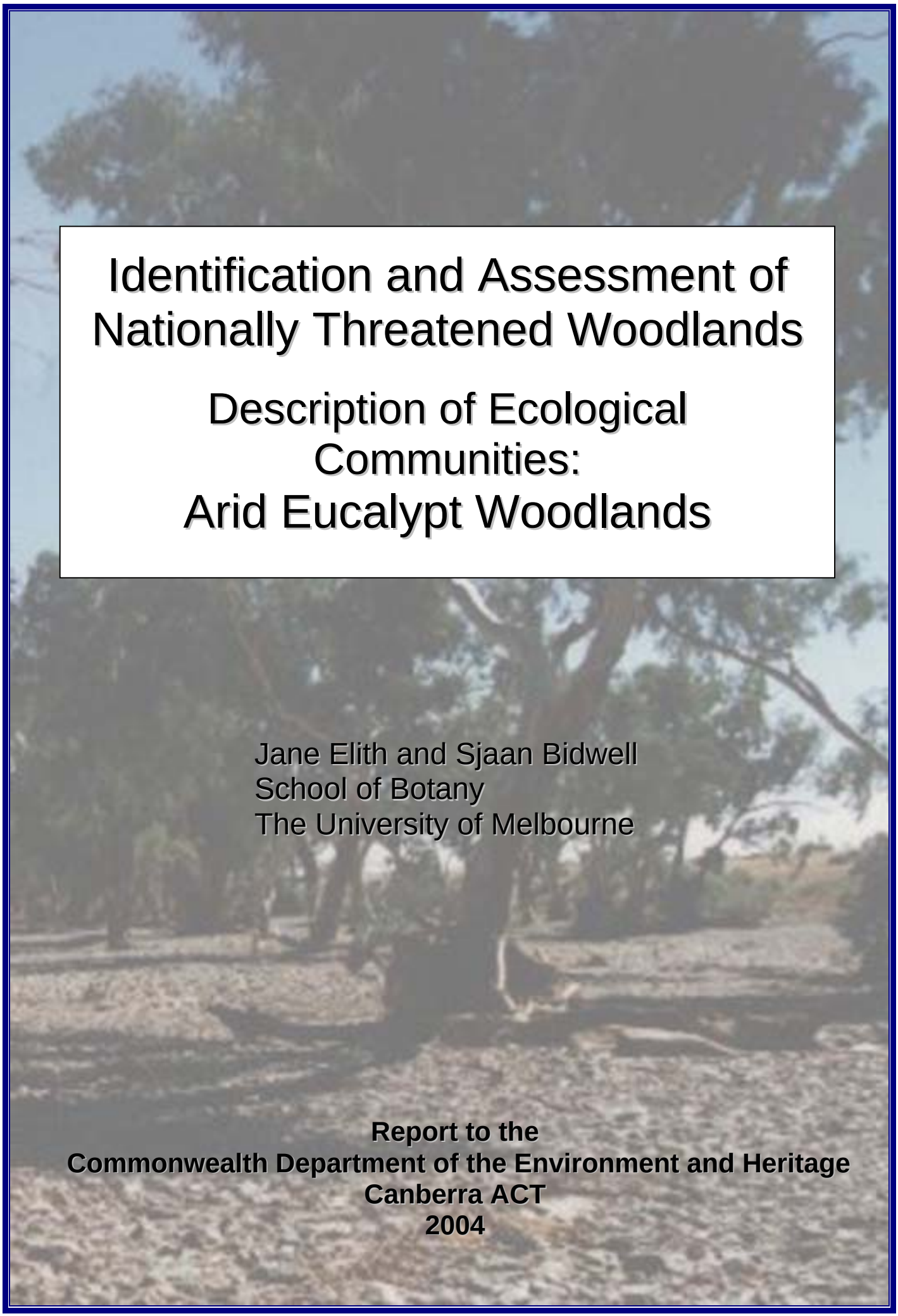

# Identification and Assessment of Nationally Threatened Woodlands

## Description of Ecological Communities:
## Arid Eucalypt Woodlands

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**Report to the**
**Commonwealth Department of the Environment and Heritage**
**Canberra ACT**
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## *Caveat*

The views expressed in this report are those of the authors and do not necessarily reflect the opinions of the Commonwealth Government, the Minister for the Environment and Heritage, the Threatened Species Scientific Committee or individuals and bodies that assisted with this project. While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication. This report and sections of this report do not constitute a nomination or nominations under the *Environment Protection and Biodiversity Conservation Act 1999*.


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Some people have very kindly supplied us with digital copies of surveys, database records etc. These are referenced throughout and acknowledged where the text has been used directly from the source documents. We particularly thank the Queensland Herbarium, John Benson, David Keith and the DEH (SA) for these data.

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## *Abbreviations*

| | |
|---|---|
| **AgWA** | Department of Agriculture, WA |
| **CALM** | Department of Conservation and Land Management, WA |
| **DEC** | Department of Environment and Conservation, NSW |
| **DEH (SA)** | Department for Environment and Heritage, SA |
| **DEH** | Commonwealth Department of the Environment and Heritage |
| **DIPNR** | Department of Infrastructure, Planning and Natural Resources, NSW (formerly DLWC) |
| **DLWC** | Department of Land and Water Conservation, NSW (now Department of Infrastructure, Planning and Natural Resources, NSW) |
| **DVT** | Definitive Vegetation Type |
| | |
| **EPA** | Environment Protection Agency |
| **EPBC** | Environmental Protection and Biodiversity Conservation Act 1999 |
| **IBRA bioregion** | Interim Biogeographic Regionalisation for Australia (version 5.1) |
| **IUCN** | International Union for Conservation of Nature and Natural Resources (now the World Conservation Union) |
| **MU** | Map Unit |
| **MVS** | Major Vegetation Subgroup |
| **NEC** | National Ecological Community |
| **NLWRA** | National Land and Water Resources Audit |
| **NSW** | New South Wales |
| **NSW NPWS** | New South Wales National Parks and Wildlife Service |
| **NT** | Northern Territory |
| **NVIS** | National Vegetation Information System |
| **Qld** | Queensland |
| **RBGSyd** | Royal Botanic Gardens, Sydney |
| **RE** | Regional Ecosystem |
| **REDD** | Regional Ecosystem Description Database |
| **SA** | South Australia |
| **TEC** | Threatened Ecological Community |
| **TSSC** | Threatened Species Scientific Community |
| **WA** | Western Australia |
| **WATSC** | Western Australian Threatened Species and Communities Unit |

## *Introduction*

This report comprises an overview with appendices and 23 descriptions of proposed National Ecological Communities (NECs) for non-mallee eucalypt woodlands of arid and semi-arid Australia. The consultancy was proposed by the Threatened Species Scientific Committee (TSSC) and the Commonwealth Department of the Environment and Heritage (DEH).

This report contains information about the objectives of this consultancy, the available data, and a description of the procedures used in forming the NECs. It also includes key definitions, and explanations of why communities in the state[1] data have been included or excluded from the NECs. These latter explanations will be important for future consultancies, to maintain consistency in the overall assessment process. The NEC descriptions provide a commentary on our opinion of the current state of the definitions of the NECs; this has been necessary because some of them are only broadly outlined, awaiting further data, and some would benefit from a more detailed consideration than this consultancy can provide. This section also contains advice that the groups (NECs) as currently defined are still very broad. In many cases we believe that the groups are closer to National Ecological Alliances (NEAs) rather than NECs. The next stage / phase may be to consider the potential for defining components of these NEAs as NECs in their own right. This may be the most satisfactory approach to nominating threatened communities for two reasons. One is that, at the broad scale we have used, some of the threatened components / communities are subsumed into a broader group that is not threatened (this is despite our effort to separate components if they face particular threats). The second is that it is hard to defend some of the broad groups as an ecological unit – the biotic and abiotic features, and their interactions, are sometimes quite diverse.

This consultancy addresses ecological communities; as such, there will be many eucalypt species in the arid / semi-arid zone that are not addressed here. The assessment of threatening processes on individual species is a separate task, and is not considered here.

The TSSC proposed that the consultancy should be defined in terms of the Major Vegetation Subgroups (MVSs) within the National Vegetation Information System (NVIS), and expected that the NVIS data would be an important starting point for analysis of vegetation. We have included an analysis of the NVIS data because this consultancy applies to the five most extensive states / territories of Australia. We expect that DEH will be interested in the current status of data collation within NVIS, and of issues that have arisen in dealing with the data. The analysis should also be useful to those doing future consultancies.

## *Terms of reference*

The terms of reference for this consultancy were outlined in several documents provided by DEH. They defined the objectives of the consultancy as follows:

1. Define all national woodland ecological communities within the "Arid Eucalyptus" woodland categories. All woodland ecological communities within this category should be described (including all sub-communities as recognised by the States). Information on species composition (including key indicator species, relative species abundance, and a list of all surveyed flora and fauna species) and the distribution of each national ecological community should be included, as well as abiotic components, and processes of interaction between the biotic and abiotic components where available. Maps showing the extent of the woodland ecological communities should be produced, at a scale appropriate to each woodland.
2. Collate existing information held by the States, Local Governments, academic researchers and other experts as to the status of any sub-communities of arid Eucalyptus woodlands within their jurisdiction. Include data on extent (current and previous), condition (including level of degradation such that the sub-community is no longer considered to be a part of a broader national woodland ecological community), threats, available maps and State listing.
3. Based on this existing information, analyse the conservation status of threatened arid Eucalyptus woodlands according to the TSSC criteria and guidelines.

[1] In this report, "state" includes states and territories of Australia

## *Definitions:*

*1. Arid and semi-arid Australia*

The study area ("arid and semi-arid Australia") was initially defined by growing season[2], then adjusted to generally include whole IBRA regions (IBRA, 2002) and to exclude largely tropical areas. After discussion with the TSSC (Dec 2002), the Desert Uplands of Queensland were removed from the study area, and the Western Division boundary was used as the eastern boundary for the NSW extent of the study area. These changes attempt to make the region more consistent with respect to threats and stresses on the ecosystems, and will generally exclude intensive land use areas (e.g., see Shepherd et al. 2002). This results in a study area covering 31 IBRA regions (Figure 1 and Table 1).


*Figure 1: The arid / semi-arid region of Australia (black outline). Letters refer to the IBRA regional code (Table 1) and grey shading indicates tropical regions as defined in Fox et al (2001)*

*2. Eucalypt woodlands*

The name for this consultancy that was originally proposed by DEH was "Arid Eucalyptus Woodlands". We have changed it to "eucalypt" woodlands because we are considering the genera *Eucalyptus, Corymbia* and *Angophora.* Details of taxonomic issues are addressed, where necessary, within the descriptions of the NECs.

'Woodlands" have been defined within NVIS and we have endeavoured to remain consistent with their classification. The classification is structural and is broadly in line with the classification of Walker and Hopkins (1990). Details are provided here (Table 2), adapted from Brocklehurst and Gibbons (2003). In summary, woodlands comprise communities where the foliage cover of the tree stratum is less than 30% and greater than a low % that would be interpreted loosely as scattered and infrequent trees. *Open* woodlands have <10% cover. If trees are <10m, it is a *low* woodland; at the other extreme trees >30m form a *tall* woodland. However, this needs qualification when applied to NECs. In describing the NECs, we have included state-mapped communities classified in NVIS as something other than "woodland" if there were logical reasons for doing so. Usually these reasons reflected the fact that communities were floristically similar even though structurally different. Since the differences in structure may be reflecting simple changes in soil fertility and / or depth, and

[2] BIOCLIM climate layers (Nix, 1986) were used to define growing season (where no. months with precipitation /evaporation is greater than 0.3 = 0 or 1 ), following Williams and Calaby (1985)

because, at a national level, broad grouping may be appropriate, communities with different structures may co-exist in one NEC. Details are given within the NEC descriptions.

In this consultancy we have generally accepted the structural classification of the data as provided by the states. In some cases a community will be mapped as a grassland in one state but neighbouring polygons in another state will be mapped as a woodland (e.g., *Eucalyptus brevifolia* in WA and NT – Appendix 5c). This seems to reflect the average cover of the community over large extents in each state rather than an inconsistent approach to classification. Details of methods for forming the NECs include explanations of how we have dealt with such variations.

*3. Other information*

Further definitions relevant to this consultancy are addressed in the section "Identification of relevant communities for forming NECs".

*Table 1. IBRA regions[1] in the arid / semi-arid area[2]*

| ***Region name*** | ***State(s)*** | ***Region code*** |
|---|---|---|
| Broken Hill Complex | NSW, SA | BHC |
| Burt Plain | NT | BRT |
| Carnarvon | WA | CAR |
| Channel Country | NSW, NT, QLD, SA | CHC |
| Coolgardie | WA | COO |
| Cobar Peneplain | NSW | CP (only subregions 1 to 5) |
| Central Ranges | NT, SA, WA | CR |
| Davenport Murchison Ranges | NT | DMR |
| Darling Riverine Plains | NSW, QLD | DRP (only subregions 1 to 10) |
| Finke | NT, SA | FIN |
| Flinders Lofty Block | SA | FLB (only subregions 3 to 5) |
| Gascoyne | WA | GAS |
| Gawler | SA | GAW |
| Gibson Desert | WA | GD |
| Great Sandy Desert | NT, WA | GSD |
| Great Victoria Desert | SA, WA | GVD |
| Hampton | SA, WA | HAM |
| Little Sandy Desert | WA | LSD |
| MacDonnell Ranges | NT | MAC |
| Murray Darling Depression | NSW, SA | MDD (only subregions 1 and 6) |
| Mitchell Grass Downs | NT, QLD | MGD |
| Mount Isa Inlier | QLD | MII[3] |
| Mulga Lands | NSW, QLD | ML |
| Murchison | WA | MUR |
| Nullarbor | SA, WA | NUL |
| Pilbara | WA | PIL |
| Riverina | NSW | RIV (only subregion 1) |
| Simpson Strzelecki Dunefields | NSW, NT, QLD, SA | SSD |
| Stony Plains | NT, SA | STP |
| Tanami | NT, WA | TAN |
| Yalgoo | WA | YAL |

[1] Based on IBRA version 5.1
[2] All subregions of a region are included unless otherwise noted
[3] note: subregional code for MII: NWH

***Table 2: Characteristics of woodlands, as defined for NVIS. The shaded cells do not refer to woodlands. Adapted from Brocklehurst and Gibbons (2003)***

| | **Cover Characteristics** | | | | | |
|---|---|---|---|---|---|---|
| | **Foliage cover *** | 70-100 | 30-70 | 10-30 | <10 | ≈0 |
| | **Crown cover **** | >80 | 50-80 | 20-50 | 0.25-20 | <0.25 |
| | **% cover ***** | >80 | 50-80 | 20-50 | 0.25-20 | <0.25 |
| | **Cover code** | d | c | i | r | Bi |
| | | | | | | |

| Growth Form | Height Ranges | Structural Formation Classes | | | | |
|---|---|---|---|---|---|---|
| Tree | <10 | low closed forest | low open forest | low woodland | low open woodland | isolated trees |
| Tree | 10-30 | closed forest | open forest | woodland | open woodland | isolated trees |
| Tree | >30 | tall closed forest | tall open forest | tall woodland | tall open woodland | isolated trees |
| * | Foliage Cover is defined for each stratum as 'the proportion of the ground, which would be shaded if sunshine came from directly overhead'. It includes branches and leaves and is similar to the Crown type of Walker & Hopkins (1990) but is applied to a stratum or plot rather than an individual crown. It is generally not directly measured in the field for the upper stratum, although it can be measured by various line interception methods for ground layer vegetation. | | | | | |
| ** | Crown Cover (canopy cover) as per Walker & Hopkins (1990). Although relationships between the two are dependent on season, species, species age etc (Walker & Hopkins (1990), the crown cover category classes have been adopted as the defining measure. | | | | | |
| *** | The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect methods on ground layer, or overstorey vegetative cover. That is for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover. | | | | | |

## *The NVIS data*

The NVIS data were the starting point for data collection in this consultancy. We recognise that NECs go further than the vegetation communities detailed in NVIS (eg faunal components, threats, responses to threats). Nevertheless, the state records of vegetation are a natural starting point for considering woodlands, and these are compiled (to varying degrees of completion) in NVIS. All consultancies will start at this point, so we envisage that a consistent approach to it and a thorough understanding of it will be helpful.

*We note that comments here relating to the NVIS data are not meant as a criticism of the intention or implementation of the database, but are relevant to the use of the data in its current format. In fact, we have been particularly impressed by the knowledge, diligence and helpfulness of the people working on the database; it will be an extremely useful resource to Australia. We recognise that it is a work in progress. In the same vein, where we highlight the lack of data from particular states or difficulties with the formats, we understand that the states are continuing to compile and supply data, and that the process of manipulating the data to suit NVIS is a large task. Some of the states with missing data in arid areas in NVIS have active research programs that are amassing high quality data. This is useful for the future; the comments throughout this report reflect the current data and issues with using it in this consultancy.*

The data available within NVIS at the beginning of this consultancy (August 2002) were variable in quality, with differences in coverage, attribute details, and mapping scale. This variability in data quality and depth is one of the biggest problems in working with the data. Table 3 gives examples of some of the data provided for extant vegetation of NT, WA, SA, NSW and pre-European vegetation of Qld. The fields included in this table are not the complete NVIS set, but are ones that are particularly relevant to this consultancy. Other data that are available for all states include statistics related to the mapped polygons (area, perimeter etc), codes that link the data to its state source, and information on the mapping scale behind the polygons. For some states there is information about whether polygons are regarded as mosaics or pure vegetation types.

The introduction to NVIS explains: "The National Vegetation Information System information framework defines a hierarchical classification system for describing the structural and floristic patterns of groups of plants in the landscape... The hierarchy is based on six levels, presenting broad vegetation classifications at national scales (Levels I-III) to a detailed level of information for users at regional scales (Levels IV-VI)"(EA, 2002). Levels 1 to VI are, respectively: class, structural formation, broad floristic formation, sub-formation, association, & sub-association. At this stage not all levels have been provided by all states (Table 3). Also, data for some levels exist but are not complete because they do not conform to the NVIS criteria (further details are in the audit report - NLWRA 2001, pp 146 on). NVIS will continue to be under development for some time; there is no clear time frame for completion but continual upgrade is expected.

*Extant data*

The following points highlight features of the extant data of the arid and semi-arid areas that impact on this consultancy (and see Tables 3 and 4). Note that in Table 3 we have highlighted data gaps or insufficient information (according to the NVIS criteria) with shaded cells. The data are a typical sample. The issues identified here are likely to be relevant but not identical for temperate and tropical areas.

1. **NT:** Most of the NT data for arid areas are mapped at 1:1 000 000. No level VI details are provided. Scientific names are not always current in this version of NVIS (eg *E. terminalis* is now *C. terminalis*). The data are largely from the 1:1 000 000 vegetation map of the NT (Wilson *et al.* 1990). Partly in response to issues that arose in supplying the first round of NVIS data, the Department of Infrastructure, Planning and Environment in NT have just completed a large investigation and planning procedure for their vegetation description and mapping (Brocklehurst and Gibbons 2003). They have now defined 365 Definitive Vegetation Types (DVTs) across the state, based on a variety of written data. They plan to update the existing NVIS data in line with these and add new data as it is available. Thus, we can expect substantial and ongoing changes to the NT NVIS data. Some of the existing NVIS units will be changed; either divided into a number of new map units or amalgamated.

2. **WA:** The WA data are largely Beard's data mapped at 1:250 000, with aerial photographs of present day vegetation used to "cut" the mapped extents to current extent. The NVIS source codes are links to this mapping. Since this Beard mapping is regional the data are relevant to each region, not summarised across the whole state. This results in discontinuities between map sheets. No level VI data or environmental descriptions are provided. Scientific names are not always current (eg *E. victrix* mapped as *E. microtheca*). Updates (to Level V and VI descriptions, and mapping polygons continuously between mapsheets) are now being completed by the state but were unavailable for this report. However, we have used any published updated ancillary material (e.g., Beeston et al 2002, Shepherd et al 2002).

3. **SA:** the SA data are mapped at a variety of scales from 1:100 000 to 1:250 000. All levels are provided, but no environmental descriptions are included. Only part of the state has been mapped (Figure 2); large portions of the arid zone are missing. Scientific names are current. The data are provided from the completed biological surveys; since these are regional the data are relevant to each region, not summarised across the whole state. The biological surveys are ongoing so more data will gradually become available (DEH 2003).

4. **NSW:** NSW data are mapped at a variety of scales from 1:250 000 to 1:1 000 000. Much of the Western Division (i.e., the arid / semi-arid area) is only broadly mapped (1:1 000 000). The level of detail in NVIS is rather limited and variable (Level VI descriptions and environmental descriptions may be missing; see Table 3), and scientific names for the species are not all current (for example, all *Corymbia* are named *Eucalyptus*). The data are sourced from a variety of vegetation mapping and are not broadly consistent. Gathering additional vegetation data is particularly difficult in NSW because there are several government agencies that undertake vegetation mapping in NSW including DIPNR (formerly DLWC), NPWS, and RBGSyd (the latter two now amalgamated with EPA as the DEC). In some cases mapping has to be obtained from individual regional offices. This is partly because DLWC mapping is ongoing and the results not yet centralised. Keith (2002) has assessed available mapped data and has ranked it according to quality; his table is a useful summary of data that can be accessed (Table 4, Keith 2002). Negotiations are still continuing about data supply to NVIS from NSW.

5. **Qld:** the Qld extant data (Table 4) are in a completely different format to the other NVIS data, and are based on Qld's regional ecosystems (REs) and mapped in fine detail (1:100 000). Most of the data in the tables behind the maps are in code form, and the look-up tables (legends) are available from the Queensland Herbarium. These REs are described in text form for all of Qld (in Sattler and Williams 1999 and, as of May 2003, in database format on the web (EPA 2003b) but are only mapped for part of the state (Figure 2). In NVIS there is no explicit link between the regional ecosystems and the level I to VI descriptions. The data are useful in their detail but slow to work

with because of their lack of generalization. This is not a complaint (the data are an excellent source of information) but a recognition of the time required to summarize the relevant parts. The Qld data available in NVIS lacks mapping for extensive areas in the arid / semi-arid area. Queensland are continuing to complete mapping; additional mapping is already completed (Figure 3) but has not yet been purchased for NVIS. The data are relevant to each region, and are not summarised across the whole state. Queensland still use the Sattler and William (1999) definitions of "provinces" (the level below IBRA regions); these do not coincide with IBRA subregions (recognised informally within DEH and used for the threat mapping (Sattler et al 2003)). In some cases the discrepancies between the two make the spatial distributions specified in Sattler and Williams (1999) and on the web difficult to "translate" to subregions – see Appendix 3 for approximate equivalents. Qld are continuing their use of provinces (renamed subregions in the REDD but not equivalent to IBRA subregions). Qld EPA are updating the NVIS data to include floristic data. They are also actively making large amounts of data available on the web; the next version will include floristic and structural details from detailed vegetation surveys.

6. **Other general comments**:

- The mapped data were supplied to us in a geographic projection. This makes accurate calculation of areas in hectares difficult, which is a problem given that estimates of extant area and pre-European extent are required in all NECs.
- These consultancies were built on the framework of the MVSs in the NVIS data. This is a problem because the MVSs do not actually exist in the current NVIS implementation. This is discussed further in the section explaining methods for identifying relevant data for the NECs.
- The NVIS data are not the only data that map and describe the vegetation. In most cases, there are numerous other, more detailed data sources. These are referred to throughout the NEC descriptions and some of the more major sources are summarised in a later section.

*Figure 2: NVIS extant data: Dark blue: data to be included in NVIS stage 2; pale blue: no data identified for inclusion (NLWRA, 2001)*


*Figure 3: Mapping completed since the NVIS data were compiled (blue* highlights)

*Pre-European data*

The terms "pre-clearing" and "pre-European" are both used to describe the vegetation before modification. Whilst much of the data is closer to "pre-clearing" than 'pre-European", we have used the term "pre-European" here to be consistent with NVIS.

The pre-European vegetation has been reconstructed using a variety of interpolation and modelling techniques (eg current mapping, historical records, early aerial photographs). The underlying data used to describe the pre-European vegetation is often the extant mapping, and some states have assumed that the vegetation types mapped as current also represent the pre-European vegetation (NLWRA, 2001). Structural and floristic changes are often not considered. The report on the NVIS data (NLWRA, 2001) does not give enough detail on the process behind the mapping to understand it properly and to assess its reliability. The uncertainty inherent in the pre-European mapping, and the variability in its quality across Australia, are of particular concern. We intend to represent the uncertainty by (1) rounding areas appropriately (2) supplying bounds where possible. This is not something that is commonly addressed in work based on this mapping, but is important. More work needs to be done on it, and a set of recommendations for ways to represent uncertainty would be a useful outcome of further research.

As a general comment, the pre-European mapping does not always have codes that link the pre-European vegetation classes to current ones. This limits our ability to map pre-European distribution.

On a state-by-state basis:

1. **NT:** the NT data are based on the current mapping. The scale is therefore 1:1 000 000 and the vegetation is described to level V. In most cases the mapping indicates no change in extent in the arid areas.

2. **WA:** WA data are mapped from the 1:250 000 Beard data, and the Beard codes are supplied. Descriptions are to level V (lacking level IV). Shepherd et al (2002) discuss its preparation: "Since 1986, work has been underway to capture to a Geographic Information System (GIS) and associated Relational Database Management System (ORACLE) all of Beard's and Hopkins' pre-European vegetation mapping [….]. This Phase is now complete: there is a seamless map coverage of the whole State at the scale of 1:250,000 with consistent nomenclature."

3. **SA:** SA is only mapped to Level II ("woodland" etc), at 1:2 000 000. This mapping is of too broad a scale to be useful in this consultancy. Mapping of pre-European vegetation is currently in progress in SA, and will be available in the future.

4. **NSW:** NSW has not supplied pre-European mapping. However, data are available: in relation to the mapped data that he used, Keith (2002) comments: "Twenty of the 32 vegetation surveys examined had some form of pre-clearing projection of native vegetation available [details provided in his Table 1]. In these studies, native vegetation patterns in cleared areas has either been modelled by interpolating environmental relationships of vegetation determined by sampling in uncleared remnant areas […] or by inference from remnant woody plants and historical information…". Keith (2002) further pointed out that lack of pre-clearing mapping was more prevalent in the Western Division, but that in many cases substantial clearing has not occurred in these areas. Presumably such data will be supplied to NVIS some time in the future.

5. **Qld:** the Qld pre-clearing data provide a high level of detail in NVIS format (Table 3) but are not mapped for the entire study area - those parts of the Mount Isa Inlier and Mitchell Grass Downs bioregions that are north of ~ 21 degrees latitude are not mapped An example of the pre-European Queensland data is included in Table 3. Wilson *et al* (2002) summarize the method used to produce these data: "..the original extent of vegetation cover was mainly derived from 1960-67 aerial photography …approximately 1:80000 scale, and supplemented with recent digital Landsat Thematic Mapper ™ imagery and available land system, geology, soil and other land resource mapping. Photo-interpretation was followed by extensive field sampling, ground truthing and collection of quantitative site data. This information was then collated and analysed and photo-patterns attributed with vegetation / regional ecosystem types. Extrapolations were made from remnant vegetation to cleared areas via landform and photopattern, where vegetation had been substantially cleared on the aerial photography. Where available, older air photos and land survey / property records …. were also referenced". Further description can be found on the herbarium website: http://www.env.qld.gov.au/environment/science/herbarium/. The Qld pre-European data

do not have references to regional ecosystems in the attribute tables, so mapping pre-European extent of REs is not straightforward. However, Sattler and Williams (1999) do supply broad estimates of change in extent, which are useful in analysis of decline in geographic distribution.

*Table 3: Examples of extant vegetation data for NT, WA, SA and NSW, and pre-European data for Qld. Shaded cells indicate missing or inadequate data. The column headings referring to levels are further explained in the text introducing the NVIS data.*

| | **LEVEL_II** | **LEVEL_III** | **LEVEL_IV** | **LEVEL_V** | **LEVEL_VI** | **ENV_DESC** (environmental description) | **SOURCE_COD** (state coding for data source) | **SOURCE_DES** (description from the source data) |
|---|---|---|---|---|---|---|---|---|
| **NT** | Low open woodland | *Eucalyptus* low open woodland | *Eucalyptus* low open-woodland+/ *Acacia* open shrubland/ *Triodia* low hummock grassland | ;U+ *Corymbia opaca*, *Eucalyptus pruinosa*, *Corymbia papuana*/tree/6/r;M *Carissa lanceolata*, *Atalaya hemiglauca*, *Acacia lysiphloia*/shrub/3/I;G *Triodia pungens*, *Eulalia aurea*, *Enneapogon polyphyllus*/hummock grass/1/c | Unknown | Gently undulating peneplain, lateritic red earths | Map unit 42 | Unknown |
| | Low woodland | *Eucalyptus* low woodland | *Eucalyptus* low woodland+/Mixed sparse shrubland/Mixed tussock grassland | ;U+ *Eucalyptus terminalis*, *Eucalyptus chlorophylla*, *Eucalyptus pruinosa*/tree/6/i;M *Carissa lanceolata*, *Hakea arborescens*, *Terminalia canescens*/shrub/3/r;G *Chrysopogon fallax*, *Sehima nervosum*, *Heteropogon* spp/tussock grass/2/c | Unknown | Gently undulating or flat plains with clays or yellow earth and some gravely loam soils | Map unit 22 | Unknown |
| | Open woodland | *Eucalyptus* low open woodland | Unknown | Unknown | Unknown | Periodically flooded drainage lines to basins, deep alluvial sandy soils to red earths and clays | Map unit 27 | Unknown |
| **WA** | Low open woodland | *Eucalyptus* low open woodland | Unknown | Open low woodland; *E. oraria* | Unknown | Unknown | E46Lr | Open low woodland; *E. oraria* |
| | Open woodland | *Eucalyptus* open woodland | Unknown | Mosaic: Medium sparse woodland; desert oak between sand dunes / Hummock grasslands, grass steppe; hard spinifex (*T. basedowii*) | Unknown | Unknown | C1Mp/t2Hi | Mosaic: Medium sparse woodland; desert oak between sand dunes / Hummock grasslands, grass steppe; hard spinifex (*T. basedowii*) |
| | Woodland | *Eucalyptus* woodland | Unknown | Medium open woodland; wandoo (*E. wandoo*) | Unknown | Unknown | E5Mr | Medium open woodland; wandoo (*E. wandoo*) |
| **SA** | Low open woodland | *Eucalyptus* low open woodland | *Eucalyptus* low open woodland/Chenopod low shrubland/Mixed low forbland | ;U+ *Eucalyptus largiflorens*/tree/6/R;M *Enchylaena tomentosa* var., *Atriplex holocarpa*, *Salsola kali*/chenopod shrub/1/*;G *Tetragonia eremaea*, *Brassica tournefortii*, *Pycnosorus pleiocephalus*/forb/1/* | ;U1+ *Eucalyptus largiflorens*/tree/6/R;M1 *Enchylaena tomentosa* var., *Atriplex holocarpa*, *Salsola kali*/chenopod shrub/1/*;G1 *Tetragonia eremaea*, *Brassica tournefortii*, *Pycnosorus pleiocephalus*/forb/1/* | Unknown | NO0017 | *Eucalyptus largiflorens* Low open woodland |

| | LEVEL_II | LEVEL_III | LEVEL_IV | LEVEL_V | LEVEL_VI | ENV_DESC (environmental description) | SOURCE_COD (state coding for data source) | SOURCE_DES (description from the source data) |
|---|---|---|---|---|---|---|---|---|
| | Low woodland | *Eucalyptus* low woodland | *Eucalyptus* low woodland/*Acacia* unknown shrubland | U+ *Eucalyptus odorata*, *Eucalyptus leucoxylon* ssp., *Eucalyptus camaldulensis* var./tree,shrub/6/i;M *Acacia wattsiana*/shrub/-9999/Unknown | U1+ *Eucalyptus odorata*, *Eucalyptus leucoxylon* ssp., *Eucalyptus camaldulensis* var., *Bursaria spinosa*, *Allocasuarina verticillata*/tree,shrub/6/i;M1 *Acacia wattsiana*/shrub/-9999/Unknown | Unknown | MN0606 | *Eucalyptus odorata* Low open forest |
| | Low woodland | *Eucalyptus* low woodland | *Eucalyptus* low woodland/Lignum shrubland/Mixed low chenopod shrubland | ;U+ *Eucalyptus coolabah* ssp. *arida*/tree/6/I;M1 *Muehlenbeckia florulenta*/shrub/3/*;M *Stemodia florulenta*/shrub/2/*;G *Sclerolaena intricata*, *Sporobolus mitchellii*, *Cyperus gymnocaulos*/chenopod shrub/1/* | ;U1+ *Eucalyptus coolabah* ssp. *arida*/tree/6/I;M1 *Muehlenbeckia florulenta*/shrub/3/*;M2 *Stemodia florulenta*/shrub/2/*;G1 *Sclerolaena intricata*, *Sporobolus mitchellii*, *Cyperus gymnocaulos*/chenopod shrub/1/* | Unknown | CG0012 | *Eucalyptus coolabah, Sclerolaena intricata* Open Woodland |
| | Woodland | *Eucalyptus* woodland | *Eucalyptus* woodland/Mixed unknown shrubland/Mixed unknown rushland | U+ *Eucalyptus microcarpa*, *Eucalyptus* aff. *viridis*/tree/7/i;M *Acacia pycnantha*, *Cassinia laevis*/shrub/-9999/Unknown;G *Lomandra multiflora* ssp. *dura*, *Maireana enchylaenoides*, *Lomandra densiflora*/tussock grass,shrub,forb/-9999/Unknown | U1+ *Eucalyptus microcarpa*, *Eucalyptus* aff. *viridis*/tree/7/i;M1 *Acacia pycnantha*, *Cassinia laevis*/shrub/-9999/Unknown;G1 *Lomandra multiflora* ssp. *dura*, *Maireana enchylaenoides*, *Lomandra densiflora*, *Rhagodia parabolica*/tussock grass, shrub, forb, rush, hummock | Unknown | MN0402 | *Eucalyptus microcarpa*, +/- *Eucalyptus* aff. *viridis* Woodland |
| **NSW** | Open woodland | *Eucalyptus* open woodland | Box unknown | Box species unspecified | Unknown | Unknown | Box sp. | New_tag |
| | Open woodland | *Eucalyptus* open woodland | *Eucalyptus* Open Forest | *Eucalyptus camaldulensis* Open Forest | -9999 | Occurs adjacent to rivers on levees and flats of grey clay soil | 1sc | Riverine Forest Scattered |
| | Open woodland | *Eucalyptus* open woodland | *Eucalyptus* open woodland | *Eucalyptus tessellaris* open woodland | Unknown | Unknown | Eute | New_tag |
| | Woodland | *Eucalyptus* low woodland | *Eucalyptus* Woodland | *Eucalyptus populnea* ssp. *bimbil* woodland | *Eucalyptus populnea* ssp. *bimbil* woodland | Mixture of unconsolidated creek sediments and brown clays. Extensive slopes and low ridges. Floodplains coming off stony downs. | 5/12 | Bimble Box communities |

| | LEVEL_II | LEVEL_III | LEVEL_IV | LEVEL_V | LEVEL_VI | ENV_DESC (environmental description) | SOURCE_COD (state coding for data source) | SOURCE_DES (description from the source data) |
|---|---|---|---|---|---|---|---|---|
| **PRE-EUROPEAN Qld** | Low woodland | *Eucalyptus* low woodland | *Eucalyptus* low woodland/mixed sparse shrubland/*Astrebla* and *Iseilema* open tussock grassland | ;U+ *Eucalyptus ochrophloia*, *Acacia cambagei*, *Eremophila mitchellii*/tree/6/i;M *Eremophila maculata*, *Eremophila mitchellii, Myoporum deserti*/shrub/3/r;G *Aristida latifolia*, *Astrebla lappacea*, *Chloris pectinata*/tussock grass,forb,fern/2/I | ;U1+ *Eucalyptus ochrophloia*, *Acacia cambagei*, *Eremophila mitchellii*/tree/6/i;M2 *Eremophila maculata*, *Eremophila mitchellii*, *Myoporum deserti*, *Senna artemisioides* ssp. *coriacea*/shrub/3/r;G1 *Aristida latifolia*, *Astrebla lappacea*, *Chloris pectinata*, *Abutilon otoc* | Flat alluvial plains along the Bulloo River and Blackwater Creek. Soils are a complex of deep red and brown alluvial texture contrast soils, and brown and grey, heavy, alluvial clays. | 198/159/150:50/30/20 | Unknown |
| **PRE-EUROPEAN Qld** | Woodland | *Eucalyptus* woodland | *Eucalyptus* woodland/mixed tall open shrubland/grassy open tussock grassland | ;U+ *Eucalyptus populnea*, *Eucalyptus melanophloia*, *Alectryon oleifolius*/tree/7/i;M *Eremophila mitchellii*, *Canthium oleifolium*, *Capparis lasiantha*/shrub/4/i;G *Bothriochloa decipiens*, *Enteropogon acicularis*, *Aristida ramosa*/tussock grass,forb,rush/2/I | ;U1+ *Eucalyptus populnea*, *Eucalyptus melanophloia*, *Alectryon oleifolius*, *Atalaya hemiglauca*, *Acacia excelsa*/tree/7/i;M1 *Eremophila mitchellii*, *Canthium oleifolium*, *Capparis lasiantha*, *Geijera parviflora*, *Acacia aneura*/shrub/4/i;M2 *Carissa ovata*, *Senna artemisioides* | Lower and middle slopes of gently undulating lowlands and plains. Soils are deep loamy red earths with ferruginous gravel or deep texture contrast soils with thin sandy or loamy surfaces over strongly alkaline subsoils. | 77/187:70/30 | Unknown |

***Table 4 : Queensland extant data****. The codes are those in the attribute tables and, for example, refer to Regional Ecosystem numbers (REs) and percentage contributions to mosaics.*

| UVEG | UVEG1 | UVEG_PERCE | UVEG _P1 | UVEG _P2 | VEG | VEG1 | VEG% | VEG_P1 | VEG_P2 | RE | RE_ SUMMARY | RE_ DISPLAY | RE_PERC_DI | RE_ZONE | RE1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 205/202 | 205 | 80/20 | 80 | 20 | 5a/4a | 5a | 80/20 | 80 | 20 | 4.9.7/4.9.11 | 4.9.7/4.9.11 | 9.7/9.11 | 80/20 | 9 | 4.9.7 |
| clear | clear | 100 | 100 | 0 | clear | clear | 100 | 100 | 0 | clear | clear | clear | 100 | nil | clear |
| clear | clear | 100 | 100 | 0 | clear | clear | 100 | 100 | 0 | clear | clear | clear | 100 | nil | clear |
| 145 | 145 | 100 | 100 | 0 | 1b | 1b | 100 | 100 | 0 | 4.9.1 | 4.9.1 | 9.1 | 100 | 9 | 4.9.1 |
| | | | | | | | | | | | | | | | |
| **continued from above...** | **VM_SYMBOL** | **VM_POLY** | **VM_ STATUS** | **VM_ STATUS1** | **RE_ PERCENT** | **RE_P1** | **RE_P2** | **L** | **V** | **MAP_NUM** | **MAP_NAME** | **MAP_ABBR** | **EA_REPC** | **RELY** | |
| | 115 | O-subdom | N/O | N | 80/20 | 80 | 20 | B | B | 7755 | CAMERON DOWNS | came | 4.9.7/4.9.11% 80/20 | BB | |
| | 1 | na | | | 100 | 100 | 0 | A | A | 7755 | CAMERON DOWNS | came | clear%100 | AA | |
| | 1 | na | | | 100 | 100 | 0 | A | A | 7755 | CAMERON DOWNS | came | clear%100 | AA | |
| | 171 | NotOfC | N | N | 100 | 100 | 0 | A | B | 7755 | CAMERON DOWNS | came | 4.9.1%100 | AB | |

## *Data on threatening processes*

An important part of defining NECs in this consultancy is to consider the different levels of threat facing the communities and the different responses to threat. A report was released in March 2003 (Sattler, 2002) that is the first national attempt at looking at processes threatening species and ecosystems. Examples of the data on threatening processes, mapped for the arid region, are presented in Appendix 2.

The data represent collations of state data for each IBRA subregion. In each subregion, threatened ecosystems have been identified by the states (the data behind the identification vary - qualitative and / or quantitative; with records of data type) and the mapping represents a record that the threat of interest is relevant to at least one threatened ecosystem (of any type - eg mound spring, wetland, clay pan, woodland) in the subregion. Note that, because there is variation in the amount of work that the states have done in mapping and identifying threatened ecosystems, the resultant data is biased by effort - no threat mapped does not imply that no threat exists. The work is underpinned by state collations of data. These vary in depth; in general, states have completed perhaps one or two subregions in detail, as case studies. However, WA has provided very detailed data (draft supplied to us by N. McKenzie, CALM, March 2003). This is particularly useful but by its nature – sub-regional and not necessarily linked to NVIS – slow to work through. Nevertheless, it provides important detail that is not available elsewhere. It is notable that, in the terrestrial biodiversity report (Sattler 2002), the NT have identified very few threatening processes in the state's subregions. Most of the records for threatening processes in the NT are ones identified in those subregions in neighbouring states. Additional descriptive information on threatening processes is now provided in the bioregional summaries available on the web (Woinarski 2002)

## *Other available data*

A list of contacts and other data is provided in the acknowledgements and in Appendix 1. In addition, the data sets and references that are providing substantial amounts of additional information for us are summarised in Table 5.

***Table 5: Major data sources in addition to state NVIS data***

| *State* | *Data* |
|---|---|
| NSW | A new mapping set for NSW that is "a compilation, interpretation and adaptation of existing surveys and maps of native vegetation" (Keith, 2002). DLWC and NPWS regional data (via contacts in regional offices). Various vegetation surveys and accompanying mapsheets published in *Cunninghamia*. John Benson (RBG, Sydney) is describing vegetation across NSW and compiling a detailed data-base with exceptional detail relevant to this work |
| NT | Wilson (1990) and mapping of tropical areas (Fox et al 2001). New directions: Brocklehurst and Gibbons (2003) |
| Qld | Sattler and Williams (1999); Environment Protection Authority (2003); mapping of tropical areas (Fox et al, 2001); plus the series of vegetation survey reports, land use studies and CSIRO land unit studies (Appendix 1) |
| SA | Series of biological surveys for the regions (Appendix 1). These have extensive information in them, including data on birds, mammals, reptiles and frogs in addition to vegetation. The full set of surveys are scheduled for completion by 2015 (DEH, 2003) |
| WA | NVIS updates from Shepherd et al (2002); data on sub-regional assessment of ecosystems at risk (McKenzie, 2003); mapping of tropical areas (Fox et al, 2001); various surveys (eg, of eastern goldfields areas; Appendix 1); Beard's descriptions. |

### *Comments on other data deficiencies, uncertainties and difficulties*

- It may already be clear from the preceding information that a substantial amount of work that would inform this consultancy is in progress. This is occurring on many fronts:
  - definition of ecological communities: a number of states (eg WA, SA) are in the process of defining ecological communities rather than just vegetation associations
  - threats: whilst information on threats to communities is available in a broad range of the literature, coordinated approaches to it have more recently started (see below). New information appears frequently
  - biological surveys: arid and semi-arid areas have not a been completely surveyed by the states and tend to be left till last (because effort is focussed on areas where threats are most severe – e.g., areas of active clearing). Survey and mapping is planned for the arid areas and gradually becoming available
  - other state data: there are several important initiatives in relation to vegetation description (such as John Benson's work from the RBGSyd) that are in progress and will be completed in the next couple of years
  - NVIS data: we were one of the first users of the NVIS data and have used the first version of the data. Changes are ongoing, as described in previous sections

  This means that our definition of the NECs and component communities needs to adapt to the new data as they become available.
- It is not clear what level or grouping is appropriate for NECs. We have endeavoured to work at a level that seemed to fit the expectations of the consultancy, but it is our opinion that the grouping often reflects alliances rather than communities. Nevertheless, it provides a useful framework for future analysis of the data. This is discussed further in subsection 4 of the section " The NECs".
- Data on fauna are patchy and most frequently are not linked with descriptions of the vegetation (exceptions are in Qld and SA). We have identified additional data to fill this gap, but the data are limited and difficult to integrate with the vegetation data.
- The information on current and pre-European extent of these communities is not precise, but there is very little information to help us to establish the true uncertainty around the estimates. This is an important shortcoming for assessment of threat to ecological communities. Keith (2002) indicates ranges for areas, to indicate uncertainty, and Benson (in prep) presents estimates of accuracy of the data that help to establish bounds. These are important initiatives; it would be useful if they were widely adopted.
- There are many areas where the scale of ecological variation is smaller than the mapping scales. In part, this is covered by the mapping of mosaics (for example, in Beard's mapping). Mosaics not only include areas where the scale of pattern was too small to be mapped. They may also include areas where the mapper was relatively uncertain about photo interpretation. Thus mosaics encompass pattern and classification uncertainty. These issues and their implications are discussed in more detail in the section "The NECs".
- Following the above point, mapping in the arid/ semi-arid areas is often small scale – for example, scales of 1:1 000 000 are common. Unless there are more detailed studies, this means that proper definition of communities is impossible – certainly, at least, from a mapping perspective. It also means that estimates of area of occupancy and % remaining will have large uncertainties. A good example of the problem can be seen in NEC14 (coolibah communities). The NSW information is supplied by John Benson; he has gone to considerable lengths to source small, detailed studies and expert opinion to try to differentiate the coolibah communities from others existing in the mapped areas (the Western Division occurrences are largely mapped by Pickard and Norris 1994). Research is needed to develop methods for quantifying uncertainty in these situations.

- For arid and semi-arid areas, the most important changes in the communities are often changes in structure and species composition in response to threats - for example, grazing by feral and domestic herbivores (Keith, 2002), or alterations to water flows. Once again, there are limited data on this for many arid and semi-arid areas.
- The NVIS data, and the biodiversity data on threats that have just been released, are currently useful but, because they are still a work in progress, are variable and at times frustrating to work with.

## *Listing threatened communities*

*1. The EPBC Act*
The Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act) came into force in July 2000. The legislation provides a framework for environmental protection through its focus on protection of environmentally significant assets and conservation of Australian biodiversity (EA 2003). The Act has provisions for identifying, nominating, and listing threatened ecological communities; the criteria for assigning a community to the critically endangered, endangered or vulnerable categories are summarised in Appendix 5. The work of this consultancy aims to inform the process of identifying threatened NECs, and may lead to nominations of these communities.

*2. Listing of communities at the state level*
The states are at different stages in relation to their identification of, and assessment of threats to, ecological communities. Not all states have legislation for listing ecological communities at a state level. The information is presented here because we mention the state assessments in the NEC papers. On a state – by- state basis for those states within arid and semi-arid areas:

a) **NT:** The Northern Territory has recently enacted legislation for classifying the conservation status of wildlife species in the Territory (Territory Parks and Wildlife Conservation Act 2000, see Parks and Wildlife Commission, 2003). However, there is no legislation for listing threatened ecological communities. There appears to be little focus on ecological communities, although the recent subregional biodiversity summaries (Woinarski 2002) address threats in terms of communities and ecosystems.

b) **WA:** Western Australia currently has no legislation dealing specifically with Threatened Ecological Communities (TECs). The Western Australian Threatened Species and Communities Unit (WATSCU) keeps an informal list of TECs and other ecosystems regarded as at risk (this is available via the CALM website). A number of regulatory agencies such as the EPA, Agriculture WA, Ministry for Planning and CALM evaluate applications to clear or develop land and assess potential impacts on TECs within WA. Currently, the Western Australian Government is developing a Biodiversity Conservation Act for Western Australia. It is proposed that under this Act, threatened ecological communities may be listed following the standards of the World Conservation Union (IUCN) that include recognition of threats, priorities or rankings (Department of Conservation and Land Management 2002).

**c)** **SA:** South Australia has legislation for listing threatened species (the National Parks and Wildlife Act 1972, DEH 2003), but this does not extend to threatened ecological communities. However, they have an unpublished and provisional list of threatened ecosystems (DEH in progress) and are considering ecosystems in their assessments of biodiversity (e.g., Neagle 2003)

d) **NSW:** New South Wales has legislation (the Threatened Species Conservation Act 1995) that allows for listing of ecological communities (NPWS 2003b) and have listed several threatened communities (NPWS 2003a)

e) **Qld:** Queensland's Nature Conservation Act 1992 allow for listing of threatened species. The Vegetation Management Act 1999 allows for an assessment of the status of vegetation (regional ecosystems) and has criteria for assessing them as: endangered, of concern, or not of concern. In addition, the Environmental Protection Agency assesses Biodiversity Status, based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem (EPA 2003a, b).

*3. Threat assessments of these NECs*: The threat assessments do not include a judgment about the benefits of listing. If the purpose is to raise awareness, the fact that they are threatened is enough. If the purpose is to guide spending on survey, protection or recovery, some idea of the benefits resulting from these actions would make a useful addition. For example, if a community is threatened but there is little to be done because the threat is too expensive to mitigate, it may not be worth making it a priority. This is a policy issue which the TSSC may like to consider for the future.

### *Identification of relevant communities for forming NECs*

The process of identifying relevant communities began with a download of NVIS data for the region. The details of the search for appropriate data varied between the states and therefore the format of the data, but a common strategy was to search for communities with "Eucalypt*", "Corymbia" or "Angophora" in Level V that were also classified as some type of woodland (eg low open woodland) at Level III. This meant that in several cases we had to return for more data later – woodland communities that were described elsewhere were not within our set - alternative classifications varied but included "forest" and "tussock grassland". We also extracted data outside our area so we could judge the arid extent of communities that extend into temperate or tropical regions.

Some communities that exist within the study area are not primarily communities of arid or semi-arid Australia - they are more frequently represented outside the study area. Table 6 lists communities by dominant eucalypt, details relevant NVIS communities in the study area, and indicates communities that have been excluded from this consultancy (greyed cells). Dominant eucalypts are used here because it is a straightforward link to the NVIS data. Note that there may be communities that exist in some states but are not listed, because they do not appear in the NVIS data. In other words, this table is not meant to be a summary of NECs nor a comprehensive list of all communities. It is an attempt to explain why we have included or excluded mapped NVIS communities. We envisage that it could be used in the future to identify other communities that occur within the arid / semi-arid area.

Note that, in the original terms of reference for this consultancy, the relevant categories were defined as Major Vegetation Subgroups 18 & 19 (Arid eucalyptus low open woodlands with hummock grass, and Arid eucalyptus low open woodlands with tussock grass). However, it became clear that there was a problem with this definition because:

- NVIS does not record MVSs in its data (they appear to be categories invented afterwards and perhaps to be applied in the future)[3]
- Many of the arid zone communities are classified (correctly) in NVIS as eucalypt woodlands with shrubby or grassy understoreys (MVS 8 or 9). Although these MVSs are considered to be temperate woodlands, they have a substantial arid component.

The problem is that the terms "arid" and "temperate" apply to a range of the MVSs, so the classification originally envisaged by DEH does not work. Part of the underlying problem is that the NVIS Major Vegetation Groups (MVGs), which sit "above" MVSs in the conceptual hierarchy, are artificial groupings of ecologically divergent vegetation types (Keith 2002) After discussion with DEH, we agreed to consider the group as we have done here - with reference to the arid zone, but not to the MVSs or even to strict subsets of the upper levels of NVIS. This will be a continuing problem and we suggest that, in the future no reference be made to MVSs.

[3] However, we note that the recent Australian Terrestrial Biodiversity Assessment (Sattler & Creighton 2002) has prompted the states to start placing their ecosystems and vegetation communities within MVSs. Examples can be found in the WA synopsis reports (McKenzie 2003)

***Table 6: Communities mapped in NVIS data that occur in the arid / semi-arid region; if excluded from this consultancy, reasons and recommendations. Greyed cells highlight communities that are excluded from this consultancy.***

| Dominant Eucalypt | NVIS level V or VI, or Qld RE description with bioregion | State[1] | Whether included or excluded |
|---|---|---|---|
| *A. floribunda* | *Angophora floribunda* ± *Eucalyptus melanophloia*, open woodland with *Triodia* spp. on old alluvial levees; ML | Qld | EXCLUDED. *A. floribunda* is mainly temperate, with very small areas in the arid zone. |
| *C. apparrerinja* | Ghost gum (*Corymbia apparrerinja*), bloodwood (*Corymbia terminalis*) open woodland on sandy terraces; MII | Qld | INCLUDED. |
| *C. aspera* | *Corymbia aspera* low open woodland on rocky soils; MII | Qld | EXCLUDED. *C. aspera* – dominated woodlands are largely tropical. |
| *C. capricornia* | *Corymbia capricornia* low open woodland on sandstone plateaus; MII | Qld | EXCLUDED. *C. capricornia* is most common between 15 and 19 degrees lat. We note that, according to Hill and Johnson (1995), *C. capricornia* occurs in the NT (figure a, Appendix 6). In NVIS the mapping for unit 34, *C. dichromophloia*, coincides with the expected location of *C. capricornia*. This may be an error in identification. Nevertheless, we have still excluded it from this consultancy. |
| *C. dichromophloia* | *C. dichromophloia* (Variable-barked Bloodwood) low open-woodland with *Triodia pungens* (Soft Spinifex) hummock grassland understorey | NT | EXCLUDED. *C. dichromophloia* is out of the arid zone according to Hill and Johnson (1995), but mapped as map unit 34 in NT, exclusively within the arid zone. This may be a misidentification - see *C. capricornia*, above. We follow Hill and Johnson and exclude it. |
| *C. ferruginea* | *C. ferruginea* (Rusty Bloodwood) low open-woodland or *Jacksonia odontocarpa* open-shrubland with *Plectrachne pungens* (Curly Spinifex) open-hummock grassland understorey | NT | EXCLUDED. Primarily outside arid zone (as are occurrences of this species in other communities). |
| *C. opaca* | 2 *C. opaca* (Bloodwood) low open-woodlands with hummock grassland understoreys | NT | INCLUDED. |
| *C. terminalis* | • *C. terminalis* (Bloodwood), *E. chlorophylla* low woodland with *Sehima nervosum* (White grass), *Chrysopogon fallax* (Golden Beard Grass) grassland understorey<br>• 3 *Corymbia terminalis* low open woodlands in MGD and one in MII | NT<br>Qld | INCLUDED. *C. terminalis* as a species occurs primarily in tropical areas, but we consider arid occurrences of bloodwoods as a whole, and therefore include arid occurrences of it. We have not included communities that may be related but are outside the arid zone. |
| *Corymbia tessellaris* | • One community in QLD in arid zone | Qld | EXCLUDED. Note that *C. tessellaris* (carbeen) is not mapped in the Wn Division of NSW in the NVIS data, but it does occur there – mapped in the DLWC regions of Brewarinna and Wn Walgett. However, it is more common to the east of the boundary. Communities in which it is dominant are more common in temperate and tropical areas of Qld (figure b, Appendix 6). |
| *C. tumescens* | • *C. tumescens* - *E. populnea* ssp. *bimbil* open woodland<br>• *C. tumescens* - *Atalaya hemiglauca* low woodland | NSW<br>NSW | EXCLUDED. Because the majority of these appear to be *Acacia* – dominated – see details within NEC1. |
| *E. brevifolia* | *E. brevifolia* (Snappy Gum) low open-woodland with *Triodia pungens* (Soft Spinifex) hummock grassland understorey | NT | EXCLUDED. Mapped as grassland in WA; this NT community is open and cover will be <10%. There are several tropical communities of *E. brevifolia* and this NT community should be considered with them. See Appendix 6, figure c for distribution of these communities, and for reference to other WA communities. |

| Dominant Eucalypt | NVIS level V or VI, or Qld RE description with bioregion | State[1] | Whether included or excluded |
|---|---|---|---|
| *E. camaldulensis* | • *E. camaldulensis* woodlands, open forests, and isolated trees open forest<br>• 3 *Eucalyptus camaldulensis* Low woodland or woodlands<br>• Medium woodland; river gum (*E. camaldulensis*)<br>• 10 Red gum (*Eucalyptus camaldulensis)* woodlands in MII, MGD, CHC, ML, DRP<br>• 1 *E. camaldulensis* woodland (in background data but not mapped in NVIS) | NSW<br>SA<br>WA<br>Qld<br>NT | INCLUDED (and EXCLUDED). For the communities fringing watercourses and on floodplains we will define NECs specifically for the arid / semi-arid region – i.e., with their border at the edge of the region. Once further information is available some details may be changed if some sub-communities fit better eg into temperate systems. Note that some *E. camaldulensis* communities (mostly forests) that are within the arid / semi-arid zone have been left for inclusion with the temperate NECs – see introduction to the riparian NECs |
| *E. coolabah* | • *E. coolabah* ssp *coolabah* open forest<br>• *Eucalyptus coolabah* open woodland<br>• 2 *Eucalyptus coolabah* woodlands or open woodland<br>• 15 open woodlands w. *Eucalyptus coolabah* as first-listed species ;MGD, CHC, ML, DRP | NSW<br>NSW<br>SA<br>Qld | INCLUDED. In some cases, as for *E. camaldulensis* |
| *E. corrugata* [2] | Medium woodland: rough fruited mallee (*E. corrugata*) on greenstone hills | WA | EXCLUDED. |
| *E. dundasii* | Medium woodland; Dundas blackbutt (*E. dundasii*) & red mallee (*E. oleosa* group) | WA | INCLUDED. |
| *E. flocktoniae* [1] | 3 Medium woodlands with merrit (*E. floctoniae*) as dominant or co-dominant tree | WA | INCLUDED. Can have a mallee form but also common as a tree. Included it in this consultancy. |
| *E. gongylocarpa* | • *E. gongylocarpa* (Marble Gum) open-woodland with open-hummock grassland understorey<br>• *Eucalyptus gongylocarpa* Open Woodland | NT<br>SA | INCLUDED. |
| *E. intertexta* | • *Eucalyptus intertexta* open woodland or woodland<br>• *Eucalyptus intertexta* over *Dodonaea* spp., *Cassinia laevis* or *Senna* spp. Open woodland | NSW<br>SA | INCLUDED. In NSW also to east, but arid communities seem sufficiently distinct to propose an NEC. |
| *E. largiflorens* | • 5 woodlands, open woodlands or open forests with *E. largiflorens* (Black box) as dominant tree<br>• *Eucalyptus largiflorens* Low open woodland | NSW<br>SA | INCLUDED. Treat as for *E. camaldulensis* |
| *E. lesoufii* | 2 “medium woodland” communities in WA with *E. lesoufii* as dominants | WA | INCLUDED |
| *E. leucophloia* | • *E. leucophloia* (Snappy Gum) low open-woodland with *Triodia pungens* (Soft Spinifex), *Plectrachne pungens* (Curly Spinifex) open-hummock grassland understorey<br>• 6 low open woodland communities with Snappy gum (*Eucalyptus leucophloia*) as dominant, all in MII | NT<br>Qld | INCLUDED. Occurs extensively in tropical areas but the arid communities seem sufficiently distinct to propose an NEC. |
| *E. leucophylla* | 4 low open woodland communities with *E. leucophylla* as dominant tree, all in MII | Qld | INCLUDED. |
| *E. leucoxylon* | 2 *Eucalyptus leucoxylon* low woodland or open forest | SA | EXCLUDED. Majority is temperate and outside the defined arid zone. |
| *E. longicornis* | 3 “medium woodlands” with *E. longicornis* as dominant eucalypt | WA | INCLUDED. |
| *E. loxophleba* | 8 medium woodlands and 1 low woodland with *E. loxophleba* ± other eucalypts as dominant trees | WA | INCLUDED. |

| Dominant Eucalypt | NVIS level V or VI, or Qld RE description with bioregion | State[1] | Whether included or excluded |
|---|---|---|---|
| *E. melanophloia* | • Silver-leaved ironbark (*Eucalyptus melanophloia*) low open woodland on low hills and torfields on biotite granites (MII)<br>• *Eucalyptus melanophloia* - *Triodia mitchellii* var. *breviloba* woodland | Qld<br>NSW | EXCLUDED. In tropical and temperate areas also. Advice from T. Bean (QLD EPA) and J. Benson (NSW) that the arid occurrences are not sufficiently distinct to warrant separating them from the other occurrences. |
| *E. melliodora* | *Eucalyptus melliodora* open woodland | NSW | EXCLUDED. Mostly to east of the NSW Western Division boundary. |
| *E. microcarpa* | *Eucalyptus microcarpa*, +/- *Eucalyptus* aff. *viridis* Woodland | SA | EXCLUDED. Mostly outside of the defined arid region. |
| *E. microtheca*<br>(NB in NT & WA mapped and described as microtheca but since then many of these renamed – dealt with later) | • 5 low or low open woodlands with *E. microtheca* as dominant tree in NT<br>• 5 low or medium woodlands with *E. microtheca* ± other eucalypts as dominant trees in WA<br>• Coolibah (*Eucalyptus microtheca*) low open woodland / woodland on alluvial floodplains and channels; MII | NT<br>WA<br>Qld | INCLUDED. |
| *E. miniata* | 2 Woollybutt (*Eucalyptus miniata*) woodlands in MII | Qld | EXCLUDED. Mostly tropical. |
| *E. normantonensis* | 2 *Eucalyptus normantonensis* tall or tall open shrublands in MGD, CC with *Triodia* spp. on plateau margins; MGD | Qld | EXCLUDED. Mostly tropical / temperate |
| *E. ochrophloia* | ▪ 2 *E. ochrophloia* open woodlands or open forest<br>▪ 1 community with *E. ochrophloia* dominant in ML | NSW<br>QLD | INCLUDED. |
| *E. odorata* | *Eucalyptus odorata* Low woodlands or low open forest | SA | EXCLUDED. Mostly outside of the defined arid region. |
| *E. oleosa* [2] | Medium woodland: red mallee (*E. oleosa* group) | WA | EXCLUDED. Primarily mallee. |
| *E. pilligaensis* | *E. pilligaensis* | NSW | EXCLUDED. Primarily to east of the NSW Western Division. |
| *E. populnea* | • 3 *E. populnea* woodlands in NSW<br>• 6 *E. populnea* woodlands in ML | NSW<br>Qld | INCLUDED. Widespread in the broader sense, but the arid communities appear sufficiently distinct to propose an NEC |
| *E. pruinosa* | • 2 *E. pruinosa* low or low open woodlands in NT<br>• 5 *E. pruinosa* low open or open woodlands in MII, Qld | NT<br>Qld | INCLUDED. |
| *E. salmonophloia* | 15 medium woodlands with *E. salmonophloia* as dominant or co-dominant tree | WA | INCLUDED. Also in temperate areas, but arid occurrences appear to be sufficiently distinct to propose an NEC. |
| *E. salubris* | 2 medium woodlands with *E. salubris* as dominant | WA | |
| *E. thozetiana* | • 2 *Eucalyptus thozetiana* woodlands in ML<br>• *Eucalyptus thozetiana* tall shrubland with *Triodia* spp. ± *E. normantonensis* on plateau margins and slopes of residuals, CC | Qld<br>Qld | INCLUDED. |
| *E. torquata* | 2 medium woodlands | WA | INCLUDED. |
| *E. transcontinentalis* | 3 medium woodlands with *E. transcontinentalis* as dominant or co-dominant tree | WA | INCLUDED. |
| *E. wandoo* | 2 medium woodlands with *E. wandoo* as dominant or co-dominant tree | WA | Possibly misclassified in Beard's mapping – see NEC 1.8. |
| Mixed eucalypts | • Mixed eucalypt woodland on sandy plains; MII<br>• Mixed shrubby woodland on folded limestones; MII<br>• Mixed eucalypt open woodland on sandy alluvial terraces; MII<br>• Mixed shrubby woodland on rocky limestone hills; MII | Qld | Allocated to appropriate arid NECs, if some exist. |

[1] State where mapped in NVIS data; the species may also occur in other states but the other states will not be recorded unless the species is mapped as a dominant eucalypt in the arid / semi-arid region.
[2] These communities are in our data because they are tagged in NVIS as "tree" rather than "mallee" in Level 1, and thus satisfied our search criteria.

## *The NECS*

**Our aim in forming the NECs has been to form the broadest possible units with reasonably similar biotic and abiotic features, facing similar threats and demonstrating similar responses to those threats.**

The NECs are described in the documents following this report and summarized in Table 7. A number of issues that are common to the NECs are addressed here:

*1. Definition of "sub-communities":*
Every NEC description includes a list of "sub-communities". These do not represent an ecological hierarchy, but are simply a compilation of communities described at the state level that fit into the NEC. In some cases there will be a number of similar sub-communities because these have been identified as different vegetation associations in different state surveys. In other cases the data may overlap – NVIS communities may be broadly described, and more detailed studies have also been identified that refer to part of the broader grouping.

*2. Interpretation of mosaics*
There are many areas where the scale of ecological variation is smaller than the mapping scales. In part, this is covered by the mapping of mosaics – this is particularly common in Beard's mapping for WA. The mapping is not detailed enough to properly estimate "area of occupancy" of the woodland community. Mapped polygons may be a reasonable indication of area of occupancy for some sub-communities, particularly those that are continuous over large areas. In other areas where different communities exist in mosaics or where the boundaries between the sub-communities are genuinely broad and diffuse, the polygon area is at the best an upper limit to the area occupied. In the mosaic description Beard listed the more prevalent association first (if one clearly occurred over a larger area). However, unfortunately there is no information on the proportion of each component of a mosaic within these units. On the other hand, the mapping has sufficient detail to be doing more than indicating extent of occurrence (defined in the EPBC Act, 1999 as "the total area contained within the shortest continuous boundary that can be drawn to encompass all the areas where the ecological community occurs").

Mosaics not only include areas where the scale of pattern was too small to be mapped. They may also include areas where the mapper was relatively uncertain about photo interpretation. Some of the communities are hard to distinguish from aerial photos, and remotely sensed images are widely used in mapping arid and semi-arid areas. Thus mosaics encompass pattern and classification uncertainty. These issues need to be kept in mind in interpreting the data presented in the NEC reports.

*3. Level of grouping:* We have endeavoured to reach a level of grouping that suits our perception of the requirements of this consultancy. Part of the intention of the work was to provide an overview of ecological communities in arid and semi-arid Australia, and to suggest how they could be broadly grouped. This means that, in many cases we believe that the groups are closer to National Ecological Alliances (NEAs) rather than NECs. An approach that considers the potential for defining components of these NEAs as NECs in their own right may be the most satisfactory approach to nominating threatened communities. Communities seem to be more appropriately defined as entities below the level of most of these 23 NECs. As they stand, each of our groups are a set of species assemblages (communities) encompassing a continuum of species composition (although the ends of the gradients may have little in common) and taxonomic relatedness of the dominant tree species. We believe that the overview has been a useful process, but that the next step of identifying threatened communities should indeed be a next step, and that a useful way forward would be to look within the defined NECs for threatened components that may be eligible for listing at a national level.

*4. Incomplete NECs:* The analyses are not all completed. In some cases this is because we have identified data that are required and that will become available in the future. Others are incomplete because priority was given to completing NECs where there were definite indications of threat.

Nevertheless, in all cases we have described the community and explained membership, and presented relevant information and references to further data.

*5. Woodlands that have been excluded from this consultancy but are nevertheless important parts of the arid / semi-arid areas*:

*E. melanophloia* woodlands. At this level of grouping, we decided that the silver-leaved ironbark woodlands that occur in the arid / semi-arid region were not sufficiently different to the more temperate occurrences to create an NEC for them (see Table 6). Data pertaining to this community and relevant references are included in Appendix 7.

*Table 7: Summary of NECs proposed for the arid eucalypt woodlands, and outstanding issues*

| NEC# | NEC name | Description | Conservation Status | Outstanding issues and other comments |
|---|---|---|---|---|
| 1.1 | Bloodwood open woodlands of the inland plains | Occur in MGD and MII bioregions in inland Queensland and Northern Territory. They are generally low open woodlands with a mixed shrub and grass understorey. The dominant bloodwoods are either *C. terminalis* or *C. opaca* | Not threatened at present | Broad alliance. Could be further divided. Alternatively, could be grouped with communities to be identified in the tropical region. |
| 1.2 | *Eucalyptus leucophloia* woodlands | Includes 7 sub-communities in Qld, all of which occur in the Mt Isa Inlier. These are low open woodlands dominated by *E. leucophloia* with a ground layer commonly dominated by *Triodia* spp. | Not threatened at present | Should the tropical occurrences of *E. leucophloia* be amalgamated with this NEC?<br>Should the grasslands wooded with *E. leucophloia* be incorporated into this NEC, not just the woodland components. |
| 1.3 | *Eucalyptus pruinosa* (Silver Box) and *Eucalyptus leucophylla* woodlands of the semi-arid and / or arid areas of Northern Territory and Queensland | This NEC includes all arid occurrences of *E. leucophylla* and *E. pruinosa* woodlands. These species occupy a similar region of the Mt Isa Inlier IBRA region in Queensland, occurring on similar landforms (mainly found on lower slopes or low hills and valley bottoms). | More data is required on the condition of the vegetation in these communities to assess the conservation status. | Should the tropical occurrences of *E. pruinosa* be included in this NEC?<br>The assessment of an appropriate conservation status of this NEC is dependent on further information on the condition of the woodlands included in this group. |
| 1.4 | *Eucalyptus gongylocarpa* woodlands of arid Australia | This NEC comprises the *E. gongylocarpa* (marble gum) open- to low-open woodlands of SA, the NT and WA. These have a hummock grass understorey (*Triodia pungens* or *T. basedowii*) | Not threatened at present | The NEC description is incomplete.<br>Some of the component communities are described as hummock grassland in WA, and perhaps are so sparse that they should be excluded from the group. |
| 1.5 | *E. thozetiana* and *Acacia* woodlands of the Mulga Lands in Queensland. | This NEC includes all arid occurrences of woodlands dominated by *E. thozetiana* (restricted to the Mulga Lands). These are generally intermixed with *Acacia* species. | Not threatened at present. | Are these woodlands more appropriately grouped with *Acacia*-dominated woodlands? |
| 1.6 | Poplar box woodlands of the arid / semi-arid zone | One or more NECs are proposed. These would include the poplar box-mulga communities, and poplar box – *E. intertexta* communities. | Not assessed. | This is incomplete, awaiting data. It is important and should be completed. A list of pertinent data sources, and analysis of the NVIS data, are amongst the data provided. |
| 1.7 | *Eucalyptus intertexta* woodlands on rocky hills of arid and semi-arid SA and NSW | *E. intertexta* (gum-barked coolibah or red box) communities with *Callitris glaucophylla* or *Acacia* species. These occur in SA and NSW. | Not threatened at present | |

| NEC# | NEC name | Description | Conservation Status | Outstanding issues and other comments |
|---|---|---|---|---|
| 1.8 | *Eucalyptus salmonophloia* and / or *E. salubris* woodlands of the semi-arid and /or arid region of Western Australia | Woodlands dominated by *E. salmonophloia* and *E. salubris* are grouped together because these two species occupy approximately the same area WA and commonly occur together on similar soil types and landforms. This NEC only includes the sub-communities that predominantly occur in the arid and / or semi-arid region (mainly the goldfields region). These woodlands are relatively undisturbed and vary from the temperate ones floristically. | This NEC may be eligible for listing under the EPBC Act according to criteria 1 (decline in geographic distribution). However, further data are required. | Is the suggested level of grouping appropriate?<br>The NEC contains some communities that have experienced a substantial reduction in extent.<br>Should the temperate occurrences of these sub-communities be dealt with separately? |
| 1.9 | Woodlands of *Eucalyptus lesouefii* and / or *Eucalyptus dundasii* and / or *E. torquata* in the Kalgoorlie and Norseman districts of Western Australia. | *Eucalyptus lesouefii*, *E. dundasii* and *E. torquata* are grouped together in this NEC, as they are reported to form an alliance in the Norseman and Kalgoorlie region of WA. These woodlands occur on similar soils types, soils are mainly derived from greenstone or alluvium washed from greenstone ridges. | Not threatened at present | Data on specific threats to this NEC are lacking, in particular mining. An assessment of criteria 3-6 is required. |
| 1.10 | Medium woodlands dominated by *Eucalyptus longicornis* in south-western Western Australia | This NEC includes all occurrences of *Eucalyptus longicornis* within the semi-arid and arid region of WA. This species is mainly confined to sites with alkaline soil, pH > 8.0. | Some of these communities have a restricted distribution and thus perhaps should be regarded as eligible for listing for this reason?<br>Further data on existing threatening processes is required to assess the conservation status of this NEC. | Are the *E. longicornis* woodlands more appropriately grouped within other NECs in WA?<br>Is this NEC vulnerable due to limited distribution and patch sizes? |
| 1.11 | *E. loxophleba* woodlands of the semi-arid and / or arid zone of Western Australia | This NEC includes the woodlands dominated by *E. loxophleba* that predominantly occur in the arid and / or semi-arid region (mainly the goldfields region of WA). These are floristically different to the temperate occurrences and exposed to different threatening processes. | Not threatened at present | Further information on the condition of the *E. loxophleba* woodlands in the Coolgardie IBRA region would be useful.<br>Are any of the sub-communities better described as mallees and not woodlands? |
| 1.12 | Woodlands of *Eucalyptus flocktoniae* and / or *Eucalyptus transcontinentalis* in the Coolgardie bioregion of Western Australia. | *Eucalyptus flocktoniae* and *Eucalyptus transcontinentalis* woodlands are grouped together in this NEC because these two eucalypts commonly occur together in the semi-arid region of WA. They are found on similar soil types; mainly pink floury calcareous soils and on similar landforms; mainly mid-slopes and ridges. | This NEC may be eligible for listing under the EPBC act according to criterion 1 (decline in geographic distribution). Further investigation is required. | Is the decline in distribution of this NEC, sufficient data to recommend that this NEC be listed as vulnerable under the EPBC act?<br>Should the sub-communities most affected by clearing form a separate NEC? Or the temperate components removed from this NEC? |

| NEC# | NEC name | Description | Conservation Status | Outstanding issues and other comments |
|---|---|---|---|---|
| 1.13a | Woodlands of *Eucalyptus formanii* of the arid region of Western Australia | This NEC includes all occurrences of low woodlands of *E. formanii* in the goldfields region (semi-arid and arid region) of Western Australia. | This NEC may be eligible for listing due to small size and threatening processes. However, further data are required (in particular regarding the current distribution and threats). | Are the *E. formanii* woodlands included in the Mt Manning Vegetation complex regarded as an ecosystem at risk by CALM?<br>Further information on threatening processes listed is needed to assess this community appropriately. |
| 1.13b | Woodlands of *Eucalyptus melanoxylon* of the arid region of Western Australia | This NEC includes all occurrences of *E. melanoxylon* woodlands in the goldfields region of WA (semi arid and arid regions). | Not threatened at present. The woodlands within the Yilgarn Hills are subject to a number of threatening processes and regarded as "at risk" by WA. | Further information regarding processes threatening this NEC and current distribution of these woodlands is needed. |
| 1.14 | Coolibah woodlands and open woodlands in the Mulga Lands and Darling Riverine Plains (and neighbouring lands) | This NEC includes woodlands and open woodlands dominated by coolibahs (*Eucalyptus coolabah* ssp *coolabah*). It is primarily restricted to two bioregions of NSW and Queensland (Mulga Lands and Darling Riverine Plains) because the woodlands face different types and degrees of threat in these bioregions compared with examples of similar communities further west. It includes communities on frequently flooded channels and on outer floodplains. | There is evidence under Criterion 1 (decline in geographic distribution), Criterion 4 (reduction in community integrity) and Criterion 5 (rate of continuing detrimental change) that this community is threatened, and could be eligible for listing. | The composition and description of the NEC needs to be discussed with state experts<br>Is this better considered as two NECs?<br>Is the decision to restrict the NEC largely to the MUL and DRP satisfactory?<br>For Queensland, is the decision to include part of a regional ecosystem realistic? |
| 1.15 | *E. coolabah* inland woodlands on levees and banks of major drainage lines, billabongs and permanent waterholes | This NEC includes communities in the CHC of Queensland, several bioregions of SA, and some occurrences in the CHC and SSD bioregions of NSW. These are dominated by coolibahs (*E. coolabah* ssp *coolabah* and ssp *arida*) and occur on levees and banks of the major drainage lines and waterholes. | Although some areas are affected by extensive and long-term impacts from grazing, these communities do not appear to be threatened at present. | Related communities may occur in southern NT, but they could not be readily identified in the data. |
| 1.16 | *E. camaldulensis* inland woodlands on levees and banks of major drainage lines, billabongs and permanent waterholes | This NEC includes all riparian woodlands that are dominated by *E. camaldulensis*, are on levees and banks of major drainage lines, billabongs or permanent waterholes, and are in central or eastern parts of the arid and semi-arid areas of Australia (IBRA regions CHC, MUL, SSD, BHC, STP, FIN, MAC and GSD). | Although some areas are affected by extensive and long-term impacts from grazing, these communities do not appear to be threatened at present. | This NEC needs further refinement with respect to its membership. |
| 1.17 | Inland eucalypt open woodlands on drainage lines and floodplains | This NEC is distinct from the other coolibah and river red gum communities of inland Australia because, rather than occurring around major river or creeks or permanent water holes, its component communities occur on floodplains, open depressions and minor drainage lines. | Although some areas are affected by extensive and long-term impacts from grazing, these communities do not appear to be threatened at present. | This NEC needs further refinement with respect to its membership. |

| NEC# | NEC name | Description | Conservation Status | Outstanding issues and other comments |
|---|---|---|---|---|
| 1.18 | *Eucalyptus camaldulensis* woodland on levees and banks of drainage lines in semi-arid parts of the Flinders and Olary Ranges | This NEC separates these *E. camaldulensis* woodlands from others in eastern and central Australia because:<br>• they face particular threats of a type and severity not faced by similar communities elsewhere<br>• the landform and water regimes are different to those river red gum woodlands on large, inland, major drainage channels and waterholes | If this NEC can truly be regarded as different to other related NECs, then there is evidence under Criterion 4 (reduction in community integrity) that this community is threatened. Because it is poorly reserved across its distribution, and threats are continuing, its long-term persistence is threatened. | The membership of the community needs to be checked with state experts |
| 1.19 | River red gum and / or coolibah woodlands of the Mitchell Grass Downs and Mount Isa Inlier bioregions | This NECs includes the more tropical woodlands, and separates them from those further south. The NEC includes two main groups, one that is mainly woodland in these bioregions, can be dominated by *E. camaldulensis* and / or coolibahs, and occurs in Queensland, and one that is mainly low open woodlands in these bioregions, can be dominated by coolibahs, and occurs in the NT . | Despite sometimes extensive and long-term impacts from grazing, this NEC does not appear to be eligible for listing. | This is a broad group and could be subdivided. Alternatively, it may be more appropriately combined with riparian NECs suggested for the tropical mapping. |
| 1.20 | Yapunyah woodlands | These are woodlands dominated by *E. ochrophloia* (yapunyah) in the Mulga Lands of NSW and Queensland. | This NEC is currently not threatened . It would, however, be threatened by changes in water regime in the region if these occur in the future. | |
| 1.21 | Black Box woodlands | This is a broad alliance, including all the black box woodlands of the arid and semi-arid zones | Although many areas are affected by extensive and long-term impacts from grazing, the arid / semi-arid occurrences of black box woodlands do not appear to be eligible for listing. However, they will be susceptible to changed flooding regimes, and therefore may be threatened over the long term. | This is a broad group and could be subdivided. |

| NEC# | NEC name | Description | Conservation Status | Outstanding issues and other comments |
|---|---|---|---|---|
| 1.22 | Riparian eucalypt communities of major creeks and rivers in WA | This NEC contains all of the riparian eucalypt woodland vegetation that lines the levees and banks of major drainage lines in the arid and semi-arid regions of WA. The dominant eucalypts in these communities are *Eucalyptus camaldulensis* and, less frequently, *E. victrix*. | In common with many riparian communities, this NEC is clearly affected by ongoing threatening processes. There are substantial impacts on the community, and in the majority of cases the condition of the community is declining. However, the state authorities do not consider it to be threatened, and without further data the appropriate recommendation appears to be that they are not currently eligible for listing. | The data on these communities is fragmented; without further resources we are unable to provide more data to analyse these communities further. Given that the condition and trend in condition of the sub-communities is generally not good, further research may be productive. |
| 1.23 | Eucalypt floodplain communities in WA | This NEC includes all arid and semi-arid riparian woodlands of the floodplain areas. These are mostly dominated by *E. victrix*. Some occur around claypans and on calcrete areas. | As a group, these woodlands do not appear to be threatened. However, it could be argued that the calcrete and / or claypan occurrences of these woodlands are sufficiently restricted and unique that they need to be separated into their own NECs and nominated for listing. Our advice is that further attention needs to be given to this group. | This NEC is incomplete in the sense that further expert advice should be sought about other occurrences of the woodlands, and about separating the calcrete and claypans occurrences into their own NECs. It has been largely written from the referenced data; there has been insufficient time to send it to experts and ask for feedback. This means that some of the data may not be correctly interpreted. |

## *Summary and Conclusions*

This consultancy has identified 23 National Ecological Communities that describe the major non-mallee eucalypt ecological communities in the arid / semi-arid zone of Australia. It has collected data about these, and assessed their conservation status. Thirteen appear to be not threatened at present, though a number of these have qualifications to this assessment. Five require more data for a final decision; one is not assessed, and two appear eligible for listing. The threatened NECS are riparian ecosystems, each of which are largely restricted to two bioregions. Further details are in Table 7 and the individual NEC reports.

A number of issues have been highlighted, both in this overview and within the NEC descriptions. Some are repeated here for emphasis:

1. The groups (NECs) as currently defined are still very broad. In many cases we believe that the groups are closer to National Ecological Alliances (NEAs) rather than NECs. The next stage / phase may be to consider the potential for defining components of these NEAs as NECs in their own right. This may be the most satisfactory approach to nominating threatened communities for two reasons. One is that, at the broad scale we have used, some of the threatened components / communities are subsumed into a broader group that is not threatened (this is despite our effort to separate components if they face particular threats). The second is that it is hard to defend some of the broad groups as an ecological unit – the biotic and abiotic features, and their interactions, are sometimes quite diverse.

2. There are important issues related to uncertainty in the data that require further work. The mapped areas of extant and pre-European vegetation are not precise anywhere. Further, the precision varies between the states. This is an important shortcoming for assessment of threat to ecological communities. More work needs to be done on methods for improving the precision of the mapping, and developing appropriate guidelines for representing uncertainty and for interpreting the mapping of mosaics.

3. The riparian communities are particularly complex, and threatening processes such as grazing pressures and hydrologic changes are often focussed on them. It would be much more satisfactory to treat the riparian communities within a consultancy arranged just for them, so that adequate time could be spent on them. Further, it could be argued that a better approach is to consider the riparian systems as a unit, not just focussing on one vegetation type and then another, but studying the whole system as one. This would be consistent with the underlying philosophy of describing ecological *communities*. There is evidence that the proper functioning of a number of these systems involves a complex interplay of various habitats and species. Threatening processes also tend to operate in similar ways on the range of communities in a riparian system. Therefore, a useful approach may be to consider riparian ecosystems as a unit. We suggest that the TSSC consider this as an option for the future.

4. Within the Coolgardie IBRA region, there is an exceptionally high diversity of eucalypt species. Many of these species are endemic to Western Australia and endemic to the Goldfields region. Most form mallee communities and thus are not dealt with in this consultancy. Five main associations or national ecological communities for eucalypt woodlands were identified from the NVIS mapping. In addition, two more woodland types were identified from the biological surveys of the eastern Goldfields area. These do not appear as eucalypt woodlands in the current NVIS data due to the broad scale of mapping. This is an example of an issue that may apply to other parts of Australia – there may be restricted woodland types that have not been identified in this consultancy. These could be added in the future.

5. The arid / semi-arid regions have not been a focus for survey work, and many of the data sets that would inform this consultancy are still being collected and collated. Similarly, a number of states are still in the early stages of identifying ecological communities and the processes threatening them. This means that any definition of the NECs and their component communities needs to adapt to new data as they become available.

## *Appendix 1: Bibliograpy of all references used throughout this report*


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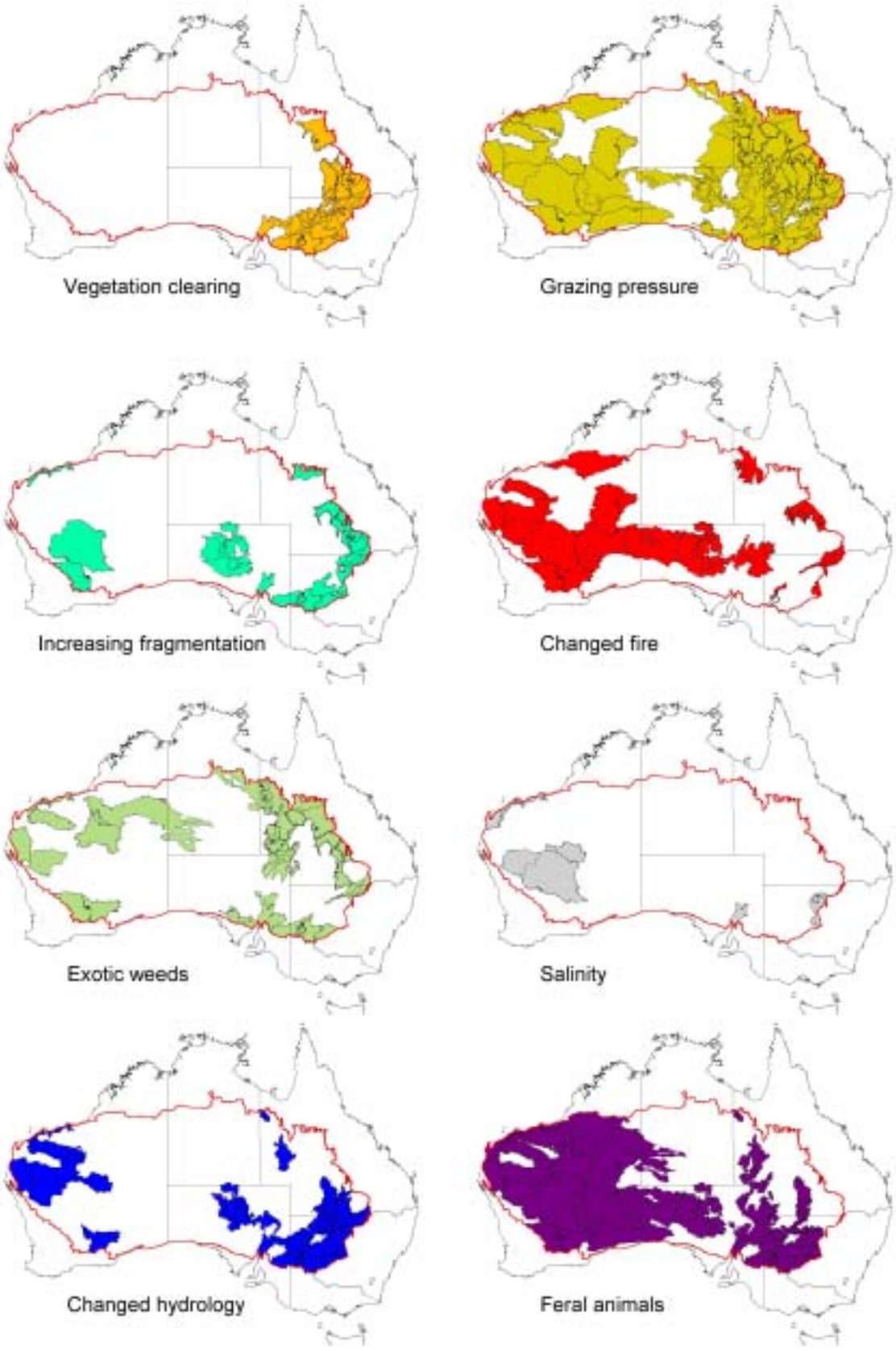
Appendix 2: Maps of processes that are threatening ecosystems within the arid / sub-arid region of Australia



## ***Appendix 3: Queensland provinces vs IBRA subregions***

| Old name | Source for old name | New name |
|---|---|---|
| MGD, Province 1 | Sattler and Williams 1999, p 4/28 | MGD3 |
| MGD, Province 2 | Sattler and Williams 1999, p 4/28 | MGD4 |
| MGD, Province 3 | Sattler and Williams 1999, p 4/28 | MGD5 |
| MGD, Province 4 | Sattler and Williams 1999, p 4/28 | MGD8 |
| MGD, Province 5 | Sattler and Williams 1999, p 4/28 | MGD7 |
| MGD, Province 6 | Sattler and Williams 1999, p 4/28 | MGD6 |
| MGD, Province 7 | Sattler and Williams 1999, p 4/28 | MGD2 |
| MII, Province 1 | Sattler and Williams 1999, p 1/28 | NWH1 |
| MII, Province 2 | Sattler and Williams 1999, p 1/28 | NWH2 |
| MII, Province 3 | Sattler and Williams 1999, p 1/28 | NWH3 |
| MII, Province 4 | Sattler and Williams 1999, p 1/28 | Re-allocated to GFU, so not arid |
| CHC, Province 1 | Sattler and Williams 1999, p 5/30 | most SSD2, some SSD5 |
| CHC, Province 2 | Sattler and Williams 1999, p 5/30 | most CHC2,CHC4 |
| CHC, Province 3 | Sattler and Williams 1999, p 5/30 | CHC3 |
| CHC, Province 4 | Sattler and Williams 1999, p 5/30 | some CHC2, CHC5, CHC7, some CHC8, CHC9, CHC11, some SSD5 |
| CHC, Province 5 | Sattler and Williams 1999, p 5/30 | CHC1 |
| CHC, Province 6 | Sattler and Williams 1999, p 5/30 | most CHC8 |
| MUL, Province 1 | Sattler and Williams 1999, p 6/34 | MUL1 |
| MUL, Province 2 | Sattler and Williams 1999, p 6/34 | MUL2 |
| MUL, Province 3 | Sattler and Williams 1999, p 6/34 | MUL3 |
| MUL, Province 4 | Sattler and Williams 1999, p 6/34 | MUL4 |
| MUL, Province 5 | Sattler and Williams 1999, p 6/34 | MUL5 |
| MUL, Province 6 | Sattler and Williams 1999, p 6/34 | MUL6 |
| MUL, Province 7 | Sattler and Williams 1999, p 6/34 | MUL7, MUL11 |
| MUL, Province 8 | Sattler and Williams 1999, p 6/34 | MUL8 |
| MUL, Province 9 | Sattler and Williams 1999, p 6/34 | MUL9 |
| MUL, Province 10 | Sattler and Williams 1999, p 6/34 | MUL10 |
| Brigalow Belt, Province 35 | Sattler and Williams 1999, p 11/79 | some DRP1, some DRP3 |

## *Appendix 4: IBRA Subregion codes and names*

| Code | Subregion Name |
|---|---|
| BHC1 | Barrier Range |
| BHC2 | Mootwingee Downs |
| BHC3 | Scopes Range |
| BHC4 | Barrier Range Outwash, Fans and Plains |
| BRT1 | Burt Plain P1 |
| BRT2 | Burt Plain P2 |
| BRT3 | Buret Plain P3 |
| BRT4 | Burt Plain P4 |
| CAR1 | Cape Range |
| CAR2 | Wooramel |
| CHC1 | Toko Plains, Channel Country P1 Toko Range |
| CHC10 | Core Ranges |
| CHC11 | Bulloo, Bulloo Overflow |
| CHC2 | Sturt Stony Desert |
| CHC3 | Goneaway Tablelands |
| CHC4 | Diamantina-Eyre, Diamantina Plains |
| CHC5 | Cooper Plains |
| CHC6 | Coongie-Lake Pure |
| CHC7 | Lake Pure |
| CHC8 | Noccundra Slopes |
| CHC9 | Tibooburra Downs, Central Downs, Fringing Tablelands and Downs |
| COO1 | Mardabilla |
| COO2 | Southern Cross |
| COO3 | Eastern Goldfield |
| CP1 | Boorindal Plains |
| CP2 | Barnato Downs |
| CP3 | Canbelego Downs |
| CP4 | Nymagee-Rankins Springs |
| CP5 | Lachlan Plains |
| CP5 | Lachlan Plains |
| CR1 | Central Ranges, Mann-Musgrave Block, Central Ranges P1 |
| CR2 | Wataru |
| CR3 | Everard Block |
| DMR1 | Davenport Murchison Range P1 |
| DMR2 | Davenport Murchison Range P2 |
| DMR3 | Davenport Murchison Range P3 |
| DRP1 | Balonne - Culgoa Fan, Culgoa-Bokhara |
| DRP2 | Narran-Lightning Ridge |
| DRP3 | Warrambool-Moonie |
| DRP4 | Macintyre - Weir Fan, Castlereagh-Barwon |
| DRP5 | Bogan-Macquarie |
| DRP6 | Louth Plains |
| DRP7 | Wilcannia Plains |
| DRP8 | Menindee |
| DRP9 | Great Darling Anabranch |
| DRP10 | Pooncarie-Darling |
| FIN1 | Finke P1 |
| FIN2 | Finke P2 |
| FIN3 | Tieyon, Finke P3 |
| FIN4 | Pedirka |
| FLB3 | Olary Spur |
| FLB4 | Southern Flinders |
| FLB5 | Northern Flinders |
| GAS1 | Ashburton |
| GAS2 | Carnegie |
| GAS3 | Augustus |
| GAW1 | Myall Plains |
| GAW2 | Gawler Volcanics |
| GAW3 | Gawler Lakes |
| GAW4 | Arcoona Plateau |
| GAW5 | Kingoonya |
| GD1 | Lateritic Plain |
| GD2 | Dune Field |
| GSD1 | McLarty |
| GSD2 | Mackay, Great Sandy Desert P1, Great Sandy Desert P2 |
| GSD3 | Great Sandy Desert P3 |
| GSD4 | Great Sandy Desert P4 |
| GSD5 | Great Sandy Desert P5 |
| GSD6 | Great Sandy Desert P6 |
| GVD1 | Shield |
| GVD2 | Central |
| GVD3 | Eastern, Maralinga |
| GVD4 | Kintore |
| GVD5 | Tallaringa |
| GVD6 | Yellabinna |

| Code | Subregion Name |
|---|---|
| HAM | Hampton |
| LSD1 | Rudall |
| LSD2 | Trainor |
| MAC1 | MacDonnell Ranges P1 |
| MAC2 | MacDonnell Ranges P2 |
| MAC3 | MacDonnell Ranges P3 |
| MDD1 | South Olary Plain, Murray Basin Sands |
| MDD6 | Darling Depression |
| MGD1 | Mitchell Grass Downs P1 |
| MGD2 | Barkly Tableland, Mitchell Grass Downs P2 Barkly |
| MGD3 | Georgina Limestone |
| MGD4 | Southwestern Downs |
| MGD5 | Kynuna Plateau |
| MGD6 | Northern Downs |
| MGD7 | Central Downs |
| MGD8 | Southern Wooded Downs |
| MUL1 | West Balonne Plains |
| MUL2 | Eastern Mulga Plains |
| MUL3 | Nebine Plains, Block Range |
| MUL4 | North Eastern Plains |
| MUL5 | Warrego River Plains, Warrego Plains |
| MUL6 | Langlo Plains |
| MUL7 | Paroo Sand Sheets, Cuttaburra-Paroo |
| MUL8 | West Warrego, Tablelands and Downs |
| MUL9 | Northern Uplands |
| MUL10 | West Bulloo |
| MUL11 | Urisino Sandplains |
| MUL12 | Warrego Sands |
| MUL13 | Kerribree Basin |
| MUL14 | White Cliffs Plateau |
| MUL15 | Paroo Overflow |
| MUL16 | Paroo-Darling Sands |
| MUR1 | Eastern Murchison |
| MUR2 | Western Murchison |
| NUL1 | Northern band, Carlisle |
| NUL2 | Central band, Nullabor Plain |
| NUL3 | Yalata |
| NWH1 | Southwestern Plateaus & Floodouts |
| NWH2 | Thorntonia |
| NWH3 | Mount Isa Inlier |
| PIL1 | Chichester |
| PIL2 | Fortescue |
| PIL3 | Hamersley |
| PIL4 | Roebourne |
| RIV1 | Lachlan |
| RIV1 | Lachlan |
| SSD1 | Simpson-Strzelecki Dunefields P1 |
| SSD2 | Simpson Desert, Simpson-Strzelecki Dunefields ..... |
| SSD3 | Dieri |
| SSD4 | Warriner |
| SSD5 | Strzelecki Desert, Strzelecki (SSD southwest), Western Dunefields |
| SSD6 | Central Depression |
| SSD7 | Bulloo Dunefields |
| STP1 | Breakaways, Stony Plains |
| STP2 | Oodnadatta |
| STP3 | Murnpeowie |
| STP4 | Peake-Dennison Inlier |
| STP5 | Macumba |
| TAN1 | Tanami, Tanami P1 |
| TAN2 | Tanami P2 |
| TAN3 | Tanami P3 |
| YAL1 | Yalgoo |

## *Appendix 5: Criteria for listing threatened ecological communities*

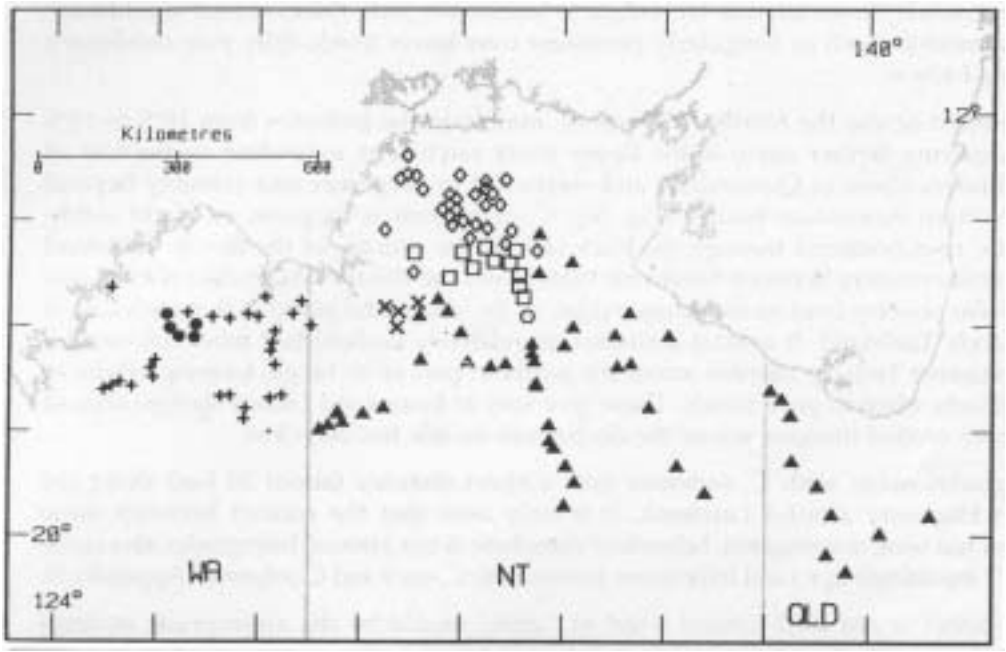
From the Department of Environment and Heritage website - Ecological Commmunity Nomination Form and Guidelines at:
http://www.deh.gov.au/biodiversity/threatened/nominations/forms/pubs/ecological-communities-nomination-form.doc

*For section 182 of the Act, an ecological community is in the critically endangered, endangered or vulnerable category if it meets any of the criteria for the category mentioned in the following table:*

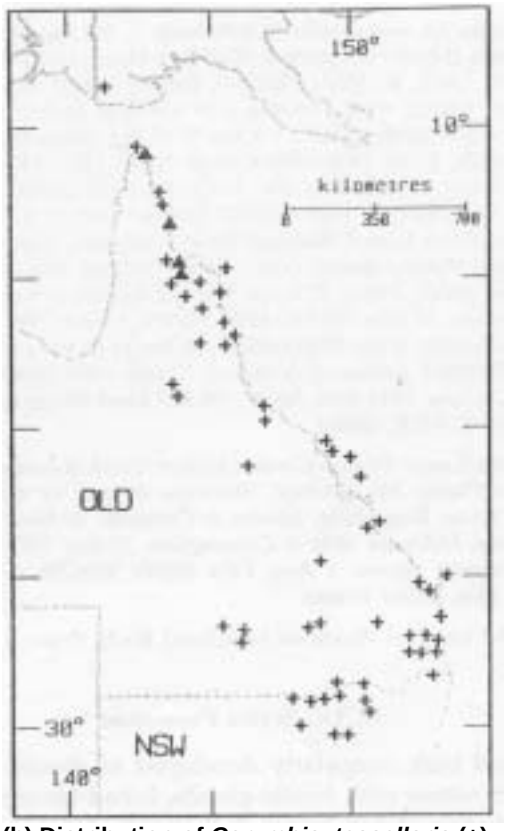
| Item | Criterion | CATEGORY | | |
|---|---|---|---|---|
| | | **Critically Endangered** | **Endangered** | **Vulnerable** |
| **1** | Its decline in geographic distribution is: | very severe | severe | substantial |
| **2** | Its geographic distribution is: | very restricted | restricted | limited |
| | and<br>the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in: | the immediate future | the near future | medium term future |
| **3** | For a population of a native species that is likely to play a major role in the community, there is a: | very severe decline | severe decline | substantial decline |
| | to the extent that restoration of the community is not likely to be possible in: | the immediate future | the near future | the medium-term future |
| **4** | The reduction in its integrity across most of its geographic distribution is: | very severe | severe | substantial |
| | as indicated by degradation of the community or its habitat, or disruption of important community processes, that is: | very severe | severe | substantial |
| **5** | Its rate of continuing detrimental change is: | very severe | severe | substantial |
| | as indicated by:<br>(a) a rate of continuing decline in its geographic distribution, or a population of a native species that is believed to | very severe | severe | serious |
| | | very severe | severe | serious |
| **6** | A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution, is: | at least 50% in the immediate future | at least 20% in the near future | at least 10% in the medium-term future |

## *Appendix 6: Figures showing distributions of some species*

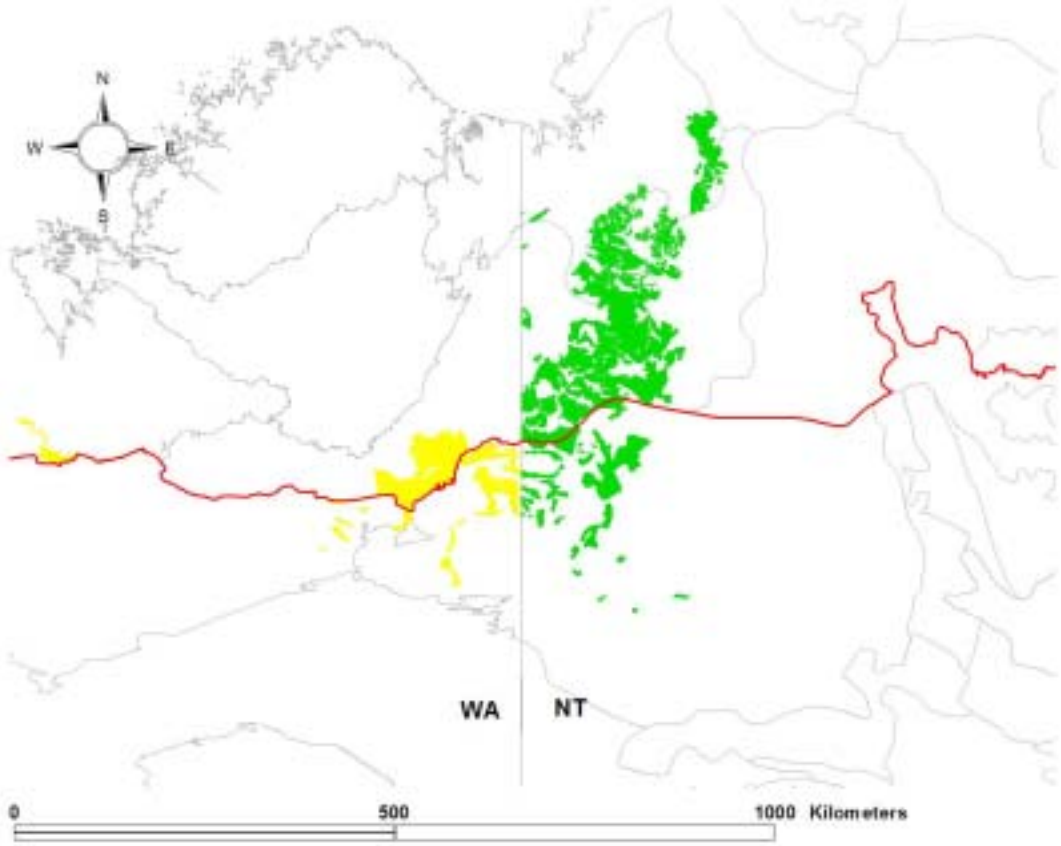
(from Hill and Johnson 1995)




**(a) Distribution of *Corymbia capricornia* (triangles)**




**(b) Distribution of *Corymbia tessellaris* (+)**




**(c) Distribution of *E. brevifolia* communities in NT and WA.** (red line = border of arid-semi-arid region; grey lines = subregion boundaries). The WA communities are grasslands whereas the NT communities are mapped as low open woodlands. They should be considered in the tropical consultancy. (Note: *E. brevifolia* is also mapped as hummock grassland in the Pilbara area, but this is a misidentification and is really *E. leucophloia* (see the *E. leucophloia* NEC))

## *Appendix 7: Information on Silver-leaved Ironbark (E. melanophloia)*

As a species, *E. melanophloia* has a broad climatic range (Figure 1), but is most abundant west of the Great Divide.

*Figure 1: Distribution of* E. melanophloia *(after Beadle 1981)*

Relevant sub-communities in the semi-arid area are listed in Table 1.

The NSW sub-communities have been classified as the statewide map unit "Sub-tropical semi-arid woodlands" by David Keith (2002, and see Table 2). This grades into semi-arid shrublands to the west that lack *E. melanophloia*. Communities that have floristic and abiotic similarities exist further east, but are under much more pressure from clearing.

It is the opinion of state experts (T. Bean and J.Benson) that the semi-arid occurrences could be grouped with the temperate and tropical woodlands. Further information on the descriptions by Beeston et al (1980) will be available when the data are databased. The NSW semi-arid occurrences are not threatened at present.

***Table 1: Sub-communities in the arid / semi-arid regions of NSW and Qld***

| State | Community, with source | Comments |
|---|---|---|
| NSW | *E. melanophloia* - *Triodia mitchellii* var *brevifolia* woodland (Pickard & Norris 1994, map unit 9) | Beadle (1948) describes this community as "a typical savanna woodland on red-brown sands between the 18 and 20 inch isohyets…only small, isolated areas are encountered; these are outliers of the extensive area of the Association found commonly to the east and in Queensland..". |
| NSW | Poplar box / silver-leaf ironbark community (DLWC mapping for Brewarrina and Western Walgett) | |
| NSW | Spinifex community (DLWC mapping for Brewarrina and Western Walgett) | includes *E. melanophloia*. Considered to be of regional value because of unique species composition |
| NSW | *E. melanophloia* alliance (Iwaszkiewicz and Semple 1988, pg 50) | A description of a grassy woodland, with useful details of species present. |
| NSW, Qld | *E. populnea* - *E. melanophloia* (Beeston et al. 1980, community C1) | Mapping not yet available but probably extends well to the east of the semi-arid boundary |
| Qld | *E. melanophloia* (Beeston 1980. community G2) | "Restricted to Queensland in most western areas south of latitude 22S" (Beeston 1980) |
| Qld, DRP | *Eucalyptus melanophloia* +/- *Callitris glaucophylla* +/- *E. populnea* woodland on Cainozoic sand plains/remnant surfaces (RE 11.5.5) | No concern at present about its biodiversity status |
| Qld, DRP | *Eucalyptus melanophloia* +/- *E. orgadophila* woodland on Cainozoic fine-grained sedimentary rocks (RE 11.9.2) | No concern at present about its biodiversity status |
| Qld, DRP | *Eucalyptus melanophloia* woodland or open woodland generally with a grassy ground layer. Occurs on levees and higher Cainozoic alluvial plains (RE 11.3.6) | Of concern (subject to clearing or thinning) |
| Qld, MII | Silver-leaved ironbark (*Eucalyptus melanophloia*) low open woodland on low hills and torfields on biotite granites (RE 1.12.2) | *E. melanophloia* not dominant on any of these except the MII occurrence, but that one has a unique habitat that is |

| State | Community, with source | Comments |
|---|---|---|
| Qld, ML | *Eucalyptus populnea* ± *Eremophila mitchellii* ± *Acacia aneura* ± *Eucalyptus melanophloia* woodland on flat alluvial plains (RE 6.3.18) | inconsistent with the rest of the group (note that its Status under the Vegetation Management Act 1999 is "Of concern"; it is not reserved and is subject to mining). The others have abiotic components in common; two (**) are of concern to the EPA because of clearing.<br><br>The communities with poplar box dominant may be considered in the Poplar Box NECs. |
| Qld, ML | *Angophora floribunda* ± *Eucalyptus melanophloia*, open woodland with *Triodia* spp. on old alluvial levees (RE 6.3.20) | |
| Qld, ML ** | *Acacia aneura* ± *Eucalyptus populnea* ± *E. melanophloia* ± *Brachychiton populneus* low woodland on sand plains (RE 6.5.13) | |
| Qld, ML | *Eucalyptus populnea* ± *E. melanophloia* ± *Callitris laucophylla* ± *Acacia aneura* woodland on sand plains (RE 6.5.17) | |
| Qld, ML | *Eucalyptus populnea*, *Acacia aneura* and/or *E. melanophloia* woodland on Quaternary sediments (RE 6.5.2) | |
| Qld, ML ** | *Acacia aneura, Eucalyptus populnea* ± *E. melanophloia* shrubby low woodland on Quaternary sediments (RE 6.5.9) | |

***Table 2: Information from Keith (2002) on the NSW map unit relevant to this NEC***

| Map Unit | **94. Subtropical semi-arid woodlands** |
|---|---|
| Structure | Open eucalypt savanna woodland 10-15 m tall, with scattered tall shrubs and a prominent groundcover of perennial grasses |
| Trees | *Eucalyptus melanophloia*, occasionally with *Eucalyptus populnea* ssp. *bimbil*. *Callitris glaucophylla, Brachychiton populneus* ssp. *populneus* |
| Shrubs & vines | *Acacia excelsa, A. aneura, A. murrayana, Grevillea juncifolia, G. albiflora, , Alstonia constricta, Eremophila mitchellii, Ventilago viminalis, Canthium oleifolium, Geijera parviflora, Atalaya hemiglauca, Capparis lasiantha, Santalum lanceolatum, Micromyrtus ciliata, Keraudrenia integrifolia* |
| Forbs, graminoids and pteridophytes | *Triodia mitchellii* var. *breviloba* (in Cumborah area)*, Aristida jerichoensis* var. *subspinulifera, Eragrostis eriopoda, Digitaria brownii, Aristida arenaria, Bothriochloa decipiens, Themeda australis, Enteropogon acicularis, Convolvulus erubescens, Oxalis ?perennans, Solanum ellipticum, Evolvulus alsinoides, Sclerolaena convexula, S. birchii, Sida corrugata, Chamaesyce drummondii, Calandrinia balonensis* |
| Habitat | Coarse-textured soils on well drained elevated stony ridges, plateaux and undulating sandy country receiving 450-500 mm annual rainfall in the far central north |
| Distribution | North and west of the Barwon River on the central northern plains, probably extending into southern Qld. |
| Notes | Restricted occurrences juxtaposed by woodlands of the peneplain and arid shrublands. Shares floristic affinities with Northwest plains semi-arid shrublands, but differs conspicuously in the presence of eucalypts at low to moderate densities. |