Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

1. Summary of conservation assessment by the Committee

This advice follows the assessment of information to list the **Mixed microphyll/notophyll vine thicket on beach ridges (Quaternary Sands)** ecological community. The nomination was made available for public exhibition and comment for a period of two months. The Threatened Species Scientific Committee (Committee) had regard to all public and expert comments that were relevant to the survival of the ecological community.

The Committee judges that the ecological community has been demonstrated to have met sufficient elements of:

- Criterion 2 to make it **eligible** for listing as **critically endangered**; and
- Criterion 4 to make it **eligible** for listing as **critically endangered**.

2. Name of the ecological community

A nomination was received for the Mixed Microphyll/Notophyll Vine Thicket on Beach Ridges ecological community that occurs on Quaternary sands in the northern portion of the South Eastern Queensland Bioregion. Experts identified similar vine forests on beach ridges and headlands in other bioregions along the east coast of Australia, including offshore islands, as components of a broader ecological community. The broader extent of this ecological community is supported by its adaptation to coastal processes. In this context, the Committee considers it appropriate to extend the current nomination to cover littoral rainforest and coastal vine thickets on the east coast of Australia from Princess Charlotte Bay in the Cape York Peninsula Bioregion, Queensland (QLD), to the Gippsland Lakes in the South East Corner Bioregion, Victoria.

To reflect the broader extent of the ecological community, the Committee recommends that the name be changed from that nominated to the **'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia'**. The ecological demarcation of this ecological community is discussed in detail under Section 5, 'National Context'.

3. Description

General Features

The ecological community represents a complex of rainforest and coastal vine thickets, including some that are deciduous, on the east coast of Australia. Typically, the ecological community occurs within two kilometres of the coast or adjacent to a large salt water body, such as an estuary and, thus, is influenced by the sea. It is naturally distributed as a series of disjunct and localised stands occurring on a range of landforms derived from coastal processes that can include dunes and flats, cheniers, berms, cobbles, headlands, scree, seacliffs, marginal bluffs, spits, deltaic deposits, coral rubble and islands. As a result, the ecological community is not associated with a particular soil type and can occur on a variety of geological substrata.

The ecological community occurs from Princess Charlotte Bay, Cape York Peninsula to the Gippsland Lakes in Victoria as well as on offshore islands on the east coast. The latitudinal range where the ecological community occurs encompasses warm temperate, sub-tropical and

tropical climate zones. In terms of temperature and humidity, the climate is more equable than sites further inland.

The ecological community is defined by habitat expressed in terms of structure, floristic composition and ecology in response to coastal processes. The unifying feature of its habitat is the salinity, derived from the ecological community's proximity to the sea. Saline influence is delivered via aerosols, saline water-tables or occasional inundation.

Whilst the ecological community's canopy species are well adapted to coastal exposure (e.g. strong and persistent salt-laden winds and storm events), the canopy protects less tolerant species and propagules in the understorey. The canopy height varies with the degree of exposure and can range from dwarf to medium (<1-25 m; Specht 1970). Due to extreme exposure to salt laden winds, the canopy often demonstrates a continuum of heights. Highly exposed patches will display the effect of windshear in the canopy. In more sheltered sites, for example, around estuaries, wind shear may not be evident in the canopy.

The canopy is typically closed but may also be patchy and may include emergents. Those stands that occur in exposed coastal situations can have many rainforest gaps caused by storm events which, in turn, may lead to canopy decapitation. In these exposed sites, there is often a secondary canopy that has developed below the old canopy.

The diversity of plant taxa (particularly canopy species) generally declines in a north to south direction, i.e. with increasing latitude. However, species richness of adjacent patches may vary considerably within one latitudinal zone.

The ecological community provides important stepping stones along the eastern Australian coast for various migratory and marine birds. For example, the nationally listed marine species *Ducula bicolor* (Pied Imperial Pigeon), a migratory species from north of New Guinea, feeds on fruit associated with mainland littoral rainforests and disperses the seeds on offshore islands where it roosts. Given its proximity to the sea, seabirds may also be associated with some stands of littoral rainforest, e.g. the nationally endangered migratory *Pterodroma leucoptera leucoptera* (Gould's Petrel) has one significant breeding locality at Cabbage Tree Island off the coast at Port Stephens in New South Wales (NSW) (DEC 2006a).

Key Diagnostic Characteristics

The key diagnostic features of the ecological community are described below to aid its identification.

- The ecological community occurs in the following IBRA bioregions: Cape York Peninsula (from Princess Charlotte Bay southwards), Wet Tropics, Central Mackay Coast, South Eastern Queensland, NSW North Coast, Sydney Basin and South East Corner.
- Patches of the ecological community occur within two kilometres of the east coast, including offshore islands, or adjacent to a large body of salt water, such as an estuary, where they are subject to maritime influence.
- The structure of the ecological community typically is a closed canopy of trees that can be interspersed with canopy gaps that are common in exposed situations or with storm events. Usually, several vegetation strata are present. However, where there is extreme exposure to salt laden winds, these strata may merge into a height continuum rather than occurring as distinct vegetation layers. The canopy forms a mosaic due to canopy regeneration, typically in the form of basal coppice following canopy decapitation due to prevailing salt laden winds and storm events. Wind sheared canopy can be present on the frontal section leading to closed secondary canopies. Emergents may be present, for

example, species from the genera *Araucaria* (northern bioregions only), *Banksia* or *Eucalyptus*. The ground stratum of the vegetation typically is very sparse.

- The ecological community contains a range of plant life forms including trees, shrubs, vines, herbs, ferns and epiphytes. To the north, most plant species diversity is in the tree and shrub (i.e. canopy) layers rather than in lower strata. The converse generally occurs from the Sydney Basin Bioregion southwards. Feather palms, fan palms, large leaved vascular epiphytes and species that exhibit buttressing are generally rare. Ground ferns and vascular epiphytes are lower in diversity in littoral rainforests compared to most other rainforest types.
- Plants with xeromorphic and succulent features are generally more common in littoral rainforest than in hinterland rainforest types. Canopy stem sizes also tend to be smaller compared to that in hinterland rainforest. Trunks rarely host mosses though lichens are usually common.
- Whilst species can be regionally predictable, there may be considerable variation in the composition of individual stands of the ecological community within any given bioregion. Attachment A provides a list of flora species for each relevant bioregion.

4. Condition Thresholds

The listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community comprises those patches that meet the key diagnostic characteristics (above) and the condition thresholds presented below.

- Small patches can be resilient and viable, but the minimum size of a patch needs to be 0.1 ha; AND
- The cover of transformer weed species (as identified in Attachment A) is 70% or less. Transformer weeds are highly invasive taxa with the potential to seriously alter the structure and function of the ecological community. This threshold recognises the relative resilience and recoverability of the ecological community to invasion by weed species; AND
- The patch must have:
    - at least 25% of the native plant species diversity characteristic of this ecological community in that bioregion (Attachment A);

    OR

    - at least 30% canopy cover of one rainforest canopy (either tree or shrub) species (Attachment A, excluding Banksia and Eucalyptus species that may be part of the ecological community).

Condition Threshold Notes

Where gaps in the canopy exist, they should be in the process of regenerating with the usual suite of rainforest gap species for the site. Where weed invasion is significant, natural regeneration of native gap species may be limited.

As species diversity diminishes from northern to southern latitudes, it is important to take into account the natural diversity of a patch in a particular bioregion when examining specific sites. For example, it is possible to find littoral rainforest stands that are dominated by single tree species or a small number of species (Miles & Kendall 2006). If such patches are in good

condition, they will also be representative of the ecological community and they may also contain rainforest dependent fauna species.

The condition criteria outlined above represent the minimum level for patches to be included in the listed ecological community.

5. National Context

Littoral rainforest occurs throughout the Indo-Pacific region, where it has a broadly similar structure and often includes widespread floristic elements (Adam 1992). Within Australia, littoral rainforest occurs along the coast from far eastern Victoria up the east coast through NSW and Qld and across the Northern Territory (NT) and Western Australia (WA). Throughout this distribution, littoral rainforest crosses different climatic zones and gradually changes in species composition. This gradual variation in composition makes it difficult to provide explicit spatial circumscription of this ecological community and a range of somewhat arbitrary disjunctions may be valid. Given this situation, the Committee considers that the ecological demarcation, discussed below, achieves the best conservation outcome.

The continuity of rainforest areas on the north-eastern coast of Australia is fragmented by a dry corridor of relatively low rainfall in the Laura Basin, which is situated in the southern portion of Cape York Peninsula and meets the coast at Princess Charlotte Bay (Winter et al. 1987). This corridor separates the northern occurrences of littoral rainforest, which encompasses most of the Cape York Peninsula, the NT and Kimberley, from the southern occurrences of littoral rainforest, which encompasses the southern portion of the Cape York Peninsula, NSW and eastern Victoria. Generally, a greater monsoonal influence further distinguishes the northern littoral rainforests from the southern littoral rainforest ecological community.

This listing advice covers the particular aspects pertaining to the southern occurrences of littoral rainforest along the eastern coastline of Australia (including offshore islands) from Princess Charlotte Bay, Cape York Peninsula to, and including, eastern Victoria. The national extent of the southern ecological community, thus, encompasses the following IBRA bioregions: Cape York Peninsula (from Princess Charlotte Bay southwards), Wet Tropics, Central Mackay Coast, South Eastern Qld, NSW North Coast, Sydney Basin and South East Corner.

In Qld, the Regional Ecosystems that equate wholly to the ecological community are: 3.2.1a, 3.2.1b, 3.2.12, 3.2.13, 3.2.28, 3.2.29, 3.2.31, 3.2.11, 3.12.20, 7.2.1a-i, 7.2.2a-h, 7.2.5a, 7.2.6b, 7.11.3b, 7.12.11d, 8.2.2 and 12.2.2. Under the *Vegetation Management Act, December 2005*, the vegetation management status of these regional ecosystems is mainly ‘of concern’ whilst the biodiversity status is mainly ‘of concern’ or ‘endangered’.

Regional Ecosystem 11.2.3, which also equates to littoral rainforest and occurs in the Brigalow Belt North Bioregion, was listed on 4 April 2001 as a component of the nationally endangered ecological community, *Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions*. As a result, Regional Ecosystem 11.2.3 is not included as part of the proposed listing of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community.

In NSW, ‘Littoral Rainforest in NSW North Coast, Sydney Basin and South East Corner Bioregions’ is listed as endangered under the *Threatened Species Conservation Act 1995*. The legal definition of the ecological community under the State Environmental Planning Policy No. 26 (SEPP 26) includes littoral rainforest occurring on headlands as well as on sand. This is consistent with the definition of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community.

The ecological community is not listed in Victoria nor was it recognised until recently, when surveys identified patches of the ecological community between Aragannu Beach, near Bermagui, NSW and the Gippsland Lakes in Victoria (Peel in prep.). The occurrence of the ecological community in Victoria is limited to eastern Gippsland.

6. Relevant Biology and Ecology

The ecological community provides a range of benefits to the landscape. It is an important buffer to coastal erosion and wind damage (Meier & Figgis 1985) and provides natural refugia, suitable nest sites and food resources for resident and seasonally migratory species (Williams 1993). For example, rainforest taxa including Lauraceae (laurels), Myrtaceae (lilypillies) and Arecaceae (palms), which are part of the ecological community, provide important fruits to the nationally endangered *Casuarius casuarius johnsonii* (Southern Cassowary) which occurs in the Cape York Peninsula and the Wet Tropics Bioregions. In return, the bird disperses the seeds of these rainforest fruits (Buosi & Burnett 2006). The mode of seed dispersal by this keystone species ensures the long-term viability of rainforest communities (Williams 1993). Similarly, *Pteropus poliocephalus* (Grey-headed Flying Fox), which occurs along the coastal belt from south-eastern Qld to Melbourne, Victoria, is responsible for the seed dispersal of many rainforest trees, such as native figs and palms (Tidemann 1998) which are components of the ecological community. The extent of seed dispersal by the species is exceptional among Australian frugivores as the species moves seeds between isolated rainforest patches (Eby 1991).

There are also insect and other invertebrate species restricted to the ecological community as it provides refuge/critical habitat for rainforest dependent species. For example, two beetle species, *Helferella manningensis* and *H. miyal* (Buprestidae), are known only from littoral rainforest remnants at Harrington and Manning Point, NSW (Williams 1993).

The ecological community exhibits a decline in plant species diversity from northern to southern latitudes. For example, compared to southern NSW, littoral rainforest stands in northern NSW are likely to have a greater number of canopy species reflecting their derivation from subtropical rainforest (Miles & Kendall 2006). In the south coast of NSW, littoral rainforest stands may be dominated by one or few tree species, e.g. *Acmena smithii* (Lillypilly), *Pittosporum undulatum* (Sweet Pittosporum), *Ficus rubiginosa* (Port Jackson Fig) or *Myrsine howittiana* (Muttonwood) (Miles & Kendall 2006).

The ecological community often occurs in a state of regeneration due to ongoing natural disturbance, e.g. from storm events. Consequently, patches may have canopy gaps that are temporary and, over time, will be filled-in with the usual suite of rainforest gap species for the site. Moreover, gaps are important for some gap-specialist species such as the nationally endangered *Cynanchum elegans* (White-flowered wax plant).

The ecological community is somewhat protected from fire by coastal processes including oceanic aerosols, salt laden wind and storm surges. Other factors that help protect the ecological community from fire include prevailing winds (south-easterly and north-easterly winds are relatively cool and maintain relatively high levels of humidity on the coast), and the occurrence of swamps, streams, coastal inlets, mangroves or salt pans, that frequently occur on the inland side of littoral rainforest. This natural protection against fire is however significantly compromised when woody weeds invade littoral rainforest patches.

A list of nationally threatened species associated with the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community is at Attachment B. Whilst the list is not exhaustive, it includes 26 endangered species listed under the EPBC Act (19 flora and 7 fauna).

7. Description of Threats

What was once an almost continuous archipelago of patches of the ecological community along the eastern coast of Australia has been reduced and fragmented primarily by coastal development, sandmining and agriculture (Bradley & Merrilyn 1992). The resulting fragmentation and reduction in patch size render the ecological community more vulnerable to other threats including weed invasion, edge effects and fire. The key threats to this ecological community are outlined below.

Past Developments

Past development actions, including sand mining and agriculture, have resulted in the decline and fragmentation of the ecological community across its range. For example, the high quality soils on the Permian volcanic Kiama coastline led to clearance for agriculture from the early 1800s' (Mills 2006, pers. comm.). Presently, there are just small remnants left at Gerroa that are listed under SEPP 26 (Mills 2006, pers. comm.).

Coastal Development

Urban development is one of the main pressures on Australia's coastal environment (Beeton et al. 2006) where the ecological community continues to be threatened by vegetation clearance. For example, in the Wet Tropics Bioregion, residential development and the widening of the Cook Highway, between Oak Beach and White Cliffs near Cairns, represent major threats to the ecological community (EPA 2005a). Also, at Mission Beach, south of Innisfail, the ecological community is threatened by clearing for residential development and tourism.

Such development is likely to intensify over time due to the predicted increase of the human population along the eastern coastline of Australia. From 1980 to 2004 coastal urban development rose (Beeton et al. 2006). As a result, it was projected that 42.3% of the Nowra (NSW) to Noosa (Qld) coastline will be urbanised by the year 2050, with the resulting loss of much of Australia's temperate and tropical coastal systems (Beeton et al. 2006) including this ecological community.

Along the Qld coast, the human population is projected to increase significantly. For example, in Qld, the statistical division of Moreton is projected to experience an increase in population of approximately 56% between 2006 and 2026. Moreover, the statistical divisions of Wide Bay-Burnett and Fitzroy are projected to experience growth of approximately 34% and 29% respectively over the same period whilst that of Mackay and the Northern regions (which overlap with the Wet Tropics Bioregion) are projected to increase by approximately 37% and 26% respectively. The Far North statistical division is also projected to grow by 31% for the same period (Queensland and Statistical Divisions 2006).

In NSW, coastal regions will continue to have the fastest growth rates in the state. By 2030, the population living in coastal NSW is projected to grow by approximately 440 000 people or 28%. This represents almost one-third of all growth projected in the State (Culpin et al. 2000). The NSW Government's South Coast Regional Strategy expects that over the next 25 years an additional 45 600 new dwellings will be built along the coast from Nowra to the Victorian border (Pacey 2007).

In Victoria, where the ecological community occurs, the human population in East Gippsland, is projected to increase from approximately 39 000 in 2001 to 47 000 by 2031, an increase of approximately 20% (DSE 2004a). Population growth in East Gippsland is likely to be concentrated around Paynesville and Lakes Entrance where the ecological community occurs (DSE 2004a).

Tourism and Visitor Disturbance

According to the Bureau of Tourism Research (DISR 2001), 50% of international visits and 42% of domestic visits are to coastal (and marine) areas. Due to the ongoing demand for tourism and recreational facilities to cater for non-consumptive uses of coastal and marine ecosystems (Ward & Butler 2006), this trend is likely to increase over time. Such pressure is likely to result in more development on coastal land and a rise in visitor numbers in conservation areas where the ecological community occurs.

Visitor disturbance in conservation areas includes soil compaction and disturbance, erosion from foot, cycle, trail bike and four wheel drive tracks, the introduction of pests and the creation of new planned and unplanned tracks. Increased visitation results in increased demand for and use of visitor facilities, such as walking tracks, viewing platforms, toilet blocks and picnic areas, many of which are located in littoral rainforest patches because of their attractive landscape features (shade, open understorey and proximity to the sea). These impacts hinder the recruitment of key canopy species, slowing regeneration rates and facilitating establishment of weeds. Other impacts in such areas include the dumping of cars and rubbish and the dumping of garden waste which has the potential to cause weed infestation (NSW Scientific Committee 2004). For example, in the Central Mackay Coast Bioregion, the ecological community receives high use by recreational vehicles and foot traffic where it occurs close to urban areas. In addition to these impacts the ecological community is invaded by Lantana (*Lantana camara*) (EPA 2005b). At Corringle Slips, near Orbost, Wingan Inlet and Mallacoota, Victoria, recreational development, such as campgrounds, is the most common and ongoing key threat to this ecological community (Peel in prep.).

Climate Change

Another significant threat is climate change which has the capacity to augment the detrimental effects of natural disturbances and other threats including fire and invasive weeds. As a result of climate change, the following changes are likely to affect the ecological community: rising sea levels; increased rainfall variability; and increased frequency of severe weather events which are projected to lead to major coastal erosion events, storm surges and saline inundation (DSE 2004b).

Weeds

The establishment of transformer weeds in littoral rainforest patches can have a significantly detrimental effect. Transformer weeds are highly invasive taxa with the potential to seriously alter the structure and function of the ecological community. Whilst it is accepted that the ecological community can tolerate a significant amount of weed cover due to its relative resilience, if left unchecked, such weeds will eventually take over and destroy the affected patch. Weeds that invade littoral rainforest, notably Pond Apple *(Annona glabra)*, Lantana, Bitou Bush *(Chrysanthemoides monilfera* subsp. *rotundata)* and Rubber Vine *(Cryptostegia grandiflora)* are all recognised as Weeds of National Significance i.e. high impact, highly invasive species.

Transformer weeds of the warm temperate climate zone of south-eastern Australia, such as Cape Ivy *(Delairea odorata)*, Bitou Bush, Lantana and Madeira Vine *(Anredera cordifolia)*, also extend into the sub-tropical zone of northern NSW (Williams 1993; Peel in prep.). Also Rubber Vine and *Senna siamea* are currently a problem near Princess Charlotte Bay and within Lakefield National Park, Cape York Peninsula, and have the potential to expand if left unchecked. This demonstrates that certain transformer weeds have the capacity to significantly expand their range on the eastern coastline.

Whether the ecological community is protected in reserves or not, the risk of weed infestation increases where patches of the ecological community are located near human habitation and/or are subject to visitor disturbance. This is supported by Peel's (in prep.) study where a positive correlation was found between proximity to human activity and weed invasion based on a sample of 251 sites. Peel (in prep.) found that the majority of weeds recorded were incidentally introduced through human activities such as agriculture, recreation, domestic gardens and associated refuse dumping.

Weed invasion can also occur through seed dispersal by birds and mammals. For example, this mode of dispersal has led to weed infestations of wilderness areas, such as Croajingolong National Park and Howe Wilderness, in Victoria. In NSW, many coastal habitats have been invaded by Bitou Bush through the spread of fruit by birds and flying foxes. Bitou Bush smothers canopy and may form dense growth around the edge of littoral rainforest (Adam 1992). This transformer weed has also spread into Qld where it has the potential to flourish in rainforest stands in southern south-east Qld. In the Cape York Peninsula Bioregion transformer weed invasion is mainly attributable to disturbance by cattle and pigs (Stanton & Fell 2005). Included in the array of transformer weeds that currently impact the ecological community in this Bioregion are Lantana, Pond Apple and Guinea Grass *(Megathyrsus maximus).*

Fire

The ecological community is generally protected from fire as a result of coastal processes (including high humidity, oceanic aerosols, wind direction, abundance of surface water), the presence of fire retardant vegetation (such as mangroves and salt marshes) and indigenous fire protection to conserve food resources. However, the accumulation of fuel loads derived from weeds with a high amount of flammable material increases the risk of fire which, depending on its intensity and frequency, can destroy an adjacent patch if not suppressed. The fragmented nature of the ecological community and the relatively small sized patches increase the risk of irreversible damage from fire.

Feral Animals

Grazing and browsing by feral deer {Sambar deer *(Cervus unicolor)* and Hog deer *(C. porcinus)*} has been shown to detrimentally impact the ecological community on both a local and landscape level. Browsing prevents regeneration of littoral rainforest canopy and understorey species and creates gaps in the vegetation which allows colonisation by weeds. This has occurred in the area near Genoa River, in Victoria, where the vegetation gaps have been colonised by Cape Ivy (*Delairea odorata*) and dense thickets of Madeira Winter-cherry (*Solanum pseudocapsicum*). These weeds are seriously contributing to the collapse of the existing littoral rainforest patches through the smothering of shrubs and young trees. Severe damage to littoral rainforest has also been observed from Twofold Bay in NSW to the Gippsland Lakes in Victoria. Persistent infestations are documented as causing the local loss of rainforest species and whole sections of mature rainforest in Victoria (Peel et al. 2005). The coastal expansion of feral deer has reached at least as far north as Bermagui (Peel in prep.). Where the ranges of the two deer overlap, patches of littoral rainforest (e.g. Marl Island) have been destroyed (Peel in prep.).

'Herbivory and habitat degradation caused by feral deer' is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act 1995.* 'Reduction in biodiversity of native vegetation by *Cervus unicolor* (Sambar Deer)' is listed as a Key Threatening Process under the Victorian *Flora and Fauna Guarantee Act 1988.*

Land Tenure

Nationally, approximately 65% of the ecological community is not protected in reserves (Accad et al. 2006; Bureau of Rural Sciences 2005; CAPAD 2004; Peel in prep.). This figure is indicative as the datasets available sometimes interface with incomplete mapping of the ecological community. Irrespective of this, residential and recreational developments and tourism will continue to exert increasing pressure both directly and indirectly on unprotected patches of the ecological community. Such development causes loss of habitat either directly through land clearing or indirectly through exposure of protected vegetation to salt and wind damage which causes loss of canopy integrity (NSW Scientific Committee 2004). Other indirect impacts include fragmentation and weed invasion which can increase the risk of fire.

Patches of the ecological community in conservation areas are detrimentally being impacted by the effects of visitor disturbance, weed invasion and feral deer browsing. If not managed effectively, such impacts will continue (Peel in prep.).

Natural Disturbance

In addition to the above anthropogenic sources of impacts, the ecological community is subject to natural disturbances, such as storm events and cyclones, which, depending on their intensity and frequency, can have a detrimental effect. For example, a severe storm can cause coastal erosion and accelerate the rate of weed invasion as the canopy and ground layer are disturbed.

8. How judged by TSSC in relation to the EPBC Act criteria.

The TSSC judges the ecological community is **eligible** for listing as **critically endangered** under the EPBC Act. The assessment against the criteria is as follows.

Criterion 1 - Decline in geographic distribution

There are significant gaps in the knowledge about the historic extent of the ecological community in Australia. In Qld, decline in extent is based on pre-European estimates and data on remnant vegetation from 1997 to 2003. The data indicate that there has been approximately an 11% decline (Table 1) (Accad et al. 2006). This figure is indicative as it is based on broad regional ecosystem datasets. With respect to individual bioregions, the greatest decline has occurred in Southeast Qld where the ecological community has experienced a 34% decline.

Data on decline over time do not exist for NSW and Victoria.

Bioregion	Regional Ecosystems	Pre-Clear Extent (ha)	Remnant Extent 1997 (ha)	Remnant Extent 2003 (ha)	Decline Pre-Clear to 2003 %
Cape York Peninsula	3.2.1, 3.2.31, 3.2.29, 3.2.28, 3.2.13, 3.2.12, 3.2.11, 3.12.20	9952	9946	9924	0.3
Wet Tropics	7.2.1, 7.2.2, 7.2.5, 7.2.6, 7.11.3, 7.12.11	22 717	20 012	20 009	12
Central Qld	8.2.2	2826	2513	2497	12
South-East Qld	12.2.2	2993	1995	1977	34
All Qld REs		38 488	34 466	34 407	11

Table 1. Decline in extent of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community based on broad regional ecosystem data in Queensland (Accad et al. 2006).

There are insufficient quantitative data available to estimate the extent to which the ecological community has undergone a decline. Although the Committee recognises that the ecological community is likely to have undergone a decline, the data are insufficient to determine whether that decline is very severe, severe or substantial. Therefore, as the ecological community has not been demonstrated to have met each of the required elements of Criterion 1, it is **not eligible** for listing in any category under this criterion.

Criterion 2 - Small geographic distribution coupled with demonstrable threat

The linear distribution of the ecological community along the eastern coastline of Australia straddles various bioregions. Within its distribution, the ecological community occurs in a range of patch sizes[1]. In Qld, there is generally a greater proportion of large patches compared to NSW and Victoria. A summary of mapping data sources including scale of mapping, list of pertinent regional ecosystems and associated species is at Attachment C. The following sections provide more detail on patch size and area of occupancy.

Queensland

In Qld, the total area of occupancy of the ecological community is approximately 16 135 ha (Table 2) (Accad et al. 2006)[2]. A total of 879 patches constitute the area of occupancy with patch sizes ranging from less than 0.1 ha to 2311 ha. More specifically, Table 2 shows that:

- the majority of patches, i.e. 77%, are less than 10 ha in size each; and
- only 18 patches (approximately 2%) are greater than 100 ha each.

Patch size (ha)	Number of patches	Total area of occupancy (ha)	Number of patches as % of total	Area of occupancy as % of total
0.1-<0.5	121	35	14	0.2
0.5-<1	122	88	14	0.5
1-<10	428	1704	49	11
10-<100	190	5770	21	36
≥100	18	8538	2	53
Total	**879**	**16 135**	**100**	**100**

Table 2. Data on area of occupancy and number of patches of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community in Queensland including islands off the east coast (Accad et al. 2006).

[1] Individual patches that are less than 0.1 ha exist in each State. However, they are not considered in the data on area of occupancy as the condition threshold on the minimum viable patch size is 0.1 ha.

[2] Because of scale limitations, which are being refined, the regional ecosystem mapping does not identify all Littoral Rainforest patches in Queensland.

New South Wales

Littoral rainforest is the least extensive of the rainforest types that occur in NSW and represents less than one per cent of the total area of rainforest (NSW Scientific Committee 2004).

Estimates for NSW are approximate as they derive from several sources (SEPP 26; Tozer et al. 2006; Miles & Kendall 2006; Peel in prep.).

The total area of occupancy of the ecological community is approximately 1624 ha (Table 3). A total of 433 patches constitute the area of occupancy with patch sizes ranging from 0.06 ha to 136 ha. More specifically, Table 3 shows that:

- the majority of individual patches, i.e. 92%, are less than 10 ha in size; and
- only one patch[3] (approximately 0.2%) is greater than 100 ha.

Patch size (ha)	Number of patches	Total area of occupancy (ha)	Number of patches as % of total	Area of occupancy as % of total
0.1-<0.5	98	23	23	1
0.5-<1	81	60	19	4
1-<10	219	629	50	39
10-<100	34	776	8	48
≥100	1	136	0.2	8
Total	**433**	**1624**	**100**	**100**

Table 3. Data on area of occupancy and number of patches of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community in New South Wales (Tindall et al. 2004; Peel in prep.; Tozer et al. 2006; Miles & Kendall 2006).

In relation to SEPP 26, the mapping is incomplete as it does not include all patches within National Parks, Flora Reserves and Jervis Bay (Australian Capital Territory). Moreover, the mapping data have not been revised since the SEPP 26 gazettal in 1988.

In determining the above area of occupancy, there is a slight overestimate where data overlap between Tuross Head and Murramarang National Park (by approximately 30 km).

Victoria

In Victoria, the total area of occupancy of the ecological community is approximately 279 ha (Table 4). A total of 108 patches constitute the area of occupancy with patch sizes ranging from 0.01 ha to 35 ha. More specifically, Table 4 shows that:

- the majority of individual patches, i.e. 91%, are less than 10 ha in size; and
- no patches are greater than 100 ha each.

[3] This patch is unmapped and is located at Iluka Nature Reserve which is the largest known stand of Littoral Rainforest in New South Wales comprising approximately 136 ha (NSW Scientific Committee 2004).

Patch size (ha)	Number of patches	Total area of occupancy (ha)	Number of patches as % of total	Area of occupancy as % of total
0.1-<0.5	53	6	49	2
0.5-<1	12	6	11	2
1-<10	33	102	31	37
10-<100	10	165	9	59
≥100	0	0	0	0
Total	**108**	**279**	**100**	**100**

Table 4. Data on area on occupancy and number of patches of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community in Victoria (Peel in prep.).

The data used to derive the above values are based on Peel's (in prep.) latest field work on the ecological community within the South East Corner Bioregion. The Victorian portion of the analysis has been used to derive the above values.

Nationally

The available data show that the ecological community has a broad though linear extent along the eastern coastline. When data from each of the States are amalgamated, the total area of occupancy of the ecological community is approximately 18 000 ha.

Nationally, a total of 1420 patches constitute the area of occupancy with patch sizes ranging from less than 0.1 ha to 2311 ha. More specifically, Table 5 shows that:

- the majority of patches, i.e. 82%, are less than 10 ha in size and, thus, generally small; and
- only 19 patches (approximately 1%) are greater than 100 ha each. Except for the patch at Iluka Nature Reserve in NSW, all the bigger patches occur in Qld. The majority of these (i.e. 14) occur in the Cape York Peninsula Bioregion where a significant portion of the mapping along the eastern coastline has not been updated (although development in this bioregion is likely to be less intense compared to the other Qld bioregions).

Patch size (ha)	Number of patches	Total area of occupancy (ha)	Number of patches as % of total	Area of occupancy as % of total
0.1-<0.5	272	64	19	0.3
0.5-<1	215	154	15	1
1-<10	680	2435	48	13
10-<100	234	6711	17	37
≥100	19	8674	1	48
Total	**1420**	**18 038**	**100**	**100**

Table 5. Data on area of occupancy and number of patches of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community including islands off the east coast (Accad et al. 2006).

Using the above data, the graph below (Figure 1) shows the frequency of the patch sizes on a national level. As the majority of patches are less than 10 ha each, the ecological community is very restricted.

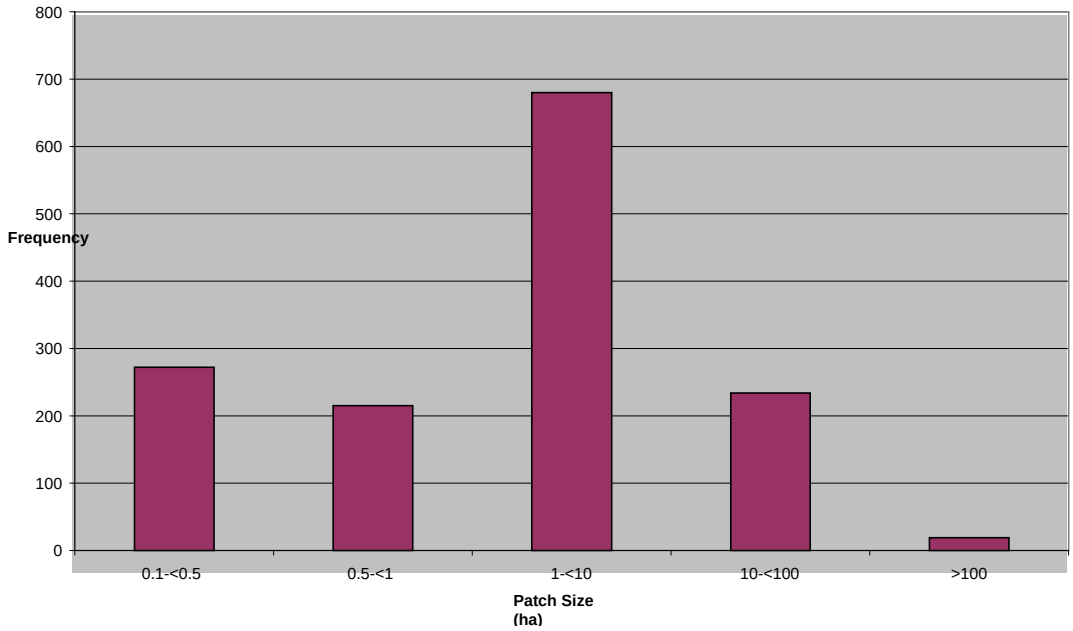

Figure 1. Frequency chart showing patch size frequency for the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.

The fragmented and linear nature of the patches, their small size and their small area to perimeter length ratios indicate that the ecological community is susceptible to disturbance including loss of fringing protective ecotones and has an inherently higher risk of extinction (Adam 1992).

Demonstrable threats to the ecological community, as outlined earlier in this document, are occurring along its entire extent on the eastern coastline. Patches with no protection are being cleared for development. This situation is unlikely to improve given the forecast of population growth in coastal areas. Patches with conservation protection are being degraded through a series of processes, including visitor disturbance, weed invasion and feral deer, on both patch and landscape scales. In addition, natural disturbances, such as cyclones, have the potential to intensify spatially and temporally due to global warming and thus increase their impact on the ecological community.

The Committee considers that the nature of the ecological community's very restricted distribution makes it likely that a threatening process could cause it to be lost in the immediate future. Therefore, the ecological community is **eligible** for listing as **critically endangered** under this criterion.

Criterion 3 - Loss or decline of functionally important species

The nationally endangered *Casuarius casuarius johnsonii* (Southern Cassowary) occurs in the Cape York Peninsula and the Wet Tropics Bioregions where it requires complex tropical vegetation consisting of dense tropical rainforest and associated habitats such as woodlands and swamps that can provide a year round supply of fleshy fruit (Bentrupperbaumer 1998). The species is recognised as a keystone species in north Qld rainforest communities (QPWS 2006) due to its role in the dispersal of larger fleshy rainforest fruits and seeds. The most important fruits in the bird's diet relevant to the ecological community include those belonging to the Lauraceae (laurels), Myrtaceae (lilypillies) and Arecaceae (palms) (Buosi & Burnett 2006).

Habitat loss and fragmentation are amongst the principal threats to the Southern Cassowary and the primary cause of the species' decline (Buosi & Burnett 2006). Nationally, the total population of this species ranges from less than 1500 to less than 2500 (Moore & Moore 2001). As the remaining cassowary habitat becomes increasingly fragmented by roads and development, the increased mortality rates due to vehicle collisions has the potential to eliminate many local populations (Bentrupperbaumer 1998) and the important role they play in sustaining rainforests. However, only a few areas, such as Mission Beach and Daintree lowlands, have been well studied and surveyed in the context of the cassowary's functional role in rainforests generally (Buosi & Burnett 2006; Crome & Moore 1993).

The nationally vulnerable *Pteropus poliocephalus* (Grey-headed Flying Fox) is also important in the processes that sustain the ecological community. The species occurs along the coastal belt from south-eastern Qld to Melbourne, Victoria. Its distribution, thus, overlaps with the ecological community. The Grey-headed Flying Fox is a canopy-feeding frugivore and nectarivore, which utilizes vegetation communities including different types of rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. The species is recognised as a functionally important species because of its seed dispersal function (Eby 1996), being responsible for the seed dispersal of many rainforest trees, including those of littoral rainforest, such as native figs and palms (Tidemann 1998). The extent of seed dispersal by this species is exceptional among Australian frugivores as it can transfer seeds between widely isolated rainforest patches (Eby 1991).

Grey-headed Flying Foxes are subject to ongoing threats, particularly habitat clearance in coastal areas in northern NSW (TSCC 2007). As a result, the population has experienced a 25% decline, based on the 1998 and 2004 national counts (Parry-Jones 2000). However, there are no studies on the role of Grey-headed Flying Foxes on the survival of the ecological community or the consequences of its decline on this ecological community. As a result, there are insufficient data to determine if the ecological community has undergone a loss or decline of the abovementioned functionally important species. Therefore, it is **not eligible** for listing in any category under this criterion.

Criterion 4 - Reduction in community integrity

There has been a reduction in the integrity of the ecological community on both patch and landscape scale due to past and present key threats outlined in detail under 'Description of Threats'.

Fragmentation

The ecological community is undergoing increasing fragmentation which, amongst other things, is causing a reduction in patch size, an increase in the distance between patches and greater susceptibility to increased degradation. As a result of fragmentation, the ecological community is more susceptible to disturbance and less amenable to recovery.

Moreover, this increased fragmentation generates secondary processes, which severely impact on the structural and compositional integrity of the ecological community. Such secondary

processes include weed invasion and genetic isolation of key species, edge effects, loss of canopy integrity from salt or wind damage as a result of clearing on the margins, degradation associated with rubbish dumping and overuse associated with increased access (Miles and Kendall 2006)**.** For example, the narrow seaward fringe of the ecological community between Manning Point and Farquhar Inlet, NSW, which survived past sandmining operations, has largely been lost since mining ceased through erosion of the frontal dune systems (Williams 1993).

With fragmentation, the risk of fire increases due to the accumulation of weeds on the perimeter of a patch. As a result, whole patches of the ecological community can be destroyed depending on fire intensity and frequency.

Fragmentation also threatens the integrity and viability of the ecological community through its impact on functionally important species, such as the nationally endangered *Casuarius casuarius johnsonii* (Southern Cassowary) and the vulnerable *Pteropus poliocephalus* (Grey-headed Flying Fox) which are key seed dispersers of the ecological community.

Weed invasion

Transformer weeds are currently detrimentally affecting the integrity and viability of the ecological community in multiple ways. The invasion and spread of weeds have the capacity to displace native plant taxa, and alter vegetation structure, animal habitat and fire regimes pertaining to an ecological community (Tozer et al 2006). For example, many rainforest plants are capable of germinating in low light conditions and slowing their growth rate until a gap in the canopy appears, whereupon they grow rapidly to occupy the gap. However, if a weed such as Lantana occupies all such gaps, there could be a significant impact on species composition over time, whereby fast-growing primary coloniser species dominate the ecological community and suppress the establishment of rainforest canopy species (Miles and Kendall 2006).

In 2002-03 Peel (in prep.) observed that weed invasion alone (i.e. without any other disturbance) in the Marlo Estuary, Victoria, destroyed a third of the littoral rainforest stand whilst the remaining two thirds was in severe decline. The transformer weeds involved include Blue Periwinkle (*Vinca major*), Cape Ivy (*Delairea odorata*) and Wandering Jew (*Tradescantia albiflora*). Peel (in prep.) concluded that the ecological community, in this area, could disappear in the next five to ten years without proper intervention. Given the aggressive nature of transformer weeds, it can generally be deduced that seriously infested patches of the ecological community will be lost in the short to medium term in the absence of effective weed control and recovery action.

In northern NSW, remnant stands of the ecological community have been invaded by vines such as Cat's Claw Vine *(Macfadyena unguis-cati)* and Madeira Vine *(Anredera cordifolia)* which aggressively invade disturbed rainforest and vine thickets (Adam 1992). Along the eastern coastline, Asparagus Fern *(Asparagus aethiopicus)* and Lantana are well established in many patches of the ecological community. These transformer weeds pose a serious threat to littoral rainforest species through their habit of climbing and smothering. Not only are established trees killed by these weeds, but germination and recruitment of seedlings are severely hindered if not inhibited (Bradley & Merrilyn 1992). The NSW Threat Abatement Plan for Bitou Bush recognises that this weed poses a serious threat to littoral rainforest in northern NSW by invading the rainforest margins and canopy gaps, thereby disrupting recruitment processes (DEC 2006b).

Fire

A further threat to the integrity of the ecological community is fire. Fire can be facilitated by the presence of weeds, fragmentation and edge effects. Moreover, climate change can alter the nature of fire with serious consequences for the ecological community. Littoral rainforest cannot develop under a regime of even occasional fires, so complete fire exclusion is necessary for full development of this community (Miles & Kendall 2006).

Fire events have the demonstrated potential to seriously impact on the structure and species composition of the ecological community. The potential impacts of fire are most obvious at Seven Mile Beach, NSW, where the area south of Beach Road, with a history of regular burning, carries only occasional young coppice of *Glochidion ferdinandi*, whereas the area north of Beach Road, that is relatively unburnt, is well advanced towards littoral rainforest development (Miles and Kendall 2006).

Existing stands of the ecological community can be eroded around the edges by fire, or if small, could be overrun by wildfire. While some of the component species have capacity to recover from fire, for example, *Glochidion ferdinandi, Acmena smithii, Ficus rubiginosa, Elaeocarpus reticulatus* and *Synoum glandulosum,* and some mature palms are relatively fire-tolerant, immature plants of all these species are unlikely to survive a fire event. Even low intensity fires will check the gradual spread of rainforest tree saplings around stand edges (Miles and Kendall 2006).

Depending on the intensity and frequency of fire and the species composition and age structure of the ecological community, regeneration of the full suite of species may not occur.

Grazing/browsing

Grazing by feral and domestic animals results in significant changes in the species diversity and structural complexity of native vegetation, depending on the grazing regimes and resilience of component plant taxa (Tozer et al. 2006).

Overgrazing by *Macropus giganteus* (Eastern Grey Kangaroos), in areas where Kikuyu (*Pennisetum clandestinum*) has invaded littoral rainforest, leads to the maintenance and extension of this weedy sward. This has three observable and cascading impacts (Peel in prep.) which lead to the reduction in integrity of the ecological community and its eventual demise:

- prevention of ground-layer regeneration of native grasses and forbs;
- maintenance of vegetation in a more open conformation that leads uninhibited access to any natural regeneration of rainforest trees and shrubs by Black Wallabies *(Wallabia bicolor)* and feral deer, which effectively prevents the rainforest from renewing itself or expanding; and
- loss of littoral rainforest species followed by a loss in structural integrity, which then leads to a contraction in stand area and ultimately the loss of the stand.

Natural disturbance

The ecological community exists in areas subject to ongoing natural disturbance. While the ecological community is generally resilient to changes imposed by natural events such as storm surges, wind storms and cyclones, the frequency and intensity of these disturbances can change the structure of individual patches and, thus, facilitate the intrusion and exacerbation of fire and weeds. For example, if a patch that is buffeted by a wind storm loses a number of canopy trees, it is more susceptible to weed invasion or to existing weeds spreading further into the patch. Similarly, that same patch may then be more susceptible to fire penetration.

Restorability

The present degraded state of the ecological community is difficult to reverse on private land due to the increasing demand on coastal land for urban development. The associated land

clearance has various cascading and irreversible impacts on the ecological community including fragmentation and associated patch size reduction, genetic isolation of key species, edge effects and loss of canopy integrity from salt or wind damage. As the majority of the ecological community occurs on private land, the change in its integrity is such that regeneration is unlikely within the immediate future.

Whilst patches of the ecological community found in conservation areas are more amenable to regeneration with positive human intervention, the nature and extent of degradation may not necessarily allow complete regeneration of the ecological community. This situation is made more difficult with the occurrence of a fire that has the capacity to completely destroy a patch of littoral rainforest. Moreover, the makeup of patches of littoral rainforest can be altered significantly if adjacent to human habitation where the impacts are constant.

Irrespective of whether the ecological community is protected, climate change has the capacity to augment the detrimental effects of natural disturbances including fire, coastal erosion, storm surges and rising sea levels. As a result, depending on the magnitude of such events, regeneration rates and success may be affected.

As a result of the above, the ecological community continues to be degraded at both patch and landscape scale. Such degradation becomes increasingly difficult to reverse as the impacts of persistent disturbance accumulate. This ongoing modification, while not necessarily leading to the total destruction of all elements of the ecological community, threatens it with extinction.

The Committee considers that the change in the integrity of this ecological community across most of its range through land clearance, fragmentation, weed invasion, fire, animal grazing/browsing and natural disturbance is very severe. The changes have been such that re-establishment of the ecological processes, species composition and community structure of the original ecological community is unlikely in the immediate future, even with positive human intervention. The ecological community is therefore **eligible for listing as critically endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

The ecological community is undergoing continuing detrimental change arising from clearance of native vegetation for coastal development, visitor disturbance, weed invasion, animal grazing/browsing, fires and the effects of fragmentation. In addition, natural disturbances, such as storms and cyclones, are likely to continue impacting the ecological community as their frequency and intensity are likely to increase due to climate change.

Estimates on decline are available for the Qld Regional Ecosystems (REs) only. These estimates cover the period from 1997 to 2003. The data indicate that the rate of decline for the ecological community is 11% which, however, is less than the minimum threshold for this criterion. No equivalent data are available for NSW or Victoria. Therefore, it is **not eligible** for listing in any category under this criterion.

Criterion 6 - Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. Therefore, it is **not eligible** for listing under this criterion.

9. CONCLUSION

Conservation status

The **Littoral Rainforest and Coastal Vine Thickets of Eastern Australia** ecological community meets:

- Criterion 2 as **critically endangered** because its geographic distribution is very restricted and the nature of its distribution makes it likely that multiple demonstrable threats could cause it to be lost in the immediate future; and
- Criterion 4 as **critically endangered** because the change in community integrity is very severe and regeneration is unlikely to occur in the immediate future even with positive human intervention.

Decision to have a Recovery Plan

The Committee has taken the following issues into account when considering the need to develop a recovery plan for the ecological community:

- the cross-jurisdictional nature of the ecological community and the lack of a national cohesive recovery approach;
- the need to raise public awareness of the ecological community as the public may not recognise, nor be fully aware of the threatened status, of the ecological community;
- the extensive nature of the ecological community and the potential for certain threats to expand their range on the eastern coastline e.g. certain transformer weeds;
- the presence of nationally threatened flora and fauna associated with the ecological community plus other species and ecological communities that are, or may be, under consideration by the Committee in the near future.

The Committee is of the view that a recovery plan for the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community would make a significant contribution to the conservation of the ecological community.

10. Recommendation

TSSC recommends that:

- the list referred to in section 181 of the EPBC Act be amended by including in the list in the **critically endangered** category: **Littoral Rainforest and Coastal Vine Thickets of Eastern Australia** ecological community; and
- there should be a national recovery plan for the **Littoral Rainforest and Coastal Vine Thickets of Eastern Australia** ecological community.

Associate Professor Robert J.S. Beeton

Chair

Threatened Species Scientific Committee

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