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

Enquiries regarding ANZECC should be directed to

The Secretary
Australian and New Zealand Environment and Conservation Council
C/- Environment Australia
GPO Box 787
Canberra ACT 2601

Enquiries regarding MCFFA should be directed to

The Secretary
Ministerial Council on Forestry, Fisheries and Aquaculture
C/- Department of Primary Industries and Energy
GPO Box 858
Canberra ACT 2601

ISBN: 0 642 26670 0

FOREWORD

For over two decades in Australia the competing demands of conservation and industry on our forests have been an area of debate and controversy. The National Forest Policy Statement (NFPS), agreed by the Commonwealth, State and Territory Governments, provides the framework for a long term solution to this issue.

The NFPS sets out the process for undertaking joint Commonwealth and State/Territory Comprehensive Regional Assessments (CRAs) of natural and cultural, and economic and social values of Australia's forests as the basis for negotiation of Regional Forest Agreements (RFAs). RFAs are to be developed between the States/Territories and the Commonwealth and they will encompass the establishment and management of a forest reserve system which is comprehensive, adequate and representative (CAR), the ecologically sustainable management of forests outside the reserve system, and the development of an efficient, internationally competitive timber industry.

The detailed information required to negotiate each RFA will be drawn together through a CRA of the full range of forest values of a region. The CRAs are intended to provide a synthesis of the relevant information upon which the development of different land allocation, forest management and industry and community development scenarios, or options, can be developed.

Following the options development phase, a draft RFA report will be released for public comment. This consultation phase will be critical as it will allow detailed discussion with stakeholders on appropriate options. The Commonwealth and relevant State/Territory Government will then negotiate final RFAs.

In accordance with the NFPS, the Governments have agreed to the development of National Forest Reserve Criteria. These Criteria are to form an essential part of the RFA process as they will be used to guide the establishment of the CAR reserve system within the RFA process.

This paper, which defines National Forest Reserve Criteria, is therefore an important contribution to implementation of the NFPS. The Criteria are applicable to all forests, and associated woodlands, within each region for which an RFA is to be developed.

These criteria were endorsed by the Australian and New Zealand Environment and Conservation Council (ANZECC) at its meeting on 29 November1996, and by the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) out-of-session during late 1996/early 1997.

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1. INTRODUCTION

The National Forest Policy Statement (NFPS) (Commonwealth of Australia 1992) is an agreement by the Commonwealth, State and Territory Governments on broad goals for the management of Australia's forests. The goals embrace the concept of ecologically sustainable development, and the aim is to manage Australia's native forests to conserve biological diversity, heritage, and cultural values, and at the same time develop a dynamic, internationally-competitive forest products industry based on native forests managed on a sustainable basis.

Major elements of the NFPS include a commitment to the development of a comprehensive, adequate and representative (CAR) reserve system, and implementation of strategies to protect old-growth forests and wilderness as part of the reserve system.

This paper sets out nationally-agreed criteria for a conservation reserve system for forests. It has been drawn from a discussion paper by Woinarski & Norton (1993) "Towards a National System of Forest Reserves", the JANIS Technical Working Group draft Report (1995) "Broad Criteria for the Establishment of a Comprehensive, Adequate and Representative Forest Reserve System in Australia", the Commonwealth position paper (1995) "National Forest Conservation Reserves Commonwealth Proposed Criteria" and extensive public submissions on both of the later reports. In addition, there has been considerable discussion between the JANIS TWG and the Commonwealth Scientific Advisory Group as well as further deliberations by JANIS.

Although many forest ecosystems are already represented in conservation reserves across Australia, these criteria will provide an objective basis for evaluating and subsequently ensuring conservation of biological diversity and other values within the reserve system.

2. THE FOREST CONSERVATION FRAMEWORK

2.1 THE CAR RESERVE SYSTEM AND CONSERVATION MANAGEMENT

The objectives of biodiversity conservation for forests are:

- to maintain ecological processes and the dynamics of forest ecosystems in their landscape context;
- to maintain viable examples of forest ecosystems throughout their natural ranges;
- to maintain viable populations of native forest species throughout their natural ranges; and
- to maintain the genetic diversity of native forest species.

These objectives will be most efficiently and effectively achieved through the development of integrated regional conservation strategies, which provide for the establishment and effective management of conservation reserves (the CAR reserve system) and complementary management of adjoining forest areas.

The NFPS adopts this approach and requires management for the conservation of all species of Australia's indigenous forest flora and fauna throughout their range.

The NFPS also specifically defines the need for the CAR reserve system to protect old-growth forest and forested wilderness to reflect "the significance of these areas to the Australian community because of their very high aesthetic, cultural and nature conservation values and their freedom from disturbance" (NFPS, p11). It also recognises the need for the CAR reserve system to safeguard endangered and vulnerable species and ecosystems.

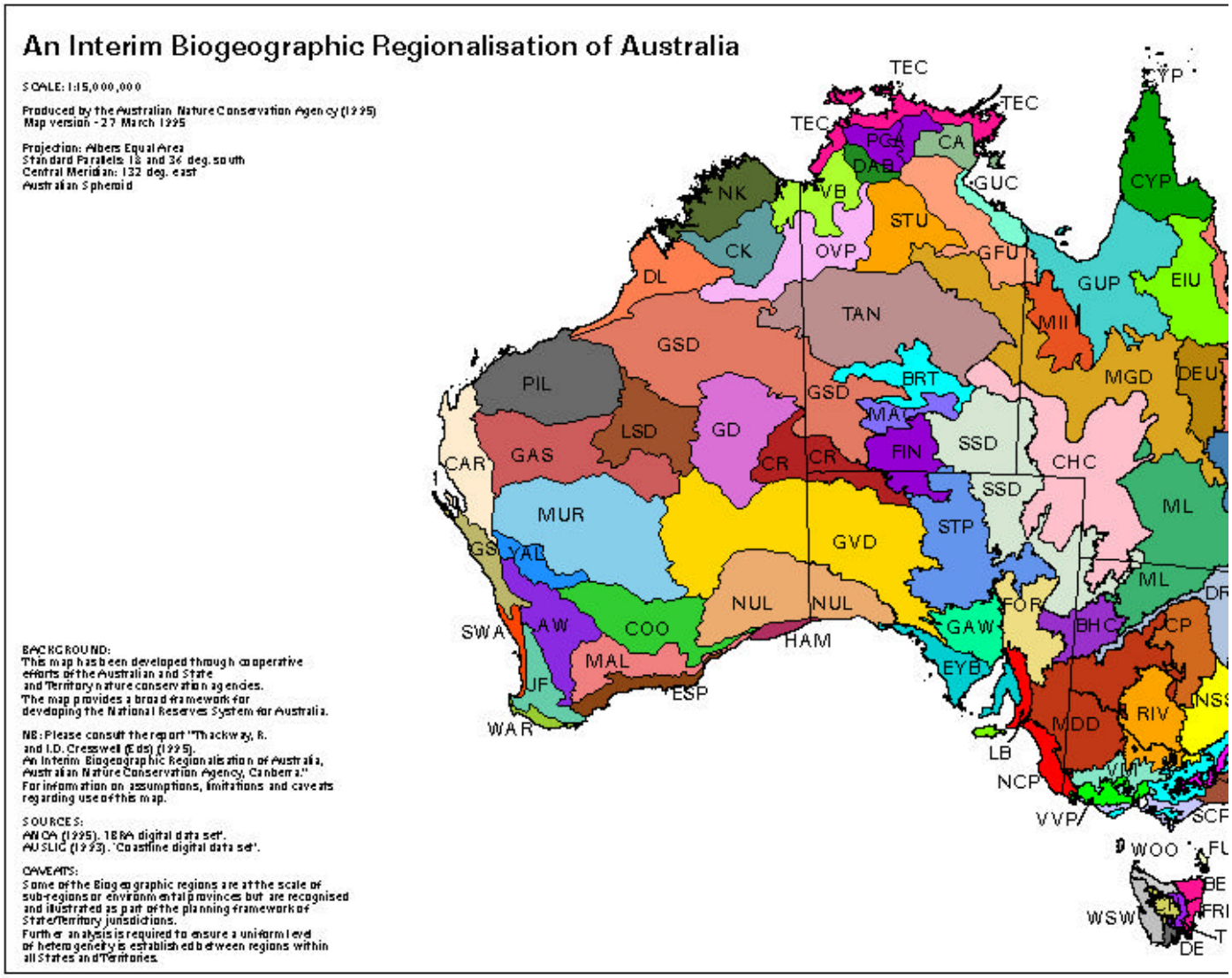
2.2 A REGIONAL APPROACH TO CONSERVATION

There has been considerable development of bioregional frameworks by each of the States and Territories as a basis for nature conservation planning. This work has led to the development of an agreed interim national bioregional framework, which reflects the environmental determinants for broad patterns in landscape, ecosystem and species diversity. This framework (IBRA, 1995) is shown in Map 1.

Further refinement of the IBRA framework is likely to occur as improved information becomes available. This refinement will assist in removing inconsistencies in the current regionalisation, such as the wide variation in the range of environments contained within regions in each of the States and the Territories.

To address the principle of representativeness (3.3 below) it may be necessary to sub-divide the larger regions. Examples of this include Queensland (bioclimatic and geomorphological provinces) and Victoria (geographical units derived from bioclimatic and geomorphological features, as described in the East Gippsland Forest Management Plan).

However, the IBRA regions will be used to help identify those regions to which the criteria should be applied when the CAR reserve system is being defined. The regions which underpin the definition of the CAR reserve system may be combinations of, or parts of, IBRA regions.



Key to Map 1:
An Interim Biogeographic Regionalisation of Australia

Key	IBRA Region	JF	Jarrah Forest
		LB	Lofty Block
AA	Australian Alps	LSD	Little Sandy Desert
AW	Avon Wheatbelt	MAC	MacDonnell Ranges
BBN	Brigalow Belt North	MAL	Mallee
BBS	Brigalow Belt South	MDD	Murray-Darling Depression
BEN	Ben Lomond	MGD	Mitchell Grass Downs
BHC	Broken Hill Complex	MII	Mt Isa Inlier
BRT	Burt Plain	ML	Mulga Lands
CA	Central Arnhem	MUR	Murchison
CAR	Carnarvon	NAN	Nandewar
CH	Central Highlands	NCP	Narracoorte Coastal Plain
CHC	Channel Country	NET	New England Tableland
CK	Central Kimberley	NK	North Kimberley
CMC	Central Mackay Coast	NNC	NSW North Coast

COO	Coolgardie	NSS	NSW South-western Slopes
CP	Cobar Peneplain	NUL	Nullarbor
CR	Central Ranges	OVP	Ord-Victoria Plains
CYP	Cape York Peninsula	PCA	Pine Creek-Arnhem
DAB	Daly Basin	PIL	Pilbara
DE	D'Entrecasteaux	RIV	Riverina
DEU	Desert Uplands	SB	Sydney Basin
DL	Dampierland	SCP	South-east Coastal Plain
DRP	Darling Riverine Plains	SEC	South East Corner
EIU	Einasliegh Uplands	SEH	South Eastern Highlands
ESP	Esperance Plains	SEQ	South Eastern Queensland
EYB	Eyre and York Blocks	SSD	Simpson-Strezlecki Dunefields
FIN	Finke	STP	Stony Plains
FOR	Flinders and Olary Ranges	STU	Sturt Plateau
FRE	Freycinet	SWA	Swan Coastal Plain
FUR	Furneaux	TAN	Tanami
GAS	Gasgoyne	TEC	Top End Coastal
GAW	Gawler	TM	Tasmanian Midlands
GD	Gibson Desert	VB	Victoria Bonaparte
GFU	Gulf Fall and Uplands	VM	Victorian Midlands
GS	Geraldton Sandplains	VVP	Victorian Volcanic Plain
GSD	Great Sandy Desert	WAR	Warren
GUC	Gulf Coastal	WOO	Woolnorth
GUP	Gulf Plains	WSW	West and South West
GVD	Great Victoria Desert	WT	Wet Tropics
HAM	Hampton	YAL	Yalgoo

3. CAR PRINCIPLES

The NFPS establishes that the forest reserve system should be based on the principles of comprehensiveness, adequacy and representativeness as described below.

3.1 COMPREHENSIVENESS

> *Comprehensiveness - includes the full range of forest communities recognised by an agreed national scientific classification at appropriate hierarchical levels (NFPS 1992).*

This principle requires that the reserve system samples the full range of forest communities across the landscape. However, the wide variation in forest ecosystems across the continent, and the large gaps between forested regions, makes effective consideration of comprehensiveness on a continental scale most difficult. Smaller and more manageable regional units (see Section 2.2) are therefore necessary as a basis for consideration of comprehensiveness.

Forest ecosystems, forest types and forest vegetation communities, together with their environmental descriptors, are commonly used as surrogates for biodiversity and as a basis for planning a comprehensive reserve system (see Glossary for specific definitions). However, these terms have different meanings across Australia. For the purposes of this document, they have been grouped under the term "forest ecosystems". These differences in definition mean that the surrogates used to assist with establishing the CAR reserve system will need to be determined on a regional basis.

3.2 ADEQUACY

> *Adequacy - the maintenance of ecological viability and integrity of populations, species and communities (NFPS 1992).*

Adequacy addresses the difficult question of extent: what is the level of reservation that will ensure viability and integrity of populations, species and communities. There are many approaches, ranging from best-guess estimates for poorly-defined ecosystems, to very accurate calculations for endangered or specific populations of animals and plants. Where data on the viability of populations are available, they should be incorporated in determining the adequacy of a reserve system.

No precise basis exists for determining criteria that provide for adequacy. However, the general rule is that the chances of long-term survival increase with increased proportions of populations or forest ecosystems reserved and appropriately managed. The degree of risk varies with different species (or suites of species) and with the degree of modification of the contiguous native forest beyond reserves. Most estimates show that the risk of loss is highest where only a small percentage of the distribution of the community or species is reserved and adjoining unreserved forest is cleared or significantly modified.

Replication across the range of geographic, environmental and biotic domains must also be considered when determining the adequacy of the reserve system. Replication is essentially "insurance" against the loss of natural values due to stochastic events (such as fire) which may dramatically reset successional processes and reduce or entirely remove key habitats. Implicit in the maintenance of biodiversity is the requirement to sustain ecological processes and functions and provide for the maintenance of natural patterns of speciation and extinction. This requires that the adequacy of a reserve system be considered in a landscape context (e.g., Saunders and Hobbs, 1991). The extent of inclusion of whole catchments, the degree of sympathetic management of

adjacent lands, and the options for provision of corridors to provide linkages are important in the development of integrated nature conservation strategies. Factors operating within the surrounding landscape that are particularly relevant to determining the adequacy of the reserve system are threatening processes (e.g., land clearing and disease), and the conservation strategies adopted in forests outside those areas reserved specifically for conservation.

3.3 REPRESENTATIVENESS

> *Representativeness - those sample areas of the forest that are selected for inclusion in reserves should reasonably reflect the biotic diversity of the communities (NFPS 1992).*

This principle is designed to ensure that the diversity within each forest ecosystem is sampled within the reserve system. An example of the application of techniques that consider representativeness is presented by McKenzie and Belbin (1991).

Many species, particularly animals, have distributions that are not easily predicted by surrogates such as forest ecosystems, and information on species distributions and genetic variation should be used in reserve design. There are good distributional data for a large number of forest species, genotypes and communities, and reserve selection methods such as described in Kirkpatrick (1984), Margules *et al* (1988) and Pressey and Nicholls (1989) can be used to ensure that all species whose distributions are relatively well known are represented in the reserve system. The focus of these methods should be on those species that that depend on reservation for protection.

Using species distributions alone will not guarantee the inclusion of all elements of biodiversity. However, using these distributions together with other measures of forest diversity can increase confidence that the reserve system does cover the full range of biodiversity. Other measures of forest diversity may include, for example, the occurrence of a vegetation type in relation to different soil types or the variation in structure and floristics present within a forest ecosystem. In practice a combination of approaches needs to be used to assess the representativeness of the reserve system.

It is not necessary to ensure that every element of biodiversity that occurs within a forest ecosystem is reserved within that ecosystem. Many species may be well represented in one forest ecosystem in a region and infrequent in another, and it is not necessary to distort reserve boundaries to ensure that they are reserved in each ecosystem occurrence. The important thing is that known species and genotypes are adequately reserved with the aim of maximising their viability within a region, not that they are reserved in every forest ecosystem in which they have been recorded.

Representativeness should be approached in a practical way. Available or readily acquirable data, depending on its type, quality, and resolution, should be used in the design of a reserve system.

4. COMPONENTS OF THE CAR SYSTEM

The CAR reserve system comprises areas of both public and private land that are reserved specifically for conservation purposes, and where the tenure of the reserved areas is secured by legislation or other methods appropriate for the area concerned.

The following principles should apply when the CAR reserve system in a region is being identified.

All reasonable effort should be made to provide for biodiversity and old-growth forest conservation and wilderness in the Dedicated Reserve system on public land. However, where it is demonstrated that it is not possible or practicable to meet the criteria in the Dedicated Reserve system, other approaches will be required. For example, conservation zones in approved forest management plans and covenants on private land that bind successors in title could be used, in conjunction with Dedicated Reserves, to define the CAR reserve system for a particular region.

Throughout the document, reference to the CAR reserve system should be taken to include the elements described below.

4.1 PUBLIC LAND

4.1.1 Dedicated Reserves

A large number of types of reserve exist under Commonwealth, State and Territory jurisdictions. Those which form the Dedicated Reserve component of the CAR reserve system should be equivalent to Categories I, II, III or IV as defined by the IUCN Commission for National Parks and Protected Areas (1994) (see Appendix 1).

Security of tenure is an important consideration in the establishment of a Dedicated Reserve as are appropriate management regimes. The tenure of the Reserve is considered to be secure if Parliamentary action by either the Commonwealth, a State or a Territory Government is required to revoke the Reserve.

Some reserves established for nature conservation within State Forest tenures in some States will meet the standard required of a Dedicated Reserve.

4.1.2 Informal Reserves

In situations where it is not possible or practicable to include conservation values into Dedicated Reserves, it is appropriate for areas to be reserved under other secure tenure or management arrangements (e.g., within approved forest management plans). In practice such areas should be set aside specifically for conservation purposes and meet the following principles:

- they are established in approved management plans and managed accordingly;
- there is an opportunity for public comment on changes to reserve boundaries;
- they are able to be accurately identified on maps;
- they are of an area and design sufficient to maintain the values they seek to protect.

Some of these reserves could have flexible boundaries that might change over time to reflect forest dynamics and the effects of climate change, but any changes must satisfy the criteria which exist to protect conservation values.

4.1.3 Values Protected by Prescription

Where the nature of a forest value that is needed to contribute to the CAR reserve system makes inclusion in either Dedicated or Informal Reserves impractical (for example, very rare values, values with fragmented distributions, or values naturally occurring in linear form such as riparian vegetation), then protection may be prescribed in Codes of Practice or Management Plans and where appropriate, identified on maps.

These prescriptions should meet the following principles:

- there is an opportunity for public comment on proposed changes;
- they have a sound scientific basis;
- they are adequate to maintain the values they seek to protect.

4.2 PRIVATE LAND

The NFPS establishes that the CAR reserve system should in the first instance be selected from public land. However, in many regions it will need to include private land. The two key priorities for biodiversity protection in private forests are to ensure comprehensiveness so that replicated samples of all forest ecosystems are included in viable reserves across their geographic range and to meet the special needs for rare, vulnerable or endangered species or ecosystems on private land.

Many of the most threatened forest species and ecosystems throughout Australia occur on private lands, especially in coastal areas and across agricultural lands. There is an urgent need for specific measures to address their conservation in the development of the CAR reserve system as opportunities for their conservation are rapidly foreclosing. For example, in Queensland more than 100 forest and woodland ecosystems are considered to be endangered or significantly restricted in distribution, and most of these occur on private lands (Sattler and Williams, in press).

A number of strategies are appropriate for protecting biodiversity on private land, ranging from purchase of priority areas to the development of incentives for the establishment of mechanisms to ensure protection, such as covenants on leasehold and freehold lands. For example, a covenant should be binding on successors in title and that appropriate management intent should be demonstrated before the area concerned could be considered to be part of the CAR reserve system. The rights of landholders will be respected whatever mechanisms are adopted.

The level of protection possible on private land will be limited by the resources available. Conservation effort therefore needs to be highly focused on the priority forest species and ecosystems.

5. APPLYING THE CAR RESERVE CRITERIA

5.1 UNDERLYING PRINCIPLE

To ensure that nature conservation effort is focused on regional priorities and not based solely on meeting criterion percentage targets, it is desirable that an overall regional assessment of forests conservation needs be carried out. This information should be used to effectively plan integrated bioregional conservation strategies that encompass the establishment of a CAR reserve system.

In applying the criteria the scientific requirements for the protection of biodiversity (e.g., sites of high biodiversity, complementarity, rarity), should first be identified together with the other values to be addressed through the establishment of the CAR reserve system. Subsequently, the contribution that such a reserve network makes to the extent of protection afforded to each ecosystem should then be assessed to ensure that all forest ecosystems are conserved across Australia relative to their identified values and vulnerability.

5.2 FLEXIBILITY

Flexibility in the application of reserve criteria is needed in consideration of differing regional circumstances to ensure that the CAR reserve system delivers optimal nature conservation outcomes as well as acceptable social and economic outcomes. Therefore the criteria described in Section 6 are to be considered as guidelines rather than mandatory targets.

Though all forest species and ecosystems should be represented in the reserve system, the effort to achieve this for the last few percent of communities and habitats may reach a point of diminishing return, and in these situations nature conservation objectives may be more efficiently and effectively achieved through other strategies.

Flexibility is also necessary to allow for changes to the CAR reserve system as a result of changes in knowledge and changes in biota (such as through climate change). Although changes may include boundary rationalisations, the CAR reserve system must be predicated on the principle that security of tenure and management intent is fundamental.

In the final selection of reserves, biodiversity, old-growth forest and wilderness values will be considered iteratively to most effectively capture the range of values within the proposed CAR reserve system. Providing that all criteria are considered when making the final reserve design, biodiversity should take precedence. This is of particular significance if the extent of socio-economic impacts are such that trade-offs are required to meet all criteria.

5.3 URGENCY AND PRACTICABILITY

The urgency of the task dictates a practical approach to the development of the CAR reserve system. The criteria established in this paper are designed to ensure a consistent approach between regions, but they are broad enough to allow the best available data to be used in each region. In most instances, local expertise and knowledge will need to be used to extend the existing mapped data. In regions where the data are too limited for adequate assessment then additional data should be urgently obtained to enable planning to proceed with confidence.

Where gaps have already been identified, and current threatening processes may preclude future reservation options, immediate action should be taken to ensure that the CAR reserve system is established. This will require the allocation of appropriate resources to afford protection to the range of important species, habitat and forest ecosystems on all land tenures.

5.4 ECONOMIC AND SOCIAL CONSIDERATIONS

There will be many possible configurations of a CAR reserve system within any particular region and, therefore, considerable scope to satisfy the reserve criteria while obtaining optimal economic and social outcomes. It should be recognised that the extent of potential social and economic impacts may limit the ability to meet reserve criteria. Determination of the CAR reserve system will therefore require a comprehensive planning approach which integrates conservation requirements with social and economic considerations. The analytical processes which integrate the application of the reserve criteria with social and economic considerations should be transparent.

The principle of least cost should be used and, where different configurations of reserves can be identified as meeting the criteria, the option which imposes the least cost on the community should be adopted. The economic and social costs and benefits of alternative reserve options could include:

- the benefits accruing from non-timber uses of reserves;
- the direct costs associated with the choice, implementation and management of a reserve system;
- the opportunity costs of existing forest uses;
- the costs associated with broader employment impacts and industry adjustment; and
- the cost of sustainable forest management options.

6. CRITERIA FOR THE CAR RESERVE SYSTEM FOR FORESTS

This section proposes national criteria for the conservation of forest biodiversity, old-growth forests and wilderness. They have been developed bearing in mind the uncertainties regarding forest values and their conservation status, the differences between regions in the nature of their forests and the different levels of data which are available in the States and Territories.

6.1 BIODIVERSITY CRITERIA

6.1.1 Discussion

Reserves should be designed so that, to the extent practicable, all elements of biodiversity have the opportunity for expression but with particular emphasis on those components of biodiversity that are dependent on reservation for protection.

The Convention on Biological Diversity and the National Strategy for the Conservation of Australia's Biological Diversity consider biodiversity at three levels; genetic, species and ecosystem. While there is considerable information on the spatial patterning of biodiversity at the ecosystem and species levels, the information on genetic variation is limited. Although it is possible and desirable to use this limited genetic information in planning a reserve network, the biodiversity criteria outlined (See Section 6.1.2) relate primarily to biodiversity at the forest ecosystem and species levels.

The priority for reservation of a forest ecosystem is related to how much remains relative to its initial distribution and its vulnerability to threatening processes. In deriving these criteria recognition has been given to current world practice, a review of practical models (Woinarski and Norton 1993), the Caracas Action Plan (1992) developed by the Commission for National Parks and Protected Areas which identifies that "a minimum of 10% of each biome" should be preserved, and the Commonwealth's proposed criterion (Commonwealth 1995) of 15% of the pre-1750 distribution of each forest ecosystem.

In consideration of the above, 15% of pre-European distribution is seen as a desirable objective, however, some flexibility is both acceptable and desirable. For instance, where socio-economic impacts are not acceptable, or where biodiversity conservation objectives can be demonstrably achieved, such as for forests ecosystems which are extensive, a lower level of reservation, (e.g., 10%) may prove adequate.

The principle of comprehensiveness requires that the reserve system should sample each forest ecosystem within a region. In applying a baseline level of reservation for each forest ecosystem, any special ecological needs should also be taken into account together with the current status of each ecosystem within the region.

Priority attention should be given to rare, vulnerable and endangered ecosystems and species, as proposed by Kirkpatrick & Brown (1991) and reflected in the Commonwealth *Endangered Species Protection Act 1992* and other State, Territory and local government legislation.

Reservation to conserve biodiversity needs to focus on the continued viability of species and ecosystems rather than the attainment of areal targets.

The criteria should generally be applied within a biogeographic regional framework based upon IBRA regions (See Section 2.2) but it is important to consider the distribution of a species or forest ecosystem in adjacent regions when applying the criteria.

Mapping of forest ecosystems at 1:100 000, or 1:250 000 is considered to be an appropriate scale for planning a reserve system. If 1:250 000 scale maps are used, they should be based on compilation sheets at 1:100 000 where available. This is based on recognition of the conservation needs of all Australian forests and the level of information and mapped data sets available, or which could be readily produced, within the next five years. Forest ecosystems need to be recognisable in the field, be able to be mapped and able to have their pre-1750 distribution modelled or mapped. Examples of mapping approaches that may be useful in this context are Ecological Vegetation Classes in Victoria (1996), the work done by Young and McDonald (1989) in Queensland, Kirkpatrick and Brown (1991) in Tasmania, and Beard (1979a, 1979b) in Western Australia, who classified forests in terms of dominant overstorey species.

Incomplete mapping indicates the operational constraints of using the 1:100 000, or 1:250 000 map scale in some areas and identifies where further data acquisition is urgently required. Map scales of 1:1 000 000 or 1:5 000 000 that are more universally available for the continent are not adequate, and where mapping and paucity of data sets constrain identification of the system in the short term, appropriate interim arrangements will be needed to preserve future reservation options.

6.1.2 Criteria

(1) As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system with flexibility considerations applied according to regional circumstances, and recognising that as far as possible and practicable, the proportion of Dedicated Reserves should be maximised (see Section 4).

Regional flexibility is necessary for several reasons and will need to be considered on a case by case basis in the application of economic and social factors as outlined in section 5.3. Reductions in the 15% criterion may also be appropriate on a case by case basis where biodiversity conservation objectives can be demonstrated to be met with a lesser area, for example where a forest ecosystem is extensive and relatively uniform or where a forest ecosystem is subject to low intensity resource use and has demonstrated resilience and stability.

For forest ecosystems occurring primarily on private land, it is likely that Dedicated Reserves will form a lower proportion of the CAR reserve system, given it is often impractical to purchase land for Dedicated Reserves. Similarly, forest ecosystems occurring in isolated small areas within a disturbed landscape, or distributed in patches throughout other forest ecosystems, might be more efficiently protected by other types of reserve. (See Section 4).

It is inherent in this criterion that those forest ecosystems that are most severely depleted are protected to a greater extent. To some extent therefore, endangered and vulnerable forest ecosystems identified under criteria (2) and (3) are addressed by this criterion. In many cases, due to substantial past clearing for example in the Brigalow (Acacia harpophylla) forests of Queensland and New South Wales, it will not be possible to achieve the criterion.

(2) Where forest ecosystems are recognised as vulnerable, then at least 60% of their remaining extent should be reserved. A vulnerable forest ecosystem is one which is:

i) approaching a reduction in areal extent of 70% within a bioregional context and which remains subject to threatening processes; or

ii) not depleted but subject to continuing and significant threatening processes which may reduce its extent.

Vulnerable ecosystems include those where threatening processes have caused significant changes in species composition, loss or significant decline in species that play a major role within the ecosystem, or significant alteration to ecosystem processes.

An example of a vulnerable forest ecosystem which is not depleted but which is sensitive to threatening processes is King Billy Pine (*Athrotaxis selaginoides*) rainforest of Tasmania. This rainforest is highly susceptible to further destruction by fire and it has limited ability to invade burned areas (Brown, 1988). Although 60% of the pre-1750 distribution of this ecosystem remains, its vulnerability justifies higher levels of reservation.

(3) All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable.

A rare ecosystem is one where its geographic distribution involves a total range of generally less than 10,000ha, a total area of generally less than 1000ha or patch sizes of generally less than 100ha, where such patches do not aggregate to significant areas. This criterion is to be applied within a bioregional context having cognisance of distribution in adjoining bioregions. It should be noted that rarity is a naturally occurring phenomenon that does not necessarily imply that the ecosystem is under immediate threat.

An endangered ecosystem is one where its distribution has contracted to less than 10% of its former range or the total area has contracted to less than 10% of its former area, or where 90% of its area is in small patches which are subject to threatening processes and unlikely to persist.

In terms of rare, vulnerable and endangered species/ecosystems it is recognised that a range of approaches ranging from reservation to prescription management and the development of species recovery plans will be needed. In practice both reservation and prescription management such as through Codes of Practice will be required to address the range of special species/ecosystem needs.

(4) Reserved areas should be replicated across the geographic range of the forest ecosystem to decrease the likelihood that chance events such as wildfire or disease will cause the forest ecosystem to decline.

(5) The reserve system should seek to maximise the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:

- the special needs of rare, vulnerable or endangered species;
- special groups of organisms, for example species with complex habitat requirements, or migratory or mobile species;
- areas of high species diversity, natural refugia for flora and fauna, and centres of endemism; and
- those species whose distributions and habitat requirements are not well correlated with any particular forest ecosystem.

(6) Reserves should be large enough to sustain the viability, quality and integrity of populations.

(7) To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem, by sampling the range of environmental variation typical of its geographic range and sampling its range of successional stages.

Forest ecosystems are often distributed across a variety of physical environments, and their species composition can vary along environmental gradients and between the micro-environments within the ecosystem.

This approach will maximise the likelihood that the samples included in the reserve system will protect the full range of genetic variability and successional stages associated with each species, and particularly those species with restricted or disjunct distributions.

(8) In fragmented landscapes, remnants that contribute to sampling the full range of biodiversity are vital parts of a forest reserve system. The areas should be identified and protected as part of the development of integrated regional conservation strategies.

6.2 OLD-GROWTH FOREST CRITERIA

6.2.1 Discussion

Old-growth forest has a range of biological, aesthetic and cultural values.

The biodiversity attributes attributed to old-growth forest are based on the fact that some plants and animals are restricted to the old-growth stages or are dependent on old-growth forest for some of their habitat requirements. For example, one of the most significant characteristics of the older stages of Australian eucalypts is the propensity for creating hollows and it is well established that the number of tree hollows can be a limiting factor in the abundance of some fauna (Mackowski 1984).

The NFPS defines old-growth forest as:

> *Forest that is ecologically mature and has been subjected to negligible unnatural disturbance such as logging, roading and clearing. The definition focuses on forest in which the upper stratum or overstorey is in the late mature to over mature growth phases.*

However, in order to define and map old-growth forests, operational interpretation based on the NFPS definition have been developed in some States, notably Victoria and New South Wales, and by the Commonwealth. Given the experience which has been gained in recent years in identifying old-growth forests, the agreed National operational interpretation is now:

> *Old-growth forest is ecologically mature forest where the effects of disturbances are now negligible.*

In applying this interpretation to a forest ecosystem within a region, the following principles will apply:

- Ecological maturity is defined by the characteristics of the older growth stages
- If data are available on the structural, floristic, and functional qualities that would be expected to characterise an ecologically mature forest ecosystem, these data should be used in the assessment of the significance of disturbance effects.
- Negligible disturbance effects will be evident in most forests by a significant proportion of trees with age - related features and a species composition characteristic of the ecologically mature forest ecosystem.

This interpretation acknowledges that age-related features and the effect of disturbances will differ between forest ecosystems due to a range of factors including physical setting, fire proneness and

species composition. For example, the Woodgate et al (1992) method which is consistent with this interpretation could be adapted to similar forest ecosystems to those used in Victoria. Other forest ecosystems such as rainforest, dry forest and tropical forest may require different methodological approaches and would be developed bilaterally. The scale at which old-growth is mapped should be complementary to the 1:100 000, or 1:250 000 map scale at which the diversity of forest ecosystems are recognised. However, where forest ecosystems are dominated by communities of other seral stages, more detailed identification of old-growth forest may be appropriate to assist reserve selection.

Old-growth forest can have a high value for biodiversity and hence a substantial proportion of the remaining extent will be incorporated by applying the CAR criteria for biodiversity. For example, old-growth forests with high nutrient levels and moderate topography have been shown to be significant habitat for certain fauna, e.g., the Greater Glider *Petauroides volans* (Kerr) (Davey and Stockwell 1991). The actual amount of old-growth forest incorporated under these criteria depends on the remaining extent in each forest ecosystem and its contribution to biodiversity goals.

In regions which are characterised by a high degree of landscape disturbance and fragmentation, and where old-growth forests are therefore limited in occurrence, old-growth forest will assume increased significance and warrant greater reservation. Conversely, lower thresholds may apply in regions where disturbance and fragmentation are less evident.

It is recognised that old-growth, as part of an ecological succession, is not static and cannot be maintained indefinitely merely through the reservation of existing examples of that age-class. The inclusion of old-growth in the reserve system should be seen in the context of the selection and reservation of an appropriate mosaic of age-classes, which, with ecological processes intact will have the potential to generate the old-growth of the future.

Old-growth forest also has aesthetic and cultural values, and to meet these community expectations old growth forest should be protected in areas which optimise those values. In some cases additional reservation may be required above that needed for biodiversity purposes and decisions on such additional reservation would vary from region to region.

6.2.2 Criteria

These criteria apply to all forested regions except those in the Northern Territory where the vast areas involved mean a different set of criteria will need to be developed.

It is necessary to approach old-growth criteria in a flexible manner according to regional circumstances, especially when forest ecosystems are still relatively widespread and retain large areas of old-growth. Wherever possible, areas of old-growth requiring protection should be included in the area identified to meet biodiversity criteria.

(1) Where old-growth forest is rare or depleted (generally less than 10% of the extant distribution) within a forest ecosystem, all viable examples should be protected, wherever possible. In practice, this would mean that most of the rare or depleted old-growth forest would be protected. Protection should be afforded through the range of mechanisms described in section 4.

(2) For other forest ecosystems, 60% of the old-growth forest identified at the time of assessment would be protected, consistent with a flexible approach where appropriate, increasing to the levels of protection necessary to achieve the following objectives:

- the representation of old-growth forest across the geographic range of the forest ecosystem;
- the protection of high quality habitat for species identified under the biodiversity criterion;
- appropriate reserve design;
- protection of the largest and least fragmented areas of old-growth;
- specific community needs for recreation and tourism.

6.3 WILDERNESS CRITERIA

Wilderness - land that, together with its plant and animal communities, is in a state that has not been substantially modified by, and is remote from, the influences of European settlement or is capable of being restored to such a state; is of sufficient size to make its maintenance in such a state feasible; and is capable of providing opportunities for solitude and self-reliant recreation (NFPS 1992).

Wilderness is a cultural concept that relates to large areas of essentially undisturbed land, and it encompasses a range of natural and cultural values. Wilderness areas are not determined on the principles of comprehensiveness, adequacy and representativeness for biodiversity conservation. Nevertheless, reservation for wilderness will have some direct benefits for biodiversity.

As forest and non-forest vegetation types form a mosaic, non-forest vegetation types may be included within largely-forested wilderness areas.

The consistent nationwide approach for identifying wilderness quality should be to apply the results of the National Wilderness Inventory (NWI) (Lesslie and Maslen 1995) through a co-operative process agreed to by the Commonwealth, States and Territories. The methodology adopted in the joint work in East Gippsland and the Central Highlands of Victoria (AHC/DCNR, 1994) serves as a model for this approach.

The NWI measures wilderness quality on a class scale by adding scores derived from four standard indicators:

- remoteness from settlement;
- remoteness from access;
- apparent naturalness; and
- biophysical naturalness.

6.3.1 Criteria

These criteria apply to all forested regions except those in northern Australia where the vast areas involved mean a different set of criteria will need to be developed.

Ninety percent, or more if practicable, of the area of high quality wilderness that meet minimum area requirements should be protected in reserves.

(1) Determining potential wilderness areas:

- Potential areas will have a minimum NWI rating of 12. In addition, minimum thresholds for each of the wilderness quality indicators will be set within the regional context. These thresholds will take into account the importance of the indicators, and in particular the biophysical naturalness component as a primary indicator.

- The guideline for size which is considered generally appropriate for areas encompassing forested wilderness is 8000 ha. However, thresholds of less than 8000 ha may apply to areas contiguous with the sea or which adjoin wilderness areas in adjacent regions. Higher thresholds may apply within a region where wilderness is extensive.

- The presence in potential areas of "nodal" areas with higher wilderness quality may provide an indication of their significance and may guide the future management of identified wilderness areas.

- Other factors which are not considered in determining the NWI rating may need to be considered, in determining wilderness quality. These factors may include the include the impacts of exotic plants and feral animals on biophysical naturalness.

(2) Determining wilderness boundaries:

- Potential areas identified using the NWI database will be considered in a regional context to ensure their viability as wilderness, including considerations of shape.

- Both ecological and management features such as topography, water catchment boundaries, roads and other transport routes, may be useful when delineating boundaries.

7. RESERVE DESIGN AND MANAGEMENT

The way in which a reserve is designed can influence not only the protection of conservation values, but the efficiency and effectiveness of subsequent management for conservation within the reserve. The criteria which should influence reserve design include:

- Boundaries should be set in a landscape context with strong ecological integrity, such as catchments;

- Large reserved areas are preferable to small reserved areas, though a range of reserve sizes may be appropriate to adequately sample conservation values;

- Boundary-area ratios should be minimised and linear reserves should be avoided where possible except for riverine systems and corridors identified as having significant value for nature conservation;

- Reserves should be developed across the major environmental gradients if feasible, but only if these gradients incorporate key conservation attributes which should be incorporated in the CAR system;

- Each reserve should contribute to satisfying as many reserve criteria as possible;

- Reserve design should aim to minimise the impact of threatening processes, particularly from adjoining areas;

- Reserves should be linked through a variety of mechanisms, wherever practicable, across the landscape.

Reservation alone will not ensure conservation of biodiversity or other natural and cultural values, and active management is required to ameliorate threatening processes and ensure that the reserve system retains the biodiversity and other values, including old-growth forest, for which it was established. Such management may involve the use of specific fire regimes, and even managed disturbance or selective reduction of certain populations. Extensively depleted forest ecosystems may need to be included in reserves and rehabilitated to ensure the primary criteria of comprehensiveness is achieved. Species and forest ecosystems recognised as endangered and vulnerable may require priority management action, such as development of recovery plans. Recognising the dynamic nature of forest ecosystems, and the inevitability of incremental loss of reserved old growth through wildfire and other natural processes, old growth values will need to be maintained by appropriate management strategies across the forest estate as a whole. Wilderness values also will need to be maintained by appropriate management and design of wilderness areas.

Reserves will require significant funding for establishment and ongoing management including the costs associated with data acquisition and monitoring of management performance.

Modifications to reserve design will be required through time as new values are identified and programs monitoring the effectiveness of established reserves identify deficiencies in reserve design and management. Monitoring programs should enable appropriate reporting of the effectiveness of the establishment and success of the CAR reserve system.

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9. APPENDIX

IUCN Protected Area Categories

The definition of "Protected Area" as defined by the International Union for the Conservation of Nature is:

> *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.*

Category I	**Strict Nature Reserve/Wilderness Area: protected areas managed mainly for science or wilderness protection** Areas of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring. Large areas of unmodified land, or slightly modified land, or land and water, retaining their natural character and influence, without permanent or significant habitation, which are protected and managed so as to preserve their natural condition.
Category II	**National Park: protected area managed mainly for ecosystem protection and recreation** Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.
Category III	**Natural Monument: protected area managed mainly for conservation of specific natural features** Areas containing one, or more, specific natural or natural/cultural features which is of outstanding or unique value because of its inherent rarity, representative of aesthetic qualities or cultural significance.
Category IV	**Habitat/Species Management Area: protected area managed mainly for conservation through management intervention** Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

10. GLOSSARY

Approved Forest Management Plans	A plan, subject to public comment and periodically reviewed, defining forest policy governing management activities within the management plan area, typically includes forest geography and history, land use allocation, objectives and prescriptions for management which is approved by the relevant management agency and/or minister. The approval process varies between jurisdictions.
Biodiversity	Biological diversity, or biodiversity, is the variety of all life-forms, the genes they contain, and the ecosystems of which they are a part. Biodiversity is generally considered at three levels: genetic diversity, species diversity, and ecosystem diversity. It is sometimes considered at the landscape diversity level.
Biogeographic Region	A biogeographic region, or bioregion, is a region in which the boundaries are determined by vegetation cover, and the earth's physical features and climate.
Biome	A biome is a geographic area containing similar lifeforms, determined by upper and lower limits of tolerance to temperature.
Comprehensive Regional Assessment (CRA)	A joint assessment of all forest values by the Commonwealth and State - environmental, heritage, economic and social - leading to the establishment of a comprehensive, adequate and representative reserve system, agreements on forest management, and the signing of a regional forest agreement (RFA).
Covenant	A voluntary legal undertaking by a landowner registered on the land title for the purposes of protection of some nominated value or condition of the land.
Dedicated Reserve	Reserves where the management regime equates to specific protected area management categories defined by the IUCN Commission for National Parks and Protected areas (1994). [Categories I, II, III and IV]. Security of tenure, as demonstrated if Parliamentary action by Commonwealth, State or Territory Governments is required for revocation of the reserve, is fundamental to the establishment and management of formal reserves.
Ecologically Sustainable Development (ESD)	The Ecologically Sustainable Development Working Group on Forest Use specified 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.
Ecological Vegetation Classes	The components of a vegetation classification system. They are groupings of vegetation communities based on floristic, structural and ecological features.
Ecosystem	The aggregate of plants, animals and other organisms, and the non-living parts of the environment with which these organisms interact.
Endangered Forest Ecosystem	An endangered forest ecosystem is defined as one which is likely to become extinct in nature unless the circumstances and factors threatening its extent, survival or evolutionary development cease to operate; as determined by the application of the criteria outlined in section 6.1.
Environmental Province	A sub-area within a bioregion that reflects the environmental attributes that influence the occurrence of forest ecosystems.
Forest	A vegetation type dominated by woody vegetation having a mature or potential mature stand height exceeding 5 metres, with an overstorey canopy cover greater than 20%.

Forest ecosystem	An indigenous ecosystem with an overstorey of trees that are greater than 20% canopy cover. These ecosystems should normally be discriminated at a resolution requiring a map-standard scale of 1:100 000. Preferably these units should be defined in terms of floristic composition in combination with substrate and position within the landscape (e.g., Young and McDonald 1989, Kirkpatrick and Brown 1991, Beard 1979a and 1979b, and Ecological Vegetation Classes as identified in Victoria as appropriate). In some parts of Australia the above level of resolution is not available. In this situation environmental resolution offered by contemporary surficial stratigraphic maps of 1:250 000 scale (e.g., Wilde and Walker 1982) are a viable surrogate provided vegetation maps are at sufficient resolution to overlay and allow for such factors as climatic influences on patterns in species composition to be identified within widespread stratigraphic units. (See p7 for use of generic term "forest ecosystem".)
Forested Region	A forested region is one dominated by forest or woodland ecosystems as a mosaic that may also contain shrubland or other ecosystem types.
Genetic Diversity	Variation in the genetic composition between individuals, populations or species.
IBRA	IBRA, or Interim Biogeographic Regionalisation for Australia, is a bioregional framework delineating "natural" regions in each State and Territory based on biophysical, environmental and vegetation considerations (e.g., climate, lithology, landform, vegetation, flora and fauna and landuse) which allow cross border regionalisation.
Informal Reserve	Reserves that contain and are managed for conservation values which unequivocally contribute to the CAR system. Such reserves have a sound basis in legislation (e.g., management plans required under legislation) with provision of opportunity for public comment on changes to reserve boundaries, and where decisions on their establishment and alteration are politically accountable. In addition, they must be able to be accurately identified (on maps), and of sufficient area and adequate design to contribute to the continued viability of the values they seek to protect.
JANIS Technical Working Group (TWG)	This group, comprising conservation scientists and planners from all States, the Northern Territory, and the CSIRO, was established in 1993 under the auspices of the Joint ANZECC/MCFFA NFPS Implementation Sub-Committee (JANIS) to draft criteria on which to base a CAR reserve system for Australia's forests.
National Wilderness Inventory (NWI)	The NWI is an environmental database and set of modelling procedures which are designed to assist in the planning and management of remote and natural lands in Australia.
Native Forest	Any locally indigenous forest community containing the full complement of native species and habitats normally associated with that community, or having the potential to develop these characteristics.
Old Growth Forest	Forest that is ecologically mature and has been subjected to negligible unnatural disturbance such as logging, roading and clearing. The definition focuses on forest in which the upper stratum or overstorey is in the late mature to over mature growth phases. This definition has been amended to produce an agreed National operational interpretation as follows: "Old-growth forest is ecologically mature forest where the effects of disturbances are now negligible".

Rare Forest Ecosystem	A rare forest ecosystem is defined as one with a restricted geographic distribution, based on 1:100 000 mapping within a region, in which the total range is generally less than 10,000 ha; or where patch sizes are generally less than 100 ha, where such patches do not aggregate into significant areas.
Recovery Plan	A comprehensive plan which details, schedules and costs all actions assessed as being necessary to support the recovery plan of a threatened species or ecological community.
Refugia	A refugium is a biological community or geographic entity, which, because of its moderating structural characteristics and/or physical isolation, provides a sanctuary to which species or groups of species have retreated or been confined in response to threatening processes, including climatic change.
Regional Forest Agreement (RFA)	An agreement about the long-term management and use of forests in a particular region between the Commonwealth and a State Government. Its purpose is to reduce uncertainty, duplication and fragmentation in government decision-making by producing a durable agreement on the management and use of forests.
Seral Stage	The specific growth stage expressed by a forest in the successional process typical of that forest.
Threatening Process	A process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community.
Vulnerable Forest Ecosystem	A vulnerable forest ecosystem is defined as one which, within the next 25 years, is likely to become endangered unless the circumstances and factors threatening its extent, survival or evolutionary development cease to operate; as determined by the application of the criteria outlined in section 6.1.
Wilderness	Land that, together with its plant and animal communities, is in a state that has not been substantially modified by, and is remote from, the influences of European settlement or is capable of being restored to such a state; is of sufficient size to make its maintenance in such a state feasible; and is capable of providing opportunities for solitude and self-reliant recreation.
Wilderness Quality	A measure of differing levels of human impact on the natural environment, as part of a continuum of remote and natural conditions varying from pristine to urban. Wilderness quality is measured in terms of four variables (the Lesslie indicators of wilderness quality): • remoteness from settlement • remoteness from access • apparent naturalness • biophysical naturalness
Woodland	A vegetation type dominated by woody vegetation having a mature or potential mature stand height exceeding 5 metres, with an overstorey canopy cover less than 20%.