

Environment and Heritage Report - East Gippsland

[Biodiversity](#)
[Rare or Threatened Plants recorded from East Gippsland](#)
[Executive Summary](#)
[Acknowledgements](#)
[Frequently Used Abbreviations](#)
[Introduction](#)
[Old Growth](#)
[Wilderness](#)
[National Estate](#)
[World Heritage](#)
[Attachment 1/Summary Outline of the Methodology for World Heritage Assessment](#)
[Attachment 2/World Heritage Expert Panel Meeting](#)
[Attachment 3/Currently listed World Heritage Places in Australia](#)
[References](#)
[Glossary](#)

See part 2 for:

[Appendix A: Key Legislation to the Environment and Heritage Assessments](#)
[Appendix B: Descriptions of Datasets](#)
[Appendix C: East Gippsland Stratification and Flora Survey Intensity](#)
[Appendix D: Fauna Survey Analysis](#)
[Appendix E: Rare or Threatened Plants](#)
[Appendix F: Rare or Threatened Fauna in East Gippsland](#)
[Appendix G: Ecological vegetation classes](#)
[Appendix H: Corrections to Large Format Maps](#)
[Appendix I: Report of the Victorian Old Growth Joint Scientific Advisory Group](#)
[List of Tables](#)
[List of Figures](#)
[List of Maps](#)

Biodiversity

- 2.1 Introduction
- 2.2 Biodiversity assessment methodology
- 2.3 Species assessment
- 2.4 Aquatic habitat assessment
- 2.5 Forest ecosystem assessment

2.1 Introduction

The *National Forest Policy Statement* (NFPS) establishes the concept of the regional assessment process, and lists the protection of biological diversity under 'The Convention on Biological Diversity' as one of the Commonwealth obligations to be included in the assessment. Strategies for conserving biodiversity, as outlined under the NFPS, for meeting these objectives are:

- establishment of a dedicated forest reserve system on public land based on the principles of comprehensiveness, adequacy and representativeness (CAR);
- complementary management of public native forests outside conservation reserves which assists biodiversity conservation; and
- promotion of the management of private forests in sympathy with nature conservation goals (Commonwealth of Australia 1992).

The proposed *National Forest Reserve Criteria* jointly developed by the Commonwealth and States (section 1.3) identifies the following objectives of biodiversity conservation (JANIS 1996):

- to maintain ecological processes and the dynamics of forest ecosystems;
- 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.

The proposed *National Forest Reserve Criteria* also include a number of biodiversity criteria for establishing a Comprehensive, Adequate and Representative reserve system as outlined in Box 1.

2.2 Biodiversity assessment methodology

The biodiversity assessment provides information about individual flora and fauna species, forest ecosystems and threatening processes.

The key steps in the biodiversity assessment process include a review of existing information and additional data collection and analysis, where necessary.

Review of existing information

The information review includes two main elements:

- a review of biological survey data to identify any major gaps in biodiversity information; and
- a review of information on species' and forest ecosystems' and threatening processes.

Data collection and data analysis

Additional data collection was not undertaken in East Gippsland, given the extensive body of information already available for the region. Significant gaps in survey and research identified in this assessment will be considered in the development of RFA options.

The data analysis includes two main elements:

- generation of maps of the distribution of different biodiversity elements (e.g. species and forest communities) (forest communities only have been mapped in East Gippsland at this stage); and
- analyses of species and ecosystem responses to disturbance, which will provide information on future management priorities.

2.3 Species assessment

2.3.1 Introduction

The species assessment provides an analysis of information which can address the issue of the viability of maintaining populations of terrestrial and aquatic native species throughout their natural ranges. It enables an evaluation against the proposed national reserve criteria, and the determination of complementary off-reserve species and habitat management.

The outputs from this assessment are:

- identification of the distribution, habitat and life history attributes of individual species;
- identification of factors affecting the conservation status (risk of extinction) and reservation needs of species;
- a description of current management prescriptions for species and their habitat, with priority given to those species which are rare or threatened;
- identification of the threatening processes (disturbances) affecting species and their habitat, and a description of current management action; and
- identification of gaps in survey and research on species, habitats and threatening processes.

2.3.2 Methodology for evaluating survey data

Austin and Heyligers (1989, 1991) and Austin and Meyers (submitted) argue that, for most ecological purposes, site-based biological data should ideally be representative of the environment (abiotic and biotic) and geographic extent of the region. To evaluate the degree of representation of environments in a region by existing biological data, those environmental variables believed to influence the distribution of species must first be identified. The distribution of existing biological records is then analysed with respect to an environmental stratification derived using these variables. The variables which can directly influence the distribution of species include solar radiation, temperature, soil moisture content, soil nutrient status, and groundwater. Indirect variables include rainfall, elevation, slope, aspect and geology. For faunal groups, variables relating to vegetation species composition or growth stage may sometimes be more important. Selection of the most appropriate variables depends on insight and awareness of relevant ecological processes, and the availability of spatial environmental data for the region of interest.

Using expert knowledge as the basis for choosing appropriate environmental variables, a stratification of East Gippsland consisting of unique environmental units (strata) was derived from the integration of classes of individual environmental variables. The variables selected as inputs to the stratification process were elevation, climate, substrate (lithology) and landform. The sources and derivation of these data are outlined below.

Elevation

A digital elevation model (DEM) for the Australian continent has been developed at a nine second grid resolution, each grid cell representing an area of approximately 250 x 250 metres on the ground (AUSLIG *et al.* 1996). A DEM for East Gippsland was extracted from the continental coverage and was one of the variables included in the stratification. Elevation in

the East Gippsland Region ranges from sea level to 1 780 metres above sea level. Five classes of elevation were selected based on 300, 600, 900 and 1 200 metres thresholds (Table 2.2).

Climate

Methods exist to estimate climate at any point in a landscape, given the availability of topographic and meteorological data. 'Climate surfaces' fitted to a DEM provide spatially reliable estimates of mean monthly climate attributes derived from long-term meteorological station records for any given longitude, latitude and elevation (Hutchinson and Bischof 1983; Hutchinson *et al.* 1984; Hutchinson 1989, 1991a, 1991b). Currently, the estimated standard errors are 0.5o C for monthly mean temperature and less than 10% for mean monthly precipitation (Hutchinson 1984; Hutchinson *et al.* 1992).

Key climatic attributes which describe the range, seasonality and extremes of climate (temperature, precipitation and radiation) for the region were calculated for each cell in the elevation grid, using the software package ANUCLIM (McMahon *et al.* 1995). Annual precipitation was selected as the climatic variable used, with three classes based on thresholds of 800 and 1 200 millimetres (Table 2.2).

Lithology (rock type)

For East Gippsland, lithology or rock type extracted from the Land Systems coverage of Victoria at a 1:250 000 scale (Rowan *et al.* in press), currently represents the best available data source for the derivation of spatial estimates of substrate that may be indicative of relative differences in soil nutrient status across the region. Thirteen lithology classes for the East Gippsland Region were extracted from the Victorian Land Systems coverage. From these 13 classes, seven generalised classes of lithology were derived by aggregating lithology classes with similar characteristics. The aggregation of the 13 lithology classes into seven generalised classes are outlined in Table 2.1.

- Table 2.1: Aggregation of lithology classes with similar characteristics.

Class 1	Coarsely-textured unconsolidated deposits. Coarsely-textured unconsolidated deposits/Finely-textured unconsolidated deposit.
Class 2	Finely-textured unconsolidated deposits Finely-textured unconsolidated deposits/Coarsely-textured unconsolidated deposit.
Class 3	Granites and gneisses. Granites and gneisses/Sedimentary rocks.
Class 4	Limestone. Sedimentary rocks/Limestone.
Class 5	Sedimentary rocks.
Class 6	Sedimentary rocks/Granites and gneisses. Sedimentary rocks/Volcanic rocks.
Class 7	Volcanic rocks. Volcanic rocks/Sedimentary rocks.

Landform

Eleven landform classes have been mapped as part of the Land Systems coverage of Victoria at a 1:250 000 scale (Rowan *et al.* in press). Of these landforms, five occur in the East Gippsland region and were extracted from the State Land Systems coverage for use as a stratification variable (Table 2.2).

The five landform classes occurring in East Gippsland are:

- Plain above flood level / Dune;
- Present flood plain;
- Gentle to moderate hill;
- Plain above flood level; and
- Steep Mountain and hill.

Table 2.2: Environmental variables identified for use in the environmental stratification of the East Gippsland CRA Region.

Thresholds for continuous variables are in brackets.

Primary Stratification Variable	Classes
Elevation	5 classes (300, 600, 900, 1 200 m)
Annual Precipitation	3 classes (800, 1 200 mm)
Lithology	7 classes (see text)
Landform	5 classes (see text)

A total of 96 strata were identified when the five classes of elevation, three classes of annual precipitation, seven classes of lithology and five classes of landform were combined. Thirteen small strata (less than 100 hectares) were re-assigned to larger strata. This was done manually by matching their lithology and landform classes with those of larger strata. The result was a stratification comprised of 83 units (Map 2).

The distribution of survey sites among environments (strata) was analysed with respect to the size of each stratum and its geographic distribution. The density of survey sites in each stratum was examined for all flora and for fauna by functional group, and strata with low densities of sites were identified.

All the environment types (strata) consist of a number of geographically separated components. Ideally, all components making up each stratum will contain at least one site, thereby replicating sampling across the geographic extent of each stratum. Finally, the spatial distribution of sites within relatively large sub-strata was also examined.

2.3.3 Fauna Assessment

The fauna assessment has three major components:

- an assessment of existing survey data;
- a review of rare and threatened species including life history attributes and population dynamics, responses and vulnerability to disturbance, current management action and species' occurrence in reserves; and
- a review of threatening processes.

Fauna Survey Data Review

Methods

The site-based biological data sets used in the fauna assessment were drawn from the Atlas of Victorian Wildlife and the Victorian Freshwater and Estuarine Fish Database. A description of these data sets is given in Appendix B.

The fauna core data fields extracted were: reference number, date, latitude, longitude, survey method, survey effort and species code. Data from both formal faunal surveys and incidental records were used.

The Atlas of Victorian Wildlife covers birds, mammals, reptiles, amphibians, threatened invertebrates and threatened fish. Of these, the following groups were excluded from the study: marine birds, waders (except Latham's Snipe), marine mammals and marine reptiles. Records with less geographic precision (i.e. greater than two minutes of latitude or longitude), were also excluded. Terrestrial invertebrate fauna, and non-listed vertebrates and aquatic invertebrates were not included in the review.

In preparation for further analysis, the data were collated into discrete data sets to cover the following species groups:

- Arboreal mammals;
- Large mammals;
- Small ground mammals;
- Bats;
- Birds;
- Large forest owls;
- Reptiles;
- Amphibians;
- Threatened fish; and
- Threatened macroinvertebrates.

The distribution of survey sites among environments (strata) was analysed with respect to the size of each stratum and its geographic distribution. The density of survey sites in each stratum was examined for fauna by functional group, and strata with low densities of sites were identified.

Results and Discussion

The results of the survey site analysis for each fauna functional group are shown in Maps 4 to 11 and in Appendix D. Incidental records were not included in the analysis but are shown on the maps referred to above.

Arboreal Mammal Surveys

A total of 1 741 sites have been surveyed for arboreal mammals in East Gippsland. Survey intensity is high in the foothills east of the Snowy River and moderate in the tableland areas. Survey effort is low however, in coastal strata and west of the Snowy River. The change in the density of survey sites between relatively well surveyed and poorly surveyed areas is distinct, rather than gradual. Site densities in the 29 best sampled strata range from 66 hectares per site to 3 400 hectares per site, while the next best sampled stratum has only two sites in more than 40 000 hectares (Appendix D). Seven strata (numbers 4, 8, 12, 16, 18, 21 and 61) greater than 10 000 hectares in area contain no survey sites or a survey intensity of less than one site per 5 000 hectares (Appendix D). All are predominantly distributed west of the Snowy River and represent snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest (Map 4). **Large Mammal Surveys**

A total of 314 sites have been surveyed for large mammals in East Gippsland. This analysis reflects the evolution of methodology for this functional group. Formal surveys for large mammals (scat censuses) were only done during latter flora and fauna surveys (1991-94). Survey effort is relatively high in coastal and lower foothill areas, but low in highland and

tableland strata and strata west of the Snowy River (Map 5). In general, large mammals have not been well sampled by systematic surveys; only 10 of 83 strata have greater than one site per 5 000 hectares (Appendix D). This analysis should be interpreted cautiously however, as site densities have been calculated using only recent formal surveys. Incidental records are well distributed through highland and tableland areas, and to a lesser extent west of the Snowy River (Map 5).

Small Ground Dwelling Mammal Surveys

A total of 2 922 sites have been surveyed for small ground dwelling mammals in East Gippsland. Survey site coverage is generally very good east of the Snowy River. All of the more extensive strata (>10 000 hectares) in this region have been quite intensively surveyed, at least in some part of their geographic range, except for stratum number 18 primarily representing rain shadow woodland in the Snowy - Deddick rain shadow. West of the Snowy River though, strata numbers 4, 8, 12, 18 and 63, representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest in the upper Buchan mountains and, to a lesser extent, the Buchan foothills, have no survey sites or less than one site per 5 000 hectares (Map 6 and Appendix D). There are, however, a number of incidental records distributed throughout those areas with few formal survey records.

Bat Surveys

A total of 622 sites have been surveyed for bats in East Gippsland. Survey intensity is moderate and relatively uniform in foothill strata. Surveys are patchy in coastal units and very low west of the Snowy River in the Orbost - Buchan foothills. Of the more extensive strata (>10 000 hectares), the most intensively surveyed are located in the Errinundra tablelands and Brodribb foothills. Low survey intensities (no survey sites or less than one site per 5 000 hectares) in relatively large strata (>10 000 hectares) are apparent in the case of strata numbers 3, 4, 8, 12, 16, 18, 21 and 63 representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest in the upper Buchan mountains, Snowy - Deddick rain shadow, Snowy River valley and Orbost - Buchan foothills (Map 7 and Appendix D).

Bird Surveys

A total of 3 192 sites have been surveyed for birds in East Gippsland. Strata east of the Snowy River are generally well surveyed, particularly in the foothills, but with notable exceptions in the Snowy - Deddick rain shadow, Snowy River valley and Lake Tyers - Corringale coast. There are, however, a number of incidental records distributed throughout these areas, with the Lake Tyers - Corringale coast area having numerous records. Strata west of the Snowy River have low sampling intensity (Map 8). Among the larger strata (>10 000 hectares), several areas which include snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest, have not been extensively surveyed (no survey sites or less than one site per 5 000 hectares) (Appendix D).

Large Forest Owl Surveys

A total of 776 sites have been surveyed for large forest owls in East Gippsland. Survey intensity is high in the Orbost - Buchan foothills, Brodribb foothills and far east foothills, moderate in coastal areas, the Cann foothills and the Snowy River valley, and low in the Errinundra tablelands. The Snowy - Deddick rain shadow and upper Buchan have very low sampling intensity. Eleven strata greater than 10 000 hectares in area (numbers 3, 4, 8, 9, 12, 16, 18, 21, 26, 61 and 63) representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest, have no survey sites or fewer than one site per 5 000 hectares (Map 9 and Appendix D).

Reptile Surveys

A total of 1 016 sites have been surveyed for reptiles in East Gippsland. Coastal and eastern foothill areas are well surveyed (Map 10). Survey intensity in the higher altitude areas is generally low, particularly in the Errinundra tablelands, Snowy - Deddick rain shadow and west of the Snowy River. Ten of the more extensive strata distributed throughout these areas (numbers 3, 4, 8, 12, 16, 18, 21, 41, 61 and 63) representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest, have no survey sites or fewer than one site per 5 000 hectares (Appendix D). Map 10 shows that there are a large number of incidental records across East Gippsland which complement the formal survey records.

Amphibian Surveys

A total of 1 130 sites have been surveyed for amphibians in East Gippsland. Survey effort is generally moderate or high east of the Snowy River, with the exception of parts of the Errinundra Tablelands and Snowy - Deddick rain shadow sub-regions. Survey intensity is low west of the Snowy River (Map 11). Of the larger strata (> 10 000 hectares), ten (3, 4, 8, 12, 16, 18, 21, 41, 61 and 63) representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and dry and wet sclerophyll forest, contain no survey sites or less than one site per 5 000 hectares (Appendix D). All of these strata are distributed predominantly west of the Snowy River, except for stratum number 16 in the Snowy - Deddick rain shadow and number 41, located predominantly in the Errinundra tablelands and, to a lesser extent, the Brodribb foothills. Map 11 shows that there are a number of incidental records which complement the formal survey records.

Summary

The overall level of fauna survey in East Gippsland is high compared to other forested regions in Australia. However, survey effort varies considerably between fauna groups. Within groups, survey effort also varies across the region. Generally, the region has relatively large areas of high survey intensity, but also some areas of low survey intensity. It is noted, that a number of the relatively extensive strata with low sampling intensity correspond with the conservation reserve system and areas of private land.

The least sampled of the more extensive strata (>10 000 hectares) are those representing snow gum woodland, montane forest, montane sclerophyll woodland, rain shadow woodland, alpine wet heathland, cool temperate rainforest, and wet sclerophyll forest in the upper Buchan mountains and Snowy - Deddick rain shadow (strata 4, 8 and 12). None of the fauna groups have been surveyed in these strata. With respect to other strata greater than 10 000 hectares in area, six fauna groups are not surveyed in montane sclerophyll woodland, rain shadow woodland, and dry sclerophyll forest located in the Snowy - Deddick rain shadow and upper Buchan mountains (strata 18 and 21), and dry and wet sclerophyll forest and warm temperate rainforest in the Snowy River valley and Orbost - Buchan foothills (stratum 61).

Five fauna groups are not surveyed in rain shadow woodland and dry sclerophyll forest in the Snowy - Deddick rain shadow (stratum 16) and dry and wet sclerophyll forest and warm temperate rainforest in the Snowy River valley and Orbost - Buchan foothills (stratum 63). Four functional groups are not surveyed in snow gum woodland, montane forest and montane sclerophyll woodland in the upper Buchan mountains and Snowy - Deddick rain shadow (stratum 3).

Fauna Species Assessment

Methods

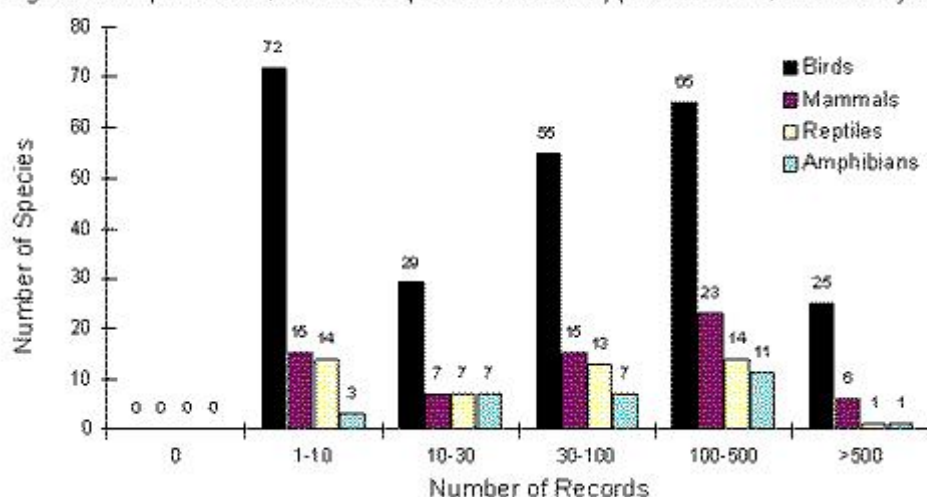
A priority list of terrestrial and aquatic forest fauna species was compiled for inclusion in the more detailed assessment of species' distribution, response to disturbance, and life history and population dynamics. The list consisted of species which occurred in East Gippsland and were listed under the Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act), the Commonwealth *Endangered Species Protection Act* 1992 (ESP Act) and the Threatened Fauna of Victoria (TFV) list. The results and discussion on aquatic fauna is presented later in this report. The terrestrial species included are shown in Table 2.3, with conservation status, the presence of Action Statements (for species listed on the FFG Act) and Recovery Plans (for species listed on the ESP Act), and whether the species is secure on other listings. Other listings include the threatened species lists or legislated lists of all States and Territories, other than Victoria, where the species occur. Where species are not listed as threatened, rare, insufficiently known or restricted in these States/Territories they are indicated as secure.

[Sampling adequacy for fauna species in East Gippsland](#) was assessed by generating frequency histograms of fauna species by number of records. The number of presence records from formal surveys were classified into six categories, namely, 0 records, 1 - 10 records, 11 - 30 records, 31 - 100 records, 101 - 500 records and >500 records. The frequency of species falling into each of these categories was then calculated. The analysis was also conducted using total records for each species (i.e. both presence records from formal surveys and incidental records combined). In addition to these analyses, the number of formal survey records and incidental records for each of the priority species listed in Table 2.3 was calculated. The adequacy of sampling for these species was also examined through a review of available literature relevant to the ecology or distribution of each species.

Results and Discussion

Formal surveys in East Gippsland have a known bias with more information available from State forest areas, due to the detailed pre-logging surveys that have been undertaken. Incidental records are also important in determining sampling adequacy. The number of records per fauna species increases substantially for many species when incidental records are added to presence records from formal surveys (Figure 1).

Figure 1: Representation of fauna species in East Gippsland from formal surveys and incidental records



Forty-one per-cent of all bird species, 34% of mammal species, 43% of reptile species and 34% of amphibian species are known from 30 records (survey and incidental) or less (Figure 1). The number of formal survey records and incidental records for threatened terrestrial forest species are shown by land tenure in Table 2.3,

Fauna Species Vulnerability Assessment

Methods

A number of biological characteristics may predispose a species or population to extinction. These are rarity, population dynamics, spatial dynamics, and life history parameters.

1. Rarity refers to the static qualities of a population: geographic range, abundance and habitat specificity (Rabinowitz 1981).
2. Population dynamics are the dynamic qualities of a population. That is, whether it is increasing, stable or decreasing (Caughley 1994).
3. Spatial dynamics, or metapopulation dynamics, is the interaction between colonisation and extinction of sub-populations that make up a population (Hanski and Gilpin 1991). The parameters that contribute to the potential risk of extinction of a species through metapopulation collapse are the variability in abundance of individual populations and dispersal ability (Turin and den Boer 1988).
4. Life history parameters are aspects of biology that may predispose a species to the threat of extinction under particular circumstances. The two most important parameters identified are reproductive output and longevity (Pimm *et al.* 1988).

Each species listed in Table 2.4 was assigned a score for the parameters associated with rarity, population dynamics, spatial dynamics, and life history, based on the scores for the contributing factors. A full explanation of the derivation of the parameters is contained in Dexter (1996). Each score indicates the relative magnitude of the contribution of each parameter to the probability of extinction, as described below.

For the parameters associated with rarity, geographic range within East Gippsland was classified for each species as large, medium or small, based on a measure or estimate of range size, and the proportion of East Gippsland in which the species is found (large >30%, medium 10 to 30%, small <10% of East Gippsland). Abundance within East Gippsland was classified as high, medium or low, based on expert opinion of the density of individuals within East Gippsland. Habitat specificity was classified as narrow or wide, based on expert opinion of the proportion of habitats used within East Gippsland.

When considering the parameters associated with rarity, species or populations with small geographic range, low abundance and narrow habitat specificity are considered more predisposed to the threat of extinction than species with large geographic ranges, high abundance and wide habitat specificity. Therefore, species with small geographic ranges scored 3, species with medium ranges scored 2 and species with large geographic ranges scored 1.

Species with low abundance scored 3, those with medium abundance scored 2, and those with high abundance scored 1. Species with a narrow range of habitats scored 2, species with a wide range of habitats scored 1 (see Table 2.4).

The first separation for population dynamics, was assessed by identifying those species whose numbers have been relatively stable or increased, and those which have declined over a recent time period (the last 10 years). Species with stable or increasing populations were then distinguished by their dependence on active management intervention, and the type of intervention was noted. Past population dynamics (from discovery by Europeans until 10 years ago), were also classified for these species as either having declined or remained stable. For species that have declined in the past, the rate of decline over the past 10 years (high, medium or low), and spatial and temporal patterns of decline were recorded.

Stable species and populations are not considered to be at as greater risk of extinction as species and populations that are declining. Species whose status is stable but dependent on active management intervention (such as predator control), are assumed to be more likely to

be at risk of extinction, and hence receive a score of 2, than those that do not depend on management intervention which receive a score of 1. It is also assumed that species that have declined in abundance since their discovery by Europeans, but have had stable abundance in the last 10 years, would have a higher risk of extinction and hence a score of 2, than species who have maintained a stable abundance since their discovery by Europeans which score only 1 (see Table 2.5).

For those species with declining abundance, the considerations were the rate of decline, and the spatial and temporal patterns of decline (see Table 2.5). Species which are declining at a high rate were considered to be at higher risk of extinction than species declining at a lower rate. Species that were estimated to have declined in abundance by up to 25% in the last 10 years scored 1, species that declined between 25% and 50% in the same time period scored 2, while species that declined by greater than 75% in the last 10 years scored 3.

The spatial pattern of decline refers to the relationship between the range and abundance of a declining species (Gaston 1994). Species are assumed to be at highest risk if abundance is declining faster than range and so score 3. This is most probably because an external factor, such as disease, predators or pollution, or habitat loss, is driving the species towards extinction or high quality habitat is being lost first. A lower risk and a score of 2 is allocated if the range is declining at the same rate as abundance, and for the lowest risk and a score of 1, if the range is declining at a faster rate than abundance as would occur if marginal habitat is being lost first.

The temporal pattern of decline refers to the change in rate of decline as a function of time. Species are assumed to be at greatest risk of extinction if their rate of decline increases over time and hence score 3. This may result from the threatening processes driving the species towards extinction becoming more intense over time. If rate of decline is constant over time, then species are considered to be at a lower risk and score 2. If rate of decline decreases over time, then species are at lowest risk and score 1, perhaps because the threatening process is being ameliorated over time.

Spatial dynamics is the interaction between colonisation and extinction of sub-populations, and can be assessed using estimates of population variability and dispersal ability. Species were classified as having high or low population variability, based on measures or estimates of changes in abundance over time. Species were classified as having high or low dispersal ability, based on measured dispersal distances or inferences from anatomy (e.g. wings developed for flying long distances). Species that have high population variability are more likely to be under threat of extinction and so score 2 than species that have low population variability which score 1. Species with high mobility score only 1 because they are more likely to colonise new patches of habitat and are less likely to be threatened by extinction than species that have low mobility which score 2 (see Table 2.4).

The two life history parameters considered in this assessment are reproductive output and longevity. Species were classified as having high, medium or low reproductive output, based on measures or estimates of litter or clutch sizes or rates of increase, and as being long or short lived based on measures or estimates of longevity or inferred from body size.

Species that have high reproductive outputs are more likely to recover quickly from major declines in abundance than species with low reproductive outputs and so avoid the threat of extinction due to accidents. Therefore, species with high reproductive outputs score 1 compared to similar species with low reproductive outputs.

Species that are long lived tend to be less susceptible to accidental extinction when abundance is low because of their low adult mortality and hence score 1, compared to species with high adult mortality which score 2 (see Table 2.4).

Results and Discussion

Detailed information on the life history and population dynamics for each species are included in Appendix F. The available life history and population dynamics information for the species reviewed is summarised in Table 2.4 and 2.5. The intention of this assessment is to provide a basis for prioritising those species requiring management action. This assessment should also be considered in conjunction with the information relating to threatening processes.

The scores for each species in relation to geographic range, abundance, and habitat specificity is presented in Table 2.4. Most of the species assessed had small geographic ranges in East Gippsland, although outside East Gippsland species such as the Eastern Wallaroo, Barking Owl and Regent Honeyeater have extensive ranges. As expected for a group of species selected because there is some documented concern for their status, most species had low abundance. In contrast, the Common Bent-wing Bat had a high abundance. However, caution must be taken in interpreting this result as a colonial species can give the impression of high abundance because of the concentration of the entire population in a small area during particular times of the year. Most of the species were rated as habitat specific with the exception of species such as the Dingo and Square-tailed Kite.

The scores for species according to population variability, mobility, reproductive output and longevity are shown in Table 2.4. Species such as the Dingo, Eastern Horseshoe-bat and Glossy Black-Cockatoo, have favourable spatial dynamic attributes that reduce the threat of extinction due to metapopulation collapse. Species, such as the Brush-tailed Phascogale, Smoky Mouse, and Ground Parrot, have high population variability and low powers of dispersal which render them more prone to the threat of extinction through metapopulation collapse.

Species such as the Dingo, Diamond Python, and Eastern She-oak Skink are at a particular advantage because of high reproductive output and longevity. However, species such as the Regent Honeyeater and Glossy Grass Skink, are at a particular disadvantage because of low longevity and low reproductive output.

For a range of species, the population trend in the past 10 years could not be determined. This is unfortunate as population trends are the clearest indicators of a species likelihood of extinction.

The scores for stable and declining species populations are presented in Table 2.5. With few exceptions, stable species have declined in abundance since discovery by Europeans.

The Dingo was scored as not being dependent on management intervention despite intensive poisoning campaigns in some parts of East Gippsland because this management intervention was not aimed at maintaining the species abundance.

For most of the declining birds and mammals presented in Table 2.5, medium levels of decline have been estimated. However, for the little studied cryptic reptiles and amphibians no assessment of the rate of decrease, spatial pattern of decline, or temporal pattern of decline could be made.

Table 2.5: Observed dynamics of species populations which have been stable or declining in the past 10 years.

Population stable in past decade. Past population trends: 1 - stable, 2 - declined.
Dependence of current status on management: 1 - no, 2 - yes.

Population declined in past decade.
Rate of decrease: 1 - low, 2 - medium, 3 - high. Spatial pattern of decline: 1 - range size declines faster than number of individuals,
2 - range size and number of individuals decline simultaneously, 3 - number of individuals declines faster than range size.
Temporal patterns of decline: 1 - rate of decline decreases over time, 2 - rate of decline constant, 3 - rate of decline increases.

Species which population have been stable in the past 10 years	Observed Dynamics		Species which population have been declining in the past 10 years	Observed Dynamics		
	Past Population Trends	Dependence of Current Status on Management		Rate of Decrease	Spatial Pattern of Decline	Temporal Pattern of Decline
Dingo	2	1	Spot-tailed Quoll	1	1	3
Common Bent-wing Bat	2	2	Brush-tailed Rock-wallaby	2	1	2
Large-footed Myotis	2	2	Smoky Mouse	2	2	3
Long-footed Potoroo	1	2	Eastern Bristlebird	2	-	-
Grey-headed Flying-fox	2	2	Swift Parrot	-	-	-
Eastern Horseshoe-bat	2	2	Regent Honeyeater	2	1	1
Grey Goshawk	2	1	Alpine Water Skink	-	-	-
Glossy Black-Cockatoo	2	2	Giant Burrowing Frog	-	-	-
White-bellied Sea-Eagle	2	1	Southern Barred Frog	-	-	-
Square-tailed Kite	2	1	Southern Barred Frog	-	-	-
Turquoise Parrot	1	1				
Powerful Owl	2	1				
Ground Parrot	2	2				
Lewin's Rail	2	1				
Masked Owl	2	1				
Sooty Owl	2	1				
Swamp Skink	2	1				
Glossy Grass Skink	-	-				

Fauna Species Reservation Analysis

Methods

A species level of assessment is required for the proposed national reserve criteria, particularly criteria (5) and (6). This assessment requires information on the distribution and habitat for individual species. For most species habitat is also protected through the reservation of EVCs in accordance with the proposed national reserve criteria.

For this assessment formal survey sites for each functional species group were intersected with existing land tenure. A measure of reservation status of each species was subsequently

estimated by calculating the proportion of presence records from formal surveys located in conservation areas, non-reserve areas, and special management zones. Conservation areas were defined as areas described in the East Gippsland forest management database as 'National Parks', 'Special Protection Zones' and 'Other Reserves and Public Land'.

The number of incidental records in conservation areas, non-reserve areas, and special management zones were also calculated for each species. Incidental records and presence records from formal surveys were combined to calculate the total proportion of records for each species in each land tenure category.

Results and Discussion

The proportion of formal survey sites, and individual species records in conservation areas, non-reserve areas and special management zones in East Gippsland for threatened species was collated and are shown in Table 2.6. Whether the majority of species' range (>50%) is within East Gippsland is also presented. This analysis will be biased because the reserve system has had fewer formal surveys. The results will therefore tend to underestimate the level of protection to species provided by the reserve system. The results should be considered in conjunction with the information on threatening processes and interpreted with some caution.

Threatening processes operating at the species level also need to be considered when interpreting this data. Many threatening processes operate across reserve and off-reserve areas and other measures are in place, in addition to reservation, to provide protection at the species level.

Table 2.6: Proportions of species records in conservation reserves and the special protection zone (Res), non-reserve areas (Non-Res) and partially reserved areas - special management zones(Part Res).

Group/Species	All Records (Formal Survey and Incidental Records)				Most Range
Small Ground Dwelling Mammals					
Spot-tailed Quoll	73	55%	42%	3%	N
Broad-toothed Rat	3	67%	33%	-	N
Brush-tailed Rock-wallaby	57	84%	16%	-	N
Long-footed Potoroo	174	41%	24%	35%	Y
Smoky Mouse	48	63%	37%	-	N
Bats					
Common Bent-wing Bat	58	60%	34%	6%	N
Large-footed Myotis	17	71%	29%	-	N
Grey-headed Flying-fox	19	47%	53%	-	N
Eastern Horseshoe-bat	53	28%	70%	2%	N
Yellow-bellied Sheath-tail-bat	3	-	100%	-	N
Large Mammals					
Dingo	0	-	-	-	N
Eastern Wallaroo	10	70%	30%	-	N
Arboreal Mammals					
Brush-tailed Phascogale	5	tenure distribution unknown			N
Owls					

Barking Owl	3	67%	33%	-	N
Powerful Owl	71	68%	31%	1%	N
Masked Owl	70	43%	46%	11%	N
Sooty Owl	98	44%	41%	15%	N
Other Birds					
Grey Goshawk	13	69%	31%	-	N
Glossy Black-Cockatoo	1	-	100%	-	N
King Quail	3	33%	67%	-	N
Eastern Bristlebird	7	100%	-	-	N
White-bellied Sea-Eagle	139	80%	19%	1%	N
Swift Parrot	6	50%	33%	17%	N
Square-tailed Kite	32	66%	34%	-	N
Turquoise Parrot	55	51%	42%	7%	N
Ground Parrot	90	87%	12%	1%	N
Lewin's Rail	9	67%	33%	-	N
Regent Honeyeater	11	36%	64%	-	N
Reptiles					
Eastern She-oak Skink	9	33%	67%	-	N
Swamp Skink	29	62%	38%	-	N
Alpine Water Skink	4	100%	-	-	N
Glossy Grass Skink	10	80%	20%	-	N
Diamond Python	0	-	-	-	N
Amphibians					
Giant Burrowing Frog	10	50%	50%	-	N
Large Brown Tree Frog	66	18%	74%	8%	N
Southern Barred Frog	2	50%	50%	-	N
Martin's Toadlet	27	70%	30%	-	Y
Tyler's Toadlet	15	47%	53%	-	N

Threatening process assessment

The decline of species can be largely attributed to the impacts of disturbances, both directly on the species and indirectly on essential components of their habitat. Disturbances which have negative effects (direct or indirect) on a species are referred to as threatening processes.

A review of the current state of knowledge of forest species, and of threatening processes was conducted to provide information to help set priorities for management, research and surveys, during the integration component of the East Gippsland CRA. The review covers forest dwelling threatened species in East Gippsland, and was based on existing scientific literature and expert opinion.

For each species the likely effects of each threatening processes was documented, and a score assigned according to whether the threat was insignificant, minor, moderate or major for each species (see explanation below). For all information, a measure of the certainty level (low, medium or high) and the source was recorded. For example, if an estimate of population rate of change came from a published experimental study the certainty would be classed as high,

while if the source was an expert opinion based on knowledge of similar species the certainty would be low. Appendix F includes the detailed review for each species.

The assessment of threatening processes was made in the following context:

- Land is available for uses and activities as specified in the East Gippsland Forest Management Plan and various National Park Management Plans;
- Practices on public land follow prescriptions developed under the Code of Forest Practices and various State Acts and Regulations (see Appendix A). Practices on Private land are in accord with the Planning and Environment Act 1987 and the Catchment and Land Protection Act 1994; and
- The ratings apply to East Gippsland only.

Threatening processes, outlined in Table 2.7, were scored for each species as follows:

- 0** - Processes not likely to be operating as a threat or there is no information to suggest that it is a threat;
- 1** - Process is a minor threat, which by itself is unlikely to lead to broad scale decline of the species;
- 2** - Process is a moderate threat, which is likely to lead to some decline of the species, especially if it operates in combination with other threatening processes; and
- 3** - Process is a major threat, which if not checked poses a significant risk to the viability of the species in East Gippsland.

The combined score for each threatening process provides a useful indication of the relative importance of different threatening processes affecting fauna in East Gippsland. Table 2.7 provides a summary of threatening processes for threatened forest fauna in East Gippsland.

An explanation of each threatening process follows along with a brief discussion of the key species affected in East Gippsland and current management to mitigate threats.

Predation

This category covers predation by introduced predators (e.g. feral cat, fox, trout). It does not include predation by naturally occurring native species.

Predation by introduced predators scores highest in the analysis, affecting 28 of the featured species. It is considered a major threat to three species; the Brush-tailed Rock-wallaby, Long-footed Potoroo, and Brush-tailed Phascogale which are preyed on by foxes, feral cats and wild dogs/dingoes. A further 14 species (two mammal, two bird and ten fish or aquatic macroinvertebrate species) face moderate threats from introduced predators. Predation by introduced fish species (for example trout, mosquitofish) is identified as a moderate threat affecting a significant number of aquatic species.

Control of foxes and wild dogs is currently limited to one Long-footed Potoroo and one Brush-tailed Rock-wallaby site. Cooperative control programs are also undertaken in public land adjacent to private land. An experimental broad scale predator control program is also planned to protect medium sized mammals susceptible to feral predators.

Altered hydrology

This category includes the effects of human-induced stream sedimentation (e.g. through

roading, streambank erosion etc.) disturbance to hydrological regimes in heathlands (by roads), and the possible effects of regrowth forest on water yields.

Altered hydrology is considered a moderate threat to 12 species (seven fish, two aquatic macroinvertebrates, two frogs and one reptile) and a minor threat to a further seven (three fish, two frogs and two skinks). The main threat is siltation of spawning areas due to increased erosion rates in catchments. The principal sources of sedimentation are likely to be associated with unsealed roads and tracks. Of greatest concern are roads and tracks that carry significant volumes of traffic and are close to streams (e.g. Bonang Road, Combienbar Road, and Errinundra Road), roads constructed for timber harvesting in State Forest, and poorly constructed or maintained four-wheel drive tracks on erodible soils, especially at stream crossings.

In State Forest, all new roads and tracks must be built to comply with the Code of Forest Practices for Timber Production (Code). Restricted use of roads and tracks in wet weather is also enforced to maintain the structural integrity of road and track surfaces. Compliance with these standards should significantly reduce risks to stream sedimentation.

Extra attention is now paid to planning the road and track network to avoid threatened species habitat, minimise environmental damage and provide high standard stream crossings. However, many roads and tracks were built prior to introduction of the Code and do not meet today's standards. This legacy of sub standard roads tracks is a potentially significant threat.

Disruption to hydrology by roads in or through heathlands is listed as a minor threat to Martins Toadlet, Tyers Toadlet, Swamp Skink and Glossy Grass Skink. While some roads have been built through heathlands in the past, the Forest Management Plan states that this is no longer to occur and that all heathlands are to be protected by 40 metre buffers.

Construction of in stream barriers, reduction of flows in small streams due to the high water use rates of regrowth forest, and changes to the riparian microclimate are also listed as moderate or minor threats to aquatic species.

Disease

Disease was thought to be a possible contributing factor to the decline of Spot-tailed Quoll earlier this century although it is not known to be currently active. Toxoplasmosis and Hydatidosis are considered possible threats to the Brush-tailed Rock-wallaby. The significance of disease may become clearer as research into the ecology of these two species progresses.

Competition

Competition from introduced forest carnivores and scavengers (foxes and cats) is considered a major threat to Spot-tailed Quoll. It is also a moderate threat to Dingoes and a minor threat to Masked Owl and Diamond Python.

Fox control measures are currently limited to protection of Long-footed Potoroo and Brush-tailed Rock-wallaby at selected sites and cooperative control is undertaken in areas adjacent to private land. Control of foxes using 1080 poison baits is problematic in Spot-tailed Quoll habitat because there is some risk of quolls taking the bait and being poisoned themselves. In response, baiting of known habitat is avoided where possible. Where baiting is undertaken, baits are buried and bait stations are monitored for evidence of Quoll presence.

As well as preying on native fish species and their eggs, trout can compete for habitat. This is thought to be a moderate threat to Mountain Galaxias and Spotted Galaxias. There are currently no programs to address the risk of competition posed by trout.

There are currently a number of streams with no exotic species present, in particular, along the coast. They are therefore very significant to the conservation of native fish. Specific provisions are in place to prohibit the introduction of exotic species to these streams.

Competition for forage and habitat from feral goats and rabbits is probably a minor threat to Brush-tailed Rock-wallaby and Eastern Wallaroo.

Clearing

Extensive clearing of native vegetation for agriculture and settlement has been a significant factor in the decline of many species and is partially responsible for the current threatened status of some species. Clearing is now confined to relatively small areas on private land. Continued clearing nonetheless, could lead to minor reductions in the habitat of the twelve threatened species that occur in areas favoured for clearing.

This threat is significantly mitigated by the implementation of native vegetation retention controls under the *Planning and Environment Act 1987*. Areas of significant vegetation and/or fauna habitat are protected by this process and fragmentation of native vegetation is also avoided. Permits to clear native vegetation are generally only granted for small areas with little significance or slightly larger areas of degraded native vegetation.

Fragmentation

Fragmentation of the forest can split a previously continuous population of a species into smaller populations which have reduced viability. While the fragmentation of forest by permanent clearing may be responsible for the current threatened status of some species, it is not considered a major threat to forest species because permanent clearing is now rare.

Fragmentation of some species habitat can also occur within the forest. For example, roads may present barriers to some species and alteration of forest structure by timber harvesting may cause fragmentation by making some forest areas sub-optimal for species dependent on old growth forest elements. Fragmentation is considered a minor threat to seven of the featured species (four mammals, two birds and one reptile).

The Forest Management Plan addresses the possible effects of fragmentation within the forest by providing protected areas (Special Protection and Special Management Zones) for threatened species across their range and linking these with a network of linear reserves of 200 metres width.

Timber harvesting

Timber harvesting using clearfall and seed tree methods, threatens a range of fauna species by its immediate and short term effect of habitat removal, and more importantly, by its medium and longer term effect of producing even aged regrowth forests that are less suitable for some species than older forest. The effect of roads associated with timber harvesting are considered under a separate threat category (altered hydrology).

Timber harvesting is considered a moderate threat to five of the listed species; Long-footed Potoroo, Powerful Owl, Sooty Owl, Southern Barred Frog and Giant Burrowing Frog, and a minor threat to a further 15 of the listed species.

All confirmed Long-footed Potoroo sites are currently protected in accordance with a conservation strategy (Saxon *et al.* 1994) and Action Statement (Thomas *et al.* 1994), and similarly, conservation of the Giant Burrowing Frog is addressed by an Action Statement (Mazzer 1994). The only site supporting a contemporary record of Southern Barred Frog is included in a Special Protection Zone. The Forest Management Plan also includes conservation strategies for the Powerful and Sooty Owl. The status and management of the 15 species considered to face minor threats from timber harvesting is discussed in the section on threatened species management.

Harvesting / disturbance by humans

This category covers direct interference to the individuals of a species by humans in the form of hunting, poisoning, visitor pressure or trapping etc.

These activities are considered to pose a moderate threat to five species: Spot-tailed Quoll, Dingo, Large-footed Myotis, Common Bent-wing Bat and Eastern Horseshoe-bat. A further nine species face minor threats from these human activities.

Dingoes and wild dogs are trapped, shot or poisoned on and adjacent to farmland in order to protect domestic stock. The more widespread control of dogs/dingoes on public land has been discontinued, except at some other threatened species sites where predation by dingoes/dogs is a threat. Spot-tailed Quoll are at risk from 1080 poisoning campaigns to control other predators (dingoes/dogs, foxes). This risk is minimised by using the buried bait technique and monitoring of the area for the presence of quolls prior to baiting.

The three bat species breed and roost in a limited number of caves in East Gippsland. Disturbance of these sites by visitors, especially during breeding, is a risk to these species. This risk is minimised by formally controlling access to maternity caves in the Buchan area and not publicising the exact location of other caves in East Gippsland.

Altered succession

Altered succession in East Gippsland relates mainly to the effect of inappropriate fire regimes, such as too frequent burning or insufficient burning, to provide habitat suitable for the species.

After predation by introduced predators, altered fire regimes is the most significant threat facing the fauna covered by this analysis. Twenty-one of the featured species are considered threatened. Three species face major threats, 11 face moderate threats and seven face minor threats. The three species facing major threats are Smoky Mouse, Eastern Bristlebird and Ground Parrot.

The Smoky Mouse is a heath specialist which depends on understorey vegetation components strongly influenced by fire frequency and intensity. The Ground Parrot is also a specialist of coastal heathlands. Pro-active fire management maintaining a mosaic of heathlands in different successional stages is required to maintain stable Ground Parrot populations. The Eastern Bristlebird is at the southern end of its range in East Gippsland where it is best known from Howe Flat in Croajingolong National Park to the east of Mallacoota. Maintenance of forest-heathland ecotones by suitable fire regimes is considered essential for this species.

The requirements of Ground Parrot (and to some extent the other species) is addressed by the Orbost Heathlands management plan (Avis 1993) which specifies preferred fire regimes and an ongoing ecological burning program to conserve Ground Parrot and a wide range of other threatened flora and fauna species in the coastal heathlands between Orbost and the New South Wales border. The Croajingolong National Park Plan, Forest Management Plan (DCNR 1995a) and Orbost Fire Protection Plan (amended from Bartlett 1990) are all consistent with the heathland plan. The Forest Management Plan includes all heathlands and a surrounding buffer of at least 40 metres in the Special Protection Zone. The ecological requirements of Smoky Mouse and Eastern Bristlebird are less well known than for Ground Parrot, and further survey and research is required for these species.

Natural disasters

While wildfire is an integral part of forest ecology, serious wildfire can have a disastrous effect in particular circumstances. Severe wildfires are considered to pose a major threat to Eastern Bristlebird because of its small population size and fire prone habitat. They are also considered to pose moderate and minor threats to a further nine and 11 of the species respectively considered in the analysis.

DNRE has the responsibility to prevent and control major wildfires. The fire protection plans covering East Gippsland (Bartlett 1990, Long 1990), and the Code of Fire Practices, include strategies to achieve these goals. Significant and sensitive natural values are taken into account by the plans, and in response tracks and fuel reduction burning zones have been sited accordingly. Moreover, the fire plans are being continually updated to take account of new

information and other requirements such as those in the Forest Management Plan and national park management plans.

Loss of organism on which other species depends

Some species are at risk from the secondary effect of the decline or loss of another species on which they depend. This is considered a moderate threat to the Powerful Owl and Sooty Owl, and a minor threat to another four species.

A significant proportion of the diet of the Powerful and Sooty Owls is hollow dependent arboreal mammals. The abundance of hollow dependent arboreal mammals will decline in State Forest as timber harvesting causes a decline in the number of hollow bearing trees.

The Forest Management Plan aims to reduce this risk by protecting strategic areas of older forest of sufficient size to support Powerful and Sooty Owl home ranges and a linear reserve network to conserve arboreal mammals across the landscape. The aim is to protect sufficient habitat for Powerful and Sooty Owls and their arboreal prey across their natural geographic range in East Gippsland.

The four species considered to face a minor threat from the loss of organisms they depend on are as follows:

Long-footed Potoroo and Smoky Mouse which both feed on hypogeal fungi. The dynamics of these fungi are poorly understood. The results of current research into the ecology of hypogeal fungi should provide information to assist in the management of these two species.

Glossy Black-Cockatoos feed specifically on seeds of the She-oak *Allocasuarina littoralis* which could possibly be depleted by inappropriate fire regimes or timber harvesting. An Action Statement is being prepared for this species. While most areas likely to contain stands of She-oak occur in Croajingolong National Park and in vegetation types not suited to timber production, the Forest Management Plan specifies that substantial stands of She-oak in areas proposed for harvesting are to be protected. The location of fuel reduction burning corridors takes account of the requirements of this species.

Contamination of life cycle

Contamination of life cycles is considered a minor risk to nine of the species considered. Most at risk are 'top of the food chain' predators that take prey from land or water where contamination from pesticides or pollution may occur. Consequently, species taking prey from agricultural land (Barking Owl, Masked Owl, Spot-tailed Quoll) or from estuaries and the sea (White-bellied Sea-Eagle) are at greatest risk. However, these are not considered major threats in East Gippsland because of the essentially natural condition of the region, and low human population.

Grazing / trampling

Of the forest species considered in this analysis, grazing by domestic stock or feral animals (goats, horses) is considered a moderate threat to the Broad-toothed Rat and a minor threat to Lewin's Rail.

Broad-toothed Rat is confined to the Alpine National park in the north-west of East Gippsland where grazing and trampling of its sedgeland habitat by cattle and brumbies is a potential threat. The National Park plan identifies research into the species distribution, ecology and threats as a priority.

Lewin's Rail occurs in swamps and wetlands which may be threatened by cattle grazing. The major area of wetlands in East Gippsland where cattle grazing occurs to any significant extent are along the lower Snowy River. Implementation of the Lower Snowy River Wetlands Management Plan should reduce these risks by the fencing and control of stocking levels in sensitive areas.

Other

Other threats identified in the analysis were the long term genetic effects on dingo populations resulting from interbreeding with wild dogs, and the effects of isolation and inbreeding depression on Eastern Bristlebird. Both these threats are considered minor in comparison to other threats operating in East Gippsland. There is currently no specific management to address these threats.

Current Management Action for Threatened Fauna

The following section describes current management arrangements that contribute to the conservation of each threatened fauna species, with the exception of aquatic species which are addressed in a separate section.

The major conservation mechanisms are as follows:

Conservation reserves

Management zones and specific actions are taken from management plans for the Alpine National Park (Cobberas - Tingaringy Unit), Snowy River National Park, Croajingolong National Park and Errinundra National Park.

Forest Management Plan

Management zones as outlined in section 1.5. The plan also includes detailed conservation guidelines for individual threatened species.

Code of Fire Practices

The Code of Fire Practices specifies practices to ensure that fire suppression and fuel reduction burning take account of environmental values.

Fire Protection Plans

The Fire Protection Plans include specific zones and provisions to avoid disturbance to threatened species habitat.

Heathland Management Plan

The Heathland Management Plan specifies an ecological burning program for coastal heathlands and associated threatened species.

Code of Forest Practices for Timber Production

Regional prescriptions prepared in accordance with the Code include protection of riparian habitats, retention of habitat trees, and provision for protection of significant habitat within coupes.

Mammals Dingo

Dingo/Wild Dog control in East Gippsland is only undertaken at endangered species sites or adjacent to farmland carrying vulnerable livestock.

Spot-tailed Quoll

An Action Statement (Mansergh and Belcher 1992) has been prepared for this species and includes research and monitoring into the distribution, ecology and threats.

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). Where the species is detected, approximately 500 hectares will be protected within a 1 500 hectare area including the detection site. The aim is to protect a network of areas in the likely home range of each animal recorded. The protected area may include conservation reserves, larger patches of SPZ, stream buffers, steep slopes and areas unsuitable for harvesting. Preference will be given to habitat that may provide suitable denning sites, such as riparian vegetation and rock outcrops. Known latrine and den sites will be protected and include a minimum buffer zone of 200 metres radius. Predator-control using 1080 baits will only be undertaken in the vicinity of quoll detection sites as part of a threatened species

conservation program. Once the species has been detected at 50 sites, this guideline will be reviewed.

In the Alpine National Park, an area identified as being one of high concentration for the Spot-tailed Quoll has been incorporated into a protection zone. Control of introduced animals in this zone will involve the use of treadle snares, not steel jawed traps, and all poison baits will be buried. Wild dog control will be concentrated on the perimeter of the park where it borders primary production areas.

This species is considered a priority species in the Snowy River National Park and management strategies will be set according to the Action Statement (Mansergh and Belcher 1992). Monitoring programs will be developed, knowledge of the management requirements of the species will be improved, and management actions for the protection of the species will be developed. Although the Spot-tailed Quoll has also been recorded in the Croajingolong National Park, there are no specific management strategies in the Park for this species.

In Errinundra National Park, the highest priority for this species will be additional surveys to ascertain its status throughout the park, particularly in Brodribb River catchment, Goolengook River headwaters and the Cobb Hill area, and the control of cat and fox populations in known habitats. The linking of the park with adjacent unlogged habitats in State Forest by wildlife corridors, has been achieved as part of the East Gippsland Forest Management Plan. In the vicinity of known sites of occurrence and dens, fuel reduction burning activities will be undertaken as needed, in autumn or late summer.

Eastern Wallaroo

The entire distribution of this species in East Gippsland is confined to the Alpine and Snowy River National Parks. Research into the distribution and habitat requirements of the Eastern Wallaroo will be undertaken and/or encouraged, and in the Snowy River National Park, the priority for this species is to improve knowledge of the management requirements, concentrating on locating the species and developing management actions for its protection.

Broad-toothed Rat

In East Gippsland this species is confined to the Alpine National Park. The park plan specifies control of foxes and feral cats, and research into the distribution, ecology and threats to this species. While not recorded in State Forest the riparian habitat in which it would be most likely to occur is protected by prescription.

Common Bent-wing Bat, Large-footed Myotis and Eastern Horseshoe-bat

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). All breeding and roosting caves and mines, and known over-wintering sites are to be protected by a buffer of approximately 100 metres and included in the SPZ. Sites will not be publicised and visitors will generally be discouraged, except as part of planned interpretive activities.

In the Alpine and Snowy River National Parks, research into the distribution, ecology and threats, and monitoring programs, to the Common Bent-wing Bat will be undertaken and/or encouraged. Access to maternity and over-wintering caves is restricted in Snowy River National Park.

Details of the location of roosting sites of the Common Bent-wing Bat in Croajingolong National Park have been included in protection zones, and are confidential. The colony will be monitored at least once per year, and the level of human disturbance will be assessed. Consideration will be given to limiting visitor access to the site if human disturbance is adversely affecting the colony. The Large-footed Myotis also occurs in Croajingolong National Park, but there are currently no specific management strategies in place for this species in the Park.

There are no specific management strategies for the Common Bent-wing Bat, Large-footed Myotis and Eastern Horseshoe-bat in the Errinundra National Park, although it is intended to

conduct further work to ascertain the status of these species in the Park and their ecological requirements.

Brush-tailed Rock-wallaby

All known populations of this species in East Gippsland are located in the Alpine and Snowy River National Parks. The Brush-tailed Rock-wallaby Action Statement (Hill and Baker-Gabb 1991) outlines intended management actions which include: determination of critical habitat of the species in Victoria; survey areas of potential habitat to locate new populations and describe the habitat at extant and extinct sites; and continue predator control at one site (in the Grampians) and monitor the effectiveness of these operations.

One active population was identified in a survey (Norris and Belcher 1986) in the Cobberas - Tingaringy unit of the Alpine National Park. This site, and five others where the animals had previously been recorded up to at least 1960, have been included in a protection zone. Until a detailed management strategy is prepared for the species, the highest priority for management will be the control of foxes and wild dogs in areas where the Brush-tailed Rock-wallaby is known, or thought to occur.

Research and monitoring into the reasons for the decline of the species will continue, and will include, monitoring of predators in areas known to support Brush-tailed Rock-wallabies, and investigation of the effects of fire on the habitat. The one active colony will be annually monitored to determine population fluctuations and movements. Further surveys to cover all potential habitat and establishing the taxonomy of the species are priorities for further work.

In the Snowy River National Park, the Brush-tailed Rock-wallaby is considered a priority species, and five SPZ have been identified. The primary management objectives of these areas is the long-term conservation of the Brush-tailed Rock-wallaby. In these zones, fuel reduction and ecological burning are under strict controls. Management strategies will be set according to the Action Statement (Hill and Baker-Gabb 1991), and monitoring programs will be developed to improve knowledge of the management requirements of the species.

Brush-tailed Phascogale

An Action Statement is being prepared for the species, which is best known from Central Victoria. Its status in East Gippsland is unclear but it is most likely to be confined to the dry open forests and woodlands of the Upper Snowy River valley, which is mostly in the Snowy River and Alpine National Parks.

Long-footed Potoroo

Management of Long-footed Potoroo is governed by a Conservation Strategy (Saxon *et al.* 1994) and Action Statement (Thomas *et al.* 1994). The Forest Management Plan and park management plans are consistent with these documents. Confirmed sites will be included in 400 - 500 hectare sub-catchment units containing suitable habitat (Rainforest, Wet or Damp Forest). Timber harvesting, new roading, and most fuel reduction burning will be excluded. Where the areas identified are in State Forest, they will be included in the SMZ, or the SPZ where they coincide with other values. Once 17 500 hectares has been protected (enough habitat for approximately 1 000 individuals), new records will be used to adjust the zoning scheme but will not create a net additional area to the SPZ or SMZ. This strategy will be reviewed in the year 2000. Some areas identified for Potoroo conservation have been placed in SMZ, as the species is known to use regrowth forest and carefully planned timber harvesting may be compatible with their conservation. However, no harvesting will be allowed in these areas until research on the species is further advanced. Fox and dog control by poisoning will occur in selected areas, in association with Long-footed Potoroo population monitoring.

In the Snowy River National Park, the Long-footed Potoroo is considered a priority species and a protection zone has been identified. Monitoring programs will be developed, knowledge of the management requirements of the species will be improved, and management actions for the protection of the species will be developed and implemented. The proposed plan for Errinundra National Park indicates that the highest priority for the Long-footed Potoroo will be

undertaking additional surveys to ascertain the species' status in the Brodribb River and Goolengook River catchments, and the control of feral predators in localities where animals are known to occur. Wherever practicable, fuel reduction burning will be excluded from riparian and gully habitat, and a mosaic of burnt and unburnt patches on lower slopes will be created.

Smoky Mouse

The species habitat includes Coastal Heathland (see conservation guidelines for heathland EVCs in East Gippsland (DCFL 1989, Bartlett 1990, Avis 1993, DCNR 1995a)). Management of Smoky Mouse habitat in the Croajingolong National Park, and in State Forest, will be in accordance with the Coastal Heathland Management Plan. In the Alpine National Park, research into the distribution, ecology and threats to the Smoky Mouse will be undertaken and/or encouraged, particularly to determine the effects of fuel reduction burning in sclerophyll forests.

Grey-headed Flying-fox

The one recorded major roost site of this species in East Gippsland is a warm temperate rainforest which is partly on private land and partly in Croajingolong National Park. The species is wide ranging and occasionally recorded at other sites in East Gippsland.

Yellow-bellied Sheathtail-bat

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). Where more than 10 individuals per trapping session are recorded, approximately 100 hectares of older forest in close proximity to the site will be included in the SPZ. Once 20 sites have been identified, this guideline will be reviewed. Guidelines for old growth forest may protect some of the habitat of the Yellow-bellied Sheathtail-bat. The species is also recorded in Errinundra National Park.

Birds

Grey Goshawk, Square-tailed Kite and White-bellied Sea-Eagle

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). All known nest sites will be included in Special Management Sites with a 250 metres radius around the site. Timber harvesting, road construction and fuel-reduction burning will be avoided in these areas during the breeding season, and at other times, harvesting and road construction will be allowed to within 100 metres of nest trees. Visitors will be discouraged and sites will be kept confidential. Management of the White-bellied Sea-Eagle in National parks and State Forest will be governed by the Action Statement for the species (Clunie 1994).

In the Snowy River National Park the priority for the Square-tailed kite is to improve knowledge of its management requirements, concentrating on locating the species and developing management actions for its protection. The White-bellied Sea-Eagle and Grey Goshawk occur in the Croajingolong National Park, but no specific management strategies are in place.

Glossy Black-Cockatoo

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). All substantial stands of Black She-oak (*Allocasuarina littoralis*), the near exclusive food source of the species, will be excluded from harvesting, and nest trees will be protected as for the Grey Goshawk. In Croajingolong National Park, it is proposed to map suitable habitat of the species and identify long unburnt stands of Black She-oak. At least 15 years will be left between fuel reduction burns to allow Black She-oak to mature and develop seed-bearing cones. Fire suppression action will be undertaken to protect important stands of habitat.

King Quail

The species is recorded from Croajingolong National Park but is probably a vagrant in East Gippsland. Its preferred habitat of swampy heathland and densely vegetated freshwater swamps are protected in conservation reserves or by prescriptions in State Forest.

Eastern Bristlebird

Howe Flat (the Victorian stronghold of the species) in Croajingolong National Park, will be managed with this species as the focus. Surveys of Eastern Bristlebirds will be undertaken to ascertain and monitor the ongoing status of the population. Ecological burning will only be undertaken when habitat conditions are considered unfavourable for the species (indicated by significant population decline). Operations to suppress high intensity wildfires around Howe Flat will be undertaken outside the species' habitat, wherever practicable. Research into the ecology and management of the Eastern Bristlebird will be encouraged.

Some suitable habitat for Eastern Bristlebirds occurs in State Forest and these areas are protected by the conservation guidelines for heathland EVCs in the Forest Management Plan and the heathland management plan. Identification and implementation of suitable fire regimes is of major importance for this species.

Swift Parrot

The Swift Parrot is an occasional visitor to East Gippsland. Most of its habitat is in conservation reserves. Selective removal of box and ironbark species in State Forest may have depleted the availability of winter nectar resources. These practices have been discontinued, and management of lowland forests now aims to progressively increase the abundance of these species (DCNR 1995a).

Turquoise Parrot

The Turquoise Parrot has been recorded from heathlands and fringing woodlands, in East Gippsland. Its habitat is mostly in the Snowy River and Croajingolong National Parks or State Forest unsuitable for timber harvesting. There are no specific management strategies for this species.

Barking Owl

The Barking Owl is typically a bird of drier country and is extremely rare in East Gippsland and probably not a resident. Processes that threaten the species over its normal geographic range include the loss of tree hollow nest sites through timber harvesting and the indirect contamination of its life cycle through poisoned prey. The operation of these threatening processes in East Gippsland is not likely to influence the overall conservation of the species due to its probable 'irregular visitor' status. <

b>Powerful Owl, Sooty Owl and Masked Owl

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). All known nesting sites will be protected as for the Grey Goshawk, and enough good quality habitat to support at least 100 pairs (see below) will be maintained in East Gippsland (protected in conservation reserves and the SPZ, or subject to modified harvesting practices in the SMZ). Special plans that allow a level of timber harvesting compatible with the conservation of the most important components of owl habitat will be prepared for SMZ sites. Once sufficient habitat for 100 pairs is being managed for owl conservation, new records may be used to adjust the zoning scheme.

The Forest Management Plan defines good quality habitat for a pair of each species as follows:

Powerful Owl - approximately 800 hectares of forest dominated by old trees. This species occupies a wide range of forest types, but areas with high populations of possums and gliders are favoured. Where the SPZ or SMZ is based on a known site the 800 hectares is to be within 1 500 hectares of forest including the detection site.

Sooty Owl - approximately 500 hectares of forest dominated by old trees and generally comprising Lowland, Damp and Riparian Forest, and Warm Temperate Rainforest. Where the SPZ or SMZ is based on a known owl locality the 500 hectares is to be within 1 000 hectares area that includes the detection site.

Masked Owl - approximately 500 hectares including old, relatively undisturbed forest, woodlands and heathlands including Lowland and Riparian Forest, coastal woodlands and areas of natural forest edge, such as heathland-forest ecotones. This species may be less dependent on older forest and arboreal prey than Powerful and Sooty Owls.

These three species of owl occur in Croajingolong National Park, but no additional management strategies are proposed. The Errinundra National Park Management Plan (DCFL 1989b) places high priority on distribution surveys and research into the ecology and management requirements of the Powerful, Sooty, and Masked Owls. The management plan proposal to link the park with adjacent unlogged habitats in State Forest has been achieved through the Forest Management Plan.

Ground Parrot

This species' preferred habitat in East Gippsland centres on wet and clay heathlands between Orbost and Mallacoota. Heathlands and a buffer of at least 40 metres are protected in State Forest. Habitat management for Ground Parrots (in State Forest and Croajingolong National Park) will be in accordance with the Orbost Heathland Management Plan (Avis 1993). This plan includes guidelines and prescriptions for management of all heathlands and a five year ecological burning strategy.

Lewin's Rail

Lewin's Rail occurs in swamps and wetlands which may be threatened by cattle grazing. The major area of wetlands in East Gippsland where cattle grazing occurs to any significant extent are along the lower Snowy River.

Implementation of the Lower Snowy River Wetlands Management Plan should reduce these risks by the fencing and control of stocking levels in sensitive areas.

Regent Honeyeater

This species is probably only an irregular, occasional visitor to East Gippsland. Management actions for public land are outlined in the Action Statement (Menkhorst 1993). It has been recorded in Snowy River and Croajingolong National Parks and in State Forest but there are no specific park management strategies for this species in East Gippsland.

Reptiles

Eastern She-oak Skink, Swamp Skink and Glossy Grass Skink

All three species occur mostly in heathlands or on the margins of swamps and waterways. These habitats are protected in State forest by the heathland conservation guideline (DCNR 1995a) and the Code of Forest Practices for Timber Production.

The management of fire in heathlands supporting populations of the Swamp and Eastern She-oak skinks (in Croajingolong National Park and State Forest) is addressed by the Heathland Management Plan (Avis 1993). Additionally, in Croajingolong National Park a range of late successional stage habitats (which are potential habitat for the skinks) will be protected by fire suppression actions.

Alpine Water Skink

The Alpine Water Skink has only been recorded from the Alpine National Park. The Alpine Bog Community and the Fen (Bog Pool) Community, which provide habitat for the Alpine Water Skink, have been listed under the *Flora and Fauna Guarantee Act* 1988. Soil erosion and vegetation damage and disturbance in the alpine regions of Victoria caused by cattle grazing has been listed as a potentially threatening process under Schedule 3 of the *Flora and Fauna Guarantee Act* 1988. A number of sites where the Alpine Water Skink is known to occur have been included in protection zones in the Alpine National Park. Sites will be protected from grazing and trampling, and monitored to measure any change or degradation of habitat. Research into the distribution, ecology and threats to this species will be undertaken and/or

encouraged. A proposed fence around significant plant species at the playgrounds will also protect Alpine Water Skink habitat.

Diamond Python

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). For each confirmed locality of this species, 100 hectares of suitable habitat will be included in the SPZ. Fuel reduction burning will be permitted, provided a suitable mosaic of different aged habitat patches can be maintained. Precise locations of the species will not be publicised and when 50 sites have been located, the guideline will be reviewed. In Croajingolong National Park, fuel reduction burning in known Diamond Python habitat will aim to achieve a mosaic of burning to enable individuals seek refuge and facilitate re-colonisation of burnt habitat.

Routine patrols and enforcement action will be undertaken to minimise the possibility of illegal collection, and the exact site localities will be kept confidential.

Amphibians

Giant Burrowing Frog

Conservation guidelines are outlined in the East Gippsland Forest Management Plan (DCNR 1995a). All sites where the Giant Burrowing Frog is recorded on first-order streams, or at sites away from streams, approximately 50 hectares (preferably a sub-catchment unit) will be included in the SPZ. Sites on second- or higher-order streams will be included in a linear reserve (SPZ) extending 100 metres from each bank for one kilometre upstream, and one kilometre downstream from the detection site. Construction of new roads in these parts of the SPZ will be avoided. When 50 sites in Victoria have been located, this guideline may be reviewed.

Additional management actions relating to fuel reduction burning are outlined in the Giant Burrowing Frog Action Statement (Mazzer 1994). These guidelines are incorporated in the yearly fuel reduction burning plans, and are as follows: for stream records on second or higher order streams, burning will be carried out so that a 100 metre buffer on each side of the stream remains unburnt; and for other records, burning will be carried out so that either the area around the Giant Burrowing Frog site is not burnt, or a mosaic of burnt and unburnt patches is formed.

The species is recorded in Snowy River and Errinundra National Parks but no additional management actions are proposed. The need to better establish the status and ecological requirements of the species in the Parks are identified.

Large Brown Tree Frog

The Large Brown Tree Frog has been recorded in a range of forest types East Gippsland where it does not appear uncommon. Little is known of the biology and habitat requirements of this terrestrial species, although it is known to breed in ephemeral water bodies including pools in logs, roadside puddles, drains and fire dams. Because it occurs in modified habitats such as farmland and is able to breed in temporary water bodies, it is thought to be able to tolerate some disturbance. Possible threatening processes within East Gippsland include loss of habitat as a result of timber harvesting and wildfire, and a reduction in litter and ground cover layers which harbour invertebrate food following timber harvesting and regeneration burning. There are no specific park management strategies for the species in State Forest or National Park.

Southern Barred Frog

State Forest guidelines are the same as those for the Giant Burrowing Frog. The only site where there is a current record of this species is included in the SPZ.

Martin's Toadlet and Tyler's Toadlet

These species occur primarily in heathlands and fringing woodlands. Conservation guidelines for all heathland EVCs in East Gippsland include the incorporation of heathlands and buffering

vegetation of at least 40 metres width, in the SPZ. Large representative examples of heathland mosaics, including fringing woodlands, are also included in the SPZ.

Road construction will be avoided in all heathlands and fire management will be in accordance with the Heathland Management Plan (Avis 1993) and the Orbost Fire Protection Plan (Bartlett 1990). No strategies in addition to habitat protection are proposed in State Forest or Croajingolong National Park.

2.3.4 Flora Assessment

The flora assessment has three main components:

- a review of existing survey data used for deriving forest community maps, species distributions and habitat;
- a review of rare and threatened species including life history attributes and population dynamics, responses and vulnerability to disturbance, current management action and species' occurrence in reserves; and
- a review of threatening processes.

The information used for the assessment of flora in East Gippsland was based largely on information held in an existing DNRE database. It was dependent on the categories of information available in the database, and its currency.

Information on rare or threatened plant species in East Gippsland are shown in Appendix E.

Flora Survey Data Review

Methods

The site-based biological data sets used in this assessment were drawn from the Flora Information System of Victoria and the Victorian Rare or Threatened Plant Database. A description of these databases is given in Appendix B. The flora core data fields extracted were; reference (quadrat) number, date, latitude, longitude and species code. The latitude/longitude is accurate to 100 metres.

The distribution of survey sites among environments (strata) was analysed with respect to the size of each stratum and its geographic distribution. The density of survey sites in each stratum was examined for all flora and strata with low densities of sites were identified.

Results and Discussion

Summary information for each stratum, along with figures relating to the flora site density analysis discussed below, is given in Appendix C. The flora survey intensity is shown in Map 3 and is discussed below in relation to the environmental strata of the region (Map 2).

More than 6 000 survey sites have been sampled in East Gippsland since 1980. These floristic quadrats have been sampled as part of a range of studies, including: region-wide studies; more than 30 pre-logging flora and fauna studies based on forest blocks (e.g. Lobert *et al.* 1991); intensive sampling of experimental areas; and other studies based on targeted sampling of particular habitats, such as rainforests and heathlands.

Of the 83 environmental strata derived for East Gippsland, 21 contained no floristic sites, although each of these occupied areas of 1 000 hectares or less. The remaining 62 strata were classified on the basis of flora survey intensity (low, moderate, high and very high; see Map 3). The geographic locations referred to in the discussion below relate primarily to the geographic sub-units identified in the East Gippsland Forest Management Plan (e.g. Errinundra Tablelands refers to a specific geographic sub-unit that encompasses a broader area than the Errinundra plateau).

Strata with no flora survey sites (9 744 ha - 1 % of total land area)

The strata with no flora survey sites comprised 9 744 hectares or one percent of the total land area. The strata were small and scattered in the Upper Buchan mountains, the Snowy Deddick rain shadow area and the Snowy River valley. Other areas which included unsurveyed strata

were the Orbost - Buchan Foothills, the Errinundra tablelands, present floodplains in the Cann and Brodribb valleys (largely cleared) and the Lake Tyers - Corringale coast (Map 3).

Strata with low site density (>1 000 hectares/site)

Strata with low site densities comprised 211 369 hectares or 17% of the total land area. The strata were concentrated largely in the same areas as those containing unsampled strata, namely the Upper Buchan mountains, the Snowy - Deddick rain shadow area, the Snowy River valley, the Orbost - Buchan foothills, the Errinundra tablelands and the Lake Tyers - Corringale coast (Map 3). **Strata with moderate site density (500 - 1 000 hectares/site)**

Strata with moderate site densities comprised 144 322 hectares or 12% of the total land area. The strata were concentrated in the coastal and foothill areas, such as Bemm - Brodribb coast, the Lake Tyers - Corringale coast, the Brodribb, Cann and Far East foothills. Some also fell within the Upper Buchan mountains, the Snowy - Deddick rain shadow area, the Snowy River valley, the Orbost - Buchan foothills and the Errinundra tablelands (Map 3). **Strata with high site density (100 - 500 hectares/site)**

Strata with high site densities comprised 677 213 hectares or 56% of the total land area. The strata occurred throughout the central, higher rainfall mountain, plateau and foothill country as well as in eastern coastal areas. A significant outlying area of high survey intensity occurred in the extreme north-west, in the Cobberas - Limestone Creek area (Map 3).

Strata with very high site density (1 - 100 hectares/site)

Strata with very high site densities 165 551 hectares or 14% of the total land area. The strata were generally those occurring in the higher rainfall, mountain and plateau areas, such as the Errinundra plateau, Ellery, Brodribb, Coast Range, Rodger, Tennyson, Coagalah and Yalmy Blocks (Map 3). Other more isolated strata with very high site densities occurred along the coast, such as the area east of Mallacoota Inlet, and in parts of the foothills, such as Tabby and Snowy Block. All of these areas correspond to areas subject to pre-logging flora and fauna survey work.

Survey intensity in largest strata (by area)

Of the 23 strata occupying more than 10 000 hectares, all but six strata fell within the moderate, high or very high site density categories. The six low site density strata occur predominantly in the Upper Buchan mountains, Snowy - Deddick rain shadow and Snowy River valley areas.

Summary

The level of flora survey in East Gippsland is high compared to other forested regions in Australia. The most intensively surveyed areas are in high rainfall mountain and plateau environments and a number of foothill environments. There is a sampling bias towards areas of high value for timber production, which have been subject to pre-logging surveys.

The most significant area within East Gippsland which has relatively low site density is in the north-west, including the Snowy valley, Buchan valley, Deddick valley, Mountain Creek catchment and Dellicknora area. The majority of this area falls within existing conservation reserves, principally the Cobberas - Tingaringy section of the Alpine National Park and the Snowy River National Park.

In general, the distribution of flora sites, while highly clustered in timber production areas, is representative of the variation across the region, although additional survey effort in less well sampled environments would improve the utility of the database.

Flora Species Assessment

Methods

For most species, protection is afforded through the application of national reserve criteria at the EVC level. The list of flora species included in this assessment included those species listed under the Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act), the Commonwealth *Endangered Species Protection Act* 1992 (ESP Act), the Victorian Rare or Threatened Species list for plants (VROTS), and the national list of Rare or Threatened Australian Plants (ROTAP - updated from Briggs and Leigh 1988). The 369 flora species included in the review, their status' on the various lists and the proportion of their range in East Gippsland and Victoria are presented in Table 2.8.

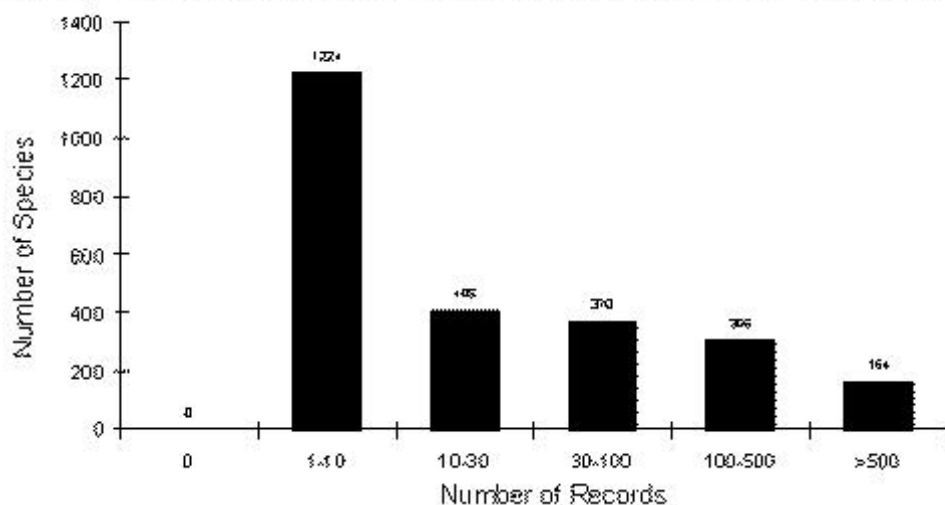
The proportion of each species range that occurred within East Gippsland was also estimated and is included in Table 2.8. This was based on the distribution of each of the species, compiled as a map from information in the Census of Australian Vascular Plants (Hnatiuk 1990) and in the relevant volumes of the Flora of Australia.

Sampling adequacy for flora species in East Gippsland was assessed by generating frequency histograms of flora species by number of records. The number of presence records from formal surveys were classified into six categories, namely, 0 records, 1 - 10 records, 11 - 30 records, 31 - 100 records, 101 - 500 records and >500 records. The frequency of species falling into each of these categories was then calculated. The analysis was also conducted using total records for each species (i.e. both presence records from formal surveys and incidental records). In addition to these analyses, the number of formal survey records and incidental records for each of the priority species listed in Table 2.8 was calculated.

Results and Discussion

Based on the flora databases provided for this assessment, a total of 2 472 species of plants are known to occur in the East Gippsland Region. Of these, 2 267 (92%) have been sampled from formal surveys in the region. A substantial number of these species (827), or 33% of all known species in East Gippsland, are known from greater than 30 formal survey records. Fifty-one percent of known plant species in East Gippsland are known from fewer than 11 formal survey records. When incidental records are included with records from formal surveys, the number of plant species known from greater than 30 records increases slightly (Figure 2).

Figure 2: Representation of flora species in East Gippsland from formal surveys and incidental records



Flora Species Vulnerability Assessment

Methods

The current lack of population sizes, range and viability information limited the data that could be incorporated into an assessment of the species' life history and population dynamics (see section 2.3 and Appendix E). The analysis for flora was limited instead to an assessment of the population's intrinsic vulnerability to stochastic disturbances, based on the proportion of the species' total population size in East Gippsland, the number of records in Victoria and the geographic range of the species within Victoria. The geographic range of the species within Victoria was determined as a linear distance between the two sites furthest apart in the State.

Results

Information on the life history and population dynamics for each species are included in Appendix E. The intention of this assessment is to provide a basis for prioritising those species requiring management action. This assessment should also be considered in conjunction with the information relating to threatening processes.

Flora Species Reservation Analysis

Methods

A species level of assessment is required for the proposed national reserve criteria, particularly criteria (5) and (6). This assessment requires information on the distribution and habitat for individual species. For most species habitat is also protected through the reservation of EVCs in accordance with the proposed national reserve criteria.

For this assessment formal survey sites for species were intersected with existing land tenure. A measure of reservation status of each species was subsequently estimated by calculating the proportion of presence records from formal surveys located in conservation areas, non-reserve areas, and special management zones. Conservation areas were defined as areas described in the East Gippsland forest management database as 'National Parks', 'Special Protection Zones' and 'Other Reserves and Public Land'.

The number of incidental records in conservation areas, non-reserve areas, and special management zones were also calculated for each species. Incidental records and presence records from formal surveys were combined to calculate the total proportion of records for each species in each land tenure category.

Results and Discussion

The proportion of formal survey sites, and individual species records in conservation areas, non-reserve areas and special management zones in East Gippsland for threatened species was collated and are shown in Table 2.8. Whether the majority of species' range (>50%) is within East Gippsland is also presented. This analysis will be biased because the reserve system has had fewer formal surveys. The results will therefore tend to under-estimate the level of protection to species provided by the reserve system.

The results should be considered in conjunction with the information on threatening processes and interpreted with some caution, as indicated in the notes on interpreting Table 2.8.

Threatening processes operating at the species level also need to be considered when interpreting this data. Many threatening processes operate across reserve and off-reserve areas and other measures are in place, in addition to reservation, to provide protection at the species level.

Rare and threatened species review

While representative conservation of forest communities provides the basis for flora conservation in East Gippsland, the habitat of some species may be further enhanced by complementary off-reserve management. Moreover, some threatening processes (weed

invasion for example) may be as significant in reserves as they are on unreserved land. It is therefore prudent to examine the current knowledge and management of species that could fall into this category. Species considered to be rare or threatened are most relevant in this context. This assessment examines the rare and threatened species of East Gippsland with a view to providing information to ensure that the CAR reserve system is sufficiently representative of species diversity, and to set priorities for future survey, research and management for flora conservation.

Three hundred and sixty nine plant species recorded in East Gippsland are considered rare or threatened. This includes species listed under the Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act), the Commonwealth *Endangered Species Protection Act* 1992 (ESP Act), the Victorian Rare or Threatened Species list for plants (VROTS), and the national list of Rare or Threatened Australian Plants (ROTAP; updated from Briggs and Leigh 1988). Non-vascular plants have not been considered in this assessment.

DNRE databases, expert opinion and available scientific literature were used to compile the following information for each species:

- conservation status (according to each of the lists mentioned above);
- the approximate proportion of the species' total Australian range in Victoria. This was estimated by compiling a distribution map for each species from information in the Census of Australian Vascular Plants (Hnatiuk 1990) and the relevant volumes of the Flora of Australia;
- numbers of Victorian and East Gippsland records, taken from DNRE databases; and
- the proportion of records in conservation areas (defined as national parks, conservation reserves and the Special Protection Zone in State forest), Special Management Zones in State Forest (many are specifically designated for threatened plant localities), and non-reserve areas (includes the General Management Zone in State Forest, other categories of public land, and private land).

These data are presented in Table 2.8. Species have been grouped into categories which give a broad indication of their priority for conservation. Each of these categories is discussed below.

1. Nationally endangered and vulnerable species.

These warrant the highest priority for conservation because they are threatened across their range in Australia. The status for all but one of these species (*Acacia caerulescens*) is confirmed by formal listing under the Commonwealth *Endangered Species Protection Act* 1992. Details of each of these species are provided in Appendix E. An analysis of threatening processes affecting them is discussed in the next section.

2. Species listed under the *Flora and Fauna Guarantee Act* 1988.

These also warrant a high priority for conservation. As part of the formal listing process under the Act their threatened status has been confirmed by an independent Scientific Advisory Committee. Details of each of these species are provided in in Appendix E. An analysis of threatening processes affecting them is discussed in the next section.

3. Species listed as endangered in Victoria.

Species in this category are not considered threatened at a national level and have not been formally listed under the *Flora and Fauna Guarantee Act* 1988 or *Endangered Species Act* 1992. They are however listed as endangered on the Victorian Rare or Threatened Plants (VROT) list and warrant more detailed assessment to determine their status in the field and the threatening processes that may be active. Some may well warrant listing under the *Flora and Fauna Guarantee Act* 1988.

Species with a significant proportion of their records on land not managed for conservation deserve the greatest attention. This is probably most important for *Echinopogon caespitosus*, *Gahnia subaequiglumis*, and *Pterostylis dubia*. Reservation is less important for the rainforest tree *Alectryon subcinereus* because the two populations on private land are in a steep and inaccessible gorge and the landowner actively protects the area. It is also of less importance for the sedge *Pseudoraphus paradoxa* which is well reserved and for which there has been an increasing number of records in recent years.

4. Species listed as vulnerable in Victoria with greater than 25% of their extent in Victoria.

Species in this category are not considered threatened at a national level and have not been formally listed under the *Flora and Fauna Guarantee Act* 1988 or *Endangered Species Act* 1992. However a significant proportion of their range occurs in Victoria which gives increased importance to their status as vulnerable. Further work is warranted to establish whether or not processes are active that may threaten them in the future. Further information on these species may show that they warrant recognition and listing at a national level.

Of greatest concern in this group are the herbs and grassland species *Amphibromus sinuatus*, *Botrychium lunaria*, *Gratiola nana*, *Barbarea grayi*, *Gingidia harveyana*, *Pterostylis pedoglossa* and *Botrychium australe* occurring in sensitive habitats that may be vulnerable to grazing and localised disturbances.

The small trees and shrubs *Eucalyptus saxatilis*, *Acacia lucasi*, *Monotoca rotundifolia*, *Olearia allenderae* are more robust, and occur in secure habitats and are less likely to be facing immediate threats. *Spyridium cinereum* is also locally common in the area around Mallacoota where it occurs and less threatened than other species in this group.

5. Species listed as vulnerable in Victoria with less than ten Victorian records.

While species in this category are not considered threatened in a national context, Victorian populations could be at risk if they are small. The status and security of these species should be further examined. Priority should be given to species with a significant proportion of their records on land not managed for conservation, in particular, *Hakea maccreana* and *Chloris ventricosa*.

6. Species listed as vulnerable in Victoria with more than ten Victorian records.

The species in this category may warrant additional work to establish their status although the number of populations suggests that there is less urgency than in the previous category.

7. Species of uncertain status in East Gippsland due to taxonomic uncertainty or lack of recent or accurate records.

There is a large number of species in this category including some listed as endangered or vulnerable at a national level. Often their status is uncertain because the records are historical and imprecise, and the species has not been found in recent years. The species may have become locally extinct, or have been incorrectly identified in the first place. In any case, little management action can be taken unless the presence and location of a species can be confirmed. A high priority should be given to identifying and documenting extant populations of the endangered and vulnerable species in this group.

8. Species that are depleted, poorly known or rare in Victoria.

Species in this category include those that are naturally rare but not considered to be under any immediate threat, species that were once widespread but have been depleted by habitat change (such as agricultural clearing), and species that may be threatened but there is currently insufficient information to judge. They warrant some attention because their rarity in itself may render them vulnerable in the future. The priority among this large group of species should be to establish the status of the poorly known species in case any of them are endangered. Attention should also be given to representation of these species in the reserve system.

9. Species presumed extinct in Victoria.

No work is proposed for these species.

Review of Key Disturbances and their Implications for Plant Taxa in East Gippsland

The interpretation of key life history attributes is a useful means of highlighting the potential threats that individual plant taxa or groups of taxa may face. In this review, particular life history attributes are used as surrogates to indicate the potential impacts of threatening processes. The distribution of rare or threatened species that exhibit particular life history attributes (e.g. post-fire regeneration response), provides a useful clue to the broad areas within East Gippsland, where a threatening process (e.g. inappropriate fire regime), might be expected to have a significant impact on those particular taxa. The attribute information is drawn directly from DNRE databases. Only threatened plant taxa have been considered in the following discussion. The results are summarised in Table 2.9.

General disturbance

Threatened species in East Gippsland that require long periods without major disturbance for survival and establishment (e.g. no fires, floods, clearing etc.).

In East Gippsland, there are 38 threatened species that require long periods without major disturbance. They occur broadly in three areas:- Nunniong - Cobberas high country in the north-west, Genoa - Mallacoota area in the far east, and the lower Snowy River - Orbost area. Many of these taxa are rainforest species. Examination of other life history attributes provides information about specific types of disturbances.

Inappropriate fire regimes

Threatened species in East Gippsland that are obligate seed regenerators; all (or nearly all)

plants are killed by fire, regeneration is solely from seed (or spores) stored in the canopy or soil pre-fire. Fire promotes germination or establishment.

There are 35 threatened species in East Gippsland that respond to fire in this way. These taxa are concentrated in two or three broad areas of East Gippsland: the upper Snowy River where Rain shadow Woodland is the dominant ecological vegetation class, Coopracambra - Kaye where Shrubby Dry Forest and Rocky Outcrop Shrubland dominate, and the Mallacoota - Croajingolong area in the far east, where rainforest and coastal vegetation predominates.

For taxa that are obligate seed regenerators, with fire-promoted germination from seed stored in long-term canopy or soil seed banks, it is important that the fire regime is managed to ensure that populations include plants that are old enough to produce viable seed, in order to store propagules so that the next generation can be initiated following the next fire. If the fire interval is too short for these taxa, and viable seed production does not occur, populations will fail to recruit new plants over the short or long term, depending on the persistence of stored seed.

Information that is required to understand the ecological requirements of these taxa is termed the 'vital attributes', as described by Noble and Slatyer (1980). Key information includes seed longevity, seed dispersal, age at which plant reaches reproductive maturity, age at which plant reaches reproductive senescence, and conditions for establishment. A summarised account of vital attribute groups is given in DCNR (1996).

In addition, it is important to distinguish between obligate seed regenerators that store seed in the soil from those that store seed in the canopy. Canopy-stored seed that is released from capsules by the heat of fire, is dependent on the flame height being sufficiently close to the canopy. Thus, there may be situations, particularly with controlled management burns (cool burns), where the fire is not sufficient to stimulate the release of seed from the canopy, thus inhibiting or preventing recruitment. For these taxa, the use of hotter fires will provide a more favourable ecological result.

Where fuel reduction burns are conducted in the vicinity of wet gullies or rainforest, it is important to ensure that fire sensitive vegetation is not breached by the fire, thus leading to its gradual attrition, either by direct loss of vegetation or by indirect means such as a lowering of microclimatic humidity, or an elevation of light intensity, both of which create conditions that are less favourable for germination of indigenous rainforest plants.

Although the relevant species have not been identified in the analysis presented in Table 2.9, it should be noted that the long term absence of fire can lead to the decline and local extinction of some species. The use of fire as an ecological management tool should be further investigated and applied where appropriate.

Threatened species in East Gippsland that are obligate seed regenerators; all (or nearly all) plants are killed by fire, regeneration is solely from seed (or spores) but no notable soil or canopy seed store exists. Often plants only re-establish via invasion from unburnt sites.

There are 24 threatened species in East Gippsland that respond to fire in this way. The majority of these taxa occur in dry habitats ranging from dry foothills to sub-alpine and rain shadow areas in the Buchan - Nunniong areas. However, eight taxa occur in rainforest habitats. As with the previously discussed group of plants, fire regime is a major determinant of long-term survival. For these taxa, it is important that mixed age populations persist on a local scale, to allow seed from reproductively mature plants to re-establish on burnt sites. It is therefore critical that where fire is used as a management tool, the local burning pattern establishes a mosaic of fire ages and frequencies, allowing for these obligate seed regenerators to reach reproductive maturity within the mosaic.

As with obligate seed regenerators with a seed bank, information about vital attributes is required to understand the ecology of these taxa with respect to fire. Key information includes

seed longevity, seed dispersal, age at which plants reach reproductive maturity, age at which plants reach reproductive senescence, and conditions for establishment.

Grazing response

Threatened species in East Gippsland that are palatable, and readily eaten by rabbits, other mammalian herbivores and stock at some stage in their lifecycle.

There are 88 threatened species in East Gippsland that are considered to be palatable to herbivores, including native, introduced and domestic animals. Palatable taxa in East Gippsland occur principally in rain shadow and sub-alpine areas around the Cobberas - Wulgulmerang area, with another focus in the lowland areas around Genoa. Palatable rare or threatened species taxa are principally herbaceous (52%) or graminoid (21%) in life-form, and are thus unlikely to be major components of forest ecosystems. Nevertheless, they constitute a substantial group of plants that is susceptible to this threatening process. Monitoring of those threatened taxa occurring in the north west of the study area would assist in determining the impact of grazing and associated trampling by domestic stock and brumbies.

Plant collection

Threatened species in East Gippsland that are threatened by deliberate human collection.

There are nine threatened taxa in East Gippsland that are considered vulnerable to deliberate collection. It is not surprising that all are orchids, as this group of plants is one of the most showy and prized in horticulture. While collection from the wild is arguably not a major threat in East Gippsland, it is imperative that land management is appropriate, ensuring that susceptible taxa are given maximum protection. Known orchid populations require adequate buffering from roads and walking tracks, as these can provide easy access to otherwise protected sites.

Rarity of habitat

Threatened species that occur in rare habitats.

There are 102 threatened taxa in East Gippsland whose major habitats occur rarely. Taxa are concentrated in sub-alpine habitats in the Upper Snowy - Nunniong area in the north west of the study area, and also in the lowland habitats around Genoa - Mallacoota in the far east. Plants that have narrow habitat tolerances and whose habitat occurs rarely are less able to withstand detrimental changes to that habitat, and less able to adapt or migrate into and survive in others. Survey and monitoring of populations of rare or threatened species with narrow habitat tolerances is desirable, placing particular emphasis on threatening processes that could potentially have a detrimental impact on them.

Geographic restriction

Threatened species that are geographically restricted in East Gippsland, with the most distant records being closer than 10 km.

There are 68 threatened taxa that are geographically restricted in East Gippsland. These taxa are concentrated in the Upper Snowy - Nunniong area and the far east Mallacoota - Genoa area, with an additional focus in the Buchan area. Surveying and monitoring of populations of these species is desirable, placing particular emphasis on threatening processes that could have a detrimental impact on them.

Reservation

Threatened species with principal occurrences on land that is not managed primarily for nature conservation.

There are 25 threatened taxa in East Gippsland that are considered to have principal populations on land that is not managed with nature conservation as a primary objective. The area with the highest concentration of rare or threatened species in this category is around Buchan, where most of the vegetation occurring on limestone has been cleared long ago for

agriculture. Some of the best remnants of indigenous vegetation in this area occur along roadsides. Elsewhere in East Gippsland, rare or threatened species in this category are concentrated on private land or on small public land remnants in the lower Snowy River - Orbost area and also near Genoa in the far east. Populations of these taxa require survey and monitoring to determine their precise location and any threatening processes that may potentially affect them.

Small population numbers

Threatened species recorded from few locations.

To highlight those taxa that are very poorly represented by current records in the database, East Gippsland threatened species that are recorded from fewer than five locations in Victoria were identified. A total of 67 taxa are included on this list. Both current and historical records of these taxa require confirmation and monitoring to ascertain whether they are at risk from threatening processes. Priority for survey and monitoring lies with those 29 taxa for which there is currently a single record, or none at all.

Other threats

Localised site disturbances

Localised site disturbances (e.g. roadworks, gravel pits or construction of communication facilities) can pose a significant risk to many taxa. The risk is greatest for species with only a few small populations immediately adjacent to roads. Ongoing liaison with the relevant authorities, public education and vigilance are required to ensure that the risks are minimised.

New roads built for timber harvesting also pose a threat to some species by directly destroying populations or by providing opportunities for weeds to invade otherwise uninfested areas. Careful planning, monitoring and prompt weed control, where necessary, is required where roads are to be built in areas where susceptible threatened species occur.

Timber harvesting

The taller, wetter forests of East Gippsland which are actively managed for timber production support relatively few threatened plant taxa compared to the rainforests, heathlands, dry forests and subalpine vegetation. These vegetation types largely occur in conservation reserves, are protected by prescription (e.g. rainforest and heathlands which are excluded from harvesting and protected by buffers), or occur in areas unsuitable for timber production (e.g. rocky gorges and mountain tops). Threatened species that occur in harvested forest areas are specifically identified and protected in the East Gippsland Forest Management Plan (DCNR 1995a).

While timber harvesting might not directly threaten many plant species, it has the potential to alter the abundance and species compositions of forest in harvested areas. For example, some species in wet forests, while being adapted to disturbance from wildfire, do not regenerate well following the mechanical disturbance that occurs during timber harvesting. This has been demonstrated in the Central Highlands for species such as the Soft Tree-fern (*Dicksonia antarctica*) and Musk Daisy-bush (*Olearia argophylla*). This issue is being addressed by the creation of 'understorey islands' in logging coupes which provide a regeneration source for species that may be adversely affected by harvesting. Such an approach may need to be considered in East Gippsland.

Recreation pressure

Recreation is a potential threat to plant taxa that occur in places frequented by visitors. It can also be an issue in cases where facilities are developed to meet the demands of recreation or tourism, such as car parks, accommodation and so on. Ongoing consultation between recreation planners, tourism operators and DNRE flora and fauna staff over significant or sensitive areas and design of facilities should minimise these risks.

Conservation measures currently in place

East Gippsland Forest Management Area Plan

This plan has identified Victorian Rare Or Threatened Species which occur within State Forest and prescribed management for these species, based on general protection within the Special Protection Zone (SPZ), as well as specific protection of identified populations where they occur within the Special Management Zone (SMZ) or General Management Zone (GMZ).

Conservation Reserve System

Dedicated conservation reserves constitute a major land use in the East Gippsland Region. These reserves provide extensive sanctuaries for native flora, including both rare or threatened species and more common species, where many (but not all) major potentially threatening processes are excluded or actively managed.

Species- or Community-specific Management

Of the species considered in this review, several are already the subject of published or Draft Action Statements under the Victorian *Flora and Fauna Guarantee Act 1988*. These species are: *Euphrasia scabra*, *Symplocos thwaitesii*, *Acacia maidenii*, *Myoporum floribundum*,

Pterostylis cucullata, *Cyathea cunninghamii*, and *Thesium australe*. Only *Myoporum floribundum* (Slender Myoporum) has a Draft Recovery Plan under the Commonwealth *Endangered Species Protection Act 1992*.

Rainforest communities are protected from timber harvesting throughout Victoria. In addition, prescribed buffers provide extra protection from activities occurring in adjacent forests. A report on rainforest Ecological Vegetation Classes and sites of botanical significance for rainforest is being prepared by the Victorian Department of Natural Resources and Environment.

Summary

The emphasis placed on potentially threatening processes or disturbances in this review is intended to identify ecological management issues and ultimately lead to their being addressed at a landscape level to the benefit of both rare or threatened species as well as more common species. Specific recovery actions should however, continue to be pursued for rare or threatened species as part of targeted Recovery Plans.

Biodiversity: continued

2.4 Aquatic habitat assessment

2.4.1 Introduction

The aquatic species assessment provides an analysis of information which can address the issue of the viability of maintaining populations aquatic native species throughout their natural ranges. It enables an evaluation against the proposed national reserve criteria, and the determination of complementary off-reserve species and habitat management.

To meet these objectives the following assessment outputs are required:

- identification of the distribution, habitat and life history attributes of aquatic biota, primarily macro-invertebrate assemblages and fish species;
- identification of factors affecting the conservation status (risk of extinction) and reservation needs of aquatic species;
- a description of current management prescriptions for aquatic species and their habitat, with priority given to those species which are rare or threatened;
- identification of the threatening processes (disturbances) affecting aquatic species and their habitat, and a description of current management action; and
- identification of gaps in survey and research on aquatic species, habitats and threatening processes.

The quality of aquatic habitats within and beyond forested areas is influenced by the activities within the catchment. Information and results from past surveys of aquatic species and ecosystems in the region have been reviewed to identify major gaps in information. Current conservation guidelines to protect aquatic fauna and mitigate threatening processes affecting aquatic species are also summarised in this section.

2.4.2 Review of existing data

The distribution of fish and aquatic macroinvertebrates survey sites is shown in Map 12.

Pre-1990 fish surveys

Raadik (1992a, 1992b, 1992c) summarised fish data from East Gippsland collected prior to 1990. He found few historical records (pre-1967) exist for the region, with the earliest record dating back to 1889. Prior to 1967 records are spasmodic, consisting of observations of individual species from only a few locations. The first systematic survey of fish assemblages in East Gippsland was undertaken in 1967 at two sites on the Combienbar River and at one site on the Cann River (B. Tunbridge, DNRE, unpublished data). From 1967 to 1990, a total of nine surveys have been undertaken in the region (Table 2.10).

Table 2.10: Surveys conducted for freshwater fish in East Gippsland prior to 1990

Date	Area Surveyed	Sites Surveyed	Source
1967	Combiembar River, Cann River	3	Tunbridge, unpublished data
1974	Buchan River, Suggan Buggan River	4	Dixon 1976
1976-1983	Low altitude, various	21	McCarraher 1986
1980	Snowy River, Deddick River, Suggan Buggan River	4	Tunbridge, unpublished data
1980-1983	Croajingolong National Park	41	Tunbridge 1983
1980-1981	Snowy River	3	Eden 1981
1979-1991	Low altitude freshwater, various	20	Baxter et al. 1991
1986	Croajingolong National Park	4	Tunbridge, unpublished data
1988	Various	31	Koehn et al. 1991

The majority of surveys (Table 2.10) sampled principally for commerce and recreation fish species (e.g. McCarraher 1986, Baxter *et al.* 1991), using techniques targeting these species, such as netting with large mesh sizes. Further, Raadik (1992a) concluded that sampling of fish species prior to 1990 in East Gippsland has been spasmodic and generally lacked a coordinated approach. As a result, there is limited data for native fish distribution or community patterns prior to 1990, and successive surveys did not address significant gaps in the knowledge of native species or community dynamics within particular river systems.

Post - 1990 fish surveys

Since 1990, the scope of surveys has broadened and a range of techniques have been employed, such as electrofishing, to sample a wider range of species. The locations of these surveys are described below.

In early 1991, Raadik (DNRE, unpublished data) surveyed 18 sites in freshwater and estuarine habitats in the east of the East Gippsland River basin and 23 sites in the Martins Creek Forest Block (Martin Creek/Brodribb River systems). These were followed by three surveys in forest blocks during late 1991 and early 1992.

Over a 12 month period, beginning In March 1992, Raadik (1995) sampled 117 sites for fish and decapod crustacea in three discrete areas of East Gippsland to assess the significance of the aquatic fauna in National Estate areas. During late 1993 and early 1994, a number of sites were re-sampled for all fish species during a survey specifically targeting Australian Bass (*Macquaria novemaculeata*).

The three surveys described above are considered the only surveys undertaken to date with sufficient coverage and sampling intensity to assess native fish in regional aquatic systems. Consequently, many areas within the East Gippsland region are still to be adequately assessed

for native fish species and it remains difficult to identify significant habitats utilised by threatened species and/or supporting a high level of species diversity (Raadik 1992a).

Aquatic macroinvertebrate fauna

The former Victorian Department of Water Resources (1989) recorded ten sites where macroinvertebrate surveys have been conducted in the East Gippsland region prior to 1990. These were all sampled in 1979 as part of a single study on water quality in East Gippsland catchments (EPA 1983). Two sites each were located in the lower Snowy and Brodribb Rivers, and in the mid reaches of the Bemm, Cann and Genoa Rivers. An additional seven sites located on BA and Ferntree Creeks, and the Ellery and Big Rivers, were sampled as part of a study into the impact of timber harvesting on aquatic fauna. Some results from the project have been reported by Marchant *et al.* (1994). Another study into the impact of forest harvesting undertaken by the EPA sampled macroinvertebrates from 18 sites in the Wingan, Thurra and Brodribb River catchments. These surveys have not been completed.

Macmillan (1990) referred to a project conducted through Monash University on the macroinvertebrate fauna of Rooty Break Creek, part of the Errinundra River system. No details of the study have been published.

The most comprehensive data set for aquatic macroinvertebrates in the region was collected as part of the National Estate Grants Program study conducted during 1992/93 (Doeg 1995). Aquatic macroinvertebrate communities from 48 sites in the Snowy and Bemm River catchments and selected coastal catchments were collected and identified. This was in conjunction with the fish survey by Raadik (1995), described above.

As part of the Monitoring River Health Initiative (MRHI), 12 sites are being monitored in the East Gippsland Basin (L. Metzeling, EPA, pers. comm.). Data from these sites are contributing to the development of a national predictive model for river systems and their associated flora and fauna communities. Once refined, the model will be able to predict the invertebrate fauna at an unknown site, based on river characteristics such as water quality, altitude and bed structure.

2.4.3 Results and discussion

Fish

Twenty native freshwater fish have been recorded from the East Gippsland Forest Management Area to date (Raadik 1992a, 1992b, 1992c, 1995). Of these, ten are listed as threatened fauna in the State (DCNR 1995b). Four of these are also listed on the State's *Flora and Fauna Guarantee Act* 1988 (FFG Act) and three are listed under the Commonwealth *Endangered Species Protection Act* 1992 (ESP Act) (Table 2.11). Detailed information on life history attributes and threatening processes affecting these ten fish species are given in Appendix F.

Fish species have been recorded to date from 322 individual sites for which collection site data are available. Of these, 275 sites were located in freshwater reaches of streams and 47 sites in estuarine habitats (Table 2.12).

A total of 275 freshwater sites have been sampled (Table 2.12). Of these, 139 sites (or 50%) are located in areas set aside for conservation purposes, nine sites (or 3%) in private land (mostly in the Snowy River estuary around Orbost), and 127 sites (or 46%) are located in State Forest. Most of the sites in State Forest have only been surveyed since 1991.

Table 2.12: Summary of information on fish survey sites in East Gippsland from 1967-1994.

Land tenure	Freshwater	Estuarine	Total
State forest	127	2	129
Conservation reserves	139	38	177
Private land	9	7	16
Total number of sites	275	47	322

Aquatic macroinvertebrates

There has been no systematic study of the aquatic macroinvertebrate fauna covering the entire East Gippsland region. However, from the data available, it is likely that the fauna consists of a diverse assemblage of species, with many taxa endemic to the area and with restricted distributions. For example, Doeg (1995) reported 249 taxa from 48 sites in three areas of East Gippsland, comparing favourably with other studies of relatively undisturbed habitats elsewhere in Victoria (Doeg 1995).

The decapod crustacea (prawns and crayfish) fauna of the area have been the best surveyed, being the target of numerous taxonomic studies (e.g. Morgan 1986; Horwitz 1990) and included as part of the fish surveys conducted since 1990, and numerous incidental records. Species known to occur in East Gippsland are listed in Table 2.13. Detailed information on life history attributes and threatening processes affecting the Eastern Freshwater Prawn, Mallacoota Burrowing Crayfish, Alpine Spiny Crayfish, and Orbost Spiny Crayfish are given in Appendix F.

Table 2.13: Scientific and common names, conservation status (DCNR 1995b) and FFG and/or ESP Act listing of the native freshwater decapod crustacea found in the East Gippsland region.

Scientific Name	Common Name	Conservation Status	FFG/ESP Act Status
Atyidae	Freshwater shrimp & prawns		
<i>Australatya striolata</i>	Eastern Freshwater Prawn	Insufficiently Known	Recommend FFG Act
<i>Paratya australiensis</i>	Freshwater Shrimp	Common	
Parastacidae	Freshwater crayfish		
<i>Engaeus laevis</i>	Gippsland Burrowing Crayfish	Common	
<i>Engaeus mallecoota</i>	Mallacoota Burrowing Crayfish	Rare	FFG Act Listed
<i>Engaeus orientalis</i>	East Gippsland Burrowing Crayfish	Common	
<i>Engaeus quardimanus</i>	Southern Burrowing Crayfish	Common	
<i>Euastacus bidawalus</i>	East Gippsland Spiny Crayfish	Common	
<i>Euastacus crassus</i>	Alpine Spiny Crayfish	Rare	
<i>Euastacus diversus</i>	Orbost Spiny Crayfish	Vulnerable	FFG and ESP Act Listed
<i>Euastacus kershawi</i>	Gippsland Spiny Crayfish	Common	

Note: **FFG** - Flora and Fauna Guarantee Act 1988;

ESP - Endangered Species Protection Act 1992.

2.4.4 Data gaps

Fish

Although there has been an increase in survey intensity over the past six years, many areas still need to be surveyed and there is a lack of data on population dynamics and processes. Data are not available from the areas listed in Table 2.14.

Table 2.14: East Gippsland areas where data on fish species is unavailable

(Areas listed in have equally high priority)

Tambo River system	Boggy and Stony Creeks and all accessible tributaries (e.g. Breakfast, Yellow Waterholes Creeks).
Snowy River system	Buchan River system and all accessible tributaries (e.g. Back, Butchers, Frying Pan, Dick, Woolshed, Mellick Munjie, Mia Mia, Campbell, Reedy, Little Reedy, Blackfellows, Bentley, Rough, Native Cat and Native Dog Creeks, and Buchan River and Murrindal River); Delegate, Bendoc and Queensborough Rivers, and Haydens Bog Creek and accessible tributaries; Brodribb River system excluding Martin and BA Creeks (including Rocky, Jack, Rich, Big, St. Patrick Rivers, and Goongerah, Ellery, Goanna Creeks and other accessible tributaries); Coastal creeks west of Orbost (Hospital, Hartland, Wombat and Simpson Creeks and

	other accessible tributaries); and Lower Snowy River, west bank (all accessible tributaries e.g. Bete Bolong Creek).
East Gippsland system	Cann River system, entire system upstream from junction with Reedy Creek (including all accessible tributaries); Wingan River system, upstream from and including Hard To Seek Creek (including all accessible tributaries); Betka River system, upstream from pumping station (including all accessible tributaries); Upper Genoa River (including all accessible tributaries); and Upper Thurra River.

There are still considerable gaps in the knowledge of aquatic macroinvertebrates in East Gippsland. While systematic, repeated sampling has occurred at 12 sites to produce large scale models of distribution, it is likely that insufficient data are available to construct regional models. More sites would need to be sampled to allow a regional model to be produced.

Taxonomically, the East Gippsland aquatic fauna is poorly studied. Only a few groups (decapod crustacea) are well known, while more common groups (e.g. mayflies and stoneflies) are only known to the generic level. This significantly limits any attempts to describe the species composition of aquatic habitats, and identify species which are rare or have restricted distributions.

2.4.5 Conservation guidelines for fish and aquatic macroinvertebrates

A network of heritage rivers (listed under the *Heritage Rivers Act* 1992) and linear reserves (where timber harvesting is excluded) has been established to protect riparian and aquatic values, including aquatic fauna.

Linear reserves in Special Protection Zones (SPZs), extending 100 metres from each bank of the watercourse for one kilometre upstream and one kilometre downstream of known sites, have been established where:

- individual significant species are found (e.g. Mountain Galaxias, Cox's Gudgeon, Freshwater Herring, Australian Grayling);
- three or more threatened species occur; or
- where six or more native fish species occur.

Within the SPZ, construction of new roads within linear reserves is to be avoided. The management guidelines prescribe a review of these conditions once 50 significant sites have been located.

Special Management Zones (SMZ) may also include wide buffers along stream channels which are also likely to have benefits for aquatic species.

Current prescriptions in the General Management Zone (GMZ) require linear reserves of a minimum of 20 to 40 metres either side of permanent streams, with filter strips along temporary streams and drainage lines to protect riparian and aquatic values, including aquatic fauna.

A description of prescriptions for individual species follows.

Mountain Galaxias

Sites supporting an extant population of Mountain Galaxias are included in linear reserves within the SPZ. When 50 sites of this species have been located, this guideline may be reviewed.

River Blackfish, Spotted Galaxias, Pouched Lamprey, Striped Gudgeon, Australian Bass

Specific guidelines have not been developed for these species as other strategies, such as, linear reserves and Heritage Rivers, in combination with the reserve system, are regarded as sufficient. A number of SPZ and SMZ linear reserves along streams are specified which include protection of these species as a conservation objective.

Cox's Gudgeon, Australian Grayling, Freshwater Herring

These species are listed under the *Flora and Fauna Guarantee Act 1988*. Sites supporting an extant population of these species are included in a linear reserve within the SPZ. When 50 sites of these species have been located, this guideline may be reviewed.

Empire Gudgeon

This species is listed under the *Flora and Fauna Guarantee Act 1988*. There are no specific guidelines for this species as the Empire Gudgeon has only recently been recorded in State forest.

Eastern Freshwater Prawn

This species has been recommended for listing under the *Flora and Fauna Guarantee Act 1988*. There are no general or specific guidelines for this species in State forest as the species has only been recorded from one site in the Snowy River National Park (T. Doeg, DNRE, pers. comm.).

Mallacoota Burrowing Crayfish

This species is listed under the *Flora and Fauna Guarantee Act 1988*. There are no specific guidelines for this species, as other strategies such as linear reserves include its protection as a conservation objective. An Action Statement will be prepared.

Alpine Spiny Crayfish

All known sites are located in the Alpine National Park.

Orbost Spiny Crayfish

This species is listed under the *Flora and Fauna Guarantee Act 1988*. An Action Statement is in preparation and is nearing completion. Guidelines include the establishment of a linear reserves within the SPZ. When 20 sites of this species have been located, this guideline may be reviewed. Additional management arrangements are being considered in the development of the Action Statement.

2.4.6 Threatening processes

There are several potential threatening processes within the East Gippsland Forest Management Area which may impact upon fish and decapod crustacean species. These are:

- siltation of spawning areas is likely to affect fish species which spawn upstream, and crayfish (River Blackfish, Mountain Galaxias, Pouched Lamprey, Cox's Gudgeon, Empire Gudgeon, Australian Grayling, Orbost Spiny Crayfish);
- sedimentation of habitat is likely to affect species which spend part of their life cycle upstream and that prefer rocky areas (not pools) (River Blackfish, Mountain Galaxias, Pouched Lamprey, Cox's Gudgeon, Freshwater Herring, Orbost Spiny Crayfish);
- alteration to flow in small streams (Mallacoota Burrowing Crayfish, Alpine Spiny Crayfish, Orbost Spiny Crayfish);
- reduction of invertebrate food sources (River Blackfish, Mountain Galaxias, Spotted Galaxias, Pouched lamprey, Striped Gudgeon, Cox's Gudgeon, Empire Gudgeon, Australian Bass, Freshwater Herring, Australian Grayling);
- changes to microclimate in the riparian zone (Mallacoota Burrowing Crayfish);
- barriers which may impede upstream migration, may affect juveniles or larvae (Spotted Galaxias, Australian Bass, Freshwater Herring, Australian Grayling), and adults (Mountain Galaxias, Australian Bass);
- predation of juveniles by introduced species (River Blackfish, Spotted Galaxias, Striped Gudgeon, Cox's Gudgeon, Australian Bass, Australian Grayling, Eastern Freshwater Prawn, Alpine Spiny Crayfish, Orbost Spiny Crayfish) and
- predation of adults by introduced species (Mountain Galaxias, Eastern Freshwater Prawn, Alpine Spiny Crayfish, Orbost Spiny Crayfish);
- competition with introduced species (Mountain Galaxias, Spotted Galaxias, Cox's Gudgeon, Australian Grayling);
- species affected by natural disasters such as wildfire which result in the loss of all habitat components (Freshwater Herring, Alpine Spiny Crayfish); and
- harvesting disturbance by humans such as collection for food or bait (Mallacoota Burrowing Crayfish, Alpine Spiny Crayfish, Orbost Spiny Crayfish).

2.5 Forest ecosystem assessment

2.5.1 Introduction

The forest ecosystem assessment provides an analysis of information to enable viable examples of forest ecosystems to be maintained throughout their natural ranges, and to maintain ecological processes and the dynamics of forest ecosystems in their landscape context. It will contribute to an evaluation against the proposed national reserve criteria, particularly criteria (1), (2), (3), (4), (5) and (7), and complementary off-reserve management as part of ESFM.

To meet these objectives the following assessment outputs are required:

- maps of both the current and pre-1750 distributions of forest ecosystems;
- determination of the current reservation status for forest ecosystems;
- a description of forest ecosystems which are endangered, vulnerable or rare;
- identification of refugia for flora and fauna; and
- a description of disturbances and management prescriptions relevant to forest ecosystems and refugia.

Ecological vegetation classes (EVCs) are the basic mapping unit used for forest ecosystem assessments, biodiversity planning and conservation management at the regional scale in Victoria. The concept of ecological vegetation classes (EVCs) was introduced and used in the *Old growth study of East Gippsland* (Woodgate *et al.* 1994).

EVCs are derived from underlying large scale forest type and floristic community mapping. Floristic, structural, and environmental attributes are used to define EVCs. The relationship of

each EVC to floristic vegetation communities and floristic sub-communities *sensu* Forbes *et al.* (1981) and forest types (Land Conservation Council studies) is discussed in Woodgate *et al.* 1994. A description of the methodology used to derive EVCs is presented in Appendix G.

2.5.2 EVC Review

An expert scientific group was established to undertake a peer review of the EVC methodology. The group met on the 5th June 1996 and the report from the workshop is included in Appendix G. Membership of the panel comprised:

Mark Burgman	University of Melbourne, Victoria
John Benson	National Herbarium, Sydney, New South Wales
Sandy Kinnear	Department of Housing and Urban Development, South Australia.
Jamie Kirkpatrick	University of Tasmania, Tasmania
Bob Parsons	LaTrobe University, Victoria

Adrian Moorrees, David Parkes and Bill Peel of Department of Natural Resources and Environment, Victoria were present at the review and answered questions. Brendan Edgar and John Neldner of Australian Nature Conservation Agency, and Harry Abrahams of Australian Heritage Commission were present at the review as observers.

The panel concluded that EVCs provide an important Statewide level of vegetation mapping and that EVCs are an appropriate basis for assessing floristic biodiversity conservation, provided that the issue of variability across some of the larger EVCs is addressed. Issues raised by the panel have either been addressed in this assessment, or will be taken into account in the ongoing RFA process.

Within East Gippsland, four extensive ecological vegetation classes were considered by the panel to contain a significant amount of variability (Damp Forest, Wet Forest, Lowland Forest and Shrubby Dry Forest). Analyses were suggested to address this issue. The variability within EVCs has been recognised in the East Gippsland Forest Management Area Plan by the establishment of eleven geographic sub-units, with representation of EVCs being considered on the basis of these sub-units. This analysis has been updated in this assessment.

Key outcomes from the peer review are provided in Appendix G.

2.5.3 Methodology for estimating the pre-1750 extent of EVCs

EVCs have been mapped on all public land in the East Gippsland region at a scale of 1:100 000 (Woodgate *et al.* 1994). For the purposes of this assessment the pre-1750 extent of each EVC on both private and public land needed to be mapped to allow a comparison of the extant distribution and area of each EVC with that estimated prior to European settlement within the region.

In cleared or heavily disturbed areas, existing remnant vegetation and a variety of physical environmental attributes were employed to map the estimated pre-1750 extent of EVCs. This process relied heavily on subjective assessments by expert staff with extensive field knowledge of the vegetation mapped. The attributes used to predict presence were specific to each EVC being mapped. Table 2.15 shows the attributes used, listed in their order of importance for each EVC.

Table 2.15: The physical attributes used to map the pre-1750 extent of EVCs.

Ecological Vegetation Class	Attributes
Rain Shadow Woodland	Geology, elevation, topography
Damp Forest	Aspect, rainfall, elevation
Lowland Forest	Geology, rainfall
Valley Grassy Forest	Geology, land systems, remnants
Grassy Dry Forest	Geology, aspect and topography
Riparian Forest/Warm Temperate Rainforest Mosaic	Land system, remnants
Montane Riparian Woodland	Topography, elevation, remnants
Montane Dry Woodland	Geology, elevation
Montane Grassy Woodland	Geology, land system, elevation, remnants
Clay Heathland	Land system, topography, remnants
Shrubby Dry Forest	Geology, aspect, elevation
Limestone Grassy Woodland	Geology, aspect, topography, climate, remnants
Warm Temperate Rainforest	Topography, remnants

The inherent reliability of mapping produced at 1:100 000 scale using current technology is adequate for the assessment. The certainty of this mapping is related to the quality of underlying data sets used to define the vegetation boundaries.

Table 2.16 outlines the regional reliability of mapping of pre-1750 vegetation in East Gippsland against three categories:

1. High reliability: Mapping used both geological and topographic data which were available at 1:100 000;
2. Moderate reliability: Mapping did not use geological or land system data, relying on topographic data (eg aspect or elevation) which were available at the presentation scale of 1:100 000; and
3. Low reliability: Mapping used land system and/or geological mapping which was only available at 1:250 000. The definition between important attributes (e.g. fertility) was inadequate and map units in general were poorly registered to base features such as rivers and roads.

Table 2.16: The reliability of the pre-1750 EVC maps by district.

High	Moderate	Low
Buchan	Buldah	Buchan South-Kanni Creek
Bendoc	Combienbar	Genoa
Bonang	Howe Range	Orbost
Deddick Valley	Lakes Entrance-Lake Tyers	Marlo-Cape Conran
Gelantipy	Mallacoota	Wangrabbell
Gillingal-Green Hills-Bald Hills	Nowa Nowa-Orbost (including Wairewa)	

Goongerah
Murrindal
Suggan Buggan
Wulgulmerang

2.5.4 Reservation status of EVCs

Information on the current reservation status and the pre-1750 extent of EVCs in East Gippsland are provided in Table 2.17.

2.5.5 Sub-regional reservation status of EVCs

The East Gippsland Forest Management Plan (DCNR 1995a) identified eleven geographic representation units to reflect the scale of landscape change across East Gippsland. These geographic units were based on similar land form, geology, vegetation and climate.

An assessment of the reservation status of ecological vegetation classes across the eleven geographic representation units was undertaken to address the issue of representativeness and replication in the reservation status of EVCs (Table 2.18).

Tables 2.17, 2.18 and 2.19 were derived from the EVC, old growth forest, land tenure and forest management zone data layers held by the Department of Natural Resources and Environment.

The EVC and old growth forest data was originally produced by Woodgate *et al.* (1994) and the forest management zones as part of the East Gippsland Forest Management Plan (DCNR 1995a).

The following should be noted when referring to Table 2.17:

- Coastal saltmarsh is thought to have increased in area since 1750 due to the incursion of saltwater In the Snowy River Estuary. Consequently it is shown as having greater than 100% of its former extent;
- The pre-1750 area of Riparian Forest includes areas mapped as Riparian Forest/Warm Temperate Rainforest Mosaic. These areas (now cleared) would have supported a complex mosaic of the two EVCs. The pattern of the mosaic would have varied over time with natural disturbances from fire and floods. It is not possible to predict the pre-1750 pattern or relative area of the two EVCs. The area of the mosaic has been included under Riparian Forest because it is considered likely that this EVC comprised the larger portion of the mosaic; and
- The "OTHER" category is due to minor data anomalies produced during analyses.

For Tables 2.18 and 2.19 the State Forest Special Protection Zone has been divided into three sub-categories as follows:

1. Mostly large and contiguous areas designed for conservation of specific values and with boundaries based on reserve design principles;
2. A network of connecting areas (200 - 400 metres width) based around riparian zones (including Heritage River corridors) but also including wildlife corridors on ridges and crossing between catchments; and
3. Areas protected by forest management prescriptions. These include all permanent streams and all rainforest stands plus adjacent buffers of at least 20 metres, and all heathland EVCs (includes Sand Heathland, Clay Heathland, Wet Heathland, Riparian Scrub Complex and Treeless Sub-alpine complex) plus a buffer of at least 40 metres. Table 2.18 provides information on the area and percent protection of ecological vegetation classes for the geographical representation units. The area figures in this table represent the total area of each EVC in each geographical representation unit.

Table 2.19 provides information on the area and percent protection of ecological vegetation classes for each growth stage. The area figures in this table represent the total area of the growth stages for each EVC.

For both Table 2.18 and 2.19 the corresponding percent protection figure refers to the percent of that area protected in conservation reserves or in SPZs (components a and b). Areas protected by prescription (component c of the SPZ) are not included in these tables.

Some refinements to the EVC layers (both current and pre-1750 layers) have been made during the pre-1750 mapping exercise for this report. However, the growth stage and disturbance information has not been updated and, as indicated above, the original old growth data layers have been used to devise Table 2.19. Consequently there are minor differences in the total EVC areas between this table and the pre-1750 representation (Table 2.17).

This assessment updates the information on sub-regional distribution of EVCs presented in the East Gippsland Forest Management Plan and takes into account the pre-1750 extent of EVCs.

2.5.6 Reservation Status of EVC Growth Stages

In addition to representation of EVCs and old growth forest in reserves, representation of a range of different forest growth stages in each EVC should be considered. Woodgate *et al.* (1994) identified the following forest disturbance classes that incorporate growth stages and are suitable for this purpose:

1. Old Growth Forest - See old growth section of this report;
2. Negligibly Disturbed Forest - Forest which has less than 10% of the eldest (senescent) growth stage and less than 10% of the youngest (regrowth) growth stage in the upper stratum, and where the effects of any disturbance are negligible or non existent;
3. Significantly Disturbed Forest - Forest which has greater than 10% of the youngest (regrowth) growth stage in the upper stratum, and has been subject to natural disturbances (i.e. wildfire); and
4. Other Forest - Includes forest that has greater than 10% of regrowth forest in the upper stratum originating from unnatural disturbance (timber harvesting) and other forest where the type and level of disturbance is unknown. Table 2.19 shows the area of these forest categories in conservation reserves and the SPZ.

Notes on Table 2.19:

This table was derived from the EVC, old growth forest, land tenure, disturbance and forest management zone data layers held by the Department of Natural Resources and Environment. The EVC and old growth forest data was originally produced by Woodgate *et al.* (1994) and the forest management zones as part of the East Gippsland Forest Management Plan (DCNR 1995a).

The area figures represent the total area of each forest category for each EVC. The corresponding percent protection figure refers to the percent of that area protected in conservation reserves or in the Special Protection Zone (components a and b). Areas protected by prescription (component c of the SPZ) are not included in this table.

2.5.6 Reservation Status of EVC Growth Stages

In addition to representation of EVCs and old growth forest in reserves, representation of a range of different forest growth stages in each EVC should be considered. Woodgate *et al.* (1994) identified the following forest disturbance classes that incorporate growth stages and are suitable for this purpose:

1. Old Growth Forest - See old growth section of this report;
2. Negligibly Disturbed Forest - Forest which has less than 10% of the eldest (senescent) growth stage and less than 10% of the youngest (regrowth) growth stage in the upper stratum, and where the effects of any disturbance are negligible or non existent;

3. Significantly Disturbed Forest - Forest which has greater than 10% of the youngest (regrowth) growth stage in the upper stratum, and has been subject to natural disturbances (i.e. wildfire); and
4. Other Forest - Includes forest that has greater than 10% of regrowth forest in the upper stratum originating from unnatural disturbance (timber harvesting) and other forest where the type and level of disturbance is unknown.

2.5.7 Endangered, vulnerable and rare forest ecosystems

To provide current information, the conservation status of EVCs in the region were assessed against a number of criteria developed from the JANIS proposed criteria (JANIS 1996). The criteria have been applied to ecological vegetation classes as the appropriate level of resolution for forest ecosystems.

The East Gippsland Forest Management Plan included an analysis of threatened EVCs. The East Gippsland National Estate assessment (outlined in section 5) also included an analysis of EVCs considered rare, threatened and uncommon at the national level. There are some differences in these analyses because of different criteria being used and because mapping has been updated.

The classification of the EVCs classified as rare, vulnerable or endangered are presented in Tables 2.21 and 2.22.

Table 2.20: Criteria used in review of the conservation status of EVCs

Status of EVC	Criteria
Rare	R1. Total range generally less than 10 000 ha. R2. Total area generally less than 1 000 ha. R3. Patch sizes generally less than 100 ha.
Vulnerable	V1. Approaching greater than 70% lost (depletion). V2. Includes EVCs 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.
Endangered	E1. Distribution has contracted to less than 10% of original range. E2. Less than 10% of original area remaining. E3. 90% of area is in small patches subjected to threatening processes.

Table 2.21: Rare ecological vegetation classes in East Gippsland

Ecological Vegetation Class	Percentage of Remaining Area Protected	Criterion
Brackish Sedgeland	100	R3
Clay Heathland	61 (additional 15% protected by Code, 16% on private land)	R3
Coastal Grassy Forest	100	R3
Coastal Lagoon Wetland	95	R3
Coastal Saltmarsh	100	R3
Coastal Sand Heathland	100	R3
Coastal Vine-rich Forest	99	R3
Cool Temperate Rainforest	62 (additional 38% protected by Code)	R3
Dry Rainforest	100	R2, R3

Estuarine Wetland	98	R3
Foothill Box-Ironbark Forest	81	R3
Limestone Pomaderris Shrubland	95 (EVC is unmapped - therefore figure is an estimate)	R2, R3
Montane Riparian Thicket	12% (additional 88% protected by Code)	R3
Montane Riparian Woodland	36 (additional 24% in stream frontages, 35% in private land)	R3
Riparian Shrubland	100	R3
Sand Heathland	3 (largely restricted to private land)	R3
Sub-alpine Shrubland	100	R1, R2, R3
Treeless Sub-alpine Complex	83	R3
Warm Temperate Rainforest	57 (additional 41% protected by Code, 2% on private land)	R3
Wet Swale Herbland	100	R1, R2, R3

Notes: The percentage of remaining area is derived from Table 2.17 - Representation assessment of pre-1750 vegetation classes.

2.5.8 Current Management Actions to Address Threatening Processes

All forest communities are potentially affected, to a greater or lesser extent, by threatening processes. While these threats are generally unlikely to lead to the broad scale destruction or severe degradation of the vegetation community, they may be widespread or locally severe in their impacts. Understandably, the threats listed below overlap substantially with those which affect individual species, some of which are discussed in later sections. Table 2.23 lists the major threats to forest communities in East Gippsland and identifies the actions taken by the Department of Natural Resources and Environment in response to each threat.

East Gippsland Forest Management Plan

The East Gippsland Forest Management Plan (DCNR 1995a) considered the representation of 44 ecological vegetation classes (EVCs) described for the East Gippsland Forest Management Area, across all public land and within Geographic Representation Units. The EVCs were ranked according to their total area across the Forest Management Area and levels of protection were specified, depending on the rarity of the EVC in the region.

The proportion of each EVC to be included within conservation reserves and Special Protection Zone (SPZ) was determined as:

- 30% of EVCs that occupy more than 10 000 hectares (1%) of the Forest Management Area;
- between 30 and 90% of EVCs that occupy between 1 000 hectares (0.1%) and 10 000 hectares (1%) of the Forest Management Area; and
- 90% of EVCs that occupy less than 1 000 hectares (0.1%) of the Forest Management Area.

In addition to the proportional representation of the EVC, according to the above principles, the size, distribution and configuration of protected areas were taken into account. These were also assessed against the conservation significance, sensitivity to disturbance and disturbance history of different EVCs to determine the reservation area required.

Seventeen EVCs in East Gippsland were identified as occupying less than 1 000 hectares in area and were protected in conservation reserves and SPZs at greater than 90%. A summary of the analyses for all EVCs is given in Appendices D, E and F of the East Gippsland Forest Management Plan (DCNR 1995a).

2.5.9 Rainforest

Rainforest in East Gippsland is classified as four distinct EVCs; Cool Temperate Rainforest, Warm Temperate Rainforest, Warm/Cool Rainforest and Dry Rainforest. Collectively, the rainforest EVCs cover 9 784 hectares (less than one percent of public land) in the region. Most significant rainforest stands are distributed along major rivers and streams.

Rainforest is protected in East Gippsland in dedicated reserves, the SPZ and through the Code of Forest Practices. Some 31% of all rainforest in East Gippsland occurs in national parks and conservation reserves, with 26% of rainforest occurring in the SPZ, and the balance (43%) is protected through the Code of Forest Practices for Timber Production (The Code). The Code requires that rainforest be excluded from timber harvesting and that it be protected by appropriately managed buffers of at least 20 metres.

In a review of rainforest protection measures, Burgman and Ferguson (1995) proposed a number of areas for improvement in rainforest management. Some of these were adopted in the East Gippsland Forest Management Plan. Others are being considered following a review of the Code by the CSIRO.

The CSIRO review proposed that rainforest buffers be expanded and these provisions have been included in a draft revised Code, as follows:

- areas of rainforest must be defined and a strategy for their management must be included as part of planning for conservation of flora and fauna in Forest Management Plans and/or in the relevant prescriptions. The most important rainforest areas should be accorded highest protection;
- rainforest areas must be shown on the Forest Coupe Plan and buffers identified in the field; and
- there should be an increasing degree of protection commensurate with increasing significance of the rainforest patch. Pending the results of further research, interim minimum levels of protection relevant to East Gippsland are as follows:
 - for stands of lesser significance: 40 metre buffers or 20 metre exclusion plus a 40 metre modified harvesting strip (greater than 40% of basal area retained, low machine disturbance, minimal burning); and
 - for stands containing nationally significant rainforest sensitive to management operation: the highest degree of protection, generally sub-catchment level, except where full protection can be provided by other measures, which are/will be outlined in approved plans.

Mixed forest

Mixed forest occurs within the Wet Forest EVC and contains rainforest elements in the understorey with an overstorey of eucalypts. Within East Gippsland mixed forest is largely confined to the Errinundra Plateau where some 470 hectares has been mapped.

The East Gippsland Forest Management Plan provides for the protection of at least 90% of 'mixed forest', with 63% in existing conservation reserves and 7% protected through the SPZ. The remaining 30% occurs in small scattered stands mostly less than 10 hectares. The Forest Management Plan requires that at least 90% of mixed forest is protected from timber harvesting.

2.5.10 Refugia

The identification of Refugia is related to three broad concepts. These are:

- evolutionary refugia - areas of the landscape in which certain types or suites of organisms are able to persist during a period in which most of the original geographic range becomes uninhabitable because of climate change;
- ecological refugia - areas of the landscape in which a species or suite of species persist for short periods when large parts of their preferred habitats become uninhabitable because of unsuitable climatic or ecological conditions (e.g. drought, flooding or biologically driven collapses in food supply); and
- refugia for threatened biota - areas of the landscape in which a species has retreated because of factors ultimately to do with environmental changes set in train by European settlement (Morton et al. 1995).

Techniques for identifying refugia in the landscape include:

- reconstruction of the spatial pattern of past major disturbance events (e.g. glaciation);
- analysis of plant and animal distributions, particularly for endemic and phylogenetically distinct species and/or species groups, linked to refugia;
- development of explicit landscape process models (Nix 1993; Mullens 1995) and correlation of predicted refugia distributions with plant and animal distributions.

An analysis of refugia was undertaken for the East Gippsland National Estate assessment, as outlined in section 5 of this report. Identification of flora refuge areas was a three stage process that incorporated:

1. Relictual (primitive and Gondwanic) flora. Those vegetation classes in East Gippsland either dominated by, or containing large proportions of species which are phylogenetically primitive or Gondwanic in origin were considered refuge dependent EVCs;
2. Ice age refuges identified as undisturbed areas of refuge dependent EVCs that occupy a climatic or topographic location that retains elements of the climatic regime of the last Ice Age (40 000 - 10 000 years BC); and
3. Refuges from frequent fire that have reduced fire frequency or intensity compared with the majority of areas in East Gippsland.

Flora refuge areas identified across the project area ranged from small patches of rainforest through to substantial tracts of montane and alpine areas. The total area of flora refuges identified in the region was 153 854 hectares.

The fauna refuge areas identified were likely to function as refuges during periods of major environmental or climatic stress (e.g. glaciation events), and during periods of medium term environmental stress for individuals or populations such as during wildfire or severe drought. These refuges included:

- Riparian Forest, Scrub and Shrubland (EVCs 17, 18 19);
- Undisturbed Wet Forest (EVCs 30, 39);
- Warm and Cool Temperate Rainforest (EVCs 31, 32, 33); and
- Permanent Wetlands.

Fauna refuges cover 81 390 hectares and are widely dispersed across the region.

Continue to Section 3, Old Growth

Rare or Threatened Plants recorded from East Gippsland

Table 2.8: Rare or Threatened Plants recorded from East Gippsland.

Notes on interpreting Table 2.8.

1. The information contained within this table has been derived from DNRE databases, expert opinion and available scientific.
2. The approximate proportion of each taxon's total Australian range that occurs within East Gippsland was estimated by compiling a distribution map for each species from information in the Census of Australian Vascular Plants (Hnatiuk 1990) and the relevant volumes of the Flora of Australia.
3. The number of records of each taxon in Victoria and East Gippsland comes from DNRE databases. It should be noted that the number of records should not be used as a reliable guide to the total number of populations. The number of records is greater than the number of population in cases such as *Pomaderris cotoneaster*, where multiple records have been collected from the single known population. In other cases where not all populations of a particular taxon have been sampled, the number of records may be significantly less than the actual number of populations.
4. The proportion of records in conservation areas (defined as national parks, conservation reserves and the Special Protection Zone in State Forest), Special Management Zones in State Forest (many are specifically designated for threatened plant localities), and non-conservation reserve areas (includes the General Management Zone in State Forest, other categories of public land, and private land). This information is not a reliable guide to the conservation status of the taxon in all cases - for example, *Thesium australe* is known from 6 populations, 5 of which are small but occur in conservation reserves. The other population occurs on private land and contains the vast majority of individual plants.
5. Species have been grouped into categories which give a broad indication of their priority for conservation. Each of these categories is discussed below.

In the column showing location of principal occurrences, where taxa are listed as "conservation reserve*", this indicates that although located within a conservation reserve, these taxa may continue to be subject to threatening processes.

Taxon	Conservation Status	Victorian Distribution	Location of records in East Gippsland by tenure	Location of principal occurrences in EG								
	ESP	ROTAP	FFG	VROTS	no of records in Victoria	Victorian range (km)	% of national range in EG (by area)	no of records in EG	Reserve	SMZ	Non-reserve	Conservation reserve, other public land or private land
NATIONALLY ENDANGERED OR VULNERABLE SPECIES												
Acacia caerulescens		V		v	18	76	100	12	83	-	17	private
Cryptostylis hunteriana	V	V	N	e	30	113	0-25	20	65	25	10	conservation
Pomaderris cotoneaster	E	E	T	e	3	0	0-25	3	100			conservation
Pomaderris sericea	V	V	T	v	9	118	25-50	6	100	-	-	conservation
Prasophyllum frenchii	V	V	Rj	e	15	623	0-25	3	100	-	-	conservation
Pterostylis cucullata	V	V	T	v	27	741	0-25	2	100	-	-	conservation
Thelymitra matthewsii	V	V	T	v	5	296	0-25	7	100	-	-	conservation
Thesium australe	V	V	T	e	55	488	0-25	19	89	-	11	private
FFG LISTED SPECIES												
Acacia maidenii			T	e	9	6	0-25	5	-	-	100	other public land
Almaleea capitata		R	T	r	34	165	75-100	19	100	-	-	conservation

Bruniella pumilio			T	e	5	12	0-25	2	100	-	-	conservation
Cyathea cunninghamii		R	T	r	175	700	0-25	25	100	-	-	conservation
Cyathea leichhardtiana			T	v	27	228	0-25	7	57	14	29	conservation
Dendrobium speciosum var. speciosum		T	e	8	21	0-25	9	11	33	56	conservation	
Discaria pubescens		R	T	v	77	561	0-25	30	67	10	23	conservation
Drabastrum alpestre		R	T	v	9	173	0-25	1	-	-	100	conservation
Euphrasia scabra		K	T	e	40	928	0-25	3	100	-	-	conservation
Isopogon prostratus			T	e	10	286	0-25	9	100	-	-	conservation
Myoporum floribundum		R	T	e	17	43	25-50	8	50	-	50`	conservation
Poa saxicola			T	v	14	164	0-25	6	100	6	-	conservation
Pterostylis baptistii			T	v	5	129	0-25	6	83	-	17	conservation
Sambucus australasica			T	v	11	158	0-25	10	70	-	30	conservation
Sarcochilus falcatus			T	e	10	154	0-25	4	100	13	-	conservation
Symplocos thwaitesii			T	e	14	9	0-25	6	67	-	33	conservation
Wahlenbergia densifolia			T	v	13	125	0-25	1	100	-	-	other public land

SPECIES LISTED AS ENDANGERED IN VICTORIA												
Abutilon oxycarpum var. subsagittatum			e			0-25	2	100	-	-	conservation	
Acacia binervia				e	5	54	0-25	2	100	-	-	conservation
Alectryon subcinereus				e	13	3	0-25	3	-	33	67	other public land
Correa lawrenciana var. genoensis				e				2	100	-	-	conservation
Cryptostylis erecta				e	5	99	0-25	5	80	-	20	conservation
Cyperus gracilis				e	7	4	0-25	5	100	-	-	conservation
Dipodium hamiltonianum			N	e	6	36	0-25	2		100	-	conservation
Echinopogon caespitosus				e	12	331	0-25	9	89	-	11	other public land
Gahnia subaequiglumis				e	11	19	0-25	2	50	-	50	conservation
Pseudoraphis paradoxa			N	e	22	184	0-25	17	94	-	6	conservation
Pterostylis dubia				e	8	89		7	86	-	14	conservation
Swainsona sp. (S. purpurea)				e	1	0		1	100	-	-	conservation
SPECIES LISTED AS VULNERABLE IN VICTORIA & WITH > 25 % OF THEIR EXTENT IN VICTORIA												
Acacia lucasii		R		v	13	5	0-25	4	100	-	-	conservation
Amphibromus sinuatus				v	27	859	0-25	2	-	-	100	conservation
Asplenium obtusatum				v	4	73	0-25	1	100	-	-	conservation
Barbarea grayi				v	7	165	0-25	3	100	-	-	conservation

Botrychium australe			v	12	393	0-25	5	60	-	40	other public land
Botrychium lunaria			v	4	12	0-25	4	100	-	-	other public land
Eucalyptus saxatilis		R	v	35	19	75-100	7	42	29	29	conservation
Gingidia harveyana			v	10	116	0-25	4	75	25	-	conservation
Gratiola nana			v	7	161	0-25	2	100	-	-	conservation
Monotoca rotundifolia		R	v	14	3	25-50	6	100	-	-	conservation
Olearia allenderae		R	v	25	687	25-50	8	75	25	-	conservation
Pterostylis pedoglossa			v	11	481	0-25	3	100	-	-	conservation
Spyridium cinereum		R	v	67	788	0-25	32	88		12	conservation
SPECIES LISTED AS VULNERABLE IN VICTORIA WITH LESS THAN TEN VICTORIAN RECORDS											
Acacia dawsonii			v	1	0	0-25	1	100	-	-	conservation
Acacia irrorata ssp. Irrorata			v	3	1	0-25	2	100	-	-	conservation
Acacia subtilinervis		R	v	6	237	0-25	2	50	-	50	conservation
Actinotus forsythii			v	1	0		1	100	-	-	conservation
Boronia ledifolia			v	3	43	0-25	2	100	-	-	conservation
Chloris ventricosa			v	3	252	0-25	2	-	-	100	status unclear
Conospermum taxifolium			v	2	0	0-25	2	100	-	-	conservation
Daviesia wyattiana			v	3	149	0-25	2	100	-	-	conservation

Deyeuxia decipiens			v	8	161	0-25	1	-	-	100	conservation
Deyeuxia imbricata			v	7	0	0-25	7	86	-	14	conservation
Deyeuxia talariata		R	v	1			1	100	-	-	conservation
Dillwynia prostrata			v	8	12	0-25	8	50	50		conservation
Dodonaea truncatiales			v	1	0	0-25	1	100	-	-	conservation
Eriostemon virgatus			v	7	19	0-25	7	86	14		conservation
Euphrasia collina ssp. aff. diversicolor (Cobberas)			v	4			4	100	-	-	conservation
Glossocardia bidens			v	2	5		2	50	-	50	conservation
Grevillea celata			v	3			3	100	-	-	other public land
Hakea macraeana			v	1	0		1		-	100	conservation
Korthalsella rubra ssp. Rubra			v	4	215	0-25	3	67	-	33	conservation
Lasiopetalum ferrugineum			v	2	0	0-25	2	-	100	-	conservation
Lastreopsis decomposita			v	2	10	0-25	2	100	-	-	conservation
Mirbelia pungens			v	3		0-25	3	100	-	-	conservation
Mirbelia rubiifolia			v	3	0	0-25	2	100	-	-	conservation
Philydrum lanuginosum			v	4	99	0-25	2	100	-	-	status unclear

Plinthanthesis paradoxa			v	2	0	0-25	1	100	-	-	conservation
Polyscias murrayi			v	2	0	0-25	2	100	-	-	conservation
Prasophyllum rogersii			v	9	45	0-25	1	100	-	-	conservation
Prasophyllum sylvestre			v	1			1	100		-	conservation
Pteris vittata			v	5	37	0-25	5	60	-	40	status unclear
Pterostylis coccinea			v	6	12	0-25	3	67	-	33	conservation
Pultenaea subspicata			v	4	10	0-25	4	-	50	50	conservation
Salvia plebeia			v	1	0	0-25	1	100	-	-	other public land
Santalum obtusifolium			v	5	131	0-25	5	80	-	20	conservation
Sicyos australis			v	7	198	0-25	6	50	-	50	conservation
Solanum brownii			v	3	124	0-25	3	67	-	33	conservation
Stylidium laricifolium			v	2	3	0-25	2	100	-	-	conservation
Vittadinia tenuissima			v	6	126	0-25	5	40	-	60	conservation
SPECIES LISTED AS VULNERABLE IN VICTORIA WITH MORE THAN TEN VICTORIAN RECORDS											
Calorophus elongatus			v	11	677	0-25	9	33	56	11	conservation
Corymbia maculata			v	17	496		11	9	-	91	other public land
Deyeuxia pungens		K	v	15	3		4	75	-	25	conservation
Diuris punctata var. punctata			v	29	480		11	64	18	18	other public land

Astrotricha linearis				r	8	178	0-25					conservation
Astrotricha aff. longifolia (Howe Ranges)			v								conservation	
Atriplex billardieri				r	12	906	0-25					conservation
Bertya findlayi		R		v	3	0	0-25					conservation
Brachyscome obovata				r	25	253	0-25					conservation
Brachyscome tadgellii				r	2	101						other public land
Caladenia aestiva				r								conservation
Caladenia australis				k	38	891						conservation
Caladenia hildae				r								conservation
Caladenia patersonii s.s.				k			0-25					conservation
Caladenia valida		R		e	3	0						conservation
Callistemon forresterae		K		v								conservation
Callistemon kenmorrisonii				v								conservation
Carex echinata				v	5	13	0-25					conservation
Carpobrotus glaucescens				r			0-25					conservation
Chenopodium erosum				v	7	28	0-25					conservation
Chiloglottis X pescottiana				r	4	79						conservation

Chorizandra sphaerocephala				r			0-25					conservation
Christella dentata			N	e	11	581	0-25					other public land
Colobanthus affinis				r	76	86	0-25					conservation
Cryptandra ericoides				v			0-25					conservation
Cyperus concinus				v	6	4	0-25					conservation
Dampiera fusca		R		r			0-25					conservation
Deschampsia caespitosa				r	21	375	0-25					conservation
Diuris palustris			N	v	43	607	0-25					other public land
Enneapogon gracilis				v	9	16	0-25	9	89	-	11	conservation
Epacris coriacea				r	3	228	0-25					conservation
Eragrostis leptostachya				v	10	485	0-25					other public land
Erigeron conyzoides				v			25-50					conservation
Eucalyptus neglecta		R		r	52	239	0-25					conservation
Euphrasia collina ssp. Diversicolor							0-25	1	100	-	-	conservation
Exocarpos syrticola				r	11	585	0-25					conservation
Genoplesium despectans		K			31	680		7	72	14	14	conservation
Genoplesium nudum				r	6	336						conservation
Gleichenia rupestris				r			0-25					conservation

Glycine latrobeana		V	T	v	108	758	0-25					other public land
Gompholobium inconspicuum				r								conservation
Gonocarpus serpyllifolius				v			0-25					conservation
Goodia medicaginea				r	2	225	0-25					conservation
Gratiola pumilo		K		k	6	296	0-25					information not
Grevillea willisii ssp. Pachylostyla				r								conservation
Hierochloe submutica		R		v	5	108	0-25					conservation
Huperzia varia				v	13	663		4	50	-	50	conservation
Hypsela tridens				v	6	202	0-25					conservation
Isolepis wakefieldiana				r	6	559	0-25					conservation
Leptospermum glabrescens s. l.		K			109	818	25-50	76	61	14	25	conservation
Leucochrysum molle				v								other public land
Leucopogon microphyllus var. pilibundus			r				0-25	5	100	-	-	conservation
Lotus cruentus				d	16	379	0-25					conservation
Luzula australasica				r	9	14	0-25					conservation
Lycopodiella serpentina				r	1	0						conservation
Microtis orbicularis				v	3	315	0-25					conservation
Muehlenbeckia axillaris				r	4	133	0-25					status unclear

Prasophyllum morganii		v		e	4	0	25-50					other public land
Prostanthera decussata				r	6	306	0-25					conservation
Prostanthera sp. aff. Melissifolia				r								conservation
Psoralea tenax				e	15	460	0-25					conservation
Pterostylis sp. aff. Aciculiformis (Stawell)			k								conservation	
Pterostylis alveata				v			0-25					conservation
Pterostylis tunstallii				v								conservation
Pterostylis hamata				r	2	268	0-25					conservation
Pultenaea altissima				r	1	0	0-25					conservation
Rulingia dasyphylla				r			0-25					other public land
Sarcocornia quinqueflora ssp. Tasmanica			e				0-25				other public land	
Schoenus ericetorum				r			0-25					conservation
Schoenus turbinatus				r			0-25					conservation
Sporobolus creber				r	4	404	0-25					status unclear
Tetragonia eremaea				r			0-25					conservation
Thelymitra X chasmogama				r			0-25					conservation

Thelymitra sp. aff. Nuda			e									conservation
Thelymitra sp. aff. Pulchella			e									conservation
Tripogon loliiformis			r	41	153	0-25						conservation
Uncinia compacta			r			0-25						conservation
Viola improcera		R	r	2	180	25-50						conservation
Westringia cremnophila		V	v	5	6	0-25						conservation
Wurmbea biglandulosa			r	3	585	0-25						other public land
Xanthosia tasmanica			r			0-25						conservation
Xyris juncea			v			0-25						conservation
Zieria sp. D		V	v									conservation
SPECIES DEPLETED, POORLY KNOWN OR RARE IN VICTORIA												
Acacia penninervis			r	5	352	0-25	1	100	-	-		conservation
Acacia subporosa			r	23	30	25-50	23	100	-	-		conservation
Acrotriche leucocarpa			r	39	156		32	75	-	25		conservation
Adiantum formosum			r	11	133	0-25	10	40	-	60		conservation
Adiantum hispidulum			r	5	272	0-25	3	100	-	-		conservation
Agrostis australiensis			r	35	191	0-25	4	75	-	25		conservation
Agrostis avenacea var. perennis			k			0-25	5	80	-	20		conservation

Allocauarina nana				r	1	0	0-25	1	100	-	-	conservation
Almaleea paludosa				r	4	85		4	75	25		conservation
Asplenium trichomanes				r	24	245	0-25	16	62	-	38	conservation
Astrotricha aff. linearis (Suggan Buggan)			r	6	37		6	83	-	17	conservation	
Australopyrum retrofractum				r	29	146		27	59	-	41	conservation
Austrofestuca eriopoda				r	11	552		2	100	-	-	conservation
Baeckea linifolia var. brevifolia				r	52	110		51	80	8	12	conservation
Bertya cunninghamii				r	6	196	0-25	2	50	-	50	conservation
Beyeria lasiocarpa				r	50	198	0-25	29	56	10	34	conservation
Beyeria viscosa				r	39	240	0-25	28	57	14	29	conservation
Bossiaea ensata				r	64	141	0-25	53	98	-	2	conservation
Bossiaea riparia				r	5	723	0-25	2	100	-	-	conservation
Brachyscome petrophila		R		r	46	306		15	93	-	7	conservation
Brachyscome radicans				r	4	23		1	-	-	100	other public land
Brachyscome riparia		R		r	23	141	50-75	5	100	-	-	conservation
Bulbine glauca				r	13	405	0-25	11	64	-	36	conservation
Burnettia cuneata				r	43	904	0-25	4	75	25	-	conservation
Caladenia alata				k	4	894	0-25	1	100	-	-	conservation

Caladenia aurantiaca				r	4	323	0-25	1	-	-	100	conservation
Caladenia flavovirens				r	14	807		1	100	-	-	conservation
Caladenia tessellata s.s.				k	14	892	0-25	2	50	-	50	conservation
Callistemon subulatus				r	18	56	0-25	18	77	17	6	conservation
Callitris glaucophylla				d	143	1124	0-25	24	62	-	38	conservation
Calochilus imberbis				r	3	420	0-25	1	-	100	-	conservation
Carex capillacea		R	Rj	r	60	167	0-25	14	100	-	-	conservation
Carex raleighii		R	Rj	r	23	234	25-50	4	75	-	25	other public land
Commersonia sp. aff. Fraseri				r	5	122		6	50	17	33	conservation
Coprosma nivalis				r	16	174	0-25	1	100	-	-	conservation
Correa lawrenciana var. rosea				r				9	78	11	11	conservation
Corybas fordhamii				r	1	0	0-25	1	100	-	-	conservation
Corybas hispidus				r	4	15	0-25	3	100	-	-	conservation
Craspedia alba		R		k	81	150		3	67	-	33	conservation
Cuscuta victoriana				r	4	295	0-25	3	67	-	33	conservation
Cyathea X marcescens				r	41	697		20	65	15	20	conservation
Cyathochaeta diandra				r	37	24	0-25	37	70	8	22	conservation
Cymbonotus lawsonianus				r	6	365	0-25	1	100	-	-	conservation

Cyphanthera albicans ssp. Albicans			r	2	4	0-25	2	50	-	50	conservation	
Cystopteris tasmanica		R		r	48	273		11	100	-	-	conservation
Dampiera purpurea				r	7	192	0-25	3	67	-	33	conservation
Darwinia camptostylis				r	7	38	0-25	6	100	-	-	conservation
Dendrobium striolatum				r	48	473	0-25	43	72	12	16	conservation
Deparia petersenii ssp. Congrua				r	4	181		4	100	-	-	conservation
Desmodium brachypodum				r	4	39	0-25	4	75	-	25	conservation
Desmodium varians				r			0-25	25	64	8	28	conservation
Deyeuxia affinis		R		r	4	86	0-25	1	100	-	-	conservation
Deyeuxia nudiflora				r			0-25	15	80	-	20	conservation
Deyeuxia parviseta var. boormanii				r			0-25	7	100	-	-	conservation
Dipodium variegatum				r	3	53		3		100	-	conservation
Diuris brevissima				k	3	141		2	50	-	50	conservation
Dodonaea rhombifolia		R		r	47	250	0-25	1	100	-	-	conservation
Epilobium pallidiflorum				d	80	883	0-25	5	60	20	20	conservation
Eucalyptus agglomerata				r	68	137	0-25	63	16	16	68	conservation

Eucalyptus alligatrix		R		r	34	567		18	33	39	28	other public land
Eucalyptus elaeophloia		R		r	8	23		3	100	-	-	conservation
Eucalyptus fraxinoides				r	3	9	0-25	16	100	-	-	conservation
Eucalyptus ignorabilis		K		k				7	100	-	-	other public land
Eucalyptus mackintii				r	52	153		43	12	5	83	other public land
Eucalyptus yarraensis		R	Rj	r	63	835	0-25					conservation
Euchiton umbricolus				r	21	324		4	100	-	-	conservation
Euphrasia caudata				r	15	55	0-25	6	100	-	-	conservation
Genoplesium pumilum			Rj	r	6	678		5	60	20	20	conservation
Glossostigma cleistanthum				r	2	0		1	100	-	-	conservation
Gompholobium glabratum				r	3	4	0-25	3	100	-	-	conservation
Goodenia bellidifolia ssp. Bellidifolia			r	4	15	0-25	2	100	-	-	conservation	
Goodenia heterophylla ssp. Heterophylla			r	2	39	0-25	4	-	75	25	status unclear	
Goodenia macmillanii				r	3	207	0-25	1	100	-	-	other public land
Grevillea willisii		R		r	33	125		1	-	-	100	conservation
Hakea dactyloides				r	2	4		2	100	-	-	conservation

Haloragodendron baeuerlenii		R		r	53	89	25-50	16	75	-	25	conservation
Hibbertia rufa				r	12	105	0-25	11	45	55	-	conservation
Hibbertia spathulata		R		r	8	762	0-25	6	83	-	17	conservation
Hovea purpurea				r			0-25	5	100	-	-	conservation
Huperzia australiana				r	21	245		4	75	-	25	conservation
Irenepharsus magicus		R		r	6	42	0-25	1	100	-	-	conservation
Juncus brevibracteus				r	6	16		6	100	-	-	conservation
Koeleria cristata		K		r	20	191		4	100	-	-	information not
Leptomeria acida				r	77	74	0-25	75	27	29	44	conservation
Leptorhynchus elongatus				r	11	778	0-25	6	34	33	33	conservation
Leptospermum emarginatum				r	5	267	0-25	3	100	-	-	conservation
Lepyrodia anarthria				r	11	387	0-25	9	34	33	33	conservation
Leucopogon esquamatus				r	10	149	0-25	10	50	-	50	conservation
Leucopogon microphyllus				r	11	166	0-25	11	55	18	27	conservation
Leucopogon microphyllus var. microphyllus			r				0-25	5	100	-	-	conservation
Leucopogon piliferus				r	12	87	25-50	5	80	-	20	conservation
Leucopogon riparius		R		r	12	84	25-50	12	83	-	17	conservation

Libertia paniculata			r	44	394	0-25	42	76	2	22	conservation
Lindsaea microphylla			r	60	368	0-25	58	24	26	50	conservation
Lobelia dentata			r			0-25	1	100	-	-	conservation
Logania pusilla			r	5	7	0-25	4	100	-	-	conservation
Lomandra longifolia ssp. Exilis			r				21	49	13	38	conservation
Marsdenia flavescens			r	18	77	0-25	9	67	-	33	conservation
Notothixos subaureus			r	5	11	0-25	4	100	-	-	conservation
Olox stricta			r	3	3	0-25	3	-	100	-	conservation
Olearia tomentosa			r	1	0	0-25	1	100	-	-	conservation
Olearia viscosa			r	15	19	0-25	4	100	-	-	conservation
Oschatzia cuneifolia		R	r	39	183	0-25	10	100	-	-	conservation
Oxalis magellanica			r	47	603	0-25	5	60	20	20	conservation
Oxalis thompsoniae			k	29	488		15	27	27	46	conservation
Ozothamnus argophyllus			r	11	307		8	87	13	-	conservation
Ozothamnus rogersianus			r	4	532		2	100	-	-	conservation
Panicum simile			r	10	158	0-25	10	80	10	10	conservation
Parsonsia eucalyptophylla			r			0-25	1	100	-	-	conservation
Persoonia brevifolia		R	r	1	0	25-50	1	100	-	-	conservation

Phebalium glandulosum ssp. Glandulosum			r	1	0	0-25	2	100	-	-	conservation	
Picris squarrosa				r			0-25	1	100	-	-	conservation
Pimelea biflora				r	22	581	25-50	12	83	-	17	conservation
Pittosporum revolutum				r	39	203	0-25	35	80	-	20	conservation
Plectorrhiza tridentata				r	41	161	0-25	41	75	10	15	conservation
Poa hothamensis var. parviflora				r				1	100	-	-	conservation
Poa labillardieri var. acris				k	21	706	0-25	2	50	-	50	conservation
Poa poiformis var. ramifer				k				2	100	-	-	conservation
Poa sp. aff. Tenera (Hairy)				r				17	35	6	59	conservation
Podolobium ilicifolium				r	56	82		56	43	-	57	conservation
Polystichum formosum				r	6	125	0-25	4	100	-	-	conservation
Pomaderris aurea				r	39	341	25-50	1	-	-	100	conservation
Pomaderris costata		R		r	27	161	25-50	6	67	-	33	conservation
Pomaderris discolor				r	42	341	0-25	16	62	19	19	conservation
Pomaderris ledifolia				r	6	17	0-25	1	100	-	-	conservation
Pomaderris oblongifolia		R		r				7	57	-	43	conservation
Pomaderris oraria		R		r	31	518	0-25	2	100	-	-	conservation

Pomaderris oraria ssp. Calicicola		R		r				7	86	-	14	other public land
Pomaderris pauciflora		R		r	24	157	0-25	3	33	-	67	other public land
Pomaderris virgata		R		r	4	2	0-25	15	73	-	27	other public land
Poranthera corymbosa				r	14	108	0-25	14	36	14	50	conservation
Prasophyllum patens				r	10	922	0-25	7	86	-	14	conservation
Prostanthera walteri		R		r	80	189	25-50	20	80	15	5	conservation
Pseudanthus divaricatissimus		R		r	31	606	0-25	4	75	25	-	conservation
Psilotum nudum			Rj	r	3	699	0-25	1	100	-	-	conservation
Pterostylis aestivalis				r	11	118	0-25	5	100	-	-	conservation
Pterostylis fischii				r	13	109	0-25	7	71	-	14	conservation
Pterostylis grandiflora				r	25	472	0-25	2	50	-	50	conservation
Pterostylis laxa				r	8	10	0-25	6	83	-	17	conservation
Pterostylis longipetala				r	4	109		4	75	-	25	conservation
Pterostylis X ingens				r	6	913		7	86	-	14	conservation
Pultenaea capitellata				r	2	4	0-25	2	50	-	50	conservation
Pultenaea polifolia				r	20	132	0-25	19	63	-	37	conservation
Ripogonum album				r	25	138	0-25	25	72	4	24	conservation

Samolus valerandii				r	7	272	0-25	3	33	-	67	status unclear
Scutellaria mollis				r	24	73	0-25	23	52	13	35	conservation
Senecio diaschides				r	10	345	0-25	6	33	-	67	conservation
Sparganium subglobosum				k	5	181		1	100	-	-	status unclear
Spiranthes sinensis				d	18	708	0-25	7	57	29	14	conservation
Stackhousia nuda				r	19	105	0-25	17	82	6	12	conservation
Sticherus flabellatus				r	13	32	0-25	13	92	-	8	conservation
Stipa setacea				r	47	740	0-25	2	100	-	-	status unclear
Taraxacum aristum		R	Rj	r	23	298	0-25	3	100	-	-	conservation
Tasmania xerophila ssp. Robusta		R		r				10	83	2	15	conservation
Thelionema umbellatum				r			0-25	1	-	-	100	conservation
Tmesipteris ovata				r	54	478	0-25	45	64	9	27	conservation
Uncinia nemoralis				r	126	355		16	71	7	22	conservation
Viola caleyana				r	22	856	0-25	19	58	16	26	conservation
Zieria cytisoides				r	3	179	0-25	2	100		-	conservation
Zieria smithii				r	45	289	0-25	43	61	9	30	conservation
SPECIES PRESUMED EXTINCT IN VICTORIA												
Asplenium polyodon				x	5	588	0-25	4	-	-	100	not applicable

Dodonaea heteromorpha				x	4	652	0-25	24	96	-	4	not applicable
Lysimachia salicifolia				x								not applicable
Muehlenbeckia gracillima				x			0-25	1	-	-	100	not applicable
Stemmacantha australis		v		x	2	70		1	-	-	100	not applicable
Trema tomentosa var. viridis				x			0-25					not applicable

Executive Summary

This report outlines the methods and findings of the environment and heritage assessments undertaken as part of the Regional Forest Agreement process for East Gippsland. These assessments cover biodiversity, endangered species, old growth, wilderness, national estate and world heritage.

This report is a precursor to the options development phase of the Regional Forest Agreement process. In the options development phase all the assessments, including the environment and heritage, and social and economic assessments, will be considered (with input from stakeholders and the public) in the development of future forest use options.

National Forest Reserve Criteria

Proposed national reserve criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia have recently been completed by officials. The criteria relate explicitly to biodiversity, old growth and wilderness, and acknowledge the important role of forest management outside reserves in meeting conservation objectives. This report provides information for assessment of the current reserve system against the proposed national reserve criteria.

The East Gippsland Region

The area covered by this Assessment is referred to as East Gippsland, or the region, in this report and corresponds to the East Gippsland Forest Management Area. East Gippsland encompasses 1.2 million hectares in far eastern Victoria.

Biodiversity Assessment

The biodiversity assessment includes a flora and fauna data review and an assessment of species and forest ecosystems.

Flora and Fauna Data Review

A review of flora and fauna survey data has been undertaken to identify any major gaps. Additional data collection was not undertaken, given the extensive body of information already available for the region.

The level of flora survey in East Gippsland is high with more than 6 000 survey sites sampled since 1980. These sites have been sampled as part of a range of studies, including: region-wide studies; more than 30 pre-logging flora and fauna studies based on forest blocks; intensive sampling of experimental areas; and other studies based on targeted sampling of particular habitats, such as rainforests and heathlands.

The overall level of fauna survey data in East Gippsland is also high, although survey effort varies considerably between fauna groups. Generally, the region has relatively large areas of high survey intensity, but also some areas of low survey intensity, which tend to correspond with the existing conservation reserve system and areas of private land.

Species Assessment

The species assessment provides an analysis of information which can address the issue of the viability of maintaining populations of terrestrial and aquatic native species throughout their natural ranges. It enables an evaluation against the proposed national reserve criteria, and the determination of complementary off-reserve species and habitat management.

A list of terrestrial and aquatic forest flora and fauna species was compiled and assessed including National and State listed rare and threatened species occurring in East Gippsland.

The assessment involved collation of information on each of these species, including distribution, habitat and life history attributes; identification of factors affecting status (risk of extinction); identification of threatening process (disturbances); a description of current management actions; and identification of gaps in survey and research.

Forest Ecosystem Assessment

The forest ecosystem assessment provides an analysis of information which can address the issue of the protection of viable examples of forest ecosystems throughout their natural ranges. It enables an evaluation against the proposed national reserve criteria, and the determination of complementary off-reserve management.

The assessment involved mapping both the current and estimated pre-1750 distributions of forest ecosystems and assessing their current reservation status: identifying those which are endangered, vulnerable or rare, identifying refugia for flora and fauna, and describing disturbances and management actions relevant to their protection.

Ecological Vegetation Classes (EVCs) are the basic vegetation unit in this assessment. They are the units used for assessment, biodiversity planning and conservation management at the regional scale in Victoria. For the purposes of the RFA process EVCs are equivalent to forest ecosystems, as defined in the proposed national reserve criteria paper.

The methodology used to derive EVCs has been described and reviewed by an independent panel of experts. The panel concluded that EVCs provide an important Statewide level of vegetation mapping and that EVCs are an appropriate basis for assessing floristic biodiversity conservation, provided that the issue of variability across some of the larger EVCs is addressed. Issues raised by the panel have either been addressed in this assessment, or will be taken into account in the ongoing RFA process.

Within East Gippsland, four extensive ecological vegetation classes were considered by the panel to contain a significant amount of variability (Damp Forest, Wet Forest, Lowland Forest and Shrubby Dry Forest). Analyses were suggested to address this issue. The variability within EVCs has been recognised in the East Gippsland Forest Management Area Plan by the establishment of eleven geographic sub-units, with representation of EVCs being considered on the basis of these sub-units. This analysis has been updated in this assessment.

An assessment of the existing reserve system in East Gippsland has been undertaken to establish current reservation levels for each EVC as a proportion of its pre-1750 extent. An assessment has also been undertaken of the reservation levels of various growth stages within EVCs in East Gippsland.

In summary, more than 15% of the pre-1750 extent of all but one EVC (Limestone Grassy Woodland) is protected in the conservation reserve system. Each EVC is also represented in all the geographic sub-units in which they occur.

Old Growth Assessment

The old growth component of the East Gippsland regional assessment is based on

the information compiled in *A study of old-growth forests of East Gippsland* by Woodgate *et al.* (1994). This study covers all the old growth assessment requirements under the RFA process.

The definition of old growth forest used by Woodgate *et al.* (1994) is consistent with the national and NFPS definitions.

The scientific validity of one of the operational requirements of the Woodgate *et al.* old growth forest definition was referred to a Joint Scientific Advisory Group (JSAG) by Victoria and the Commonwealth. The JSAG recommended adoption of the 10% regrowth crown cover rule used by Woodgate *et al.* (1994).

An assessment of the existing reserve system in East Gippsland has been undertaken to determine current reservation levels of old growth forest for each EVC. In addition an analysis has been undertaken to determine whether old growth in each EVC is represented in the reserve system across its geographic range. This was achieved by sub-dividing the region into eleven geographic units.

In relation to the representation of old growth across the region, examples of all old growth occurrences in each of the eleven geographic units in the region are represented in the current reserve system.

The analysis shows that, for most EVCs in the region, 60% or greater is protected in the conservation reserve system. However, the level of old growth protection in some EVCs will need to be considered as part of the development of RFA options.

Wilderness

The assessment uses the methodology developed by the Australian Heritage Commission (AHC) through the National Wilderness Inventory (NWI). The assessment of wilderness has been undertaken in the wider regional context of the forests of eastern Victoria, given their broad similarity. Areas of high wilderness quality were identified and delineated and an assessment has been undertaken to establish current reservation levels of wilderness.

This assessment of the eastern Victorian forests identified 18 areas that meet the wilderness threshold requirements, nine of which are within the East Gippsland Region.

In the eastern Victorian forests region 95% of the total area delineated as significant for high wilderness quality is within the existing reserve system. The proposed national reserve criteria specify that 90%, or more if practicable, of the area of high quality wilderness that meet the minimum area requirements should be protected in reserves.

National Estate

The objectives of the National Estate assessment were to identify those areas in East Gippsland which merit listing in the Register of the National Estate, and to assess the representation of national estate values in the current reserve system, as well as the protection afforded by other mechanisms.

An overview of the broad National Estate themes, their sensitivity to disturbance, and the extent to which a particular value occurs within the conservation reserve system has been assessed. The detailed assessment included a wide range of values addressing aspects of both the natural and cultural heritage of the forests

of the region. A full list of values identified is provided in a separate CRA report, *The National Estate Values in East Gippsland, Victoria, 1996*.

World Heritage

In accordance with the Commonwealth's obligations under the World Heritage Convention, there is a requirement to identify and assess World Heritage values. To meet this obligation, a methodology for assessment of World Heritage values in forested areas of Australia has been developed between the Commonwealth and the States.

In accordance with this methodology, a panel of experts was convened to identify themes and sub-themes of outstanding universal value relevant to Australia and to determine which of these themes and sub-themes are relevant to Victoria. The panel subsequently met and developed a list of places in Victoria warranting further investigation as part of the CRA, to determine whether they best express the identified themes.

One of the themes identified focussed on *Eucalyptus* evolution and diversity which would include a wide variety of *Eucalyptus* types from a variety of environments. An excellent representative sample of these can be found in South East Australia, centred on East Gippsland, encompassing a range of habitats from the sea to the alpine hermland, and then to the inland plains.

This sample would not be found in a single, contiguous area but would be comprised of several large areas, most of which could be expected to already have protected area status.

The Victorian RFA Steering Committee is now developing the details of how assessment work relating to the places identified by the expert panel is to be progressed.

It should be emphasised that none of the places identified so far fulfil the definition of 'identified property' in the *World Heritage Properties Conservation Act* 1983. The Attorney's General's Department advised the Commonwealth's World Heritage Unit of this in correspondence of 7 June 1996. The Department outlined that "the mere application of any or all stages of the methodology to a place will not make that place 'identified property' for the purposes of the *World Heritage Properties Conservation Act* 1983. The Act will not be capable of applying to a place solely by reason of the application of the above steps of the methodology."

It is also important to note that places identified might not in themselves have World Heritage values. Only places that meet the requirements of all of the steps of the methodology, including the final step involving a formal assessment against the criteria and operational guidelines, are likely to have World Heritage value. Such places are then likely to be the 'best of the best' of their type in the world.

Acknowledgements

The environment and heritage assessments of East Gippsland could not have been completed without the effort of many people. Particular thanks go to:

- The members of the Technical Working Group;
- The members of the Ecological Vegetation Class Review Group;
- The members and Secretariat of the Victorian Joint Commonwealth/State Scientific Advisory Group; and
- The members of the World Heritage Expert Panel.

The following people made major contributions to the analysis, report writing and map production.

Commonwealth

Australian Heritage Commission (AHC): - Catherine Bright, Harry Abrahams

Australian Nature Conservation Agency (ANCA): - Dave Barratt, Nick Dexter, Brendan Edgar, Suzie Edwards, Jasmyn Lynch, Helen Neave, John Neldner, Andrew Taplin, Annemarie Watt, Sue Wright

Bureau of Resource Sciences (BRS): - Stuart Davey, Kim Ritman, Phil Tickle

Department of the Environment, Sport and Territories (DEST): - Jane Coram, Bronwyn Goody, Daryl King, Sarah May, Tracy Pateman, Bruce Wellington, Elizabeth Williams

Environmental Protection Agency (EPA): - Paul Marsh

Environmental Resources Information Network (ERIN): - Simon Bennett, Adrian Bugg, Maria Cofinas, Donald Glasco, Elizabeth McDonald, Kate Ord, Peter Rey, John Symond

Victoria

Arthur Rylah Institute (ARI): - Andrew Corrick, Jenny Nelson

DNRE: - Tim Doeg, Gill Earl, Steve Henry, Bruce Kilgour, Malcolm Macfarlane, Adrian Moorrees, David Parkes, Bill Peel, Taarmo Raadik, Brian Thompson, Rolf Willig

Natural Resource Systems (NRS): - George Mansour

Frequently Used Abbreviations

API Aerial photograph interpretation
CAR Comprehensive, adequate and representative (reserve system)
CRA Comprehensive Regional Assessment
DFA Deferred Forest Agreement
ESFM Ecologically sustainable forest management
EVC Ecological vegetation class
GIS Geographical information system
IGAE Inter-governmental Agreement on the Environment
NFPS National Forest Policy Statement
NWI National Wilderness Inventory
RFA Regional Forest Agreement
VROTS Victorian rare or threatened species
ROTAP Rare or threatened Australian plants

Organisations

AGSO Australian Geological Survey Organisation
AHC Australian Heritage Commission
AAV Aboriginal Affairs Victoria
AUSLIG Australian Surveying and Land Information Group
CALM Department of Conservation and Land Management (Western Australia)
CRES Centre for Resource and Environmental Studies
DCE Department of Conservation and Environment (now DNRE)
DCFL Department of Conservation, Forests and Lands (now DNRE)
DCNR Department of Conservation and Natural Resources (now DNRE)
DNRE Department of Natural Resources and Environment (Victoria)
DWR Department of Water Resources (Victoria)
EPA Environment Protection Authority (Victoria)
CSIRO Commonwealth Scientific and Industrial Research Organisation
JANIS Joint Australian and New Zealand Environment and Conservation Council (ANZECC)/Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA)
National Forest Policy Statement Implementation Sub-committee
LCC Land Conservation Council

Introduction

- **1.1 Purpose**
- **1.2 East Gippsland region**
- **1.3 Reserve criteria**
- **1.4 Conservation reserves**
- **1.5 East Gippsland forest management zones**
- **1.6 Data review**
- **1.7 Accreditation**

1.1 Purpose

This report outlines the methods and findings of the Environment and Heritage assessments undertaken jointly by the Commonwealth and Victoria for the East Gippsland region. These assessments cover biodiversity, endangered species, old growth, wilderness, national estate and world heritage. Full reports for old growth, wilderness and national estate are published separately, with a summary included within this report.

In the integration phase, which is the next phase in the RFA process, all the assessments, including the environment and heritage, social and economic assessments, will be considered in the development of future forest use options, following input from stakeholders. This analysis will include identification of areas proposed for commercial forest production, industry opportunities, areas to be included in the forest reserve system, and management prescriptions and guidelines for ecologically sustainable forest management. A draft RFA report will be released for public comment. Following this, the Commonwealth and State Government will negotiate a Regional Forest Agreement for East Gippsland.

1.2 East Gippsland region

The area covered by this assessment is shown on Map 1 and is referred to as East Gippsland, or the region, in this report. This area corresponds to the East Gippsland Forest Management Area and encompasses 1.2 million hectares in far eastern Victoria. Most of the land is in public ownership (87%), comprising mainly State forest and National Park. The region is characterised by extensive areas of relatively intact and diverse native vegetation, ranging from subalpine to montane and coastal forests. East Gippsland's native forests form a substantial and contiguous part of the forested land in south-eastern Australia.

1.3 Reserve criteria

Following signing of the NFPS in 1992, an Inter-governmental Technical Working Group on Reserve Criteria was established in 1993 to draft national reserve criteria, under the Joint Australian and New Zealand Environment and Conservation Council (ANZECC)/Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) NFPS Implementation Sub-committee (JANIS). The Technical Working Group comprised representatives from state forestry and conservation agencies, and the CSIRO.

A paper on the proposed nationally agreed criteria for the establishment of a CAR reserve system for forests in Australia has recently been completed by JANIS, drawing from an earlier draft paper of 1995 and from the Commonwealth position paper on reserve criteria published in July 1995 (JANIS 1996).

The JANIS paper includes criteria for the reservation of biodiversity, old growth and wilderness, and also considers the important role of forest management outside conservation reserves in meeting conservation objectives. This report provides information for assessment of the current reserve system against the proposed reserve criteria.

The proposed criteria for biodiversity have been established on the basis that 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. These criteria are summarised below.

1.4 Conservation reserves

Reserves with protection of natural values as a principle objective (in accordance with Land Conservation Council recommendations) are regarded as conservation reserves for the purposes of this report (Table 1.1).

• **Table 1.1: Current reserve system in East Gippsland.**

Reserve Classification	Type of Reserve
Dedicated Conservation Reserves	Reference Area
	National Park
	State Park
	Coastal Park
	Regional Park
	Flora and Fauna Reserve
	Flora Reserve
	Wildlife Reserve
	Bushland Reserve
	Coastal Reserve
	Gippsland Lakes Reserve
	Streamside Reserve
	Natural Features and Scenic Reserves
	Cave Reserve
	Education Area
	Scenic Reserve
	Wildlife Co-operative Management Area

1.5 East Gippsland forest management zones

Under the *East Gippsland Forest Management Plan* (DCNR 1995a) State forest is divided into the Special Protection Zone (SPZ), the Special Management Zone (SMZ) or the General Management Zone (GMZ). These zones are described as follows.

Special Protection Zone (SPZ) is managed for conservation. Timber harvesting is excluded and other activities (such as fuel reduction burning and grazing) are only permitted where they are compatible with the maintenance of values of the zone. The SPZ complements the existing conservation reserves and portions form a network designed to link key elements of the overall reserve system.

Large components of the zone consist of:

- representative examples of ecological vegetation classes and old-growth forest;
- representative examples of heathland mosaics and their hinterland;
- sub-catchments for protection of significant rainforest areas;
- Long-footed Potoroo special management areas, where they coincide with other values; and
- key threatened and sensitive fauna localities.

The SPZ is connected, and linked to conservation reserves, by:

- natural features zones on rivers and streams, including heritage rivers (LCC 1983a, 1983b, 1986);
- linear SPZ reserves of 200 metres average width;
- areas protected in accordance with the Code of Forest Practices for Timber Production, including stream buffers (at least 20 metres) and all rainforest stands with their associated buffers (at least 20 metres); and
- all heathland areas and buffering vegetation, at least 40 metres width.

The **Special Management Zone (SMZ)** is managed to conserve specific features, while catering for timber production under certain conditions. Management arrangements for areas in the SMZ are determined on a case-by-case basis according to the values present. Each area has a plan prepared detailing if, and under what conditions, timber harvesting may occur.

This management zone includes areas for: conservation of fauna species; point localities (special management sites) of significant features (historic sites and isolated populations of key threatened plant species); and areas where modified timber harvesting techniques will be used to minimise the visual impact of harvesting and risks to catchment values.

The **General Management Zone (GMZ)** is managed for a range of uses, but timber production has a high priority. Secondary aims include protection of landscape values, provision of recreation and educational opportunities, fire protection and conservation to complement adjacent zones.

The GMZ also contains areas unsuitable for sawlog production due to steep slopes or low productivity. While activities such as fuel-reduction burning, harvesting of minor forest products (such as firewood, poles and honey), and recreation are permitted, these activities tend to be limited to small areas. Consequently, parts of the GMZ remain relatively undisturbed and contribute substantially to conservation, particularly the drier forest types and their associated fauna.

1.6 Data review

As part of the Regional Forest Agreement process, the Commonwealth and Victoria have agreed to the need to evaluate the adequacy of data in order to meet the statutory and policy obligations of both governments. The data review provides a systematic approach for evaluating data within and across regions.

The review process involves documenting the quality and coverage of data sets to be used in the CRA process. Where the available information is not considered to be sufficient, additional projects have been proposed to improve the quality and

coverage of data. If the data were considered suitable and were used in the assessment, then they have been accredited for this purpose.

The data information required to assess the range of forest values across the region was reviewed by the joint Commonwealth/Victorian Technical Working Group.

Key steps in the review of data included:

- identifying data sets required for environment and heritage assessments;
- describing the data sets against a standard list of criteria and guidelines (Appendix B);
- analysing the data to determine its utility for assessments; and
- identifying gaps in existing data and collecting new information, where necessary.

This report includes the data review undertaken for the environment and heritage assessments for East Gippsland. Additional data collection was not undertaken in East Gippsland because of the large amount of information already available in comparison to other forested regions. Nevertheless, where gaps in data occur they have been identified.

1.7 Accreditation

An objective of Regional Forest Agreements is that, to the maximum extent possible, existing data sets and processes used in the assessments be accredited.

The framework for accrediting data sets and processes is set out in the Inter-governmental Agreement on the Environment (IGAE 1992). Accreditation, as outlined in the IGAE, refers to the Commonwealth or a State endorsing a process used by the other jurisdiction(s) as having accommodated part or all of the interests of the accrediting government.

The data sets used in the environment and heritage assessments are described in Appendix B. These data sets have been accredited by the Commonwealth and Victoria for use in the East Gippsland RFA process, subject to any qualifications or limitations as outlined in the various data review sections of this report.

Old Growth

- 3.1 Introduction
- 3.2 Description of old growth forest assessment methodology
- 3.3 Old growth data review
- 3.4 Old growth forest reservation analysis

3.1 Introduction

Under the 1992 *National Forest Policy Statement* (NFPS) the Commonwealth and State Governments agreed to a strategy to conserve and manage areas of old growth forests as part of the comprehensive, adequate and representative (CAR) reserve system. This strategy acknowledges the significance of old growth forests to the Australian community because of their high aesthetic, cultural and nature conservation values and their lack of disturbance.

When old growth values are lost from a forest, these values may not return for several cycles of regeneration and senescence or not at all depending on the initial severity of the disturbance. The time it takes to return to an old growth state and its importance to biodiversity justifies the need to consider its protection as part of the CAR reserve system.

As part of the East Gippsland Comprehensive Regional Assessment (CRA) required to complete a Regional Forest Agreement (RFA), the Commonwealth Government and Victorian Government agreed to jointly undertake an assessment of the extent of old growth forest.

Proposed national criteria have been established for the conservation of old growth forests (JANIS 1996). This report includes an assessment of the extent of old growth forest in East Gippsland against which the criteria for its protection can be applied.

The old growth component of the East Gippsland regional assessment is based on the information compiled in *A study of old-growth forests of East Gippsland* by Woodgate *et al.* (1994) which was jointly funded by the Commonwealth Government and Victorian Government and conducted from 1990 to 1994. This study covers all the old growth assessment requirements under the NFPS and RFA process.

Copies of the Woodgate *et al.* (1994) report can be obtained from the Department of Natural Resources and Environment, Outdoors Information Centre, 240 Victoria Parade, East Melbourne.

3.1.1 The significance of East Gippsland old growth forest

As described in the introduction to this report, East Gippsland contains some of the largest tracts of forest in south eastern Australia. These forests are significant for their diversity of native plants and animals and levels of old growth. East Gippsland is likely to contain the largest contiguous areas of old growth forest in Victoria and is significant in the context of the 'south east corner' biogeographic region as defined by Thackway and Cresswell (1995).

3.1.2 Old growth forest definition

The *National Forest Policy Statement* 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 overmature growth phases.'

The Woodgate *et al.* (1994) definition of old growth which was used as the basis for the old growth assessment in East Gippsland states that:

'Old growth forest is a forest which contains significant amounts of its oldest growth stage in the upper stratum - usually senescing trees - and has been subjected to any disturbance, the effect of which is now negligible.'

The Commonwealth developed an operational definition of old growth for application in the RFA process which was adopted in full by the JANIS in its development of national forest reserve criteria. The nationally agreed definition of old growth is:

'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 a mature forest ecosystem, this data should be used in the assessment of the significance of disturbance effects; and
- Negligible disturbance effects will be evident in most forests by a significant proportion of trees with age-related features and species composition characteristic of the ecologically mature forest ecosystem.

The definition used by Woodgate *et al.* (1994) in their assessment of old growth in East Gippsland is consistent with the national and NFPS definitions.

3.1.3 Joint Commonwealth / State Scientific Advisory Group

The Woodgate *et al.* (1994) report describes twelve important technical requirements of the old growth definition (p. 64). These technical requirements allow the old growth definition to be applied in the field. During the Deferred Forest Assessment process of 1995 the following requirement was questioned by conservation groups:

"If regrowth stages are present they must be 'sparse' (generally less than 10% of the crown cover) of the upper stratum for the stand to qualify as old growth. More regrowth than this probably indicates a greater than negligible (i.e. significant) disturbance."

The scientific validity of this requirement was referred to a Joint Scientific Advisory Group (JSAG) by Victoria and the Commonwealth. The JSAG was asked, in relation to East Gippsland, to:

"advise on whether the Woodgate et al. premise (that for an area of forest to be classed as old growth there should be no more than 10% regrowth) is

appropriate. If it is not, provide advice and reasons on the figure that should be adopted, bearing in mind the range of forest communities."

The JSAG recommended adoption of the 10% regrowth crown cover rule on the following basis:

- the definition used by Woodgate et al. (1994) was conservative in that it permitted up to 90% mature trees, as distinct from late mature and over-mature trees, to be included in the classification of old growth forest;
- field transects and inspections by Woodgate et al. (1994) suggested that regrowth crown cover of more than 10% was almost always associated with significant unnatural disturbance; and
- expanding the regrowth crown cover limit to the next identified level of 50% would be much more likely to include forests that have experienced significant disturbance than it would be to include additional old growth forests.

JSAG also noted that at least 53% (50% for Jacobsian types, 57% for non-Jacobsian types) of the area of forest that exhibits regrowth crown cover of between 10% to 50% is already protected in reserves.

Two further issues were originally to be referred to the JSAG in accordance with the Interim Forest Agreement. The first of these was raised by conservation groups and related to the definition of old growth forest and the way that natural disturbance (wildfire) was treated in the study undertaken by Woodgate *et al.* The second issue related to the appropriate levels of protection that should be afforded to old growth in the Lowland Forest and Damp Forest ecological vegetation classes in East Gippsland.

The definition of old growth forest that has been agreed between officials (see Section 3.1.2) places more importance on the physical characteristics and ecological functioning of forests than on the origin of disturbance and wildfire is treated in the same way as human-induced disturbance. This resolved the issue relating to the treatment of wildfire and, therefore, JSAG consideration was not required.

During the Deferred Forest Assessment process there was disagreement about the levels of protection required for Lowland Forest and Damp Forest old growth. Agreement between officials at a national level on the appropriate levels of protection that should be afforded to Lowland Forest and Damp Forest old growth was reached in the JANIS deliberations. As a consequence, this issue was not referred to the JSAG.

The full findings of the JSAG are contained at Appendix I to this report.

Implications of the JSAG Decision

As a result of the JSAG findings no further analysis was required on the Woodgate *et al.* (1994) old growth forest data layer.

JSAG noted that, although the reference was specific to East Gippsland, its decision could have implications for CRAs and RFAs conducted in other regions, both in Victoria or in other States, where forest types were of a similar nature to those in East Gippsland and the Woodgate *et al.* (1994) interpretation would be applicable.

Further JSAG findings that have implications for future old growth studies are as follows:

1. JSAG recommended that before the Woodgate *et al.* (1994) protocols are used to classify old growth forest in other Victorian CRA regions, they should be validated using explicit, repeatable procedures. There is also a need for scientifically and field-based validation of the aerial photo interpretation typing of old growth forests in East Gippsland;
2. Any system of classification is subject to error. Without validation, it is not possible to gauge precisely the magnitude of error and hence the risk of failing to identify areas of old growth. JSAG is satisfied that, in the East Gippsland study, the magnitude of error is reasonably low, given the extent of field calibration;
3. In addressing the Term of Reference, JSAG considered that the next major step in clarifying our understanding of old growth forest would involve an examination of the temporal dynamics of individual vegetation types to clarify their successional processes and to establish specific rules for identifying old growth; and
4. In an Australian context, a scientifically and field-based investigation of other ecological attributes of old growth forest, listed in Appendix G of Woodgate *et al.* (1994) is necessary to further explore the relationship between those attributes and 'old growth'. JSAG noted that in the absence of this latter investigation, the approach taken to identify old growth in East Gippsland was deliberately chosen to be conservative. JSAG considered that this same approach is appropriate in other regions until the results of such research are available.

3.2 Description of old growth forest assessment methodology

3.2.1 Overview of methodology

The Woodgate *et al.* (1994) report describes in detail the methodology used to map old growth forest in East Gippsland. The overview below is taken from the summary of that document.

The survey parameters used to delineate old growth characteristics in the study were growth stage and crown cover of the upper stratum, forest type (dominant species, density and height), ecological vegetation class and disturbance type and level. Most were mapped using remote sensing techniques, field checking and the collation of archival records.

The growth stages defined in the study were regeneration, regrowth, mature and senescing. Each growth stage was identified and mapped by aerial photograph interpretation (API) and ground checking. In certain low environmental site quality forest types where senescing growth stages could not be discriminated from mature growth stages using aerial photograph interpretation (API), mature dominated growth stages were assumed to contain significant amounts of the oldest growth stage (see section 3.2.2 below).

Eight disturbance types were comprehensively researched from existing records and mapped for the study area. These are listed in the data audit section below.

Using the Woodgate *et al.* (1994) definition, the two primary characteristics which were pre-eminent in delineating old growth forests were growth stage and disturbance level. This is consistent with the NFPS and national definitions of old growth forest.

The information gathered during the study was entered into a geographic information system (GIS) and analysis rules were developed to describe forests according to their disturbance level, growth stage, ecological vegetation class and forest type. The disturbance levels comprised undisturbed, negligible natural, negligible unnatural, significant natural and significant unnatural disturbance.

Old growth forest was then delineated as forest of the oldest expression that exhibited negligible disturbance or was undisturbed for a particular site.

3.2.2 Growth stages in eucalypt forest

At different stages in their development, trees can exhibit different forms or growth stages. Jacobs (1955) described typical eucalypt growth stages in terms of tree morphologies. The four growth stage categories used by Woodgate *et al.* (1994) (regeneration, regrowth, mature and senescing) were based on Jacobs description but were modified according to the detail evident from 1:40 000 scale aerial photos. These growth stages were apparent from API in most (Jacobsian) forest stands. However, there were some forest stands, termed non-Jacobsian, not exhibiting typical form as described by Jacobs. No growth stage mapping from API was undertaken for non-Jacobsian forests that did not contain eucalypts.

In eucalypt dominated non-Jacobsian stands senescing features were not apparent from air photos and the forest stands could only be classified as 'regrowth' or 'mature'. Subsequent field inspection of these forests indicated they were of a more senescent growth stage than the API classification suggested. As part of the final old growth analysis, mapped mature growth stages in these eucalypt dominated non-Jacobsian stands were reclassified to senescing.

3.2.3 Private land

Private land was not included in the old growth assessment. Private forest was assumed to be significantly disturbed due to the potential for repeated selective logging, grazing and agricultural clearing and the lack of comprehensive records to indicate otherwise.

No further assessment of old growth is proposed to be conducted on private land in East Gippsland because:

- the area of private forested land is small;
- the extant potential areas of old growth forest on private land are small and isolated and likely to be significantly disturbed by grazing, burning and selective logging; and
- an assessment of disturbance impacts in private forests would require extensive on-ground checking which would be impractical.

3.2.4 Assessment outputs

The Woodgate *et al.* (1994) study identified old growth forest on 21% (224 362 hectares) of public land in East Gippsland and occurring in 26 of the 33 forested EVCs. About 75% of the identified old growth forest occurred in just three of these EVCs; Shrubby Dry Forest (88 013 hectares), Damp Forest (42 749 hectares) and Wet Forest (36 585 hectares). Table 3.1 provides a breakdown of area of old growth forest by EVC.

Map 13 shows the distribution of old growth, negligibly disturbed and significantly disturbed (natural and unnatural) forest, freehold land and rainforest. Rainforest is identified separately as no growth staging using API was undertaken for these forests that do not display many of the typical age-related features found in eucalypt forest.

3.3 Old growth data review

Under the RFA Scoping Agreement the Victorian Government and Commonwealth Government agreed to the completion of a data audit, evaluation and accreditation for all CRA regions using existing data sets where they meet the required standard.

An old growth CRA data review has been undertaken for East Gippsland. The data review examined each data layer used in the Woodgate *et al.* (1994) study as an input to derive the old growth layer. The layers consist of ecological vegetation classes, growth stage and crown cover projections, structural forest type and forest disturbance. The layers were analysed through a GIS to determine the extent of old growth forest.

The following section describes the data layers, how they were collected and utilised in the old growth study and an assessment of their suitability for the old growth assessment. This information is drawn from the Woodgate *et al.* (1994) report and personal communication with study team members.

3.3.1 Ecological vegetation classes

A full description of the methodology used to derive EVCs and a review of their suitability as a surrogate for biodiversity is described in the biodiversity section of this report.

In the old growth assessment, the area of old growth was determined for each EVC. EVCs also provided an ecological context for the assessment of disturbance impacts on forest stands, for example, to help establish the significance of broadscale grazing records on EVCs with palatable flora versus EVCs with unpalatable flora.

3.3.2 Growth stage and crown cover projection

Growth stage refers to the developmental stage of the tree based on its physical form. Distinctive features of tree crowns at different growth stages allow key growth stages (regrowth, mature and senescing) to be identified from aerial photographs. Crown cover refers to the total proportion of a forest stand's area which is occupied by the canopy crowns. This can also be an indication of the developmental stage of forest stands, and of their disturbance level.

In the old growth study, the crown cover and relative proportion of each growth stage in the upper stratum was categorised and mapped for each homogeneous forest stand using API of recent 1:40 000 aerial photographs. The relative proportion of the growth stages in the upper stratum were classified into dominant (>50%), co-dominant (30 - 50% in equal proportion to other classes) and subdominant (11 - 50% with lesser crown proportion than other classes), sparse (<10%) and absent.

The three growth stages were able to be identified from API in most vegetation classes. In some forest types which either did not exhibit typical growth stage forms or which had crowns which were too small to permit discrimination between mature and senescing growth stages, only regrowth and mature growth stages could be identified.

Ongoing field checking of the crown cover and growth stage information was undertaken to calibrate aerial photograph interpretation. While no statistically valid verification was undertaken for this data layer, project officers undertaking aerial photo interpretation were required to spend one day field checking for

every four days interpreting. This was undertaken to ensure accuracy and consistency between interpreters.

The growth stage mapping was used in the old growth assessment to estimate the relative maturity of forest stands, and was also used with crown cover estimates to identify significantly disturbed forest stands.

Suitability of the growth stage and crown cover layers

In summary the issues that affect the suitability of the API methodology include the following:

- Although API was confirmed in the field, field checking was generally restricted to areas accessible by road or track;
- Field inspection indicated that senescing features apparent from the ground were not always fully apparent from an aerial perspective and as a consequence the actual proportion of senescing trees was sometimes underestimated. Regrowth or growth restricted crowns beneath the overstorey are difficult to detect from API and were specifically excluded from the mapping;
- As the 'mature' class embraces a long period of forest development, 'older mature' forests were not differentiated from 'young mature' forests;
- The relatively small scale of the air photos resulted in the API being most accurate in Jacobs forests (see section 3.2.2) with large crowned trees. In non-Jacobsian forests with small crowns (for example, on fire-prone and low site quality locations in Shrubby Dry Forest), no differentiation between senescing and mature growth stages was possible from air photos. On-ground inspection revealed that the senescing features sensu Jacobs (1955) did not develop in the lower height classes of some species in these EVCs and that senescence and death occurred in Jacob's mature growth stages for these species;
- Some stands which were mapped as senescing were likely to have been of a younger growth stage subject to the influence of recent wildfire. However, wherever possible the mapping attempted to indicate recently fire affected crowns;
- No assessment of growth stages of non-eucalypt forests was attempted; and
- There was no field checking of forest type or growth stages on private land.

Despite the limitations discussed above, field checking and ground truthing during the old growth study confirmed the value of API as a technique for mapping growth stages and crown cover. Given the scale of the maps and photographs, the time available, the large area surveyed and the presentation scale of the results, the survey has produced a comprehensive and reliable database of forest growth stages and crown cover.

The use of API to identify forest growth stages is now widely accepted as being practicable and cost effective. The accuracy of this method has been subject to scrutiny during the Interim Assessment Process in New South Wales and in field trials of the technique in south eastern Queensland. These studies have proven the accuracy of the technique.

The East Gippsland growth stage layer, although not itself subject to statistical validation, was subject to ongoing calibration and field checking throughout the study. The growth stage and crown cover layer is suitable for the purposes of old growth assessment.

3.3.3 Forest disturbance

Forest disturbances with the potential to alter the attributes of forests were identified as part of the study. Extensive research of historical and contemporary records was undertaken to map the extent and severity of identified forest disturbances (agricultural selection, grazing, mining, dieback, clearfell and selective harvesting, wildfire, fuel reduction burning). Roading and other cultural features were also entered into the GIS. The reliability and quality of the information gathered on disturbance varies between the layers but is the best available.

The disturbance layers were incorporated in a GIS. After extensive analysis using all records, API verification and modelling of disturbance effects through EVCs, forest stands were assigned a disturbance level and origin. Significant disturbance had markedly affected one or more of the following attributes: growth stage, crown cover, floristics, relative abundance or ecological processes.

The origin was either natural or unnatural. Those with minor disturbance impacts were classified as having negligible disturbance. 'Undisturbed areas' were identified where no verified form of disturbance was described, although it is assumed that no area within the study areas is truly undisturbed. It is important to note that a conservative approach was used when assigning disturbance, in that API evidence of disturbance was used to validate any record of logging and wildfire and EVC/forest type mapping was used to validate any record of logging or grazing. If a record of disturbance existed for a site but was not confirmed it was disregarded.

Agricultural selection

Agricultural clearing information was researched from archival files. This information was entered into a text database and into the GIS. This data included information on the location, extent and approximate period of clearing for each agricultural selection. The current extent of tree clearing on freehold land was determined from 1992 Landsat TM satellite imagery.

Grazing

Information on significant grazing leaseholds was researched from a variety of sources including historic plans and maps, archival Crown Lands and Survey files, Forests Commission records and Victorian Government Gazettes. The information was collated as text into a database. Data on leases greater than 400 hectares were entered into the GIS at a scale of 1:100 000.

This information was based upon administrative boundaries and did not account for factors such as slope and steepness which are likely to preclude grazing. However, the information was refined in the disturbance analysis using growth stage and crown cover data, and using rules based on the predicted palatability to stock of each EVC.

Mining

Information on historical mining was obtained primarily from the records of the Geological Survey of Victoria, reports of the former Department of Minerals and Energy, and from a range of secondary sources. This information was entered as text into a database and into a GIS. The database information indicates the location, type and dates of the operation of the mines.

Mining records indicate only the point location of mines. The analysis therefore included an arbitrary zone of disturbance of 500 metres around reef mines and a 100 metre buffer on either side of streams within 500 metres of alluvial mines.

Mining areas within this arbitrary zone were categorised as having significant unnatural disturbance.

Dieback

Dieback from *Phytophthora cinnamomi* was mapped in 1973 by the former Forests Commission of Victoria using aerial photography and field inspection.

The aerial photos were taken in a dry year. Normally wet or damp forest trees were suffering from drought stress during this time. Drought stress caused foliage dieback and death, producing a similar response to that of fungal related dieback. It is therefore likely that the extent of dieback from *Phytophthora cinnamomi* was overestimated.

Timber harvesting

Information on historic logging in the study area was obtained from a number of sources dating from the 1940s including 1940 air photos (at 1:40 000), logging maps and detailed log allocation records by licence area (1945-1970). Clearfelling from the 1970s and 1980's were interpreted using 1:100 000 Landsat MSS imagery. Clearfelling from the late 1980's to 1992 were interpreted from 1:100 000 satellite imagery (Landsat TM transparencies).

Historical selective logging records were considered to be unreliable and were verified against EVC, growth stage and crown cover mapping. EVCs with merchantable species on moderate to high quality sites were categorised as being significantly disturbed if the growth stage or crown cover data confirmed logging records. Other EVCs with non-merchantable species or merchantable species on low quality sites were assumed to be negligibly disturbed.

Wildfire

Wildfire information was gathered from Department of Natural Resource and Environment records, which recorded the boundaries of most wildfires since 1960, and the severe 1952 and 1939 wildfire boundaries. This information was compiled and digitised into the GIS at a scale of 1:100 000.

Wildfire records were not considered to be always reliable, and hence the effects of wildfire were assumed to be significant only where they could be confirmed using growth stage mapping or crown damage evident through aerial photograph interpretation.

Fuel reduction burning

It was acknowledged that frequent fuel reduction burning can degrade old growth values. The fuel reduction burning areas were identified from fuel reduction burning maps, at scales of 1:100 000 to 1:126 000. These records only indicated the frequency and perimeter of the burn, not the actual intensity or total area burnt.

Due to these inadequacies in the data, all forest stands with a record of fuel reduction burning were assigned either a negligible or no disturbance category, which depended on the predicted flammability of each EVC.

Suitability of disturbance layer

The study involved 18 months of detailed research to build up a picture of the nature and extent of disturbance in the East Gippsland region. However, given the limitations of available records, the reliability of the disturbance layers listed above is variable. It is therefore likely that in some cases this has resulted in the

exclusion of potential old growth areas or that some stands with significant disturbance have been included as old growth.

Some field checking was undertaken to verify the disturbance records but this was not comprehensive. However, it is not possible to validate the old growth mapping without further extensive field work.

In the assignment of the final disturbance classes to forest stands (which incorporates all the information contained for each disturbance type listed above), extensive field checking was carried out iteratively when assigning disturbance classes to given areas. The impact of certain disturbance types was also assessed using expert opinion, for example, to determine the impact of selective logging on particular EVCs.

In recognition of the level of field checking and expert opinion that were utilised to interpret and refine the available historical information, the disturbance levels layer is considered suitable for use in the old growth forest assessment.

3.4 Old growth forest reservation analysis

3.4.1 National reserve criteria

The proposed JANIS national reserve criteria (JANIS 1996, section 1.4) states the following in relation to reservation of old growth forest:

'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 of the draft JANIS reserve criteria.
2. For other forest ecosystems, a minimum of 60% of the old growth forest identified at the time of assessment should be protected, with higher levels of protection wherever 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; and
 - specific community needs for recreation and tourism.

3.4.2 Old growth reservation levels

Table 3.1 provides information on the reservation status of the old growth forest in each ecological vegetation class. This table shows the amount of old growth protected in legislated parks and reserves, Special Protection Zones (SPZs) and

by prescription (such as streamside and rainforest buffers). Descriptions of the conservation reserves and forest management zones in East Gippsland are given in section 1.4 and 1.5 of this report.

The State forest Special Protection Zone has been divided into three sub-categories as follows:

1. Mostly large and contiguous areas designed for conservation of specific values and with boundaries based on reserve design principles.
2. A network of connecting areas (200 - 400 metres width) based around riparian zones (including Heritage River corridors) but also including wildlife corridors on ridges and crossing between catchments.
3. Areas protected by forest management prescriptions. These include all permanent streams and all rainforest stands plus adjacent buffers of at least 20 metres, and all heathland EVCs (includes Sand Heathland, Clay Heathland, Wet Heathland, Riparian Scrub Complex and Treeless Sub-alpine complex) plus a buffer of at least 40 metres.

Table 3.2 provides information on the area and protection of old growth forest for the geographical representation units. The area figures in this table represent the total area of old growth for each EVC in each geographical representation unit. The corresponding percent protection figure refers to the percent of that area protected in conservation reserves or in SPZs (components a and b). Areas protected by prescription (component b of the SPZ) are not included in this table.

Table 3.1 and 3.2 were derived from the EVC, old growth forest, land tenure and forest management zone data layers held by the Department of Natural Resources and Environment. The EVC and old growth forest data was originally produced by Woodgate *et al.* (1994) and the forest management zones as part of the East Gippsland Forest Management Plan (DCNR 1995a).

Some refinements to the EVC layers (both current and pre-1750 layers) have been made during the pre-1750 mapping exercise for this report. However, the growth stage and disturbance information has not been updated and, as indicated in above, the original old growth data layers have been used to devise both Table 3.1 and 3.2. Consequently there are minor differences in the total EVC areas between this table and the pre-1750 representation (Table 2.13).

Minor differences between the figures in this table and those in the East Gippsland Forest Management Plan and Woodgate *et al.* (1994) are due to corrections made to public land tenure information and data processing methods since publication of those reports.

Results

The analysis shows that, for most EVCs in the region, the protection of old growth generally satisfies the proposed nationally agreed reserve criteria. However, the level of old growth protection in some EVCs will need to be considered as part of the development of RFA options.

In relation to the representation of old growth across the region, Table 3.2 shows that examples of all old growth occurrences in each of the eleven geographic units in the region are represented in the current reserve system.

Wilderness

- 4.1 Introduction
- 4.2 Data
- 4.3 Methods
- 4.4 Results
- 4.5 Conclusion

4.1 Introduction

For the purposes of the Comprehensive Regional Assessments (CRA), Victoria has been divided into five regions, East Gippsland, Central Highlands, the North East, Gippsland and the West. However, in the assessment of wilderness it is considered appropriate to undertake the analysis in the wider regional context of the forests of Eastern Victoria, given their broad similarity. The report *Wilderness Assessment of the Eastern Victorian Forests* (1996) analyses wilderness across the first four CRA regions noted above. A summary of the report follows.

The assessment has been undertaken using the methodology developed by the Australian Heritage Commission (AHC) through the National Wilderness Inventory (NWI) and is essentially the same as that undertaken as part of the Deferred Forest Agreement (DFA) for Victoria in 1995. The only difference between this analysis and that undertaken for the DFA relates to the inclusion of Wilsons Promontory. Given that this report covers the whole of Eastern Victoria, the inclusion of Wilsons Promontory in the analysis was considered appropriate.

4.2 Data

The data used in the analysis was that used in the NWI and includes a wide range of information and data sources. The distance related indicators (settlement, access and apparent naturalness) are essentially current AUSLIG digital mapping data updates with additional information in the detailed study areas. The disturbance information, that provides the base data for the biophysical naturalness indicator, is of variable quality and lineage across the region studied in this project.

In East Gippsland and the Central Highlands the disturbance information is that used in the detailed old growth surveys of the region with a currency of April 1993 and December 1993 respectively. For the remainder of the region the best available systematic disturbance information was most recently updated in 1986. Although this represents the best available information its currency should be taken into consideration when interpreting the results of the analysis.

4.3 Methods

The concept of wilderness embraces measures of remoteness, naturalness and lack of disturbance. The National Forests Policy Statement (NFPS) states that:

'forested wilderness areas will be protected by means of reserves developed in the broader context of protecting wilderness values of all lands.' Consistent with this, non-forest vegetation types have been included where they form a mosaic within largely forested wilderness identified in this current assessment.

The approach taken in this assessment has been to first identify and delineate areas of high wilderness quality and then calculate the percentage of these areas within the existing reserve system.

The NWI methodology developed by Lesslie and Maslen (1995), produces a database of 'wilderness quality' across the region. This is undertaken by measuring the variation in wilderness quality across the landscape using four wilderness quality 'indicators' that represent the two essential attributes of wilderness; remoteness and naturalness (See *Wilderness Assessment of the Eastern Victorian Forests* 1996).

To identify areas with high wilderness quality, the criteria used in this assessment were areas with a NWI wilderness quality of greater than or equal to 12 and larger than 8 000 hectares. In the East Gippsland and Central Highlands analyses, specific thresholds were also applied on the four wilderness quality indicators.

Boundaries were delineated around areas that satisfied these criteria. Wherever possible, the boundaries adopted followed catchment divides or other topographic features. Where such features did not prove suitable, boundaries were drawn that reflected the influence of nearby features affecting wilderness quality, such as roads.

4.4 Results

This assessment of the eastern Victorian forests identified 18 areas that meet the threshold requirements, nine of which are within the East Gippsland Region (see Table 4.1).

Both the total area and the area included within the existing legislated reserve system was calculated and is presented in Table 4.1. Those areas included within the existing legislated reserve system were considered to be protected.

4.5 Conclusion

In the Eastern Victorian forests region, 95% of the total area delineated as significant for high wilderness quality is protected in the existing reserve system. The proposed national reserve criteria specify that 90%, or more if practicable, of the area of high quality wilderness that meet the minimum area requirements should be protected in reserves.

Table 4.1: Summary of protection of areas of high quality wilderness

Area	Total Hectares	Reserve Status	Hectares Reserved
East Gippsland			
Cape Howe	7,120	Full	7,120
Sandpatch	28,540	Part	17,150
Petrel	10, 960	Full	10, 960
Tamboon	5,000	Full	5,000

Coopracambra	28, 050	Part	25,460
Upper -Brodribb	5,310	Part	4,850
Tingaringy	25,250	Part	25,060
Snowy	54,560	Full	54,560
Buchan	12,580	Full	12,580
Areas elsewhere in eastern Victoria			
Avon	39,650	Full	39,650
Mount Darling/Snowy Bluff	40,400	Full	40,400
Razor/Viking	15,700	Full	15,700
Wabba	19,700	Full	19,700
Indi Addition to Pilot and Davies Plain	24,300	Full	24,300
MacAlister	33,300	Full	33,300
Yarrarabulla Creek*	13,000	Full	13,000
Dartmouth	26,950	Part	20,370
Wilsons Promontory	33,228	Full	33,228
Totals	423,688		402,388

* Yarrarabulla Creek Area. Part of this area is not included in a legislated reserve but is covered by an Order in Council requiring its protection as a Remote and Natural Area.

National Estate

- 5.1 Introduction
- 5.2 Data review
- 5.3 Consultation process
- 5.4 Discussion
- 5.5 Conclusion

5.1 Introduction

Background

The Register of the National Estate is a national register of places in Australia which have heritage value. Heritage values are features which have cultural or natural significance to the national, regional and local community as defined in section 4 of the *Australian Heritage Commission Act 1975*.

Many forest areas are listed on the Register of the National Estate. The Commonwealth Government, in making decisions concerning forests, such as the granting of licences to export woodchips, must consider the National Estate.

A regional assessment model for identifying the National Estate was developed in 1991-92 by the Australian Heritage Commission (AHC), in co-operation with the Western Australian Department of Conservation and Land Management (CALM), for the Southern Forest Region of south-west Western Australia, (AHC and CALM 1992). A regional assessment has been completed for the Central Highlands in Victoria and the East Gippsland study is the third regional national estate assessment.

The East Gippsland assessment was coordinated by a steering committee consisting of senior Victorian Department of Natural Resources and Environment (DNRE) and AHC staff, and also including observers from the Land Conservation Council (LCC) and the Department of Aboriginal Affairs Victoria (AAV).

The objectives of the study were to:

- identify those areas in East Gippsland which merit listing in the Register of the National Estate;
- assess the representation of national estate values in the existing nature conservation reserve system and other protective land tenures;
- involve the community in the identification of its heritage;
- inform all sectors of the community about the study (that is local people and organisations, industry groups, conservation organisations and unions);
- be open and transparent about process, methods and decisions;
- encourage a better understanding of heritage, the AHC's role and processes; and
- encourage a stronger understanding of management and conservation measures.

This section provides a summary of the major findings of the National Estate East Gippsland project.

To gain a full understanding of the project, methods and outcomes, and the assessments for the RFA, the following reports should be consulted:

- *National estate values in East Gippsland, Victoria (AHC and DNRE 1996b);*
- *Methods papers: East Gippsland national estate assessment; Volume one:- Natural values (AHC and DNRE 1996c); and*
- *Methods papers: East Gippsland and Central Highlands Joint Forest Projects; Volume two: Cultural values (AHC and DCNR 1994).*

Approach to the assessment

The study involved two distinct phases, the identification phase, followed by the protection analysis phase.

The **identification phase** involved assessing the available information against the national estate sub-criteria to determine areas of value. The major components of this phase were: determining the appropriate methods; applying the sub-criteria to the data available; and applying thresholds of significance.

The **protection analysis** involved an assessment of each national estate value and its sensitivity to various types of disturbance. For example, significant historic fabric may not exist at the site of a major event, such as a bushfire disaster, so the place will retain its significant associations despite changes to the site, (whether another bushfire or the building of a visitors' centre). However, old growth forest values are considered sensitive to harvesting, roading or wildfire.

5.2 Data review

Much of the data came from extensive data sets assembled by DNRE over many years. These were supplemented by consultancies and special projects, and through community involvement. Where possible, one source of data was used to complement or confirm another. A description of the data sets used in this assessment is at Appendix B.

Seven broad types of data and information were used in the assessment:

- previous scientific studies;
- site specific data obtained from field observation;
- data collected from mapping, usually aerial photo interpretation;
- existing databases of cultural heritage places;
- information derived from models, using limited ground data;
- studies conducted by consultants;
- community information; and
- information from experts.

The data sets used in the study were:

- ecological vegetation classes mapping;
- disturbance mapping;
- the Flora Information System;
- the Atlas of Victorian Wildlife;
- the forest growth stage data set;
- the DNRE Historic Places Section Database;
- the visual management system;

- the heritage workshops;
- the Aboriginal Affairs Victoria database; and
- the Aboriginal oral history/ethno-history data.

Ecological vegetation classes

A full description of the methodology used to derive ecological vegetation classes (EVCs) and their suitability as a surrogate for biodiversity is described in the biodiversity section of this report.

The AHC recognises that any vegetation mapping exercise has limitations and the EVCs are no exception. EVCs were recognised as the best available mapping units at the time of the assessment.

Disturbance data sets

A full description of the methodology used to derive disturbance data sets for the East Gippsland old growth assessment is described in section 3.3 of this report.

Validation of some disturbance information was required and undertaken during the period of the national estate assessment. Of particular note were the discrepancies between some cadastral based information (especially vegetation clearance) and more recent air-photo interpretation.

The information contained in the disturbance data sets was also used as baseline information for the assessment of historical values.

Flora Information System

The Flora Information System (FIS) is a botanical database containing floristic data across Victoria. These include locations, including quadrats, and species lists derived from a variety of surveys conducted within the East Gippsland region. Records from formal survey quadrats (usually 30 metres), plus incidental site records, were used in the study.

Although there is a comprehensive data set for East Gippsland, there is a sampling bias toward State Forest areas, where data collection has been undertaken during pre-logging surveys. Information is also stored at varying levels of accuracy. Non quadrat information was not accurate enough to include in most of the analyses undertaken. To redress the sampling bias, additional information from scientific reports was incorporated where possible.

Atlas of Victorian Wildlife database

The Atlas of Victorian Wildlife is a database of incidental and survey records of Victorian fauna. Information is available for mammals, birds, reptiles and amphibians, threatened freshwater fish and a small number of threatened invertebrates. There are over 1.5 million records from a range of sources, including DNRE fauna surveys; incidental records from rangers and other field staff; museums; field naturalist clubs; natural history journals and the public. The Atlas includes records from the many fauna surveys undertaken in East Gippsland.

As with the Flora Information System, the Atlas stores information of variable accuracy. For this reason, only post-1982 records with precise location information were used in the national estate assessment. The fauna data is again

somewhat biased and more information is available for State Forest due to the data having been collected during pre-logging assessments.

Forest growth stage data set

A full description of the data set and methodology used to derive growth stages for the East Gippsland old growth assessment is described in section 3.3 of this report. This data was utilised for the national estate assessment.

Wetlands database

The Wetlands database contains a range of information on each wetland, including classification into categories and sub-categories (according to salinity, depth, permanence of water and vegetation); total area (hectares), and area of each sub-category for each wetland; information on both conservation status and value; and various types of location data. Within the database, there is an inventory of wetlands greater than one hectare in area.

Historic Places database

The Historic Places Section of DNRE maintains a database of historic places on public land, grouped according to regional historical themes. Most of the East Gippsland historic places on this register had been recorded as part of the review of public land use by the LCC. This was supplemented by the collation of disturbance history in the old-growth study (Woodgate *et al.* 1994). A State-wide register of historically significant sites is also held by the Heritage Council.

Existing registers of historic places within East Gippsland were reviewed to determine the adequacy of data for assessment, and to identify gaps where additional studies would need to be undertaken.

As part of the national estate assessment, a study was undertaken by the Historic Places Section of DNRE (Brady and Perham 1993) to fill gaps in existing lists of heritage sites. Themes covered included mining and quarrying sites and areas, former selection farms, pastoralism and grazing sites, community settlements, and places associated with forest recreation and tourism.

Visual Management System

Information relevant to assessing aesthetic values was not available in a readily accessible form. DNRE utilises a Visual Management System which provides a scenic quality classification for State forest areas. These data were used to assist in determining the methods for assessment of aesthetic value. Detail regarding the method developed for aesthetic value assessment and the limitations of the data set is available in the cultural methods papers.

Heritage workshops

Communities have a wealth of knowledge about heritage, which has not often been tapped by professional organisations. Communities and interest groups also have strong opinions about heritage significance and its conservation.

The agencies, with the involvement of a number of community organisations, have developed a range of ways to involve and inform the public about regional assessment studies. These ideas were implemented through a community participation program.

Heritage workshops were designed to obtain data on national estate values within the region, especially places of social and aesthetic value to communities. Following the workshops, field recording of selected places was undertaken to collect further data for assessment. Information was compiled and returned to

communities for comment and verification. Values identified by the community and assessed to be above the threshold for National Estate have since been entered onto the geographic information system (GIS). Details of the methods are available in *Methods Papers: East Gippsland and Central Highlands Joint Forest Projects; Volume Two - Cultural Values* (1996).

Aboriginal Affairs Victoria database

Aboriginal Affairs Victoria (AAV) maintains a register of Aboriginal places which includes archaeological, traditional, historic, Aboriginal historic and contemporary places. The data are derived from a variety of sources but primarily from field survey and documentary literature. The locations of the sites are generally treated as confidential information.

At the commencement of the East Gippsland assessment there were nearly 800 records of Aboriginal archaeological places in the AAV register. A further study was undertaken by AAV to fill some of the geographic gaps in the existing survey coverage of the region.

Aboriginal oral history / ethno-history

AAV undertook a consultancy, the Aboriginal Historic Places Project, to document all layers of historical records and ethnographic accounts relating to the Aboriginal occupation of the region. This work was also cross-referenced with oral history work with the Aboriginal communities in the study area. Social values and associations with place were documented and assessed. The database compiled by AAV was validated by the Aboriginal communities during meetings held progressively throughout the study. Unfortunately, it has not been possible to complete the identification and assessment of Aboriginal places of National Estate significance in East Gippsland within the time frame of this assessment.

Additional Consultancies

Consultancies were also undertaken on a number of cultural values including forest activity sites, routes of human movement and development of conservation guidelines for the protection of cultural values identified in the study. Additionally, geological and geomorphological values were assessed by a consultant, Mr Neville Rosengren, of LaTrobe University College, Bendigo, and are presented in the Method Papers.

5.3 Consultation process

A Technical Advisory Committee was established for this assessment. The Committee included independent experts, to provide feedback and advice on the methodology and implications for the assessment process. The membership of the Committee is listed in the *National estate values in East Gippsland, Victoria* report.

Additionally, a series of technical workshops were held to help clarify and discuss some specific issues, such as: the assessment of diversity for national estate purposes, and the identification and assessment of 'representative' fauna. These workshops were held in Canberra and Melbourne, and a series of experts from a number of universities, consultant firms and Commonwealth and State agencies attended.

These workshops covered the following areas (see *National estate values in East Gippsland, Victoria* report for detailed references):

- identifying Aboriginal archaeological places;

- Aboriginal archival and oral history;
- identifying and assessing aesthetic value;
- assessing diversity in natural heritage;
- identifying places containing fauna values;
- representative vegetation: identifying natural heritage places which demonstrate the principal characteristics of their class; and
- people's places: identifying and assessing social value for communities.

Five individual Aboriginal community organisations were originally identified as having responsibilities in the East Gippsland Regional Assessment area. These are Moogji Aboriginal Council, Lake Tyers Aboriginal Trust, Gunai Women's Aboriginal Co-operative, Far East Gippsland Aboriginal Corporation and Gippsland and East Gippsland Aboriginal Co-operative. A series of meetings were held with these groups during 1993/94. In 1995 an organisation known as the Gunai/Kurnai Heritage Land Council was incorporated, and more recent consultations have taken place with this body.

Discussions are presently underway with the Gunai/Kurnai Heritage Land Council on its possible involvement in furthering the process of assessing Aboriginal values, the next stage of which is the development of "statements of significance" for sites/areas of importance to local indigenous people.

5.4 Discussion

The detailed assessment of national estate places undertaken included a wide range of values addressing aspects of both the natural and cultural heritage of the forests of the region. A full list of values identified is included in the *National estate values in East Gippsland, Victoria* report.

This section is a summary of the assessments undertaken. The broad themes assessed are introduced and a summary of the reserve and sensitivity analyses are included. It is stressed that this section is a summary and should not be considered without reference to the more detailed reports referred to earlier.

Extensive natural values

East Gippsland is typified by large areas of undisturbed vegetation both in the coastal zone and in the more rugged terrain of sub-coastal ranges and plateaux. Extensive montane and small sub-alpine areas at Tingaringy and Nunniong contribute to the diversity of ecosystem types and the high species diversity of the study area. The lack of fragmentation of native vegetation in the region means that extensive areas occur as natural landscapes, old-growth forests and places with high wilderness quality.

Flora

The large areas of undisturbed vegetation, combined with strong biogeographic influences (such as cold sub-Antarctic ocean currents, warm temperate influences, rugged topography including high altitude areas and a distinct climate) distinguish East Gippsland as a place of major biogeographic significance at a continental scale. This is reflected in extensive refuge areas for temperate flora and the large number of species of flora that are endemic, rare and threatened, or at their distributional limits (including disjunct populations).

Coastal and montane areas, in particular, appear to be major zones of flora speciation. Similarly, the lack of disturbance in many areas enables ecological processes, such as vegetation succession, to operate unimpeded at a landscape

scale and provides many intact examples of plant communities that have been extensively impacted by European settlement elsewhere.

Fauna

Limited forest fragmentation and high diversity of vegetation communities in East Gippsland make the area outstanding for fauna. Values for all major fauna groups were assessed. Insufficient information was available on invertebrates except for the endemic crayfish. Fauna values have frequently been identified as small areas of key habitat.

Places important for endemic fauna species and rare and threatened fauna species were assessed. The analysis highlighted the special importance to fauna of coastal areas, moist forests and mountain streams.

As much of the fauna of East Gippsland breeds within the region, the associated analysis focussed on colonial roosting and breeding sites. This included breeding colonies of waterbirds and seals on the coastal islands and estuaries, roosting camps of flying foxes near Mallacoota, and roosting and maternity sites for bats, mainly in the limestone areas around Buchan and Murrindal.

Many fauna values were related to ecological vegetation classes (EVCs). For example, places identified as important flora refuges because of the plant communities involved (e.g. Warm and Cool Temperate Rainforest), also had importance for fauna. Their importance for invertebrate fauna values was recognised but not assessed.

Places of unusually high fauna species richness within the region were identified. These are generally along the lower reaches of rivers and in coastal areas.

Other natural history values

Places important as wetlands, as research, teaching or benchmark sites, and as sites of geological or geomorphological significance were also assessed.

As East Gippsland is relatively remote, little use has been made of the area for research or teaching. The study sites for Long-footed Potoroo, the Silvicultural Systems Project site at Cabbage Tree and educational sites at Buchan, Cape Conran and Mallacoota are notable exceptions. The study also identified one Reference Area in East Gippsland, plus research sites and important type localities for a range of natural values as having national estate values. These sites provide a series of important scientific datum points and an opportunity to study a range of natural values.

The number of coastal wetlands identified reflects the relative lack of disturbance in the coastal zone of East Gippsland and the presence of major estuary and lagoon systems. The study area contains several outstanding marine/intertidal complexes, especially in the Lower Snowy River Floodplain. Many of these wetlands are in excellent condition and some in the far east such as Lake Barracoota and Lake Wau Wauka (associated with dune systems in Croajingolong National Park), are virtually undisturbed.

The sites of geological and geomorphological importance reflect the diversity of landforms in the region. These include the active depositional landforms along the coast relating to the Snowy River flood plain and extensive coastal dune fields. Other features include the ancient and heavily weathered sites in the Snowy and Genoa River gorges and the Errinundra escarpment, which are dominant features within the landscape. They also include smaller limestone and periglacial features,

and landforms from tectonic and sedimentary developments on the continental margin.

Cultural values

The most extensive cultural value identified is associated with areas of high aesthetic value. This generally relates to coastal environments, valleys, forest areas, intact catchments, scenic rivers, as well as mountain ranges and gorges. The Buchan Caves Reserves, a major recreational area, is important for aesthetic, social and historic values.

Several historic landscapes were also identified. The largest are associated with the rich history of Mallacoota Inlet and the Lake Tyers/Lake Bunga area, as well as mining in the Deddick and Bonang districts. Smaller farming landscapes are associated with the Genoa River Flats, Brodribb Drainage Scheme area, Bete Bolong, Wangarabell Valley, Wairewa Valley and the Wallagaraugh River.

Throughout the region there are major routes which have been important in the exploration and settlement of the area, including both historic and more ancient Aboriginal routes. These include the Snowy River Road and the Bairnsdale to Orbost Railway.

A range of smaller sites are located across the region, including those associated with the timber industry and early European settlement. As well, a scatter of smaller sites which are important for aesthetic values include waterfalls, bays, river sections and caves.

The active participation of local Aboriginal communities is regarded as an integral and essential part of the identification and assessment process for Aboriginal places, especially in relation to verification of levels of significance. Unfortunately, it has not been possible to complete the identification and assessment of Aboriginal places of national estate significance in East Gippsland within the time frames of this study. Neither the proposed method nor any results have therefore been included in this assessment report.

The protection of national estate values in East Gippsland

One of the objectives of the national estate assessment was to assess the protection of all national estate values within the study area. The effectiveness of the protection depends on the nature of the value. For example, the conservation of historic mining sites can be undertaken through sympathetic management in timber production areas, while conservation of places with high wilderness quality is best ensured through their inclusion in the dedicated reserve system.

The first step in assessing the protection of national estate values was to determine which values were sensitive or potentially sensitive to disturbance. The second step was to determine which reserve types provided protection for these values (see *National estate values in East Gippsland, Victoria* report). The third step was to determine the current reservation status of these values. The final step was to determine which legislative mechanisms provide additional protection for these values.

Sensitivity of values to disturbance

The sensitivity of identified national estate values can be gauged from the factors used in their identification and the setting of thresholds of significance. In many instances, disturbance of one type or another has been integral to the application of the threshold, for example, natural landscapes and principle characteristics of class.

The focus for the assessment is timber harvesting, but various other types of disturbance occur in the study area which affect national estate values. Many EVCs which occur in the coastal zone in particular do not contain timbers which are harvested for sawlogs, but some may be subject to removal of trees for fence posts and poles. In coastal areas recreation impacts, such as damage from boat wash, vehicles and concentrated pedestrian movement affect a range of values from geomorphological features through to aesthetics.

Broadly speaking there are three levels of sensitivity recognised:

1. Firstly, some natural values, are sensitive to a wide variety of disturbance, notably natural landscapes, wilderness, and old growth forests;
2. The second category is those values that are relatively resilient over time to disturbances of the type likely to occur in the area. The modelled flora or fauna richness (sub-criterion A3), and the majority of values associated with geological or geomorphological sites fall into this category; and
3. The third category is especially applicable to species-related values such as rare fauna, and endemic flora species. In these values the response to disturbance varies with the individual species. The only valid assessment of sensitivity for these value is at the species level.

Reserve analysis

This analysis ascertains the extent to which a particular value occurs within the conservation reserve system. Values of a local nature, such as localities for rare fauna, have not been included. The reasons were firstly that sensitivity to disturbance varies depending on the species, and secondly that the proportion of known locations in reserves is not necessarily a good indication of the conservation status of the value. Tables 5.1 - 5.3 indicate the reserve status of natural values in the study area.

Summary of protection of the National Estate

Tables 5.1 - 5.3 summarise the reserve status of natural values identified in the assessment. Jointly, the reserve status and the application of other legislative mechanisms provide a guide to the level of protection necessary for those values that are sensitive to disturbance.

Map 14 shows the areas identified as having national estate value. The map outlines;

- Areas of high wilderness quality (see section 4);
- Areas that contain extensive natural values; and
- Areas or locations of cultural or restricted natural value.

Table 5.1: Reserve status of natural values (excluding D1 flora values).

National Estate Value and Sub-criterion	National Estate Value on Public Land (ha)	Area in Reserves (ha)	Percent of Value in Reserves
Landscape evolution (A1)	89,100	84,490	94.8
Existing landscape processes (A2)	62,210	61,330	98.6
Places with unusually high landscape diversity (A3)	55,990	55,140	98.5

Rare, uncommon landscapes (B1)	13,640	13,550	99.3
Geological and geomorphological features characteristic of their class (D1)	11,660	11,560	99.1
Places with unusually high flora species richness (A3)	53,330	29,810	55.9
Places with unusually high fauna species richness (A3) - Forest Management Area	47,500	34,780	73.2
Places with unusually high fauna species richness (A3) - Geographical Regional Unit	40,160	34,350	85.5
Climatic and environmental history sites (A1)	8,930	8,880	99.4
Endemic flora (A1)#	189,240	121,850	na
Endemic fauna (A1)#	13,270	6,020	na
Flora refuges (A1)	153,860	127,150	82.6
Relictual fauna (A1)+	na	na	na
Limit of range of flora - including disjuncts (A1)	111,820	109,370	97.8
Limit of range of fauna (A1)	35,970	27,810	77.3
Disjunct fauna (A1)	38,490	30,100	78.2
Undisturbed catchments (A2) *	--	--	All
Old-growth forests (A2 and B1)	176,700	127,920	72.4
Remnant vegetation (A2)	46,050	32,500	70.6
Places important for flora succession (A2)	185,480	134,450	72.5
Wetland fauna habitat (A2)+	3,760+	3,530	93.7
Important fauna breeding sites (A2)+	3,010+	2,720	90.4
Fauna refuge areas (A2)**	81,390	51,240	63.0
Natural landscapes (B1)	360,650	277,750	77.0
Places with wilderness quality (B1)	177,120	164,990	93.2

Nationally rare, uncommon EVCs (B1)	80,040	67,520	84.4
Rare, threatened fauna (B1)#	148,620	100,090	na
Rare, uncommon wetlands (B1)+	460+	440	95.7
Natural history sites (C1)	67,230	64,570	96.0
Wetlands characteristic of their class (D1)+	700+	700	100.0
Notes:			
Code of Forest Practices exclusions have not been included as reserves.			
Water bodies are not included in the above analysis.			
+ Values with a high proportion of their area in water bodies are:			
Relictual fauna (A1)	250		
Wetland fauna habitat (A2)	3,000		
Important fauna breeding sites (A2)	1,550		
Rare, uncommon wetlands (B1)	220		
Wetlands characteristic of their class (D1)	2,080		
# The area reserved is not an appropriate measure of protection status; additional protection measures exist. See Table 5.3.			
* Digital data unavailable to calculate areas and percents.			
** Riparian vegetation and Rainforest are protected under the Code.			

Table 5.2: Reserve status of EVCs on public land (sub-criterion D1)

Ecological Vegetation Class	Total Area (ha)	National Estate Value Area (ha)	NE Value Reserved (ha)	NE Value Reserved (%)	Subject to Timber Harvesting
1. Coastal Dune Scrub	3,245	2,490	2,488	99.9	No

2. Coast Banksia Woodland	3,413	2,659	2,659	100.0	No
3. Coastal Grassy Forest	95	40	40	100.0	No
4. Coastal Vine-rich Forest	121	73	73	100.0	No
5. Coastal Sand Heathland	681	681	681	100.0	No
6. Sand Heathland	4	0	0	na	No
7. Clay Heathland	1,780	426	421	98.8	No
8. Wet Heathland	9,514	5,681	5,058	89.0	No
9. Coastal Saltmarsh	831	458	458	100.0	No
10. Estuarine Wetland	237	70	69	98.6	No
11. Coastal Lagoon Wetland	541	171	171	100.0	No
12. Wet Swale Herbland	789	0	0	na	No
13. Brackish Sedgeland	195	195	195	100.0	No
14. Banksia Woodland	36,996	25,121	21,517	85.7	Part
15. Limestone Box Woodland	4,659	4,657	3,432	73.7	Yes
16. Lowland Forest	245,165	62,252	40,071	64.4	Yes
17. Riparian Scrub Complex	17,697	7,044	5,292	75.1	No

18. Riparian Forest	12,958	12,713	10,639	83.7	Part
19. Riparian shrubland	649	388	382	98.5	No
20. Heathy Dry Forest	2,989	2,126	1,840	86.5	Part
21. Shrubby Dry Forest	209,874	125,106	88,113	70.4	Part
22. Grassy Dry Forest	16,902	3,000	2,819	94.0	Part
23. Herb-rich Forest	9,679	9,451	5,834	61.7	Part
24. Foothill Box Ironbark Forest	596	263	192	73.0	Yes
25. Limestone Grassy Woodland	471	470	435	92.6	No
26. Rain shadow Woodland	22,231	20,831	20,788	99.8	No
27. Rocky Outcrop Scrub	5,051	4,173	3,775	90.5	No
28. Rocky Outcrop Shrubland	1,606	1,193	1,187	99.5	No
29. Damp Forest	238,314	109,865	65,425	59.6	Yes
30. Wet Forest	90,287	47,901	30,027	62.7	Yes
31. Cool Temperate Rainforest	2,564	1,776	1,278	72.0	No
32. Warm Temperate Rainforest	6,796	6,778	3,900	57.5	No
33. Cool/Warm Temperate	269	191	125	65.4	No

Rainforest Overlap					
34. Dry Rainforest	11	6	6	100.0	No
35. Tableland Damp Forest	6,999	6,442	3,889	60.4	Yes
36. Montane Dry Woodland	48,569	33,747	28,614	84.8	Part
37. Montane Grassy Woodland	4,824	4,824	3,683	76.3	No
38. Montane Damp Forest	13,962	11,247	10,425	92.7	Yes
39. Montane Wet Forest	13,506	9,976	9,336	93.6	Yes
40. Montane Riparian Woodland	515	515	502	97.5	No
41. Montane Riparian Thicket	37	5	5	100.0	No
42. Sub-alpine Shrubland	202	202	202	100.0	No
43. Sub-alpine Woodland	7,322	6,662	6,403	96.1	No
44. Sub-alpine Treeless Complex	1,088	241	236	97.9	No
Total	1,044,233	532,110	382,685		

NB: Water bodies not included in analysis.

Code of Forest Practices exclusions not included as reserves.

Table 5.3: National Estate Value afforded protection by legislated mechanisms

National Estate Value and Sub-criterion	Afforded Protection by <i>Flora and Fauna Guarantee Act or Code of Forest Practices</i>
a. Values sensitive to disturbance:	
Climatic and environmental history sites (A1)	Wetlands
Undisturbed catchments (A2)	
Old-growth forests (A2 and B1)	
Remnant vegetation (A2)	
Places important for flora succession (A2)	Rainforest and riparian EVCs
Wetland fauna habitat (A2)	Wetlands
Important fauna breeding sites (A2)	
Places with unusually high flora species richness (A3)	Rainforest and riparian EVCs
Places with unusually high fauna species richness (A3)	Rainforest and riparian EVCs
Natural landscapes (B1)	
Places with wilderness quality (B1)	
Nationally rare , uncommon EVCs (B1)	Rainforest and riparian EVCs
Rare, uncommon wetlands (B1)	Wetlands
Natural history sites (C1)	
Principle Characteristics of Vegetation Class (D1)	Rainforest and riparian EVCs
Wetlands characteristic of their class (D1)	Wetlands
b. Values relatively resilient to disturbance:	
Landscape evolution (A1)	
Existing landscape processes (A2)	
Places with unusually high landscape diversity (A3)	
Rare, uncommon landscapes (B1)	

Geological and geomorphological features characteristic of their class (D1)	
c. Values whose sensitivity is species dependent:	
Endemic flora (A1)	VROTs only
Endemic fauna (A1)	VROTs only
Relictual fauna (A1)	VROTs only
Limit of range of flora - including disjuncts (A1)	VROTs only
Limit of range of fauna (A1)	VROTs only
Disjunct fauna (A1)	VROTs only
Rare, threatened fauna (B1)	VROTs
d. Values whose sensitivity to disturbance is yet to be determined	
Flora refuges (A1)	Rainforest and riparian EVCs
Fauna refuge areas (A2)	Rainforest and riparian EVCs

Notes: VROTS: Victorian Rare or Threatened Species

5.5 Conclusion

This study has produced a number of significant outcomes, as follows:

- a regional approach to identification of the National Estate, assessing both natural and cultural heritage values across the East Gippsland forests;
- an improved information base for the full range of national estate values on public land within the study area;
- a basis on which to incorporate the National Estate into the regional assessment process for East Gippsland;
- an analysis of protection mechanisms for national estate values in the region; and
- the integration of cultural environment assessments with those of the natural environment, which were the focus of the study. The forests of East Gippsland have both cultural and natural heritage significance and these are strongly inter-related.

The Australian Heritage Commission follows a statutory process to list identified places on the register of the National Estate. The assessment report and methods provide the basis for identifying those areas to be registered. The places outlined in the assessment report are considered indicative until that process is complete. It is intended that the identification and documentation of places to be interim listed will be finalised before the Regional Forest Agreement is completed.

World Heritage

- 6.1 Introduction and methodology
- 6.2 Identification of Australian thematic contexts and themes of universal value (Step A)
- 6.3 Themes and subthemes relevant to forested areas of Australia (Step A)
- 6.4 Implementation of World Heritage assessment in Victoria (Step B)
- 6.5 Summary 1466.6 Further work - report by officials
- 6.6 Further work - report by officials

Record of the Expert Panel meeting in Melbourne on the 13th and 14th of June 1996.

6.1 Introduction and methodology

6.1.1 Introduction

The Comprehensive Regional Assessment (CRA) process, agreed by governments as part of the 1992 National Forest Policy Statement (NFPS), requires an assessment of all forest values prior to the development of Regional Forest Agreements (RFAs). These agreements are intended to provide the basis for ensuring that the full range of obligations and interests of both Commonwealth and State governments are met in relation to the protection of forest values and the sustainable use and development of forest resources.

In accordance with the Commonwealth's obligations under the World Heritage Convention, there is a requirement to identify and assess World Heritage values. In the case of forested areas this obligation is being undertaken as part of the CRA process. A proposed methodology for assessment of these is being discussed between the Commonwealth and the States. The methodology is outlined below.

6.1.2 A Thematic methodology for World Heritage assessment

Places on the World Heritage List are defined as those which have outstanding universal value. The methodology used for this forest assessment process is based on a thematic approach to identifying and assessing this level of value. The approach assesses significance by developing themes of outstanding universal value and then testing places against these by working through a series of steps. A sieve model is used and places which do not meet particular tests of significance, integrity and authenticity are discarded at various steps. The methodology involves the use of an Expert Panel and provides a systematic, comparative and efficient means for identifying a list of places that meet the criteria and operational guidelines of the World Heritage Convention.

The framework on which the methodology is based was originally developed by Domicelj *et al.* (1992) to identify those places which have outstanding universal cultural value. The thematic approach is consistent with those being used globally to assess World Heritage value. While the original Domicelj study concentrated on places with cultural values, the methodology is a generic one and has been adapted for the forest World Heritage work to assess outstanding universal natural value as well as cultural value.

In identifying places of outstanding universal value the forest assessment methodology is designed to identify those places which are the most outstanding

of their kind in the world. The UNESCO World Heritage Committee, in evaluating whether a place nominated to the World Heritage List has outstanding universal value uses a short-hand way of considering this level of significance by asking 'is this place the best of the best in the world?' To be consistent with the work of the World Heritage Committee, and to ensure that it is indeed working at the level of outstanding universal value, the Expert Panel must continuously pose the following question when working through the assessment steps - 'are we dealing with the best of the best of its kind in the world?'

The first step (Step A) of the methodology involves the Expert Panel providing advice to Governments on themes of outstanding universal value relevant to Australia. These themes are then used in the second step (Step B) to develop a list of places that might include, as a subset, those that best represent the identified themes in a global context.

These potential places are then further examined against the Operational Guidelines for the World Heritage Convention to determine whether they have World Heritage value. They are tested using a series of sieves where the places identified at Step B are assessed for authenticity and integrity (Step C), and adequacy of management and legal protection (Step D), prior to formal assessment against the World Heritage criteria in the final step (Step E). Places that do not meet the required standards and criteria are eliminated at each step of the assessment process.

It should be emphasised that none of the places identified by Steps B - E fulfil the definition of 'identified property' in the *World Heritage Properties Conservation Act* 1983. The Attorney's General's Department advised the Commonwealth's World Heritage Unit of this in correspondence of 7 June 1996. The Department outlined that "the mere application of any or all stages of the methodology to a place will not make that place 'identified property' for the purposes of the *World Heritage Properties Conservation Act* 1983. The Act will not be capable of applying to a place solely by reason of the application of the above steps of the methodology."

It is also important to note that places identified in Step B might not in themselves have World Heritage values. Only places that meet the requirements of all of the steps of the methodology, including the final step involving a formal assessment against the criteria and operational guidelines, are likely to have World Heritage value. Such places are then likely to be the 'best of the best' of their type in the world.

A more detailed outline of the methodology for World Heritage assessment is at Attachment 1.

6.1.3 Implementation of World Heritage assessment

A Panel of Experts was established to implement Step A of the methodology. The Panel met on 13 and 14 June to undertake the following tasks:

- provide advice on the identification of significant themes relating to World Heritage natural or cultural values for all terrestrial areas of Australia;
- assess these themes in their global context in order to provide advice to Governments on which themes are of outstanding universal value;
- and
- identify the subset of outstanding universal themes relevant to forested areas in Australia.

The definition of 'forest', as agreed by Governments in the National Forest Policy Statement, was used as the basis for identifying forested areas for World Heritage Assessments, viz:

"an area, incorporating all living and non-living components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding 5 metres, and with existing or potential projective cover of overstorey strata about equal to or greater than 30 per cent. This definition includes Australia's diverse native forests and plantations, regardless of age. It is also sufficiently broad to encompass areas of trees that are sometimes described as woodlands. The focus of this Statement excludes woodlands"

(National Forest Policy Statement p.47)

6.1.4 The Expert Panel

Members of the Expert Panel were drawn from amongst Australia's foremost experts in disciplines relevant to the World Heritage natural and cultural criteria. Panel members were required to have international standing in their fields of expertise. This ensures that they can assess themes and places in their global perspective. Expertise and experience in the identification and assessment of World Heritage values was also an important factor in the selection process; the Panel included members with substantial experience in this area, as well as in their areas of specialist technical expertise.

The agreed structure of the Panel included a chairman and at least two experts from each of the following five disciplinary areas, identified in relation to the World Heritage criteria:

- Aboriginal cultural values;
- European cultural values;
- natural geological and geomorphological values;
- natural flora values; and
- natural fauna values.

The Panel was chosen following discussions between the Commonwealth and the States. A list of Panel members is at Attachment 2.

6.2 Identification of Australian thematic contexts and themes of universal value (Step A)

The methodology identifies the major thematic contexts which relate to the development of the Australian continent and the shaping of its unique landscapes, biota, and human cultures. These are then used to develop the themes of outstanding universal value. The Expert Panel identified themes by considering processes, conditions, events or other factors that had important influences on Australia's natural and cultural history. The process of developing themes of outstanding universal value was described by Domicelj *et al.* (1992) as a complex one, involving, in practice, a certain amount of stepping backwards and forwards, between theme and expression of theme, in terms of values and places.

In undertaking its work, the Panel often found itself moving back and forth between thematic contexts, themes, various aspects of these themes that were construed as sub-themes or exemplars of the themes, and examples of places that might best represent the themes or sub-themes.

At this stage of the identification process, the Panel worked within the broader context of all terrestrial areas of Australia. This was seen to be important both in ensuring that truly Australian themes were identified in the appropriate context of the whole continent, and to avoid any possibility that either themes or places might be mis-identified or over-represented as a result of working in too narrow a context. The Panel's discussion of places also referred both to places in Australia and places in other parts of the world. This was done to determine whether places within Australia were potentially outstanding examples at a global scale.

The Panel chose to record thematic contexts, themes of outstanding universal value and one or more sub-themes or exemplars for each theme identified in relation to terrestrial areas of Australia. The sub-themes or exemplars were also defined with an explanatory sentence.

The Panel considered that the themes and sub-themes which they identified had outstanding universal value and that it was possible that the places which best express them lie within Australia. The Panel stressed however that all steps of the methodology (Steps B - E) must be undertaken before a decision could be made on whether the places are of outstanding universal value.

Australian thematic contexts, themes and sub-themes of outstanding universal value identified by the Panel are summarised below:

6.2.1 Thematic context: 'An ancient land'

The 'Ancient Land' thematic context derives from the long-term geological stability of the Australian continent. Geological stability is a characteristic that has resulted in only relatively minor change to Australia's geological substrates and many of its landscapes over extremely long periods of time. Australia is unique in exhibiting this stability at a continental scale. In contrast, most other continents have been subject to large-scale geological processes that have resulted in extensive change, including the obliteration of records of early landscapes and biota.

Australia's unique geological stability is of prime importance in telling the story of the early development of life on the planet. The significance of this thematic context centres on the fact that outstanding examples of ancient landforms and fossil remains of early life forms are readily visible in parts of the Australian continent. These include fossil remnants of the earliest known forms of life on Earth, dating back more than 3.4 billion years.

The following theme and sub-theme of outstanding universal value associated with the 'Ancient Land' thematic context was identified by the Panel:

Theme: Ancient records of life and landforms

Sub-theme: **Ancient landforms and fossils**

Explanation: Australia has outstanding examples of the earliest known records of life and early physiographic features.

6.2.2 Thematic context: 'Continental isolation'

The 'Continental Isolation' thematic context is associated with the origin and development of the Australian continent. In particular, it draws on Australia's

origins as part of the supercontinent Gondwanaland, the unique, long-term isolation of the Australian land-mass following the break-up of the supercontinent, and the onset of increasingly stressful environmental conditions as the newly-isolated continent moved slowly northwards as a result of global plate tectonics. With this northwards movement came greater climatic unpredictability, as the continent came under the influence of different atmospheric systems.

As Australia separated from Gondwanaland, new continental boundaries developed. The boundary which formed along Australia's eastern edge is of the type known as a passive continental margin. This type, in contrast to an active continental margin, is not formed by seismic or volcanic activity. While passive continental margins are relatively common on a global scale, Australia's eastern boundary is unusual in that along much of its edge it coincides with sites of volcanic activity. These sites were not responsible for the formation of the margin itself however and developed as the continent drifted north over a particularly thin section of the underlying crustal plate. The timing of volcanic activity at each of the sites can be determined because volcanic rocks, unlike many other types of rocks, can be directly dated. Because the sites happen to be associated with the continental margin, the history of the margin itself can be studied through the dating of the sites. This is unique on a global scale as passive continental margins, by definition, are not usually associated with volcanic activity.

The global significance of Australia's relative geological stability has been discussed for the 'Ancient Land' thematic context. This stability is also important for the development of the Australian continent. For example, Australia has remains of ancient land surfaces termed 'paleoplains' which are outstanding on a global scale. These features are substantially expressed by the continent's very old soils such as laterites and duricrusts. Other significant features are the remains of ancient river systems. Examples which are 65 million years old are known.

The 'Continental Isolation' thematic context is central to any understanding of the origins and development of Australia's past and present landscapes, flora and fauna. It centres on the co-evolution of landscapes, biota and, latterly, human societies under high levels of environmental stress associated with various combinations of increasing climatic variability, low nutrient soils, high fire frequencies, and the interaction of surface water and ground water in a flat landscape.

The vegetation has adapted to these stresses in a variety of ways, many of which are exceptional on a global scale. For example, the development of scleromorphy (typically hard, thickened leaves and pronounced leaf cuticle development) in response to factors such as water stress and low nutrient soils is unmatched in any other continental floras. Similarly outstanding is the adaptation of eucalypts, which dominate forest and woodland vegetation on a continental scale, to an extraordinary range of environments and conditions.

The low nutrient soils are particularly unusual on a global scale. The majority of Australia's soils are derived from ancient, heavily leached substrates, formed when the climate across the whole continent was warmer and wetter. Also associated with the pronounced age of the continent is its relatively flat landscape, formed as a result of long periods of weathering and erosion.

The combination of all of these factors has been critical in influencing the evolution of Australia's unique landscapes and flora and fauna. The Australian

biota includes extant elements of flora and fauna similar to the Gondwana biota and Australia also has outstanding fossil records demonstrating the evolutionary sequences of these elements. As well, Australia has globally significant examples of flora and fauna that have evolved in isolation from other continents following the break-up of Gondwanaland. These also have outstanding expression in the continent's fossil record.

This thematic context is also associated with a unique continuity in the record of changing landscapes and life forms. The stability of the continent has resulted in preservation of sites with long-term records, or of sequences of sites that together constitute continuing records of change. These records of change include landscape remnants, fossil remnants, and stratigraphies that document climate change. For example, globally significant records of climatic change and its impacts are found in the lake sediments of a number of Australia's volcanic lakes.

The following themes and sub-themes of outstanding universal value associated with the 'Continental Isolation' thematic context were identified by the Panel:

Theme: Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation

Sub-theme: **Passive continental margins**

Explanation: Marginal swells are characteristic of all passive continental margins. The Australian marginal swells are outstanding and exceptional in having volcanics to allow the process to be dated.

Sub-theme: **Paleoplains**

Explanation: Australia has outstanding examples of ancient soil forms in its ancient laterites and duricrusts.

Sub-theme: **Paleo-drainage systems**

Explanation: Australia has outstanding examples of Mesozoic and older river systems extant in its landscapes.

Sub-theme: **Fossils**

Explanation: Cretaceous fossil sites in Victoria (particularly including fossil remnants of dinosaurs, fish and birds) are the best examples of southern high latitude Cretaceous faunas known.

Fossil sites at Riversleigh and Naracoorte provide evidence of key stages in the evolution of the Australian biota. These are linked in a temporal sequence to other sites such as the Victorian brown coal deposits.

Sub-theme: **Refugia, relicts**

Explanation: Australia has outstanding examples of relict biota reflecting ancient Gondwana biota.

Sub-theme: **Rainforest**

Explanation: Australian rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relictual species, many of which are similar to fossils from Gondwanaland.

Theme: Evolution of landforms, species and ecosystems under conditions of stress

Sub-theme: **Scleromorphy**

Explanation: The Australian flora includes outstanding examples of the evolution of a diverse range of scleromorphic characteristics in response to low nutrient soils and a highly variable climate.

Sub-theme: **Arid landscapes and adaptations**

Explanation: Australia, as the most arid, non-polar continent on earth, has outstanding examples of arid landforms and arid-adapted biota in its sandy deserts, including the longest, longitudinal dune systems in the world.

Sub-theme: ***Eucalyptus*-dominated vegetation**

Explanation: *Eucalyptus*-dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency.

Sub-theme: **Alpine**

Explanation: Australia has outstanding examples of globally-unusual alpine vegetation that has developed in response to maritime conditions and poor soils.

Theme: Climate change and its impacts

Sub-theme: **Records of ancient climates**

Explanation: Australia has outstanding and globally significant records of past climates preserved in the sediments of a number of its lake systems.

6.2.3 Thematic context: 'Settlement of Australia by hunting- and-gathering societies'

An important thematic context was identified associated with human settlement of the Australian continent. Australia is unique in that the entire continent has been occupied by a hunting-and-gathering society up until the time of European settlement, and that this type of society continues to play a major role in the occupation of significant parts of the continent. The Australian landscape includes globally outstanding records of this hunting-and-gathering society, including artistic expression associated with rock art sites, and religious expression associated with dreaming sites.

The unusual character of Australia's landscape and biota, described above for the 'Continental Isolation' thematic context, has been important for the development of human societies on the continent. There has been a dynamic interaction between landscape, biota and human land uses involving fire, hunting and other

factors. The two thematic contexts draw together several aspects of Australia's natural and cultural heritage; for example: the adaptation of hunting-and-gathering societies to the unique Australian environment, modifications by people to the landscape and the biota through the use of fire, and the exploitation of various natural resources by hunting-and-gathering societies.

The following themes and sub-themes of outstanding universal value associated with the 'Settlement of Australia by Hunting-and-Gathering Societies' thematic context were identified by the Panel:

Theme: Traditional human settlement and land use

Sub-theme: **Complex persistence of a hunting-and-gathering society on a single continent**

Explanation: Australia provides the only example of where the hunting-and-gathering way of life has dominated an entire continent up until modern times. This way of life continues to play a significant role in the occupation of the continent, particularly in its northern and central sections.

Theme: Artistic expression

Sub-theme: **Rock art**

Explanation: Australia has Aboriginal art sites that represent a unique artistic achievement, as well as providing an outstanding record of human interaction with the environment over tens of thousands of years.

Theme: Religious expression

Sub-theme: **Dreaming sites**

Explanation: Australia provides an outstanding example of where the religious system of hunting-and-gathering societies is embodied in the landscape.

6.2.4 Thematic context: 'European expansion'

A major thematic context associated with the global expansion of European societies was identified by the Panel as being very important in the Australian context. Early European colonisation of the Australian continent, although motivated to a large extent by forced migration associated with the transportation of convicts, also provided ready access to abundant sources of the raw materials necessary for industrial economies. The strength of many European economies in the eighteenth and nineteenth centuries and their domination of global economic activity often stemmed in large measure from earlier colonial expansion and the opportunity to exploit natural resources from areas that had been recently colonised. The aspect of this thematic context associated with convict transportation to Australia is a globally significant example of the occupation of an entire continent by a European-dominated culture.

The Australian goldrushes represent another important expression of the thematic context relating to 'European expansion in the Eighteenth and Nineteenth Century'. The goldrushes in Australia are an outstanding example of a major global migration of people from a wide range of European and non-European cultures. This global migration was a fundamental factor influencing the

development of Australia both via acceleration of the settlement of the continent, and as a result of the further integration of the country into the global economy.

The following themes and subthemes of outstanding universal value associated with the 'European Expansion' thematic context were identified by the Panel:

Theme: European expansion of the eighteenth and nineteenth centuries

Sub-theme: **Forced migration - a major way in which the expansion took place**

Explanation: Convict transportation to Australia is an outstanding example of how European powers initiated the occupation of an entire continent.

Sub-theme: **Integration of a continent into the global economy**

Explanation: The Australian goldrushes are an outstanding example of the global migrations associated with the nineteenth century goldrushes.

Theme: Masterpiece of human creative genius

Theme: Outstanding example of a type of building/technological ensemble of landscape

6.2.5 Thematic context: 'Encounter between cultures'

The thematic context 'Encounter between Cultures', was identified by the Expert Panel as providing an important link between the previously discussed thematic contexts of 'Traditional Human Settlement' and 'European Expansion'. This thematic context characterises an important aspect of the history of Australia. It relates to the ongoing encounter between the traditional hunting-and-gathering societies that have occupied Australia for tens of thousands of years, and the invasion of the continent by European occupation associated with the expansion of nineteenth century European societies.

The following theme of outstanding universal value associated with the 'Encounter between Cultures' thematic context was identified by the Panel:

Theme: Encounter between cultures

Explanation: Australia provides examples of the encounter between hunting-and-gathering societies and nineteenth century European societies.

While the Expert Panel considered that this theme had outstanding universal value, in contrast to the other major themes discussed, the Panel was undecided whether the best global examples of the theme undoubtedly lie within Australia.

In developing the lists of themes and subthemes, the Panel considered whether Australia's listed World Heritage Areas best express particular themes, or subthemes, or aspects of these. As a result of these discussions the Panel developed a table, which is presented in Attachment 3.

6.3 Themes and subthemes relevant to forested areas of Australia (Step A)

Once the Panel had developed the thematic contexts, themes and subthemes, they then advised on which of these are most likely to be relevant to the forested areas of Australia. This was achieved by the Panel listing those themes and subthemes that are directly relevant to forested areas (eg 'Rainforest') and also those other themes and subthemes which, while not as directly relevant, require further work to establish whether they are best expressed in such areas.

The Panel advised that the themes and subthemes relevant to the forested areas of Australia are:

Theme: Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation

Sub-theme: **Passive continental margins**

Sub-theme: **Fossils**

Sub-theme: **Refugia, relicts**

Sub-theme: **Rainforest**

Theme: Evolution of landforms, species and ecosystems under conditions of stress

Sub-theme: **Scleromorphy**

Sub-theme: ***Eucalyptus*-dominated vegetation**

Theme: Climate change and its impacts

Sub-theme: **Records of ancient climates**

Theme: Traditional human settlement and land use

Sub-theme: **Complex persistence of a hunting-and-gathering society on a single continent**

Theme: Artistic expression

Sub-theme: **Rock art**

Theme: Religious expression

Sub-theme: **Dreaming sites**

Theme: European expansion of the eighteenth and nineteenth centuries

Sub-theme: **Forced migration - a major way in which the expansion took place**

Sub-theme: **Integration of a continent into the global economy**

The Panel then went on to determine which of these themes and subthemes are relevant to Victoria.

6.4 Implementation of World Heritage assessment in Victoria (Step B)

The Victorian RFA Steering Committee asked the Panel to undertake Step B of the World Heritage assessment methodology for places in Victoria, as part of the CRA process for all Victorian regions. To achieve this, the Steering Committee asked the Panel to undertake the following tasks:

- to determine which, if any, of the subset of outstanding universal themes for forested areas identified in Step A are relevant to Victoria; and
- to provide advice on whether there are places in Victoria which need to be further investigated as part of the comprehensive regional assessment process, as to whether they best express the themes.

The Panel considered the above list of themes and subthemes relevant to Australia's forested areas and then identified those which are relevant to Victoria. This was achieved by determining which of the above outstanding universal themes and subthemes, or aspects of these, are likely on a global scale, to be best expressed within Victoria.

In undertaking this process, the Panel worked between themes, subthemes and potential places. In so doing, they developed a list of places in Victoria warranting further investigation as part of the comprehensive regional assessments, to determine whether they best express the themes. These are the places identified in 'Step B'. They are presented below in Table 1.

Table 6.1: List of themes, subthemes, and potential places in Victoria, warranting further investigation.

Natural Values (Geology, Geomorphology, Flora, Fauna)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Places in Victoria Warranting Further Investigation
Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation.	Passive continental margins	Marginal swells are characteristic of all passive continental margins. The Australian marginal swells are outstanding and exceptional in having volcanics to allow the process to be dated.	Parts of the Australian marginal swells associated with the Eastern Highlands (only partly represented in Victoria).

	Fossils	Cretaceous fossil sites in Victoria (particularly including fossil remnants of dinosaurs, fish and birds) are the best examples of southern high latitude Cretaceous faunas known.	Fossil sites at the Otway Coast (Cape Otway), Koonwarra (Leongatha region) and the Bunurong Marine Park (Inverloch region).
--	---------	--	---

Natural Values (Geology, Geomorphology, Flora, Fauna)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Places in Victoria Warranting Further Investigation
Evolution of landforms, species and ecosystems under conditions of stress.	<i>Eucalyptus</i> dominated vegetation	<i>Eucalyptus</i> dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency.	Areas with outstanding relevant examples of <i>Eucalyptus</i> dominated vegetation associated with the Eastern Forests of Victoria (see statement regarding East Gippsland below).
Climate change and its impacts	Records of ancient climates	Australia has outstanding and globally significant records of past climates recorded in the sediments of a number of its lake systems.	Lakes with climatic sequences in their sediments associated with a number of Western Victoria volcanic lakes.

Cultural Values (Aboriginal, European)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Places in Victoria Warranting Further Investigation
European expansion of the eighteenth and nineteenth centuries	Integration of a continent into the global economy	The Australian goldrushes are an outstanding example of the global migrations associated with the nineteenth century goldrushes.	Goldrush sites in the central Goldfields of Victoria.

To assist further work that might be undertaken to identify places in forested areas of East Gippsland that might best represent the sub-theme of *Eucalyptus*-dominated vegetation, the Panel made the following statement:

A strong nomination focussed on *Eucalyptus* evolution and diversity would include a wide variety of *Eucalyptus* types from a variety of environments. An excellent representative sample of these can be found in south east Australia, centred on East Gippsland, encompassing a range of habitats from the sea to the alpine hermland, and then to the inland plains.

This sample would not be found in a single, contiguous area but would comprise several large areas, most of which could be expected to already have protected area status. A more comprehensive nomination could be proposed involving additional areas remote from south east Australia.

Because vegetation evolution and diversification are co-evolutionary processes associated with geophysical and climatological change, any sample identified on the basis of values associated with the biota is also likely to represent significant values in landform evolution. In the case of South East Australia, any sample focussed on *Eucalyptus* is most likely to represent an outstanding example of the long-term processes of landform evolution associated with passive continental margins.

6.5 Summary

As a summary of the work undertaken by the Panel, outcomes of Steps A and B have been listed in Table 6.2. The table has been constructed so as to show the sieving approach that the Panel adopted in reaching these outcomes.

Table 6.2: Summary table showing sieving of themes, subthemes and places in Victoria warranting further investigation.

STEP A				STEP B
AUSTRALIA				VICTORIA
	All Terrestrial Areas		Australian Forested Areas	Victorian Forested Areas
Australian Themes of Outstanding Universal Value	Australian Subthemes / Exemplars	Explanatory Sentence	Australian Forest Subthemes / Exemplars	Potential places in Victoria warranting further investigation
NATURAL				
Ancient records of life and landforms	Ancient landforms and fossils	Australia has outstanding examples of the earliest known records of life and early physiographic features		
Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation.	Passive continental margins	Marginal swells are characteristic of all passive continental margins. The Australian marginal swells are outstanding and exceptional in having volcanics to allow the process to be dated.	Passive continental margins	Parts of the Australian marginal swells associated with the Eastern Highlands (only partly represented in Victoria)
	Paleoplains	Australia has outstanding examples of ancient soil forms in its ancient laterites and duricrusts.		
	Paleo-drainage systems	Australia has outstanding examples of Mesozoic and older river systems extant in its landscapes.		

	Fossils	Cretaceous fossil sites in Victoria (particularly including fossil remnants of dinosaurs, fish and birds) are the best examples of southern high latitude Cretaceous faunas known.	Fossils	Fossil sites at the Otway Coast (Cape Otway), Koonwarra (Leongatha region) and the Bunurong Marine Park (Inverloch region).
STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes / Exemplars	Explanatory Sentence	Australian Forest Subthemes / Exemplars	Potential places in Victoria warranting further investigation
(cont) Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation	Refugia, Relicts	Australia has outstanding examples of relict biota reflecting ancient Gondwana biota	Refugia, Relicts	
	Rainforest	Australian rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relictual species, many of which are similar to fossils from Gondwanaland.	Rainforest	

Evolution of landforms, species and ecosystems under conditions of stress.	Sclero-morphy	The Australian flora includes outstanding examples of the evolution of a diverse range of scleromorphic characteristics in response to low nutrient soils and a highly variable climate	Sclero-morphy	
	Arid landscapes and adaptations	Australia, as the most arid, non-polar continent on earth, has outstanding examples of arid landforms and arid-adapted biota in its sandy deserts, including the longest, longitudinal dune systems in the world.		
	<i>Eucalyptus</i> dominated vegetation	<i>Eucalyptus</i> dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency.	<i>Eucalyptus</i> dominated vegetation	Areas with outstanding relevant examples of <i>Eucalyptus</i> dominated vegetation associated with the Eastern Forests of Victoria (see statement regarding East Gippsland in section 6.4)

STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes / Exemplars	Explanatory Sentence	Australian Forest Subthemes / Exemplars	Potential places in Victoria warranting further investigation
(cont) Evolution of landforms, species and ecosystems under conditions of stress.	Alpine	Australia has outstanding examples of globally unusual vegetation that has developed in response to maritime conditions and poor soils.		
Climate change and its impacts	Records of past climates	Australia has outstanding and globally significant records of past climates preserved in the sediments of a number of its lake systems	Records of past climates	Lakes with climatic sequences in their sediments, including a number of Western Victoria volcanic lakes
CULTURAL				
Traditional human settlement and land use	Complex persistence of a hunting and gathering society on a single continent	Australia provides the only example of where the hunting and gathering way of life has dominated an entire continent up until modern times. This way of life continues to play a significant role in the occupation of the continent, particularly in its northern and central sections.	Complex persistence of a hunting and gathering society on a single continent	
Artistic expression	Rock art	Australia has Aboriginal art sites that represent a unique artistic achievement, as well as providing an outstanding record of human interaction with the environment over tens of thousands of years.	Rock art	

Religious expression	Dreaming sites	Australia provides an outstanding example of where the religious system of hunting and gathering societies is embodied in the landscape.	Dreaming sites	
STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes / Exemplars	Explanatory Sentence	Australian Forest Subthemes / Exemplars	Potential places in Victoria warranting further investigation
Encounter between cultures		Australia provides examples of the encounter between hunting and gathering societies and nineteenth century European societies.		
European expansion of the eighteenth and nineteenth centuries	Forced migration - a major way in which the expansion took place	Convict transportation to Australia is an outstanding example of how European powers initiated the occupation of an entire continent.	Forced migration - a major way in which the expansion took place	
	Integration of an economic system and the resources of a continent into the economy	The Australian goldrushes are an outstanding example of the global migrations associated with the nineteenth century goldrushes.	Integration of an economic system and the resources of a continent into the global economy	Goldrush sites global associated with the Central Goldfields of Victoria
Masterpiece of human creative genius				
Outstanding example of a type of building / technological ensemble of landscape				

6.6 Further work - report by officials

Having considered the work undertaken by the Expert Panel, the Victorian RFA Steering Committee will determine the timetable for further assessment relating to forested places in Victoria. At this stage, priority will be given to the assessment of places relevant to East Gippsland. The Steering Committee noted that several of the places identified by the Expert Panel, such as the fossil sites at Cape Otway, Koonwarra and Inverloch, and the volcanic lake sites in western

Victoria, are not within major forested areas and are therefore not likely to be affected by decisions made through the RFA process. The Steering Committee will, however, determine whether these places will be further considered during the RFA process when work commences in the relevant RFA regions.

Attachment 1 / Summary Outline of the Methodology for World Heritage Assessment

Step A: Identify, on expert advice, significant themes relating to natural and cultural values relevant to all biomes in Australia. By consideration of their global context, sort the themes into:

- (a) outstanding universal value
- (b) important universal value
- (c) outstanding national/regional value
- (d) important national/regional value.

Identify those themes of (a) outstanding universal value relevant to forest biomes in Australia.

Outcome: Only forest themes of (a) outstanding universal value proceed

Step B: Identify, on expert advice, and with reference to the World Heritage criteria, those places where further work is needed to determine whether they represent the forest themes of outstanding universal values.

Step C: Determine, with reference to the World Heritage criteria, which of those places identified in Step B have integrity and authenticity, and identify existing legal protection and management mechanisms.

Outcome (i) Only places with integrity and authenticity proceed.

(ii) Current management status and any further management requirements are identified.

Step D: Evaluate the significant places selected in Step C by consideration of their global context, into those:

- (a) essential to a theme of outstanding universal value
- (b) integral to a theme of outstanding universal value
- (c) peripheral to a theme of outstanding universal value
- (d) no relevance to a theme of outstanding universal value

Outcome: Only places (a) essential and (b) integral to a theme of outstanding universal value proceed

Step E: Undertake final assessment of the places selected in Step D against the definitions in Articles 1 and 2 of the World Heritage Convention and the criteria in paragraphs 24 (a) and 44 (a) of the Operational Guidelines

Outcome: Only places which satisfy one or more of the criteria as well as the test of integrity and authenticity to proceed.

Note: The Attorney's General's Department has advised the World Heritage Unit in correspondence of 7 June 1996 that: "the mere application of any or all stages of the methodology to a place will not make that place 'identified property' for the purposes of the *World Heritage Properties Conservation Act* 1983. The Act will not be capable of applying to a place solely by reason of the application of the above steps of the methodology.

Attachment 2 / World Heritage Expert Panel Meeting

Melbourne 13-14 June 1996

The Expert Panel comprised the following members:

Chairman

Professor Ralph Slatyer (World Heritage, Environmental Science), Emeritus Professor of Environmental Biology, The Australian National University

Aboriginal Cultural Values

Professor Sandra Bowdler (Aboriginal prehistory, Archaeology), Professor of Archaeology, University of Western Australia

Dr Bill Jonas (Aboriginal Cultural Heritage, Anthropology), Director Australian Institute of Aboriginal and Torres Strait Islander Studies

Dr Brian Egloff (Aboriginal prehistory, Historical Archaeology), Senior Lecturer Cultural Heritage Studies, University of Canberra

European Cultural Values

Dr Mike Pearson (Historical archaeology, Cultural Heritage), Director Heritage Management Consultants

Professor Graeme Davison (Australian history, Cultural Heritage), Professor of History, Monash University

Natural Geology and Geomorphology Values

Professor Jim Bowler (Geomorphology, Geology), Professorial Associate in Earth Sciences, University of Melbourne

Professor Cliff Ollier (Geomorphology, Geology), Emeritus Professor of Geography and Planning, UNE, and Visiting Fellow, CRES, The Australian National University

Natural Fauna Values

Dr Tim Flannery (Evolution - Fauna, Paleontology), Head, Department of Mammalogy Australian Museum

Dr Alan Yen (Invertebrate fauna, Ecology), Senior Curator, Invertebrate Survey National Museum of Victoria

Natural Flora Values

Professor Jamie Kirkpatrick (Vegetation Ecology, Biogeography), Professor of Geography and Environmental Studies University of Tasmania

Dr Brian Barlow (Evolution - Flora, Plant systematics), former Deputy Chief, CSIRO Plant Industry, Head Australian National Herbarium

Attachment 3 / Currently listed World Heritage Places in Australia

Attachment 3 Currently listed World Heritage Places in Australia and the best expressions of the themes of outstanding universal value

As part of its work in identifying themes and subthemes of outstanding universal value (Step A) and possible places in Victoria that might best express them (Step B), the Expert Panel's discussion often touched on listed World Heritage Areas in Australia and the extent to which these might best express particular themes. Instances of where a listed World Heritage Area was regarded by the Panel as best expressing a particular theme, sub-theme, or aspects of these, are outlined in the following table. It is noted that in a number of cases however, the Panel believed that while a listed World Heritage Area best expressed particular aspects of the themes and subthemes, other places need to be further investigated to determine whether they might best express other aspects. The Panel developed a list of these other places for forested themes for Victoria. This is presented in Table 6.2.

Table 6.3: List of themes, subthemes and Australia's listed World Heritage Areas which best express particular themes, or subthemes, or aspects of these.

Natural Values (Geology, Geomorphology, Flora, Fauna)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Listed World Heritage Areas which best express the themes, subthemes, or aspects of these.
Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation	Fossils	Fossil sites at Riversleigh and Naracoorte provide evidence of key stages in the evolution of the Australian biota. These are linked in a temporal sequence to other sites such as the Victorian brown coal deposits.	Australian Fossil Mammal Sites (Riversleigh, Naracoorte).
	Refugia, Relicts	Australia has outstanding examples of relict biota reflecting ancient Gondwana biota	The Tasmanian Wilderness, Central Eastern Rainforest Reserves, Wet Tropics of Queensland.

	Rainforest	Australian rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relictual species, many of which are similar to fossils from Gondwanaland.	The Tasmanian Wilderness, Central Eastern Rainforest Reserves, Wet Tropics of Queensland.
--	------------	---	---

Natural Values (Geology, Geomorphology, Flora, Fauna)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Listed World Heritage Areas which best express the themes, subthemes, or aspects of these.
Evolution of landforms, species and ecosystems under conditions of stress	<i>Eucalyptus</i> dominated vegetation	<i>Eucalyptus</i> dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, and/or nutrient deficiency, and/or high fire frequency	Kakadu National Park, The Tasmanian Wilderness.
Evolution of landforms, species and ecosystems under conditions of stress	Alpine	Australia has outstanding examples of globally unusual vegetation that has developed in response to maritime conditions and poor soils	The Tasmanian Wilderness
Climate change and its impacts	Records of past climates	Australia has outstanding and globally significant records of past climates preserved in the sediments of a number of its lake systems	

Cultural Values (Aboriginal, European)

Theme of Outstanding Universal Value	Subthemes, Exemplars	Explanatory Sentence	Listed World Heritage Areas which best express the themes, subthemes, or aspects of these.
Traditional human settlement and land use	Complex persistence of a hunting and gathering society on a single continent	Australia provides the only example of where the hunting and gathering way of life has dominated a complete continent up until modern times. This way of life continues to play a significant role in the occupation of the continent, particularly in its northern and central sections.	Kakadu National Park, Uluru-Kata Tjuta National Park, Willandra Lakes Region, The Tasmanian Wilderness.
Artistic expression	Rock art	Australia has Aboriginal art sites that represent a unique artistic achievement, as well as providing an outstanding record of human interaction with the environment over tens of thousands of years	Kakadu National Park, The Tasmanian Wilderness.
Religious expression	Dreaming sites	Australia provides an outstanding example of where the religious system of hunting and gathering societies is embodied in the landscape	Uluru-Kata Tjuta National Park

References

AHC and CALM 1992, *National estate values in the southern forest region, south-east Western Australia*, Draft report, Australian Heritage Commission and Department of Conservation and Land Management, Western Australia.

AHC and DCNR 1994, *Methods papers: East Gippsland and Central Highlands joint forest projects. Volume two: Cultural values*, Australian Heritage Commission and Department of Conservation and Natural Resources, Victoria.

AHC and DNRE 1996a, *Wilderness assessment of the eastern Victorian forests*, Australian Heritage Commission and Department of Natural Resources and Environment, Victoria.

AHC and DNRE 1996b, *National estate values in East Gippsland, Victoria*, Australian Heritage Commission and Department of Natural Resources and Environment, Victoria.

AHC and DNRE 1996c, *Methods papers: East Gippsland national estate assessment. Volume one: Natural values*, Australian Heritage Commission and Department of Natural Resources and Environment, Victoria.

AUSLIG, AGSO, AHC and CRES 1996, *Geodata 9 second Digital Elevation Model (DEM)*, Australian Survey and Land Information Group, Australian Geological Survey Organisation, Australian Heritage Commission and Centre for Resource and Environmental Studies, Canberra.

Austin, M. P. and Heyligers, P. C. 1989, 'Vegetation survey design for conservation: gradsect sampling of forests in north-eastern New South Wales', *Biological Conservation*, 50: 13-32.

Austin, M. P. and Heyligers, P. C. 1991, 'New approach to vegetation survey design: gradsect sampling', In Margules, C. R. and Austin, M. P. (eds) *Nature conservation: Cost effective biological surveys and data analysis*, CSIRO, Australia: 31-6.

Austin, M. P. and Meyers, J. A., (submitted), 'Current approaches to modelling the environmental niche of eucalypts: implications for management of forest biodiversity', *Journal of Forest Ecology and Management*.

Avis 1993, *Orbost Heathland Management Plan*, Department of Conservation and Natural Resources, Orbost, Victoria.

Bartlett, A. G. 1990, *Regional Fire Protection Plan - Orbost Region*, Department of Conservation, Forests and Lands, Victoria.

Baxter, A., Vallis, S. and Quinlan, P. 1991, *A summary of the trout management group fish population surveys 1990*, Fisheries Management Report No. 36, Department of Conservation and Environment, Victoria.

Brady, A. and Perham, G. 1993, *Historic places in the East Gippsland Forest Management Area. A report for the Australian Heritage Commission and the Department of Conservation and Natural Resources*, Department of Conservation and Natural Resources, Victoria (unpublished).

Briggs, J. D. or Leigh, J. H. 1988, *Rare or Threatened Australian Plants*, Special Publication No. 14, Australian National Parks and Wildlife Service, Canberra.

Burgman, M. A. and Ferguson, I. S. 1995, *Rainforest in Victoria - a review of the scientific basis of current and proposed protection measures*, Forest Service Technical Report 95-4, Department of Conservation and Natural Resources, Victoria.

Caughley, G. 1994, 'Directions in conservation biology', *Journal of Animal Ecology*, 63: 215-244.

Clunie, P. 1994, *White-bellied Sea-eagle Haliaeetus leucogaster*, Action Statement No. 60, Department of Conservation and Natural Resources, Victoria.

Commonwealth of Australia 1992, *National forest policy statement, A new focus for Australia's forests*, Australian Government Publishing Service, Canberra.

Coventry, A. J. and Robertson, P. 1980, 'New records of scincid lizards from Victoria', *Victorian Naturalist*, 97: 190-193.

DCFL 1989, *Department of Conservation, Forests and Lands Code of Forest Practices for Timber Production* (Review No. 1), Department of Conservation, Forests and Lands, Victoria.

DCNR 1995a *Forest Management Plan for the East Gippsland Forest Management Area*, Department of Conservation and Natural Resources, Victoria.

DCNR 1995b *Threatened fauna in Victoria 1995*, Department of Conservation and Natural Resources, Victoria.

Dexter, N. 1996, *Priority Setting For Forest Taxa: (Ecological Criteria)*, Unpublished manuscript, Australian Nature Conservation Agency, Canberra.

Dixon, J. M. 1976, *Report on the vertebrate fauna of the Alpine Study Area of Victoria*, Museum of Victoria, Melbourne.

Doeg, T. J. 1995, *An assessment of the aquatic macroinvertebrate fauna of three areas of East Gippsland, Victoria. Final report to the Australian Heritage Commission*, National Estate Grants Project No. 93/125, Department of Conservation and Natural Resources, Victoria.

DNRE 1996a, *Environmental resource directory for Victoria*, Department of Natural Resources and Environment, Melbourne.

DNRE 1996b, *Helping the community manage environmental weeds in Victoria*, Department of Natural Resources and Environment, Melbourne

DNRE (in prep a), *Environmental weeds management handbook*, Department of Natural Resources and Environment, Melbourne

DNRE (in prep b), *Environmental weeds direction plan for Victoria*, NOE, Melbourne.

Domicelj, J., Halliday, H. and James, P. 1992, *Australia's cultural estate. Framework for the assessment of Australia's cultural properties against the World Heritage criteria*, Vols 1-3, Unpublished report to the Department of the Arts, Sport, the Environment and Territories.

DWR 1989, *The environmental condition of Victorian streams*, Department of Water Resources, Victorian Government Printing Office, Melbourne.

Eden, T. 1981, *Fish distribution data from surveys in the Snowy River estuary*, Museum of Victoria, Melbourne (unpublished file notes).

EPA 1983, *An assessment of water quality in East Gippsland*, Publication No. 162, Environment Protection Authority, Melbourne.

Forbes, S. J., Gullan, P. K. and Walsh, N. G. 1981, *Sites of botanical significance in East Gippsland*, Environmental Studies Division, Study Series No. 322, Ministry for Conservation, Victoria.

Gaston, K. J. 1994, *Rarity*, Chapman and Hall, London.

Hanski, I. and Gilpin, M. 1991, Metapopulation dynamics: brief history and conceptual domain, *Biological Journal of the Linnean Society*, 42: 3-16

Hill, R. and Baker-Gabb, D. 1991, Brush-tailed Rock-wallaby *Petrogale penicillata*, Action Statement No. 19, Department of Conservation and Natural Resources, Victoria.

Hnatiuk, R. J. 1990, *Census of Australian Vascular Plants*, Australian Flora and Fauna Series No. 11, Australian Government Publishing Service, Canberra.

Horwitz, P. 1990, 'A taxonomic revision of species in the freshwater crayfish genus *Engaeus* Erichson (Decapoda: Parastacidae)', *Invertebrate Taxonomy*, 4: 427-614.

Hutchinson, M. F. 1984, *A summary of some surface fitting and contouring programs for noisy data*, Consulting Report, 84/6, CSIRO Division of Mathematics and Statistics, Canberra.

Hutchinson, M. F. 1989, 'A new objective method for spatial interpolation of meteorological variables from irregular networks applied to the estimation of monthly mean solar radiation, temperature, precipitation and windrun', In *Proceedings of a UNU workshop need for climatic and hydrologic data in agriculture in southeast Asia*, Technical Memorandum, 89/5, CSIRO Division of Water Resources: 95-104.

Hutchinson, M. F. 1991a, 'The application of thin plate smoothing splines to continent-wide data assimilation', In Jasper, J. D. (ed) *Data Assimilation Systems*, BMRC Research Report, No. 27, Bureau of Meteorology, Melbourne: 104-13.

Hutchinson, M. F. 1991b, 'Climatic analyses in data sparse regions', In Muchow, R. C. and Bellamy, J. A. (eds) *Climatic risk in crop production*, CAB International, Wallingford: 55-71.

Hutchinson, M. F. and Bischof, R. J. 1983, 'A new method for estimating the spatial distribution of mean seasonal and annual rainfall applied to the Hunter Valley, New South Wales', *Australian Meteorological Magazine*, 31: 179-84.

Hutchinson, M. F., Booth, T. H., McMahon, P. J. and Nix, H. A. 1984, 'Estimating monthly mean values of daily total solar radiation for Australia', *Solar Energy*, 32: 277-90.

Hutchinson, M. F., Nix, H. A. and McMahon, J. P. 1992, 'Climate constraints on cropping systems', In Pearson, C. J. (ed) *Ecosystems of the world: Field crop ecosystems*, Elsevier, Amsterdam: 37-58.

IGAE 1992, *Inter-governmental agreement on the environment*, Commonwealth of Australia.

Jacobs, M. R. 1955, *Growth habits of the eucalypts*, Forest and Timber Bureau, Canberra.

JANIS 1995, *Broad criteria for the establishment of comprehensive, adequate and representative forest reserve system in Australia*, Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee, Canberra.

JANIS 1996, *Proposed nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia*, Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee, Canberra.

Koehn, J. D., O'Connor, J. P., O'Connor, W. G., O'Mahony, D. J., Raadik, T. A., Saddler, S. R. and Tumbridge, B.R. 1991, *Miscellaneous surveys of freshwater fish in Victoria: 1982-1990*, Arthur Rylah Institute Technical Report No. 110, Department of Conservation and Environment, Victoria.

LCC 1983a, *Land Conservation Council final recommendations, Gippsland Lakes Hinterland Study Area*, Land Conservation Council, Victorian Government Printing Office, Melbourne.

LCC 1983b, *Land Conservation Council final recommendations, Alpine Area special investigation*, Land Conservation Council, Victorian Government Printing Office, Melbourne.

LCC 1986, *Land Conservation Council final recommendations, East Gippsland Area (Review)*, Land Conservation Council, Victorian Government Printing Office, Melbourne.

LCC 1991, *Land Conservation Council Rivers and Streams Special Investigation Final Recommendations*, Victorian Government Printing Office, Melbourne.

Lesslie, R. and Maslen, M. 1995, *National Wilderness Inventor. Handbook of principles, procedures and usage*, 2nd Edition, Australian Heritage Commission, Canberra.

Lobert, B. O., Gillespie, G. R., Lunt, I. D., Peacock, R. J. and Robinson, D. 1991, *Flora and fauna of the Goolengook forest block East Gippsland, Victoria*, Ecological Survey Report No. 35, Department of Conservation and Environment, Victoria.

Long, I. 1990, *Regional fire protection plan - Bairnsdale Region*, Department of Conservation, Forests and Lands, Victoria.

Macmillan, L. 1990, *Conservation value and status of Victorian rivers. Part II East Gippsland*, Faculty of Environmental Design and Construction Research, RMIT, Melbourne.

Mansergh, I. M. and Belcher, C. 1992, *Tiger Quoll *Dasyurus maculatus**, Action Statement No. 15, Department of Conservation and Natural Resources, Victoria.

Marchant, R., Barmuta, L. and Chessman, B. 1994, Preliminary study of the ordination and classification of macroinvertebrate communities from running waters in Victoria, Australia, *Australian Journal of Marine and Freshwater Research*, 45: 945-62.

Mazzer, T. 1994, *Giant Burrowing Frog *Heleioporus australiacus**, Action Statement No. 61, Department of Conservation and Natural Resources, Melbourne.

McCarraher, D. B. 1986, *Distribution and abundance of sport fish populations in selected Victorian estuaries, inlets, coastal streams and lakes. 1 Orbost Region*, Arthur Rylah Institute Technical Report No. 43, Department of Conservation, Forests and Lands, Victoria.

McMahon, J. P., Hutchinson, M. F., Nix, H. A. and Ord, K. D. 1995, *ANUCLIM Users Guide*, Centre for Resource and Environmental Studies, Institute of Advances Studies, The Australian National University, Canberra.

Menkhorst, P. W. 1993, *Regent Honeyeater *Xanthomyza phrygia**, Action Statement No. 41, Department of Conservation and Natural Resources, Victoria.

Morgan, G. J. 1986, 'Freshwater crayfish of the genus *Euastacus* Clark (Decapoda: Parastacidae) from Victoria', *Memoirs of the Museum of Victoria*, 47: 1-57.

Morton, S. R., Short, J. and Barker, R. D. 1995, *Refugia for Biological Diversity in Arid and Semi-arid Australia*, Biodiversity Series Paper No. 4, Biodiversity Unit, Department of the Environment, Sport and Territories, Canberra.

Mullens, I. C. 1995, *Environmental process and landscape pattern: Rainforests of the south coast of New South Wales*, Unpublished Honours Thesis, Department of Geography, The Australian National University, Canberra.

Nix, H. A. and Switzer, M. A. 1991, *Rainforest animals, Atlas of vertebrates endemic to Australia's wet tropics*, Kowari 1, Australian National Parks and Wildlife Service, Canberra.

Noble, I. R. and Slatyer, R. O. 1980, 'The use of Vital attributes to predict successional changes in plant communities subject to recurrent disturbances' *Vegetatio* 43: 5-21.

Norris, K. C. and Belcher, C. A. 1986, *The Brush-tailed Rock-wallaby in Gippsland*, 1986, Unpublished report to the Department of Conservation, Forests and Lands, Victoria.

- Pimm, S. L., Jones, H. L., and Diamond, J. 1988, 'On the risk of extinction', *The American Naturalist* 132: 757-785.
- Raadik, T. A. 1992a, 'Distribution of freshwater fishes in East Gippsland, Victoria, 1967-1991', *Proceedings of the Royal Society of Victoria*, 104: 1-22.
- Raadik, T. A. 1992b, *Aquatic fauna of East Gippsland: a resource document*, VSP Technical Report No. 14, Department of Conservation and Natural Resources, Victoria.
- Raadik, T. A. 1992c, *Aquatic fauna of East Gippsland: Fish and macroinvertebrates*, VSP Technical Report No. 16, Department of Conservation and Natural Resources, Victoria.
- Raadik, T. A. 1995, *An assessment of the significance of the fishes and freshwater decapods in three areas of East Gippsland*, Flora and Fauna Technical Report No. 140, Department of Conservation and Natural Resources, Victoria.
- Rabinowitz, D. 1981, 'Seven forms of rarity', In Synge, J. (ed) *The Biological Aspects of Rare Plant Conservation*, John Wiley, New York: 205-217.
- Rowan, J., Russell, L. and Ransome, S. (in press) *Land systems of Victoria*, Edition 2, Department of Natural Resources and Environment, Victoria.
- Saxon, M. J., Henry, S. R. and Seebeck, J. H. 1994, *Management strategy for the conservation of the Long-footed Potoroo Potorous longipes, in Victoria*, Arthur Rylah Institute Technical Report No. 127, Department of Conservation and Environment, Victoria.
- Thackway, R. and Cresswell, I. D. 1995, *An Interim Biogeographic Regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperative Program*, Australian Nature Conservation Agency, Canberra.
- Thomas, V. C., Henry, S. R. and Baker-Gabb, D. J. 1994, *Long-footed Potoroo Potorous longipes*, Action Statement No. 58, Department of Conservation and Natural Resources, Victoria.
- Tunbridge, B. R. 1983, *Fish populations in the Croajingolong National Park*, Arthur Rylah Institute Technical Report No. 9, Department of Conservation, Forests and Lands, Victoria.
- Turin, H., and den Boer, P. J. 1988, 'Changes in the distribution of carabid beetles in the Netherlands since 1880 II. Isolation of habitats and long-term trends in the occurrence of carabid species with different powers of dispersal (Coleoptera, Carabidae)', *Biological Conservation* 44: 179-200.
- Woodgate, P. W., Peel, W. D., Ritman, K. T., Coram, J. E., Brady, A., Rule, A. J. and Banks, J. C. G. 1994, *A Study of the old growth forests of East Gippsland*, Department of Conservation and Natural Resources, Victoria.

Glossary

Biological diversity

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.

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).

Ecological sustainable forest management

The ecologically sustainable development and management of the forest estate. The Ecologically Sustainable Development Working Group on Forest Use specified three requirements for sustainable forest use. They are: maintaining the ecological processes within a forest (the formation of soil, energy flows, and the carbon, nutrient and water cycles); maintaining the biological diversity of forests; and optimising the benefits to the community from all uses of forests within ecological constraints.

Old growth forest

Forest which contains significant amounts of its oldest growth stage in the upper stratum, usually senescing trees, and has been subject to any disturbance, the effect of which is now negligible.

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.

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.

Definitions of Conservation Status Categories

Endangered Species Protection Act

(E) Endangered - A species is endangered if:

- it is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or
- its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction; or
- it might already be extinct, but is not presumed extinct.

In addition, a species may be regarded as endangered if at any stage of its biological development it is difficult to visually differentiate it from an endangered species.

(V) Vulnerable - A species is vulnerable at a particular time if:

- within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

In addition, a species may be regarded as vulnerable if at any stage of its biological development it is difficult to visually differentiate it from a vulnerable species.

(PX) Presumed extinct - A species is presumed extinct at a particular time if:

- it has not been definitely located in nature during the preceding fifty years; or
- it has not been definitely located in nature during the preceding ten years despite thorough searching during the period.

ANZECC

Source: Australian and New Zealand Environment and Conservation Council (April 1991) *Threatened Australian Vertebrate Fauna*, Australian Nature Conservation Agency, Canberra.

(PX) Presumed extinct -Species or subspecies not definitely located in the wild during the past fifty years.

(E) Endangered-Species or subspecies in danger of extinction and whose survival is unlikely if the causal factors continue to operate.

(V) Vulnerable -Species or subspecies believed likely to move into the 'Endangered' category in the near future if the causal factors continue to operate.

Threatened Fauna of Victoria

Source: Office of the Commissioner for the Environment - *Agriculture and Victoria's Environment: State of the Environment Report*, Government of Victoria, Melbourne.

(X) Extinct -Taxa that are considered to have occurred in Victoria since European settlement but that have not definitely been recorded in the wild in Victoria during the past 50 years.

(E) Endangered -Taxa in danger of extinction in Victoria and whose survival is unlikely if the factors causing their decline continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of

extinction. Also included are taxa that may be extinct but have definitely been recorded in the wild in the past 50 years.

(V) Vulnerable -Taxa believed likely to move into the Endangered category in the near future if the factors causing their decline continue operating. Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still common but are under threat from severe adverse factors throughout their range.

(R) Rare -Taxa with small Victorian populations that are not at present Endangered or Vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly distributed over a more extensive range.

(K) Insufficiently Known-Taxa in Victoria that are suspected but not definitely known to belong to any of the above categories.

(RC) Restricted Colonial Breeding or Roosting -Taxa which may be common but have only a few colonial breeding or roosting sites in Victoria have been included in the list of threatened fauna because they are at risk when gathered together.