# Border Ranges Rainforest

# Biodiversity Management Plan

## NSW & Queensland

March 2010

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Queensland Government

Australian Government

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# Foreword

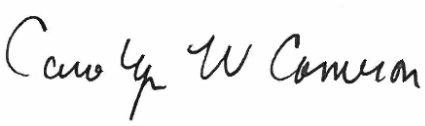
The Border Ranges Rainforest Biodiversity Management Plan is a regional recovery plan for threatened species and communities of the Border Ranges North and South (Queensland and New South Wales) Biodiversity Hotspot. The Plan considers the conservation requirements of rainforest and closely related species and communities in the Border Ranges region of New South Wales and Queensland, which is centred on the McPherson Ranges. It also addresses other species of conservation significance so as to manage the area's biodiversity in a holistic and cost-effective manner. It constitutes the formal national recovery plan for those rainforest species which are endemic to the Hotspot region.

Although it was primarily developed by the New South Wales Department of Environment, Climate Change and Water, with Australian Government funding assistance, the Plan represents a milestone in the cooperative management of our biodiversity assets. Because of the cross-border nature of the region, its successful development has also relied on input and endorsement by the Queensland Government and the relevant regional natural resource management body in each state. Local and Indigenous communities were also extensively consulted.

The Plan identifies the actions to be taken to ensure the long-term viability of the threatened species and other bodiversity assets of the rainforest and related vegetation of the Border Ranges region. Actions include working with landowners to restore and protect identified priority areas, including vegetation corridors for the movement and dispersal of species. There is also an emphasis on landowners and agencies working together to help manage the impacts of weeds and feral pests, as well as fire management. The involvement of the local community, including the Indigenous community, is seen as integral to the successful implementation of the Plan.

It is intended that this Plan be implemented over a ten-year period.

The Border Ranges Rainforest Biodiversity Management Plan is presented in two parts. The first consists of this document containing the background information relevant to the recovery of the priority species and ecological communities, and the outcomes and actions required to achieve their long-term recovery. The second part is presented electronically on a compact disk (CD) which can be found on the inside back cover of this document. This second part provides background information, including a number of appendices and figures that accompany the main Plan.



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Approvals and Wildlife Division, DEWHA

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The Plan has benefited from substantial references to the *Byron Biodiversity Conservation Strategy 2004* (Byron Shire Council 2004 – thanks to Byron Shire Council), the *Northern Rivers Pest Animal Management Strategy 2008–2013* (Northern Rivers CMA 2008), draft *Northern Rivers Invasive Plants Action Strategy 2008–2013* (Northern Rivers CMA & North Coast Weeds 2008), North Coast Weeds Border Ranges Weeds Prioritisation process (Iain Jamieson), draft *Northern Rivers Weeds and Pests Prioritisation Strategy* (DEC 2005), *Northern Rivers Region Pest Management Strategy 2008–2011* (DECC 2007a) and the draft South-east Queensland Rainforest Recovery Plan (WWF-Australia 2005). Thanks to the Pest Management Unit of the Parks and Wildlife Group within DECCW for allowing access to the threats on biodiversity dataset. Thanks also to Robert Kooyman and Maurizio Rossetto for reports generated on flora traits analysis and Robert Kooyman, Maurizio Rossetto and Iain Jamieson for weeds trait analysis.

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Also, thank you to the large number of people and organisations that contributed ideas and information through the community consultation process and the public exhibition process undertaken as part of the preparation of this Plan.

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# 1 Introduction

## 1.1 Scope of document

The Border Ranges Rainforest Biodiversity Management Plan ('the Plan'), covers the Australian Government's Border Ranges North and South (Queensland and New South Wales) Biodiversity Hotspot. Biodiversity Hotspots are areas that support largely intact natural ecosystems where native species and communities are well represented, and where a high diversity of locally endemic species persists.

The Border Ranges North and South Biodiversity Hotspot ('the hotspot') refers to the rainforest and related vegetation communities that occur in the Border Ranges region of north-east New South Wales (NSW) and south-east Queensland (Department of the Environment and Water Resources 2007). The location of the Border Ranges region, as delineated for the preparation and implementation of this Plan and shown in Figure 1, extends along the coast from Beenleigh in the north to Evans Head in the south and as far west as Killarney.

In line with the Australian Government's description of the Border Ranges Hotspot, this Plan refers to 'rainforest and related vegetation' as:

- rainforest; that is, subtropical, warm temperate, cool temperate, dry and littoral rainforest and semi-evergreen vine thickets
- wet sclerophyll forest
- vegetation communities of limited extent that are typically surrounded by rainforest; that is, cliffs, rocky outcrops and montane heath
- riparian vegetation surrounded by, or adjacent to, rainforest.

The rainforest and related vegetation located in the Border Ranges region designates the 'Planning Area' and is the subject of this Plan. Where relevant, 'rainforest and related vegetation' also refers to the priority species, ecological communities and/or habitats encompassed by this vegetation.

The objective of this Plan is to protect rainforest and related biodiversity and to provide a consistent and effective recovery program for species and communities of conservation concern. The recovery program will focus on improving the condition (connectivity and integrity) of rainforest and related vegetation communities and their component species and systems.

Within NSW, vegetation communities, species and habitats of the Border Ranges region that are not encompassed by rainforest and related vegetation are considered in the *Draft Northern Rivers Regional Biodiversity Management Plan* (DECC 2009a).

In 2009, the Queensland Government created several new departments and the Plan reflects these changes. In particular, the former Queensland Environmental Protection Agency (QEPA) and Department of Natural Resources and Water now occur within the Department of Environment and Resource Management (DERM).

Also in 2009, the NSW Government created several new 'super agencies' and the Plan reflects these changes. In particular, the former NSW Department of Environment and Climate Change (DECC) now occurs within the Department of Environment, Climate Change and Water (DECCW).

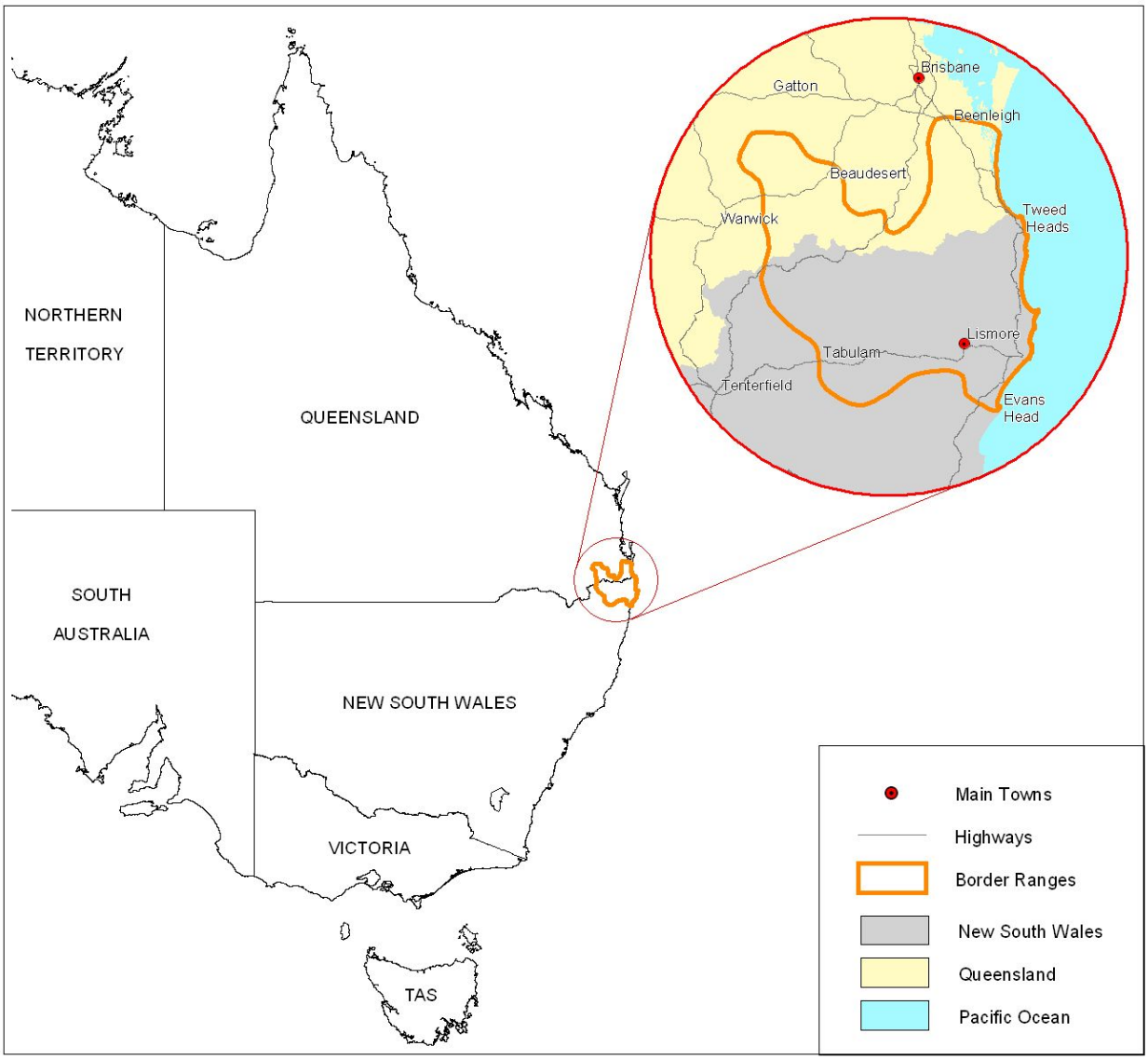


**Figure 1 Location of the Border Ranges region**

## 1.2 Interaction with other documents

There are a number of existing state and national recovery plans and threat abatement plans that address species and communities covered by this Plan (see Appendix 1 on the enclosed CD). This Plan does not replace these existing plans, but complements them by incorporating the species in a broader regional context. Existing management actions and the spatial extent to which they apply are referred to where relevant. Existing plans have also been used to inform the prioritisation of actions across relevant species and ecological communities in this Plan.

Some species and communities addressed in this Plan occur in locations outside the Planning Area, and recovery actions identified for the Planning Area may also be relevant for species in adjoining areas. This Plan identifies a range of recovery actions that vary in spatial scale, priority and potential benefit. It should be noted that such action priorities may vary at different times within the life of this Plan depending on the availability of resources, opportunistic project proposals and other competing priorities and interests.

## 1.3 Limits to the use of this Plan

It is recognised that there will be a variety of potential users of this Plan, each with specific information requirements. Due to the broad regional scope of the Plan, some details, particularly for individual species, are not included within the text. However, links to species' profiles, recovery plans and the NSW Threatened Species Priorities Action Statement are provided.

The use of geographic information system mapping and the Biodiversity Forecasting Tool (see Section 3) provides an opportunity for the Plan to be adaptive and interactive rather than a static document. The level of adaption and interaction will rely on partners and on-ground implementers feeding spatial information and data back so that the Tool can be updated. The mapping and modelling utilised to identify priority areas for biodiversity investment are constrained by the data available and users of the Plan need to carefully consider the constraints identified in regard to interpreting and using the mapped information. Planning at the site level for implementation projects will have to be undertaken for each individual site utilising information provided in the Plan as a base.

## 1.4 Legislative context

This Plan constitutes the regional recovery plan for species and ecological communities that occur within the Planning Area that are subject to the listings under the relevant state and Commonwealth nature conservation legislation identified in Table 1. The Plan covers 58 fauna species, 134 flora species and 25 ecological communities associated with rainforest or related vegetation that are listed as threatened at either a national or state level. Additionally, the Plan includes 49 fauna (including freshwater fish and invertebrates) and 33 flora species of conservation significance, making a total of 107 rainforest-related animals and 166 rainforest-related plants. Of these, 21 fauna species and 69 flora species are endemic to the rainforests or related vegetation of the Planning Area. The species and communities covered by this Plan are listed in Appendix 2 and are referred to as 'priority species and ecological communities' hereafter.

During the Plan's ten-year duration, it can also provide management guidance for the recovery of any additional species, populations and communities that may be listed under the legislation in Table 1 that meet the criteria for inclusion in the Plan.

**Table 1 Legislation relevant to threatened species and communities**

| Government | Legislation | Status categories |
|---|---|---|
| Australian | *Environment Protection and Biodiversity Conservation Act 1999* | • critically endangered<br>• endangered<br>• vulnerable |
| NSW | *Fisheries Management Act 1994* | • critically endangered<br>• endangered<br>• vulnerable |
| | *Threatened Species Conservation Act 1995* | • critically endangered<br>• endangered<br>• vulnerable |
| Queensland | *Nature Conservation Act 1992* | • endangered<br>• vulnerable<br>• rare<br>• near threatened<br>• least concern |
| | *Fisheries Act 1994* | • protected<br>• no-take |
| | *Vegetation Management Act 1999* | • endangered<br>• vulnerable |

## 1.5 Recovery plan preparation, consultation and implementation

Legislation at Commonwealth and state levels provides the framework for the protection and recovery of threatened species, populations and communities. The Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the NSW *Threatened Species Conservation Act 1995* (NSW TSC Act) and NSW *Fisheries Management Act 1994* include specific requirements for matters to be addressed by recovery plans, and the process for preparing recovery plans. This Plan satisfies the provisions of both the EPBC Act and NSW TSC Act. Queensland legislation does not require the development of recovery plans.

Potential contributors to the implementation of actions identified in the Plan will include the Australian Department of the Environment, Water, Heritage and the Arts (DEWHA), regional natural resource management bodies, local governments, conservation groups and the community. State agencies will include DECCW and DERM.

### 1.5.1 Critical habitats

Nationally, the EPBC Act requires a recovery plan to identify the 'areas of habitats that are critical to the survival' of the species or community concerned, and the actions needed to protect those habitats. In order to satisfy this requirement, all rainforest and related vegetation has been identified and mapped along with areas of high conservation or restoration priority (see Sections 2 and 3). Moreover, where possible and relevant to actions, key populations and sites have also been individually identified (see Section 4.5).

The NSW TSC Act makes provision for the identification and declaration of 'critical habitat'. Critical habitat may be identified for endangered species, populations and ecological communities, or critically endangered species and ecological communities in NSW. Once declared, it is an offence to damage critical habitat (unless the action is specifically exempted under the provisions of the NSW TSC Act) and a species impact statement is mandatory for all developments and activities proposed

within declared critical habitat. There is currently one NSW critical habitat declaration within the Planning Area: Stotts Island Nature Reserve declared critical habitat for Mitchell's Rainforest Snail *Thersites mitchellae* (NPWS 2001a). Any future declarations in NSW will be identified on the critical habitat register on the DECCW website.

In Queensland, the *Vegetation Management Act 1999* delineates 'essential habitat', which are areas of vegetation where a species that is endangered, vulnerable, rare or near threatened has been known to occur. These areas are mapped by DERM and are used to regulate vegetation clearing in such a way as to prevent the loss of biodiversity. Requests for essential habitat maps for an area can be made through the DERM website. An example of such a map can be found in Appendix 3 (on the enclosed CD).

### 1.5.2 Key threatening processes

Under the EPBC Act a process can be listed as a key threatening process if it threatens, or may threaten, the survival, abundance or evolutionary development of a species or ecological community. The NSW TSC Act and NSW *Fisheries Management Act 1994* have similar provisions for listing of key threatening processes, for which threat abatement plans can be prepared. There are no provisions under Queensland legislation to list threatening processes. A table of key threatening processes relevant to this Plan is provided in Section 3.

### 1.5.3 Consultation with the Border Ranges community

The EPBC Act and NSW TSC Act require that adequate levels of community consultation are undertaken as part of the preparation of any recovery plan. To achieve meaningful and effective consultation, the planning team incorporated several key elements into the consultation process. The Plan also provided an opportunity to explore innovative approaches to engage Indigenous community groups in biodiversity planning and management.

#### *Community engagement*

Several approaches were used during the Plan's development to encourage community input. Firstly, the Border Ranges Integrated Biodiversity Project steering committee oversaw the preparation of the Plan. Secondly, a community consultation working group developed and implemented the communication strategy. Working group members included the Northern Rivers Catchment Management Authority (CMA), South East Queensland Catchments Ltd (SEQC), DERM, Queensland biodiversity natural resource facilitator, and DECCW.

The aim of the communication strategy was to inform the wider community of the preparation of the Plan and to:

- increase awareness of the significance of rainforest and related vegetation in the region, its values and threats
- provide opportunities for land-holders and other stakeholders to gain more detailed information on the Plan's development
- provide a mechanism for community feedback on the preliminary content of the Plan
- initiate a consultation network and begin effective two-way communication (SEQC 2008).

The working group members agreed to undertake separate consultations in NSW and Queensland and to coordinate content and process through regular communication. Specific consultation with the Indigenous and traditional owner communities was undertaken by DECCW (see below).

In NSW, a community representative undertook the consultation with assistance from Northern Rivers CMA and DECCW (Morrison 2007a). In Queensland, a consultation team comprising the Queensland biodiversity natural resource management facilitator, DERM and WWF-Australia, supported SEQC in undertaking the consultation (SEQC 2008).

The existing community networks of Northern Rivers CMA and SEQC were used for distribution of material such as newsletters and media advertising. Three newsletters, a community consultation flyer, poster, PowerPoint presentations, newsletter articles and a number of other fact sheets were distributed amongst community networks whilst the draft Plan was in preparation. To enable continual and informal feedback from the community, background documents, maps and discussion papers were made available on a community-based website. A separate project-based web server was also established so Plan contributors could access large datasets, maps and information.

Community meetings were held across the Border Ranges region. In NSW, the community representative, Northern Rivers CMA and DECCW staged meetings at Urbenville, Woodenbong, Bangalow, and the PRIMEX Agricultural exhibition. In Queensland, SEQC and DERM held events at West Burleigh Heads, Upper Tallebudgera, Boonah, Beaudesert, Killarney, Allora, Boonah, Springbrook and Rathdowney, as well as a display as part of Tamborine Green Domain Day. A total of 183 people (65 in NSW and 118 in Queensland) attended the meetings.

A range of local and state government agencies and stakeholder organisations were also contacted in NSW and Queensland (Morrison 2007a; SEQC 2008) and presentations made at a number of conferences and forums. In NSW, the Mayor of Byron Shire Council also held a Local Government Councillor's forum on behalf of the planning team.

As a result of the community consultation, a number of species of conservation concern, management issues and individual sites and areas were identified. These include locations where, for example, important populations of priority species occur, specific threats are active, or restoration activities are being undertaken by community groups and individuals. Specific locations include rainforest in gullies along the lower Richmond Range in the Mallanganee – Upper Mongogarie area, the Springbrook Plateau where a rainforest acquisition and restoration program is being undertaken, and the high conservation value areas of Nicholls Scrub and Bahrs Scrub in south-east Queensland. Section 3.3.2 provides a more detailed discussion on the community-identified priority areas in the Planning Area.

## *Indigenous community engagement*

The Indigenous peoples of north-east NSW and south-east Queensland have strong cultural and spiritual connections to the biodiversity in their Country. Within the Border Ranges region, the main Indigenous organisations with a particular interest in biodiversity management fall into the following categories:

- NSW Local Aboriginal Land Councils
- Native Title Groups
- Traditional Owner Natural Resource Management Groups.

During preparation of this Plan, contact was made with a number of organisations including the following:

- Casino Boolangle Local Aboriginal Land Council
- Gugin Gudduba Local Aboriginal Land Council
- Jali Local Aboriginal Land Council
- Jubullum Local Aboriginal Land Council
- Muli Muli Local Aboriginal Land Council

- Ngulingah Local Aboriginal Land Council
- Tweed Byron Local Aboriginal Land Council
- Arakwal Aboriginal Corporation (Bandjalang of Byron Bay)
- Gold Coast Native Title Group
- Jagera Daran
- Bandjalang people
- Widjabu
- Githabul
- Warwick-based Aboriginal natural resource management organisations
- South-east Queensland Traditional Owners Land and Sea Management Alliance Limited
- Bundjalung Nation Aboriginal Cultural Heritage, Natural Resources Environment Management Committee (Jugun–Yabay)
- Kombumerri Aboriginal Corporation for Culture
- Eastern Yugambeh Ltd.

Ten areas within the NSW reserve system are now part of the recently signed Githabul Indigenous Land Use Agreement between DECCW and the Githabul People. The 2001 Arakwal Indigenous Land Use Agreement between the former NSW National Parks and Wildlife Service and Arakwal Aboriginal Corporation resulted in the creation of, and funding for, Arakwal National Park. These agreements allow for the joint management of areas between DECCW and traditional owners.

*Partnerships Queensland* and NSW *Two Ways Together* are the state governments' primary policy initiatives for Indigenous communities, providing advice and support to local government in establishing successful partnership arrangements.

The Indigenous engagement process was coordinated in NSW and Queensland (on behalf of DERM), by DECCW. Two DECCW project officers from the Culture and Heritage Division and Biodiversity Conservation Section collaborated to develop a range of engagement mechanisms and coordinate trialling approaches with Indigenous communities.

Based on previous experience in engaging Indigenous communities on threatened species recovery (e.g. Baker et al. 1993; Baker 1996; Nesbitt et al. 2001; Robinson et al. 2003; English & Baker 2003; Baker 2004), it was considered that undertaking a broad consultation process was unlikely to be effective and that more engaging, practical mechanisms should be investigated. To assist in designing this approach, a south-east Queensland-based Aboriginal organisation was engaged to develop a scoping document which would identify the Indigenous groups within the Border Ranges region, determine their interest in biodiversity management, and assess their capacity to become involved in biodiversity projects.

The resulting 'Indigenous Engagement Strategy' (Eastern Yugambeh Ltd 2006) provided guidance for establishing partnerships between Aboriginal organisations, knowledge holders' groups and government agencies. The strategy identified a number of key points to assist with engaging Indigenous communities in biodiversity conservation. These were:

- identify an activity that engages the community
- identify organisations with an interest in participation
- identify the aspects of interest of those organisations in that project
- identify the capacity of each interested organisation to facilitate involvement of their members

- structure the activity or target to ensure that it meets the needs of the government agencies and other stakeholders.

Based on these key points, a 'toolkit' was developed to provide a range of opportunities to involve Indigenous groups in biodiversity planning and management. The key to the toolkit was the recognition that integrating protection and enhancement of culture and biodiversity creates opportunities for Indigenous education, training and employment, and increases the recognition and integration of Indigenous knowledge of Country into biodiversity management.

The toolkit identified four mechanisms for participation which can be implemented separately or in combination: 1) Indigenous property biodiversity restoration and management plans and their implementation; 2) community self-consultation; 3) ethno-ecological survey; and 4) cultural landscape mapping. Examples of where these mechanisms have been implemented are provided below.

Due to the geographic overlap of Country between the Border Ranges region and the area covered by the Northern Rivers CMA, the toolkit was developed to address Indigenous participation in biodiversity conservation for both of these areas. The toolkit continues to be tested and expanded, and the results of trials are discussed in detail in the *Draft Northern Rivers Regional Biodiversity Management Plan* (DECC 2009a).

Taking into account the recommendations of the 'Indigenous Engagement Strategy', negotiations were undertaken with Casino Boolangle Local Aboriginal Land Council to participate in a trial biodiversity restoration and management plan on a community-owned property. A property planning contractor with connections to the community was engaged to work with community members on preparing the plan. The plan identified the biodiversity and cultural assets of the property, threats to those assets, and management recommendations and costings (Morrison 2007b). The contractor then assisted the community to access natural resource management funding to implement the plan and has continued to provide on-ground support through the implementation process.

Following the success of this trial, the Casino Boolangle Local Aboriginal Land Council agreed to participate in the preparation of another three property management plans (Morrison 2007c, 2007d, 2007e) and the Jubullum Aboriginal Community participated in the preparation of a plan for the Jubullum Flat Camp Aboriginal Area (Morrison 2007f). Other Indigenous community groups have since become actively engaged in the process and the rate of preparation of the management plans is now dictated by available funding and contractor time.

Another component of the toolkit included contracting Indigenous community groups to collate knowledge on particular threatened species. Community self-consultation provides community groups with an opportunity to undertake their own biodiversity-based consultation. Community groups are contracted to undertake oral history and ethno-ecological interviews with their Elders and knowledge-holders and prepare a report relating to knowledge and management issues for species or groups of species. For example, the Ngulingah Local Aboriginal Land Council prepared a report on the cultural significance of three threatened species covered by this Plan: Davidson's Plum *Davidsonia jerseyana*, Smooth Davidson's Plum *D. johnsonii* and Small-leaved Tamarind *Diploglottis campbellii* (Ngulingah Local Aboriginal Land Council 2007). Other projects have provided information and recommendations on Headland Zieria *Zieria prostrata*, endangered Coastal Emu *Dromaius novaehollandia*e populations, Osprey *Pandion haliaetus*, Brush-tail Rock Wallaby *Petrogale penicillata* and Beach Stone-curlew *Esacus neglectus*.

Opportunities to work with Indigenous communities on ethno-ecological surveys have also been explored. Koala *Phascolartos cinereus* surveys undertaken with Glen Innes Local Aboriginal Land Council in NSW have helped facilitate preparation of a property fire plan and the successful application for an Indigenous Protected Area and associated Plan of Management.

A project to explore opportunities for cultural landscape mapping was undertaken in Bandjalang Country (Hofmeyer & McDermott 2006). The project aimed to assist in protecting and understanding the cultural landscape of the Bandjalang people. DECCW officers worked with Bandjalang Elders to

map their cultural landscape within ten DECCW reserves. Biodiversity, including threatened species and natural resources, were recorded as a component of the cultural landscape and management of these assets was considered as part of the management of the cultural landscape.

### 1.5.4 Other conservation measures

Much of the public land within the Planning Area is declared conservation reserve under the NSW *National Parks and Wildlife Act 1974* and the Queensland *Nature Conservation Act 1992* and must be managed in accordance with the provisions of these Acts. Some of these reserves are also part of the Gondwana Rainforests of Australia World Heritage Area (WHA) or included on the National Heritage List and must be managed in accordance with international obligations under the relevant provisions of the EPBC Act. Additionally, some areas within NSW conservation reserves are declared as wilderness and must be managed in accordance with the provisions of the NSW *Wilderness Act 1987*.

Currently a relatively small area of private and public land (less than one per cent) within the Planning Area is protected to varying degrees under a range of voluntary conservation covenants including Land for Wildlife, wildlife refuges, nature refuges or local government environmental protection zoning arrangements.

### 1.5.5 Additional NSW and Queensland legislation

There is additional state-based legislation that is relevant to the conservation and management of biodiversity within the Planning Area. In NSW, this includes:

- *Environmental Planning and Assessment Act 1979*
- *Local Government Act 1993*
- *Rural Fires Act 1997*
- *Rural Fires and Environmental Assessment Legislation Amendment Act 2002*
- *Catchment Management Authorities Act 2003*
- *Native Vegetation Act 2003*
- *Natural Resources Commission Act 2003.*

In Queensland, this includes:

- *Forestry Act 1959* and Regulations 1998
- *Acquisition of Lands Act 1967*
- *State Development and Public Works Organisation Act 1971* and Regulations 1999
- *Public Safety Preservation Act 1986*
- *Soil Conservation Act 1986*
- *Mineral Resources Act 1989*
- *Fire and Rescue Service Act 1990* and Regulations 2001
- *Queensland Heritage Act 1992*
- *Environmental Protection Act 1994* and Regulation 1998
- *Land Act 1994*
- *Coastal Protection and Management Act 1995*
- *Integrated Planning Act 1997* and Regulation 1998
- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Aboriginal Heritage Act 2003*
- *Biodiscovery Act 2004*.

# 2 Description of the Planning Area

It is beyond the scope of this Plan to provide a detailed description of the natural, cultural and physical history that has shaped the distribution of rainforest and related vegetation in the Border Ranges region. Generally, the natural and physical history of the area is reflected in the region's topography which in turn influences climatic patterns. These factors, in combination with numerous others such as geology and fire history, have determined the historic distribution and pattern of rainforest and related vegetation. More recent contemporary factors associated with human activities such as clearing, burning, agriculture and urbanisation, have changed these patterns to create the mosaic of vegetation present today. This section of the Plan provides a brief description of land tenures, topography, geology, climate, broad vegetation, and flora and fauna.

The Planning Area relates to the Border Ranges North and South (Queensland and NSW) Biodiversity Hotspot. The Border Ranges hotspot is a region that is recognised for its high diversity and large proportion of locally endemic species. It encompasses a variety of significant habitats including rainforests, wet sclerophyll forest, montane heath, rocky outcrops and transition zones between forests (Department of the Environment and Water Resources 2007).

The natural values of the hotspot are at risk, and it is likely this risk will increase in the future in the absence of active conservation management. The area, therefore, has high national priorities for conservation management (Department of the Environment and Water Resources 2007).

The Border Ranges hotspot region is primarily located in the South-east Queensland and North Coast New South Wales Bioregions (Environment Australia 2000), with small portions in the New England and Brigalow Belt South Bioregions. It occupies over 14 500 $km^2$; nearly 1.5 million hectares. The boundary of the Border Ranges region (as delineated for this Plan) extends along the coast from Beenleigh in the north to Evans Head in the south, inland across the Richmond Range to Tabulam. It then follows the upper Clarence Valley north to the NSW–Queensland border near Killarney and then extends further north along the Main Range to just south of Gatton. From here it swings east and south, following the foothills of the Main and McPherson Ranges from Boonah to Beaudesert. Note that the Border Ranges region does not include any off-shore Islands.

The south-east Queensland and north-east NSW region of Australia has significant and unique Indigenous cultural values that are continually interconnected to Country. This attachment is through earth, water, plants, animals, knowledge, traditions and stories; all of which are inter-woven and inseparable. Cultural responsibilities, meaning, associations and understanding are intertwined with the identification of Indigenous knowledge-holders to protect, acknowledge and appreciate cultural values associated with Country that are still strong today.

Historically, vast areas in the region have been cleared for agriculture, and timber harvesting has occurred through much of the midslopes and ranges. The region's current high population growth, with associated urban and tourist developments, is a major cause of continued habitat loss and fragmentation along coastal areas and in the hinterland. Although many remaining natural areas are protected, these areas are often under considerable threat from weeds, pest animals, fire, recreational use and the potential impacts of climate change. The region also includes remnants of highly cleared and fragmented rainforests, such as the Big Scrub near Lismore and small pockets of littoral rainforest along the coast.

The Border Ranges region and surrounds, particularly the coastal areas of the Tweed and south-east Queensland, are experiencing growth rates among the highest in Australia. The demographic structure of the population is generally weighted towards an ageing population. Household incomes are below the average of larger cities, and unemployment rates in the region are higher than NSW and Queensland averages.

## 2.1 Tenure

Within the Border Ranges region, 76% of the total land area is private land and 15% is national park estate. Of the national park estate, half is part of the Gondwana Rainforests of Australia WHA, and small amounts are wilderness. Figure 2 shows land tenures in the Border Ranges region and Table 2 provides summary statistics.

Within the Border Ranges region there are 108 conservation reserves, including: 31 national parks, 38 nature reserves, 21 conservation parks, 3 Aboriginal areas, 9 forest reserves, 1 historic site and 5 state conservation areas. The Gold Coast City Council owns 11 properties acquired through its Open Space Acquisition Strategy (Gold Coast City Council 2007) and there are 50 private conservation properties. The Border Ranges region also contains 33 state forests, 2 Commonwealth reserves (Canungra Warfare Centre and Gold Coast Airport) and 55 crown reserves. A full list of public land properties is provided in Appendix 4 (on the enclosed CD).

**Table 2 Land tenure statistics**

| Tenure | Area (ha) | Proportion of region (%) |
|---|---|---|
| Private property freehold | 1 121 820 | 76.1 |
| Conservation reserve* | 214 922 | 14.6 |
| State forest | 68 726 | 4.7 |
| Crown land | 39 393 | 2.7 |
| Water | 13 227 | 0.9 |
| Private property conservation | 6 763 | 0.5 |
| Commonwealth land | 6 322 | 0.4 |
| Gold Coast City Council # | 2 295 | 0.2 |
| Total | 1 473 466 | 100 |

* includes 108 177 ha of WHA

# Gold Coast Open Space Acquisition Strategy

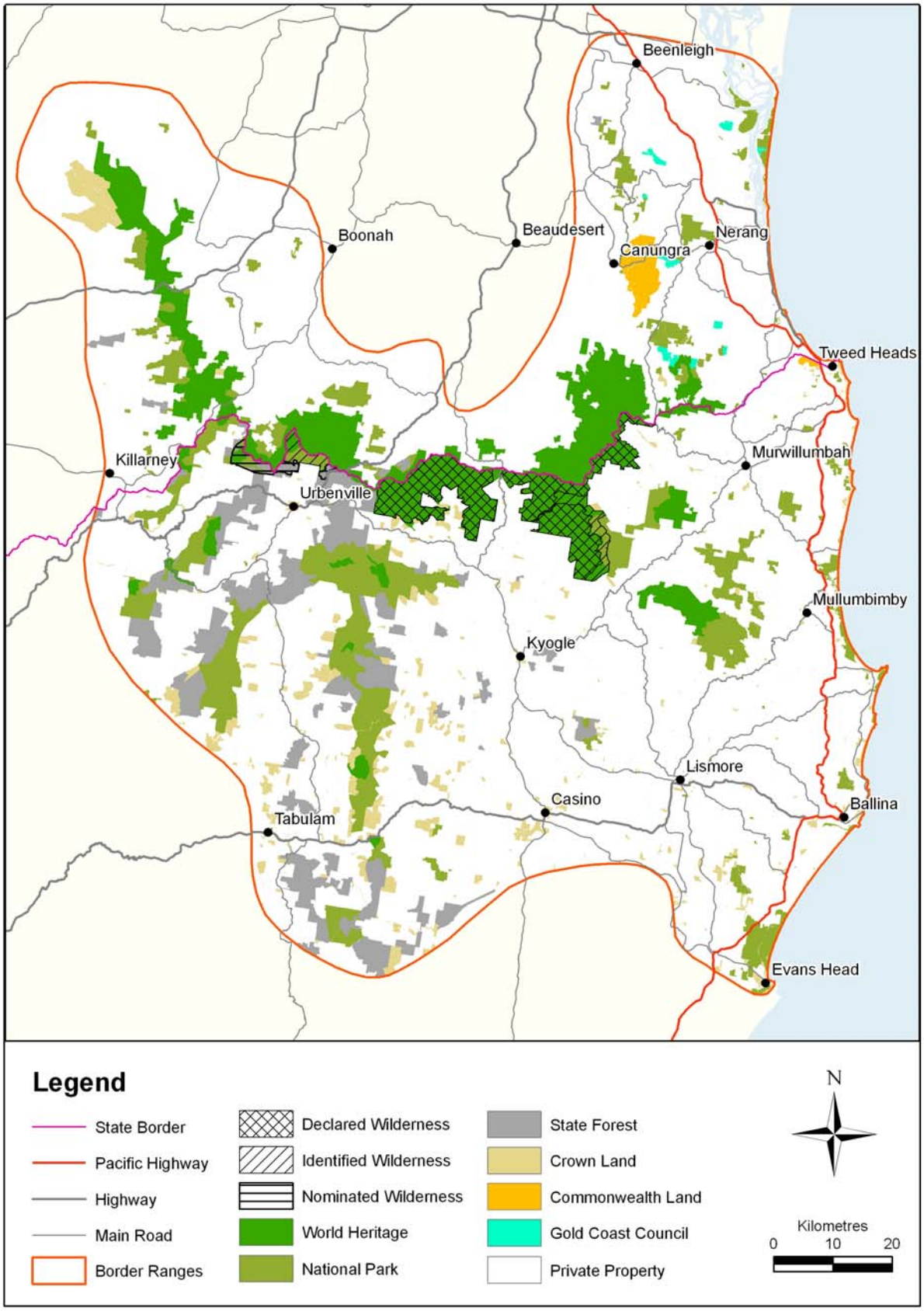


**Figure 2 Land tenure**

## 2.2 Topography

The topography of the region ranges from coastal floodplains to mountainous ranges as shown in Figure 3. The highest point in the Border Ranges region is Mount Superbus (1375 m) in south-east Queensland. The eroded calderas of Mt Warning and Focal Peak form a series of radiating ranges that connect to each other through the McPherson Range that runs along the NSW–Queensland border and joins the Great Dividing Range at Wilsons Peak in the west of the Planning Area. The Great Dividing Range turns north from Wilsons Peak along the high altitude Main Range that drops in elevation as it heads inland in the far north-west of the Planning Area. The McPherson Range and Main Range form steep east and north facing scarps over the Bremer, Logan and Albert River Valleys that drain north to Moreton Bay. To the west of the Main Range, the tributaries of the Condamine River form deeply incised valleys that drain west into the Murray–Darling Basin. These valleys become less incised as the Great Dividing Range loses altitude in the north-west of the area.

In the east of the Border Ranges region the escarpments of the Lamington and Springbrook Plateaus, together with the Tweed Range and Nightcap Range, form high cliffs over the eroded Mt Warning caldera which is centred on Mt Warning itself. In the north-east, the Beechmont, Canungra and Darlington Ranges form long fingers of elevated land that drop in altitude to the north onto the Logan River floodplain. The exception to this is Mount Tamborine, an elevated plateau on the northern end of Darlington Range, which forms a prominent backdrop to the Coomera and Nerang Valleys.

Along the coastal strip, the Nimmel, Tallai, Wunburra and Burringbar Ranges form a series of steep-sided valleys that drain into the smaller coastal catchments of the Tallebudgera and Currumbin Creek Valleys and the Coomera, Nerang and Brunswick River Valleys, all of which have narrow floodplains. In the south-east, the low basaltic plateau centred on Alstonville and bounded by the Mackellar Range to the west, is dissected by numerous gently sloping valleys that lead south to the broad floodplain of the Richmond Valley.

Further west, the Richmond River floodplain expands towards Casino and Kyogle. It is bounded in the west by the Richmond Range, which forms the divide between the Richmond and upper Clarence Valleys. West of the Richmond Range, the Tooloom and Koreelah Ranges drop abruptly into the narrow upper Clarence Valley and are separated by the broad valleys of Duck and Tooloom Creeks. Further west, Koreelah Creek runs to the east of the Great Dividing Range escarpment along the high elevation Acacia Plateau.

## 2.3 Geology

The following section has been derived from discussions in Stevens (1977) and interpretation of the various geological 1:250 000 mapsheets covering the Border Ranges region (Brunker et al. 1972; Olgers et al. 1972; Geological Survey of Queensland 1973, 1974). Figure 4 shows the distribution of broad geological groups in the region.

The predominant features of the Border Ranges region are the two eroded shield volcano calderas of Mt Warning in the Tweed Valley and Focal Peak to the west near Mt Barney, both of which were formed about 20–30 million years ago. The Tweed, Nightcap, Darlington, Beechmont and eastern McPherson Ranges are the eroded remnants of the Mt Warning volcano, while the Richmond, Tooloom, Koreelah, Main and western McPherson Ranges are eroded remnants of the Focal Peak volcano. These two volcanoes underwent a series of eruptions creating two significantly different types of lava flows. The most extensive flows were of Tertiary basalt that weathered to form the deep fertile red soils typical of the area around Lismore and Springbrook. These soils usually support subtropical rainforest in wetter areas and dry rainforest in areas where the rainfall is lower. Much of these once-extensive basalt plateaus have eroded to expose the older underlying geologies and form the coastal floodplain of the major river valleys. The other type of lava flow was of rhyolite, which weathers slowly to form low-nutrient, free-draining soils. A third lava type present in these

volcanoes, trachyte, generally did not occur as a flow but formed volcanic plugs and dykes. Rhyolites and trachytes are particularly resistant to erosion and can be seen as prominent cliffs, mountains and outcrops such as Mt Warning, Mt Lindesay, Nimbin Rocks and the cliffs of the Tweed caldera. Soils derived from trachyte and rhyolite typically support drier eucalypt forest, but at higher elevation where rainfall is greater, these soils can support tracts of warm temperate rainforest.

Underlying these volcanic rocks are older, Triassic sedimentary rocks of the Clarence–Moreton Basin (135–200 million years old), the Triassic volcanics (200 million years old) and Silurian metamorphosed sediments (meta-sediments) of the Neranleigh–Fernvale Series (250–500 million years old). The Clarence–Moreton Basin typically comprises sandstones, claystones, mudstones and conglomerate which erode to form low-nutrient, free-draining soils. However, in higher rainfall areas along elevated ranges, along with enrichment from the overlying basalt outcrops, soils often support areas of dry rainforest, as occurs along the Richmond Range. The Neranleigh–Fernvale meta-sediments include greywackes and phyllites that outcrop along coastal headlands, the Condong and Burringbar Ranges and the hills of the Gold Coast hinterland. Because of their elevation and proximity to the coast, these areas attract higher rainfall and often support subtropical rainforest in protected gullies. In the south-west of the region there are small areas of the New England Fold Permian granites (200–300 million years old) that form low-nutrient, free-draining soils supporting drier sclerophyll vegetation.

The most recently laid down geological strata, the Quaternary sediments, occur in valleys, lowlands and floodplains. These sediments have been laid down in the last 2.6 million years.

## 2.4 Climate

North-east NSW and south-east Queensland are located in a transition zone between a belt of steady trade winds to the north and an anticyclonic belt to the south. The oscillation of these two features over the region results in a climate that is largely subtropical. In summer, easterly to south-easterly winds predominate, while in winter, dry westerly to south-westerly winds predominate. These result in a distinct summer–autumn rainfall maximum, relatively dry springs, and fine sunny days with cool nights in winter (Natural Resource Audit Council 1995; DECCW website).

Within the Border Ranges region rainfall generally reduces as distance from the coast increases (see Figure 5). This trend is modified by topography, however, with higher orographic rainfall occurring in the mountainous areas and lower rainfall in the low-lying valleys and floodplains. Many of the valleys in the lee of the higher elevation ranges and prominent mountains experience rain-shadow effects and have markedly lower precipitation than the adjacent ranges to the east (Adam 1987). The highest rainfall areas are the Springbrook and Lamington Plateaus and the Tweed and Nightcap Ranges, with annual falls over 3000 mm.

Climate change predictions for northern NSW and south-eastern Queensland indicate a shift to warmer minimum and maximum temperatures, more extreme fire event days, fewer but more intense extreme weather events, and rises in sea level.

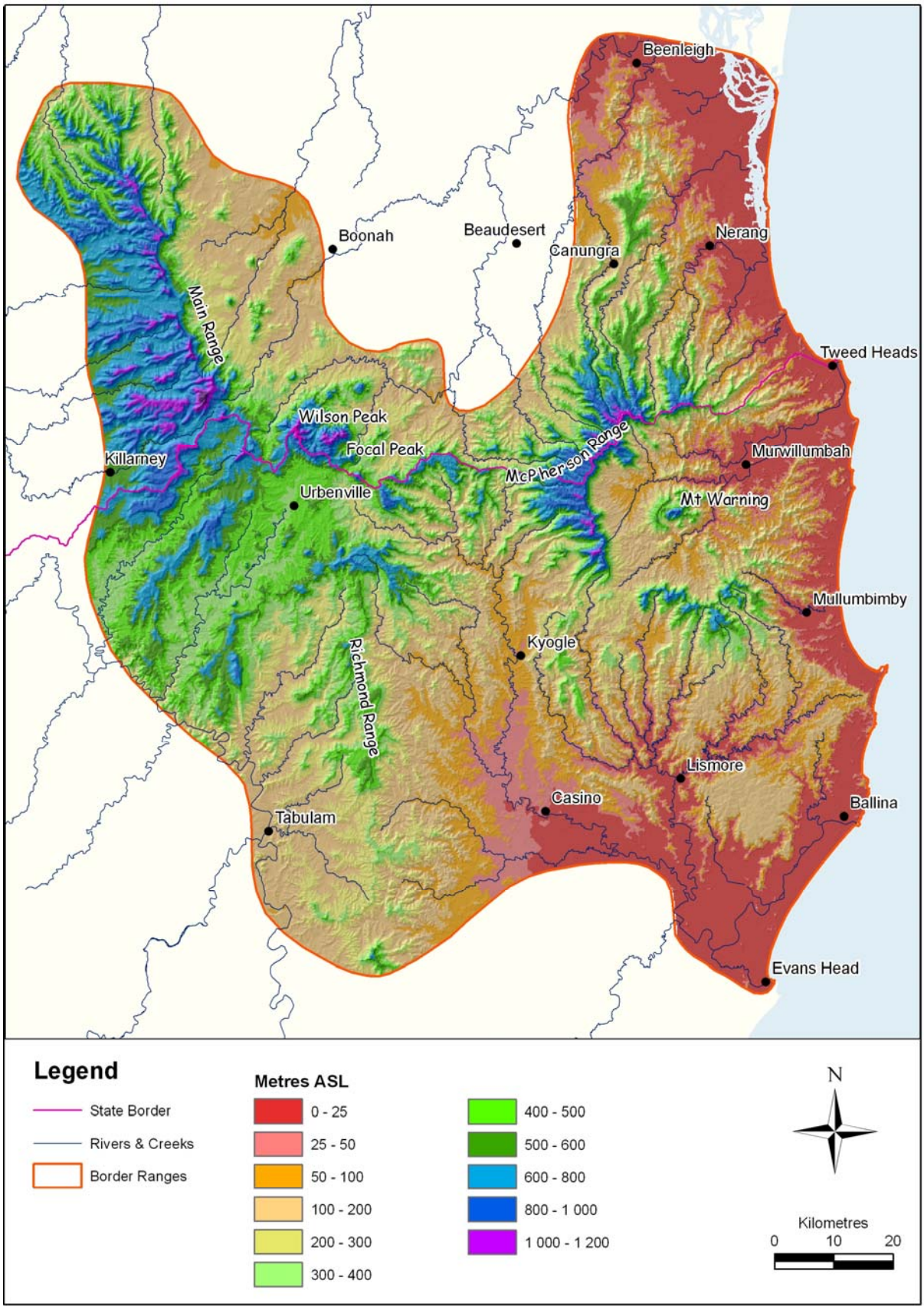


**Figure 3 Topography**

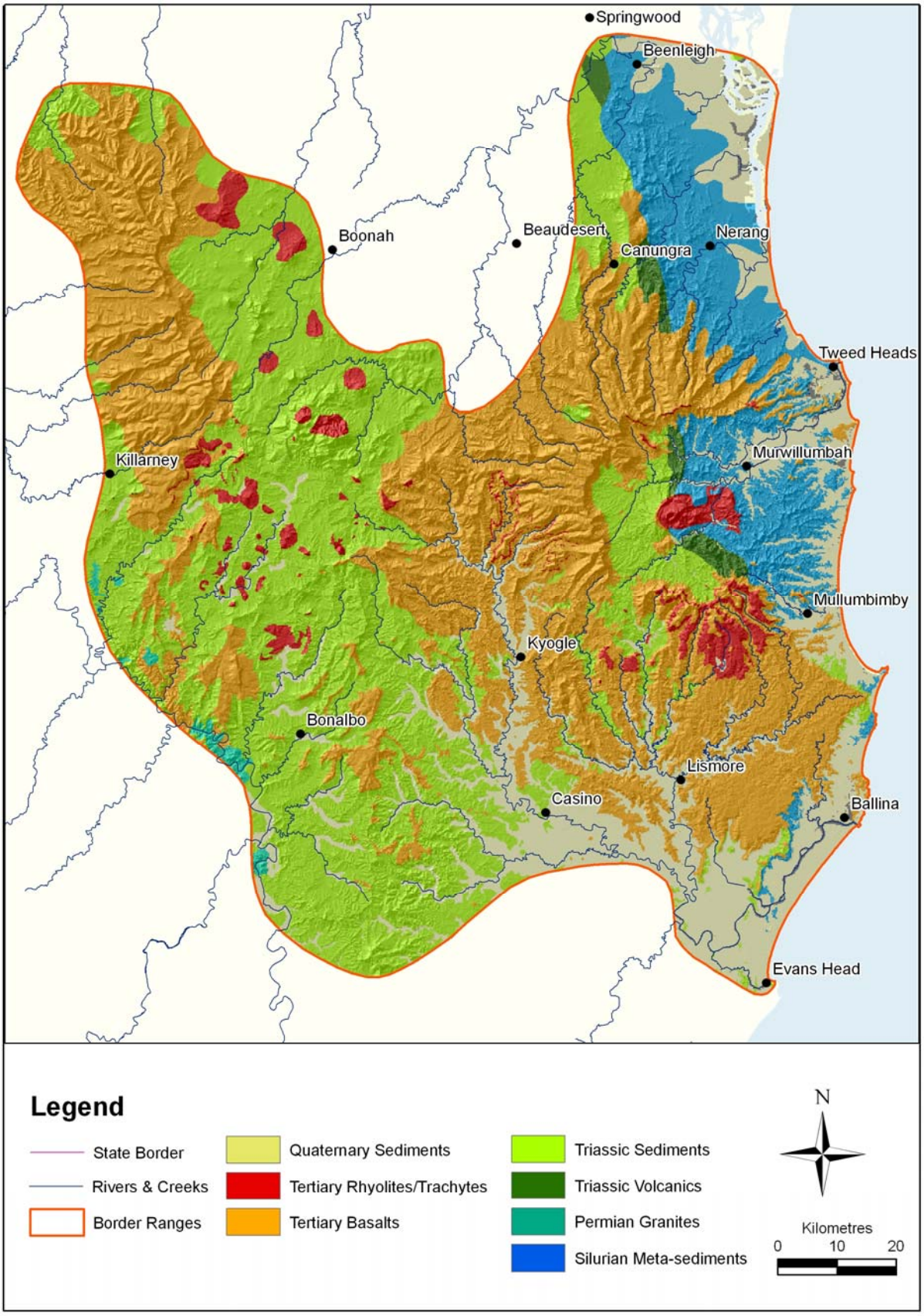


**Figure 4 Geology**

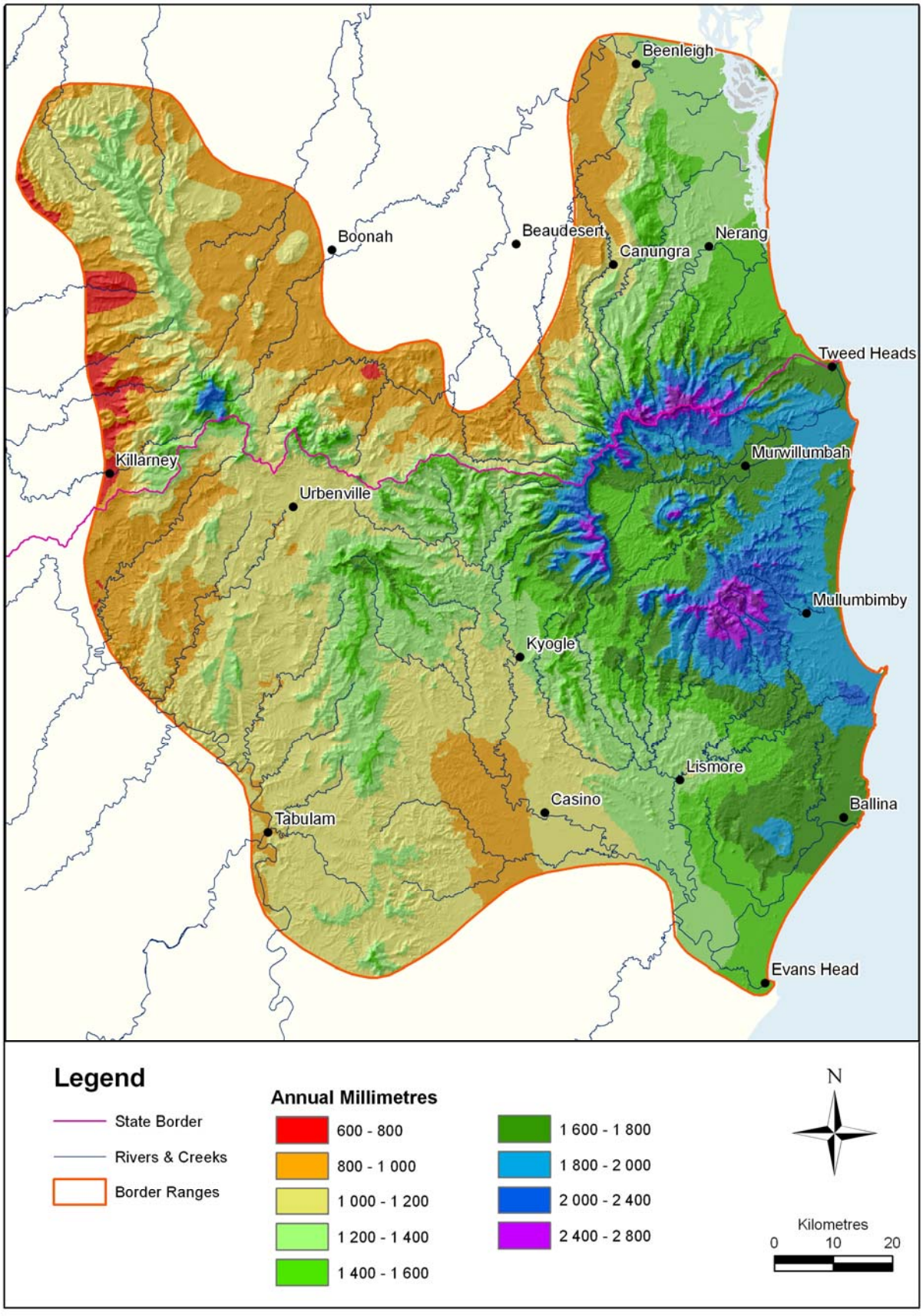


**Figure 5 Annual rainfall**

## 2.5 Broad vegetation groups

Around 710 000 ha (49%) of the Border Ranges region supports some form of native vegetation. This includes estuarine mangroves and saltmarshes, wetlands, heathlands, swamp sclerophyll forests, grassy sclerophyll woodlands, dry and wet sclerophyll forests, rainforests and highly restricted communities such as montane heathlands.

The classification systems used for vegetation mapping are not consistent between NSW and Queensland. To allow cross-border mapping, spatial modelling and planning for this Plan, various classifications have been integrated to derive a single, consistent classification. Over 100 distinct vegetation communities or ecosystems were identified in this process, and these were grouped into 17 vegetation formations and then 6 broad vegetation groups as detailed in Table 3. Figure 6 shows the distribution of broad vegetation groups in the Border Ranges region.

**Table 3 Vegetation groups and formations**

| Broad vegetation group | Vegetation formation | No. of ecosystems |
|---|---|---|
| Rainforest | Cool temperate rainforest | 2 |
| | Dry rainforest | 3 |
| | Littoral rainforest | 3 |
| | Semi-evergreen vine thicket | 5 |
| | Subtropical rainforest | 8 |
| | Warm temperate rainforest | 1 |
| Wet sclerophyll forest | Wet sclerophyll forest | 18 |
| Dry sclerophyll forest | Dry sclerophyll shrub forest | 10 |
| | Dry sclerophyll shrub/grass forest | 37 |
| Other native | Swamp sclerophyll forest | 4 |
| | Estuarine and saline wetland | 2 |
| | Freshwater wetland | 2 |
| | Grassland | 1 |
| | Heathland | 10 |
| Introduced | Introduced | 1 |
| | Plantation | 2 |
| Camphor Laurel | Camphor Laurel | 1 |

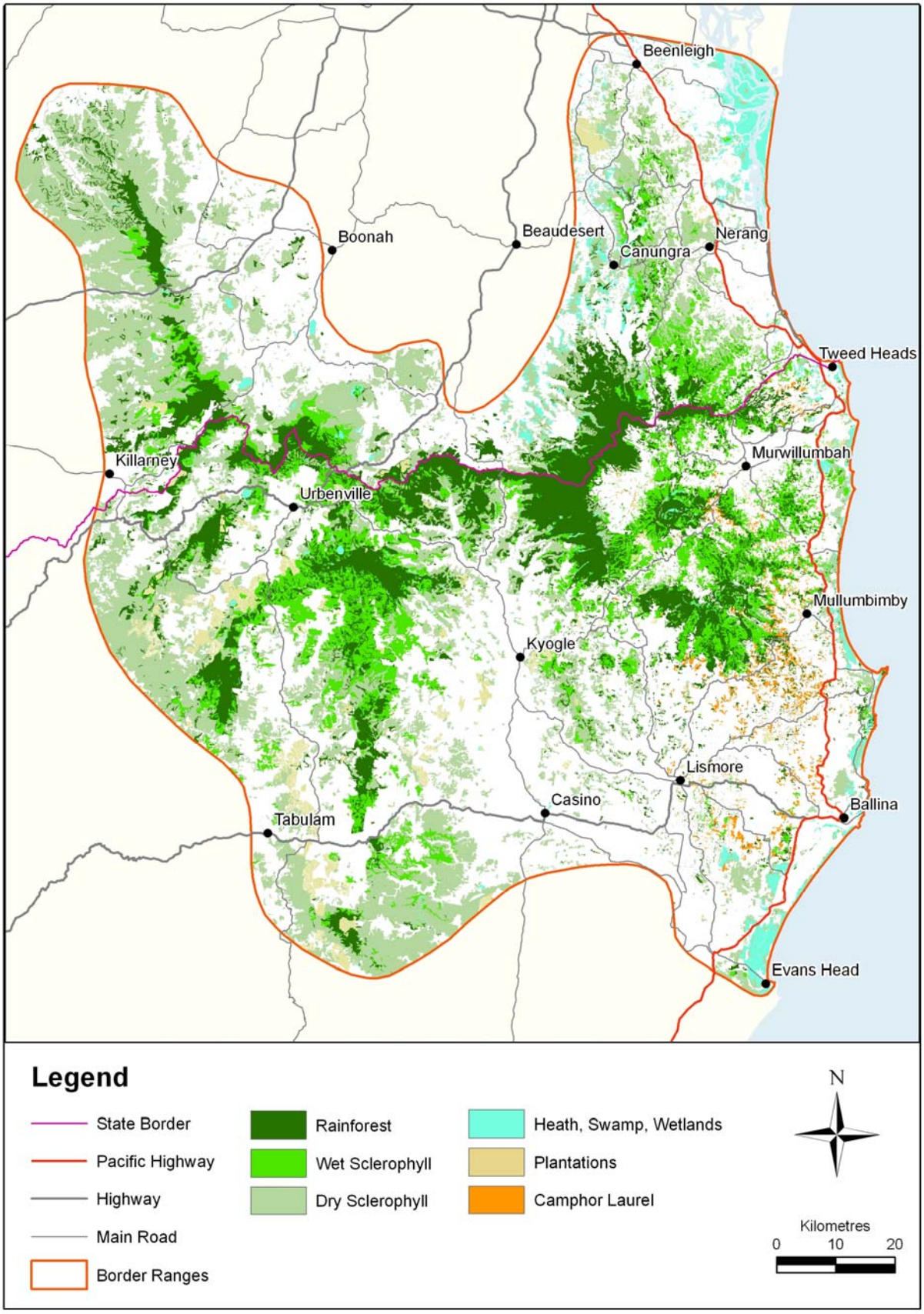


**Figure 6 Broad vegetation groups**

## 2.6 Rainforest and related vegetation

This Plan seeks to address threats to 'rainforest and related vegetation' which encompasses the following:

- rainforest; that is, subtropical, warm temperate, cool temperate, dry and littoral rainforest and semi-evergreen vine thickets
- wet sclerophyll forest
- vegetation communities of limited extent that are typically surrounded by rainforest; that is, cliffs, rocky outcrops and montane heath
- riparian vegetation surrounded by or adjacent to rainforest.

This definition mirrors the Australian Government's description of the Border Ranges North and South (Queensland and NSW) Biodiversity Hotspot (Department of the Environment and Water Resources 2007). Riparian vegetation is deemed to be a 'transition forest', and these areas are included in this Plan where they occur within or adjoining rainforest. As such, tables and figures do not distinguish riparian vegetation.

Appendix 5 (on the enclosed CD) contains a detailed discussion on the classification systems used for mapping and delineating rainforest and related vegetation for the purposes of this Plan. Figure 7 shows the distribution of rainforest and related vegetation in the Planning Area.

Rainforest and related vegetation covers approximately 291 600 ha, or 20%, of the Border Ranges region. As Table 4 shows, the majority of this is comprised of subtropical rainforest (46%) and wet sclerophyll forest (36%). The subtropical rainforests of the Border Ranges region represent the most significant Australian refugia for early Tertiary subtropical and dry rainforests (Department of the Arts, Sport, Environment and Territories 1992). It is also significant that over 11% of the rainforest and related vegetation is dry rainforest. The other vegetation types make up a much smaller component of the Planning Area.

**Table 4 Rainforest and related vegetation**

| Component vegetation types | Area (ha) | Proportion of all rainforest and related vegetation (%) |
|---|---|---|
| Subtropical rainforest | 135 579 | 46.5 |
| Wet sclerophyll forest | 104 779 | 35.9 |
| Dry rainforest | 32 530 | 11.2 |
| Camphor Laurel * | 11 269 | 3.9 |
| Heath & rocky areas | 2 946 | 1.0 |
| Cool temperate rainforest | 1 797 | 0.6 |
| Semi-evergreen vine thicket | 1 680 | 0.6 |
| Warm temperate rainforest | 606 | 0.2 |
| Littoral rainforest | 417 | 0.1 |
| TOTAL | 291 600 | 100 |

* see discussion below on Camphor Laurel

Table 5 provides information on where rainforest and related vegetation occurs in relation to the various land tenures in the Planning Area. Over half of rainforest and related vegetation occurs on national parks and other conservation reserves, while approximately 37% is located on private land. This highlights the importance of managing rainforest across both public and private tenure.

**Table 5 Proportion of rainforest and related vegetation occurring on different land tenures**

| Tenure | Rainforest and related vegetation | |
|---|---|---|
| | Area (ha) | Proportion of total (%) |
| Conservation reserves* | 153 101 | 52.5 |
| Private property freehold | 107 745 | 36.9 |
| State forests | 22 506 | 7.7 |
| Crown lands | 3 852 | 1.3 |
| Commonwealth lands | 1 872 | 0.6 |
| Private property conservation | 1 579 | 0.5 |
| Gold Coast Council land | 944 | 0.3 |

* includes 85 655 ha of rainforest and related vegetation in Gondwanan Rainforests of Australia WHA

The rainforest and related vegetation of the Border Ranges region forms an important component of the Gondwana Rainforests of Australia WHA, formerly Central Eastern Rainforest Reserves of Australia WHA. They support four rainforest types: cool temperate rainforest, warm temperate rainforest, subtropical rainforest, and dry rainforest. The Gondwana Rainforests of Australia WHA is recognised as containing important and significant habitats where threatened species of plants and animals of outstanding universal value still survive (Commonwealth of Australia 2007). The Gondwana Rainforests are also included on the National Heritage List because they possess uncommon, rare or endangered aspects of Australia's natural or cultural history (Commonwealth of Australia 2007). Within the Border Ranges region, the Gondwana Rainforest reserves attract a high number of visitors per year, and as such are very significant to the socio-economics of the area.

Much of the following information has been summarised from Adam (1987), Floyd (1990) and QEPA (2007), and these sources should be referred to for more detailed information. The general pattern of rainforest distribution is related to temperature, rainfall, soil type and fire history. Localised climate variations and fire behaviour are affected by topography, which in turn affect patterns of rainforest distribution.

For some rainforest types such as cool temperate rainforest, climate is the strongest influence on distribution, while soil fertility has a relatively low influence. Warm temperate rainforest generally occurs on lower fertility soils than subtropical rainforests. It also occurs at higher altitudes, possibly reflecting a requirement for higher rainfall or an adaptation to cooler temperatures. Where high soil fertility occurs at higher altitudes, subtropical rainforest may occur at similar altitudes to warm temperate rainforest. Where there is a strong seasonality to rainfall and lower overall rainfall, dry rainforest is more likely to occur than subtropical rainforest. Dry rainforest is more likely to persist in areas that have a higher degree of fire protection than exposed sites. Littoral rainforest occurs at coastal sites protected from fire but subject to persistent salt spray and strong winds. Semi-evergreen vine thickets occupy the driest sites, typically on higher fertility soils.

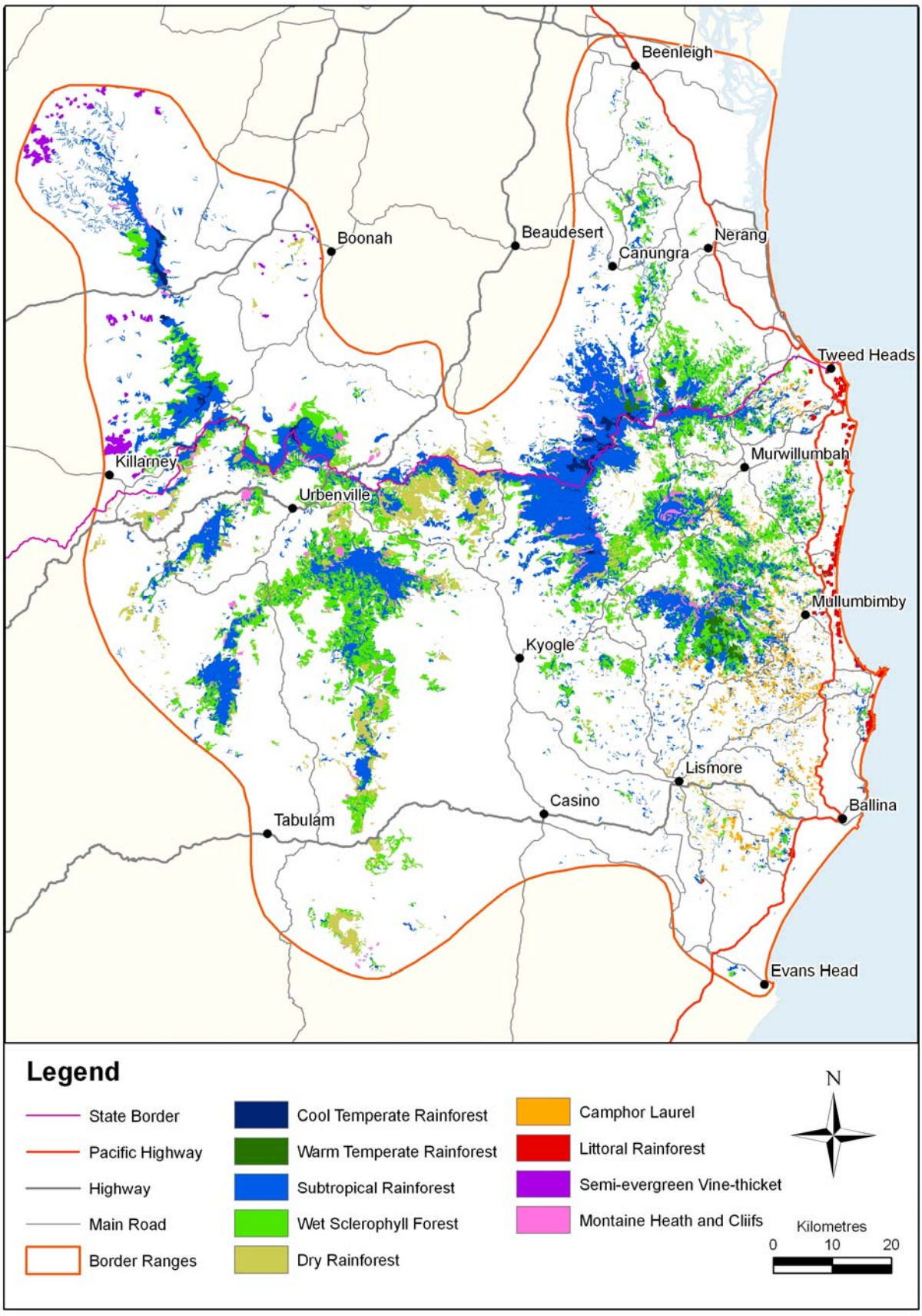


**Figure 7 Rainforest and related vegetation**

Subtropical rainforest covers approximately 135 580 ha, or 46%, of the Planning Area. This rainforest community once covered extensive areas of the fertile lowlands and floodplains in the Border Ranges region. In the east of the region, it is generally restricted to soils of basaltic origin, with large stands remaining at mid to high altitudes in Wollumbin, Border Ranges, Nightcap and Lamington National Parks, and Limpinwood and Numinbah Nature Reserves. There are also stands on metasediments and basalt in sheltered valleys along many of the coastal ranges such as the Burringbar, Condong, Beechmont and Darlington Ranges.

Isolated fragments of subtropical rainforest that represent the remnants of the Big Scrub occur near Lismore on both private land and in a number of conservation reserves such as Boatharbour, Victoria Park, Moore Park and Davis Scrub Nature Reserves. Further north, Stotts Island Nature Reserve supports the largest stand of lowland subtropical rainforest in the Tweed Valley and there are other lowland remnants at Nichols and Bahrs Scrubs in Queensland. Further west, along the McPherson Range, there are stands of subtropical rainforest at the base of Mt Glennie, Mt Chinghee, Mt Nothofagus and Mt Lindesay, with the largest unlogged stand occurring on Levers Plateau. There are also large stands in the Richmond Range at Dome Mountain and Murrays Scrub near Toonumbar, as well as further south at Bungdoozle and Cambridge Plateau. In the upper Clarence, stands exist along the Tooloom Range culminating in a large stand at the southern end on the elevated plateau of Yabbra Scrub, and also along the Koreelah Range including the extensive Tooloom Scrub area. Stands also exist along the Main Range in Queensland, with the most extensive being in the Mt Roberts and Mt Superbus area just north of the NSW–Queensland border and further north on the Mistake Plateau to the north of Cunninghams Gap.

Wet sclerophyll forest occurs extensively throughout the Planning Area covering some 104 780 ha, or 36%. Major stands occur in the east along many of the coastal ranges such as the Nightcap, Burringbar, Condong, Beechmont, Darlington and Blackall Ranges, as well as the flanks of Mt Warning. Other major stands occur further west on the Richmond and Tooloom Ranges and around the flanks of Mt Lindesay and Mt Barney. Additionally, wet sclerophyll forest occurs in other smaller stands along the Main, Koreelah, McPherson, Mackellar and Tweed Ranges, often interspersed as a mosaic amongst rainforest. Throughout the region, it often forms a transitionary community between the wetter rainforest of the higher ranges and the dry sclerophyll forests of the lower slopes.

Dry rainforest covers 32 530 ha, or 11%, of the Planning Area. Dry rainforest typically occupies fertile soils, particularly on drier northern and western slopes where there is a marked seasonality in rainfall figures. Extensive stands in the Planning Area occur on Levers Plateau and along the lower southern sections of the Richmond Range, with well developed stands at Mallanganee and near Mt Pikapene. Other occurrences include the drier slopes of the western Tweed Valley in Limpinwood Nature Reserve and Mebbin National Park. There are also numerous small isolated pockets along the floodplain and the foothills of the Richmond Valley in areas such as Ruthven and Ettrick. In the upper Clarence there are larger stands in Captains Creek Nature Reserve at the southern end of the Koreelah Range, and also on the lower slopes below Acacia Plateau near Old Koreelah. In Queensland, there are large stands of dry rainforest in the north and west of Lamington National Park, particularly Coomera Valley and Canungra Creek Valley. Numerous small stands also occur near Boonah, Beaudesert and Canungra.

Stands of the introduced Camphor Laurel *Cinnamomum camphora* are particularly prevalent in some parts of the Planning Area, covering around 11 270 ha, or 3.9%. In some areas where it dominates it may be regarded as a type of rainforest vegetation for management purposes in that it can provide important seasonal resources (such as food for rainforest frugivores), and appropriate microclimates that facilitate rainforest regrowth (Neilan 2004). However, in those parts of the Planning Area where it is not as prevalent and is still actively taking over native vegetation, it should be considered an invasive species and be prevented from establishing.

Camphor Laurel favours high rainfall areas on fertile soils – such as those derived from basalt – and floodplains. In south-east Queensland, Camphor Laurel is widespread in the Tallebudgera and Nerang valleys, especially along the waterways were it is replacing the native riparian vegetation. In NSW, Camphor Laurel is most prevalent in the coastal areas but also occurs further inland, particularly along streams. In the Tweed Valley it occurs in three main areas: from Cobaki to Duroby,

from Uki to Burringbar, and around the Duranbah area. In the Brunswick Valley it is common in an area encompassing Billinudgel, Main Arm and Mullumbimby. In the Richmond Valley it is especially common in the Wilson River catchment north of a line from Wardell to Lismore, with heavy infestations around the Alstonville, Tintenbar and Bangalow areas (Scanlon & Camphor Laurel Task Force 2001).

Montane heath, rocky outcrops and cliffs typically occur as small narrow bands on the precipitous slopes of the Mt Warning and Focal Peak Calderas. These areas cover just one per cent of the Planning Area. Major occurrences include the upper slopes of Mt Warning on trachyte, the prominent rhyolitic escarpments of the Tweed, McPherson and Nightcap Ranges, as well as the cliffs surrounding the Lamington Plateau. Further west, montane heath, rocky outcrops and cliffs occur on the trachyte plugs associated with Mt Lindesay and Mt Barney as well as around Urbenville and on the cliffs along the Koreelah and Main Ranges. An extensive area of montane heath and rocky outcrops also occurs in Bald Rock State Forest west of Woodenbong.

Cool temperate rainforest reaches its northern limit in the Planning Area and covers less than one per cent, or 1780 ha. Most occurrences are above 1000 m elevation and are typically subject to persistent rain, clouds and mists. The largest stand of cool temperate rainforest in the Planning Area is on the NSW–Queensland border in the Mt Nothofagus and Mt Ballow areas. In Queensland, stands dominated by Lilly Pilly *Syzygium smithii* occur at higher altitudes along the Main Range near Mt Roberts and Mt Superbus, Mt Huntley and Panorama Point, and north of Cunninghams Gap. There are also several stands in Lamington and Springbrook National Parks along the top of the McPherson Range escarpment and the higher headwaters of the north-flowing creeks. In NSW, all other stands are much further east of the Mt Nothofagus occurrence, on the tops of the Tweed Range escarpment and the higher headwaters of the western flowing creeks of the eastern Border Ranges. The most easterly stand is a small occurrence in Numinbah Nature Reserve.

Semi-evergreen vine thickets only occur in the far west and north-west of the Planning Area, covering an area of 1680 ha. They occupy small isolated patches in two main areas: north of Killarney in the headwaters of the Condamine River, and along Lower Black Duck Creek in the headwaters of Lockyer Creek.

Warm temperate rainforest, with the exception of a few high altitude outliers further north in Queensland, also reaches its northern limit in the Planning Area. It covers just 606 ha of the Planning Area. It is generally found on soils that are too infertile to support subtropical rainforest, as well as on high, windswept ridges where the thin basaltic soils and strong cold winds prevent the development of subtropical rainforest. The major occurrence of warm temperate rainforest is on the rhyolitic soils of the Nightcap Range with other small pockets in higher-altitude gullies of Lamington and Springbrook National Parks and along the eastern Border Ranges in exposed locations. There are also small stands at lower elevations at upper Currumbin, Tallebudgera and Mudgeeraba Creeks. Further west, warm temperate rainforest occurs on the high plateau of Mt Glennie and at Mt Nothofagus.

Littoral rainforest has been extensively cleared and is now restricted to coastal headlands and dunal systems in close proximity to the coast. There are just 417 ha of littoral rainforest in the Planning Area. The major occurrences are at Broken Head, Brunswick Heads, Wooyung and near Fingal Head.

## 2.7 Priority species and ecological communities

The rainforest and related vegetation of the Planning Area support a large variety of fauna and flora species. These include many that are naturally restricted, such as Albert's Lyrebird *Menura alberti*, Fleay's Barred Frog *Mixophyes fleayi*, Richmond Birdwing Butterfly *Ornithoptera richmondia*, Nightcap Oak *Eidothea hardeniana*, Ormeau Bottletree *Brachychiton* sp. Ormeau, Springbrook Pinkwood *Eucryphia jinksii* and Davidson's Plum.

Priority rainforest and related species and ecological communities are those occurring in the Planning Area that are threatened species, threatened ecological communities, or species that are not listed as threatened but are considered to be of conservation significance. For the purpose of the Plan, only species that are rainforest-dependent or that occur in rainforest or related vegetation were considered. Priority species of the Planning Area include a broad range of groups or life forms, covering flora, terrestrial vertebrate fauna, freshwater fin fish, invertebrate fauna and ecological communities (see Table 6). The full list of priority species and ecological communities can be found in Appendix 2. This Plan covers either the part range or full range of 25 priority ecological communities and 273 priority species, including 107 fauna and 166 flora species.

**Table 6 Priority species groups or life forms**

| Group or life form | Number of priority taxa |
|---|---|
| Fauna | |
| Invertebrate | 17 |
| Fin fish | 20 |
| Amphibian | 9 |
| Reptile | 17 |
| Bird | 22 |
| Mammal | 22 |
| Subtotal | 107 |
| Flora | |
| Epiphytic/epilithic orchid | 11 |
| Fern/fern ally | 12 |
| Graminoid | 5 |
| Herb | 9 |
| Parasitic mistletoe | 3 |
| Shrub | 29 |
| Shrub or small tree | 20 |
| Small tree | 31 |
| Tree | 32 |
| Vine | 14 |
| Subtotal | 166 |
| Total | 273 |

Priority threatened species and ecological communities are those listed under one or more of the Acts:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- New South Wales *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994*
- Queensland *Nature Conservation Act 1992*, *Vegetation Management Act 1999* or *Fisheries Act 1994*.

The number of threatened species and ecological communities listed under these Acts that are addressed by this Plan is summarised in Table 7. There are 58 threatened fauna, 134 threatened flora, and 25 threatened ecological communities covered by this Plan.

Those species that are not listed as threatened but are considered a priority in the Plan are either endemic to the Planning Area or are species of particular conservation concern. There are 32 flora and 49 fauna species of non-threatened priorities species (see Appendix 2). These species were identified through two processes: 1) consultation with ecological experts, government department representatives and members of the community; 2) identification of species based on their relative distributions inside and outside the Planning Area.

The species and ecological communities addressed by the Plan will continue to be updated as new threatened listings are made or as new information becomes available.

**Table 7 Summary of threatened species and ecological communities addressed by this Plan**

| Status | National | NSW | Queensland |
|---|---|---|---|
| Fauna | | | |
| Critically endangered | 1 | 3 | - |
| Endangered | 9 | 13^ | 6 |
| Vulnerable | 7 | 28 | 9 |
| Rare | - | - | 19 |
| Protected* | - | - | 1 |
| Total (58) | 17 | 44 | 35 |
| Flora | | | |
| Critically endangered | 2 | 1 | - |
| Endangered | 20 | 51 | 17 |
| Vulnerable | 32 | 34 | 27 |
| Rare | - | - | 47 |
| Total (134) | 54 | 86 | 91 |
| Threatened ecological community or regional ecosystem | | | |
| Critically endangered | 1 | 0 | - |
| Endangered | 1 | 5 | 7 |
| Vulnerable | 0 | 0 | - |
| Of concern | - | - | 11 |
| Total (25) | 2 | 5 | 18 |

* under the definition of the *Queensland Fisheries Act 1994* only; ^ Brush-tailed Rock-wallaby excluded in NSW component of Planning Area; - = not applicable.

### 2.7.1 Flora and fauna assemblages

#### *Flora*

Floristically, the Planning Area forms part of the Macleay–McPherson overlap (Burbidge 1960). This is a distinct phyto-geographical zone between the McPherson Ranges in the north and the Macleay River in the south that contains tropical and temperate species, many at the limits of their distributions. Over 4000 different plants have been recorded from within the area. This rich

assemblage of plant species results in a complex mosaic of vegetation communities that has led to national and international recognition of the outstanding biodiversity of this zone (NPWS 1995).

Given the large number of priority flora species (166), species were assigned to one of five trait-based groups (Kooyman & Rossetto 2007, provided in Appendix 6 on the enclosed CD). This was done to help define risk-based assessment categories and inform management priorities and actions for all species, even those for which little ecological information was available. Information that was used to develop these five groups included life history information (e.g. seed size, fruit type, dispersal mode, leaf size and persistence), broad vegetation type and landscape unit (see Section 3.2) the species occurs in (see Kooyman & Rossetto 2007).

A brief description of the five trait-based Flora Groups is provided in Table 8, and a listing of species within each Flora Group is provided in Appendix 7. (Appendix 2 also indicates which Group each priority species is in.)

In addition to developing the functional trait groupings, Kooyman and Rosetto (2007) provided an audit of the known information on population size, overall threats to priority species and identified knowledge gaps which can inform future research priorities. More detailed information is provided in Appendix 8 (on the enclosed CD).

**Table 8 Trait-based Flora Groups**

| Flora Group | Group description | Vulnerability to threat |
|---|---|---|
| Group 1 | Flora in this group are large-fruited species that are often dispersal-limited, mostly large canopy to medium-to-small persistent trees with the capacity to resprout, and are mature phase shade tolerant rainforest species. One anomaly is *Doryanthes palmeri*, which is a rocky outcrop specialist with big leaves and big fruits. | Large fruit may mean dispersal limitation and therefore susceptibility to fragmentation and a reduction in dispersal vectors. Species most under threat in this group are those that occur in the lowland landscape (see Section 3.2) where fragmentation is most severe. Species assigned to Flora Groups 1 and 5 can, in some instances, be combined for management purposes. |
| Group 2 | This group is comprised of small-seeded herbs, sedges, shrubs and trees. A specialist habitat subgroup is dominated by high altitude shrubs and herbs, while a wet sclerophyll habitat subgroup includes sedges and shrubs. A rainforest habitat subgroup includes a variety of life forms that occur in the lowland landscape (see Section 3.2). | The rainforest habitat subgroup of the lowlands landscape is the subgroup most under threat from fragmentation and associated factors. Some specialist habitat species from Flora Group 3 could be included in Flora Group 2 for management purposes. |
| Group 3 | The flora of this group are mostly ferns, orchids and epiphytes. The group also includes several woody plants and several habitat specialists. | This group includes many species that are potentially under threat from collection. Sedges and specialist habitat herbs from this group could be included in Flora Group 2 for management purposes. |
| Group 4 | This group contains two subgroupings based on habitats. One representing moist rainforest habitats, including woody vines, trees, shrubs and mistletoes. The second representing species of drier vine forest, wet sclerophyll forest and specialist habitats. | Many of the species in this group are lowland rainforest species and it is probably these that are most under threat due to fragmentation and associated factors such as dispersal. |
| Group 5 | This flora group contains two subgroupings. The first is of rainforest habitats, mostly persistent (clonal and resprouting) trees and shrubs. The second represents wet sclerophyll and rocky outcrop species. | Clonal species can be resistant to certain disturbance-related threats. However, infrastructure projects that completely remove habitat can still pose a major threat, particularly in the lowland landscape of the Planning Area. Clonal species can potentially be under threat from stochastic or demographic effects because, although they often persist, effective population sizes can be low at sites. Species assigned to Flora Groups 1 and 5 can, in some instances, be combined for management purposes. |

## *Fauna*

Species from all five of the Australian biogeographic terrestrial fauna biotas occur in the Border Ranges region (see Schodde & Calaby 1972; Schodde & Faith 1991; Schodde 1993; Landmark et al. 1999). Priority terrestrial fauna species were grouped into biogeographical biota groups. Most Border Ranges species represent one of three biotas: Torresian, Bassian and Tumbunan (Landmark et al. 1999).

The Torresian biota extends from the tropical, grassy savannah woodlands of northern Australia and is the prevailing non-rainforest biota at altitudes up to 200 m (Tanton 1996). The Bassian biota is the fauna of the eucalypt-dominated forests of southern Australia and is widespread in the Border Ranges region, down to about 200 m altitude where it mingles with the Torresian biota (Tanton 1996). The most important group in the Planning Area is the Tumbunan biota (Landmark et al. 1999) which comprises the subtropical rainforest biota that was formerly distributed continuously across the continent during wetter periods (Schodde & Calaby 1972; Schodde & Faith 1991; Schodde 1993). Table 9 lists the priority fauna species in the Planning Area that have Tumbunan origins.

The Tumbunan fauna is now essentially relictual, having contracted to two main core areas centred on the Border Ranges and the Herbert–Daintree uplands of north-east Queensland. The Tumbunan biota is characterised by fauna with restricted distributions and specialised ecological requirements, and although some species now extend into eucalypt forests, they are Tumbunan in origin (Tanton 1996; Landmark et al. 1999). Due to the relictual nature of this biota, suitable refugia are important to their persistence in the Planning Area. Milledge (2007) recommended that refuge areas become a focus for revegetating cleared gaps, increasing the size of isolated rainforest remnants (including buffering), linking of isolated remnants with larger patches, and generally maintaining or improving overall ecosystem function (see Section 3.3.2).

Non-terrestrial species – for example, fin fish and aquatic invertebrates, including four identified endemic freshwater cray fish (Coughran 2002, 2005) – were grouped into basic assemblages based on the landscape unit (upland, midland or lowland – see Section 3.2) and broad habitat type (rainforest or wet sclerophyll). The vulnerability of these groups was then assessed against the threats identified in the Plan. The Border Ranges region supports a large number of native freshwater fish and crustaceans, some of which are listed as threatened, such as the Eastern Freshwater Cod *Maccullochella ikei*, or are extremely restricted within the region, such as *Euastacus* spp., *Cherax leckii* n. sp. and *Tenuibranchiurus* sp. (Coughran 2006).

Non-rainforest groups that are ecotonal to and/or interact with rainforest were also considered in this Plan, for example, the northern population of the Eastern Bristlebird *Dasyornis brachypterus* which has less than 30 individuals still surviving in the wild (D. Stewart pers. comm.).

**Table 9 Priority Tumbunan fauna**

| Fauna group | Taxon | |
|---|---|---|
| | **Scientific name** | **Common name** |
| Birds | *Menura alberti* | Albert's Lyrebird |
| | *Coracina lineata* | Barred Cuckoo-shrike |
| | *Turnix melanogaster* | Black-breasted Button-quail |
| | *Cyclopsitta diophthalma coxeni* | Double-eyed Fig-parrot / Coxen's Fig-parrot |
| | *Ailuroedus crassirostris* | Green Catbird |
| | *Orthonyx temminckii* | Logrunner |
| | *Podargus ocellatus plumiferus* | Marbled Frogmouth |
| | *Ptiloris paradiseus* | Paradise Riflebird |
| | *Atrichornis rufescens* | Rufous Scrub-bird |
| | *Tyto tenebricosa* | Sooty Owl |
| Frogs | *Assa darlingtoni* | Pouched Frog / Australian Marsupial Frog |
| | *Lechriodus fletcheri* | Black-soled Frog / Fletcher's Frog |
| | *Litoria pearsoniana* | Cascade Tree Frog / Pearson's Green Tree Frog |
| | *Litoria revelata* | Whirring Tree Frog |
| | *Mixophyes fleayi* | Fleay's Barred Frog |
| | *Mixophyes iteratus* | Giant Barred Frog |
| | *Philoria kundagungan / Kyarranus kundagungan* | Mountain Frog / Red-and-yellow Mountain Frog |
| | *Philoria loveridgei / Kyarranus loveridgei* | Loveridge's Frog / Masked Mountain-frog |
| | *Philoria richmondensis* | Richmond Range Frog |
| Mammals | *Macropus parma* | Parma Wallaby |
| | *Thylogale stigmatica* | Red-legged Pademelon |
| Reptiles | *Cacophis krefftii* | Dwarf Crowned Snake |
| | *Coeranoscincus reticulatus* | Three-toed Snake-tooth Skink |
| | *Egernia major* | Land Mullet |
| | *Egernia mcpheei* | Eastern Crevice Skink |
| | *Eulamprus murrayi* | Blue-speckled Forest-skink |
| | *Eulamprus tryoni* | |
| | *Harrisoniascincus zia* | Rainforest Cool-skink / Beech Skink |
| | *Hoplocephalus stephensii* | Stephens' Banded Snake |
| | *Hypsilurus spinipes* | Southern Forest Dragon / Southern Angle-headed Dragon |
| | *Ophioscincus truncatus* | Short-limbed Snake-skink |
| | *Saiphos equalis* | Yellow-bellied Three-toed Skink |
| | *Saltuarius swaini* | Southern Leaf-tailed Gecko |
| | *Saproscincus challengeri* | Orange-tailed Shadeskink |
| | *Saproscincus oriarus* | A shadeskink |
| | *Saproscincus rosei* | A shadeskink |
| | *Saproscincus spectabilis* | Spectacled Shade-skink |

# 3 Addressing Threats

This Plan assessed threats in three ways. Firstly, threats to rainforest and related vegetation were listed, assessed and ranked. Secondly, different biological and geographic scales at which these threats operate were identified. Thirdly, geographic areas to form the focus of recovery action implementation were identified and mapped. In order to provide context to the actions in this Plan, the discussion of individual threats is presented in Section 4: Management Actions.

## 3.1 Assessing and ranking threats to biodiversity

The approach to assess and rank threats adopted for this Plan was an adaptation of the *Conservation Action Planning Process* (Nature Conservancy 2007).

When considering the direct and indirect ways in which threats and threat activities affect biodiversity, it is useful to distinguish between the *source* of a stress upon biodiversity and the actual stress itself. For the purposes of this Plan, the sources of a stress are defined as the threatening processes and activities that cause stress on biodiversity. The stresses themselves are defined as the actual impacts caused by these threatening processes and activities. For this Plan, the four fundamental stresses on biodiversity have been identified as:

- habitat loss
- habitat modification
- loss of individuals
- loss of genetic integrity [1].

Threats affecting biodiversity and priority species and ecological communities were determined from a combination of expert opinion, published literature and available databases, including *Unified Classification of Direct Threats* (IUCN–CMP 2006) and *Dataset on Threats to Biodiversity Listed under the NSW* Threatened Species Conservation Act 1995 *and the NSW* Fisheries Management Act 1994 (DEC 2006a).

The dataset on threats (DEC 2006a) included all key threatening processes listed under the EPBC Act, NSW TSC Act and NSW *Fisheries Management Act 1994*. Key threatening processes are processes that threaten, or may threaten, the survival, abundance or evolutionary development of a species or ecological community. There are no provisions under Queensland legislation to list threatening processes.

Table 10 identifies the key threatening processes (or legislative equivalents) that are relevant to the Planning Area, and also indicates which of the listed processes has a relevant threat abatement plan or NSW statement of intent (as of September 2009). These plans detail appropriate actions and measures to ameliorate the impacts of the threat, and are referred to by this Plan in Section 4 and outlined in Appendix 1 (on the enclosed CD).

[1] Loss of genetic integrity is also referred to as 'genetic stochasticity' (Lindenmayer & Fisher 2006; Ouborg et al. 2006) or 'genetic deterioration' (Hobbs & Yates 2003).

## Table 10 Key threatening processes relevant to the Planning Area

TAP = Threat abatement plan approved or draft under consideration; SoI = Statement of intent approved; FM Act = NSW *Fisheries Management Act 1994*

| Key threatening process (or equivalent) | EPBC Act | NSW | |
|---|---|---|---|
| | | TSC Act | FM Act |
| Climate change | | | |
| Anthropogenic climate change | ✓ | ✓ | |
| Habitat loss or change | | | |
| Clearing of native vegetation | ✓ | ✓ | |
| Eucalypt dieback associated with over-abundant psyllids and Bell Miners *Manorina melanophrys* | | ✓ | |
| High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition | | ✓ | |
| Loss and/or degradation of sites used for hill-topping by butterflies | | ✓ | |
| Loss of hollow-bearing trees | | ✓ | |
| Removal of dead wood and dead trees | | ✓ | |
| Weeds | | | |
| Invasion and establishment of exotic vines and scramblers | | ✓ | |
| Invasion of native plant communities by Bitou Bush and Boneseed *Chrysanthemoides monilifera* | | TAP | |
| Invasion of native plant communities by exotic perennial grasses | | ✓ | |
| Invasion, establishment and spread of Lantana *Lantana camara* | | ✓ | |
| Pests | | | |
| Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus* | TAP | ✓ | |
| Competition and habitat degradation by feral Goats *Capra hircus* | TAP | ✓ | |
| Competition from feral Honeybee *Apis mellifera* | | ✓ | |
| Herbivory and environmental degradation caused by feral Deer | | ✓ | |
| Reduction of biodiversity due to Red Imported Fire Ants *Solenopsis invicta* | ✓ | ✓ | |
| Introduction of the Large Earth Bumblebee *Bombus terrestris* | | ✓ | |
| Invasion and establishment of the Cane Toad *Bufo marinus* | ✓ | ✓ | |
| Invasion of the Yellow Crazy Ant *Anoplolepis gracilipes* | TAP | ✓ | |
| Predation by the Plague Minnow *Gambusia holbrooki* | | TAP | |
| Predation by the European Red Fox *Vulpes vulpes* | TAP | TAP | |
| Predation by the feral Cat *Felis catus* | TAP | ✓ | |
| Predation and hybridisation by feral Dogs *Canis lupus familiaris* | | ✓ | |

| Key threatening process (or equivalent) | EPBC Act | NSW | |
|---|---|---|---|
| | | TSC Act | FM Act |
| Predation, habitat degradation, competition and disease transmission by feral Pig *Sus scrofa* | TAP | ✓ | |
| Diseases | | | |
| Infection of frogs by amphibian chytrid causing the disease chytridiomycosis | TAP | SoI | |
| Infection of native plants by *Phytophthora cinnamomi* | TAP | SoI | |
| Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations | ✓ | ✓ | |
| Aquatic habitats | | | |
| Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands | | ✓ | |
| Degradation of native riparian vegetation along watercourses | | | ✓ |
| Hook and line fishing in areas important for the survival of threatened fish species | | | ✓ |
| Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams | | | ✓ |
| Introduction of fish to fresh waters within a river catchment outside their natural range | | | ✓ |
| Removal of large woody debris from rivers and streams | | | TAP |

One hundred and eighty threat activities (i.e. 180 sources of the above four stresses) were identified as being active either in the past, present or future. These threats have been grouped into broad threat categories. Two over-arching threat categories (universal threats) were identified:

- organisational-related impediments
- anthropogenic climate change.

These two threat categories are treated separately because, although they are threats in their own right, both are considered over-arching threats that interact with and potentially exacerbate the other threat categories. The other ten broad threat categories identified were:

1. habitat loss (human-induced)
2. habitat degradation (human-induced)
3. weed invasion and competition
4. inappropriate fire regimes
5. introduced pest animals
6. Bell Miner associated dieback
7. grazing and trampling by livestock
8. human interference
9. pathogens and disease
10. demographic effects.

Each of these ten threats were ranked based on their overall contribution to the four threat stresses (habitat loss, modification, loss of individuals and genetic integrity) and their geographical extent, severity, and irreversibility across the Planning Area. In accordance with the ranking, categories are

presented in *decreasing* order of severity, and therefore priority, in which they operate across the Planning Area. The objectives in Section 4: Management Actions are also ordered to reflect these priorities. Appendix 9 (on the enclosed CD) contains a full list of the threats assigned to each of the ten broad threat categories. It is important to note that many of these threat categories are frequently interconnected, and therefore often exacerbate each other.

## 3.2 Scale-based threat management

The approach taken by this Plan is to direct recovery actions to the most appropriate scale in order to maximise cost-effective management of the threat and its identified impacts. To achieve this, threat activities were assessed against two key aspects:

1. the threat's impact on biodiversity, priority species and ecological communities
2. the geographical or biological scale/s at which the threats operate.

This involved ranking each threat at the appropriate geographical and biological scale for severity, irreversibility and contribution to the four stresses described above (adapted from Nature Conservancy 2007). Three geographical scales were defined for this purpose (see Figure 8): the Planning Area, landscape scale, and site or landscape feature. Three landscapes were delineated: lowland 0–100 m altitude, midland 100–600 m altitude, and upland over 600 m altitude (see Figure 9 and further discussion below). These landscapes broadly reflect patterns of landuse and, to a certain extent, the severity of threats operating across the altitudinal range of the Planning Area. Four biological scales were identified: the Planning Area, trait or species group, single species, and population or critical habitat feature.

This approach resulted in a hierarchy of actions directing effort to the most appropriate level for integrated and cost-effective management dependent on the scale at which a particular threat operates. At the finer scale, the Plan identifies those particular species, populations, vegetation communities or habitat features that require species-specific or site-specific actions. This ensures that those entities subject to threats not covered by a broader scale of management are still identified and appropriate actions accounted for.

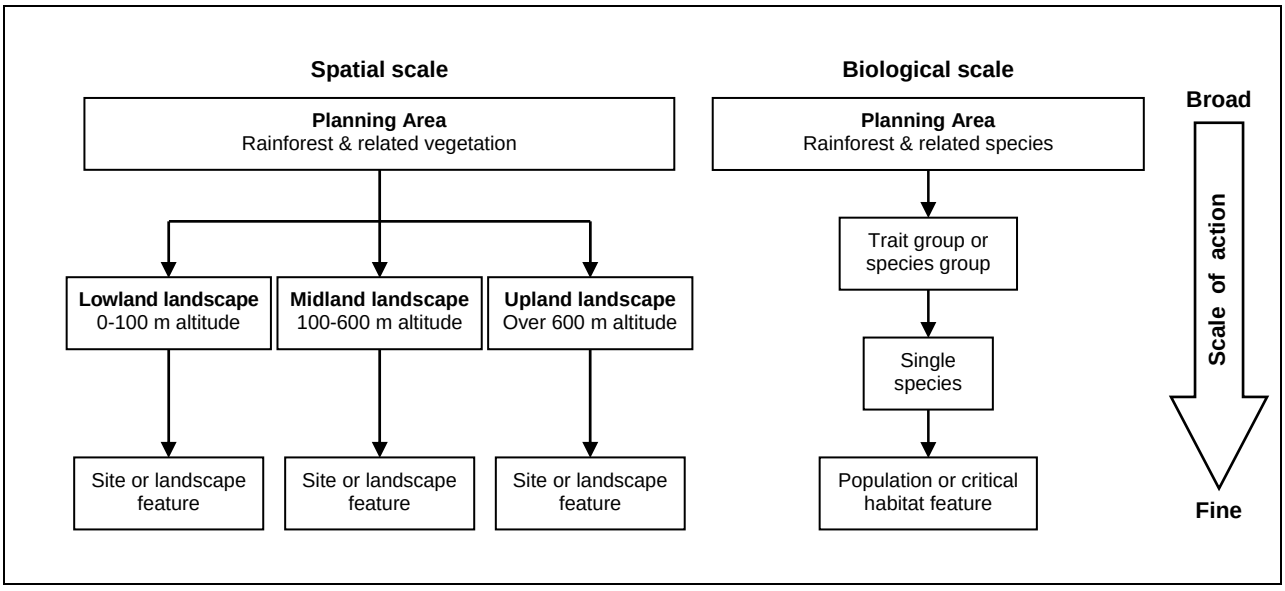


**Figure 8 Spatial and biological scales of recovery actions**

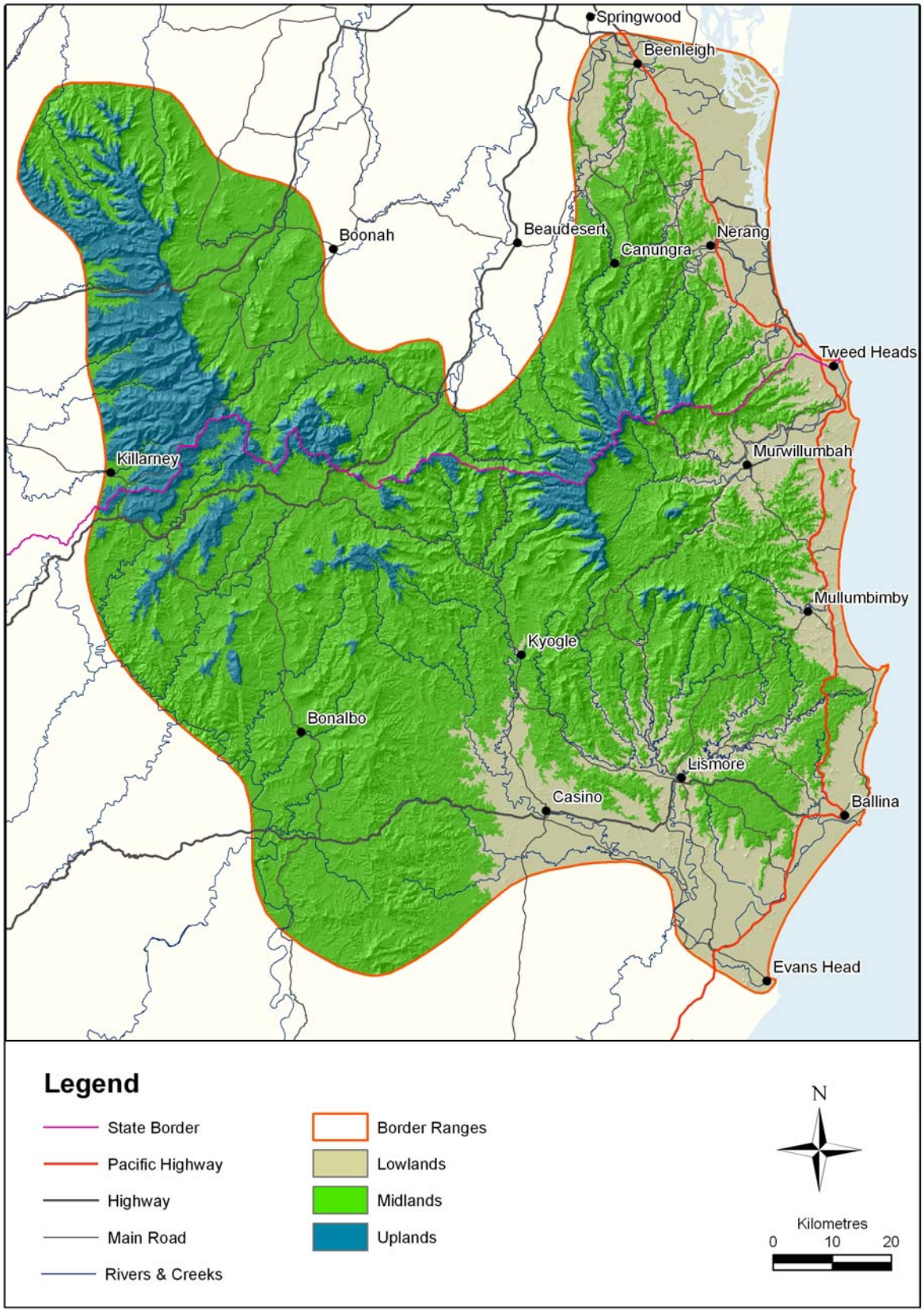


**Figure 9 Landscapes**

The lowland landscape occupies 22% of the spatial extent of the Border Ranges region. It contains the coast and adjacent valleys where there is intensive urban and agricultural development and, accordingly, is subject to the greatest overall threats to biodiversity. The lowlands are largely cleared of native vegetation and what remains is highly fragmented and often degraded. Only small areas of rainforest vegetation are reserved for conservation. The midland landscape includes the adjacent coastal foothills and much of the hinterland occupying 67% of the Border Ranges region. Just over 10% of this landscape occurs in conservation reserves. This landscape also contains nearly three-quarters of the rainforest and related vegetation of the Planning Area. The upland landscape occupies 11% of the Border Ranges region. It covers the higher ranges and plateaus where the primary landuse is conservation. This landscape includes nearly one-quarter of the rainforest and related vegetation of the Planning Area.

## 3.3 Priority areas

The Plan recognises that there is a significant amount of biodiversity conservation work and community ownership of projects currently being undertaken outside the identified priority areas and that there is likely to be sound justification for continuing to work in those areas. The identification of priority areas does not necessarily preclude actions being undertaken in other parts of the Planning Area, but seeks to assist natural resource management bodies, land managers, community groups and land-holders in making decisions on where to invest their funds and effort in implementing the recovery actions in Section 4.

Priority areas for targeting implementation of actions in the Plan have been identified through several processes, including computer modelling, community input and collation of expert information as outlined below. Table 11 lists the priority areas where targeted implementation of recovery actions is recommended; and the location of the figures/maps within the Plan. Table 11 also provides an indication of whether conserve and/or repair actions are the intended focus of management action in each priority area. Other items in the Plan, including appendices and tables, provide additional information to assist in implementation of the Plan's actions.

**Table 11 Priority areas for implementation of actions**

(Plan/CD identifies whether the Figure is included in the Plan's main document or on the enclosed CD)

| Priority area | Figure no. | Plan / CD | Action focus |
|---|---|---|---|
| Conserve Priorities and Precincts | 10 / 10a–j | Plan / CD | Conserve |
| Repair Priorities and Precincts | 11 / 11a–j | Plan / CD | Repair |
| Big Scrub Remnants | 13 | CD | Conserve & Repair |
| Stotts Island Nature Reserve critical habitat | 2 | Plan | Repair |
| Tumbunan fauna refugia | 14 | CD | Conserve & Repair |
| Rainforest fire risk | 15a | CD | Conserve |
| Dry rainforest fire pilot areas | 15b | CD | Conserve |
| Climate change linkages | 16 | Plan | Conserve & Repair |
| Community-identified priority areas | 17 | CD | Conserve & Repair |
| Gold Coast Open Space Acquisition Strategy areas | 2 | Plan | Conserve & Repair |
| Gondwana Rainforests of Australia WHA | 2 | Plan | Repair |
| Priority Bitou Bush control sites | App 10* | Plan | Repair |

* Appendix 10 provides descriptions of the geographic locations of the priority Bitou Bush control sites

### 3.3.1 Conserve and Repair Priorities

A range of options were considered for identifying priority areas for implementation of recovery actions, including:

- DERM's Biodiversity Planning Assessment scheme which uses the *Biodiversity Assessment and Mapping Methodology* (QEPA 2002)
- DECCW's Biodiversity Forecasting Tool (DEC 2006b)
- multi-criteria analysis.

On the basis of access to software and various data limitations and access, the Biodiversity Forecasting Tool was selected to generate a set of computer-modelled management priorities within the Planning Area.

The process focuses on estimating the relative differences in the predicted persistence of biodiversity across the Planning Area as a consequence of various planning scenarios and modelled threats. The process uses information on the extent, condition and configuration (connectivity) of vegetation types and/or individual species, coupled with available data and expert knowledge on various threats and ecological processes (Turbill & Steed 2006). This process allows for the identification of modelled priority areas which contribute to the overall priorities of the Planning Area.

The Biodiversity Forecasting Tool can be applied to individual species or to biodiversity in general. When modelling for biodiversity in general, vegetation communities or other forms of mapped land classes (e.g. abiotic environmental units) are used as surrogate measures for biodiversity (Ferrier 2005). Given the limited spatial data available for the priority species in the Planning Area, the general biodiversity approach provides the most appropriate outputs for priority identification. The modelling of priorities at this level using the tool involves three main interacting components:

1. Predicting future vegetation (or habitat) condition as a function of current vegetation condition, spatial distribution and magnitude of threats, and existing or proposed landuse and management.
2. Predicting the level, or likelihood, of persistence for each vegetation community, as a function of its spatial distribution and the configuration of future vegetation (or habitat) condition for that entity (from component 1).
3. Aggregating the predicted persistence levels of each vegetation community into an overall estimate of persistence for biodiversity as a whole.

The above process requires that many of the main regional threats to biodiversity are represented spatially across the Planning Area. Surrogate threat datasets were derived, where possible, from existing datasets available for the NSW and Queensland components of the Planning Area. Threats that were able to be derived and used in the process include clearing, domestic grazing, human disturbance, timber harvesting, introduced predators and weeds. The complexity of some threats meant that not all were able to be modelled spatially. Therefore, some significant threats, such climate change, were unable to be used in the Biodiversity Forecasting Tool analysis. Some of these more complex and a-spatial threats are accounted for by identifying additional priority areas independent of the Biodiversity Forecasting Tool process.

The results of the analysis provided a spatial representation of the relative levels of biodiversity priority (or significance) across the Planning Area. Depending on their management implications, these were designated as either 'Conserve Priorities' or 'Repair Priorities' that are depicted spatially on maps. The Conserve Priorities and Precincts map (see Figure 10) identifies areas that, if lost, would have the greatest impact on the biodiversity of the Planning Area. These are generally areas of existing conservation value where the focus should be on retaining the values that currently exist through mechanisms appropriate to their current tenure. National parks are not included here as they are already conserved. The Repair Priorities and Precincts map (see Figure 11) identifies areas that, if restored, would contribute the greatest biodiversity gains to the Planning Area. Repair

Priorities are generally poorly conserved or over-cleared vegetation communities and are not restricted by land tenure (Turbill & Steed 2006). Areas where clusters of Conserve or Repair Priorities occur have been delineated and mapped as 'Precincts'.

A series of maps as shown on Figure 12 (on the enclosed CD) and listed in Table 12 below, break up the Planning Area into smaller 1:200 000 scale maps to provide more detail. Figures 10a to 10j show Conserve Priorities and Precincts and Figures 11a to 11j show Repair Priorities and Precincts. All of these figures are on the enclosed CD. These areas, in combination with additional priorities identified below, assist with guiding recovery actions in the Plan. It should be recognised, however, that isolated and fragmented communities tend to be given a lower priority because the Biodiversity Forecasting Tool uses extent and connectivity as two primary considerations. The Plan recognises that there are high priority fragmented areas such as sites supporting threatened ecological communities, critical habitat, and the Big Scrub which have high community and biodiversity value. These are considered further below.

The Biodiversity Forecasting Tool has ongoing value to the Plan as a monitoring and reporting tool. If spatial reporting of on-ground activities is fed back and the input layers are updated over time, the process can be re-run to assess changes in predicted biodiversity outcomes and identify priority areas as a result of implementation activity. More detailed information on the Biodiversity Forecasting Tool process in general can be found in DECC (2006b) and Turbill & Steed (2006).

**Table 12 Key to 1:200 000 Conserve and Repair Priorities and Precincts maps (on the enclosed CD)**

| Description | Figure number | |
|---|---|---|
| | Conserve | Repair |
| Tamborine – far north-east of the Planning area | 10a | 11a |
| Tweed Caldera – Mt Warning caldera and Tweed Valley | 10b | 11b |
| Nightcap Range – southern flank of the Mt Warning caldera | 10c | 11c |
| Lower Richmond – lower Richmond Valley around Coraki | 10d | 11d |
| Border Ranges – Border Ranges area north of Kyogle | 10e | 11e |
| Mid Richmond – mid Richmond Valley south of Kyogle | 10f | 11f |
| Main Range North – Main Range north of Cunninghams Gap | 10g | 11g |
| Main Range South – Main Range north of Woodenbong–Urbenville | 10h | 11h |
| Tooloom Yabbra – south of Woodenbong and north of Bonalbo | 10i | 11i |
| Mallanganee – the south-western area east of Tabulam | 10j | 11j |

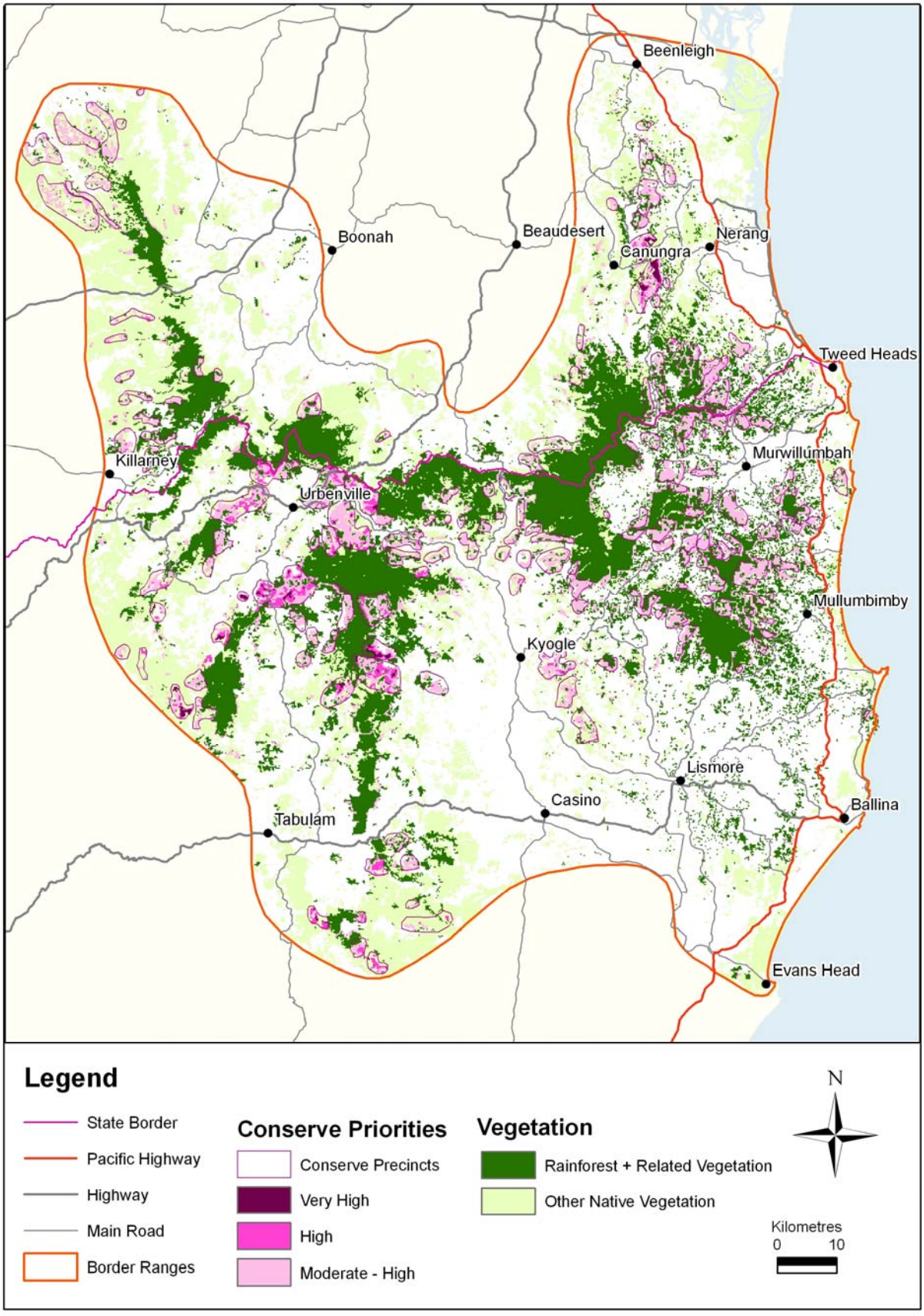


**Figure 10 Conserve Priorities and Precincts**

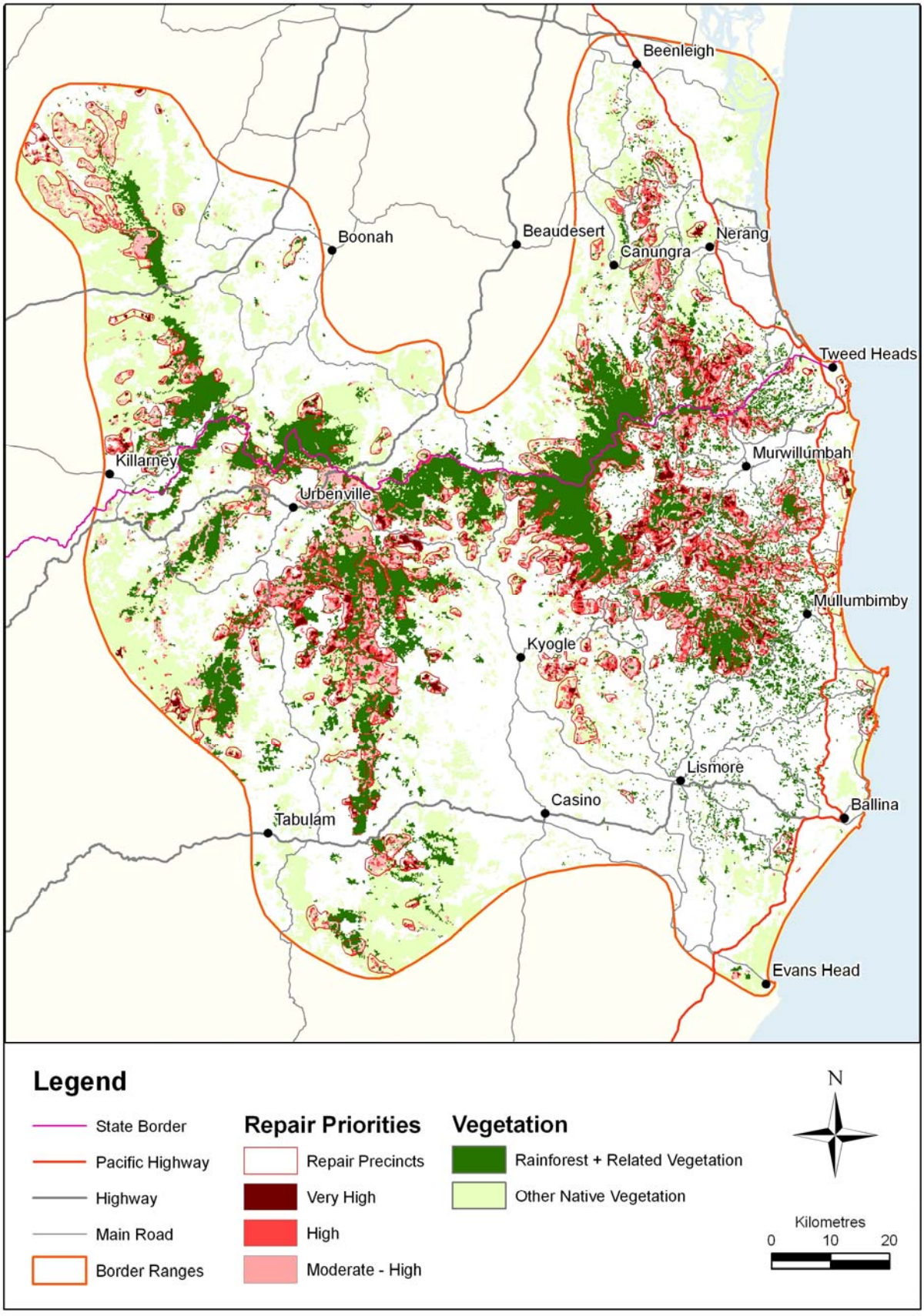


**Figure 11 Repair Priorities and Precincts**

### 3.3.2 Other priority areas

A process of identifying further priority areas within the Planning Area was undertaken independently of the Biodiversity Forecasting Tool process. These priorities for the Plan were identified through the community engagement process and in consultation with experts and government representatives. The areas identified often represent highly fragmented landscapes containing threatened ecological communities or multiple threatened species. Identification of these areas is also acknowledgement that there is a significant level of biodiversity conservation work and community ownership of projects across the Planning Area, all of which contribute to the objectives of the Plan (see also Section 1.3).

#### *Big Scrub remnants*

The Big Scrub is an area of subtropical rainforest that once covered 75 000 ha of fertile basalt-derived soils between Nightcap Range and Richmond River in north-east NSW. Less than one per cent of the original rainforest remains, mostly as about 50 small, scattered remnants. These areas have high conservation value and are the focus of many restoration activities. For example, in 2009 the Big Scrub Rainforest Landcare Group received a $368 000 one-year *Caring for Our Country* grant on behalf of an 11-member partnership for an endangered lowland rainforest restoration program. This program is funding restoration activities in lowland rainforest sites in northern NSW, including 40 Big Scrub remnants. Figure 13 (on the enclosed CD) shows the original extent of the Big Scrub and the remaining remnants within the Planning Area. Due to their small and fragmented nature, Figure 13 may not include all identified Big Scrub remnants, including some of those remnants in which restoration activities are currently occurring.

Due to the fragmented nature of the Big Scrub, some rainforest species are likely to become locally extinct in small (less than 5 ha) and highly isolated rainforest remnants (H. Bower pers. comm.). This is particularly the case for species that are confined to small remnants or that don't readily traverse cleared or modified landscapes. Tumbunan fauna species that are potentially at risk of localised extinctions in these small isolates include the Paradise Riflebird as well as several bird species that have not been identified as priority species (e.g. Pale Yellow Robin *Tregellasia capito*, Yellow-throated Scrubwren *Sericornis citreogularis* and White-throated Treecreeper *Cormobates leucophaea*). Although some of these species have not been identified as priorities in the Plan, restoration activities in the Big Scrub undertaken as part of the Plan will assist in their longer-term local viability.

#### *Critical habitat*

In NSW, critical habitat for Mitchell's Rainforest Snail at Stotts Island Nature Reserve contains the largest known population of the species and largest area of remaining suitable habitat (Stanisic 2000). Mitchell's Rainforest Snail is likely to be placed under increased pressure through climate change due to its restricted distribution and habitat requirements. In addition, Stotts Island also contains the largest remnant of the lowland rainforest on floodplain endangered ecological community in NSW. Therefore, Stotts Island Nature Reserve has been identified as a priority area for management.

#### *Tumbunan fauna refugia*

As discussed in the Section 2, conserving and repairing refugia which support Tumbunan fauna is a priority for this Plan. Major Tumbunan fauna refugia have been identified through consultation with experts and analysis of species records (see Figure 14 on the enclosed CD). The aim is to target these areas for protection, restoration and long-term monitoring. Consideration should be given to using these refugia as a focus for revegetation of corridors and cleared areas, and expansion of

isolated rainforest remnants. Tumbunan fauna and their habitat are considered likely to be susceptible to climate change impacts. Monitoring the current and future distribution of Tumbunan fauna will be important to indicate changes that may be occurring, particularly with regard to climate change impacts.

## *High fire risk*

Rainforest is one of the few vegetation communities in the Border Ranges region that is not adapted to fire. Therefore, identification of areas of rainforest at a high potential risk from fire can provide priorities for fire-based planning at the regional level. Figure 15a (on the enclosed CD) shows the predicted relative fire risk of rainforest in the Planning Area. The predictions were based on the size of the rainforest patch and the type of adjacent vegetation. Areas of high fire risk are where cross-tenure strategic planning involving landowners and land management agencies could potentially reduce the negative impacts of fire intensity and frequency upon rainforest and adjacent wet sclerophyll forests. Dry rainforest remnants were also identified as a high priority. Figure 15b (on the enclosed CD) identifies a number of dry rainforest areas that could be used as pilot areas for cross-tenure strategic planning.

## *Climate change linkages*

Re-establishing native vegetation and enhancing habitat connectivity across the Border Ranges region is an important strategy in maintaining species' dispersal capacity and viability. This is especially the case in regard to the potential effects of climate change. Creation and enhancement of latitudinal and altitudinal connectivity is one mechanism for allowing for adaptive change to climate change.

In NSW, existing and potential vegetation and habitat linkages for fauna assemblages within the north-east of the State were identified by Scotts (2003). Further refinement of this work has been undertaken and has identified areas significant for the dispersal of wildlife that may be vulnerable to the adverse effects of climate change (DECC 2007b). Byron Shire Council (see Byron Shire Council 2004) has refined the corridors within the shire that were identified by Scotts (2003).

In addition, the Great Eastern Range Initiative has identified a substantial network of existing national parks that form the core of the Great Eastern Ranges Corridor within NSW (DECCW website). This corridor overlaps with sections of the corridors discussed above. The goal of the Initiative is to interconnect these areas by retaining, enhancing or restoring native vegetation on public and private lands using a range of voluntary programs.

In Queensland, some preliminary work has been undertaken as part of the Biodiversity Assessment and Mapping Method to identify priority bioregional linkages. To ensure a consistent approach across the entire Border Ranges region, a desktop assessment of the Queensland vegetation mapping was undertaken to identify moist vegetation linkages. These were then connected to the NSW rainforest and moist corridors derived from the corridors described above.

The cross-regional rainforest corridors aim to identify priority areas that contribute to existing and potential linkages from the uplands in the west to the lowlands along the coast. Figure 16 shows the two types of climate change linkages that were delineated for the Border Ranges region. The first, 'rainforest corridors', link the larger rainforest patches in the region. The second, 'moist corridors', contain smaller rainforest patches linking larger areas of wet sclerophyll forest in the region. Within these corridor types, four categories have been identified (based on DECC 2007b):

- Reserve buffers and linkages: Predominantly vegetated areas located around or linking existing reserves and other public lands containing large areas of key habitats and other high conservation value features that have been subject to low levels of disturbance and fragmentation.

- Protect and enhance: Predominantly high levels of vegetated land containing high conservation value forest that has at least some continuity with adjacent areas of vegetation or public land. Priorities in this category should focus on the protection of the existing high conservation value features, or enhancement of existing vegetation through plantings, weed management and removal of other threatening processes.
- Stepping stone consolidation: Fragmented remnant vegetation that enhances landscape connectivity and provides good connectivity for more mobile fauna such as bats, birds and insects, but may have low value for fauna unable to disperse large distances over cleared land. These are more effective than narrow linear corridors and are important priority areas for consolidation, maintenance and protection through activities such as replanting, rehabilitation, weed management, pest animal control, protection of existing remnants, and installation of nest boxes.
- Valley floor linkages: Areas that link highly fragmented and poor condition remnants across cleared alluvial flats and riparian areas. This category is important for productivity, connectivity and wildlife movement. Management actions would predominantly be associated with revegetation.

The linkages identified in the processes described above take into account potential changes to existing vegetation due to climate change (e.g. the prospect that bushfires will increase in their frequency, intensity and extent). Such changes have the potential to affect species adapted to rainforest as many existing moist habitats become drier (Natural Resource Management Ministerial Council 2004).

## *Community-identified areas of interest*

The community consultation process has identified over 40 specific locations in the Planning Area as priorities for management. Figure 17 (on the enclosed CD) shows these priorities. Table 13 provides the location, community-identified values and the map identification number of these areas.

**Table 13 Community-identified areas of interest**

| Figure 17 reference | Location | Community-identified value |
|---|---|---|
| 1 | Bahrs Scrub | Area of dry rainforest under threat |
| 2 | Beechmont Plateau | Linkage between Lamington and vegetation to north |
| 3 | Big Scrub Remnants | Numerous rainforest remnants, high community interest |
| 4 | Boonah Scrubs | Important rainforest stepping stone habitats |
| 5 | Border Ranges | Opportunities for private land initiatives |
| 6 | Broken Head | SEPP 26 – NSW Bitou Bush threat abatement plan priority |
| 7 | Brunswick River | Brunswick River rainforest |
| 8 | Byron Bay | Littoral rainforest |
| 9 | Canungra Warfare Centre | High quality rainforest |
| 10 | Upper Mongogarie | Unmapped rainforest gullies |
| 11 | Cunninghams Gap | Area of Bell Miner associated dieback |
| 12 | Denham Scenic Reserve | National Estate, vegetation corridor, high community interest |
| 13 | Rocky Cutting | Numerous threatened flora species |
| 14 | Foothills south of Gatton | Dry rainforest regrowth |
| 15 | Tomewin–Urliup | Numerous threatened flora species |
| 16 | Fingal Head | SEPP 26 – Littoral rainforest |
| 17 | Gambubal–Teviot forests | High quality rainforest vegetation |
| 18 | Goomburra – Main Range | High quality rainforest vegetation |
| 19 | Hinze Dam | Numerous threatened flora species |

| Figure 17 reference | Location | Community-identified value |
|---|---|---|
| 20 | Hopkins Creek Road | Numerous threatened flora species |
| 21 | Jerusalem NP – Nightcap NP | Rainforest linkages including Upper Wilson Creek and Huonbrook |
| 22 | Limpinwood | Opportunities for private land initiatives |
| 23 | MacKellar Range | Unsurveyed rainforest pockets |
| 24 | Mount Maroon | Important rainforest stepping stone habitats |
| 25 | Mt Chinghee | Black-breasted Button-quail habitat |
| 26 | Mt Gipps | Eastern Bristlebird habitat and area of Bell Miner associated dieback |
| 27 | Mt Jerusalem | Albert's Lyrebird habitat |
| 28 | Mt Nothofagus | High quality rainforest |
| 29 | Mt Pikapene | Flying-fox camp, Black-striped wallaby *Macropus dorsalis* habitat, Black-breasted Button-quail habitat |
| 30 | Wollumbin NP (includes Mt Warning) | High quality rainforest and species habitat |
| 31 | Nicoll Scrub | High quality rainforest vegetation |
| 32 | Ormeau | Unique biodiversity and conservation values |
| 33 | Paddys Flat – Currawinya | Rainforest pockets |
| 34 | Pretty Gully | Rainforest reserve |
| 35 | Springbrook–Numinbah | High quality rainforest |
| 36 | Terranora | Numerous threatened flora species |
| 37 | Toonumbar | High quality rainforest and species habitat |
| 38 | Upper Coomera River | Riparian rainforest linkage corridor |
| 39 | Uralba – Blackwall Range | Disjunct Albert's Lyrebird population |
| 40 | Veresdale Scrub | Dry rainforest in small remnants |
| 41 | Whian Whian | High quality rainforest and species habitat |
| 42 | Yabbra | Dingo *Canis lupus dingo* Management Area |
| 43 | Moore Park NR | Remnant Black Bean *Castanospermum australe* – Silky Oak *Grevillea robusta* gallery rainforest, flying-fox camp |
| 44 | Lowland rainforest remnants in NSW | Various remnants of conservation value and high community interest |

SEPP = State environmental planning policy; NP = National Park; NR = Nature Reserve

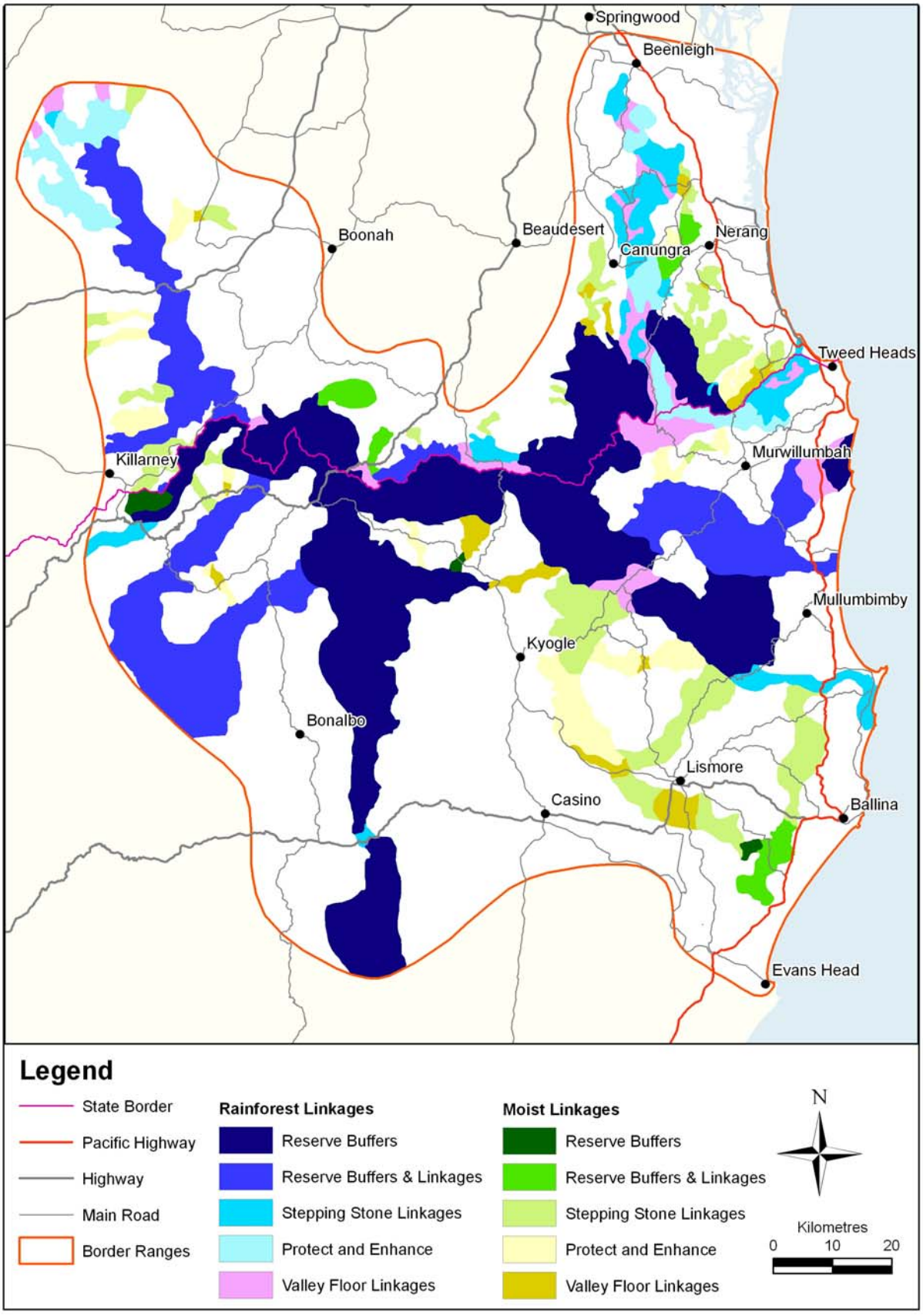


**Figure 16 Climate change linkages**

# 4 Management Actions

## 4.1 How to use this section

### 4.1.1 Action prioritisation

Objectives and actions relating to climate change and organisational-related impediments are presented first because they represent universal threats that apply across all other actions of the Plan. Thereafter, objectives are threat-based and are presented in their decreasing order of priority across the entire Planning Area. Within each objective, outcomes are then presented in order of priority. Within a given outcome the actions are presented in a hierarchical framework for delivery at the most appropriate geographical or biological scale as discussed in Section 3.2. The intention is that the majority of actions will be addressed at the Planning Area or landscape level and that there should be relatively few actions targeted to the species or site based level. Appendix 11 provides a threatened species action summary showing which objective (and therefore outcome and action) is relevant to each priority species.

### 4.1.2 Implementation scale

This section has been presented so that the user can target their area of responsibility or interest and receive guidance on the relative priority of actions. For example, a government agency may require guidance on actions to address habitat loss, modification and degradation across the Planning Area. Another example may be where the Northern Rivers CMA wishes to address a particular target for weeds in the lowlands, in which case they would consider the lowlands actions for weeds. A local government may want to deliver an integrated program of actions within their area, so they may consider a range of threat based actions within the appropriate landscape. Local land-holders or Landcare groups may be interested in the landscape or species- and site-specific actions and priority areas.

A number of actions in this section refer to identified/mapped priority areas (see Table 11 for a list of figures). Unless otherwise specified, these figures indicate broad areas within which to target activities but aren't intended to identify specific sites (due to data and mapping constraints). The Plan recognises that there is a significant amount of biodiversity conservation work and community ownership of projects currently being undertaken outside the identified priority areas and the identification of priority areas does not necessarily preclude actions being undertaken in other parts of the Planning Area. As stated earlier, this Plan does not replace existing plans or threat abatement plans relevant to the Planning Area, and may refer to some of these existing documents and identify additional actions.

In order to implement the actions below, the reader is referred to a number of items. The location of these items has been provided at each instance by reference to the relevant section, figure, table or appendix number. In relation to figures and appendices, they are either within this document or on the enclosed CD (on the inside back cover of this Plan).

## 4.2 Affected interests and potential contributors

While DECCW, DERM, Northern Rivers CMA, SEQC and the Australian Government's DEWHA took the lead role in developing the Plan, its implementation will require a coordinated approach involving a range of partnership arrangements. Support from a diverse group of stakeholders will be required to support implementation of the objectives and actions. This support could be realised through the

provision of services, funding, participation in training and public awareness programs, liaison with other organisations, or other relevant contributions. Such an approach is critical to achieving the objectives of the Plan and to maximising the effectiveness of actions taken individually by each group. Establishment of a working group would assist in negotiating partnerships and funding, and in coordinating and monitoring the implementation of actions.

Many stakeholders have a role in the protection and management of rainforest and related vegetation within the Planning Area including: Australian Department of Defence, Bush Care and Landcare groups (e.g. Big Scrub Rainforest Landcare Group), conservation groups (e.g. Nature Conservation Council), Condamine Alliance, Darling Downs – Moreton Rabbit Board, DECCW, DERM, DEWHA, Gold Coast Water, Indigenous groups (e.g. Local Aboriginal Land Councils, native title and Elders groups), Nature Conservation Trust, NSW Environment Trust, NSW and Queensland Farmers Federation, NSW and Queensland local government authorities, NSW Rural Fire Service, NSW Department of Planning, NSW Department of Primary Industries (including Forests NSW), Northern Rivers CMA, private land-holders, Queensland Department of Community Safety (including Queensland Rural Fire Service and Queensland Corrective Services), Queensland Department of Infrastructure and Planning, Queensland Department of Employment, Economic Development and Innovation (including Biosecurity Queensland and Forestry), Rous Water, SEQC, special interest groups (e.g. Australian Rainforest Conservation Society), Threatened Species Network, universities and others.

There are opportunities for weed-based partnerships between groups such as community organisations and individuals, Condamine Alliance, DECCW, DERM, Far North Coast Weeds, Forests NSW, herbaria, Indigenous land-holders, local governments, NSW Department of Lands, North Coast Weeds Advisory Committee, Northern Rivers CMA, Queensland Department of Employment, Economic Development and Innovation, and SEQC.

Partnerships relating to fire management could be fostered between groups including Condamine Alliance, DECCW, DERM, Forests NSW, Indigenous land-holders and local land-holders, local governments, local Landcare groups, Nature Conservation Council Hotspots, Northern Rivers CMA, NSW Rural Fire Service, Queensland Department of Employment, Economic Development and Innovation, Queensland Rural Fire Service, SEQC, and Southeast Queensland Fire and Biodiversity Consortium.

Pest animal management could be enhanced by partnerships between groups such as Condamine Alliance, DECCW, DERM, Indigenous land-holders, local land-holders and Landcare groups, Northern Rivers CMA, pest advisory committees, Queensland Department of Employment, Economic Development and Innovation, SEQC, and South East Queensland Pest Advisory Forum.

## 4.3 Existing plans, policies and programs

Within the Planning Area a range of planning instruments, management plans, policies and programs are already in existence. The Plan refers to many of these directly or has the potential to interact with them and, in most instances, does not intend to restate relevant actions or information contained in them. The Plan does, however, seek to identify common approaches and actions between these existing plans and programs to provide an integrated and efficient approach to the management of the biodiversity in the Planning Area. The synthesis of documents will identify opportunities for linkages and interactions at a number of levels but may also indicate areas of conflicting management actions.

Many of these existing plans and programs, while relevant to the Planning Area, cover a wider geographic or biological range than is relevant to this Plan, such as the *National Strategy for the Conservation of Australia's Biological Diversity* (Department of the Environment, Sport and Territories 1996). While considering the recommendations of these documents, the Plan may seek to identify priorities particular to the Planning Area that are supplementary to those of existing plans or programs as a whole.

Documents, strategies and programs relevant to the management of biodiversity in the Planning Area, including a brief description of their contents and purpose, are outlined in Appendix 1 (on the enclosed CD).

## 4.4 Plan objectives

The overall objective of the Plan is to protect rainforest and related biodiversity and to provide a consistent and effective recovery program for priority species and ecological communities within the Planning Area. The recovery program will focus on improving the condition (connectivity and integrity) of rainforest communities and their component species and systems.

### 4.4.1 Aims

1. Achieve a net gain in the extent of rainforest and related vegetation.
2. Promote the survival and adaptive capacity of species, populations and ecological communities of plants, animals and micro-organisms native to the rainforest and related vegetation of the Planning Area.
3. Promote a consistent cross-regional, landscape approach seeking biodiversity conservation improvement across all land tenures.
4. Recognise and incorporate cultural values into biodiversity management of the Planning Area through ongoing Indigenous engagement.
5. Promote the importance of native biodiversity protection and restoration through strengthening existing initiatives and developing new partnerships in consultation with the community, industry and relevant government agencies.
6. Improve management through an increasing scientific, social and cultural knowledge base.
7. Undertake long-term, prioritised commitment to cost-effective recovery processes.

## 4.5 Management actions

### Organisational-related impediments – universal

Some institutional and jurisdictional arrangements can be an impediment to the successful implementation of conservation management across the Planning Area. These impediments can affect an organisation's potential to deal effectively with the other threat categories identified in the Plan. The types of issues considered in this threat category include integration of delivery across agencies and groups; impact of licensing requirements on efficient delivery of on-ground programs; funding frameworks and time frames; lack of funding support for updating datasets, knowledge and mapping; impediments to sharing information; and the maintenance of knowledge management systems. Examples of these impediments include:

- inability to fully implement recovery initiatives due to a lack of resources
- short funding application time frames, short-term funding cycles and annual funding expenditure requirements which make implementation difficult or inefficient
- impediments to information sharing within and between agencies and departments due to diverse information sharing licenses, agreements and policies
- incompatible mapping systems and data management systems
- differences in state and national species listings

- differences in state agency responsibilities and laws
- complicated approvals for environmental management, for example, approvals for environmental burning
- inconsistent reporting requirements
- lack of funding support for research and monitoring.

# OBJECTIVE 1: To reduce organisational-related impediments to biodiversity conservation

## OUTCOME 1.1: Communication and information sharing improved, and processes between agencies, departments and communities streamlined

### ACTIONS: Planning Area

1.1.1. Establish a cross-agency (intra and interstate) working group. The working group will:
- ensure integrated implementation of this Plan
- plan investment and seek funding opportunities
- oversee prioritisation and implementation of projects
- review the progress and outcomes of projects
- facilitate efficient information-sharing arrangements.

1.1.2. Support and develop partnerships, consortiums or alliances between departments, agencies, community groups and other stakeholders to encourage coordinated cross-tenure management and sharing of resources and information.

1.1.3. Encourage a consistent cross-agency approach to protect rainforest and related vegetation through planning controls and mechanisms.

1.1.4. Encourage funding sources to improve funding processes through longer application time frames, longer-term funding for projects and consistent reporting requirements.

1.1.5. In NSW, finalise and promote existing guidelines that assist with the simplification of the licensing process required when undertaking weeding and other bush regeneration activities within habitat of threatened species or within rainforest threatened ecological communities.

1.1.6. In NSW, review and encourage streamlined licensing for conservation programs, environmental burn operations, pest programs and environmental flows.

1.1.7. Streamline processes between agencies, departments and the community for data exchange.

1.1.8. Establish compatible mapping systems and data management systems. Consideration should be given to ensuring that future north-east NSW vegetation classification systems are compatible with Queensland Regional Ecosystems.

1.1.9. Improve the resolution, accuracy and consistency of vegetation mapping in the Planning Area.

1.1.10. Regularly update mapping and biodiversity data that assist with decision making to improve the accuracy of information on plant and animal species, vegetation communities, maps and models.

1.1.11. Develop a process to ensure that the list of priority species and ecological communities addressed by the Plan is maintained and updated. This includes an assessment of each new listing to ensure that any additional management actions are developed at the correct scale.

## Climate change (anthropogenic) – universal

Warming of the global climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Intergovernmental Panel on Climate Change 2007). At a national level, modelled projections of temperature, precipitation, evapo-transpiration and wind indicate that changes to more localised climate systems are probable, which will influence drought and fire weather patterns (Watterson et al. 2007). Any changes in temperature, rainfall or evaporation resulting from climate change will have long-term consequences for the Border Ranges region, with the impacts of any potential change most likely felt through extreme events such as increases in the number of hot days, bushfires, drought events and intense storms.

While the impacts of climate change are not likely to be significant over the life of this Plan, there are things that can be done now to help the ecological systems in the Planning Area adapt to and cope with longer-term changes.

Responses to climate change fit into two categories. The first is mitigative planning: reducing greenhouse gases either through reducing emissions or increasing the capture and storage of these gases. Much mitigative planning is beyond the scope of this Plan, however, it is recognised that revegetation and restoration works identified in the Plan will contribute to the capture and storage of greenhouse gases. The second category of response is adaptation planning. The alarming fact is even if society were able to stabilise emissions of greenhouse gases today, there is a lag in the world's weather systems such that the trends in climate change will continue to be felt for many centuries to come. Society needs to be capable of adapting to those changes.

Potential direct and indirect effects of anthropogenic climate change on the Australian biota have been reasonably well documented (e.g. Howden et al. 2003; Hughes 2003; Natural Resource Management Ministerial Council 2004; Chambers et al. 2005). Any change to the climate of the Northern Rivers region of NSW is likely to have significant effects on biodiversity (CSIRO 2007), including changes in the distribution of some species and the disappearance or establishment of others. For those species able to cope with a change in climate itself, a bigger threat may result from the cumulative effects of multiple stresses associated with the exacerbation of threatening processes.

In the Border Ranges region, it is predicted that both maximum and minimum temperatures will rise, with the greatest increases expected in winter. Rainfall is likely to increase in summer and autumn and decrease slightly in winter.

To assist in identifying and addressing climate change issues within the Planning Area, a preliminary assessment of species and vegetation communities was undertaken. This work was based on the CSIRO predicted climate change scenarios for 2030 (Hennessy et al. 1998; McInnes et al. 1998; Hennessy et al. 2004a; Hennessy et al. 2004b). The assessment process focused on four climate change indicators (rainfall variability, temperature change, weather events and sea level rise), and the potential impacts that changes in these indicators may have on specific features of the Planning Area. The assessment focused on specific indicators of climate change and their respective impacts on the priority features and biodiversity. A more detailed overview is provided in Appendix 12 (on the enclosed CD).

The potential effects of climate change on other threats have been considered within each identified threat category relevant to the Planning Area. It is beyond the scope of the Plan, however, to identify or prioritise each biodiversity unit (i.e. landscape, ecosystem and species) at risk from the cumulative effects of climate change.

Adaptive management will be required to take into account the uncertainty involved in climate change predictions and associated effects on biodiversity. This Plan considers the implications of known and potential human-induced climate change on the effects of the other threatening

processes. Many other actions in the Plan, while not being specifically related to climate change, will assist species and vegetation communities to respond to change.

## OBJECTIVE 2: To minimise the impacts of climate change on biodiversity

### OUTCOME 2.1: Regional climate change linkages (Figure 16) promoted to improve connectivity and habitat quality

**ACTIONS: Planning Area**

2.1.1. Promote private land covenants, incentives and land acquisition within identified linkages (Figure 16) and other priority areas (see Table 11).

2.1.2. Undertake targeted management within the identified linkages to improve habitat connections for terrestrial and aquatic fauna and flora.

2.1.3. Undertake targeted management to increase vegetation remnant size in priority areas.

2.1.4. Provide Indigenous communities with incentives and support to participate in conservation agreements and biodiversity management on Indigenous-owned land.

2.1.5. Remove barriers restricting the movement and dispersal of fauna, including aquatic species, where possible.

2.1.6. Encourage local governments to protect climate change linkages (Figure 16) through relevant environmental planning instruments.

### OUTCOME 2.2: Secondary linkages of habitat and vegetation promoted

**ACTIONS: Planning Area**

2.2.1. Create or increase secondary linkages within disturbed habitats or modified landscapes supporting exotic vegetation such as Camphor Laurel forests.

2.2.2. Promote incremental replacement of exotic vegetation using natural regeneration and targeted revegetation, including mixed species timber plantations.

2.2.3. Promote the incremental establishment of vegetation linkages across cleared landscapes through use of mixed species timber plantations, riparian rehabilitation, shelter belts and targeted revegetation programs.

2.2.4. Identify opportunities for carbon sequestration through rehabilitation of cleared and modified landscapes.

### OUTCOME 2.3: Activities that ameliorate the effects of climate change promoted

**ACTIONS: Planning Area**

2.3.1. Identify and implement habitat protection and enhancement activities that maximise opportunities for biological adaptation to change.

2.3.2. Promote community awareness of climate change-related threats to biodiversity of the Planning Area.

2.3.3. Integrate climate change mitigation measures into relevant environmental planning instruments.

2.3.4. Adapt weed, pest and fire management practices to take account of potential climate change impacts.

2.3.5. Promote the role of the individual in climate change mitigation (e.g. car-pooling, reduction in energy and water use).

### OUTCOME 2.4: Knowledge, understanding and communication of climate change research increased

**ACTIONS: Planning Area**

2.4.1. Use the cross-agency working group and experts to oversee, investigate and raise awareness of climate change issues.

2.4.2. Design and implement climate change-related monitoring focussing on the Tumbunan fauna and refugia (see Table 9 and Figure 14 on the enclosed CD).

2.4.3. Trial methods for prioritising landscapes, ecosystems and species at risk of climate change-related threats.

2.4.4. Implement climate change-adaptive activities based on prioritised entities from Action 2.4.3.

2.4.5. Promote local climate change initiatives with the community in order to supplement larger-scale climate change strategies.

2.4.6. Incorporate best available knowledge of climate change into adaptive management of threatening processes in the Planning Area.

2.4.7. Promote research for improving knowledge on the following climate change related themes:

- impacts on rainforest and moist vegetation communities caused by changes to water accessibility
- rates of change, for example, extreme events weighed against gradual climate change
- population size, dispersibility, mobility, trait-based life history and environmental gradients
- identification of climate refugia.

Note that some research of this sort is already underway. For example, *IBISCA – Queensland* is a program currently undertaking a range of climate change-related projects in subtropical rainforest in Lamington National Park, including the potential for climate-induced floristic and structural shifts (Kitching 2009).

**ACTIONS: Species-specific**

2.4.8. On the basis of the priorities identified in Action 2.4.3, consider nominations for listing or upgrading listings on appropriate nature conservation legislation.

2.4.9. Implement in situ management to assist species identified in Action 2.4.3.

## Habitat loss, modification and degradation – high priority

Rainforest and related vegetation throughout the Planning Area has been significantly degraded and fragmented, particularly in lower elevation areas. The extent of decline at the landscape level makes it imperative that all remaining areas of rainforest and related vegetation are managed for their conservation values and, where possible, restored toward self-sustaining systems.

Current human-induced habitat loss within the Border Ranges region is mostly development-related. This is largely due to the effects of urban, industrial, rural, rural-residential and infrastructure development, and includes both the direct loss of habitat and the secondary consequences of development such as clearing for aesthetics and maintenance of asset protection zones. Habitat loss is also a result of other landuses in the Planning Area such as mining, agriculture, horticulture, native forestry and plantation forestry.

Habitat degradation occurs through landuse activities such as development, agriculture, resource use, including ground water extraction, and maintenance of assets. Many of the individual threat activities of this category are related to habitat loss; the difference being in the effect (i.e. stress) an individual threat has on biodiversity. Due to this interconnectedness, actions to address habitat loss and habitat degradation have been combined.

The interrelation of threats that cause habitat degradation is reflected in the fact that many of the identified threat categories contain individual threats that contribute to habitat degradation (e.g. weeds, fire, domestic grazing). Such threats have been assigned to distinct categories because they are considered to be significant in their own right and, therefore, require their own set of objectives and priority actions. It is recognised that actions undertaken to address one category may also assist in mitigating a threat identified in another category, and that where possible, integrated management of threats is preferable.

## OBJECTIVE 3: To protect rainforest, related vegetation and species from clearing

### OUTCOME 3.1: Statutory and other instruments used to their full extent by government planning agencies to protect rainforest and related vegetation from clearing

**ACTIONS: Planning Area**

3.1.1. Promote compliance with state and Australian government legislation to prevent clearing and/or degradation of rainforest and related vegetation.

3.1.2. Incorporate this Plan into the review or preparation of environmental planning instruments including regional strategies, regional conservation plans, NSW State environment planning policies, Queensland *Integrated Planning Act 1997* planning schemes, settlement guidelines, the Biodiversity Banking and Offset scheme (BioBanking) and Biodiversity Certification.

3.1.3. In NSW, undertake expert workshops to identify potential areas for critical habitat nomination.

3.1.4. Where clearing cannot be prevented, implement a policy of net-gain of rainforest and related vegetation.

3.1.5. Ensure that protection of rainforest and related vegetation is a priority when designing tourism infrastructure on public lands.

3.1.6. Promote the benefits to local government of strategic accreditations and endorsement available (e.g. NSW biocertification, Queensland *Integrated Planning Act 1997* planning and EPBC Act strategic assessment processes).

3.1.7. Encourage and promote opportunities for conserving rainforest and related vegetation through land acquisition, private land covenants and conservation agreements.

### OUTCOME 3.2: Improvements identified to current planning controls and assessment processes and changes encouraged to maximise the protection and management of biodiversity values

**ACTIONS: Planning Area**

3.2.1. Ensure that adequate planning controls, such as environmental zonings and development control plans, are included in environmental planning instruments and schemes to protect areas of rainforest and related vegetation. Consideration should also be given to non-rainforest and non-vegetated areas associated with climate change linkages identified in this Plan.

3.2.2. In NSW, ensure that biodiversity assessment and reporting for development applications are consistent with DECCW *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004a) and DECCW *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007c).

3.2.3. In Queensland, ensure that the Biodiversity Assessment and Mapping Methodology (QEPA 2002) adequately incorporates rainforest biodiversity values and identifies areas of high conservation value within planning schemes.

3.2.4. Ensure that the likely impacts of developments and activities adjacent to rainforest and related vegetation are fully assessed and appropriate buffers included.

3.2.5. Ensure that asset protection zones for new developments are contained within the development proposal area and do not impact on, or require clearing of, adjacent rainforest or related vegetation.

3.2.6. Ensure that the development of community land management plans and other local government management plans and strategies take into account rainforest and related vegetation and priority species.

3.2.7. Encourage the use of tree preservation orders in NSW and Queensland planning instruments to protect significant remnant rainforest trees.

3.2.8. Ensure that landuse objectives for local environment plan environmental zones (for the types of activities permissible) are compatible with the long-term protection and management of rainforest and related vegetation, including corridors, buffers, and ecological restoration activities.

## OUTCOME 3.3: Incentive schemes to protect rainforest and related vegetation from clearing promoted

Local governments and regional natural resource management bodies are well positioned to promote incentive schemes that encourage private landowners to implement sustainable land management practices and conserve biodiversity through education and training, property agreements, partnerships and, where possible, financial assistance (Bateson 2000, 2001; Byron Shire Council 2004). Incentives can work to integrate planning, regulation and education, and encourage community participation between land-holders and government.

### ACTIONS: Planning Area

3.3.1. Promote uptake of voluntary conservation agreements, market-based instruments and other incentives available in NSW and Queensland (see Appendix 13 on the enclosed CD). Focus efforts in priority areas (see Table 11), particularly in corridors and high priority Conserve Priorities and Precincts.

3.3.2. Promote partnerships between government and non-government agencies to deliver combinations of incentive options.

3.3.3. Encourage local governments and regional natural resource management bodies to develop partnerships with non-government conservancy groups that offer voluntary incentive schemes.

3.3.4. Encourage local governments to introduce a reduced differential rate for lands managed for rainforest and related vegetation conservation purposes (including the seeking of external funding to cover costs where reduced rates are offered).

3.3.5. Investigate and promote options for grants to private land-holders for rainforest and related vegetation protection and rehabilitation in priority areas.

3.3.6. Encourage local governments to establish voluntary land acquisition trust funds.

3.3.7. Promote the introduction of non-financial motivational incentives including the provision of resources such as trees, fencing materials and materials for weed control, the delivery of biodiversity-related training and extension advice, and adoption of local awards schemes.

3.3.8. Encourage local governments to negotiate and implement conservation agreements on local government lands.

3.3.9. Encourage local governments to seek funding for a Land for Wildlife Officer.

3.3.10. Encourage the engagement of non-government conservancy groups to provide covenants and to acquire or provide incentives to private land-holders whose land supports high conservation value rainforest and related vegetation.

3.3.11. Public land managers should seek opportunities for partnerships with neighbours to protect rainforest and related vegetation, particularly where it occurs across land tenures.

# OBJECTIVE 4: To protect rainforest and related vegetation from fragmentation, modification and degradation

## OUTCOME 4.1: Active management of threats associated with degradation and rehabilitation undertaken across private and public tenure

### ACTIONS: Planning Area

4.1.1. Implement rehabilitation and restoration actions in priority areas according to:

- Repair priority areas identified in this Plan (see Table 11).
- Priorities identified in local government biodiversity strategies (e.g. Byron Shire Council 2004), Northern Rivers CMA and SEQC investment strategies, Queensland *NatureAssist* statewide incentive program, *Draft South East Queensland Back on Track Biodiversity Action Plan* (QEPA 2008a), *Great Eastern Ranges Initiative*, DECCW plans of management, restoration plans and strategies, and other relevant strategic plans including the *National Strategy for Conservation of Australia's Biological Diversity* (Department of the Environment, Sport and Territories 1996).
- Areas identified as having high stakeholder engagement in existing rehabilitation and restoration programs.

4.1.2. Undertake revegetation of cleared land within priority areas and corridor linkages using best practice methods.

4.1.3. Investigate the inclusion of priority areas in rehabilitation schemes for BioBanking, local government biodiversity strategies, NSW and Queensland planning instruments, settlement guidelines and carbon credit or carbon trading schemes.

4.1.4. Support community groups seeking funds for rehabilitation and restoration projects in rainforest and related vegetation.

4.1.5. Promote the rehabilitation and management of rainforest and related vegetation on public land through plans of management, pest strategies and restoration and rehabilitation plans.

4.1.6. Ensure that buffers are included in approvals for new developments or activities that occur in close proximity to rainforest or related vegetation.

4.1.7. Where appropriate, ensure local provenance flora is selected for revegetation and rehabilitation projects.

4.1.8. Encourage preparation of restoration plans prior to commencement of restoration activities. These should consider potential impacts on priority and threatened species present at a site.

4.1.9. Support provision of extension advice, training and support to land-holders outside of identified priorities of the Planning Area.

### ACTIONS: Flora Group 1 species in lowland and midland landscapes

Flora Group 1 species (refer Appendix 2 or Appendix 7) within the lowland landscape (see Figure 9) require special consideration with regard to habitat loss and modification due to their restrictive dispersal mechanisms. Species from this group are particularly at risk of being removed or lost from fragments as a result of clearing or habitat modification and associated effects from climate change.

4.1.10. Provide advice to decision-makers that outlines why Flora Group 1 species are particularly at risk and should therefore be assessed appropriately.

4.1.11. Identify sites supporting Flora Group 1 species and target these as priorities for habitat rehabilitation and restoration.

**ACTIONS: Flora Group 3 species in lowland and midland landscapes**

Some Flora Group 3 species (refer Appendix 2 or Appendix 7) are considered susceptible to grazing, clearing of understorey (underscrubbing) and modification of understorey habitat through disturbance and weed invasion.

4.1.12. Provide advice to relevant natural resource management organisation and agencies outlining why Flora Group 3 species require protection from agricultural activities that disturb the understorey in remnants and riparian areas.

4.1.13. Provide advice to decision-makers outlining why Flora Group 3 species should be protected and ways this can be achieved.

**ACTIONS: Flora Group 4 species in lowland and midland landscapes**

Flora Group 4 species (refer Appendix 2 or Appendix 7) are frugivore- and wind-dispersed. The distance between remnants can be an impediment to effective dispersal of Group 4 species across remnants.

4.1.14. Create guidelines identifying preferred minimum distances between remnants to assist in selecting rehabilitation sites, particularly with regard to the potential for pollination and dispersal.

4.1.15. Provide advice to decision-makers outlining why Flora Group 4 species should be protected and ways this can be achieved.

4.1.16. In areas where Camphor Laurel is already established (i.e. is not actively invading native vegetation), encourage its staged removal. This will ensure food, shelter and breeding resources are retained to support frugivores in remnants and encourage native species recruitment.

**ACTIONS: Flora Group 5 species in lowland and midland landscapes**

Flora Group 5 species (refer Appendix 2 or Appendix 7) includes plants that reproduce through cloning or resprouting. Clonal species can be severely impacted by major infrastructure projects that remove individuals or populations, such as highway upgrades.

4.1.17. Provide advice to decision-makers on how to determine the presence of, and assess impacts on, Flora Group 5 species when conducting environmental assessments for infrastructure and development projects.

**ACTIONS: Species-specific and key habitat features**

**Tree hollows**

Tree hollows provide critical roost and nesting habitat for hollow-dependent fauna. Hollows are a depleted resource throughout much of the Planning Area. It is therefore important to retain and protect mature and old growth sclerophyll forest adjacent to rainforest, as well as individual hollow bearing trees.

4.1.18. Identify areas that contain high densities of hollow-bearing trees as areas of high conservation value in planning instruments and land management negotiations.

4.1.19. Ensure retention of existing hollow-bearing trees. Also encourage the protection of recruitment trees that will ensure hollow resources are available into the future.

### Flying-fox camps

Three species of flying-fox utilise the rainforest and related habitats within the Planning Area: Grey-headed Flying-fox *Pteropus poliocephalus*, Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*. Although only two of these are identified as priority species, all three play a critical role in pollination of rainforest flora and dispersal of rainforest seeds. Food sources for these species are widespread and vary considerably over different seasons and although provision of year-round food sources is vital, the most important habitat component for flying-foxes are the camps where the species roost during the day. Camps that are used as maternal sites where flying-foxes congregate to mate, give birth and raise young are of paramount importance.

4.1.20. Protect flying-fox camps by providing appropriate zonings and buffers in relevant environmental planning instruments to help minimise landuse conflicts.

4.1.21. Prevent disturbance in and adjacent to active flying-fox camps, in particular known maternity camps.

4.1.22. Protect and rehabilitate flying-fox camps through revegetation and weed removal. Works should not be undertaken during the breeding season or during extremely hot or cold weather.

4.1.23. Undertake community and neighbour awareness programs on the importance of camps to the long-term survival of the species and the importance of flying-foxes in maintaining healthy rainforest communities.

4.1.24. Undertake monitoring of flying-fox camps to provide data on seasonal use, which can assist in managing public concern and identify anomalies in camp use that may indicate habitat conservation issues.

4.1.25. In NSW, encourage and support wildlife carer groups in assisting distressed flying-foxes during extreme weather events.

### Rainforest invertebrates

4.1.26. Promote restoration and rehabilitation of priority invertebrate species' habitats (see Appendix 2), particularly in the lowland landscape and in Stotts Island critical habitat.

## Weeds – high priority

There are numerous weeds impacting upon the Planning Area which are a significant and ongoing threat to biodiversity. Weeds can be grouped into three fundamental threat types: potential new invaders, recently established or emerging weeds, and wide-spread well-established weeds. A number of weeds are identified as key threatening processes.

During the period that this Plan was in preparation, a number of regional weed strategies became available including:

- *Queensland Weed Spread Prevention Strategy* (Department of Primary Industries and Fisheries 2008)
- Draft 'Northern Rivers Invasive Plants Action Strategy 2008–2013' (Northern Rivers CMA & North Coast Weeds 2008)
- Northern Rivers Region and North Coast Region pest management strategies for 2008–2011 (DECC 2007a, 2007d).

The strategies identify the need for prevention, early detection and control of new invaders; implementation of prioritised and integrated weed control programs; and collaborative control across tenures. These plans provide a substantial basis for the strategic delivery of weed control initiatives and actions on private and public lands. This Plan generally refers to those documents. Additionally, in NSW, the DECCW has been developing a database identifying specific site priorities for existing weeds affecting biodiversity (see www.environment.nsw.gov.au/cmaweeds).

To refine some weed-based issues with respect to rainforest within the Planning Area, consideration was given to functional groups of weeds and their potential to establish and impact on rainforest. A list of relevant weeds was identified by an expert panel and a trait-based analysis similar to that used for the priority flora was undertaken (Kooyman et al. 2007, provided in Appendix 14 on the enclosed CD). The analysis identified Weed Management Groups based on their shade tolerance, dispersal mechanism and height class. This allowed the potential for each group to disperse, establish and impact on rainforests of varying condition to be assessed and actions targeted toward priority areas. Table 14 provides a summary of the Weed Management Groups and Appendix 15 lists weed species in each Group and provides more information on this process. Additional weed species can easily be placed into one of the management groups by identifying the weed's functional traits.

The potential influence of climate change on the impacts of weeds in the Planning Area will be varied. In some instances the impacts of weed species may be lessened, while in other instances weeds may spread or impacts increase as climate-based constraints are lessened. The effective control of noxious and environmental weeds, including those identified as key threatening processes, will require long-term management based on a coordinated and consistent approach.

**Table 14 Summary description of rainforest weed management groups (after Kooyman et al. 2007)**

| Weed Management Group |
|---|
| Group 1: Shade tolerant |
| 1.1 Shade tolerant, frugivore dispersal |
| 1.2 Shade tolerant, wind dispersal |
| 1.3 Shade tolerant, unassisted dispersal (gravity, water, tuber) |
| Group 2: Semi-shade tolerant |
| 2.1 Semi-shade tolerant, frugivore dispersal |
| 2.2 Semi-shade tolerant, wind dispersal |
| 2.3 Semi-shade tolerant, unassisted dispersal (gravity, water, tuber) |
| Group 3: Shade intolerant |
| 3.1 Shade intolerant, frugivore dispersal |
| 3.2 Shade intolerant, wind dispersal |
| 3.3 Shade intolerant, unassisted dispersal (gravity, water, tuber) |

# OBJECTIVE 5: To protect rainforest and related vegetation from the impact of weeds

## OUTCOME 5.1: Regional weed management strategies implemented

### ACTIONS: Planning Area

5.1.1. Implement regional weed strategies relevant to rainforest and related vegetation.

5.1.2. Target rainforest and related vegetation priority repair focus areas listed in Table 11 for delivery of weed control programs.

5.1.3. Promote cross-tenure partnerships in strategic delivery of regional weed strategies.

5.1.4. Ensure implementation takes an integrated and systematic approach to incrementally control all weeds within a defined management area and promote native species regeneration.

5.1.5. Promote weed information websites.

5.1.6. Support training and employment opportunities for community members, particularly Indigenous people, in weed control and eradication.

## OUTCOME 5.2: A consistent approach to the strategic control of weeds encouraged through partnerships and alliances between key agencies and land-holders

### ACTIONS: Planning Area

5.2.1. Support integrated programs through a cross-border weeds alliance or network and regional weeds advisory committees.

5.2.2. Conduct regular weed and pest management forums in the Planning Area to share latest information and strategies.

5.2.3. Update the functional trait-based Weed Management Groups (Kooyman et al. 2007, Appendix 14 and Appendix 15) to include an expanded list of Planning Area weeds.

5.2.4. Promote consistent monitoring, evaluating and reporting across agencies and tenures.

5.2.5. Investigate the potential for the trait-based weed management group approach to assist in prioritising sleeper weeds.

## OUTCOME 5.3: New weed invasions and establishment of new weeds prevented

Bridal Creeper *Asparagus asparagoides* is a weed of national significance that poses a major threat to biodiversity in temperate areas of Australia (ARMCANZ 2001) and has been identified as a species of particular concern. It is currently not present in the Planning Area, although south-east Queensland has been identified as an area where it has the potential to spread.

Newly emerging weeds that are yet to establish in the Planning Area include the following:

- Indian Plum *Flacourtia jangomas*
- Aerial Yam *Dioscorea bulbifera*
- Sicklethorn *Asparagus falcatus*
- White Trumpet Vine *Pithecoctenium cynanchoides*
- Japanese Climbing Fern *Lygodium japonicum*
- Barbados Gooseberry *Pereskia aculeata.*

Also, Cherry Guava *Psidium cattelianum* is being widely cultivated in the Planning Area and has the potential to become a weed. In NSW, there is a widespread infestation at Broken Head and a smaller infestation at Wilsons Creek (H. Bower pers. comm.).

### ACTIONS: Planning Area

5.3.1. Develop a cross-border new weed invader alert and rapid response plan for the Planning Area.

5.3.2. Implement the new weed invader alert and rapid response plan from Action 5.3.1 through the cross-border weeds alliance or network.

5.3.3. Develop and/or integrate NSW pest and weed mapping systems with the Biosecurity Queensland 'PestInfo' system for recording spatial information on weeds.

5.3.4. Develop and implement a vehicle and equipment hygiene manual for agencies and individuals.

5.3.5. Promote vehicle hygiene with tour operators, national park visitors and the general public through a public awareness campaign, pamphlets, signage, and provision of boot cleaning trays in priority car parks.

5.3.6. Develop agreements and partnerships with the nursery and fodder industries to implement best practices for reducing weed dispersal.

**ACTIONS: Species- and site-specific**

5.3.7. Prevent establishment of Bridal Creeper in the Planning Area.

5.3.8. Review regional strategies to identify species, locations and resources for early intervention control of new and emerging weeds affecting rainforest and related vegetation, for example, Indian Plum, Aerial Yam, Sicklethorn, White Trumpet Vine, Japanese Climbing Fern and Barbados Gooseberry.

5.3.9. Control Cherry Guava infestations at Broken Head and Wilsons Creek and discourage the sale of this species through nurseries.

## OUTCOME 5.4: Impact of existing weeds reduced

**ACTIONS: Planning Area**

5.4.1. Encourage partnerships between government authorities and other major land managers to implement a strategic and coordinated cross-tenure response to weed control in the Planning Area.

5.4.2. Target priority areas for integrated weed control programs, including those identified in the regional strategies, this Plan, threat abatement plans and the DECCW weed management database website (see www.environment.nsw.gov.au/cmaweeds).

5.4.3. Prepare site management plans and adopt best practice weed control and removal practices.

5.4.4. Schedule control of frugivore- and wind-dispersed weeds prior to seeding and fruiting to prevent dispersal and prevent younger plants from reaching fruiting age.

5.4.5. Identify funding for primary, secondary and follow-up weed control to ensure long-term resourcing of projects.

5.4.6. Monitor weed control programs and undertake spatial mapping of infestations and control areas for input into NSW geographic information systems, DECCW Biodiversity Forecasting Tool and the Biosecurity Queensland 'PestInfo' system.

5.4.7. Support Indigenous training and employment opportunities in integrated weed control and habitat rehabilitation.

**ACTIONS: Upland landscape**

Priority potential and existing weeds for the upland landscape are: Weed Management Group 1 and 2 species (Appendix 15) which are capable of establishing in intact rainforest; and riparian weeds in the upper catchment.

5.4.8. Prioritise riparian weed programs based on location of infestations in a catchment. Undertake control of upstream infestations first, in an attempt to prevent reinfestation of downstream locations.

5.4.9. Monitor upland rainforest and related vegetation for climate change-induced weed introductions, particularly shade and semi-shade tolerant species. If detected, undertake immediate control.

5.4.10. Target shade tolerant weed species in upland rainforest and related vegetation.

**ACTIONS: Lowland and midland landscapes**

Much of the rainforest and related vegetation in the lowland landscape exists as fragmented remnants that are exposed to weeds around their edges. All three trait-based Weed Management Groups (Appendix 15) are represented in these landscapes.

5.4.11. Target weed control efforts toward priority areas (see Table 11) in intact rainforest or related vegetation, or remnants in good condition.

- When selecting sites, have regard to potential for reinfestation by, for example, considering the distance to other weed infestations.
- Target shade and semi-shade tolerant weeds.

5.4.12. Undertake staged removal and replacement of weeds with suitable native species that provide alternative resources and habitat for wildlife (e.g. food resources for frugivores).

5.4.13. Minimise reinfestation by taking into account the dispersal characteristics of weed species.

5.4.14. Create native species buffers between cleared areas and habitat restoration sites to reduce re-establishment of weeds.

5.4.15. Use best practice weed removal techniques to minimise creation of canopy gaps.

**ACTIONS: Species- and site-specific**

DECCW is developing a site-based weed management priority database across catchment management areas.

5.4.16. In NSW, consider the DECCW weed management database for specific site priorities for existing weeds: www.environment.nsw.gov.au/cmaweeds.

## OUTCOME 5.5: Lantana effectively managed

A national Lantana management plan is currently being prepared by Biosecurity Queensland and DECCW. The plan will assess at-risk priority fauna and flora species and compile priority sites for Lantana control. Many species and sites identified by the Lantana management plan are likely to be relevant to the Planning Area. Once adopted, the management plan should direct actions for Lantana control in the Planning Area.

**ACTIONS: Planning Area**

5.5.1. Identify sites for Lantana control based on priority areas and species identified in this Plan, the 'Bell Miner Associated Dieback Strategy' (Bell Miner Associated Dieback Working Group 2004), and when available, the national Lantana management plan. In NSW, Lantana control within conservation reserves should also be based on DECCW's regional pest management strategies (DECC 2007a, 2007d).

5.5.2. Undertake best practice Lantana control at sites identified in Action 5.5.1.

5.5.3. When available, implement the national Lantana management plan.

## OUTCOME 5.6: Bitou Bush effectively managed

In NSW, the Bitou Bush and Boneseed Threat Abatement Plan (DEC 2006c) identifies 15 high priority control sites within the Planning Area. These sites target 11 priority flora species and one endangered ecological community. Appendix 10 lists these priority sites.

In Queensland, Bitou Bush is a Class 1 pest under the *Land Protection (Pest and Stock Route Management) Act 2002*. Therefore, all land-holders in Queensland are required to keep their land Bitou Bush-free.

**ACTIONS: Planning Area**

5.6.1. In NSW, undertake control of Bitou Bush at high priority locations in accordance with the Bitou Bush and Boneseed Threat Abatement Plan (DEC 2006c) and 'Northern Rivers Regional Bitou Bush Strategy 2007–2012' (DEC 2006d).

5.6.2. In Queensland, undertake control of Bitou Bush in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002*.

5.6.3. Support the NSW–Queensland Memorandum of Understanding Northern Containment Zone program to prevent reinvasion of Bitou Bush into south-east Queensland from north-east NSW.

## OUTCOME 5.7: Camphor Laurel forests effectively managed

In the Big Scrub, Camphor Laurel forests provide habitat and corridors for native species. They also provide food resources for large-gaped frugivores, which are the primary dispersers of large-seeded native rainforest plants. Therefore, 'Camphor conversion' is recommended to take advantage of natural regeneration and recruitment of native species and to ensure the presence of a transitional food resource for frugivores (Kanowski & Catterall 2007). In other areas such as the Tweed Valley and Gold Coast hinterland, Camphor Laurel is invading eucalypt forest and 'Camphor conversion' is not recommended in areas such as these where invasion is ongoing.

### ACTIONS: Planning Area

5.7.1. In areas where Camphor Laurel forests are established (e.g. the Big Scrub), use the existing forests as aids in regenerating subtropical rainforest via the 'Camphor conversion' techniques of staged removal or patch removal. For riparian areas, use best practice control methods to prevent stream-bank disturbance.

5.7.2. Undertake early control of Camphor Laurel in areas where it is still actively invading native vegetation, and where newly established infestations exist.

5.7.3. Encourage landowners and land managers to undertake Camphor Laurel control in priority repair areas using appropriate techniques in accordance with level of infestation (see Actions 5.7.1 and 5.7.2 and Table 11).

5.7.4. Where appropriate, plant native strangler fig species into Camphor Laurel trees as a long-term strategy for replacement (e.g. heritage, street or public space plantings).

5.7.5. Develop best practice Camphor Laurel replacement methods for a range of landforms and forest structures.

## OUTCOME 5.8: Exotic rainforest vines and scramblers effectively managed

Many of the Planning Area's most significant environmental weeds are invasive exotic rainforest vines or scramblers that were imported into Australia for horticultural or agricultural purposes. Rainforests are sensitive to invasion by exotic vines, particularly after canopy disturbance (Floyd 1989). Riparian vegetation is susceptible to infestation by vines due to high water and nutrient availability. The following exotic vines and scramblers are known to occur, or have the potential to occur, in the rainforests of the Planning Area (see also Big Scrub Rainforest Landcare Group 2000; NSW Scientific Committee 2008):

- Aerial Yam *Dioscorea bulbifera*
- Asparagus Fern *Asparagus africanus*
- Balloon Vine *Cardiospermum grandiflorum*
- Black-eyed Susan *Thunbergia alata*
- Blue Trumpet Vine *Thunbergia grandiflora*
- Brazilian Nightshade *Solanum seaforthianum*
- Bridal Creeper *Asparagus asparagoides*
- Cape Ivy *Delairea odorata*
- Cat's Claw *Macfadyena unguis-cati*
- Climbing Asparagus *Asparagus plumosus*
- Climbing Nightshade *Solanum seaforthianum*

- Common Morning Glory *Ipomoea purpurea*
- Corky Passion Flower *Passiflora suberosa*
- Dutchman's Pipe *Aristolochia elegans*
- Five-leaved Morning Glory *Ipomoea cairica*
- Glycine *Neonotonia wightii*
- Golden Shower *Pyrostegia venusta*
- Ground Asparagus *Asparagus aethiopicus*
- Honeysuckle *Lonicera japonica*
- Jasmine *Jasminum* spp.
- Kudzu *Puearia lobata*
- Madeira Vine *Anredera cordifolia*
- Moon Flower *Ipomoea alba*
- Morning Glory *Ipomoea indica*
- Moth Vine *Araujia sericifera*
- Night Flowering Cactus *Hylocereus undatus*
- Passionfruit *Passiflora edulis*
- Sicklethorn *Asparagus falcatus*
- Siratro *Macroptilium atropurpurpureum*
- Stinking Passionfruit *Passiflora foetida*
- Striped Wandering Jew *Tradescantia zebrina*
- Thorny Poinciana / Mysore Thorn *Caesalpinia decapetala*
- Turkey Rhubarb *Acetosa sagittaria*
- Wandering Jew *Tradescantia fluminensis*
- White Passion Flower *Passiflora subpeltata*.

**ACTIONS: Upland landscape**

5.8.1. Prioritise works in upper catchment infestations and continue downstream.

5.8.2. Control new outbreaks starting at the upper catchment.

**ACTIONS: Lowland and midland landscapes**

5.8.3. Undertake works to connect with upper catchment programs where possible, and undertake works in priority areas and in accordance with regional strategies.

**ACTIONS: Site-based**

5.8.4. Control exotic vines along the riparian strip in the Tallebudgera Valley, which was identified as a priority during community consultation.

## OUTCOME 5.9: Weed control and habitat management education promoted

Promotion and awareness are important components of any integrated weed strategy. Several programs and training courses already exist that are either relevant to the weeds of the Planning Area or can easily be extended to include the Planning Area.

**ACTIONS: Planning Area**

5.9.1. Encourage participation in conservation and land management certificate courses and promote the use of qualified and experienced bush regenerators to undertake on-ground implementation.

5.9.2. Support and develop partnerships for standardised extension material and weed information.

5.9.3. Negotiate with tertiary institutions for 'weed spotter training' to be recognised as competencies for appropriate certificates, for example, Conservation and Land Management National Training Package for a unit of competency for Weed Collection Techniques.

5.9.4. Promote organisational and individual training in accredited weed hygiene practices, for example, Australian qualification framework accredited RTD2312A 'Inspect machinery for plant, animal and soil material training', and RTD2313A 'Clean machinery of plant, animal and soil material training'; or the Victorian Government's 'WeedStop' training.

5.9.5. Promote weed education programs, for example 'Weed Warriors' and 'Weed Web' programs for schools.

5.9.6. Support Indigenous community training and employment in weed management and vegetation rehabilitation.

5.9.7. Promote incentive schemes for land-holders to implement weed control and habitat rehabilitation through Landcare, Queensland NatureAssist, natural resource management bodies and local governments. Preferably, this should be in combination with neighbours and in priority areas.

## Inappropriate fire regimes – high priority

Rainforest is sensitive to fire and provides a microclimate that does not promote the spread of fire. However, fire can affect rainforest by encroaching on edges and keeping rainforest expansion in check (Adam 1987). During extreme dry periods, wildfires can burn into some rainforest areas. Isolated and remnant rainforest, particularly dry rainforest and semi-evergreen vine thickets, typically occur in areas with pronounced rainfall seasonality and are therefore most likely to be impacted by fire, which can also be exacerbated by drought and climate change. Many of these rainforest communities are on private land and require special attention to minimise the impacts of fire. Climate change is likely to increase the frequency, intensity and size of bushfires in the future (Ellis et al. 2004).

Rainforests support many endemic and highly restricted flora and fauna species. The exclusion of fire is critical for the long-term survival of these species. The fauna species associated with the Tumbunan biogeographic biota are particularly susceptible to changes in the extent, composition and microclimate of rainforest. Major Tumbunan fauna refugia are shown on Figure 14 (on the enclosed CD) and should be considered during fire planning.

Wet sclerophyll forest requires fire at appropriate intervals and intensities to maintain species and structure and to prevent rainforest encroachment. The tension between the requirements of these vegetation communities at the ecotone also affects a number of rainforest – wet sclerophyll ecotone fauna species (e.g. Eastern Bristlebird, Black-breasted Button-quail and Sooty Owl). Appropriate management of fire in these adjacent communities is important in maintaining habitat for such species.

Managing fire requirements for wet sclerophyll forest and other vegetation adjacent to rainforest is a challenge for the Plan. Appendix 16 (on the enclosed CD) provides a comparison of fire threshold interval guidelines for vegetation communities relevant to the Planning Area. In particular, the variation in recommended intervals for various forms of wet sclerophyll forest pose challenges and demonstrate that a single regime still requires flexibility in its implementation. Some of these

guidelines should, however, be viewed with caution. In particular, the Northern Rivers Hotspot recommendations (Watson 2006) are currently being reviewed (P. Watson pers. comm.).

The relationship between rainforest and adjacent vegetation communities and fire regimes is dynamic. A fire regime can be classified as inappropriate on the basis of one or more aspects that define that particular regime. This is not restricted to fire interval (in the form of over-burning or under-burning), but can include such aspects as intensity and seasonality. Further to this, a particular regime is influenced by a combination of human-induced hazard reduction burns and unplanned wildfire.

Climate change has the potential to greatly increase the impact of fire regimes on the rainforest and related vegetation and species within the Planning Area through increased high risk fire days, and changes to minimum and maximum temperatures, humidity and rainfall patterns. Remnant patches of dry rainforest are likely to be susceptible to increases in the frequency and intensity of wildfires.

Activities associated with fire suppression can potentially impact on rainforest and associated aquatic systems, for example, off-road activities increasing eutrophication and turbidity in waterways, and potential impacts of surfactants entering waterbodies.

This Plan is principally focused on protecting and managing rainforest and related vegetation communities. The priority for the Plan is, therefore, protecting rainforest communities and remnants from the effects of fire and excluding fire from rainforest where possible. The management of fire in vegetation adjacent to rainforest aims at maintaining the rainforest ecotone and managing those ecotonal communities.

## OBJECTIVE 6: To protect rainforest from fire and to promote the implementation of appropriate fire regimes in related vegetation

### OUTCOME 6.1: Fire excluded from rainforest

#### ACTIONS: Planning Area

6.1.1. Identify areas of rainforest that are most vulnerable to degradation from fire due to their location adjacent to sclerophyll vegetation communities, and undertake strategic fire management activities to eliminate or reduce these impacts wherever possible. Figure 15a (on the enclosed CD) identifies broad areas of risk.

6.1.2. Ensure fire management strategies eliminate or reduce the risk of fire burning areas of rainforest within Tumbunan fauna refugia (see Figure 14 on the enclosed CD).

### OUTCOME 6.2: A consistent and coordinated approach to fire management and rainforest protection promoted

#### ACTIONS: Planning Area

6.2.1. Promote a consistent and coordinated approach to fire management in the Planning Area by encouraging partnerships and alliances between Southeast Queensland Fire and Biodiversity Consortium, Nature Conservation Council Hotspots Fire Project, DERM, DECCW, Northern Rivers CMA, SEQC, Forests NSW, Queensland Department of Employment, Economic Development and Innovation, local governments, and NSW and Queensland Rural Fire Services.

6.2.2. Create a NSW Northern Rivers Fire and Biodiversity Consortium separate from, but with links to the Southeast Queensland Fire and Biodiversity Consortium and the Nature

Conservation Council's Hotspots Fire Project. The proposed NSW Northern Rivers Consortium would:

- cover a small enough geographic area to allow for efficient coordination and emphasis on the fire-related dynamics of local vegetation types
- draw its core membership from agency, land and fire managers
- link with networks that have already been established in other natural resource management contexts
- seek support from local governments.

6.2.3. Investigate options for using the regional fire thresholds recommended by the Nature Conservation Council's Hotspots Fire Project and the Southeast Queensland Fire and Biodiversity Consortium in the Planning Area. Recommendations could be used by regional bushfire management committees, DECCW Parks and Wildlife Group, DERM, Forests NSW and Queensland Department of Primary Industries and Fisheries.

6.2.4. Encourage a consistent approach to preparation and style of fire strategy maps across all tenures.

6.2.5. Promote collaboration between organisations managing projects of common interest (e.g. the preparation of property vegetation plans under the NSW *Native Vegetation Act 2003*, property management plans and property fire management planning for biodiversity outcomes).

6.2.6. Support the property-based fire planning programs of the Southeast Queensland Fire and Biodiversity Consortium in south-east Queensland and Nature Conservation Council's Hotspots Fire Project in north-east NSW.

6.2.7. Consider implications of climate change on fire management planning and incident response, particularly the ongoing feasibility of using rainforest edges for fire containment.

## OUTCOME 6.3: The broader community engaged in fire management and protection of rainforest from fire

### ACTIONS: Planning Area

6.3.1. Encourage land-holders to participate in the property-based fire planning programs of the Nature Conservation Council's NSW Hotspots Fire Project and Southeast Queensland Fire and Biodiversity Consortium.

6.3.2. Support property-based fire planning on Indigenous-owned land and the incorporation of traditional knowledge into these plans.

6.3.3. Encourage partnerships and cooperation between neighbouring private and public land-holders to prepare compatible fire management plans and implement hazard reduction and environmental burns across groups of properties rather than each individual property.

6.3.4. In Queensland, provide support and assistance to nature refuge properties to promote a consistent approach to the use of fire to manage rainforest communities.

6.3.5. Undertake pilot programs to protect dry rainforest remnants from fire by negotiating a coordinated approach to fire management property planning with neighbouring land-holders and using adjacent vegetation communities to provide fire buffers to dry rainforest remnants.

- Although actual sites still need to be identified, broad areas identified for potential pilot projects in the NSW part of the Planning Area are identified in Figure 15b (on the enclosed CD). Upper Findon Creek was proposed as a potential pilot area through the community consultation process.

6.3.6. Support the implementation of fire management strategies and statements of fire management intent in Queensland and NSW protected areas.

6.3.7. Integrate likely weed response when proposing planned fire regimes and, when necessary, incorporate weed management into property fire planning. Conversely, it may also be feasible to incorporate a fire regime into an integrated weed strategy.

6.3.8. When preparing fire plans, consider potential impacts on aquatic species from hazard reduction and environmental burns in proximity to riparian areas.

6.3.9. In NSW, investigate options available through bush fire risk management plans to deter the establishment of fire-prone eucalypt plantations in close proximity to rainforest.

**ACTIONS: Species- and site-specific**

6.3.10. Investigate mechanisms to reduce risk from wildfire and arson events in priority locations. Locations identified at risk from fire through community consultation include:

- public and private land connected to Springbrook and Border Ranges National Parks
- Spicers Gap
- eastern side of Main Range north to Mt Castle
- Mt Moon
- North-east corner of Planning Area in Queensland
- Plunkett Conservation Park
- Tamborine National Park
- west of Lamington National Park
- Wickham Flora Reserve.

6.3.11. Support ongoing work with land-holders by SEQC and Southeast Queensland Fire and Biodiversity Consortium in the Mt Barney and Main Range area.

## OUTCOME 6.4: Ecological burns undertaken

Although rainforest is one of the few vegetation communities of the Planning Area that is not fire-adapted, fire regimes remain an important component in the maintenance of habitat and life cycle processes for many of the priority species of the Plan. Fire, however, generally remains an under-used management tool for landscape-based biodiversity conservation. This is usually due to the uncertainties involved, the legal approvals required, and the lack of capacity to implement such burns.

Some existing programs in the Planning Area have already identified a need for ecological burns, and this Plan supports their implementation.

**ACTIONS: Planning Area**

6.4.1. In NSW, investigate options for encouraging implementation of environmental burns, including options for streamlining approval processes.

**ACTIONS: Midland and upland landscapes**

6.4.2. Support the use of fire regimes as part of an integrated management approach for Lantana and Bell Miner associated dieback control at priority dieback sites, provided adjacent rainforest is protected (see also Outcomes 5.5 and 8.1).

**ACTIONS: Species- and site-specific**

6.4.3. Identify priority grassy wet sclerophyll areas that are known to contain Eastern Bristlebird and Hastings River Mouse *Pseudomys oralis* habitat. Develop and apply appropriate fire management strategies to control weed and shrubby acacia encroachment while protecting adjacent rainforest. Fire management strategies should include a monitoring component.

6.4.4. Implement the NSW draft targeted threatened species management strategy for Border Ranges National Park (DECC 2007e) and the threat management plan for the Eastern Bristlebird population in Lamington National Park.

6.4.5. At Richmond Gap in NSW, establish five trial fire management sites in previously occupied territories of the Eastern Bristlebird.

## OUTCOME 6.5: Species ecological requirements in fire planning and hazard reduction guidelines reviewed and updated

Along with other features of the landscape and built environment, biodiversity should be considered as an asset, and fire regimes managed accordingly to balance the requirements of the natural landscape with the protection of human life and property. For this to occur, the fire regime recommendations for species and vegetation communities need be based on up-to-date knowledge and be consistent across plans and guidelines.

### ACTIONS: Planning Area

6.5.1. Review ecological requirements for rainforest, related species and habitats in fire management plans, including hazard reduction guidelines and procedures.

6.5.2. Knowledge gaps identified in Action 6.5.1 should be used to inform research proposed in Outcome 6.6.

## OUTCOME 6.6: Research into effects of different burning regimes undertaken on species and communities

### ACTIONS: Planning Area

6.6.1. Assess fire regime requirements for priority species and habitats of the Planning Area. Species identified as requiring assessment include:

**Flora:**

- Marbled Baloghia *Baloghia marmorata*
- *Bosistoa selwynii*
- *Bosistoa transversa*
- *Brachychiton* sp. Ormeau
- *Callitris baileyi*
- Native Jute *Corchorus cunninghamii*
- *Corokia whiteana*
- *Cupaniopsis newmanii*
- Smooth Davidson's Plum *Davidsonia johnsonii*
- *Diospyros ellipticifolia* var. *ebenus*
- Spear Lily *Doryanthes palmeri*
- Basket Fern *Drynaria rigidula*
- Hairy Quandong *Elaeocarpus williamsianus*
- Southern Fontainea *Fontainea australis*
- *Hibbertia hexandra*
- Southern Ochrosia *Ochrosia moorei*
- Bog Onion *Owenia cepiodora*
- *Rhynchosia acuminatissima*
- Blotched Sarcochilus *Sarcochilus weinthalii*

- *Sophora fraseri*
- *Xylosma terra-reginae*

**Fauna:**

- Black-striped Wallaby
- Brush-tailed Rock-wallaby (Queensland)
- Golden-tipped Bat *Kerivoula papuensis*
- Parma Wallaby
- Red Goshawk *Erythrotriorchis radiatus*
- Red-legged Pademelon
- Richmond Birdwing Butterfly
- Rufous Scrub-bird
- Spotted-tailed Quoll (southern subspecies) *Dasyurus maculatus maculatus*
- Stephens' Banded Snake
- Three-toed Snake-tooth Skink

## Pest animals – medium priority

This threat category includes the numerous, often multiple, effects that pest animal species can have on rainforest and related vegetation and species in the Planning Area. This ranges from the direct effects of herbivory, predation, habitat degradation and competition upon species through to trampling, wallowing and other forms of disturbance. In the case of the Cane Toad, it also includes poisoning through ingestion.

Similar to weeds, there are three fundamental threat types: potential new invaders, recently established or emerging pests, and wide-spread well-established pests. This Plan refers to a number of existing regional strategies and forums as the principal guiding documents for pests in the Planning Area, including:

- *Northern Rivers Pest Animal Management Strategy 2008–2013* (Northern Rivers CMA 2008)
- *Northern Rivers Region Pest Management Strategy 2008–2011* (DECC 2007a)
- *North Coast Region Pest Management Strategy 2008–2011* (DECC 2007d)
- South East Queensland Pest Advisory Forum.

Where necessary, the Plan considers specific actions relevant to rainforest and related vegetation.

The potential influence of climate change upon the introduced pest animal threat to the Planning Area will be varied. In some instances, the impacts of some pest species may be lessened, while in other instances pests may spread or impacts increase as climate-based constraints are lessened.

Several pest animal species are established in the Planning Area (e.g. European Red Fox and Plague Minnow), some are expanding their distribution within the region (e.g. Cane Toad) and others have the potential to become established. Effective management will require a long-term approach addressing established, expanding and potential (new and emerging) pest species. The approach taken in the Plan reflects the regional strategies and involves:

- protecting rainforest and related vegetation, habitat and species from invasion by new and emerging predators and competitors
- minimising the impact of new and emerging predators and competitors on rainforest and related vegetation, habitat and species through control and/or eradication

- reducing the impact of established predators and competitors on the long-term viability of rainforest and related vegetation, habitat and species through control or eradication at appropriate spatial scales.

# OBJECTIVE 7: To protect rainforest and related vegetation from the impact of pest animals

## OUTCOME 7.1: Regional pest management strategies implemented

In NSW, DECCW (DECC 2007a, 2007d) and Northern Rivers CMA (Northern Rivers CMA 2008) have recently completed strategic plans for pest animals relevant to the Planning Area. These will be the principal documents referred to for pest animals. In Queensland, the South East Queensland Pest Advisory Forum provides a discussion body for pest-related issues in south-east Queensland and provides advice to the Land Protection Council which is an advisory body to the Minister. The agency responsible for the control of pests in Queensland is the Department of Primary Industries and Fisheries, through Biosecurity Queensland.

### ACTIONS: Planning Area

7.1.1. Implement regional pest strategies relevant to rainforest and related vegetation in the Planning Area.

7.1.2. Target identified priority repair areas listed in Table 11 and areas identified in regional strategies for delivery of pest control programs.

7.1.3. Promote cross-tenure partnerships in the strategic delivery of regional strategies.

7.1.4. Discourage the development of roads and tracks into Conserve Priorities (see Figures 10a–j on the enclosed CD) as they promote pest animal access.

7.1.5. Promote consistent monitoring, evaluating and reporting of pest programs across agencies and tenures.

7.1.6. Promote pest information websites.

## OUTCOME 7.2: A consistent approach to the strategic control of pests encouraged through partnerships and alliances between key agencies and land-holders

A coordinated cross-jurisdictional approach to the detection, control, monitoring and reporting of new and emerging pest animals is required to prevent establishment. Currently, geographical information systems have been developed independently in NSW and Queensland (Biosecurity Queensland 'PestInfo'). Integrating these systems to report on pest animals across the Planning Area is required.

### ACTIONS: Planning Area

7.2.1. Support integrated programs through a cross-border pest animal network and regional pest animal advisory committees.

7.2.2. Conduct regular rainforest pest management forums in the Planning Area to share latest information and strategies.

7.2.3. Develop a 'Pest Animal Spotter and Rapid Response Plan' to be coordinated by a Queensland–NSW pest alliance or network, relevant pest advisory committees and government agencies.

7.2.4. Develop and/or integrate a NSW pest and weed mapping system with the Biosecurity Queensland 'PestInfo' system for recording spatial information on weeds and pests.

## OUTCOME 7.3: New and emerging pests prevented from establishing

### Invasive tramp ant species

Invasive exotic tramp ants (e.g. Red Imported Fire Ant, Yellow Crazy Ant) are a diverse group of species originating from many regions of the globe. They share genetic, behavioural, and ecological attributes that increase their risk of entry, establishment and spread, ecological dominance, and high level of impact. Many species of tramp ants have the ability to affect Australia's native biodiversity. Their impacts may be felt directly through predation upon, or competition with, native animals. Indirectly, they can modify habitat structure and alter ecosystem processes. Most tramp ant species can affect plant and animal health, social and cultural values, and human health.

A tramp ant threat abatement plan has been adopted by the Australian Government (Department of the Environment and Heritage 2006a). Red Imported Fire Ants have become established at a number of sites in the greater Brisbane area, but have since been subject to a targeted control program.

### ACTIONS: Planning Area

7.3.1. Undertake regular surveillance of protected areas within the Planning Area for tramp ant species.

7.3.2. Target land-holders and local governments in tramp ant awareness programs.

7.3.3. Include tramp ant species in any Pest Animal Spotter and Rapid Response Plan from Outcome 7.2.

7.3.4. In Queensland, contact Biosecurity Queensland if tramp ants are suspected. In NSW, contact the Department of Primary Industries. Do not disturb suspected nests.

7.3.5. Implement hygiene and quarantine protocols for transport vehicles and goods deposition sites, especially when goods are transported from high risk areas.

### Red-eared Slider Turtle

A native of the United States, the Red-eared Slider Turtle *Trachemys scripta elegans* is now a well-established pest in many parts of the world. It has been identified among the world's 100 worst invaders by the World Conservation Union, and is considered a major threat to biodiversity. The species is a Class 1 declared pest animal in Queensland. There are reports of the turtle in the Planning Area, in south-east Queensland, but it is not clear whether these originate from illegal dumping of pets or wild populations.

The Red-eared Slider Turtle is very aggressive and can out-compete native species for food and space in wetland systems. They have the potential to multiply rapidly and spread throughout eastern Australian waterways, with possible serious impacts on freshwater biota. Of additional concern is the potential for the species to carry new diseases and pathogens that could kill native turtles and other freshwater species. In Queensland, further information can be found at www.nrw.qld.gov.au.

### ACTIONS: Planning Area

7.3.6. Provide information on the identification and threat of Red-eared Slider Turtle to the general public through media campaigns, regional natural resource management bodies and other means to increase public awareness and to encourage people to report sightings.

7.3.7. Undertake regular surveillance of protected areas within the Planning Area for the Red-eared Slider Turtle.

7.3.8. Encourage land-holders and local governments to undertake surveillance on their land for the Red-eared Slider Turtle.

7.3.9. Control identified outbreaks using south-east Queensland established methods (e.g. sniffer dogs and trapping).

7.3.10. Map areas subject to control on a spatial pest database.

### Banded Grunter

The Banded Grunter *Amniataba percoides,* a fish species native to northern Australia, is a relatively new and emerging pest species in the Clarence River, NSW. It is a potential priority species for control in the Planning Area (Department of Primary Industries 2005).

### ACTIONS: Lowland and midland landscapes

7.3.11. To determine distribution and abundance, continue implementing control methods including the sonic tagging program.

7.3.12. Implement appropriate control methods based on location and other factors.

### Feral deer

In Australia, the full environmental impacts of deer are yet to be quantified, although identified impacts are related mostly to degradation of native vegetation and habitat through overgrazing, browsing, trampling, ring-barking, antler rubbing, dispersing weeds, creating trails, concentrating nutrients and accelerating erosion (Clarke et al. 2000; NPWS 2002a; Keith & Pellow 2004; Moriarty 2004; Dolman & Wäber 2008). Feral deer are known to have impacted upon littoral rainforest in the Sydney region (NPWS 2002a) and this vegetation community is considered to be potentially under threat from feral deer in NSW (NSW Scientific Committee 2004).

Six species of deer have established feral populations in NSW. These are Rusa Deer *Cervus timorensis*, Red Deer *Cervus elaphus*, Sambar Deer *Cervus unicolor*, Chital Deer *Axis axis*, Hog Deer *Axis porcinus*, and Fallow Deer *Dama dama* (Moriarty 2004). There are no recorded populations of any of these species within the NSW component of the Planning Area (DECC 2007a), although West and Saunders (2006) identified deer as the most important emerging pest animal threat in NSW.

In Queensland, no established deer populations are known to occur within the Planning Area, although established populations of Red Deer occur nearby in the Brisbane and Mary River valleys, and Fallow Deer around Stanthorpe and Warwick. Bioclimatic data for Queensland indicate that there is potential for rapid expansion of some deer species within the State, including Red Deer, Rusa Deer and Chital Deer (Jesser 2005).

### ACTIONS: Planning Area

7.3.13. Identify areas where feral deer are impacting upon rainforest and related biodiversity in the Planning Area.

7.3.14. Where control is required, undertake community consultation for control options.

7.3.15. Based on community consultation, undertake appropriate control of deer in identified areas.

7.3.16. Monitor for effectiveness of the control activities on the biodiversity of the Planning Area.

## OUTCOME 7.4: Spread of invading pest animals limited

### Cane Toad

The Cane Toad is established in the lowlands of Queensland and far north NSW, and yet it is absent or at very low densities in the upland areas and many parts of the NSW section of the Planning

Area. Given that Newell (2007) has reported individuals at altitudes above 1100 m, the prediction that toad distribution will be restricted by elevation appears to be incorrect and the potential distribution may be more widespread than previously thought.

Impacts from Cane Toad are likely through predation on arthropods, competition for shelter and food, toxic effects on the eggs and tadpoles of native frogs and other aquatic organisms, and toxic effects to native predators following ingestion of Cane Toad.

### ACTIONS: Planning Area

7.4.1. In NSW, implement the DECCW Northern Branch Cane Toad Management Strategy (DECC n.d.).

7.4.2. Identify and map Cane Toad-free zones within the NSW part of the Planning Area.

7.4.3. In NSW, ensure compliance with any standard handling, euthanasia and disposal procedures when managing cane toads.

7.4.4. Implement Cane Toad containment in NSW using an integrated approach on public and private land.

7.4.5. Support local governments in implementing the *Toad Buster* program.

7.4.6. Develop and disseminate guidelines for making dams unsuitable for Cane Toads.

7.4.7. Continue to educate the community in identifying Cane Toads and their eggs and similar native species, for example, through DECCW's *Catch that Toad* program.

7.4.8. Encourage businesses that transport materials likely to contain Cane Toads to implement hygiene strategies to prevent their transport.

7.4.9. Educate the general public on the risk of transporting toads and provide a pre-travel check list.

7.4.10. Liaise with research institutions to ensure new research is adapted into management where relevant.

### ACTIONS: Upland landscape

Cane Toads have been recorded within rainforest in the eastern section of the Border Ranges National Park in NSW at altitudes of up to 1130 m. They have been recorded along isolated sections of Tweed Range Road (Newell 2007, in press), suggesting that they have migrated from lower elevations via the forested escarpment on the eastern edge of the national park. Management is required to control and eliminate this population before further intrusions into the national park occur.

7.4.11. Monitor for Cane Toads in the Gondwana Rainforests of Australia WHA within the upland landscape of the Planning Area.

- Undertake immediate control or eradication where detected.
- Monitor indicator species such as Spotted-tailed Quoll and native frogs for Cane Toad impacts.

7.4.12. Undertake summer surveys (January to March) and remove Cane Toads and tadpoles in priority areas, particularly in the vicinity of Border Ranges and Nightcap National Parks, including waterbodies associated with roadside drains.

### Feral Pigs

Feral Pigs are common and widely distributed over large expanses of Australia. Within the Planning Area, they currently occur in low numbers in restricted locations. They have a high potential to spread throughout the rainforest and related vegetation of the region with significant impact. These impacts may be direct through predation, consumption or habitat destruction, or indirect through spread of disease and pathogens (e.g. *Phytophthora cinnamomi*). There is a national *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs* (Department of the Environment and Heritage 2005a).

### ACTIONS: Planning Area

7.4.13. Implement the relevant actions of the national threat abatement plan, pest strategies and conservation reserve management documents.

7.4.14. Identify where feral Pigs are impacting upon biodiversity in the Planning Area.

7.4.15. Undertake control of feral Pigs in locations identified under Action 7.4.14.

7.4.16. Map control locations on a pest spatial database for the Planning Area.

7.4.17. Monitor the effectiveness of the control activities, including any re-establishment.

7.4.18. Undertake public education to discourage feral Pig reintroductions.

7.4.19. Liaise with the Invasive Animals Cooperative Research Centre to get updated information on latest research in feral Pig control methods (e.g. delivery of a commercial, shelf-stable bait).

### ACTIONS: Species- and site-specific

7.4.20. Control feral Pigs in Main Range National Park.

7.4.21. Eradicate feral Pigs in the New England Blackbutt *Eucalyptus campanulata* open forest adjacent to rainforest at Gambubal. This site has an important population of Hastings River Mouse. Although the level of damage is currently low, the Pigs have the potential to become established and to damage the understorey.

### Feral populations of released poultry

The ongoing release of domestic poultry at particular locations in the Planning Area is resulting in the establishment of feral populations (DECC 2007a). Feral poultry can disturb the understorey of rainforest and related vegetation, spread weeds and compete with native species for food. In the Planning Area, they have been identified as a potential threat to Thorny Pea *Desmodium acanthocladum* and Mitchell's Rainforest Snail (DECC 2007a).

### ACTIONS: Planning Area

7.4.22. Identify areas of rainforest and related vegetation potentially under threat from feral poultry populations (e.g. areas that contain priority rainforest invertebrates).

7.4.23. Control outbreaks in priority areas.

### ACTIONS: Site-specific

7.4.24. Implement the DECCW *Northern Rivers Region Pest Management Strategy* (DECC 2007a) to control ongoing outbreaks at Brunswick Heads and Boatharbour Nature Reserves.

### Indian Myna *Acridotheres tristis*

The Indian Myna is an aggressive and adaptable bird that is recognised as one of the world's most invasive species (Lowe et al. 2000). In south-east Queensland, the species prefers rural and urban environments, although it appears that some form of modification and disturbance of natural environments is an important factor (Spina 2007). Therefore, even though it does not usually enter closed-canopy forest (Tidemann 2007), it has the potential to affect rainforest edges where they are fragmented, disturbed or adjacent to urban and rural areas.

Impacts of the Indian Myna on biodiversity are not well quantified in Australia (Tidemann 2007), although the species may have potentially adverse effects on the breeding success of hollow-dependent species, particularly in woodland of southern Australia (Pell & Tidemann 1997), and may pose a long-term threat to native birds in urban areas (DECC 2007a).

### ACTIONS: Planning Area

7.4.25. Identify areas at risk of invasion by Indian Myna brought about by a loss of nesting resources in areas adjacent to rainforest and related vegetation.

7.4.26. Implement targeted Indian Myna control based on best practice control techniques identified through regional strategies and Indian Myna working groups.

## OUTCOME 7.5: Existing pest animals strategically controlled

### Feral Cats

With the exception of some of the wettest rainforests, feral Cats are found in all habitats on mainland Australia, Tasmania and many offshore islands (DEWHA 2008a). They affect biodiversity directly through predation and competition, but can also transmit diseases and parasites to wildlife (Dickman 1996).

Dickman (1996) identified areas of Australia containing species at high risk of Cat impact. The Planning Area was excluded from these areas, although the coast of northern NSW and southern Queensland was identified as an area with localised distributions of high-risk species. Several species relevant to the Planning Area have been identified by a range of sources as being under threat from feral Cats, including Eastern Bristlebird, Black-breasted Button-quail, Brush-tailed Rock-wallaby and Hastings River Mouse (Dickman 1996; NSW Scientific Committee 2000; DECC 2007a; DEWHA 2008a). Many other fauna species in the Planning Area are negatively affected by the effects of feral Cats and any form of abatement would benefit these species as well.

Any broadscale control of feral Cats is problematic as they avoid human contact, are hard to trap, and do not readily take baits (DECC 2007a). Available methods are also expensive and labour intensive (DEWHA 2008b). Trials involving various baiting methodologies continue to be undertaken in an attempt to develop a cheap, effective broadscale method of feral Cat control.

### ACTIONS: Planning Area

7.5.1. Implement relevant actions in the national *Threat Abatement Plan for Predation by Feral Cats* (DEWHA 2008a).

7.5.2. Support finalisation of a NSW feral Cat threat abatement plan.

7.5.3. Monitor research on feral Cat control methods and implement trials when opportunities occur.

7.5.4. Identify priority areas and species most at risk from feral Cats within the Planning Area and implement control where possible.

7.5.5. Integrate feral Cat control into other integrated pest control programs, particularly where control programs reduce competition pressure of other carnivores.

7.5.6. Undertake community awareness on the impacts of feral Cats on the biodiversity of the Planning Area and encourage landowners to undertake control.

### European Red Fox

Foxes occur throughout the Planning Area in both urban and non-urban areas (Gentle 2006; DECC 2007a). They are probably less numerous in intact closed forests than other habitats (Catling & Burt 1995), although they will commonly use tracks, roads and cleared corridors to gain access to such vegetation (DEWHA 2008c).

Foxes have a wide dietary range and are known to predate on a variety of small to medium sized ground and semi-arboreal vertebrates as well as invertebrates (NSW Scientific Committee 1998; NPWS 2001b; DEWHA 2008c; Johnson & Isaac 2009). The opportunistic nature of their diet means

that foxes will also eat wild fruit, which can result in the dispersal of weeds such as Bitou Bush (Meek 1998).

Several species relevant to the Planning Area have been identified by a range of sources as being under threat from foxes, including Albert's Lyrebird, Black-breasted Button-quail, Eastern Bristlebird, Brush-tailed Rock-wallaby, Hastings River Mouse, Long-nosed Potoroo *Potorus tridactylus tridactylus*, Parma Wallaby, Red-legged Pademelon and Spotted-tailed Quoll (NSW Scientific Committee 1998; NPWS 2001b; DECC 2007a; DEWHA 2008c). Many other fauna species of the Planning Area, including ground-nesting birds, mid-sized mammals, reptiles and invertebrates are also negatively affected by fox predation.

### ACTIONS: Planning Area

7.5.7. Implement regional pest strategies where relevant.

7.5.8. Undertake coordinated and cooperative European Red Fox control for species and sites considered locally significant in the Planning Area.

### ACTIONS: Species-specific

7.5.9. Encourage coordinated European Red Fox control in the vicinity of Blackwall Range and Uralba Nature Reserves to reduce impacts on Albert's Lyrebird.

### Plague Minnow or Mosquito Fish

The Plague Minnow is a small freshwater fish introduced into Australia in the 1920s. The species is an aggressive predator and research has shown it can have serious impacts on native fish, invertebrates and frogs (NPWS 2003a). In NSW, the threat abatement plan for the Plague Minnow ranks frog species based on susceptibility to population-level impacts. Those species considered a priority are, in descending order of ranking, Cascade Tree Frog, Giant Barred Frog and Black-soled Frog.

Plague Minnow may also influence the distribution and abundance of particular native fish in areas where they co-occur due to either predation or competition (Arthington & Lloyd 1989). No systematic ranking of the susceptibility of native fin fish to the Plague Minnow has been undertaken, although the NSW Fisheries Scientific Committee reported that the decline in Purple Spotted Gudgeon *Mogurnda adspersa* (including the population of coastal northern NSW) may include predation by introduced fish such as Plague Minnow (Fisheries Scientific Committee 2008). The Plague Minnow is also a possible cause of decline in the endangered population of the Olive Perchlet *Ambassis agassizii* in western NSW (Fisheries Scientific Committee n.d.).

### ACTIONS: Lowland and midland landscapes

7.5.10. Identify whether the rainforest and related vegetation of the Planning Area contains sites requiring control of Plague Minnow (e.g. important frog breeding sites or populations of susceptible fish species).

7.5.11. Undertake targeted control of Plague Minnow at key sites where control is assessed to be feasible.

7.5.12. Participate in broader river health programs which will benefit from the management of Plague Minnow.

### Wild Dogs (*Canis lupus familiaris* and *C. l. dingo* and hybrids)

Wild Dogs occur throughout the NSW component of the Planning Area (Casino Rural Lands Protection Board (RLPB) 2006; Northern New England RLPB 2006; Tweed–Lismore RLPB 2006; DECC 2007a, 2007d) and are present in all areas of Queensland (Department of Natural Resources and Mines 2002).

Wild Dogs impact on biodiversity through predation of native wildlife, including small to medium sized mammals and birds. They also act as a vector for disease and hybridise with Dingoes (DECC 2007a; NSW Scientific Committee 2009). The NSW Scientific has recently listed 'predation and hybridisation by Feral Dogs (*Canis lupus familiaris*)' as a key threatening process under the NSW TSC Act (NSW Scientific Committee 2009).

**ACTIONS: Planning Area**

7.5.13. In NSW, implement wild Dog management plans and regional pest plans.

7.5.14. Assess the impact of wild Dogs on priority species and undertake strategic ground-based control where required.

**Feral cattle and feral Goats**

Feral cattle are present in low numbers in some parts of the Planning Area. Their impacts are similar to domesticated livestock and some of the actions proposed in that section will reduce impacts. Feral Goats also have a limited distribution, although they have the potential to occupy a more extensive area.

**ACTIONS: Planning Area**

7.5.15. Identify sites requiring control of feral cattle and feral Goats based on their impacts on the biodiversity of the Planning Area, including riparian areas.

7.5.16. Encourage cross-tenure and collaborative control programs where warranted.

7.5.17. Erect and maintain fencing of rainforest and related vegetation or conservation reserve boundaries to prevent access by feral cattle and Goats.

**European Rabbit and Brown Hare *Lepus capensis***

Although Rabbits and Hares occur in the Planning Area, direct impacts are likely to be low. However, secondary effects may occur as a result of control programs or from the role Rabbits can have in maintaining feral predators such as European Red Fox. A Rabbit control fence runs through rainforest areas in the western section of the Planning Area and maintenance of this fence must consider impacts on rainforest communities.

**ACTIONS: Planning Area**

7.5.18. Implement monitoring and control in accordance with pest management strategies.

**ACTIONS: Midland and upland landscapes**

7.5.19. Develop and implement a Rabbit control program to target Rabbit and Hare populations in proximity to rainforest in the western part of the Planning Area.

7.5.20. Consult with the Darling Downs – Moreton Rabbit Board along the Queensland–NSW border in the western section of the Planning Area to encourage maintenance practices that minimise damage to rainforest and related vegetation.

## Bell Miner associated dieback – medium priority

Bell Miner associated dieback continues to be a major cause of eucalypt vegetation decline. In the Planning Area, it directly affects wet sclerophyll communities adjacent to rainforest and therefore also affects the rainforest communities. The factors implicated in the spread of this particular form of dieback include tree stress, psyllid infestation, weed invasion, drought, logging, road construction, pasture improvement, biodiversity loss, soil nutrient changes, and changing fire and grazing

regimes. Although most of these factors have been identified as threats in their own right, Bell Miner associated dieback is identified as a particular threat category due to the complicated interrelation of these factors that see a normally minor, positive interaction between sap-feeding psyllids and the native Bell Miner become a major cause of wet sclerophyll forest decline in otherwise relatively intact sections of the Planning Area.

Bell Miner associated dieback affects both wet sclerophyll and dry sclerophyll forest communities. The forests most susceptible to dieback are those dominated by Dunn's White Gum *Eucalyptus dunnii*, Sydney Blue Gum *E. saligna*, Flooded Gum *E. grandis*, Grey Ironbark *E. siderophloia* and *E. paniculata*, Narrow Leaved White Mahogany *E. acmenoides* and Grey Gum *E. punctata*. Dieback-affected areas are located in the catchments of the major rivers of north-east NSW including the Tweed, Richmond and Clarence Rivers. Dieback is also known to occur in Queensland in the western McPherson Range and along the Main Range, around Cunninghams Gap, Goomburra and Emu Creek.

Impacts of dieback on forest productivity can be severe. Dieback defoliates the crown, ultimately leading to the death of standing trees. As trees decline, flowering and subsequent fruiting reduce and eventually eliminate seed production necessary for forest regeneration. Dense understorey development (primarily Lantana) continues with little overstorey and reduced alternative species competition. Reduced eucalypt flowering directly impacts on honey production and on bird species and populations that share habitat with Bell Miners. Impacts of dieback on private lands are significant, as these areas are critical to the livelihoods and well-being of local communities. Forest woodlots and timber supplies, honey production, shelter belts and forest-related lifestyles are under threat from dieback.

Widespread degradation of forest ecosystems due to Bell Miner associated dieback has already occurred in World Heritage Areas such as Border Ranges National Park; Murray Scrub and Dome Mountain in Toonumbar National Park; Bungdoozle and Cambridge Plateau in Richmond Range National Park; and Mt Nothofagus, Koreelah, and Mt Clunie National Parks. There is also localised degradation in Main Range National Park.

## OBJECTIVE 8: To minimise the effects of Bell Miner associated dieback on rainforest and associated wet sclerophyll forest

### OUTCOME 8.1: Management of Bell Miner associated dieback undertaken across the Planning Area

#### ACTIONS: Planning Area

8.1.1. Support implementation of the NSW 'Bell Miner Associated Dieback Strategy' (Bell Miner Associated Dieback Working Group 2004).

8.1.2. Implement Lantana removal trials within areas adjacent to rainforest that are affected by dieback.

8.1.3. Continue to trial integration of fire and Lantana weed control in dieback-infected sites using hot fires to kill Lantana, whilst protecting rainforest edges.

8.1.4. Develop guidelines for restoration of severe dieback-affected sites which may be implemented by land-holders and government agencies.

8.1.5. Continue mapping, surveying and assessing the extent of dieback within north-east NSW and south-east Queensland.

8.1.6. Implement an 'alert system' so that new outbreaks are reported to the Bell Miner Associated Dieback Working Group.

8.1.7. Undertake targeted surveys and monitoring of Bell Miners, rapid census of native bird species, and assessment of vegetation condition at priority locations.

**ACTIONS: Site-specific**

8.1.8. Focus control and management on priority locations where degradation is not yet extreme and opportunities exist for recovery of vegetation. Priority locations identified within the Planning Area include:

- Murray Scrub
- Ironpot Creek National Park camping area
- Somerville property (private land)
- Peacock Creek National Park camping area
- Sheepstation Creek National Park camping area
- Donaldson and Mt Lindesay State Forests.

8.1.9. Select priority sites for restoration projects subject to advice from the Bell Miner Associated Dieback Working Group.

## Grazing and trampling by livestock – medium priority

### OBJECTIVE 9: To protect rainforest and related vegetation from grazing and trampling by livestock

Grazing and trampling by livestock is a particular form of habitat loss or modification that overlaps with individual threats in other threat categories but is related to a particular landuse. Threat activities that fall within this category include grazing, trampling, disturbance, erosion of riparian edges, reduction of water quality, and stream-bed disturbance. Management associated with livestock grazing can also exacerbate other threats through native vegetation clearing, pasture burning regimes and weed dispersal.

Along with the direct effects of grazing and trampling of rainforest and related vegetation, appropriate management of livestock in adjacent vegetation can be important in maintaining a buffer against other threats. Livestock management can influence fuel loads as well as accessibility for weed and pest species.

#### OUTCOME 9.1: Rainforest, related vegetation and associated watercourses protected from livestock

**ACTIONS: Planning Area**

9.1.1. Encourage fencing of riparian zones and use of off-stream watering points.

9.1.2. Establish or renew boundary fencing in key Queensland protected areas.

9.1.3. In NSW, ensure that no areas of rainforest or related vegetation are included within a grazing lease area or, alternatively, fence these areas to protect from livestock.

9.1.4. Encourage landowners to implement best practice grazing management on wet sclerophyll forests and other habitats adjacent to rainforest. Maintain the buffering capacity of these forests by reducing fuel loads and access for weeds and pests.

9.1.5. Encourage land-holders to prepare property management plans and seek incentives from regional natural resource management groups and other sources (see Appendix 13 on the enclosed CD) to protect rainforest and related vegetation from the impacts of livestock.

9.1.6. Develop awareness in the rural community of the potential biodiversity impacts from the grazing of livestock in rainforest and related vegetation.

**ACTIONS: Flora Group 3 species in all landscapes**

9.1.7. Protect rainforest and related vegetation supporting Flora Group 3 species from grazing and trampling by removing livestock, erecting fencing and implementing weed control.

**ACTIONS: Species- and site-specific**

In Queensland, sections of Main Range National Park are unfenced and there are serious impacts on riparian systems (threatened frog habitat) and grassy open forests and woodlands (Hastings River Mouse habitat and potential Eastern Bristlebird habitat). At Gambubal, domestic cattle from an adjoining property are traversing rainforest to graze in the grassy New England Blackbutt forest where a significant population of Hastings River Mouse occurs.

9.1.8. In Queensland, protect Hastings River Mouse and Eastern Bristlebird habitat by fencing along priority sections of Gambubal and Main Range National Parks.

9.1.9. Protect Fleay's Barred Frog breeding sites in protected area estate through removal of cattle and establishment or maintenance of fences. In south-east Queensland, sites with a current or past history of damage from grazing are: Blackfellows Creek, Dalrymple Creek, Steamers Creek and Paddys Knob, Main Range; and Stockyard Creek, Lamington National Park.

## Human interference – medium priority

This category includes direct threats to rainforest and related vegetation as well as secondary threats that occur as a result of negative impacts of other landuses or management activities. Particular threats that fall within this category include:

- road and traffic impacts (road kills or injuries)
- uncontrolled domestic pet-killings or harassment
- culling, hunting, persecution, fishing, collection, electrocution and interference
- unmanaged tourism and recreation activities, for example, bushwalking, 4WDs, trail bikes, rock-climbing and other visitor-based activities
- impacts from pollution and chemicals (see Table 15), including sunscreens, insect repellents and secondary effects of rehabilitation programs and weed control programs.

**Table 15 Pollution types and examples**

| Pollution type | Examples |
|---|---|
| Poisons | Chemicals, solvents, detergents, pesticides*, herbicides, fungicides, heavy metals, petro-chemicals, oils etc. Includes sunscreens, insect repellents and secondary effects such as spray drift and run-off, leaching, spillages, waste disposal. |
| Nutrients | Fertilisers, sewage (on site systems, treatment plants, animals), intensive animal husbandry, soil erosion, discharge/release of poor quality water (including untreated stormwater, water with low oxygen and acid sulphates). |
| Sedimentation | Soil erosion, gravel roads, development construction activities, poor agricultural practice (e.g. overgrazing, clearing steep ground, excessive soil exposure etc.), inappropriate fire, dust (unsealed roads, quarries, concrete batching plants, land fill). |
| Other pollution | Litter, building and garden waste, discarded fishing tackle, cigarette butts, emissions (methane, carbon dioxide, hydrocarbons), noise, light. |

*In NSW, the definition of a pesticide under the *Pesticides Act 1999* includes herbicides, insecticides, fungicides and rodenticides. Under this Act it is an offence to use a pesticide in a way that causes harm to a non-target plant or animal. There are exceptions to this, although these exceptions do not apply to the wilful or negligent misuse that significantly harms a threatened or protected animal.

In Queensland, the definition of a pesticide under the *Pest Management Act 2001* is a chemical or biological entity that is ordinarily used to:

(a) kill, stupefy or repel a pest; or
(b) inhibit the feeding of a pest; or
(c) modify the physiology of a pest to alter its natural development or reproductive capacity.

# OBJECTIVE 10: To minimise the impacts of human interference

## OUTCOME 10.1: Impacts of road, track and utility corridor construction and maintenance reduced

### ACTIONS: Planning Area

10.1.1. To reduce access for pest animals and weeds, discourage the construction of new roads and tracks in priority areas.

10.1.2. Provide local governments, relevant state agencies and utility providers with roadside and corridor records for priority flora and fauna species (see Appendix 2).

10.1.3. Implement a standardised roadside marking system for threatened flora, fauna, threatened ecological communities and their habitats. Several versions of this type of marking system already exist, but a standardised system throughout the Planning Area is encouraged.

10.1.4. Review roadside maintenance practices and, if necessary, modify the practices to ensure protection of species and their habitat.

10.1.5. Consider whether the Wet Tropics WHA road maintenance code of practice (Department of Main Roads 2002) can be adapted for the Gondwana Rainforests of Australia WHA.

- In regard to infrastructure construction and maintenance, support in situ conservation of flora and promote translocation and ex situ conservation as a last option.

10.1.6. Adopt best practice methods to control sedimentation and erosion resulting from construction and maintenance activities.

## OUTCOME 10.2: Impacts of tourism reduced

There are a number of indirect impacts caused by tourism (Buckley & Pannell 1990; Buckley 2001). Changes in physical characteristics as a result of the provision of infrastructure for tourism, such as compaction of soil, changes in drainage patterns, and nutrient amplification associated with run-off from landscaping, can alter ecosystem function in a way that may disadvantage native plant species already under threat. Biotic changes such as the flow-on effects of the introduction of feral animals, weeds and pathogens into ecosystems as a result of tourism activities and infrastructure can also adversely affect vulnerable taxa (Buckley & Pannell 1990; Buckley 2001).

### ACTIONS: Planning Area

10.2.1. Prevent commercial tourism activities being conducted along existing roads or tracks that coincide with the habitat of sensitive or collectable species.

10.2.2. Ensure visitor management plans, tourism development plans and impact assessments consider potential impacts on rainforest and related vegetation.

10.2.3. Investigate the potential impacts that tourism and recreation can have on priority species, particularly less-obvious indirect impacts.

10.2.4. Use education and interpretation in conservation reserves to discourage visitor-based impacts such as trampling and chemical use near waterways.

10.2.5. Encourage visitors to conservation reserves to stay on marked trails and implement hygiene protocols.

**ACTIONS: Flora Groups 2 and 3 species in the upland landscape**

Flora Group 2 and Flora Group 3 species (see Appendix 2 or Appendix 7) within the upland landscape contain cliff top and rocky outcrop specialist species at risk from tourism-based activities associated with walking tracks and lookouts.

10.2.6. Review track and tourism infrastructure development in conservation reserves to protect Flora Group 2 and Flora Group 3 species. Ensure these species are protected during the maintenance of existing infrastructure.

**ACTIONS: Species- and site-specific**

10.2.7. In areas where *Isoglossa eranthemoides* occurs, do not construct walking tracks within 50 m of the species.

10.2.8. Determine the impacts of human visitation and existing walking tracks on *I. eranthemoides* and minimise these impacts.

10.2.9. If required, re-route walking tracks away from collectable priority flora species such as orchids and bush food species.

10.2.10. Provide firewood in areas where high visitor recreational use overlaps with Three-toed Snake-tooth Skink habitat. Alternatively, consider a policy of gas or fuel stove use in these areas.

10.2.11. Assess and implement options for minimising the impacts of human visitation on aquatic and adjacent habitats which support priority crayfish: *Euastacus dalagarbe* and *E. jagabar* in Border Ranges National Park; *E. girurmulayn* in Nightcap National Park and Whian Whian State Conservation Area; *E. guruhgi* at Wollumbin National Park; and *E. mirangudgir* at Toonumbar National Park.

10.2.12. Discourage the feeding of native wildlife at recreational areas through regulation and education, including the provision of information on secondary effects of feeding wildlife (e.g. the attraction of native birds that predate on other birds' nests).

10.2.13. In conservation reserves in NSW, assess the effects of tourism on the critical seasonal resources of rainforest fauna and consider directing visitors away from these resources at particular times of year. Priorities include:

- Flying-fox maternity camps; in particular the period from when females are heavily pregnant to when young can fly independently, and periods of extreme heat or cold.
- Fruiting individuals of fleshy-fruited trees in high visitation areas.

## OUTCOME 10.3: Impacts of collection, fishing and other forms of harvesting reduced

**ACTIONS: Planning Area**

10.3.1. In NSW, ensure sustainable collection of wild fruit and other propagation material from priority flora species by continuing to implement the current licensing program for collection control.

10.3.2. Manage records of collectible and harvestable species to maintain site confidentiality. In NSW, threatened species under threat from collection are included on the *Threatened Species Information Disclosure Policy* (DEC 2004b) under a category appropriate to the risk from collection. In particular, Flora Group 3 (see Appendix 2 or Appendix 7) contains a number of ferns, orchids and epiphytes that are potentially susceptible to illegal

collection. NSW and Queensland agencies should consider extending confidentiality to collectible and harvestable aquatic species.

10.3.3. Continue to regulate hunting, fishing and collecting in rainforest and related vegetation.

10.3.4. Develop targeted education and awareness programs that highlight the threats to native flora from illegal collecting, and the importance of purchasing plants from licensed nurseries.

## OUTCOME 10.4: Impacts of chemicals and other forms of pollution reduced

### ACTIONS: Planning Area

10.4.1. Adopt best practice methods to control sedimentation, ash run-off and erosion resulting from fire hazard reduction operations.

10.4.2. Prevent access to sites supporting priority populations of threatened stream-breeding frogs and *Euastacus* spp. during the breeding season when species are most vulnerable to trampling and chemical use.

10.4.3. Discourage the use of surfactants in chemical weed control operations near waterbodies.

10.4.4. Encourage responsible use of herbicide in weed control operations and promote control techniques appropriate to the sensitivity of the area.

10.4.5. Support research into the effects of repeated use of fire retardants and surfactants on rainforest and wet sclerophyll forests (including waterways), particularly the surfactants considered corrosive.

### ACTIONS: Lowland and midland landscapes

10.4.6. Encourage local governments to establish recycling and wetland management of storm water and sewage.

10.4.7. Establish buffers between rainforest remnants adjoining agricultural or horticultural land to reduce the impact of spray drift.

10.4.8. Encourage best practice rodent management within the macadamia industry to minimise secondary impacts on native species.

### ACTIONS: Species and habitat features

#### Aquatic and semi-aquatic species

10.4.9. Implement relevant actions identified within the *Eastern (Freshwater) Cod* Maccullochella ikei *Recovery Plan* (NSW Fisheries 2004) and actions of the Department of Primary Industries (Fisheries) Priorities Action Statement. These actions need not be specific to the Eastern Freshwater Cod, as a number of actions identified for this species can also be applied to other priority aquatic fauna.

10.4.10. When undertaking fire control activities near or upstream of waterbodies, take a precautionary approach toward the use of surfactants and chemical retardants.

## OUTCOME 10.5: Human-induced mortality of priority fauna reduced

### ACTIONS: Planning Area

10.5.1. Promote public awareness of responsible pet ownership, particularly in urban areas, urban fringes and rural residential areas in the vicinity of rainforest and related vegetation.

10.5.2. Continue public awareness campaigns on the need to de-sex domestic Cats, and to keep Cats contained at night within properties.

10.5.3. Encourage local and state governments to reduce legal speed limits and place signs on roads where priority fauna species are likely or known to cross.

10.5.4. Quantify the entanglement rates of fruit-eating rainforest species under various netting practices (both commercial and backyard) and investigate techniques to reduce entanglements of both target and non-target species, for example, fruit-eating birds, flying-foxes and Eastern Tube-nosed Bat *Nyctimene robinsoni*.

10.5.5. In NSW, ensure Schedule 2 Dingo Management Areas of the NSW *Rural Lands Protection Act 1998* are managed to ensure ecosystem function by protecting Dingo within these areas. Undertake genetic sampling of Dingo within Dingo Management Areas to assess impact of hybridisation.

10.5.6. Consult with Githabul nation representatives regarding conservation and management of Dingo populations within the Githabul Indigenous Land Use Agreement area.

**ACTIONS: Species- and site-specific**

10.5.7. In association with local governments, undertake public awareness programs on responsible pet ownership in areas near Albert's Lyrebird populations at Blackwall Range and Mt Tamborine.

10.5.8. Investigate options to reduce roadkill mortality of Fleay's Barred Frog on Lamington National Park Road between O'Reilly's Guest House and Mount Cainbable. Options include traffic calming devices or installation of frog-friendly fauna crossing points.

10.5.9. Identify areas where the Spotted-tailed Quoll is at high risk of road kill or injury, and implement measures to reduce impacts.

10.5.10. Review, and revise as necessary, material produced by the Quoll Seekers Network in Queensland promoting quoll-proof poultry housing and aviaries. Ensure that the material highlights the positive effect that such housing provides in relation to protection from other predators as well. Produce and widely distribute this material within the Planning Area.

10.5.11. Reduce mortality of fruit-doves and other rainforest birds caused by window strike.

- Within rainforest bird flight-paths, encourage the use of window screening or other devices to reduce the incidence of window strike.
- Provide the general community with information on ways to reduce the incidence of window strike.

10.5.12. Develop and implement a grower-based program to monitor trends in damage to horticultural crops by flying-foxes and use the results to monitor the performance of actions to reduce crop damage.

10.5.13. Assess the impacts on flying-foxes of electrocution on powerlines and entanglement in fences. In high mortality areas, consider the use of powerline spreaders and replacement of the top, barbed wire strand with non-barbed wire.

## OUTCOME 10.6: Adverse effects of other forms of human interference reduced

**ACTIONS: Planning Area**

10.6.1. Continue to undertake public awareness on the negative effects of dumping pets and other introduced animals, particularly Cats, poultry, aquarium fish and turtles.

10.6.2. Implement measures to reduce the effects of rubbish and garden refuse dumping in rainforest remnants.

10.6.3. Discourage the use of some fauna survey techniques at inappropriate times of year (e.g. forms of call playback that may interfere with breeding behaviour).

**ACTIONS: Species- and site-specific**

10.6.4. Restrict access to significant bat roost sites where possible (e.g. by gating cave entrances). Significant sites include maternity, hibernation and transient sites (and may include artificial structures).

10.6.5. Discourage the collection of dead fallen timber in areas where ground-dwelling priority invertebrates and reptiles are known to occur. This can be undertaken through compliance, signs and local community education.

10.6.6. Encourage and undertake works to reduce the effect of aquatic structures on fin fish movement. In NSW, this includes the construction of fishways, removal of redundant weirs and modification of private stream crossings in accordance with NSW Department of Primary Industries (Fisheries) guidelines for fish passage.

10.6.7. Restrict de-snagging practices to ensure that natural accumulation of logs and other large debris maintain healthy aquatic ecosystems. In areas where de-snagging has occurred or natural snag development is slow, investigate the need for creating snag habitat for fin fish.

## Pathogens – low priority

Pathogens and disease are currently impacting upon, or have the potential to impact upon, both flora and fauna within the Planning Area. Fauna diseases include amphibian chytrid fungus *Batrachochytrium dendrobatidis*, toxoplasmosis, hydatid disease, sarcoptic mange and psittacine circoviral (beak and feather) disease. Pathogens and disease of flora identified as a known or potential threat include *Phytophthora cinnamomi* dieback. There have also been instances where unknown pathogens, disease or insect-related dieback have affected rainforest plants within the Planning Area (see NPWS 2003b; DEC 2004c), while coastal dieback or windshear can also be a threat to the coastal areas.

# OBJECTIVE 11: To control and minimise impacts of introduced pathogens and diseases

### OUTCOME 11.1: Hygiene protocols implemented to prevent introduction of diseases and pathogens

**ACTIONS: Planning Area**

11.1.1. Implement existing hygiene protocols for diseases and pathogens including:

- Those addressing particular diseases and pathogens, for example NSW Hygiene Protocol for the Control of Diseases in Frogs (NPWS 2001c); Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia – National Best Practice Guidelines (O'Gara et al. 2005); Queensland Interim Hygiene Protocol for Handling Amphibians (QEPA 2008b).
- Protocols from single-species recovery plans, for example, Minyon Quandong *Elaeocarpus sedentarius* (NPWS 2003b) and Coastal Fontainea *Fontainea oraria* (DEC 2004c).

11.1.2. Prepare a single, overall hygiene protocol that incorporates the hygiene requirements for known pathogen and disease risks to rainforest and related flora and fauna within the Planning Area. This single protocol should incorporate information from existing protocols and hygiene-related information contained in relevant threat abatement plans and recovery plans. Where possible, the protocol should also capitalise on other hygiene-related issues such as weed and pest dispersal. Several 'levels' of protocol compliance might be required, depending on the activity and associated risk.

11.1.3. Conduct training on the implementation of hygiene protocols for land managers and field staff. This should be undertaken in combination with training on the identification of diseases, pathogens and their symptoms.

11.1.4. Promote hygiene protocols designed to prevent the spread of pathogens and disease. Awareness of hygiene protocols is high in certain sections of the community through

hygiene conditions relating to licences. However, a large number of researchers and workers from non-biological backgrounds may not be aware of the risk they pose through the spread of pathogens and disease. The general community should be included in any promotion of protocols.

## OUTCOME 11.2: Pathogen and disease threats planned for and control measures undertaken

### ACTIONS: Planning Area

11.2.1. Incorporate monitoring for *P. cinnamomi* and other fungal pathogens into the Gondwana Rainforests of Australia WHA monitoring strategy.

11.2.2. Coordinate monitoring of fungal pathogens with benchmark surveys already completed at sites across the Gondwana Rainforest estate (e.g. monitoring for the prevalence of chytrid in populations of threatened frogs has been undertaken in sections of Lamington National Park and the Main Range, and *P. cinnamomi* testing has also occurred in the area).

### *Phytophthora cinnamomi*

There is no known mechanism to eradicate *P. cinnamomi* once it has established, so minimising the spread is a key component of its management. Although the pathogen itself is widespread in eastern NSW, disease expression is rare and recognition of vegetation that possibly has the disease itself can be important in minimising its spread. Therefore, a precautionary approach to the pathogen is required, including an assumption that it is absent from a location unless it can be proven to be present (McDougall & Summerell 2003).

### ACTIONS: Planning Area

11.2.3. Adapt and apply the National Risk Assessment Model for *P. cinnamomi* to assess the level of risk that the disease poses to rainforest and related species, populations and communities.

- Test the susceptibility of species, populations and ecological communities (including key habitat for threatened fauna) that are considered at risk.
- Conduct training for public land managers and field staff that covers the identification of diseases, pathogens and their symptoms, particularly in relation to *P. cinnamomi*. This should be undertaken in combination with training on the implementation of hygiene protocols.

11.2.4. In NSW, implement the DECCW *Northern Rivers Region Pest Management Strategy* (DECC 2007a), including preparation of a containment strategy for affected areas to prevent further spread.

11.2.5. If further infection of species or sites within the Planning Area is detected, implement relevant actions for on-ground management contained in the national *Threat Abatement Plan for Dieback Caused by the Root-Rot Fungus* Phytophthora cinnamomi (Environment Australia 2001) and, for NSW, the DECCW *P. cinnamomi* statement of intent (DECC 2008).

### Chytrid fungus resulting in chytridiomycosis

There are a number of wild frog populations in Australia that are known to be infected with chytridiomycosis. Of the priority frog species in the Planning Area, the chytrid fungus is known to occur in populations of Pouched Frog, Black-soled Frog, Cascade Tree Frog, Fleay's Barred Frog and Giant Barred Frog. However, details on the distribution, prevalence and impacts of the disease within the Planning Area are lacking (see Appendix 17 on the enclosed CD). A national threat abatement plan and a NSW statement of intent for infection of frogs by chytrid fungus have been developed, and it is recommended that relevant actions are undertaken.

**ACTIONS: Planning Area**

11.2.6. Implement relevant actions identified in the national *Threat Abatement Plan for Infection of Amphibians with Chytrid Fungus Resulting in Chytridiomycosis* (Department of the Environment and Heritage 2006b) and the NSW *Statement of Intent 2 – Infection of Frogs by Amphibian Chytrid Causing the Disease Chytridiomycosis* (DECCW 2009).

11.2.7. Ensure all permits and licenses issued to researchers working with frogs or routinely coming into contact with waterbodies include conditions that require their compliance with existing NSW and Queensland hygiene protocols.

11.2.8. Increase public education and awareness of the disease in the Planning Area, its impact on frogs and the need to minimise its spread.

11.2.9. Monitor frog populations for mortality events.

11.2.10. Licensed people should be encouraged to collect specimens of ill or dead frogs for pathology investigations.

11.2.11. Support research into the epidemiology of the disease, its impacts on frog populations and the means of managing its impact on wild populations.

### *Phellinus noxius* fungal infection

*Phellinus noxius* is a fungal pathogen that causes root rot in plants. It has been detected in a littoral rainforest remnant at The Pass, Cape Byron State Conservation Area, where it was responsible for the death of a Scented Acronychia *Acronychia littoralis* individual as well as other rainforest species in 2003 (Pegg & Ramsden 2003). *Phellinus noxius* generally spreads through root-to-root contact but can also spread via fallen branches of infected trees. The pathogen is also known to affect Hoop Pine *Araucaria cunninghamii* and several eucalyptus species. It is quite widespread from Cape York to the NSW border and tends to infect plants that have also been subject to some other form of disturbance (B. McDonald pers. comm.).

**ACTIONS: Lowland and midland landscapes**

11.2.12. Implement the appropriate section of the DECCW *Northern Rivers Region Pest Management Strategy* (DECC 2007a).

11.2.13. Implement hygiene protocols for equipment and clothing after accessing infected locations.

11.2.14. Implement hygiene protocols when removing infected plant material.

11.2.15. Develop an awareness program highlighting the potential threat of *P. noxius* to rainforest and related vegetation.

### Psittacine circoviral (beak & feather) disease

Beak and feather disease virus is widespread and present in wild and captive parrot populations, however, most populations thrive despite its presence. The virus is known to be present in common parrot species that occur within the Planning Area, including the Sulphur-crested Cockatoo *Cacatua galerita* and Galah *Cacatua roseicapillus*.

The national *Threat Abatement Plan for Beak and Feather Disease Affecting Endangered Psittacine Species* (Department of the Environment and Heritage 2005b) doesn't identify Coxen's Fig-parrot as a particular taxon under threat from this disease. However, the NSW Scientific Committee determination for the key threatening process states that Coxen's Fig-parrot is considered to have a high potential for being adversely impacted (NSW Scientific Committee 2002). Neither the national nor NSW Coxen's Fig-parrot recovery plan specifically mention the disease, but disease in general is mentioned in these plans when referring to potential captive breeding opportunities (Coxen's Fig-parrot Recovery Team 2001; NPWS 2002b). The *Action Plan for Australian Birds 2000* doesn't mention beak and feather disease in the recovery outline for the taxon (Garnett & Crowley 2000).

**ACTIONS: Planning Area**

11.2.16. Identify whether psittacine circoviral (beak and feather) disease poses a threat to parrot diversity within the Planning Area.

11.2.17. If psittacine circoviral (beak and feather) disease is identified as a threat to parrot diversity, implement relevant actions in the national threat abatement plan (Department of the Environment and Heritage 2005b).

### *Favolaschia calocera* fungus

The introduced wood decaying fungus *Favolaschia calocera* has been recorded in the Queensland part of the Planning Area at Green Mountains, Binna Burra and Springbrook, as well as Main Border Track, Coomera Track and on private land at the Natural Arch. It has also been recorded in the Border Ranges National Park in NSW. It has the potential to spread rapidly through the Planning Area (N. Fechner pers. comm., L. Webber pers.comm.).

**ACTIONS: Midland and upland landscapes**

11.2.18. Investigate the spread of *Favolaschia calocera* and its potential environmental effects on rainforest and related vegetation.

11.2.19. If required, assess feasibility of control options.

## Demographic effects – low priority

Demographic-related threats are those largely associated with population biology and genetics, and how these affect species viability. This includes potential threats such as genetic pollution, loss of genetic variation and inbreeding depression, as well as a range of other effects associated with life history and reduced fitness. These effects can increase the susceptibility of a population or species to the detrimental impacts associated with demographic and environmental stochasticity. In this regard, many of the threats in this category relate to populations and individual species, particularly those that are small or in decline. Climate change is likely to exacerbate this threat, for example, through contraction of rainforest or related vegetation, changes to carbon dioxide levels affecting plant physiology, and disruption between breeding events and food availability.

# OBJECTIVE 12: To maintain the viability and evolutionary potential of rainforest and related populations, species and communities

### OUTCOME 12.1: In situ management of flora and fauna undertaken

**ACTIONS: Planning Area**

12.1.1. Develop buffering strategies for naturally occurring populations of rainforest and related flora that are used for domestic, horticultural or agricultural purposes (e.g. *Macadamia* and *Davidsonia* species) and that have the potential to hybridise with closely related taxa.

12.1.2. Ensure that regeneration and rehabilitation projects incorporate the principles of genetic diversity into their design and implementation. This includes considerations such as the genetic provenance of plant source stock and the appropriateness of natural regenerative processes as opposed to replanting. Threatened flora should not be planted, nor should licences for their propagation be approved, unless part of a recovery program.

12.1.3. Investigate the need for enhancing or supplementing existing populations of flora species within the Planning Area. In the event of enhancement being undertaken, preference

should be given to locations that have already been disturbed or are being revegetated, as opposed to those that have not been disturbed.

**ACTIONS: Species- and site-specific**

**Scented Acronychia**

Due to the relatively recent evolution of Scented Acronychia, it is unknown whether the species is still capable of cross-fertilisation with parent species (White Aspen *A. oblongifolia,* Silver Aspen *A. wilcoxiana* or Logan Apple *A. imperforata*). This could potentially result in introgression where the uniqueness of Scented Acronychia is lost due to genetic 'swamping' by the more common parent taxa. If the balance in numbers between the taxa involved is changed, the effect may be enhanced which could lead to the loss of Scented Acronychia at a site over time. This is more likely to occur in Form 1 of the species, as Form 2 is not known to reproduce sexually. This has implications for revegetation works carried out in Scented Acronychia habitat.

12.1.4. Until there is further clarification of the potential for introgression of the two forms of Scented Acronychia, ensure that White Aspen, Silver Aspen and Logan Apple are not used in replantings or rehabilitation programs in Scented Acronychia habitat.

## OUTCOME 12.2: Ex situ conservation undertaken and need for follow-up translocation programs assessed

**ACTIONS: Planning Area**

12.2.1. Identify flora and fauna that require ex situ conservation or translocation.

- Collate information on the identification and origin of current ex situ collections.
- If a flora species is determined to require some form of translocation, develop proposals in accordance with the Guidelines for the Translocation of Threatened Plants in Australia (Vallee et al. 2004).

12.2.2. In accordance with Action 12.2.1, establish and maintain live ex situ collections of identified flora species with appropriate botanic gardens and/or nurseries. Establishment of ex situ collections in these instances should be based upon collection of propagation material rather than removal of entire plants from the wild.

12.2.3. Develop plant propagule collection programs in collaboration with botanic gardens.

12.2.4. Where plant propagule collection is not possible or practical, collect and store other genetic material.

**ACTIONS: Species-specific**

12.2.5. In NSW, support preparation of a translocation proposal and experimental translocation of Hairy Quandong and Coastal Fontainea.

## OUTCOME 12.3: Existing populations undergoing decline or under threat from stochastic events monitored and potential new populations of species investigated

**ACTIONS: Planning Area**

12.3.1. Undertake a review of existing monitoring programs and identify priority species or populations that require new or ongoing monitoring.

12.3.2. Undertake monitoring of identified priority species or populations from Action 12.3.1.

12.3.3. Consideration should be given to adopting the Victorian framework for establishing indicators, setting targets and monitoring and reporting on outcomes for threatened species and threatened ecological communities (see Duncan & Coates 2006).

12.3.4. Undertake surveys to identify new populations of species that are currently in decline, are at risk from small population effects, or at risk from stochastic events.

- Priorities for integrated flora research are identified in Appendix 8 (on the enclosed CD).
- Priority fauna species should be those that occur in small populations, are dispersal-limited and under most threat from stochastic events or climate change.

### OUTCOME 12.4: Research assisting management of genetic viability undertaken

#### ACTIONS: Planning Area

12.4.1. Prioritise and undertake integrative research based on demographic, genetic and breeding systems information.

- Priorities for integrated flora research are identified in Appendix 8 (on the enclosed CD). Flora Groups 2 and 3 appear to be most lacking in management-related information. Species identified for research from these flora groups include Native Jute, Native Justicia *Harnieria hygrophiloides*, Pretty Eyebright *Euphrasia bella*, Ravine Orchid *Sarcochilus fitzgeraldii*, Hartmann's Sarcochilus *S. hartmannii* and Blotched Sarcochilus.
- Priority fauna species for this research should be those that occur in small populations, are dispersal-limited and are under most threat from stochastic events or climate change.

12.4.2. Consider opportunistic research to inform management when circumstances allow. Examples include investigating Native Jute seed viability using seed buried at Toonumbar State Forest in 2001 or undertaking opportunistic research following a wildfire.

12.4.3. Undertake research into propagation techniques of flora species that are priorities for ex situ conservation or are potential candidates for translocation programs in the future.

## Community engagement

## OBJECTIVE 13: To recognise the cultural value of rainforest and related vegetation to the Indigenous community and engage the Indigenous community in the protection and enhancement of rainforest and associated biodiversity and cultural values

### OUTCOME 13.1: Development and implementation of Indigenous Engagement Toolkit continued (see Section 1)

#### ACTIONS: Planning Area

13.1.1. Provide support to Indigenous communities to undertake biodiversity and cultural property management planning on community-owned properties.

13.1.2. Provide support to Indigenous communities to undertake training and implement fire management for biodiversity through the Nature Conservation Council's Hotspots Fire Program and Southeast Queensland Fire and Biodiversity Consortium fire for biodiversity programs.

13.1.3. Seek funding to support training and employment for Indigenous community members in biodiversity management and in the preparation and implementation of the plans from Actions 13.1.1 and 13.1.2.

13.1.4. Seek partnerships between Indigenous communities and groups and government agencies, organisations and research bodies in integrated threat management programs. Where possible, build on existing programs or networks, for example, Indigenous Green Teams.

13.1.5. Encourage Indigenous communities to collect historical and ethno-ecological knowledge through oral history and written interviews with community knowledge-holders and Elders, and integrate this information into biodiversity management plans (where culturally appropriate).

13.1.6. Use spatial mapping systems to map biodiversity and cultural landscapes (where culturally appropriate).

13.1.7. Develop and disseminate culturally appropriate educational material for schools and communities.

### OUTCOME 13.2: Implementation of Indigenous land use agreements and Indigenous protected areas supported

#### ACTIONS: Planning Area

13.2.1. Support the implementation of Indigenous land use agreements and Indigenous protected areas through information provided in this Plan and implementation of the Indigenous Engagement Toolkit.

## OBJECTIVE 14: To engage the community and private land-holders in biodiversity conservation

### OUTCOME 14.1: Broader community actively engaged in biodiversity conservation

#### ACTIONS: Planning Area

14.1.1. Provide assistance to land-holders in property management planning, including information and advice on the role of fire in biodiversity management.

- Promote the inclusion of biodiversity conservation in property management planning. See *Planning for Biodiversity Management – Including Biodiversity in Property Management Plans* (NPWS 2002c).
- Promote community training programs such as Southeast Queensland Fire and Biodiversity Consortium and Nature Conservation Council's Hotspots fire projects.

14.1.2. Support extension officers in the implementation of education programs and provision of on-ground advice.

14.1.3. Seek partnerships between government agencies, organisations, research bodies and private land-holders in integrated threat management programs (e.g. rainforest fire risk, weeds). Where possible, build on existing programs or networks.

14.1.4. Use existing incentive schemes to assist land-holders undertake threatened species surveys (see Appendix 13 on the enclosed CD).

14.1.5. Support regional natural resource management bodies and local governments in the delivery of biodiversity extension services, including but not be limited to:

- property-based biodiversity assessments
- advice on threatened species management and provision of background information
- advice on weed management, bush regeneration, revegetation and animal pest control
- property planning advice

- provision of available data and assistance in the preparation of property management plans
- advice on forms of assistance available to landowners to manage biodiversity values (see Appendix 13 on the enclosed CD)
- vegetation and other constraint mapping.

14.1.6. Support local governments' employment of biodiversity education officers to deliver education programs, including but not limited to:

- provision of information to the community on the benefits of conserving biodiversity and how groups and individuals can conserve, survey, monitor and sustainably utilise biodiversity in their own area
- development of educational materials on best practice guidelines for weed identification, management and control of fire, establishing farm forestry plantations, environmental restoration and threatened species.

14.1.7. Offer training workshops on bush regeneration and biodiversity management to encourage greater community involvement in restoration actions on private and public land.

14.1.8. Develop education and training programs with a focus toward developing community partnerships.

14.1.9. Maintain an up-to-date and accessible list of potential funding sources to support community groups in conservation projects (see Appendix 13 on the enclosed CD).

14.1.10. Encourage community groups to consider projects that address multiple species or have connections with other natural resource issues.

## Information collation, monitoring and evaluation

The delivery of long-term rainforest and related biodiversity conservation outcomes is reliant upon improving the knowledge and understanding of rainforest biodiversity-related issues. Effective monitoring and review is required to ensure that changes in data and knowledge are captured. Research needs to be prioritised to fill data and knowledge gaps.

Various spatial analysis tools such as the Biodiversity Forecasting Tool have ongoing value to the Plan as a monitoring and reporting tool. Throughout the life of the Plan, spatial information used in the original prioritisation process can be updated and reanalysed by the Tool to reassess the effectiveness of on-ground delivery and prioritisation of areas (provided that on-ground programs are recorded spatially by implementers). These layers can be linked to a data spreadsheet so that the Tool's spatial outputs and the associated spreadsheet can be used for monitoring, reporting and evaluation. The Tool has an additional function that could be trialled which allows for different management scenarios to be costed and analysed to provide a cost-benefit analysis for the best biodiversity outcome for a given funding allocation.

As part of implementation of the Plan, partners will be encouraged to use standard reporting proformas for on-ground projects and spatial mapping of projects. Mechanisms for sharing information on funding, implementation and outcomes of projects are required. In NSW, the Threatened Species Priorities Action Statement could be used for centralised reporting. The *South East Queensland Natural Resource Management Plan 2009–2031* (DERM 2009) identifies measurable regional targets for the condition and extent of environment and natural resources for south-east Queensland (see Appendix 1). Some of the targets are supported by maps, and linking these to spatial data of this Plan will be important in achieving some outcomes in the Plan.

Performance criteria for actions in this Plan are identified in Section 4.6.

# OBJECTIVE 15: To establish effective monitoring of biodiversity-related projects

## OUTCOME 15.1: Monitoring and evaluation programs for all biodiversity projects established and undertaken as part of the implementation of this Plan

### ACTIONS: Planning Area

15.1.1. All on-ground projects implemented as part of this Plan should be mapped in a format compatible with geographic information system analysis. This will allow for updating and re-evaluating Plan priorities through the Biodiversity Forecasting Tool and also for providing feedback to partners and stakeholders.

15.1.2. Outcomes and successes achieved through actions implemented as part of the Plan should be reported to the relevant management body coordinating the action, and be provided to a central location so that adaptive management can be used to improve the success of Plan implementation. The outcomes should also be provided to broader management initiatives such as the NSW Priorities Action Statement, Property Vegetation Plan Developer and BioBanking. Reporting can potentially be part of existing arrangements (e.g. State of the Environment reporting, regional natural resource management reporting).

15.1.3. Compare the alignment of the spatial outputs of this Plan with mapped targets of the *South East Queensland Natural Resource Management Plan 2009–2031* (DERM 2009).

15.1.4. Encourage and provide training on survey and monitoring techniques to regional natural resource management staff and local government staff, community groups, land-holders and schools.

15.1.5. Develop and assess cultural indicators as part of monitoring the implementation of this Plan.

15.1.6. When developing monitoring and evaluation requirements for the Plan, consider existing processes such as Natural Resource Council targets; regional natural resource management reporting requirements; and local, state and Australian government agency reporting requirements.

## 4.6 Performance criteria for recovery actions

### *Better coordination of recovery efforts across states and agencies*

| Objectives / Outcomes | Performance criteria | Potential contributors |
|---|---|---|
| 1<br>2.4<br>5.1, 5.2<br>6.2<br>7.1, 7.2, 7.5<br>13.2 | 1. Cross-agency working group established within one year.<br>2. Formal communication links and information sharing processes established within two years.<br>3. Licensing and approval processes for ecological restoration and environmental burns streamlined within five years.<br>4. Resolution, accuracy and consistency of vegetation mapping improved within the life of the Plan.<br>5. Partnerships between government agencies, organisations, research bodies and private land-holders sought throughout the life of the Plan.<br>6. An integrated spatial pest and weed database developed for the Planning Area within five years of Plan commencement.<br>7. A Northern Rivers Fire and Biodiversity Consortium established within two years. | DECCW<br>Dept Environment, Water, Heritage and the Arts<br>NSW Dept Primary Industries (fisheries, forestry, agriculture)<br>DERM<br>Local governments<br>NSW & Qld Rural Fire Services<br>Qld Dept of Employment, Economic Development and Innovation |

### *Better engagement with stakeholders*

| Objectives / Outcomes | Performance criteria | Potential contributors |
|---|---|---|
| 2.1, 2.3<br>3<br>4<br>5.9<br>6.3<br>8<br>9<br>10<br>11<br>13<br>14 | 1. The number of Indigenous groups implementing the Indigenous Engagement Toolkit increases throughout the life of the Plan.<br>2. The number of Indigenous groups engaged in Indigenous land use agreements and Indigenous protected areas increases throughout the life of the Plan.<br>3. The number of Indigenous people engaged in training and employment in biodiversity and cultural management increases throughout the life of the Plan.<br>4. The number of land-holders engaged in private land conservation initiatives increases throughout the life of the Plan.<br>5. Education programs and provision of on-ground advice supported throughout the life of the Plan.<br>6. The uptake of private land conservation mechanisms and incentives increased throughout the life of the Plan.<br>7. Extent of private land conservation expansion mapped and used to reassess priorities after five years from the commencement of the Plan. | Community conservation groups<br>Dept of Aboriginal Affairs<br>DECCW<br>Dept Environment, Water, Heritage and the Arts<br>Educational institutions<br>Employment networks<br>Envite<br>DERM<br>ICC Indigenous centre for cooperation<br>Indigenous groups<br>Landcare, Bushcare, community groups<br>Land-holders<br>Local governments<br>Nature Conservation Councils Hotspots<br>Northern Rivers CMA<br>SEQC<br>Southeast Queensland Fire and Biodiversity Consortium<br>Special interest groups<br>Threatened Species Network<br>WetlandCare Australia |

## *Better delivery of conservation outcomes and actions*

| Objectives / Outcomes | Performance criteria | Potential contributors |
|---|---|---|
| 2.1, 2.2, 2.4<br>3<br>4<br>5.1, 5.3–5.8<br>6.1, 6.4–6.6<br>7<br>8<br>9<br>10<br>11<br>12<br>15 | 1. Conservation and rehabilitation programs within identified priority areas undertaken throughout the life of the Plan.<br>2. Sites to improve flora and fauna connectivity within climate change linkages/corridors identified and management actions implemented throughout the life of the Plan.<br>3. Climate change adaptive management projects developed and undertaken throughout the life of the Plan.<br>4. Monitoring programs for impacts on rainforest and related biodiversity established within five years.<br>5. Research programs to inform management of rainforest and related fauna and flora commenced within five years.<br>6. Government agencies utilise statutory instruments and this Plan to protect extant rainforest and related vegetation throughout the life of the Plan.<br>7. Strategies, plans and market-based schemes include priority areas, landscapes and features throughout the life of the Plan.<br>8. No new weeds, pests or diseases established in the Planning Area during the life of the Plan. | Community conservation groups<br>Dept of Aboriginal Affairs<br>DECCW<br>Dept Environment, Water, Heritage and the Arts<br>Educational institutions<br>Employment networks<br>Envite<br>DERM<br>ICC Indigenous centre for cooperation<br>Indigenous groups<br>Landcare, Bushcare, community groups<br>Land-holders<br>Local governments<br>Nature Conservation Councils Hotspots<br>Northern Rivers CMA<br>SEQC<br>Southeast Queensland Fire and Biodiversity Consortium<br>Special interest groups<br>Threatened Species Network<br>WetlandCare Australia |

# 5 Mechanisms and Incentives to Implement the Plan

There is a broad range of instruments and mechanisms used to ameliorate threats to biodiversity in Australia. Instruments and mechanisms refer to something introduced by any level of government that has either a positive or negative influence on the way people behave. These have been detailed in Young et al. (1996) and include the following:

- financial instruments
- covenants and management agreements
- voluntary instruments
- motivational and educational instruments
- institutional arrangements (i.e. various strategies and programs at national, state, local levels)
- regulatory instruments (i.e. state and Commonwealth legislation aimed at protecting native vegetation and biodiversity).

No single mechanism can provide appropriate protection for biodiversity; a mix of policies, strategies and incentives is needed (Young et al. 1996). The mechanisms and incentives currently known to be available to assist in the implementation of this Plan are discussed in detail in Appendix 13 (on the enclosed CD).

# 6 Social and Economic Consequences

Preparing a regional recovery plan that takes into account 217 listed threatened entities is an efficient use of resources in terms of plan preparation, and provides for an efficient and effective implementation of recovery actions. This Plan meets the partial or full recovery plan requirements for 58 animals, 134 plants and 25 ecological communities associated with rainforest and related vegetation that are listed as threatened at either a national or state level. Potential future listings on threatened species schedules could be included through the addition of an addendum to the Plan with a minimal amount of additional work needed to meet the recovery plan requirements of these species.

The Plan benefits rainforest and related vegetation and priority species in addition to listed threatened entities within the Border Ranges Hotspot. Actions from this Plan may be applicable to biodiversity outside the area covered by the Plan and may assist in recovery programs elsewhere. The approach taken in the preparation of this Plan was adapted from the *Lord Howe Island Biodiversity Management Plan* (DECC 2007f). The process used in this Plan has been further adapted for the preparation of the *Draft Central Coast Pilot Biodiversity Management Plan* (DECC 2009b) and the *Draft Northern Rivers Regional Biodiversity Management Plan* (DECC 2009a). Being able to build on the work and learning from each of these previous plans has promoted cost-effective and efficient preparation of plans.

It is intended that the Plan be implemented over a ten-year period and will be reviewed after five years. Implementation of priority actions will be guided by a business plan over the life of the Plan. It is not practicable to provide meaningful costing figures against particular years within this Plan given the cross-regional nature of the Plan, the Plan's wide scope and number of actions, the ten-year time frame, and the fact that funding of actions will be subject to successful funding applications. A business plan will be developed once the Plan is approved.

The Plan is focused on promoting partnerships and voluntary participation in biodiversity management and is not prescriptive. It is therefore anticipated that there will be no significant adverse social or economic costs associated with the implementation of the Plan and that the overall benefits of implementation will outweigh any specific costs to society.

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# 8 Acronyms

| | |
|---|---|
| CD | Compact disk |
| CMA | Catchment management authority |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DECC | Department of Environment and Climate Change NSW |
| DECCW | Department of Environment, Climate Change and Water NSW |
| DERM | Queensland Department of Environment and Resource Management |
| DEWHA | Department of the Environment, Water, Heritage and the Arts (Australian Government) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) |
| NSW | New South Wales |
| NSW TSC Act | *Threatened Species Conservation Act 1995* (New South Wales) |
| QEPA | Queensland Environmental Protection Agency |
| RLPB | Rural land protection board |
| SEQC | South East Queensland Catchments Ltd |
| WHA | World Heritage Area |

# Appendix 2: Priority species and ecological communities addressed by the Plan

The tables below list the priority species and ecological communities addressed by this Plan. The status of each threatened species and ecological community relates to its listing under one or more of the following pieces of legislation:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- New South Wales *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1994*
- Queensland *Nature Conservation Act 1992*, *Vegetation Management Act 1999* or *Fisheries Act 1994*.

Abbreviations used to define status are as follows:

- CE = Critically endangered
- E = Endangered
- R = Rare
- V = Vulnerable
- P = Protected (under Queensland *Fisheries Management Act 1999* only)

## Priority fauna

| Scientific name | Common name | Status | | | Group or life form |
|---|---|---|---|---|---|
| | | Aust | NSW | QLD | |
| *Accipiter novaehollandiae* | Grey Goshawk | | | R | Bird |
| *Ailuroedus crassirostris* | Green Catbird | | | | Bird |
| *Ambassis agassizii* | Olive Perchlet | | | | Fin fish |
| *Anguilla reinhardtii* | Long-finned Eel | | | | Fin fish |
| *Antechinus subtropicus* | Subtropical Antechinus | | | | Mammal |
| *Antechinus swainsonii* | Dusky Antechinus | | | | Mammal |
| *Assa darlingtoni* | Pouched Frog / Australian Marsupial Frog | | V | R | Amphibian |
| *Atrichornis rufescens* | Rufous Scrub-bird | | V | V | Bird |
| *Cacophis krefftii* | Dwarf Crowned Snake | | | | Reptile |
| *Cercartetus nanus* | Eastern Pygmy-possum | | V | | Mammal |
| *Chalinolobus dwyeri* | Large-eared Pied Bat | V | V | R | Mammal |
| *Cherax leckii** | Leckie's Crayfish | | | | Invertebrate |
| *Climacteris erythrops* | Red-browed Treecreeper | | | R | Bird |
| *Coeranoscincus reticulatus* | Three-toed Snake-tooth Skink | V | V | R | Reptile |
| *Coracina lineata* | Barred Cuckoo-shrike | | V | | Bird |
| *Craterocephalus marjoriae* | Marjorie's Hardyhead | | | | Fin fish |
| *Cyclopsitta diophthalma coxeni* | Double-eyed Fig-parrot / Coxen's Fig-parrot | E | CE | E | Bird |
| *Dasyornis brachypterus* | Eastern Bristlebird | E | E | E | Bird |

| Scientific name | Common name | Status | | | Group or life form |
|---|---|---|---|---|---|
| | | Aust | NSW | QLD | |
| *Dasyurus maculatus maculatus* | Spotted-tailed Quoll (southern subspecies) | E | V | V | Mammal |
| *Egernia major* | Land Mullet | | | | Reptile |
| *Egernia mcpheei* | Eastern Crevice Skink | | | | Reptile |
| *Erythrotriorchis radiatus* | Red Goshawk | V | CE | E | Bird |
| *Euastacus dalagarbe** | Mud Gully Crayfish | | | | Invertebrate |
| *Euastacus girurmulayn** | Smooth Crayfish | | | | Invertebrate |
| *Euastacus gumar** | Bloodclaw Crayfish | | | | Invertebrate |
| *Euastacus guruhgi** | Swollen Crayfish | | | | Invertebrate |
| *Euastacus jagabar** | Black and Blue Crayfish | | | | Invertebrate |
| *Euastacus jagara** | A freshwater crayfish | | | | Invertebrate |
| *Euastacus maidae** | A freshwater crayfish | | | | Invertebrate |
| *Euastacus mirangudjin** | Orange-bellied Crayfish | | | | Invertebrate |
| *Euastacus sulcatus** | Mountain Crayfish | | | | Invertebrate |
| *Euastacus valentulus** | Powerful Crayfish | | | | Invertebrate |
| *Eulamprus murrayi* | Blue-speckled Forest-skink | | | | Reptile |
| *Eulamprus tryoni** | | | | | Reptile |
| *Falsistrellus tasmaniensis* | Eastern False Pipistrelle | | V | | Mammal |
| *Gadopsis marmoratus* | River Blackfish | | | | Fin fish |
| *Galaxias olidus* | Mountain Galaxias | | | | Fin fish |
| *Gobiomorphus coxii** | Cox's Gudgeon | | | | Fin fish |
| *Harrisoniascincus zia* | Rainforest Cool-skink / Beech Skink | | | R | Reptile |
| *Hoplocephalus stephensii* | Stephens' Banded Snake | | V | R | Reptile |
| *Hypseleotris galii* | Fire-tailed Gudgeon | | | | Fin fish |
| *Hypseleotris klunzingeri* | Western Carp Gudgeon | | | | Fin fish |
| *Hypsilurus spinipes* | Southern Forest Dragon / Southern Angle-headed Dragon | | | | Reptile |
| *Kerivoula papuensis* | Golden-tipped Bat | | V | R | Mammal |
| *Lechriodus fletcheri* | Black-soled Frog / Fletcher's Frog | | | R | Amphibian |
| *Leiopotherapon unicolor* | Spangled Perch | | | | Fin fish |
| *Litoria pearsoniana* | Cascade Tree Frog / Pearson's Green Tree Frog | | E | V | Amphibian |
| *Litoria revelata* | Whirring Tree Frog | | | R | Amphibian |
| *Maccullochella ikei* | Eastern (Freshwater) Cod | E | E | | Fin fish |
| *Maccullochella peelii mariensis* | Mary River Cod | E | | P | Fin fish |
| *Macquaria novemaculeata* | Australian Bass | | | | Fin fish |
| *Macropus dorsalis* | Black-striped Wallaby | | E | | Mammal |
| *Macropus parma* | Parma Wallaby | | V | | Mammal |
| *Melanotaenia duboulayi* | Duboulay's Rainbowfish | | | | Fin fish |
| *Menura alberti* | Albert's Lyrebird | | V | R | Bird |

| Scientific name | Common name | Status | | | Group or life form |
|---|---|---|---|---|---|
| | | Aust | NSW | QLD | |
| *Miniopterus australis* | Little Bentwing-bat | | V | | Mammal |
| *Miniopterus schreibersii oceanensis* | Eastern Bentwing-bat | | V | | Mammal |
| *Mixophyes fleayi* | Fleay's Barred Frog | E | E | E | Amphibian |
| *Mixophyes iteratus* | Giant Barred Frog | E | E | E | Amphibian |
| *Mogurnda adspersa* | Purple Spotted Gudgeon | | | | Fin fish |
| *Monarcha leucotis* | White-eared Monarch | | V | | Bird |
| *Myxus petardi* | Freshwater Mullet | | | | Fin fish |
| *Nameria insularis** | Burleigh Heads Spider | | | | Invertebrate |
| *Notechis scutatus* | Mainland Tiger Snake | | | | Reptile |
| *Notesthes robusta* | Bullrout | | | | Fin fish |
| *Nurus atlas** | Atlas Rainforest Ground-beetle | | E | | Invertebrate |
| *Nurus brevis** | Shorter Rainforest Ground-beetle | | E | | Invertebrate |
| *Nyctimene robinsoni* | Eastern Tube-nosed Bat | | V | | Mammal |
| *Nyctophilus bifax* | Eastern Long-eared Bat | | V | | Mammal |
| *Ophioscincus truncatus* | Short-limbed Snake-skink | | | R | Reptile |
| *Ornithoptera richmondia* | Richmond Birdwing Butterfly | | | V | Invertebrate |
| *Orthonyx temminckii* | Logrunner | | | | Bird |
| *Pachycephala olivacea* | Olive Whistler | | V | R | Bird |
| *Petrogale penicillata*^ | Brush-tailed Rock-wallaby | V | E | V | Mammal |
| *Philoria kundagungan / Kyarranus kundagungan** | Mountain Frog / Red-and-yellow Mountain Frog | | E | R | Amphibian |
| *Philoria loveridgei / Kyarranus loveridgei** | Loveridge's Frog / Masked Mountain-frog | | E | R | Amphibian |
| *Philoria richmondensis** | Richmond Range Frog | | E | | Amphibian |
| *Philypnodon* sp. 1 | Dwarf Flathead Gudgeon | | | | Fin fish |
| *Phyllodes imperialis* southern subspecies | Pink Underwing Moth | E | E | | Invertebrate |
| *Podargus ocellatus plumiferus* | Marbled Frogmouth / Plumed Frogmouth | | V | V | Bird |
| *Potomalosa richmondia* | Freshwater Herring | | | | Fin fish |
| *Potorous tridactylus tridactylus* | Long-nosed Potoroo | V | V | V | Mammal |
| *Pseudomys oralis* | Hastings River Mouse | E | E | V | Mammal |
| *Pteropus alecto* | Black Flying-fox | | | | Mammal |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | V | V | | Mammal |
| *Ptilinopus magnificus* | Wompoo Fruit-dove | | V | | Bird |
| *Ptilinopus regina* | Rose-crowned Fruit-dove | | V | | Bird |
| *Ptilinopus superbus* | Superb Fruit-dove | | V | | Bird |
| *Ptiloris paradiseus* | Paradise Riflebird | | | | Bird |
| *Rallus pectoralis* | Lewin's Rail | | | R | Bird |
| *Retropinna semoni* | Australian Smelt | | | | Fin fish |
| *Saiphos equalis* | Yellow-bellied Three-toed Skink | | | | Reptile |

| Scientific name | Common name | Status | | | Group or life form |
|---|---|---|---|---|---|
| | | Aust | NSW | QLD | |
| *Saltuarius swaini* | Southern Leaf-tailed Gecko | | | | Reptile |
| *Saproscincus challengeri* | Orange-tailed Shadeskink | | | | Reptile |
| *Saproscincus oriarus* | A shadeskink | | | | Reptile |
| *Saproscincus rosei* | A shadeskink | | | R | Reptile |
| *Saproscincus spectabilis** | Spectacled Shade-skink | | | R | Reptile |
| *Stipiturus malachurus* | Southern Emu-wren | | | V | Bird |
| *Syconycteris australis* | Common Blossom-bat | | V | | Mammal |
| *Tandanus tandanus* | Freshwater Catfish / Tandan | | | | Fin fish |
| *Thersites mitchellae** | Mitchell's Rainforest Snail | CE | E | | Invertebrate |
| *Thylogale stigmatica* | Red-legged Pademelon | | V | | Mammal |
| *Trichosurus caninus* | Short-eared Possum | | | | Mammal |
| *Turnix melanogaster* | Black-breasted Button-quail | V | CE | V | Bird |
| *Tyto novaehollandiae* | Masked Owl | | V | | Bird |
| *Tyto tenebricosa* | Sooty Owl | | V | R | Bird |
| *Vespadelus darlingtoni* | Large Forest Bat | | | | Mammal |

*Endemic to the rainforest and associated vegetation of the Planning Area

^Queensland part of species distribution within Planning Area only

# Priority flora

Trait-based Flora Groups are provided (1-5), and also the Landscape they occur in:
L = lowland, M = midland, U = upland

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *Acacia bakeri* | Marblewood | | V | | Tree | 4 LMU |
| *Acacia orites* | Nightcap Wattle | | | R | Tree | 2 U |
| *Acalypha* sp. Booyong [formerly *Acalypha eremorum*]* | Acalypha | | E | | Shrub | 5 LM |
| *Acronychia baeuerlenii* | Byron Bay Acronychia | | | R | Shrub/small tree | 4 U |
| *Acronychia littoralis* | Scented Acronychia | E | E | E | Small tree | 5 LM |
| *Actephila grandifolia** | | | | | Shrub | 5 LMU |
| *Alloxylon pinnatum* | Dorrigo Waratah | | | R | Small tree | 4 U |
| *Amyema plicatula* [formerly *A. scandens*] | Rosewood Mistletoe | E | E | | Parasitic mistletoe | 4 LM |
| *Angiopteris evecta* | Giant Fern | | E | | Fern/fern ally | 3 LM |
| *Archidendron hendersonii* | White Lace Flower | | V | | Tree | 4 LM |
| *Archidendron muellerianum** | Veiny Lace Flower | | | R | Small tree | 4 LMU |
| *Ardisia bakeri** | | | | R | Shrub | 5 LMU |

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *Argophyllum nullumense* | Silver Leaf | | | R | Shrub | 2 LMU |
| *Arthraxon hispidus* | Hairy-joint Grass | V | V | V | Graminoid | - |
| *Asplenium harmanii** | | | | | Fern/fern ally | 3 U |
| *Austrobuxus swainii* | Pink Cherry | | | R | Tree | 4 U |
| *Baloghia marmorata* | Jointed Baloghia | V | V | V | Shrub/small tree | 4 LM |
| *Belvisia mucronata* | Needle-leaf Fern | | E | | Fern/fern ally | 3 LMU |
| *Bosistoa pentacocca* var. *pentacocca** | Ferny-leaved Bosistoa | | | | Tree | 2 LMU |
| *Bosistoa selwynii* | Heart-leaved Bonewood | V | V | | Tree | 2 LM |
| *Bosistoa transversa* | Yellow Satinheart | V | V | | Tree | 2 LM |
| *Brachychiton* sp. Ormeau* | Ormeau Bottletree | | | | Tree | 4 LM |
| *Bulbophyllum argyropus* | | | | R | Epiphytic/epilithic orchid | 3 U |
| *Bulbophyllum caldericola** | | | | | Epiphytic/epilithic orchid | 3 U |
| *Bulbophyllum globuliforme* | Hoop Pine Orchid | V | V | R | Epiphytic/epilithic orchid | 3 U |
| *Bulbophyllum weinthalii* subsp. *weinthalii* | | | | V | Epiphytic/epilithic orchid | 3 U |
| *Callitris baileyi* | Bailey's Cypress Pine | | E | R | Tree | 3 LM |
| *Carex hubbardii* | | | | | Graminoid | 2 U |
| *Cassia marksiana* [*C. brewsteri* var. *marksiana*]* | Brush Cassia | | E | R | Tree | 2 LM |
| *Cassinia collina* | | | | R | Shrub | 3 U |
| *Choricarpia subargentea* | Giant Ironwood | | E | R | Tree | 5 LM |
| *Citrus australasica** | Finger Lime | | | | Shrub/small tree | 5 LM |
| *Clematis fawcettii* | Northern Clematis | V | V | V | Vine | 3 LMU |
| *Coatesia paniculata* [formerly *Geijera paniculata*] | Axe-breaker | | E | | Small tree | 5 LM |
| *Corchorus cunninghamii* | Native Jute | E | E | E | Shrub | 2 LMU |
| *Cordyline congesta** | | | | | Shrub | 4 LM |
| *Corokia whiteana** | | V | V | | Shrub | 5 U |
| *Corynocarpus rupestris* subsp. *arborescens* | Southern Corynocarpus | | | R | Tree | 1 LMU |
| *Crepidomanes vitiense* | | | | | Fern/fern ally | 3 U |
| *Croton mamillatus* (Qld) | | | | | Shrub | - |
| *Cryptocarya floydii* | Gorge Laurel | | | R | Small tree | 5 U |
| *Cryptocarya foetida* | Stinking Cryptocarya | V | V | V | Small tree | 4 LM |
| *Cryptocarya meisneriana* | Thick-leaved Laurel | | | | Shrub/small tree | 5 U |
| *Cupaniopsis flagelliformis* var. *australis** | | | | | Tree | 4 LMU |
| *Cupaniopsis newmanii** | | | | R | Shrub/small tree | 4 LMU |
| *Cupaniopsis serrata* | Smooth Tuckeroo | | E | | Small tree | 4 LM |
| *Cupaniopsis tomentella* | Boonah Tuckeroo | V | | V | Small tree | 4 LMU |
| *Cyathea cunninghamii* | Slender Tree Fern | | | R | Fern/fern ally | 3 LMU |
| *Cyperus rupicola** | Cliff Sedge | | V | R | Graminoid | 2 U |

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *Cyperus semifertilis* | Missionary Nutgrass | V | E | V | Graminoid | 2 U |
| *Daphnandra tenuipes** | Red-flowered Socketwood | | | | Tree | 5 U |
| *Davidsonia jerseyana** | Davidson's Plum | E | E | | Small tree | 4 LM |
| *Davidsonia johnsonii** | Smooth Davidson's Plum | E | E | E | Small tree | 5 LM |
| *Dendrobium schneiderae* var. *schneiderae* | | | | R | Epiphytic/epilithic orchid | 3 U |
| *Dendrocnide moroides* | Gympie Stinger | | E | | Shrub/small tree | 4 LMU |
| *Desmodium acanthocladum* | Thorny Pea | V | V | | Shrub | 2 LM |
| *Diospyros ellipticifolia* var. *ebenus* [*Diospyros major* var. *ebenus*] | Shiny-leaved Ebony | | E | | Shrub/small tree | 4 LM |
| *Diospyros mabacea** | Red-fruited Ebony | E | E | | Shrub/small tree | 4 LM |
| *Diploglottis campbellii** | Small-leaved Tamarind | E | E | E | Tree | 4 LM |
| *Doryanthes palmeri** | Giant Spear Lily | | V | | Herb | 1 U |
| *Drynaria rigidula* | Basket Fern | | E | | Fern/fern ally | 3 LMU |
| *Eidothea hardeniana** | Nightcap Oak | CE | E | | Tree | 1 U |
| *Elaeocarpus sedentarius* [formerly *E.* sp. Rocky Creek]* | Minyon Quandong | E | E | | Tree | 1 U |
| *Elaeocarpus williamsianus** | Hairy Quandong | E | E | | Tree | 5 LM |
| *Endiandra compressa* | White Bark | | | | Small tree | 1 LM |
| *Endiandra floydii** | Crystal Creek Walnut | E | E | E | Tree | 1 LM |
| *Endiandra globosa** | Black Walnut | | | R | Tree | 1 LMU |
| *Endiandra hayesii** | Rusty Rose Walnut | V | V | V | Tree | 4 LMU |
| *Endiandra introrsa* | Dorrigo Plum | | | R | Tree | 1 U |
| *Endiandra muelleri* subsp. *bracteata* | Green-leaved Rose Walnut | | E | | Tree | 4 LMU |
| *Eucalyptus dunnii* | Dunn's White Gum | | | R | Tree | 4 LM |
| *Eucryphia jinksii** | Springbrook Pinkwood | | | E | Tree | 5 U |
| *Euphrasia bella** | Pretty Eyebright | V | V | E | Herb | 2 U |
| *Floydia praealta* | Ball Nut | V | V | V | Tree | 1 LM |
| *Fontainea australis** | Southern Fontainea | V | V | V | Small tree | 5 LMU |
| *Fontainea oraria** | Coastal Fontainea | E | CE | | Small tree | 5 LM |
| *Fontainea venosa* | Bahrs Scrub Fontainea | V | | V | Small tree | 5 LM |
| *Gaultheria* sp. (Mt Merino G.Leiper AQ502686) [*Gaultheria viridicarpa* subsp. *merinoensis*]* | Mt Merino Waxberry | | V | V | Shrub | 2 U |
| Gen.(Aq247974) sp. (Mt Merino S.T.Blake 21554) / *Helichrysum* sp. 1* | | | | | Herb | 3 U |
| *Gossia fragrantissima* | Sweet Myrtle | E | E | E | Small tree | 5 LM |
| *Grammitis stenophylla* | Narrow-leaf Finger Fern | | E | | Fern/fern ally | 3 U |
| *Grevillea hilliana* | White Yiel Yiel | | E | | Tree | 4 LM |
| *Gyrostemon osmus** (Qld) | | | | | Shrub/small tree | - |
| *Harnieria hygrophiloides* [formerly *Calophanoides* | Native Justicia | | E | | Shrub | 2 LM |

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *hygrophiloides*] | | | | | | |
| *Helicia ferruginea* | Rusty Oak | | | R | Small tree | 4 U |
| *Helmholtzia glaberrima** | | | | R | Herb | 2 U |
| *Hibbertia hexandra* | Tree Guinea Flower | | E | R | Shrub | 5 U |
| *Hicksbeachia pinnatifolia* | Red Bopple Nut | V | V | V | Tree | 1 LMU |
| *Huperzia varia* | Long Clubmoss | | | R | Fern/fern ally | 2 U |
| *Hypserpa decumbens* | | | | | Vine | 4 LM |
| *Isoglossa eranthemoides** | Isoglossa | E | E | | Herb | 2 LM |
| *Jasminum jenniae* | Beechmont Jasmine | | | E | Shrub | 4 LMU |
| *Lastreopsis silvestris** | Mountain Shield Fern | | | R | Fern/fern ally | 3 U |
| *Leionema elatius* subsp. *beckleri* | Tall Phebalium | | | E | Shrub/small tree | 5 U |
| *Leionema gracile** | Moogerah Peaks Leionema | | | R | Shrub | 2 U |
| *Lenwebbia prominens** | Velvet Myrtle | | | R | Small tree | 5 U |
| *Lenwebbia* sp. Main Range* | Main Range Lenwebbia | | | | Small tree | 5 U |
| *Lepiderema pulchella* | Fine-leaved Tuckeroo | | V | R | Small tree | 4 LMU |
| *Lepidosperma lapidicola* | | | | | Graminoid | - |
| *Leucopogon* sp. (Lamington G.Leiper AQ633386)* | Lamington Beard Heath | | | | Shrub/small tree | 4 U |
| *Lindsaea brachypoda* | Short-footed Screw Fern | | E | | Fern/fern ally | 3 U |
| *Macadamia integrifolia* | Macadamia Nut | V | | V | Small tree | 1 LM |
| *Macadamia tetraphylla** | Rough-shelled Bush Nut | V | V | V | Small tree | 1 LM |
| *Marsdenia coronata* | Slender Milkvine | V | | V | Vine | 4 LMU |
| *Marsdenia hemiptera* | | | | R | Vine | 4 LM |
| *Marsdenia longiloba* | Slender Marsdenia | V | E | V | Vine | 4 LM |
| *Melicope vitiflora* | Coast Euodia | | E | | Small tree | 4 LM |
| *Mischocarpus lachnocarpus* | Woolly Pear-fruit | | | | Small tree | 5 LMU |
| *Muellerina flexialabastra** | Hoop Pine Mistletoe | | | | Parasitic mistletoe | 4 LM |
| *Muellerina myrtifolia* | Myrtle-leaf Mistletoe | | E | R | Parasitic mistletoe | 4 LM |
| *Myrsine richmondensis* [formerly *Rapanea* sp. 'Richmond River']* | Ripple-leaf Muttonwood | E | E | | Shrub/small tree | 5 LMU |
| *Neisosperma poweri* | Milkbush | | | | Shrub/small tree | 1 LM |
| *Niemeyera chartacea* | Smooth-leaved Plum | | E | | Small tree | - |
| *Niemeyera whitei* [formerly *Amorphospermum whitei*] | Rusty Plum | | V | V | Tree | 1 LMU |
| *Oberonia complanata* | Yellow-flowered King of the Fairies | | E | | Epiphytic/epilithic orchid | 3 LM |
| *Ochrosia moorei** | Southern Ochrosia | E | E | E | Small tree | 5 LMU |
| *Olearia heterocarpa** | | | | R | Shrub | 2 U |
| *Owenia cepiodora** | Onion Cedar | V | V | V | Tree | 4 LMU |
| *Ozothamnus vagans** | | V | | V | Shrub | 3 U |
| *Pandorea baileyana** | Large-leaved Wonga Vine | | | R | Vine | 4 U |
| *Pararistolochia laheyana** | | | | R | Vine | 4 U |

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *Pararistolochia praevenosa* | Birdwing Vine | | | R | Vine | 4 LM |
| *Parsonsia tenuis** | Slender Silkpod | | | R | Vine | 4 U |
| *Peristeranthus hillii* | Brown Fairy-chain Orchid | | V | | Epiphytic/epilithic orchid | 3 LM |
| *Phebalium distans* (Qld) | | CE | | | Shrub/small tree | - |
| *Phyllanthus microcladus* | Brush Sauropus | | E | | Shrub | 5 LM |
| *Pimelea umbratica** | | | | R | Shrub | 5 U |
| *Pittosporum oreillyanum** | | | | R | Shrub | 5 U |
| *Plectranthus nitidus** | Nightcap Plectranthus | E | E | E | Shrub | 5 U |
| *Pneumatopteris pennigera* (Qld) | | | | | Fern/fern ally | - |
| *Podolepis monticola** | | | | R | Herb | 3 U |
| *Pomaderris notata** | McPherson Range Pomaderris | | V | R | Shrub/small tree | 5 U |
| *Pouteria cotinifolia* var. *cotinifolia* [*Planchonella cotinifolia* var. *cotinifolia*] | Yellow Lemon | | | | Small tree | 5 LM |
| *Pouteria eerwah* | Shiny-leaved Condoo | E | | E | Tree | 1 LM |
| *Psilotum complanatum* | Flat-fork Fern | | E | | Fern/fern ally | 3 LM |
| *Quassia* sp. (Mt Nardi B.L.Walker AQ330746) | Quassia sp. 'Mt Nardi' | | | | Shrub | 5 LMU |
| *Randia moorei** | Spiny Gardenia | E | E | E | Small tree | 4 LM |
| *Rhodamnia maideniana** | | | | R | Shrub/small tree | 5 LM |
| *Rhynchosia acuminatissima* | Pointed Trefoil | | V | | Vine | 2 LMU |
| *Sarcochilus dilatatus* | Brown Butterfly Orchid | | E | | Epiphytic/epilithic orchid | 3 LMU |
| *Sarcochilus fitzgeraldii* | Ravine Orchid | V | V | E | Epiphytic/epilithic orchid | 3 LMU |
| *Sarcochilus hartmannii* | Hartmann's Sarcochilus | V | V | V | Epiphytic/epilithic orchid | 3 LMU |
| *Sarcochilus weinthalii* | Blotched Sarcochilus | V | V | E | Epiphytic/epilithic orchid | 3 U |
| *Senna acclinis* | Rainforest Cassia | | E | R | Shrub | 2 LMU |
| *Solanum limitare* | Border Ranges Nightshade | | E | | Shrub | 4 U |
| *Solanum mentiens* (Qld) | | | | | Shrub | - |
| *Sophora fraseri* | Brush Sophora | V | V | V | Shrub | 2 LMU |
| *Streptothamnus moorei* | | | | | Vine | 4 U |
| *Symplocos baeuerlenii** | Small-leaved Hazelwood | V | V | V | Shrub/small tree | 4 U |
| *Syzygium hodgkinsoniae* | Red Lilly Pilly | V | V | V | Small tree | 4 LMU |
| *Syzygium moorei** | Durobby | V | V | V | Tree | 4 LM |
| *Tinospora smilacina* | Tinospora Vine | | E | | Vine | 4 LMU |
| *Tinospora tinosporoides** | Arrow-head Vine | V | V | V | Vine | 4 LM |
| *Triflorensia cameronii* [formerly *Tarenna cameronii*] | Cameron's Tarenna | | E | | Small tree | 4 LM |
| *Turraea pubescens* | Native Witch Hazel | | | | Shrub/small tree | 4 LMU |
| *Tylophora woollsii* | Cryptic Forest Twiner | E | E | E | Vine | 4 LMU |

| Scientific name | Common name | Status | | | Group or life form | Trait-based Flora Group |
|---|---|---|---|---|---|---|
| | | Aust | NSW | QLD | | |
| *Uromyrtus australis** | Peach Myrtle | E | E | | Small tree | 5 U |
| *Uromyrtus lamingtonensis** | Lamington Myrtle | | | R | Shrub/small tree | 5 U |
| *Wahlenbergia glabra** | | | | R | Herb | 2 U |
| *Wahlenbergia scopulicola** | Rock-face Bluebell | | E | R | Herb | 2 U |
| *Westringia blakeana** | | | | R | Shrub | 2 U |
| *Wilkiea austroqueenslandica** | Smooth Wilkiea | | | | Shrub/small tree | 5 LMU |
| *Xerochrysum bracteatum* subsp. (Mt Merino S.T.Blake 22869)* | Mt Merino Golden Everlasting | | | | Herb | 2 U |
| *Xylosma terra-reginae* | Queensland Xylosma | | E | | Small tree | 5 LM |
| *Zieria collina** | | V | | V | Shrub | 2 LMU |
| *Zieria southwellii* | | | | | Shrub | 2 U |

*Endemic to the rainforest and associated vegetation of the Planning Area

# Priority ecological communities

## *Commonwealth* Environment Protection and Biodiversity Conservation Act 1999 *critically endangered ecological communities*

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.

## *Commonwealth* Environment Protection and Biodiversity Conservation Act 1999 *endangered ecological communities*

- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions. Occurs in the western part of the Planning Area in Queensland. There is an equivalent listing for this community in NSW but it does not occur within the NSW part of the Planning Area.

## *NSW* Threatened Species Conservation Act 1995 *endangered ecological communities*

- Littoral rainforest in the NSW North Coast, Sydney Basin and South-east Corner bioregions
- Lowland rainforest in the NSW North Coast and Sydney Basin bioregions
- Lowland rainforest on floodplain in the NSW North Coast bioregion
- White Gum *Eucalyptus dunnii* moist forest in the NSW North Coast bioregion
- Grey Box – Grey Gum wet sclerophyll forest in the NSW North Coast bioregion

## *Queensland* Vegetation Management Act 1999 *endangered ecosystems*

- *Acacia harpophylla* open forest on Cainozoic igneous rocks
- *Acacia harpophylla* open forest on sedimentary rocks
- Araucarian microphyll to notophyll vine forest on sedimentary rocks
- Gallery rainforest (notophyll vine forest) on alluvial plains
- Semi-evergreen vine thicket with *Brachychiton rupestris* on Cainozoic igneous rocks
- Semi-evergreen vine thicket with *Brachychiton rupestris* on sedimentary rocks
- Tall open forest of *Eucalyptus pilularis* open forest on metamorphics and interbedded volcanics

## *Queensland* Vegetation Management Act 1999 *of concern ecosystems*

- Araucarian complex microphyll vine forest on Cainozoic igneous rocks
- *Eucalyptus dunnii* tall open forest on Cainozoic igneous rocks
- *Eucalyptus grandis* tall open forest on alluvial plains
- *Eucalyptus laevopinea* tall open forest on Cainozoic igneous rocks
- *Eucalyptus nobilis* tall open forest on alluvial plains
- *Eucalyptus obliqua* tall open forest on Cainozoic igneous rocks
- *Eucalyptus oreades* tall open forest on Cainozoic igneous rocks
- *Eucalyptus saligna* or *E. grandis* tall open forest on Cainozoic igneous rocks
- Notophyll vine forest on parabolic high dunes
- Simple microphyll fern forest with *Nothofagus moorei* on Cainozoic igneous rocks
- Simple microphyll fern thicket with *Acmena smithii* on Cainozoic igneous rocks

# Appendix 7: Functional trait-based Flora Groups

The following list identifies which trait-based Flora Group each priority flora species belongs to (Kooyman & Rossetto 2007). The analysis undertaken by Kooyman and Rossetto (2007) used two altitudinal categories, as opposed to the three altitudinal landscapes later adopted for use in this Plan. The 'Lowland' altitudinal category of Kooyman and Rossetto (2007) is approximately equivalent to the combined Lowland and Midland landscapes of the Plan. Consequently, the Lowland of Kooyman and Rossetto (2007) has been renamed in the tables below to 'Lowland to Midland'. Note that priority taxa may occur in more than than one altitudinal category.

Some priority species are yet to be allocated to a Flora Group (e.g. *Arthraxon hispidus* and *Niemeyera chartacea*). For these, and for species that are added to the Plan at a later date, expert knowledge can be used to add the relevant taxon to the appropriate Flora Group.

## *Group 1*

Large-fruited species that are often dispersal limited, mostly large canopy to medium to small persistent trees with the capacity to resprout, and are mature phase shade tolerant rainforest species. Anomaly is *Doryanthes palmeri*, which is a rocky outcrop specialist with big leaves and big fruits.

| Landscape | Habitat | Taxon |
|---|---|---|
| Lowland to Midland | Drier vine forest | *Macadamia integrifolia* |
| | | *Pouteria eerwah* |
| | Moist rainforest | *Corynocarpus rupestris* subsp. *arborescens* |
| | | *Endiandra compressa* |
| | | *Endiandra floydii* |
| | | *Endiandra globosa* |
| | | *Floydia praealta* |
| | | *Hicksbeachia pinnatifolia* |
| | | *Macadamia tetraphylla* |
| | | *Neisosperma poweri* |
| | | *Niemeyera whitei* |
| Upland | Moist rainforest | *Corynocarpus rupestris* subsp. *arborescens* |
| | | *Eidothea hardeniana* |
| | | *Elaeocarpus sedentarius* |
| | | *Endiandra globosa* |
| | | *Endiandra introrsa* |
| | | *Hicksbeachia pinnatifolia* |
| | | *Niemeyera whitei* |
| | Specialist | *Doryanthes palmeri* |

## *Group 2*

Mostly small-seeded herbs, sedges, shrubs and trees. A specialist habitat subgroup is dominated by high altitude shrubs and herbs, while a wet sclerophyll habitat subgroup includes sedges and shrubs. A rainforest habitat subgroup includes a variety of life forms that occur in the Lowland landscape.

| Landscape | Habitat | Taxon |
|---|---|---|
| Lowland to Midland | Drier vine forest | *Corchorus cunninghamii* |
| | | *Rhynchosia acuminatissima* |
| | Moist rainforest | *Bosistoa pentacocca* var. *pentacocca* |
| | | *Bosistoa selwynii* |
| | | *Bosistoa transversa* |
| | | *Cassia marksiana [C. brewsteri* var. *marksiana]* |
| | | *Desmodium acanthocladum* |
| | | *Harnieria hygrophiloides* |
| | | *Isoglossa eranthemoides* |
| | | *Senna acclinis* |
| | Specialist | *Argophyllum nullumense* |
| | Wet sclerophyll forest | *Sophora fraseri* |
| | | *Zieria collina* |
| Upland | Drier vine forest | *Corchorus cunninghamii* |
| | | *Rhynchosia acuminatissima* |
| | Moist rainforest | *Acacia orites* |
| | | *Bosistoa pentacocca* var. *pentacocca* |
| | | *Carex hubbardii* |
| | | *Helmholtzia glaberrima* |
| | | *Olearia heterocarpa* |
| | | *Senna acclinis* |
| | Specialist | *Argophyllum nullumense* |
| | | *Cyperus rupicola* |
| | | *Euphrasia bella* |
| | | *Gaultheria* sp. Mt Merino *[Gaultheria viridicarpa* subsp. *merinoensis]* |
| | | *Huperzia varia* |
| | | *Leionema gracile* |
| | | *Wahlenbergia glabra* |
| | | *Wahlenbergia scopulicola* |
| | | *Xerochrysum bracteatum* subsp. Mt Merino |
| | Wet sclerophyll forest | *Cyperus semifertilis* |
| | | *Lepidosperma clipeicola* |
| | | *Sophora fraseri* |
| | | *Westringia blakeana* |
| | | *Zieria collina* |
| | | *Zieria southwellii* |

## *Group 3*

Mostly ferns, orchids and epiphytes with small seeds (or spores). Includes several woody plants and several rocky outcrop specialists from higher altitudes. Habitat is important division for management.

| Landscape | Habitat | Taxon |
|---|---|---|
| Lowland to Midland | Moist rainforest | *Angiopteris evecta* |
| | | *Belvisia mucronata* |
| | | *Clematis fawcettii* |
| | | *Cyathea cunninghamii* |
| | | *Oberonia complanata* |
| | | *Peristeranthus hillii* |
| | | *Psilotum complanatum* |
| | | *Sarcochilus dilatatus* |
| | | *Sarcochilus fitzgeraldii* |
| | | *Sarcochilus hartmannii* |
| | Specialist | *Drynaria rigidula* |
| | Wet sclerophyll forest | *Callitris baileyi* |
| Upland | Drier vine forest | *Bulbophyllum weinthalii* subsp. *weinthalii* |
| | Moist rainforest | *Belvisia mucronata* |
| | | *Bulbophyllum argyropus* |
| | | *Bulbophyllum caldericola* |
| | | *Bulbophyllum globuliforme* |
| | | *Clematis fawcettii* |
| | | *Crepidomanes vitiense* |
| | | *Cyathea cunninghamii* |
| | | *Dendrobium schneiderae* var. *schneiderae* |
| | | *Grammitis stenophylla* |
| | | *Lastreopsis silvestris* |
| | | *Lindsaea brachypoda* |
| | | *Sarcochilus dilatatus* |
| | | *Sarcochilus fitzgeraldii* |
| | | *Sarcochilus hartmannii* |
| | | *Sarcochilus weinthalii* |
| | Specialist | *Asplenium harmanii* |
| | | *Drynaria rigidula* |
| | | Gen.(Aq247974) sp. Mt Merino |
| | | *Ozothamnus vagans* |
| | | *Podolepis monticola* |
| | Wet sclerophyll forest | *Cassinia collina* |

## *Group 4*

Contains two subgroupings based on habitats. One representing moist rainforest habitats, including mostly woody vines, trees, shrubs, several mistletoe. The second representing drier vine forest, wet sclerophyll forest and specialist habitats.

| Landscape | Habitat | Taxon |
|---|---|---|
| Lowland to Midland | Drier vine forest | *Acacia bakeri* |
| | | *Brachychiton* sp. Ormeau |
| | | *Cupaniopsis serrata* |
| | | *Cupaniopsis tomentella* |
| | | *Marsdenia longiloba* |
| | | *Melicope vitiflora* |
| | | *Muellerina myrtifolia* |
| | | *Tinospora smilacina* |
| | | *Triflorensia cameronii* |
| | | *Turraea pubescens* |
| | Moist rainforest | *Amyema plicatula* |
| | | *Archidendron hendersonii* |
| | | *Archidendron muellerianum* |
| | | *Baloghia marmorata* |
| | | *Cordyline congesta* |
| | | *Cryptocarya foetida* |
| | | *Cupaniopsis flagelliformis* var. *australis* |
| | | *Cupaniopsis newmanii* |
| | | *Davidsonia jerseyana* |
| | | *Dendrocnide moroides* |
| | | *Diospyros ellipticifolia* var. *ebenus [Diospyros major* var. *ebenus]* |
| | | *Diospyros mabacea* |
| | | *Diploglottis campbellii* |
| | | *Endiandra hayesii* |
| | | *Endiandra muelleri* subsp. *bracteata* |
| | | *Grevillea hilliana* |
| | | *Hypserpa decumbens* |
| | | *Jasminum jenniae* |
| | | *Lepiderema pulchella* |
| | | *Marsdenia coronata* |
| | | *Marsdenia hemiptera* |
| | | *Muellerina flexialabstra* |
| | | *Owenia cepiodora* |
| | | *Pararistolochia praevenosa* |
| | | *Randia moorei* |
| | | *Syzygium hodgkinsoniae* |
| | | *Syzygium moorei* |
| | | *Tinospora tinosporoides* |
| | Wet sclerophyll forest | *Eucalyptus dunnii* |
| | | *Tylophora woollsii* |

| Landscape | Habitat | Taxon |
|---|---|---|
| Upland | Drier vine forest | *Acacia bakeri* |
| | | *Cupaniopsis tomentella* |
| | | *Muellerina myrtifolia* |
| | | *Tinospora smilacina* |
| | | *Turraea pubescens* |
| | Moist rainforest | *Acronychia baeuerlenii* |
| | | *Alloxylon pinnatum* |
| | | *Archidendron muellerianum* |
| | | *Austrobuxus swainii* |
| | | *Cupaniopsis flagelliformis* var. *australis* |
| | | *Cupaniopsis newmanii* |
| | | *Dendrocnide moroides* |
| | | *Endiandra hayesii* |
| | | *Endiandra muelleri* subsp. *bracteata* |
| | | *Helicia ferruginea* |
| | | *Jasminum jenniae* |
| | | *Lepiderema pulchella* |
| | | *Marsdenia coronata* |
| | | *Owenia cepiodora* |
| | | *Pandorea baileyana* |
| | | *Pararistolochia laheyana* |
| | | *Parsonsia tenuis* |
| | | *Streptothamnus moorei* |
| | | *Symplocos baeuerlenii* |
| | | *Syzygium hodgkinsoniae* |
| | Specialist | *Leucopogon* sp. Lamington |
| | Wet sclerophyll forest | *Solanum limitare* |
| | | *Tylophora woollsii* |

## *Group 5*

Contains two subgroupings. The first represents rainforest habitat types, mostly with persistent (resprouting) smaller seeded shrubs and trees. The second represents wet sclerophyll and rocky outcrop species.

| Landscape | Habitat | Taxon |
|---|---|---|
| Lowland to Midland | Drier vine forest | *Acalypha eremorum* |
| | | *Choricarpia subargentea* |
| | | *Citrus australasica* |
| | | *Coatesia paniculata* |
| | | *Fontainea venosa* |
| | | *Gossia fragrantissima* |
| | | *Pouteria cotinifolia* var. *cotinifolia [Planchonella cotinifolia* var. *cotinifolia]* |
| | Moist rainforest | *Acronychia littoralis* |
| | | *Actephila grandifolia* |
| | | *Ardisia bakeri* |

| Landscape | Habitat | Taxon |
|---|---|---|
| | | *Davidsonia johnsonii* |
| | | *Elaeocarpus williamsianus* |
| | | *Fontainea australis* |
| | | *Fontainea oraria* |
| | | *Mischocarpus lachnocarpus* |
| | | *Ochrosia moorei* |
| | | *Phyllanthus microcladus* |
| | | *Quassia* sp. Mt Nardi |
| | | *Rhodamnia maideniana* |
| | | *Wilkiea austroqueenslandica* |
| | | *Xylosma terrae-reginae* |
| | Wet sclerophyll forest | *Myrsine richmondensis* |
| Upland | Drier vine forest | *Cryptocarya floydii* |
| | Moist rainforest | *Actephila grandifolia* |
| | | *Ardisia bakeri* |
| | | *Corokia whiteana* |
| | | *Cryptocarya meisneriana* |
| | | *Daphnandra tenuipes* |
| | | *Eucryphia jinksii* |
| | | *Fontainea australis* |
| | | *Lenwebbia prominens* |
| | | *Lenwebbia* sp. Main Range |
| | | *Mischocarpus lachnocarpus* |
| | | *Ochrosia moorei* |
| | | *Pittosporum oreillyanum* |
| | | *Quassia* sp. Mt Nardi |
| | | *Uromyrtus australis* |
| | | *Uromyrtus lamingtonensis* |
| | | *Wilkiea austroqueenslandica* |
| | Specialist | *Pimelea umbratica* |
| | | *Plectranthus nitidus* |
| | Wet sclerophyll forest | *Hibbertia hexandra* |
| | | *Leionema elatius* subsp. *beckleri* |
| | | *Myrsine richmondensis* |
| | | *Pomaderris notata* |

## *References*

Kooyman, R. and Rossetto, M. 2007, Border Ranges Biodiversity Management Plan: Defining plant functional groups for use in resource-limited multi-species recovery implementation scenarios, Unpub. report prepared for DECC, National Herbarium of NSW, Botanic Gardens Trust, Sydney.

# Appendix 10: Priority sites for Bitou Bush control

| Site number | Site name | Priority species or community |
|---|---|---|
| NR52 | Angels Beach, Ballina | Littoral rainforest, *Acronychia littoralis, Archidendron hendersonii, Cryptocarya foetida* |
| NR32 | Arakwal NP | Littoral rainforest |
| NR21 | Billinudgel NR (including SEPP 26 no. 13a, 13b, 13c, Billinudgel NR – Crabbes Creek Beach north) | Littoral rainforest, *Endiandra globosa* |
| NR47 | Boulder Beach, Ballina (including SEPP 26 no. 38, Boulder Beach south) | Littoral rainforest, *Arthraxon hispidus, Syzygium hodgkinsoniae* |
| NR61 | Broadwater NP | Littoral rainforest |
| NR36 | Broken Head NR (including SEPP 26 no. 32, 33b, 34a) | Littoral rainforest, *Acronychia littoralis, Archidendron hendersonii, Cordyline congesta, Cryptocarya foetida, Syzygium moorei, Xylosma terra-reginae* |
| NR25 | Brunswick Heads NR (including SEPP 26 no. 18) | Littoral rainforest, *Acronychia littoralis, Cryptocarya foetida, Endiandra globosa, Grevillea hilliana, Melicope vitiflora, Niemeyera chartacea, Syzygium moorei, Xylosma terra-reginae* |
| NR29 | Cape Byron SCA (including SEPP 26 no. 27, 27a, 27b) | Littoral rainforest, *Acronychia littoralis, Cordyline congesta, Cryptocarya foetida, Syzygium moorei, Xylosma terra-reginae* |
| NR34 | Clarkes Beach Caravan Park | Littoral rainforest |
| NR9 | Cudgen NR (SEPP 26 no. 4) | Littoral rainforest, *Cryptocarya foetida* |
| NR22 | Fern Beach – South Golden Beach | Littoral rainforest, *Acronychia littoralis, Cryptocarya foetida* |
| NR5 | Fingal Southwest – Shallow Bay (SEPP 26 no. 2c) | Littoral rainforest, *Acronychia littoralis* |
| NR4 | Fingal West – Golf Course (SEPP 26 no. 2b) | Littoral rainforest |
| NR46 | Lennox Head, inland from Boulder Beach (including SEPP 26 no. 37, 37a, 37b, 37c) | Littoral rainforest, *Acronychia littoralis, Fontainea oraria* |
| NR55 | Lighthouse Beach, Ballina | Littoral rainforest |
| NR39 | Seven Mile Beach North – 1km south of Jews Point (SEPP 26 no. 34) | Littoral rainforest, *Cordyline congesta, Cryptocarya foetida* |
| NR51 | Sharps Beach, Ballina | Littoral rainforest, *Cryptocarya foetida* |
| NR54 | Shaws Bay, Ballina | Littoral rainforest, *Acronychia littoralis, Cryptocarya foetida* |
| NR53 | Shelley Beach, Ballina | Littoral rainforest |
| NR56 | South of Lennox Head (including SEPP 26 no. 37) | Littoral rainforest, *Fontainea oraria, Xylosma terra-reginae* |
| NR3 | Tweed Coastal Reserve (including SEPP 26 no. 2a, Fingal Head) | Littoral rainforest, *Archidendron hendersonii, Cordyline congesta, Cryptocarya foetida, Syzygium moorei* |
| NR2 | Ukerabagh NR including Tweed Heads Historic Site | Littoral rainforest |
| NR18 | Wooyung NR (including SEPP 26 no. 11, Wooyung NR South) | Littoral rainforest, *Cryptocarya foetida* |
| NR16 | Wooyung NR North (SEPP 26 no. 10) | Littoral rainforest |
| NR19 | Wooyung Rd junction, near caravan park, Wooyung Beach (SEPP 26 no. 12) | Littoral rainforest |

NR = Nature Reserve; NP = National Park; SCA = State Conservation Area; SEPP 26 = State environmental planning policy no. 26 littoral rainforest

Source: Department of Environment and Conservation (NSW) 2006, *NSW Threat Abatement Plan - Invasion of Native Plant Communities by* Chrysanthemoides monilifera *(Bitou Bush and Boneseed)*, Department of Environment and Conservation (NSW), Hurstville. Available at: http://www.environment.nsw.gov.au/threatenedspecies/ThreatAbatementPlansByDoctype.htm

# Appendix 11: Threatened species actions summary

This table summarises which Objectives and Outcomes address Actions for the listed threatened species, populations and communities considered in this Plan.

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1: Organisational-related impediments | 2: Climate change impacts | 2.1: Climate change linkages | 3: Clearing | 4: Fragmentation, modification and degradation | 5; 5.3: Weed invasion | 5; 5.4: Existing weeds | 6: Fire | 7; 7.3: New pest animals | 7; 7.4: Invading pest animals | 7; 7.5: Existing pest animals | 8: Bell Miner Associated Dieback | 9: Livestock | 10: Human interference | 11: Pathogens and diseases | 12: Viability and evolutionary potential | 13: Cultural value to Indigenous community | 14: Community engagement | 15: Monitoring of projects |
| Fauna | | | | | | | | | | | | | | | | | | | |
| Albert's Lyrebird | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | x |
| Barred Cuckoo-shrike | x | | x | x | x | x | x | | | | | | | | | | x | x | x |
| Black-breasted Button-quail | x | x | x | x | x | x | x | x | x | x | x | | x | | | x | x | x | x |
| Black-soled Frog / Fletcher's Frog | x | x | x | x | x | x | x | | x | x | | x | | x | x | x | x | x | x |
| Black-striped Wallaby | x | | x | x | x | x | x | x | x | | x | x | x | | | | x | x | x |
| Brush-tailed Rock-wallaby[1] | x | | x | x | x | x | x | x | x | | x | | x | | | | x | x | x |
| Cascade Tree Frog / Pearson's Green Tree Frog | x | x | x | x | x | x | x | | x | x | | x | | x | x | x | x | x | x |
| Common Blossom-bat | x | x | x | x | x | x | x | x | x | | x | | | | | | x | x | x |
| Double-eyed Fig-parrot / Coxen's Fig-parrot | x | | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| Eastern (Freshwater) Cod | x | x | x | x | x | x | x | x | x | | | | x | x | x | | x | x | x |
| Eastern Bentwing-bat | x | | x | x | x | x | x | | | | x | | | | | | x | x | x |
| Eastern Bristlebird | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | x |
| Eastern False Pipistrelle | x | | x | x | x | x | x | x | | | x | | | | | | x | x | x |
| Eastern Long-eared Bat | x | | x | x | x | x | x | x | | | x | | | | | | x | x | x |
| Eastern Pygmy-possum | x | | x | x | x | x | x | x | | | x | | x | | | x | x | x | x |
| Eastern Tube-nosed Bat | x | x | x | x | x | x | x | x | | | x | | x | x | | | x | x | x |
| Fleay's Barred Frog | x | x | x | x | x | x | x | | x | x | | | x | x | x | x | x | x | x |
| Giant Barred Frog | x | x | x | x | x | x | x | | x | x | | x | | x | x | x | x | x | x |
| Golden-tipped Bat | x | | x | x | x | x | x | x | | | x | | | | | | x | x | x |
| Grey Goshawk | x | | x | x | x | x | x | | | | x | x | | | | | x | x | x |
| Grey-headed Flying-fox | x | x | x | x | x | x | x | | | | | | | x | | | x | x | x |
| Hastings River Mouse | x | | x | x | x | x | x | x | x | x | x | x | x | | | x | x | x | x |
| Large-eared Pied Bat | x | | x | x | x | x | x | | | | x | | | | | | x | x | x |
| Lewin's Rail | x | x | x | x | x | x | x | | x | x | x | | x | x | | | x | x | x |
| Little Bentwing-bat | x | | x | x | x | x | x | x | | | x | | | | | | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1: Organisational-related impediments | 2: Climate change impacts | 2.1: Climate change linkages | 3: Clearing | 4: Fragmentation, modification and degradation | 5; 5.3: Weed invasion | 5; 5.4: Existing weeds | 6: Fire | 7; 7.3: New pest animals | 7; 7.4: Invading pest animals | 7; 7.5: Existing pest animals | 8: Bell Miner Associated Dieback | 9: Livestock | 10: Human interference | 11: Pathogens and diseases | 12: Viability and evolutionary potential | 13: Cultural value to Indigenous community | 14: Community engagement | 15: Monitoring of projects |
| Long-nosed Potoroo | x | | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x |
| Loveridge's Frog / Masked Mountain-frog | x | x | x | x | x | x | x | | x | x | | x | x | x | x | x | x | x | x |
| Marbled Frogmouth / Plumed Frogmouth | x | x | x | x | x | x | x | x | | | | | x | | | | x | x | x |
| Mary River Cod | x | x | x | x | x | x | x | | x | | | | x | x | | | x | x | x |
| Masked Owl | x | | x | x | x | x | | | | x | | x | | | | | x | x | x |
| Mitchell's Rainforest Snail | x | x | | x | x | x | x | | x | x | x | | | x | | | x | x | x |
| Mountain Frog / Red-and-yellow Mountain Frog | x | x | x | x | x | x | x | | x | x | | x | x | x | x | x | x | x | x |
| *Nurus atlas* | x | x | x | x | x | x | x | x | x | x | x | | | x | | x | x | x | x |
| *Nurus brevis* | x | x | x | x | x | x | x | x | x | x | x | | | x | | x | x | x | x |
| Olive Whistler | x | x | x | x | x | x | | x | | | | | | | | | x | x | x |
| *Ophioscincus truncatus* | x | x | x | x | x | x | x | | x | x | x | | | | | x | x | x | x |
| Parma Wallaby | x | | x | x | x | x | x | x | x | | x | x | x | x | | | x | x | x |
| *Phyllodes imperialis* southern subspecies | x | x | x | x | x | x | x | | x | | | | x | x | | | x | x | x |
| Pouched Frog / Australian Marsupial Frog | x | x | x | x | x | x | x | x | x | x | | | | x | | x | x | x | x |
| Rainforest Cool-skink / Beech Skink | x | x | x | x | x | x | x | | x | | x | | | | | x | x | x | x |
| Red Goshawk | x | | x | x | x | x | x | | | | x | x | | x | | | x | x | x |
| Red-browed Treecreeper | x | | x | x | x | x | x | | | | | | | | | | x | x | x |
| Red-legged Pademelon | x | | x | x | x | x | | x | x | | x | | | | | | x | x | x |
| Richmond Birdwing Butterfly | x | x | x | x | x | x | x | | x | | | | x | x | | | x | x | x |
| Richmond Range Frog | x | x | x | x | x | x | x | | x | x | | x | x | x | x | x | x | x | x |
| Rose-crowned Fruit-dove | x | x | x | x | x | x | x | x | | | | | | x | | | x | x | x |
| Rufous Scrub-bird | x | x | x | x | x | x | x | x | x | x | x | | | x | | x | x | x | x |
| *Saproscincus rosei* | x | x | x | x | x | x | x | | x | | x | | | | | x | x | x | x |
| *Saproscincus spectabilis* | x | x | x | x | x | x | x | | x | | x | | | | | x | x | x | x |
| Sooty Owl | x | | x | x | x | x | | | | x | | x | | | | | x | x | x |
| Southern Emu-wren | x | | x | x | x | x | x | | x | | x | | | | | | x | x | x |
| Spotted-tailed Quoll (southern subspecies) | x | | x | x | x | x | x | x | | x | x | | x | x | x | | x | x | x |
| Stephens' Banded Snake | x | | x | x | x | x | x | x | x | x | x | | | x | | x | x | x | x |
| Superb Fruit-dove | x | x | x | x | x | x | x | x | | | | | | x | | | x | x | x |
| Three-toed Snake-tooth Skink | x | x | x | x | x | x | x | x | x | x | x | | x | x | | x | x | x | x |
| Whirring Tree Frog | x | x | x | x | x | x | x | | x | x | | x | | x | x | x | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1: Organisational-related impediments | 2: Climate change impacts | 2.1: Climate change linkages | 3: Clearing | 4: Fragmentation, modification and degradation | 5; 5.3: Weed invasion | 5; 5.4: Existing weeds | 6: Fire | 7; 7.3: New pest animals | 7; 7.4: Invading pest animals | 7; 7.5: Existing pest animals | 8: Bell Miner Associated Dieback | 9: Livestock | 10: Human interference | 11: Pathogens and diseases | 12: Viability and evolutionary potential | 13: Cultural value to Indigenous community | 14: Community engagement | 15: Monitoring of projects |
| White-eared Monarch | x | | x | x | x | x | x | x | | | | x | | | | | x | x | x |
| Wompoo Fruit-dove | x | x | x | x | x | x | x | x | | | | | | x | | | x | x | x |
| Flora | | | | | | | | | | | | | | | | | | | |
| *Acacia bakeri* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Acacia orites* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Acalypha* sp. Booyong formerly *Acalypha eremorum* | x | | x | x | x | x | | x | | | x | | x | x | x | x | x | x | x |
| *Acronychia baeuerlenii* | x | x | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Acronychia littoralis* | x | x | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Alloxylon pinnatum* | x | | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Amyema plicatula* [formerly *A. scandens*] | x | | | x | x | x | | | | | | | x | x | x | x | x | x | x |
| *Angiopteris evecta* | x | | | x | x | x | x | | | | | | | x | x | x | x | x | x |
| *Archidendron hendersonii* | x | x | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Archidendron muellerianum* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Ardisia bakeri* | x | | x | x | x | x | | | | | | | | | x | | x | x | x |
| *Argophyllum nullumense* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Arthraxon hispidus* | x | | x | x | x | x | x | x | x | | | | x | | x | x | x | x | x |
| *Austrobuxus swainii* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Baloghia marmorata* | x | | x | x | x | x | x | x | | | x | | x | x | x | x | x | x | x |
| *Belvisia mucronata* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Bosistoa selwynii* | x | | x | x | x | x | x | x | | | x | | x | | x | x | x | x | x |
| *Bosistoa transversa* | x | | x | x | x | x | x | x | | | x | | x | | x | x | x | x | x |
| *Bulbophyllum argyropus* | x | x | x | x | x | x | | | | x | | | | x | x | | x | x | x |
| *Bulbophyllum globuliforme* | x | x | x | x | x | x | | | | x | | x | | x | x | | x | x | x |
| *Bulbophyllum weinthalii* subsp. *weinthalii* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Callitris baileyi* | x | x | x | x | x | x | x | x | | | | x | x | x | x | x | x | x | x |
| *Cassia marksiana* [*C. brewsteri* var. *marksiana*] | x | x | x | x | x | x | x | | | | x | | x | x | x | | x | x | x |
| *Cassinia collina* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Choricarpia subargentea* | x | x | | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Clematis fawcettii* | x | | x | x | x | x | x | x | | | | | x | | x | x | x | x | x |
| *Coatesia paniculata* [formerly *Geijera paniculata*] | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| *Corchorus cunninghamii* | x | | | x | x | x | x | x | x | x | x | x | | | x | x | x | x | x |
| *Corokia whiteana* | x | | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Corynocarpus rupestris* subsp. *arborescens* | x | x | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Cryptocarya floydii* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Cryptocarya foetida* | x | x | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Cupaniopsis newmanii* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Cupaniopsis serrata* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Cupaniopsis tomentella* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Cyathea cunninghamii* | x | | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| *Cyperus rupicola* | x | x | x | x | x | x | x | | | x | x | | | | x | | x | x | x |
| *Cyperus semifertilis* | x | | x | x | x | x | x | | | x | x | | | | x | | x | x | x |
| *Davidsonia jerseyana* | x | | x | x | x | x | x | | | | x | | x | x | x | x | x | x | x |
| *Davidsonia johnsonii* | x | | x | x | x | x | x | | | | x | | x | x | x | x | x | x | x |
| *Dendrobium schneiderae* var. *schneiderae* | x | | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Dendrocnide moroides* | x | | x | x | x | x | x | | | | x | | x | x | x | | x | x | x |
| *Desmodium acanthocladum* | x | | x | x | x | x | x | x | x | | x | | x | x | x | | x | x | x |
| *Diospyros ellipticifolia* var. *ebenus* [*Diospyros major* var. *ebenus*] | x | | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Diospyros mabacea* | x | | x | x | x | x | x | x | | | x | | x | x | x | x | x | x | x |
| *Diploglottis campbellii* | x | | x | x | x | x | x | | | | x | | x | x | x | x | x | x | x |
| *Doryanthes palmeri* | x | x | x | x | x | x | x | x | | | x | | | x | x | x | x | x | x |
| *Drynaria rigidula* | x | | x | x | x | x | | x | | | | | x | x | x | | x | x | x |
| *Eidothea hardeniana* | x | x | | x | x | x | | | | | | | | x | x | x | x | x | x |
| *Elaeocarpus sedentarius* [formerly *E.* sp. Rocky Creek] | x | x | | x | x | x | | | | | | | | x | x | x | x | x | x |
| *Elaeocarpus williamsianus* | x | | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Endiandra floydii* | x | x | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Endiandra globosa* | x | x | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Endiandra hayesii* | x | x | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Endiandra introrsa* | x | x | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Endiandra muelleri* subsp. *bracteata* | x | x | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Eucalyptus dunnii* | x | | | x | x | x | x | x | | | | x | | | x | | x | x | x |
| *Eucryphia jinksii* | x | x | | x | x | x | | x | | | | | | x | x | | x | x | x |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| *Euphrasia bella* | x | x | | x | x | x | x | | | | x | | | x | x | x | x | x | x |
| *Floydia praealta* | x | x | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Fontainea australis* | x | x | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Fontainea oraria* | x | x | | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Fontainea venosa* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Gaultheria* sp. (Mt Merino) [*Gaultheria viridicarpa* subsp. *merinoensis*] | x | x | | x | x | x | | | | | x | | | x | x | x | x | x | x |
| *Gossia fragrantissima* | x | | x | x | x | x | x | | | | | | x | | x | x | x | x | x |
| *Grammitis stenophylla* | x | | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| *Grevillea hilliana* | x | | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| *Harnieria hygrophiloides* [formerly *Calophanoides hygrophiloides*] | x | x | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| *Helicia ferruginea* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Helmholtzia glaberrima* | x | x | x | x | x | x | x | | | x | | | | x | x | | x | x | x |
| *Hibbertia hexandra* | x | | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Hicksbeachia pinnatifolia* | x | x | x | x | x | x | x | | | | x | | | x | x | x | x | x | x |
| *Huperzia varia* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Isoglossa eranthemoides* | x | | x | x | x | x | x | x | | | x | | x | x | x | x | x | x | x |
| *Jasminum jenniae* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Lastreopsis silvestris* | x | x | x | x | x | x | x | | | | | | | x | x | | x | x | x |
| *Leionema elatius* subsp. *beckleri* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Leionema gracile* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Lenwebbia prominens* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Lepiderema pulchella* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Lindsaea brachypoda* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Macadamia integrifolia* | x | x | x | x | x | x | x | | | | | | x | x | x | x | x | x | x |
| *Macadamia tetraphylla* | x | x | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Marsdenia coronata* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Marsdenia hemiptera* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Marsdenia longiloba* | x | | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Melicope vitiflora* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Muellerina myrtifolia* | x | | x | x | x | x | | | | | | | | | x | | x | x | x |
| *Myrsine richmondensis* [formerly *Rapanea* | x | | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| sp. 'Richmond River'] | | | | | | | | | | | | | | | | | | | |
| *Niemeyera chartacea* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Niemeyera whitei* [formerly *Amorphospermum whitei*] | x | x | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Oberonia complanata* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Ochrosia moorei* | x | | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Olearia heterocarpa* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Owenia cepiodora* | x | | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Ozothamnus vagans* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pandorea baileyana* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pararistolochia laheyana* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pararistolochia praevenosa* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Parsonsia tenuis* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Peristeranthus hillii* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Phebalium distans* | x | x | x | x | x | x | x | x | | | | | | x | | | | x | x |
| *Phyllanthus microcladus* | x | | x | x | x | x | x | | | | | | x | | x | | x | x | x |
| *Pimelea umbratica* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pittosporum oreillyanum* | x | | x | x | x | x | | | | | | | | | x | | x | x | x |
| *Plectranthus nitidus* | x | x | | x | x | x | | x | | | x | | | x | x | x | x | x | x |
| *Podolepis monticola* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pomaderris notata* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Pouteria eerwah* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Psilotum complanatum* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Randia moorei* | x | x | x | x | x | x | x | | | | x | | | x | x | x | x | x | x |
| *Rhodamnia maideniana* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Rhynchosia acuminatissima* | x | | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Sarcochilus dilatatus* | x | x | x | x | x | x | | x | | | | | | x | x | | x | x | x |
| *Sarcochilus fitzgeraldii* | x | x | x | x | x | x | | x | | | | | | x | x | | x | x | x |
| *Sarcochilus hartmannii* | x | x | x | x | x | x | | x | | | x | | | x | x | | x | x | x |
| *Sarcochilus weinthalii* | x | x | x | x | x | x | | | | | | | | x | x | | x | x | x |
| *Senna acclinis* | x | | x | x | x | x | x | x | | | | | | x | x | | x | x | x |
| *Solanum limitare* | x | x | | x | x | x | x | | | | | | | x | x | x | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| *Sophora fraseri* | x | | x | x | x | x | x | x | | | | | x | | x | | x | x | x |
| *Symplocos baeuerlenii* | x | | x | x | x | x | x | x | | | | | | | x | | x | x | x |
| *Syzygium hodgkinsoniae* | x | x | x | x | x | x | x | | | | | | x | x | x | | x | x | x |
| *Syzygium moorei* | x | x | x | x | x | x | x | x | | | | | x | x | x | x | x | x | x |
| *Tinospora smilacina* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Tinospora tinosporoides* | x | | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Triflorensia cameronii* [formerly *Tarenna cameronii*] | x | x | x | x | x | x | x | x | | | | | x | | x | | x | x | x |
| *Tylophora woollsii* | x | | x | x | x | x | x | x | | | | | | x | x | x | x | x | x |
| *Uromyrtus australis* | x | | x | x | x | x | x | x | | | | | | | x | x | x | x | x |
| *Uromyrtus lamingtonensis* | x | x | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Wahlenbergia glabra* | x | x | | x | x | x | x | | | | | | | | x | | x | x | x |
| *Wahlenbergia scopulicola* | x | x | | x | x | x | x | x | | | x | | | x | x | x | x | x | x |
| *Westringia blakeana* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| *Xylosma terra-reginae* | x | x | x | x | x | x | x | x | | | x | | | x | x | | x | x | x |
| *Zieria collina* | x | | x | x | x | x | x | | | | | | | | x | | x | x | x |
| Vegetation Communities[2] | | | | | | | | | | | | | | | | | | | |
| *Acacia harpophylla* open forest on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| *Acacia harpophylla* open forest on sedimentary rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| Araucarian complex microphyll vine forest on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| Araucarian microphyll to notophyll vine forest on sedimentary rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| *Eucalyptus dunnii* tall open forest on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| *Eucalyptus grandis* tall open forest on alluvial plains (Qld) | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x |
| *Eucalyptus laevopinea* tall open forest on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | | x | x | x | x | | x | x | x | | x | x | x |
| *Eucalyptus nobilis* tall open forest on alluvial plains (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | | x | x | x |
| *Eucalyptus obliqua* tall open forest on Cainozoic igneous rocks (Qld) | x | x | x | | | x | | x | x | | x | | | | x | x | x | x | x |

| | Objective/Outcome | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1: Organisational-related impediments | 2: Climate change impacts | 2.1: Climate change linkages | 3: Clearing | 4: Fragmentation, modification and degradation | 5; 5.3: Weed invasion | 5; 5.4: Existing weeds | 6: Fire | 7; 7.3: New pest animals | 7; 7.4: Invading pest animals | 7; 7.5: Existing pest animals | 8: Bell Miner Associated Dieback | 9: Livestock | 10: Human interference | 11: Pathogens and diseases | 12: Viability and evolutionary potential | 13: Cultural value to Indigenous community | 14: Community engagement | 15: Monitoring of projects |
| *Eucalyptus oreades* tall open forest on Cainozoic igneous rocks (Qld) | x | x | x | | | x | | x | x | | | | | x | x | | x | x | x |
| *Eucalyptus saligna* or *E. grandis* tall open forest on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | | x | x | x | x | x | x | x | x | | x | x | x |
| Gallery rainforest (notophyll vine forest) on alluvial plains (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | | x | x | x |
| Grey Box - Grey Gum Wet Sclerophyll Forest EEC (NSW) | x | x | x | x | x | x | x | x | x | | | x | x | x | x | | x | x | x |
| Littoral rainforest EEC | x | x | x | x | x | x | x | x | x | | x | | x | x | x | x | x | x | x |
| Lowland rainforest EEC (NSW) | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | x | x | x | x |
| Lowland rainforest on floodplain EEC | x | x | x | x | x | x | x | x | x | | x | | x | x | x | x | x | x | x |
| Notophyll vine forest on parabolic high dunes (Qld) | x | x | x | | | x | | x | x | x | | | | | x | | x | x | x |
| Semi-evergreen vine thicket with *Brachychiton rupestris* on Cainozoic igneous rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| Semi-evergreen vine thicket with *Brachychiton rupestris* on sedimentary rocks (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| Semi-evergreen vine thickets EEC (Commonwealth - Qld component only) | x | x | x | x | x | x | x | x | x | x | x | | x | | x | | x | x | x |
| Simple microphyll fern forest with *Nothofagus moorei* on Cainozoic igneous rocks (Qld) | x | x | x | | | x | | x | x | | | | | x | x | | x | x | x |
| Simple microphyll fern thicket with *Acmena smithii* on Cainozoic igneous rocks (Qld) | x | x | x | | | x | | x | x | | | | | | x | | x | x | x |
| Tall open forest of *Eucalyptus pilularis* open forest on metamorphics and interbedded volcanics (Qld) | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | | x | x | x |
| White gum (*Eucalyptus dunnii*) moist forest (NSW) | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |

[1]Queensland part of species distribution within Planning Area only

[2]Juristiction of listed vegetation community indicated in brackets

# Appendix 15: Functional trait-based Weed Management Groups

The trait-based approach to weed management utilises functional traits to categorise weeds into management groups based on their behaviour (Kooyman et al. 2007). Initially, 53 rainforest weeds were identified and then categorised into five broad groups that represent the influence of dispersal (including fruit size, seed size and dispersal mode), shade tolerance, persistence (capacity to resprout or persist on site by seed-based regeneration) and the component of the forest structure they are most likely to affect (ground, mid canopy or canopy). Further refinement of the five groups has identified three management groups and several subgroups provided below. Since the original analysis of Kooyman et al. (2007), further weed taxa have been identified and placed in the category that best reflects their functional traits.

The final weed groupings provide an overall indication of a weed's ability to exploit undisturbed or disturbed rainforest or edges of rainforest, its method of dispersal and the stratum of the forest it potentially threatens most. Those weeds able to establish in full shade (i.e. exploit intact rainforest) and affect the canopy are possibly the group of greatest threat in the Planning Area, while weeds in shade intolerant groups are most likely to be a threat to riparian edges and fragmented remnants.

A weed's dispersal mechanism also has the potential to influence management options. For example, the ability to contain an infestation is potentially greater for weeds that are not actively dispersed by vectors such as wind or frugivory. An exception to this, however, is in riparian areas where water can provide an effective dispersal mechanism. In such areas, treatment of weeds immediately adjacent to the water edge is essential before working in areas further back. It is also important to work in the upper catchment first to prevent ongoing reinfestation from upstream areas.

| Scientific name | Common name | Height class |
|---|---|---|
| Weed Management Group 1: Shade tolerant | | |
| 1.1 Shade tolerant, frugivore dispersal | | |
| *Asparagus plumosus* | Climbing Asparagus | Canopy |
| *Asparagus aethiopicus* | Ground Asparagus Fern | Ground |
| 1.2 Shade tolerant, wind dispersal | | |
| *Ageratina riparia* | Mistflower | Ground |
| *Macfadyena unguis-cati* | Cat's Claw Creeper | Canopy |
| 1.3 Shade tolerant, unassisted dispersal (gravity, water, tuber) | | |
| *Paspalum mandiocanum* | Paspalum | Ground |
| Weed Management Group 2: Semi-shade tolerant | | |
| 2.1 Semi-shade tolerant, frugivore dispersal | | |
| *Ardisia crenata* | Coral Berry | Ground |
| *Rivina humilis* | | Ground |
| *Ochna serrulata* | Mickey Mouse Plant | Ground |
| *Hedychium gardnerianum* | Kahili Ginger | Mid canopy |
| *Ligustrum sinense* | Small Leaved Privet | Mid canopy |
| *Schefflera actinophylla* | Umbrella Tree | Mid canopy |
| *Coffea arabica* | Coffee | Mid canopy |
| *Psidium guajava* | Guava | Mid canopy |

| Scientific name | Common name | Height class |
|---|---|---|
| *Senna septemtrionalis* | Smooth Senna | Mid canopy |
| *Passiflora suberosa* | Corky Passion Flower | Mid canopy |
| *Passiflora subpeltata* | White Passion Flower | Mid canopy |
| *Ligustrum lucidum* | Large Leaved Privet | Canopy |
| *Solanum seaforthianum* | Brazilian Nightshade | Ground to mid canopy |
| *Cinnamomum camphora* | Camphor Laurel | Canopy |
| *Gloriosa superba* | Glory Lily | Ground |
| 2.2 Semi-shade tolerant, wind dispersal | | |
| *Ageratina adenophora* | Crofton Weed | Ground |
| *Lilium formosanum* | Formosa Lily | Ground |
| *Caesalpinia decapetala* | Thorny Poinciana / Mysore Thorn | Ground |
| *Delairea odorata* | Cape Ivy | Ground |
| *Senecio tamoides* | | Ground |
| *Aristolochia elegans* | Dutchman's Pipe | Mid canopy |
| *Ipomoea indica* | Morning Glory | Canopy |
| 2.3 Semi-shade tolerant, unassisted dispersal (gravity, water, tuber) | | |
| *Tradescantia fluminensis* | Wandering Jew | Ground |
| *Gleditsia triacanthos* | Honey Locust | Mid canopy |
| *Erythrina crista-galli* | Indian Coral Tree | Canopy |
| *Erythrina x sykesii* | | Canopy |
| *Anredera cordifolia* | Madeira Vine | Canopy and ground |
| Weed Management Group 3: Shade intolerant | | |
| 3.1 Shade intolerant, frugivore dispersal | | |
| *Lonicera japonica* | Honeysuckle | Ground to mid canopy |
| *Murraya paniculata* | | Mid canopy |
| *Physalis viscosa* | Cape Gooseberry | Ground |
| *Chrysanthemoides monilifera* subsp. *rotundata* | Bitou Bush | Mid canopy |
| *Lantana camara* | Lantana | Mid canopy |
| *Pyracantha* spp. | Firethorn | Mid canopy |
| *Solanum chrysotrichum* | Giant Devil's Fig | Mid canopy |
| *Solanum mauritianum* | Tobacco Bush | Mid canopy |
| *Citrus trifoliata* | Bush Lemon | Mid canopy |
| *Passiflora edulis* | Passionfruit | Mid canopy |
| *Celtis sinensis* | Chinese Celtis / Chinese Elm | Canopy |
| *Schinus terebinthifolius* | Broadleaf Pepper | Canopy |
| *Ficus* spp. | Non-native figs | Canopy |
| *Syagrus romanzoffiana* | Cocos Palm | Canopy |
| 3.2 Shade intolerant, wind dispersal | | |
| *Buddleja davidii* | Buddleia | Mid canopy |
| *Araujia sericifera* | Moth Vine | Mid canopy |

| Scientific name | Common name | Height class |
|---|---|---|
| *Cardiospermum grandiflorum* | Balloon Vine | Canopy |
| *Corymbia torelliana* | Cadaghi | Canopy |
| 3.3 Shade intolerant, unassisted dispersal (gravity, water, tuber) | | |
| *Paspalum* spp. | Paspalum | Ground |
| *Pennisetum clandestinum* | Kikuyu | Ground |
| *Pueraria lobata* | Kudzu | Mid canopy |
| *Desmodium uncinatum* | | Mid canopy |
| *Neonotonia wightii* | Glycine | Mid canopy |

Identification of rainforest weeds of the Planning Area is an ongoing process. For each new weed taxon, expert knowledge can be used to add the taxon to the relevant weed management group. Taxa are still being identified as being either present in the rainforest of the Planning Area or potential invaders (Big Scrub Rainforest Landcare Group 2000; H. Bower pers. comm.; B. McDonald pers. comm.). These are yet to be placed in appropriate groups and include:

- *Cestrum elegans* at Mt Glorious and Tamborine Springs
- African Boxthorn *Licium ferocissimum* in western Main Range
- Pepper Tree *Schinus areira* in western Main Range
- Guinea Grass *Megathyrsus maximus* var. *maximus* and Green Panic *M*. *m*. var. *pubiglumus* in drier rainforest areas
- Cherry Guava *Psidium cattleianum* at Broken Head and Wilsons Creek in NSW
- Asparagus Fern *Asparagus africanus*
- Bridal Creeper *Asparagus asparagoides*
- Sicklethorn *Asparagus falcatus*
- India Plum *Flacourtia jangomas*
- Aerial Yam *Dioscorea bulbifera*
- White Trumpet Vine *Pithecocteniun cyanchoides*
- Japanese Climbing Fern *Lygodium japonicum*
- Barbados Gooseberry *Pereskia aculeata*
- Loquat *Eriobotrya japonica*
- African Olive *Olea europa* subsp*. cuspidata*
- Creeping Bamboo *Arundinaria* spp.
- Five-leaved Morning Glory *Ipomoea cairica*
- Common Morning Glory *Ipomoea purpurea*
- Brazil Cherry *Eugenia uniflora*
- Groundsel Bush *Baccharis halimifolia*
- Winter Senna *Senna pendula* var. *glabrata*
- Castor Oil Plant *Ricinus communis*
- Mother-of-Millions *Bryophyllum delagoense*
- Resurrection Plant *Bryophyllum pinnatum*

- Butterfly Bush *Buddleja madagascariensis*
- Canna Lily *Canna indica*
- Hairy Commelina *Commelina benghalensis*
- Striped Wandering Jew *Tradescantia zebrina.*

The weed species grouping that resulted from the cluster analysis of Kooyman et al. (2007) and informed the Weed Management Groups above, are shown below.

| Scientific Name | Common Name | Group | Dispersal Mode | Seed (mm) | Fruit (mm) | Persistence (clonality) | Shade tolerance | Height |
|---|---|---|---|---|---|---|---|---|
| *Paspalum* spp. | Paspalum | 1 | unassisted | 1-6 | 1-6 | partial | no | ground |
| *Pennisetum clandestinum* | Kikuyu | 1 | unassisted | 1-6 | 6-15 | partial | no | ground |
| *Inga edulis* | Icecream Bean | 1 | unassisted | 6-15 | >30 | partial | no | mid |
| *Desmodium uncinatum* | Silver-leaved Desmodium | 1 | unassisted | 1-6 | 6-15 | yes | no | mid |
| *Neonotonia wightii* | Glycine | 1 | unassisted | 1-6 | 6-15 | partial | no | mid |
| *Pueraria lobata* | Kudzu | 1 | unassisted | 1-6 | >30 | yes | no | mid |
| *Gloriosa superba* | Glory Lily | 1 | unassisted | 1-6 | 6-15 | yes | partial | ground |
| *Tradescantia fluminensis* | Wandering Jew | 1 | unassisted | 1-6 | 1-6 | partial | partial | ground |
| *Gleditsia triacanthos* | Honey Locust | 1 | unassisted | 6-15 | >30 | yes | partial | mid |
| *Erythrina crista-galli* | Indian Coral Tree | 1 | unassisted | 6-15 | >30 | yes | partial | canopy |
| *Anredera cordifolia* | Madeira Vine | 1 | unassisted | 1-6 | 1-6 | yes | partial | canopy |
| *Lonicera japonica* | Honeysuckle | 2 | frugivore | 1-6 | 6-15 | yes | no | ground |
| *Physalis viscosa* | Cape Gooseberry | 2 | frugivore | 1-6 | 6-15 | partial | no | ground |
| *Buddleja davidii* | Buddleia | 2 | wind | <1 | 6-15 | yes | no | mid |
| *Chrysanthemoides monilifera* subsp. *rotunda* | Bitou Bush | 2 | frugivore | 1-6 | 6-15 | yes | no | mid |
| *Duranta erecta* | Duranta | 2 | frugivore | 1-6 | 6-15 | yes | no | mid |
| *Lantana camara* | Lantana | 2 | frugivore | 1-6 | 1-6 | partial | no | mid |
| *Pyracantha* spp. | Firethorn | 2 | frugivore | 1-6 | 6-15 | yes | no | mid |
| *Solanum chrysotrichum* | Giant Devil's Fig | 2 | frugivore | 1-6 | 6-15 | partial | no | mid |
| *Solanum mauritianum* | Tobacco Bush | 2 | frugivore | 1-6 | 6-15 | partial | no | mid |
| *Celtis sinensis* | Chinese Celtis / Chinese Elm | 2 | frugivore | 1-6 | 6-15 | partial | no | canopy |
| *Jacaranda mimosifolia* | Jacaranda | 2 | wind | <1 | 6-15 | yes | no | canopy |
| *Schinus terebinthifolius* | Broadleaf Pepper | 2 | frugivore | 1-6 | 6-15 | yes | no | canopy |
| *Cinnamomum camphora* | Camphor Laurel | 2 | frugivore | 1-6 | 6-15 | yes | partial | canopy |
| *Ageratina adenophora* | Crofton Weed | 3 | wind | 1-6 | 1-6 | yes | partial | ground |
| *Ageratina riparia* | Mistflower | 3 | wind | 1-6 | 1-6 | yes | partial | ground |
| *Ardisia crenata* | Coralberry | 3 | frugivore | 1-6 | 6-15 | partial | partial | ground |

| Scientific Name | Common Name | Group | Dispersal Mode | Seed (mm) | Fruit (mm) | Persistence (clonality) | Shade tolerance | Height |
|---|---|---|---|---|---|---|---|---|
| *Lilium formosanum* | Formosa Lily | 3 | wind | <1 | 6-15 | partial | partial | ground |
| *Rivina humilis* | Coral Berry | 3 | frugivore | 1-6 | 1-6 | partial | partial | ground |
| *Ochna serrulata* | Mickey Mouse Plant | 3 | frugivore | 1-6 | 6-15 | partial | partial | ground |
| *Asparagus asparagoides* | Bridal Creeper | 3 | frugivore | 1-6 | 6-15 | yes | partial | mid |
| *Coffea arabica* | Coffee | 3 | frugivore | 1-6 | 6-15 | yes | partial | mid |
| *Ligustrum sinense* | Small Leaved Privet | 3 | frugivore | 1-6 | 6-15 | yes | partial | mid |
| *Schefflera actinophylla* | Umbrella Tree | 3 | frugivore | 1-6 | 1-6 | partial | partial | mid |
| *Aristolochia elegans* | Dutchman's Pipe | 3 | wind | 1-6 | 6-15 | partial | partial | mid |
| *Ligustrum lucidum* | Large Leaved Privet | 3 | frugivore | 1-6 | 6-15 | yes | partial | canopy |
| *Ipomoea indica* | Morning Glory | 3 | wind | 1-6 | 6-15 | yes | partial | canopy |
| *Solanum seaforthianum* | Brazilian Nightshade | 3 | frugivore | 1-6 | 6-15 | partial | partial | canopy |
| *Asparagus aethiopicus* | Ground Asparagus | 3 | frugivore | 1-6 | 6-15 | yes | yes | ground |
| *Asparagus plumosus* | Climbing Asparagus | 3 | frugivore | 1-6 | 1-6 | yes | yes | canopy |
| *Citrus trifoliata* | Bush Lemon | 4 | frugivore | 1-6 | >30 | yes | no | mid |
| *Araujia sericifera* | Moth Vine | 4 | wind | 1-6 | >30 | yes | no | mid |
| *Passiflora edulis* | Passionfruit | 4 | frugivore | 1-6 | >30 | partial | no | mid |
| *Ficus* spp. | Feral (non native) Figs | 4 | frugivore | 1-6 | >30 | yes | no | canopy |
| *Cardiospermum grandiflorum* | Balloon Vine | 4 | wind | 6-15 | >15-30 | yes | no | canopy |
| *Macfadyena unguis-cati* | Cat's Claw Creeper | 4 | wind | 6-15 | >30 | yes | no | canopy |
| *Caesalpinia decapetala* | Thorny Poinciana / Mysore Thorn | 4 | wind | 6-15 | >30 | yes | partial | ground |
| *Psidium guajava* | Guava | 4 | frugivore | 1-6 | >30 | yes | partial | mid |
| *Senna septemtrionalis* | Smooth Senna | 4 | frugivore | 1-6 | >30 | partial | partial | mid |
| *Passiflora suberosa* | Corky Passion Flower | 4 | frugivore | 1-6 | >30 | partial | partial | mid |
| *Passiflora subpeltata* | White Passion Flower | 4 | frugivore | 1-6 | >30 | partial | partial | mid |
| *Syagrus romanzoffiana* | Cocos Palm | 5 | frugivore | >15-30 | >15-30 | partial | no | canopy |
| *Corymbia torelliana* | Cadaghi | 5 | wind | <1 | 6-15 | no | no | canopy |

## *References*


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# Border Ranges Rainforest

## Biodiversity Management Plan

NSW & Queensland

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