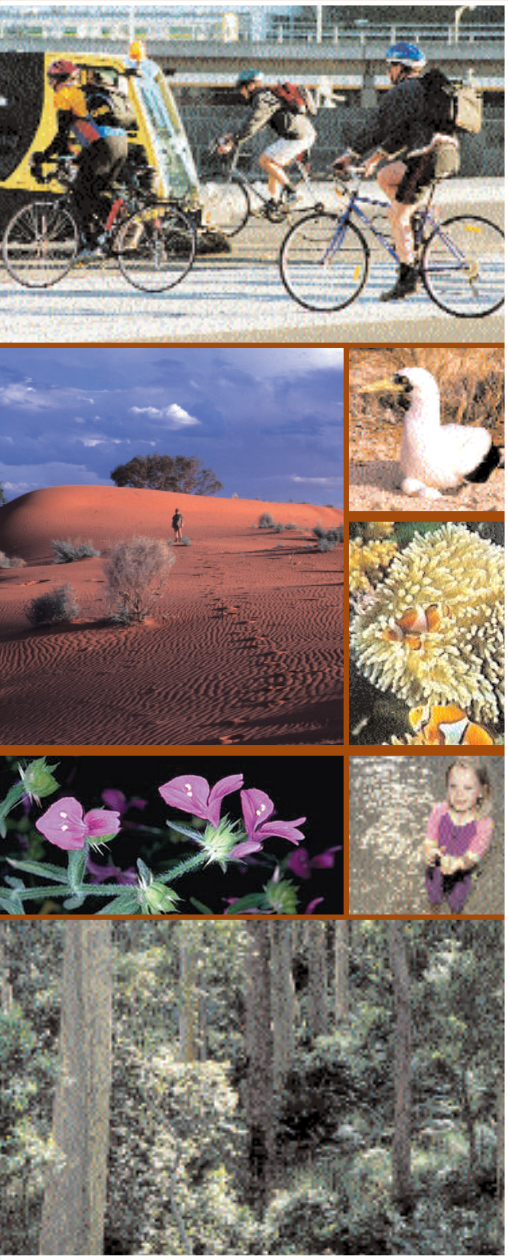

Consultation Paper

Developing a National Biodiversity and Climate Change Action Plan

Comments are invited on the development of a National Biodiversity and Climate Change Action Plan

Prepared by the National Task Group on The Management of Climate Change Impacts on Biodiversity Convened under the NRM Ministerial Council's Land, Water And Biodiversity Committee

Developing a National Biodiversity and Climate Change Action Plan. Prepared by the National Task Group on the Management of Climate Change Impacts on Biodiversity convened under the NRM Ministerial Council's Land, Water and Biodiversity Committee.

For bibliographic purposes this report may be cited as:
National Task Group on the Management of Climate Change Impacts on Biodiversity (2003): *Developing a National Biodiversity and Climate Change Action Plan*, Australian Government, Department of Environment and Heritage, Canberra.

Secretariat,
National Task Group on the Management of Climate
Change Impacts on Biodiversity
% Biodiversity Policy Section
Natural Resource Management Branch
Australian Government
Department of Environment and Heritage
GPO Box 787
Canberra ACT 2601

This report is available at: http://www.deh.gov.au/nrm/publications/biodiversity and
Department of Environment and Heritage
Community Information Unit
John Gorton Building
PO Box 787, CANBERRA ACT 2601
Telephone 1800 803 772
Facsimile (02) 6274 1970

Cover photographs: Australian Greenhouse Office, Trevor Hobbs, Arthur Mostead, Great Barrier Reef Marine Park Authority (A. Elliot), Australian National Botanical Gardens (M Fagg).
Cover page: Design One Solutions, Hall, ACT.
Printing and binding: Outsource Australia, Canberra, ACT

Information for Stakeholders

The National Task Group on the Management of Climate Change Impacts on Biodiversity was established earlier this year by the Land, Water and Biodiversity Committee, convened under the Natural Resource Management Ministerial Council.

This consultation paper has been prepared by the National Task Group to facilitate stakeholder engagement and comment on the development of a National Biodiversity and Climate Change Action Plan (NBCCAP) with a view to identifying potential mechanisms for managing climate change impacts on Australia's biodiversity.

Who needs to read this discussion paper?

If your work involves natural resource management, or you are a natural resource management stakeholder including, but not restricted to, government, scientific community, regional NRM groups, industry and non-government environment organisations, you will have an interest in shaping the future of how climate change impacts on biodiversity are managed.

What should I comment on?

Your comment is being sought on the development of the NBCCAP, potential adaptation initiatives for managing the impacts of climate change on Australia's biodiversity, and the integration of these mechanisms into natural resource management and planning processes.

The National Task Group is seeking comments to inform the development of the NBCCAP, in particular, on:

- adaptation initiatives for managing and protecting Australia's biodiversity in the face of climate change threats and impacts;
- potential approaches to protecting those elements of biodiversity immediately threatened by climate change; and
- possible mechanisms for monitoring and evaluating the impacts of climate change on Australia's biodiversity.

Contributors are invited to provide feedback on any aspect of this consultation paper and a series of questions are presented throughout the consultation paper to help guide input.

Where should I send my comments?

Please direct your comments on the questions to be received **by Friday 17 October 2003** to the National Task Group care of:

Via e-mail (preferred method):	chm@ea.gov.au
Via post:	Attention: Gerard Crutch Natural Resource Management Policy Branch Department of the Environment and Heritage GPO Box 787, Canberra ACT 2601
Or:	Send your comments to the National Task Group member in your State or Territory (see Appendix A)

Summary

This consultation paper consists of two sections:

- The first part of the paper introduces the concepts and policy considerations behind the proposal to develop a National Biodiversity and Climate Change Action Plan (NBCCAP).
- The second part outlines a possible structure and content for the plan, identifying key strategies and examples of specific adaptation initiatives for managing climate change impacts on biodiversity.

Other points include:

- a number of international obligations and national State/Territory frameworks have outlined the need to undertake action on addressing the impacts of climate change on biodiversity. In particular the *National Objectives and Targets for Biodiversity Conservation 2001-2005* specified developing a National Biodiversity and Climate Change Action Plan. The Commonwealth's Governments *Forward Climate Change Strategy* further identified the need to promote "*policies and programs that assist adaptation to the consequences of the climate change that is already unavoidable*";
- this work will support the main climate change focus of governments, which is to lower Australia's greenhouse signature whilst maintaining a strong and internationally competitive economy. Addressing the causes of climate change is clearly an important mechanism for reducing the impacts of climate change on biodiversity;
- integrating the development and implementation of adaptation initiatives addressing climate change impacts on species, communities and ecosystems with measures to reduce emissions provides a more comprehensive and integrated approach to addressing climate change impacts than managing these issues in isolation;
- changes to Australia's climate are already occurring (e.g. spatial and temporal changes in rainfall and temperature patterns) and these changes are having a measurable impact on Australia's biological diversity;
- climate change will add to existing pressures on Australia's biodiversity, potentially magnifying the negative influence of a range of existing pressures such as invasion by weeds, pests and diseases, degradation and fragmentation of ecosystems and, pollution;
- reducing the impacts of existing pressures on biodiversity will decrease the vulnerability of species and ecosystems to climate change impacts;
- limited available resources should be utilized strategically and cost-effectively to address the impacts of climate change on biodiversity. As part of this approach, initiatives addressing climate change impacts on biodiversity should be integrated with existing natural resource management and planning processes where practicable; and
- targeted monitoring, evaluation and research is needed to improve our ability to understand and address the impacts of climate change on biodiversity.

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Notice

This is not a draft of the National Biodiversity and Climate Change Action Plan.

This document has been prepared to facilitate stakeholder engagement and comments to inform the development of a National Biodiversity and Climate Change Action Plan.

Specific actions outlined in this consultation paper are only intended as examples and are not comprehensive or indicative of any commitment to a particular course of action. Similarly, the views contained in this document do not necessarily reflect those held by members of the National Task Group or the jurisdictions which members represent.

Introduction

Background

The key objective of the National Task Group on the Management of Climate Change Impacts on Biodiversity (the National Task Group) is to develop adaptation initiatives to address the impacts of climate change on biodiversity as part of a broader national approach to climate change. The National Task Group comprises representatives from all State and Territory Governments and the Commonwealth.

The National Biodiversity and Climate Change Action Plan (NBCCAP) will be a key part of *Australia's Forward Climate Change Strategy*, particularly those elements promoting policies and programs that assist adaptation to the unavoidable consequences of climate change.

The National Task Group have prepared a set of principles proposed to guide the development and implementation of the NBCCAP, reflecting both current policy trends and accepted conservation practice, providing solid building blocks for action.

Please keep these principles in mind when reviewing this consultation paper.

Guiding Principles[1]

1. The plan will be adaptive, allowing for change as new information becomes available.
2. The plan will be integrated with existing and future natural resource management and biodiversity conservation policies and programs, and coordinated with broader policy frameworks.
3. Actions will be prioritised to maximise biodiversity conservation outcomes.
4. Actions will be delivered at a range of levels including at the national, state, regional and local levels.
5. The plan will be informed by good science.
6. The plan will recognise the dynamic nature of biodiversity, both at a spatial and temporal scale including natural variation and evolutionary processes.

The Need for a National Approach

Biodiversity is arguably the single most important resource on Earth. Biodiversity underlies the goods and services provided by natural ecosystems that are critical for human survival and wellbeing (SBSTTA 2003). Humans derive a variety of significant benefits from ecosystems, including natural medicines and pharmaceuticals, industrial products, recreational opportunities, and ecosystem services such as clean air and water, and the provision of fertile soils. For many Australians, the natural environment also plays a powerful spiritual and aesthetic role in their lives. However, natural ecosystems are becoming increasingly threatened by the impacts of Australia's growing population through habitat destruction, clearing of native vegetation, and the pollution of soils, air and water. Ecosystems and their constituent biodiversity are being further stressed by accelerated rates of climate change, which threatens to endanger the integrity of the natural functions and processes on which we depend.

For the next century at the very least, we are locked into an inescapable rise in global temperature (Müller 2002; IPCC 2001*a*). As a result, significant climate impacts will occur

[1] The Guiding Principles are discussed further at Appendix B.

and, as long as there is a residual risk of impacts, appropriate impact response measures remain critical (Müller 2002).

The *United Nations Framework Convention on Climate Change* (UNFCCC) and the *Convention on Biological Diversity* (CBD) have identified climate change impacts on biodiversity as a significant issue. In its *Third Assessment Report* (2001*a*,*b*), the Intergovernmental Panel on Climate Change (IPCC; convened under the UNFCCC) highlighted the need for countries to develop climate change adaptation strategies in addition to greenhouse gas emission reduction programs.

Australia, a signatory to the abovementioned conventions, is identified in the *Third Assessment Report* (2001*b*) as having significant vulnerability to the changes in temperature and rainfall projected over the next decades to 100 years, stating conservation and natural resources as key sectors likely to be considerably impacted (information on the degree of uncertainty attached to conclusions in the IPCC reports is presented at Appendix F).

In addition to the direct impacts of climate change resulting from altered rainfall and temperature patterns, climate change can influence the intensity and magnitude of existing stresses on biodiversity and ecosystem structure, function and processes. For example, a hotter, drier climate can influence fire regimes in such a way as to stimulate increases in the frequency, intensity and extent of fire events, amplifying the impacts of this type of disturbance. Therefore, a likely consequence of the interaction between climate change and existing stresses is a reduction in the ability of biodiversity to adapt to climate change.

The likely added effect of projected human-induced climate change is that the climatic envelope for the habitats of many species will move toward the poles or upward in elevation from their current locations. The many and varied affects of climate change on species and ecosystems may include:

- altered composition of communities and ecosystems as we know them: species that make them up are unlikely to shift together, their rates of movement are likely to be highly variable and dependent on, for example, species mobility; physical and chemical variation across landscapes, and barriers to movement in landscapes including fragmentation;
- spatial and temporal changes in disturbance regimes: changes in the frequency, intensity, extent, and location of disturbances will affect the capacity of biodiversity to cope with climate change;
- sea-level rise: impacts on coastal ecosystems will vary regionally and be influenced by factors such as coastal geology and topography; and
- increased frequency of extreme events: this may lead to sudden extinctions as species' physiological threshold are exceeded. These events may occur within short time frames.

A key component of the IPCC (2001*b*) assessment of climate change impacts in Australia is an assessment of Australia's vulnerability based on a number of greenhouse gas emission scenarios. In these scenarios, the Earth's mean surface temperatures are projected to warm between 1.4 and 5.8°C by the end of the 21st Century (IPCC 2001*a*), with land areas warming more than oceans, and high latitude areas warming more than the tropics- the extent of warming being dependent on regional peculiarities and future emission scenarios. Within the thresholds of the IPCC scenarios, adaptation actions would probably only be effective at the lower end of the emission scenarios. In other words, the greater the magnitude of future

climate change, the greater the threat to biodiversity, and the greater the likely need for investment to replace lost ecosystem services (Dunlop and Howden 2003).

The bio-climatic ranges of endemic rainforest vertebrates in Australia's Wet Tropics provide a good example of predicted impacts. An increase of 1°C in mean temperature, which is considered a certainty, is predicted to decrease the current range of certain Wet Tropics rainforest species by a mean of 27% of their current range (Williams 2003). A mean temperature rise of 3.5°C will cause a predicted mean reduction of current range sizes by 89% and will completely remove the bioclimates currently occupied by 30 species of endemic vertebrates (Williams 2003). Similarly, significant impacts are predicted for Australia's coral reefs (Hoegh-Guldberg 2003; Hughes 2003). Combined with certain water movement patterns, an increases in sea-surface temperatures by as little as 0.8°C above the long-term summer maxima will lead to mass bleaching events (Hoegh-Guldberg 2003). Although coral reefs may recover in these cases, warming of sea-surface temperatures between 2 and 3°C above the long-term summer maxima can result in large-scale mortality from bleaching episodes (Hoegh-Guldberg 2003). Severe bleaching events can lead to changes in species composition as communities once dominated by coral shift to macroalgae dominated systems (Hoegh-Guldberg 1999).

It is important that any strategy to conserve biodiversity from the impacts of climate change addresses both abatement (reducing greenhouse gas emissions) and adaptation (reducing vulnerability to impacts). In this context, the NBCCAP will form a critical part of a comprehensive and integrated approach to addressing climate change impacts.

Key Policy Instruments

Climate change impacts on biodiversity are recognised as a high priority for action in Australia and are acknowledged through a number of international, national and state level commitments and obligations.

Key policies for progressing national action on addressing the impacts of climate change on biodiversity are the:

- *National Strategy for the Conservation of Australia's Biological Diversity* (1996): this strategy includes the objective of planning "*to minimise the potential impacts of human-induced climate change on biological diversity*"; and
- *National Greenhouse Strategy* (1998): this strategy has been developed and endorsed by Commonwealth, State and Territory governments. Module 8 of this strategy lays the foundation for forward planning and adaptation in response to climate change impacts.

The new delivery arrangements for achieving natural resource management outcomes is through regional initiatives. The States, Territories and Commonwealth support these initiatives through the *Natural Heritage Trust* and *National Action Plan for Salinity and Water Quality*. Adaptation, or impacts management activities, must also be structured to support regional initiatives delivering natural resource management outcomes.

The impacts of climate change on biodiversity are identified as a high priority for action in a number of key recent biodiversity publications including:

- *Sustaining Our Natural Systems and Biodiversity* (2002), Prime Minister's Science, Engineering and Innovation Council (PMSEIC); and
- *State of the Environment* (2002), State of the Environment Committee.

In a joint media release between the Minister for the Environment and Heritage, the Hon. Dr David Kemp and the Minister for Foreign Affairs, the Hon. Alexander Downer, the Government committed Australia to the *Forward Climate Change Strategy* to implement "*policies and programs that assist adaptation to the consequences of the climate change that is already unavoidable. As a first step, research will be undertaken to improve our understanding of likely impacts on Australia, and on mitigation and adaptation options*".

A number of States have identified the need to assess and manage the potential impacts on biodiversity of climate change in biodiversity and greenhouse strategies. For instance, climate change adaptation is specified as a Priority Action in the *National Objectives and Targets for Biodiversity Conservation 2001-2005* (2001) with the stated aim to "*develop an action plan to identify the potential impacts of climate change on Australia's biodiversity and measures to address these impacts*". The importance of this objective was highlighted again in the Commonwealth Government's 2001 election commitment to "*contribute to achieving the biodiversity targets in the National Objectives and Targets for Biodiversity Conservation 2001-2005, agreed with State and Territory governments*".

Developing a National Plan

The most effective non abatement action for reducing the impacts of climate change on biodiversity is to reduce the pressures of other threatening processes. This will decrease the vulnerability of biodiversity to climate change impacts.

Many existing biodiversity conservation policies and programs already assist in this task. Increasing the level of adoption of adaptation principles and initiatives within these strategies will significantly improve the capacity of many species and ecosystems for survival. For some species and ecosystems however, more direct action may be required, and for others, there may be little opportunity for maintaining viable wild populations.

The Intergovernmental Panel on Climate Change (1998) categorises adaptations as either 'autonomous' – where biota and ecosystems respond and change of their own accord; or 'planned' or 'conscious' – where there is direct humans intervention[2].

Autonomous adaptations include designing landscapes to incorporate corridors for species migration and dispersal to adapt to new climate regimes, and may result in changes to genetic diversity within and between populations, community composition and ecosystem structure and function over time.

Planned adaptations might be necessary where extreme events push species over thresholds leading to potential extinction events and/or invasion by exotic species. An extreme example of a planned adaptation would be the translocation of a species from its current location to another location that is predicted to be more suitable under climate change scenarios.

Finally a NBCCAP will need to be responsive to both the short-term impacts of climate change (that already exist and that need to be addressed immediately) and the longer-term impacts that may emerge given the potential rate of climate change. The extent of the longer-term climate change impacts on biodiversity will be dependent on the success of abatement, mitigation and adaptation strategies. It will be important for the NBCCAP to be responsive to the uncertainty associated with future climate change impacts on biodiversity and that priorities can be adjusted accordingly.

[2] Adaptations are defined as responses that decrease the negative effects and capitalise on positive opportunities associated with climate change impacts (IPCC1998).

The following section sets out the possible contents of the National Biodiversity and Climate Change Action Plan based on the Guiding Principles outlined earlier.

For further information on many of the issues outlined above, refer to Howden *et al*. (2003) *Climate Change Impacts on Biodiversity in Australia,* Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee, 1-2 October 2002. Commonwealth of Australia, Canberra.

Possible Structure and Indicative Content

Proposed Elements

The National Biodiversity and Climate Change Action Plan (NBCCAP) will need to be an integrated package of actions that can address the impacts of climate change on biodiversity in a way that fits within the broader national policy context, delivers tangible on the ground biodiversity outcomes and facilitates the planning and management of existing and future risks to natural resources.

It is proposed that the structure of the NBCCAP be modelled on the *National Objectives and Targets for Biodiversity Conservation 2001-2005* and include the following elements:

The Goal

The preservation of biodiversity and maintenance of ecosystem integrity in the face of climate change threats and impacts.

Key Strategies

1. *Incorporate adaptation to climate change as a key component of core business for all natural resource planning and management.*
2. *Maintain ecosystem structure, function and processes.*
3. *Improve our understanding of future climates, climate change scenarios and likely impacts on biodiversity.*
4. *Communication: building awareness, understanding and capacity.*

Actions

A comprehensive range of actions will be developed for implementation consistent with the strategies outlined above.

Adaptation is not only necessary to address the impacts of projected changes in climate over time but also because climate change is already affecting many ecosystems (SBSTTA 2003).

The actions provided in the following tables are indicative only and are not comprehensive. They are intended as examples of possible actions and have been included to facilitate comments to the questions.

Strategy 1. Incorporate adaptation to climate change as a key component of core business for all natural resource planning and management.

A key approach to putting an action plan into practice will be its integration with relevant processes at a range of levels of operation, from on-ground initiatives to high-level policy. For example, it is proposed that this action plan form one of the strategic components of *Australia's Forward Climate Change Strategy* as well as inform related parallel processes such as the *National Framework for a Cooperative Approach to Coastal Issues*, the *National Plan for Greenhouse in Agriculture*, and the *National Reserve System Future Directions Statement* or future developments such as the new generation *National Greenhouse Strategy*. It is also expected that this action plan will be integrated into natural resources management regional delivery processes and programs.

Priority setting is also an important component for incorporating adaptation actions into natural resource management. Planners are more able to incorporate actions into NRM processes if priorities are identified through transparent process.

Theme 1.1: Integration with natural resource planning and management processes.	
Specific Actions	**Explanation**
• Coordinate and develop policy in conjunction with all levels of government to address the impacts of climate change on biodiversity to inform the planning and management of a comprehensive, adequate and representative national reserve system. • Consider climate change impacts on biodiversity as part of regional and local integrated NRM planning and implementation processes. • Encourage local governments to incorporate the consideration of climate change impacts on biodiversity into planning decisions and strategic land-use planning and management processes. • Include addressing climate change impacts on biodiversity as a component of the new National Cooperative Framework for Managing Australia's Coastal Resources. • Incorporate assessing the impacts of climate change on species into guidelines and criteria for determining the conservation status and level of threat as part of systematic vulnerability analysis (e.g. part of national and state/territory based threatened species regulations). • Broaden existing climate variability programs to include climate change with the view of investigating the impacts of climate change and variability on biodiversity. • Expand existing work on catchment scale climate predictions and linking future climate forecasts with expansion and contraction of biodiversity components. • Include reporting on the impacts of climate change on biodiversity within *State of the Environment* reporting. • Incorporate monitoring of the National Biodiversity and Climate Change Action Plan as a component of the NRM Monitoring and Evaluation Framework.	Small changes to current conservation policies and planning and management initiatives could incorporate climate change impacts on biodiversity providing a cost effective and strategic advantage. Climate change is already recognized as a process threatening the survival of a wide range and number of species. However, assessing the impacts of climate change on species is not part of a systematic analysis of their vulnerability. Addressing this issue will help when assessing the scope of current and future threats and impacts as well as inform evaluations of the scale of investment required to help manage biodiversity under climate change.

Question 1. How can planners and decision makers be assisted to be up-to-date on regional climate change scenarios as these affect biodiversity?

Question 2. Should planning make provisions to mitigate adverse impacts where the likelihood of occurrence is relatively high?

Question 3. Are their examples of planning that could offer useful models on risk management here?

Question 4. What current natural resource planning and management processes could consideration of climate change impact on biodiversity easily fit into?

Theme 1.2 Facilitating integration with planning and management processes.	
Specific Actions	**Explanation**
• Develop guidelines on the collection and use of data for input into predictive modelling systems and on the interpretation and use of climate change scenarios in NRM planning and management. • Establish early warning systems for detecting new incursions of alien species as well as detecting critical changes to the presence, absence, abundance and distributions of alien species. • Undertake an integrated risk assessment on the response of terrestrial and aquatic weeds and pest species to a range of climate change scenarios. Integrate this information into alien species management plans. • Develop planning tools for local government and regional decision makers that help manage the impacts of climate on key terrestrial, freshwater aquatic and marine habitats and biotic communities. • Review Australian territorial areas in the Southern Ocean and the Antarctic for sensitivity to climate change and adjusting regulatory regimes for access if necessary. • Incorporate planning for multiple climate change scenarios into NRM planning and management processes at a range of levels (e.g. national, state, regional and local).	By considering climate change impacts in both strategic and statutory planning processes it will be possible to mitigate the impacts of climate change on biodiversity at a range of scales. It is only by building the capacity of planners, managers and decision makers to understand climate change impacts and detect their occurrence that effective integration will occur.

Question 5. What is the type and level of information required?

Question 6. Is there sufficient quality data to allow regional decision makers to identify species, communities and ecosystems at risk from, or threatened by, climate change impacts?

Theme 1.3 Performance and priority setting.	
Specific Actions	**Explanation**
• Identify priority actions for addressing the impacts of climate change on biodiversity using a robust and appropriate methodology. For example, the decision analysis approach described in Morton *et al*. (2002), *Sustaining Our Natural Systems and Biodiversity* (refer to Appendix D). • The NBCCAP to be reviewed every three years by the NRM Ministerial Council. • Feed the results of any NBCCAP review process into broader greenhouse, natural resource management and industry processes. • Develop integrated tools for modelling impacts on biodiversity as a result of hydrological changes in groundwater cycles due to climate change with a view to managing risk and informing regional investment priorities. • Develop enhanced biophysical, economic and social assessment tools to explicitly account for climate change and variability and to assist assessing trade-offs and risk management at the regional level.	Monitoring and evaluating the progress and effectiveness of adaptation interventions will be an important component of the action plan. This will allow the action plan to be modified and priorities to be adjusted according to changing circumstances or success or failure of initial interventions. Priority setting and risk management are also important components of monitoring performance: Priority setting: involves analysis of the costs, benefits and trade-offs in order to rank the level of importance. This can be applied to prioritise actions. The priorities could include actions that address a mix of short, medium and long-term climate change impacts on biodiversity. Risk management: involves the systematic application of policies, procedures and practices to identify the risks, their potential impacts and the likelihood of it happening. The risk management process is about reducing the likely hood of the risks and being ready to manage the consequences should the risk materialise.

Question 7. Setting priorities for biodiversity conservation:

a) Is the decision analysis approach discussed in *Sustaining Our Natural Systems and Biodiversity* (Morton *et al*. 2002) a useful methodology for setting priorities to address climate change impacts on biodiversity?

(Refer to Appendix D for an outline of this method).

b) What do natural resource managers and planners need to assist prioritising action?

Strategy 2. Maintain ecosystem structure, function and processes.

Current habitats, locations, conditions and/or resources may become unsuitable as a result of climate change impacts. Species and ecosystems will respond to climate change in a variety of ways including migration and dispersal. The rate of this change may be highly variable and occur over very long periods of time.

Theme 2.1: Species, communities and ecosystems.	
Specific Actions	**Explanation**
• Within the agreed boundaries of areas identified as particularly vulnerable to climate change (e.g. Australian Alps and Wet Tropics): ➢ phase-out current activities and processes that place stress on species, communities and ecosystems; ➢ prohibit current and future activities and processes that threaten refugia, relictual biota and centres of endemism; ➢ using revolving funds and covenants encourage a change in land-use to reduce impacts on species, communities and ecosystems on the boundaries these areas; and ➢ promote the introduction of sound ecologically based management for certain types of land-use and disturbance regimes (e.g. grazing, fire) on the boundaries of climate sensitive areas. Specific actions continued over page.	Healthy functioning ecosystems and their components are more resilient to impacts such as climate change. Synergistic effects: Ecosystems are dynamic and complex. They comprise a myriad of interconnected parts and processes that collectively maintain the compositional, structural and functional diversity of the system. The effects of climate change on the interconnected parts and processes of ecosystems have the potential to directly and indirectly amplify or dampen impacts. For example: • Direct impacts - climate changes influence the physiological tolerances and functional interactions of species. Their responses have consequences for ecosystem processes (e.g. primary production, nutrient cycling) potentially reducing the resilience of species, communities and ecosystems to withstand and recover from disturbance events. • Indirect impacts - climate changes influence other processes impacting on species, communities and ecosystems. Of particular importance is the influence of climate change on the type, frequency, intensity and extent of disturbance events such as fire.

Question 8. Are the principles and assumptions underlying the National Reserve System appropriate given current climate change predictions?

Question 9. What are the main impediments to the migration and dispersal of species?

Question 10. Is it practical to establish reserves in anticipation of future climates (i.e. in areas that do not currently meet biodiversity conservation objectives)?

Question 11. Will market based mechanisms such as taxation incentives be a useful tool for establishing future habitat?

Question 12. How do we identify populations, species and/or ecosystems to target for these actions?

Question 13. How do we ensure the genetic diversity of species is maintained to enable future autonomous adaptation?

Theme 2.1 continued.	
Specific Actions	**Explanation**
• Assess potential climate change impacts on the development of the National Reserve System and strategies to meet comprehensive, adequate and representative objectives. • Incorporate impacts of climate change on biodiversity into guidelines for identification & selection of terrestrial, freshwater aquatic and marine protected areas. • Increase focus on the vulnerability of candidate areas and ecosystems to climate change scenarios and the implementation of appropriate reserve design principles in this context. • Incorporate the use of buffer zones into land-use management and conservation planning to protect sensitive and important ecological communities. For example: ➢ around ecological communities identified as particularly sensitive to climate change impacts; and ➢ around wetlands of national significance. • Using modelling and risk management tools undertake a pilot study in the Murray Darling Basin of the risks and projected impacts of climate change on biodiversity and spin off social and economic impacts.	Feedback effects: changes to ecosystem processes affect the function and composition of species assemblages through complex feedback mechanisms. Protected area networks are currently the centre piece of most conservation strategies around the world. There is a number of ways reserve system design and management can respond to better address the consideration of climate change impacts. Some changes to interpretation or priorities may be required to achieve this. Buffer zones are essential for all conservation areas and provide a degree of protection from threatening process and impacts. They are especially important for those areas where the small size of the reserve is already compromising conservation objectives. Buffer zones should be implemented outside reserve boundaries to prevent part of the reserve being sacrificed from its primary conservation purposes.

Theme 2.2: Migration and dispersal.	
Specific Actions	**Explanation**
• Identify and protect key native ecosystems that will contribute towards meeting the objectives of the National Reserve System (i.e. comprehensive, adequate and representative) in the context of current and future climate change impacts. • Identify and protect a national system of corridors linking refugia and reserves to assist migration and dispersal. • Develop and promote incentives for landholders adjacent to parks and reserves to manage parts of their land for the provision of buffer zones and corridors to increase connectivity between reserves. • Implement landscape-scale habitat restoration to improve species and communities resilience to climate change. • Remove impediments to migration and dispersal of species, communities and ecosystems. Ensure future developments do not impact negatively on migration and dispersal.	The movement of some species and ecosystems will be influenced by features in the landscape (e.g. mountain tops, transition zones between terrestrial and aquatic systems). Programs developed to facilitate migration and dispersal across the landscape will need to be able to accommodate a range of spatial and temporal responses by species and ecosystem.

Strategy 3. Improve our understanding of future climates, climate change scenarios and likely impact on biodiversity.

While there is still considerable uncertainty about future emissions, climate change and impacts on biodiversity, there is a need to decrease levels of uncertainty and improve levels of knowledge about future impacts and management options to facilitate informed priority setting and choices about NRM investment.

Monitoring the impacts of climate change and focusing research to minimize the uncertainties and facilitate more direct and specific adaptations can help achieve this.

Theme 3.1: Monitoring and evaluating impacts.	
Specific Actions	**Explanation**
• Ensure climate change indicators are incorporated into NRM monitoring programs, including NHT and NAP monitoring and evaluation programs. • Identify areas that are particularly vulnerable to climate change using a mixture of decision support tools such as Bioclim and species databases. • Develop a framework for national climate change impacts monitoring which incorporates the following elements: ➢ The development of a monitoring strategy as the next step in the outcomes of the Biological Diversity Advisory Council report on biodiversity and climate change; ➢ A set of standards and protocols for monitoring impacts of biodiversity on climate change; and ➢ The capacity building and encouragement of university graduate school programs and naturalist groups to undertake long-term but simple monitoring. • Review the life histories of species of conservation significance to identify taxa that may need to colonise other parts of the landscape in response to changing climatic conditions and identify potential habitats, which are a priority for inclusion in protected areas.	Monitoring of the actual impacts on biodiversity of climate change can be delivered through various routes. There would be significant advantage in a centralised data repository, as it is likely to be the consistency of responses across regions, time and taxa that provides the most robust evidence of actual biotic changes and the role of climate change in them (see Chapter 3.1 in Howden *et al*. (2003)). Monitoring and evaluating biodiversity over a broad range of species, communities and ecosystems would provide robust data sets for analysing actual biotic changes resulting from climate change impacts.

Question 14. Climate predictions:

a) How would climate predictions improve management and decision making processes?

b) Is there sufficient biodiversity data to use with climate predictions to support decision making?

c) Would the data be reliable?

d) At what scale would this information be most useful?

Theme 3.2: Predicative capability for climate change and variability (scenarios and impacts).	
Specific Actions	**Explanation**
• Develop an overarching climate modelling working group as part of a high level mechanism to input and advise the national greenhouse process that provides coordination across all sectors likely to be impacted by climate change. • Build the capacity of predictive modelling systems to incorporate a range of new data (e.g. species biology and physiology; ecosystem structure, function and processes; land-use and landscape planning; impediments to migration and dispersal; refugia; threatened species, communities and ecosystems, threatening processes).	A significant constraint on decision-making in a climate change context is the lack of information and appropriately scaled tools. This could be overcome by developing information packs and tools to inform mainstream decision-making processes at regional, state and national levels Climate change modelling can now be produced at regional or other sub-continental scales for Australia. Use of regional climate change modelling data in concert with consideration of other threatening processes would improve the usefulness of climate change impact scenarios

Theme 3.3: Monitoring, evaluation and research priorities.	
Specific Actions	**Explanation**

• Using the BDAC report as a starting point organise a national conference split into two components:
  ➢ biological and climate research; and
  ➢ economic and social needs.
• The conference should have the following objectives:
  ➢ to identify research priorities for addressing climate change impacts;
  ➢ to establish if the research priorities are being or are likely to be taken up within the existing research programs (e.g. Australian Research Council, Greenhouse Science Program or generic NRM programs such as the NHT and NAP); and
  ➢ to work out areas of priority research dealing with impacts on biodiversity of climate change that fall outside existing funding.
• Build on the Australian Greenhouse Office initiative of publishing research onto a web site by creating an online facility for submitting research projects and results.
• Develop a national centralised data repository served through a dedicated web based clearing-house.
• Develop an Australian journal on biodiversity and climate change to provide an interface between science and policy as well as a forum to facilitate the exchange of ideas.
• Improve methods and techniques for identifying, collecting, managing and using information and data for measuring the impacts of climate change on biodiversity.
• Identify information gaps and specific research needs and how they can be addressed.
	The information gleaned from these actions could contribute to determining research priorities and possible new investment opportunities. Research is needed to assist priority setting, determine investment levels, and develop appropriate delivery mechanisms.

Question 15. How do we take the ideas and strategies discussed at a conference (as suggested above) and implement them?

Question 16. How are research results interpreted and implemented for natural resource management – how is the science heard and converted to action?

Strategy 4. Communication: building awareness, understanding and capacity.

Many biodiversity policy makers and program administrators currently regard climate change as a minor or long-distant future issue. It is also seen as an additional threat to be managed, rather than an on-going process to be accommodated in the management of all other threats to biodiversity. These perceptions can be addressed by providing information for policy makers, on the impacts of climate change on biodiversity and tools to assist with managing these impacts at a local level.

The aim of these activities is to ensure climate change impacts become part of mainstream biodiversity conservation management and a key part of integrated natural resource management.

Theme 4.1: Communication strategies and networks.	
Specific Actions	**Explanation**
• Incorporate information on climate change impacts on biodiversity into existing communication strategies and disseminate through current networks. For example: ➢ Commonwealth, state and territory NRM communication and capacity building strategies; ➢ dedicated NRM program communication strategies; ➢ NRM support and extension personnel (e.g. NRM Facilitators, Coordinators and other NRM extension personnel, Local Government Environmental Resource Officers; and ➢ NRM extension networks (e.g. Threatened Species Network, Land for Wildlife).	In addition to developing supporting information, it is important to ensure comprehensive dissemination of the information. The aim of this is to facilitate the removal of impediments to change, to assist adaptation to change, and to build the capacity of individuals, groups and organisations to participate effectively in biodiversity conservation in the face of climate change. Communication strategies and network links already exist (especially with proven NRM networks) and need to be utilised for informing management, planning and policy activities as well as educating and increasing awareness in the broader community on: ➢ the impacts of climate change on biodiversity ➢ why actions need to be taken; and ➢ what the possible on-the-ground actions might be that can help manage the impacts.

Question 17. Who should communication be targeted at (e.g. individual landholders, producer groups, Landcare/NHT/NRM Facilitators and Coordinators, policy officers)?

Question 18. In your experience, what are the most effective communication strategies that could be used for disseminating information on climate change impacts on biodiversity?

Theme 4.2: Informing decision-making processes in planning, management and implementation.	
Specific Actions	**Explanation**
• Develop a package of information and tools to support management, planning and policy activities at regional, state and national levels covering: ➢ generic and regionally specific climate change and biodiversity issues; ➢ the consequences of climate change impacts on biodiversity and how this translates to practical conservation and natural resource management; ➢ mechanisms for avoiding, or reducing the influence of, climate change impacts on biodiversity; and ➢ methods and techniques for identifying, collecting, managing and using information and data. • Build the capacity of regional planners and managers to use a range of prediction tools (e.g. Rainman, Rainman-streamflow, AussieGRASS, Bioclim).	Accurate and up-to-date information is needed for those engaged in management, planning and policy activities in order to assist decision-making processes.

Question 19. Are the actions presented above the right measures to address climate change impacts on biodiversity? If not, what additional actions would you suggest?

Appendices

Appendix A

Contact Details for Your State or Territory

Please direct your comments on the questions to be received **by Friday 17 October 2003** to the National Task Group care of:

Via e-mail (preferred method): chm@ea.gov.au

Via post: Attention: Gerard Crutch
Natural Resource Management Branch
Department of the Environment and Heritage
GPO Box 787, Canberra ACT 2601

Or: Send your comments to the National Task Group member in your State or Territory

Jurisdiction	Name	Contact Details	E-mail
Chair	Rod Anderson	Senior Policy Officer Greenhouse Policy Unit Department of Sustainability And Environment Level 13 - 8 Nicholson Street East Melbourne 3002 VICTORIA	rod.anderson@dse.vic.gov.au
Secretariat	Gerard Crutch	% Natural Resource Management Branch Department of the Environment and Heritage GPO Box 787, Canberra 2601 AUSTRALIAN CAPITAL TERRITORY	Gerard.crutch@ea.gov.au
Victoria	Ian Mansergh	Manager Biodiversity & Natural Resources Department of Sustainability And Environment Level 14 - 8 Nicholson Street East Melbourne 3002 VICTORIA	ian.mansergh@dse.vic.gov.au
New South Wales	Ian Hunter	A/Manager Strategic Policy Division National Parks and Wildlife Service PO Box 1967, Hurstville 2220 NEW SOUTH WALES	ian.hunter@npws.nsw.gov.au
Western Australia	Angas Hopkins	Project Officer Policy Division Department of the Premier And Cabinet 197 St Georges Terrace Governor Stirling Tower Perth 6000 WESTERN AUSTRALIA	ahopkins@dpc.wa.gov.au
Northern Territory	Tony Bowland	Regional Manager Natural Systems Department of Infrastructure, Planning and Environment P O Box 2130 Alice Springs 0871 NORTHERN TERRITORY	tony.bowland@nt.gov.au

Jurisdiction	Name	Contact Details	E-mail
Queensland	Julia Playford	Director Forestry and Wildlife Division Conservation Sciences Unit, Environmental Protection Agency PO Box 155, Brisbane 4002 QUEENSLAND	julia.playford@epa.qld.gov.au
South Australia	Adrian Stokes	Senior Ecologist Ecological Restoration Science and Conservation Directorate Department for Environment and Heritage GPO Box 1047, Adelaide 5001 SOUTH AUSTRALIA	stokes.adrian@saugov.sa.gov.au
CSIRO	Michael Dunlop	Research Scientist CSIRO Sustainable Ecosystems Gungahlin Homestead Barton Highway Canberra 2601 AUSTRALIAN CAPITAL TERRITORY	Michael.Dunlop@csiro.au

Appendix B

Guiding Principles

The following principles are proposed to guide the development and implementation of the NBCCAP. The principles reflect both current policy trends and accepted conservation practice providing a solid building block for action.

	Principle	Rationale
1	The plan will be adaptive, allowing for change as new information becomes available.	Adaptive management allows changes to be made as new information becomes available about impacts and potential measures to promote biodiversity conservation and adaptation within a climate change context. Impacts are uncertain. Adaptive management is consistent with NRM target-setting, monitoring and evaluation principles. A first stage in the adaptive approach could include the development of climate change and biodiversity indicators, assessments of the range of possible impacts on biodiversity of future climates, and early implementation of some adaptation actions.
2	The plan will be integrated with existing and future natural resource management and biodiversity conservation policies and programs, and coordinated with broader policy frameworks.	The Action Plan needs to be focused on conservation of biodiversity in a globally changing climate, but in the context of existing threatening processes and conservation priorities. Many of the actions necessary to maximize adaptation to climate change can be delivered through existing Commonwealth, State and Territory government natural resource management programs to achieve multiple benefits (e.g. National Strategy for the Conservation of Australia's Biological Diversity, relevant State and Territory Strategies, Australia's Forward Climate Change Strategy and the new generation National Greenhouse Strategy). The Action Plan should contribute to national greenhouse policies to ensure comprehensive, effective and coordinated biodiversity conservation outcomes. Furthermore, existing and future biodiversity conservation policies and programs need to be robust enough to address multiple threats and deliver multiple benefits.
3	Actions will be prioritised to maximize biodiversity conservation outcomes.	There is a need to conserve areas where biodiversity is under immediate threat from climate change impacts. Prioritisation informed by up-to-date and comprehensive information about the range of possible impacts of climate change on biodiversity and potential adaptation actions are critical. The effects of climate change could vary in different regions of Australia. Priorities will need to be reviewed as new information becomes available.
4	Actions will be delivered at a range of levels including at the national, state, regional and local levels.	Actions appropriate to national state and regional delivery need to be identified. A core component of the *Natural Heritage Trust* and *National Action Plan for Salinity and Water Quality* is the regional delivery of outcomes.
5	The plan will be informed by good science.	In order to predict the impacts of climate change, identify measures, evaluate the success of measures and adapt program delivery, the Action Plan will be underpinned by good science and good policy. The Action Plan will need to be flexible to new information as it becomes available. For example: decision making processes would benefit a great deal from being informed by robust information identifying those parts of our biodiversity most susceptible to climate change and an increased understanding of the way in which species, communities and ecosystems currently adapt to changing climatic conditions.

	Principle	Rationale
6	The plan will recognise the dynamic nature of biodiversity, both at a spatial and temporal scale including natural variation and evolutionary processes.	Ecosystem change and species evolution is natural and biodiversity management can accommodate for these changes. Climate change has the potential to increase the rate and magnitude of these changes beyond the capacity of ecosystems to adapt. Adaptation measures can aim to increase the resilience of ecosystems, increasing the likelihood of successful adaptation and decreasing the risk of ecosystem collapse. It is widely recognised that a diverse range of essential benefits are derived from ecosystem services by society (e.g. clean water and fertile stable soils). It is therefore critical that adaptation measures be adopted to conserve ecosystem integrity.

Appendix C

Australia's Forward Climate Change Strategy

The following is an extract from a joint media release by the Minister for the Environment and Heritage, Hon. Dr David Kemp, and Minister for Foreign Affairs, Hon. Alexander Downer, on 15 August 2002.

Four elements underpin the development of Australia's forward climate change strategy:

- Australia will strive for a more comprehensive global response to climate change;
- Australia will position itself to maintain a strong and internationally competitive economy with a lower greenhouse signature;
- Domestic policy settings will balance flexibility with sufficient certainty to allow key decisions on investment and technology development, and also emphasise cost effectiveness; and
- Australia will implement policies and programs that assist adaptation to the consequences of the climate change that is already unavoidable.

From an adaptation perspective Australia will prepare for unavoidable climate change impacts, including on agriculture, tourism, insurance, infrastructure, and on natural ecosystems. Research will be undertaken to improve understanding of likely impacts, and on mitigation and adaptation options.

Appendix D

Decision Analysis Approach

Extract from Morton *et al*. (2002): *Sustaining Our Natural Systems and Biodiversity: an independent report to the Prime Minister's Science, Engineering and innovation Council*.

The methodology used in the workshop

"The workshop adopted a **decision analysis style approach** to setting priorities for biodiversity conservation. This approach follows the general philosophy that underlies Hugh Possingham's Tela paper '*The business of biodiversity*' (2001), which argues that maximising long term biodiversity should be dealt with in a business-like way. While the currency of business is dollars and the currency of nature conservation is biodiversity, for a fixed financial investment we should aim to maximise our long-term biodiversity gains.

In the past, biodiversity conservation problems have not always been efficiently solved, often because the problem is not properly posed, objectives are not clearly stated, constraints are not identified and relevant data are not used in decision making.

Describing the system in cost and benefit terms presents a challenge, as the available data are woolly at best. However, the quantification of the different options does allow for comparison between them, at least to an order of magnitude. The set of options are not mutually exclusive and no importance should be attached to the sum of all the options.

The following process was used in considering each of the options put forward as a biodiversity priority.

1. Outline the ***nature of the current risk*** to biodiversity of each major threatening process.
2. Clearly state the ***objective(s)*** in addressing each risk. We took most objectives straight from *National objectives and targets for biodiversity conservation 2001-2005*.
3. In locations where the risk is greatest, list ***some management options*** to reduce or remove each risk. Make these options as specific and quantifiable as possible.

   Quantify the ***risk*** in terms of the number of native species at risk due to that particular threatening process - in the area addressed by each option. Species (or regional ecosystems in one case) are used as a surrogate for biodiversity because data on genetic diversity or ecosystem diversity are even less available than data on threatened species. The total numbers of species affected are estimated by extrapolating from available data on either threatened birds, other vertebrates or plants, using a multiplier based on their estimated proportions amongst all Australian biodiversity. The concept here is that when a plant or animal becomes extinct, many unrecorded species associated with it are also likely to become extinct: beetles, nematodes, spiders, fungi etc. However, the focus is not intended to be on threatened species *per se*. Rather, the numbers of threatened species have been used to indicate the **relative strength of the threatening process** that each management option addresses.

   From the number of species at risk, calculate a ***biodiversity benefit***, depending on the assumed effectiveness of the action.
4. Estimate the ***financial cost*** of the management option. Actions are either one-off costs, or require multi-year efforts. If the latter, costs have been estimated over a 10

year period. At this stage, costs do not include on-going maintenance costs, monitoring or R&D costs.

5. Calculate a ***cost per species secured*** for each option.
6. Describe the nature of the ***collateral benefits*** (those beyond biodiversity itself) that would flow from the management option, and estimate the value of the most important in orders of magnitude.

We emphasise that the purpose of the calculations was for comparison between options where options might differ by orders of magnitude."

Appendix E

Monitoring, evaluation and research

Monitoring and evaluation

Any Action Plan will need to be integrated and coordinated with broader policy frameworks and existing programs. For example, the *National Natural Resource Management Monitoring and Evaluation Framework* was established to assess progress towards resource condition and management targets under the *Natural Heritage Trust* and *National Action Plan for Salinity and Water Quality*. Small changes or adjustments to Monitoring and Evaluation programs under this framework could provide a cost effective and strategic advantage to initiatives addressing climate change impacts on biodiversity.

The Framework sets out protocols for data collection and management and will ensure that governments and community groups can access data easily. The Framework structure has been designed to answer 5 fundamental questions about programs, strategies and policies and is applicable to initiatives addressing climate change impacts on biodiversity:

1. Are programs being delivered effectively?;
2. Are the programs, policies and strategies delivering desired outcomes?;
3. How is resource condition changing in response to individual programs?;
4. How is resource condition changing at a national scale?; and
5. Are the models and assumptions underlying interventions still valid and appropriate?

Monitoring Climate Change Impacts

Monitoring of the actual impacts on biodiversity of climate change can be delivered through various routes. There would be significant advantage in a centralised data repository, as it is likely to be the consistency of responses across regions, time and taxa that provides the most robust evidence of actual biotic changes and the role of climate change in them (Howden *et al*. 2003)

A Possible Approach to Climate Impacts Research (National Science and Technology Council 2000)

This approach focuses on integrated regional analysis and a close partnership of natural and social scientists with local, regional, state/territory and national stakeholders. Integrated research activities would consider the full range of stresses affecting resources and systems including: climate change and variability, land-use change, air and water pollution and other human and natural impacts across all the spatial scales relevant to the resource or system being studied.

Central to this approach is being able to address, with increasing certainty, the following questions:

- how vulnerable are Australian species, communities and ecosystems to climate change impacts, now and in the future?
- what are the effects of current and potential climate change on spatial and temporal distribution patterns and on the existence of species and ecosystems? and,

- how do we minimise or reduce the risk of the impacts of climate change on biodiversity and ensure adequate management responses to these impacts?

The following issues provide a focus for research:

1. *Spatial and temporal distributions of taxa*: investigating correlations between data on the distributions of taxa and climate data within an area.
2. *Migration and dispersal potentials of taxa*: autecological research on the response capabilities of taxa investigating potential migration rates, probabilities of establishment and survival, consequences of the change in the old habitat and that newly established.
3. *Genetic diversity and variability of species and populations*: climate change impacts are likely to lead to increasingly isolated populations, influencing long-term genetic diversity. Investigating the effects of increasing reproductive isolation on population viability and the maintenance of genetic diversity within and between populations is critical for understanding the consequences of climate impacts.
4. *Physiological tolerances of species*: changes in climate factors (e.g. temperature, rainfall, humidity and solar radiation) and their seasonal patterns will affect physiological processes of flora, fauna and other organisms. In addition, the phenology of organisms, i.e. the timing and duration of different phases of their life cycles, will be altered. Research on species' physiological tolerance to changes in climate factors will enable risk assessments for species survival. This is especially relevant for rare species with a low capacity for dispersal or migration.
5. *Disturbance of functional interactions*: ecosystems are dynamic and complex systems comprising a myriad of interconnected and interacting parts. System components (e.g. species, communities) are affected by climate change in different ways, altering functional interactions and adding a level of uncertainty to predicting the results of interactions. The consequences of these changes may be positive or negative for the spatial and temporal persistence of species and is therefore an important area requiring further research.
6. *Ecosystem processes*: the effects of climate change on physiological tolerances and functional interactions of species can have consequences for ecosystem processes (e.g. primary production, nutrient cycling). A consequence of changes in ecosystem processes are effects on species, species assemblages and functional interactions through complex feedback systems. Assessing the consequences of temporal and spatial changes in ecosystem processes needs research.

Appendix F

IPCC Uncertainties and Confidence Scales

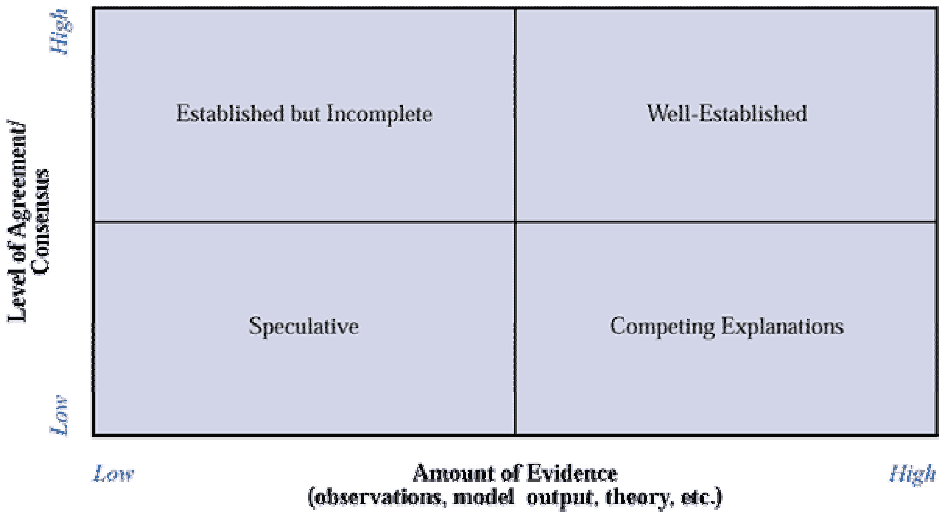
The many conclusions presented in this report [IPCC 2001] are subject to varying degrees of uncertainty. The degree of uncertainty attached to conclusions in this report are assessed and reported in two different ways. One is to assess and report a confidence level for a conclusion, using a Bayesian probability framework. (Bayesian assessments of probability distributions would lead to the following interpretation of probability statements: The probability of an event is the degree of belief that exists among lead authors and reviewers that the event will occur, given observations, modeling results, and theory currently available.) The second is to assess and report the quality or level of scientific understanding that supports a conclusion.

The 5-point confidence scale below is used to assign confidence levels to selected conclusions. The confidence levels are stated as Bayesian probabilities, meaning that they represent the degree of belief among the authors of the report in the validity of a conclusion, based on their collective expert judgment of all observational evidence, modeling results, and theory currently available to them.

5-Point Quantitative Scale for Confidence Levels

95% or greater	:	Very High Confidence
67–95%	:	High Confidence
33–67%	:	Medium Confidence
5–33%	:	Low Confidence
5% or less	:	Very Low Confidence

For some conclusions, the 5-point quantitative scale is not appropriate as a characterization of associated uncertainty. In these instances, authors qualitatively evaluate the level of scientific understanding in support of a conclusion, based on the amount of supporting evidence and the level of agreement among experts about the interpretation of the evidence. The matrix below has been used to characterize the level of scientific understanding.



Key to Qualitative "State of Knowledge" Descriptors

- Well-Established: Models incorporate known processes; observations are consistent with models; or multiple lines of evidence support the finding.
- Established but Incomplete: Models incorporate most known processes, although some parameterizations may not be well tested; observations are somewhat consistent but incomplete; current empirical estimates are well founded, but the possibility of changes in governing processes over time is considerable; or only one or a few lines of evidence support the finding.
- Competing Explanations: Different model representations account for different aspects of observations or evidence or incorporate different aspects of key processes, leading to competing explanations.
- Speculative: Conceptually plausible ideas that haven't received much attention in the literature or that are laced with difficult to reduce uncertainty.

Extract from: *Intergovernmental Panel on Climate Change 2001: Impacts, Adaptation and Vulnerability Report.*

"*…confidence is high that a range of impacts will occur in Australia and New Zealand as a result of climate change over the coming decades. This level of certainty, and the possibility that the early stages of greenhouse-related changes already may be occurring, justify prudent risk management through initiation of appropriate mitigation and adaptation strategies. Probabilistic assessments of risk, which account for the uncertainties, are regarded as a way forward. These assessments attempt to quantify the various sources of uncertainty to provide a conditional probability of climate change that would cause critical system performance thresholds to be exceeded and require adaptation or result in losses*."

Some examples for Australia and New Zealand are presented at:
http://www.grida.no/climate/ipcc_tar/wg2/1252
http://www.grida.no/climate/ipcc_tar/wg2/1261
http://www.grida.no/climate/ipcc_tar/wg2/1282, and
http://www.grida.no/climate/ipcc_tar/wg2/1284, but more are needed.

Appendix G

Glossary

Term	Meaning in this Discussion Paper
Abatement	Reducing greenhouse gas emissions.
Accreditation	Approval of integrated catchment/regional natural resource management (NRM) plans by the Commonwealth and the relevant State/Territory government in order to seek funding under NRM programs such as the NAPSWQ and the NHT.
Adaptation	Reducing the vulnerability of biodiversity and ecosystems to climate change impacts. In this context, adaptations are responses that decrease the negative effects and capitalise on positive opportunities associated with climate change impacts.
Adequate reserve system	The reserve system includes a sufficient amount of each ecosystem is protected to ensure the long-term maintenance of ecological viability and integrity of populations, species and communities. *(National Reserve System)* Forests: as a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in a CAR reserve system. (*JANIS Forests Criteria*)
Amelioration	Making or becoming better (i.e. improvement in ecosystem function).
Aussie GRASS	A project in Queensland using advanced computer simulation techniques and a Cray supercomputer to build on 50 years of agronomic research conducted throughout the State in order to enable the condition of Queensland's grasslands to be assessed and monitored.
Bilateral agreement	Agreement between two parties. In the context of the Framework, an agreement between the Commonwealth and one of the States/Territories defining the regional boundaries and identifying or establishing appropriate regional bodies responsible for developing the catchment/regional NRM plans. See Framework paragraphs 13(v), 20 and 22 first dot point.
BIOCLIM	A decision support tool / expert system that identifies all geographical areas with a similar climate to the locations of specific species.
Biodiversity **Biological diversity**	The variety of all life forms – the different plants, animals and micro-organisms, the genes they contain and the ecosystems of which they form a part. (*The National Strategy for the Conservation of Australia's Biodiversity*) Biodiversity is generally considered at three levels: genetic diversity, species diversity and ecosystem diversity. It is sometimes considered at the landscape diversity level. (*JANIS Forests*) **Ecosystem diversity** means the variety of ecosystems in an area. **Community diversity** means the variety of communities in an area. **Species diversity** means the variety of species and their relative abundance in an area. **Genetic diversity** means the variety of genetic information contained in the total genes of individual plants, animals and micro-organisms in an area. (*Natural Heritage Charter)*
Comprehensive reserve system	The reserve system encompasses the full range of native ecosystems discernible at the bioregional scale. *(National Reserve System)*
Conserve	Look after a place so as to retain its natural significance. Always includes protecting, maintaining and monitoring. (*Natural Heritage Charter)*
Conservation management	The techniques for achieving conservation of biological diversity and geo-diversity. These may include physical intervention, binding legal agreements, planning instruments, land acquisition and the like. *(Natural Heritage Charter)*
Degradation	Any decline in the quality of natural resources or the viability of ecosystems, caused directly or indirectly by human activities. *(Natural Heritage Charter)*

Term	Meaning in this Discussion Paper
Disturbance	Accelerated change caused by human activity or extreme natural events. *(Natural Heritage Charter)* A process that alters a physical or biological state resulting in temporary or permanent accelerated competition for resources between individuals and species.
Ecological community	The living parts of an ecosystem. ("Community": *Natural Heritage Charter)* An assemblage of native species that inhabits a particular area in nature. *(EPBC Act)*
Ecological processes	All those processes that occur between organisms, and within and between populations and communities, including interactions with the non-living environment, that result in existing ecosystems and bring about changes in ecosystems over time. *(Natural Heritage Charter)*
Ecologically sustainable development (ESD)	A combination of using, conserving and enhancing resources so that the ecological processes on which life depends are maintained, and the total quality of life – now and in the future – can be increased. *(Heritage)*
Sustainable Forestry	Three requirements for sustainable forest use: maintaining the ecological processes in forests (the formation of soil, energy flows, and the carbon, nutrients and water cycles); maintaining the biological diversity of forests; and optimising the benefits to the community from all uses of forests within these ecological constraints. (*JANIS Forests*)
Ecosystem	The aggregate of plants, animals and other organisms, and the non-living parts of the environment with which these organisms interact. (*JANIS Forests*)
Ecosystem services	The conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. *(Gretchen Daily, 1997)*
Endangered species and ecological communities	**Endangered**: A threatened native species or ecological community facing a very high risk of extinction in the wild in the near future. *(EPBC Act sections 179 (4), 182 (2))* An endangered forest ecosystem is one where: (i) its distribution has contracted to less than 10% of its former range; or (ii) the total area has contracted to less than 10% of its former range; or (iii) 90% of its area is in small patches which are subject to threatening processes and [the patches] are unlikely to persist. (*JANIS Forests Criteria*) **Critically endangered**: A threatened native species or ecological community facing an extremely high risk of extinction in the wild in the immediate future. *(EPBC Act sections 179 (3), 182 (1)*
Evolutionary processes	Genetically-based processes by which life forms change and develop over generations. *(Natural Heritage Charter)*
Extinct	**Extinct**: There is no reasonable doubt that the last member of the species has died. *(EPBC Act)* **Extinct in the wild**: The species is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form. *(EPBC Act section 179 (2))*
Habitat	The subset of physical environmental factors that permit an organism to survive and reproduce. Implicitly these factors are associated with a geographic location. *(Burgmann and Lindenmeyer 1998)*
Alien species	A translocated or alien species occurring at a place outside its historically known natural range as a result of intentional or accidental dispersal by human activities. *(Natural Heritage Charter)* Most are introduced (ie alien or non-native) species such as weeds and feral animals. Some are native species that occur beyond their natural range.
Maintain	Provide continuous protective care of the biological diversity and geo-diversity of a place. *(Natural Heritage Charter)*

Term	Meaning in this Discussion Paper
Mitigation	To moderate (a quality or condition) in force or intensity. Mitigation involves reducing the greenhouse gas emissions from man-made or biological sources or enhancing the sinks of greenhouse gasses.
Monitoring	Ongoing review, evaluation and assessment to detect changes in condition of the natural integrity of a place, with reference to a baseline condition. Monitoring is used to allow review of decisions assisted by knowledge of the effects of conservation processes and actions. *(Natural Heritage Charter)*
Native species	A species that occurs at a place within its historically known natural range and that forms part of the natural biodiversity of a place *("Indigenous species", Natural Heritage Charter)*
Population	An occurrence of a species or ecological community in a particular area. *(EPBC Act)*
Preserve	Maintain the biodiversity and/or an ecosystem of a place at the existing stage of succession. *(Natural Heritage Charter)*
Protect	Take care of a place by maintenance and by managing impacts to ensure that natural significance is retained. *(Natural Heritage Charter)*
Protected area	An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. *(IUCN 1994)*
Rainman	A software program that provides long-term daily rainfall trends including information on the southern oscillation index, sea-surface temperatures and monthly average temperatures for 3,700 locations around Australia.
Rainman-streamflow	A module of the Rainman software program that forecasts stream flow and run off.
Regeneration	The recovery of the natural integrity following disturbance or degradation. *(Natural Heritage Charter)* Regrowth of new trees and understorey after an event which causes the loss or death of plants *(adapted: Macmillan Dictionary of the Australian Environment)*. Can occur naturally after a threatening process ceases e.g. following fencing which reduced grazing.
Rehabilitate	Return existing habitats to good condition by repairing degradation, by removing introduced species or by reinstatement of native species.
Reinstate	Introduce to a place one or more species or elements of habitat or geo-diversity that are known to have existed there naturally at a previous time but that can no longer be found at that place. *(Natural Heritage Charter)*.
Representative reserve system	The reserve system includes samples of the biotic diversity within each ecosystem. *(National Reserve System)*
Restore	Return existing habitats to a known past state or to an approximation of the natural condition by repairing degradation, by removing introduced species or by reinstatement. *(Natural Heritage Charter)*
Revegetate	Introduce to a place plant species that are known to have existed there naturally at a previous time.
Species	A group of biological entities that interbreed to produce fertile offspring or possess common characteristics derived from a common gene pool. *(EPBC Act)*
Succession	The natural changes over time where one community is replaced by another. *(Natural Heritage Charter)*

Term	Meaning in this Discussion Paper
Target	**Target**: a minimum result being aimed at. **Resource condition target**: a minimum result aimed at for the physical state of the natural resource. For instance, vegetation understorey present in a defined area with a certain number of locally native species. See Framework, paragraph 12(b). **Management action target**: a minimum result aimed at for an action taken. For instance, a defined area fenced to exclude large grazing animals. See Framework, paragraph 12(c). **Aspirational target**: see Framework, paragraph 12(a). **National matters for targets**: Commonwealth, State and Territory agreed aspects of natural resources for which each regional body will set specific targets in their integrated catchment/regional natural resource management (NRM) plan. In most cases these are physical aspects of the natural resource; in some cases these are types of management action. For instance: "extent and distribution of native vegetation communities".
Threat / Threatening process	A process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community. (*JANIS Forests*)
Threatened species and ecological communities	A species that is conservation dependent, vulnerable, endangered or presumed extinct. An ecological community that is vulnerable, endangered or presumed extinct. *(EPBS Act)*
Viable	The long-term survival of a particular population, species or ecosystem is likely. *(National Reserve System)*
Vulnerable species and ecological communities	A threatened native species or ecological community facing a high risk of extinction in the wild in the medium-term future. *(EPBC Act sections 179 (5) and 182 (3))* A vulnerable forest ecosystem is one (i) approaching 30% or less of its pre-1750 extent in the bioregion and is subject to threatening processes or (ii) subject to continuing and significant threatening processes which may reduce its extent. Where forest ecosystems are recognised as vulnerable, then at least 60% of their remaining extent should be reserved. (*JANIS Forests Criteria*)

Australian Natural Heritage Charter: http://www.ahc.gov.au/infores/publications/anhc/index.html

A glossary of general heritage terms: http://www.ahc.gov.au/infores/glossary.html

Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Section 528 definitions: http://SCALEplus.law.gov.au/html/pasteact/3/3295/top.htm

Information about the EPBC Act: http://www.ea.gov.au/epbc/about/index.html#act

JANIS Forests glossary and criteria: ANZECC and MCFFA (1997) *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia*. A Report by the Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee. Regional Forest Agreements process. Commonwealth of Australia, Canberra.

National Reserve System glossary: http://www.ea.gov.au/parks/nrs/sciguide/index.html

Appendix H

Abbreviations

AGO	Australian Greenhouse Office
ABARE	Australian Bureau of Agriculture and Resource Economics
ABS	Australian Bureau of Statistics
DAFF	Commonwealth Department of Agriculture, Fisheries and Forestry (formerly AFFA: Agriculture, Fisheries and Forestry – Australia)
ANZECC	Australian and New Zealand Environment and Conservation Council (now defunct)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand (now defunct)
BDAC	Commonwealth Biological Diversity Advisory Committee
BRS	Bureau of Rural Sciences (formerly: Bureau of Resource Sciences)
CAR	comprehensive, adequate and representative [reserve system]
CBD	Convention on Biological Diversity
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEH	Commonwealth Department of the Environment and Heritage (formerly EA: Environment Australia)
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
GBRMPA	Great Barrier Reef Marine Park Authority
IBRA	Interim Biogeographic Regionalisation of Australia
IGA	Intergovernmental Agreement (e.g. National Action Plan for Salinity and Water Quality)
INRM	Integrated Natural Resource Management
IPCC	Intergovernmental Panel on Climate Change
LWBC	Land, Water and Biodiversity Committee
NAP	National Action Plan [for Salinity and Water Quality]
NBCCAP	National Biodiversity and Climate Change Action Plan
NHT	Natural Heritage Trust
NLWRA	National Land and Water Resources Audit
NRM	Natural Resource Management
NVIS	National Vegetation Information System
NWQMS	National Water Quality Management Strategy
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
RDC	Research and Development Corporation
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (convened under the Convention on Biological Diversity)
SMART targets	Specific, Measurable, Achievable, Realistic and Time-bound targets
SoE	State of the Environment
UNEP	United Nations Environment Program
UNFCC	United Nations Framework Convention on Climate Change

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