

***Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)  
(s266B)***

**Draft Conservation Advice (incorporating listing advice) for  
Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin  
Bioregion**

1. The Threatened Species Scientific Committee (the Committee) was set up under the EPBC Act to give advice to the Minister for the Environment (the Minister) on the listing and conservation of threatened ecological communities, including under sections 189, 194N and 266B of the EPBC Act.
2. The Committee will provide its advice on the Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion ecological community to the Minister in 2019.
3. The Minister will decide whether to amend the list of threatened ecological communities under section 184 of the EPBC Act to include Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion ecological community. The ecological community is comparable with two locally defined ecological communities that are listed as threatened in New South Wales (under the NSW *Biodiversity Conservation Act 2016*): ‘Illawarra Subtropical Rainforest in the Sydney Basin Bioregion’ and ‘Milton Ulladulla Subtropical Rainforest in the Sydney Basin Bioregion’.
4. This draft conservation advice will be made available for expert and public comment for a minimum of 30 business days. The Committee and Minister will have regard to all public and expert comment that is relevant to the consideration of the ecological community for listing.
5. This document was developed based on the available information at the time.



*Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion. Berkeley Hills.  
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## 1. CONSERVATION OBJECTIVE

To mitigate the risk of extinction of the *Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion* ecological community and help recover its biodiversity and function, by protecting it from significant impacts as a Matter of National Environmental Significance under national environmental law and by guiding implementation of management and recovery, consistent with the recommended priority conservation and research actions set out in this advice.

This document contains information relevant to the conservation objective by:

- describing the ecological community and where it can be found
- identifying the key threats to the ecological community
- presenting evidence (listing advice) to support the ecological community being listed as nationally threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- outlining the priority conservation and research actions that could stop decline and support recovery of the ecological community

## 2. DESCRIPTION OF THE ECOLOGICAL COMMUNITY AND THE AREA IT INHABITS

An ecological community is a group of plants, animals and other organisms interacting in a specific habitat, under similar environmental conditions. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species.

This section describes the assemblage of native species that characterises the Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion ecological community throughout its range at the time of listing. It outlines the vegetation structure of the ecological community, including some of its characteristic vascular plants and macroscopic<sup>1</sup> animals. The ecological community also includes fungi and cryptogamic plants; however, these are relatively poorly documented. More comprehensive species lists are in Appendix A. However, even these do not mention all the species that make up the ecological community and many sites may have species that are not documented here.

The number and identity of species recorded at a particular site is partly due to natural variation across the range of the ecological community and other environmental factors, such as disturbance, or the time of year. The species recorded can also be affected by sampling scale, effort and expertise. At some sites characteristic native species are now locally extinct and/or non-characteristic species have established themselves, or have become more abundant. In general, the number of species recorded is likely to increase with the size of the site.

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<sup>1</sup> Macroscopic: Large enough to see with the naked eye (i.e. without magnifying optical instruments); not microscopic.

Characteristic species may be abundant or rare and are only a subset of the complete list of species recorded in known examples of the community. Species presence and relative abundance (dominance) depends on many factors, such as, soil properties (e.g. moisture, chemical composition, texture, depth and drainage), topography and hydrology. They also change over time, for example, in response to disturbance (by clearing, fire, logging, or grazing), or to the climate and weather (e.g. floods, drought and extreme heat or cold). Moisture is a key driver for this ecological community and its species composition (e.g. the variation in species between the drier Berkeley Hills, and the wetter escarpment benches).

This section also describes the area that the ecological community inhabits, including its location, physical environment, some key ecological processes and other factors that help determine where the ecological community occurs in nature.

## **2.1 Name of the ecological community**

The name of the ecological community is the ‘Illawarra–Shoalhaven subtropical rainforest of the Sydney Basin Bioregion’ (hereafter called Illawarra–Shoalhaven subtropical rainforest, or the ecological community).

The ecological community is comparable with two New South Wales (NSW) state listed endangered ecological communities: The ‘Illawarra subtropical rainforest in the Sydney Basin Bioregion’ and the ‘Milton Ulladulla subtropical rainforest in the Sydney Basin Bioregion’ (NSW Scientific Committee 2002).

## **2.2 Location and physical environment**

### **2.2.1 Location**

The Illawarra–Shoalhaven subtropical rainforest ecological community occurs south of Sydney in NSW, near to the coast in the Sydney Basin Bioregion. Its range is from the Royal National Park (north of Wollongong) to the Milton-Ulladulla district in the south. It typically occurs on the coastal plain and among the foothills below the steep slopes of the coastal escarpment.

The ecological community is mainly found where relatively fertile soils occur on the slopes and benches<sup>2</sup> of the Illawarra Escarpment and across the Illawarra coastal (and near-coastal) lowlands. It rarely extends onto the upper slopes of the Escarpment. There are also limited occurrences of the ecological community in the Shoalhaven region, to the south of the Illawarra, particularly in the Milton-Ulladulla district; and some in the Hacking River catchment (e.g. in Royal National Park), upstream of the river’s tidal limit (Audley Weir).

It is usually found below 350 m above sea level (ASL); but there are occurrences up to around 550 – 600 m ASL, for example around Cambewarra Mountain.

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<sup>2</sup> Bench: A flatter strip of land that runs along a sloped area (a shelf or step-like feature on the way down a hillside). Benches can be formed by the differential erosion of rocks or sediments of varying hardness and resistance to erosion.

Much of the ecological community occurs between Gerringong (where it was termed the Illawarra Brush<sup>3</sup> by Mills & Jakeman (1995)) and Stanwell Park. It continues south to the Shoalhaven River; and westwards into Kangaroo Valley, where other areas of relatively fertile soils occur (e.g. volcanics, coal measures, or colluvial<sup>4</sup> sediments from the escarpment - particularly on the benches). Further occurrences of the ecological community occur around Milton and Ulladulla (approximately 50 to 70 km to the south), associated with the igneous Milton Monzonite.

### **2.2.2 Physical environment**

The ecological community occupies a number of topographic positions, including the slopes of the escarpment, on rocky scree<sup>5</sup> and in gully lines. It typically occurs on fertile volcanic soils; and also, on other relatively high-nutrient soils on escarpment benches and in sheltered gullies.

Structurally and floristically, patches of subtropical rainforest vary according to rainfall, geology, altitude and exposure to drier aspects or severe winds, including coastal influences. For example, in deeper more sheltered gullies, the rainforest is often taller and subtropical species are more pronounced.

### **2.2.3 Geology and soils**

The ecological community typically occurs on the more fertile (higher nutrient)<sup>6</sup> soils associated with coastal Permian and Triassic igneous rocks, including: Gerringong Volcanics, Cordeaux Crinanite and exposed latite on slopes and benches of the Illawarra. It also occurs in deep, sheltered gullies (e.g. where the Hacking River has cut down from sandstone into the shale). In the Milton-Ulladulla district, the ecological community typically occurs on Milton Monzonite<sup>7</sup>, as well as on deep alluvium and soils of the Conjola Formation enriched by monzonite; and it also occurs widely on skeletal exposed monzonite (Tozer et al. 2010).

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<sup>3</sup> North of Lake Illawarra on the Berkeley Hills, it is termed the 'Berkeley Brush'. The Illawarra Brush and Berkeley Brush originally covered about 13 600 ha and made up 60% of the rainforest of the Illawarra area (reference?).

<sup>4</sup> Colluvium: Loose material, such as soil or sediments, which has accumulated at the base of a slope through the action of gravity (e.g. talus, avalanche debris and material moved by soil creep, frost action or sheet erosion). As opposed to alluvium (e.g. soil/sediments deposited by a river on a floodplain).

<sup>5</sup> Scree: A collection of broken rock fragments that accumulate to form or cover a slope on a hill/mountain, or as a pile at its base (e.g. of cliffs or escarpments). Created by periodic rockfalls. Landforms associated with these materials are often called talus deposits.

<sup>6</sup> These soils are more fertile than those just derived from the sandstone substrates more prevalent in the region.

<sup>7</sup> Monzonite is a relatively uncommon intrusive/plutonic igneous rock -. It contains less quartz and more plagioclase than granite. Latite is the approximate extrusive/volcanic equivalent of monzonite. Crinanites are dark coloured, fine-grained, basic rocks consisting mainly of olivine, augite, and plagioclase feldspar.

#### **2.2.4 Regions, subregions and Local Government Areas**

The ecological community occurs in the Sydney Basin IBRA<sup>8</sup> Bioregion (SYB). It has been mapped as occurring in the Illawarra, Jervis and Sydney Cataract (SYB12, SYB14 and SYB10) subregions and just over the borders into Burragorang (SYB09), Moss Vale (SYB11) and Ettrema (SYB13); it may occur elsewhere in the Sydney Basin Bioregion. The majority of the ecological community occurs in the Illawarra IBRA Subregion (SYB12).

At the time of this assessment (2018-19), the ecological community is known to occur in the South East Local Land Services (SE LLS) Natural Resources Management Region and has been recorded in areas in the Local Government Areas (LGAs) of Kiama, Shellharbour, Shoalhaven, Sutherland and Wollongong; and may occur in adjacent LGAs such as Goulburn Mulwaree and Wingecarribee.

#### **2.2.5 Climate**

The ecological community occurs in coastal areas with a wet temperate climate. It is warm and humid, with typically higher rainfall in autumn, lower rainfall in late winter to spring and little chance of hard frosts. It occurs where mean annual rainfall is greater than 1000 mm (Tozer et al. 2010).

Coastal areas around Sydney are at the southern limit of the coastal subtropical climate zone and experience warmer, more humid summers than coastal areas further south (Stern et al. (1999), in Tozer et al (2010)). This is reflected by the fact that many subtropical rainforest species reach their southern limit of distribution in the Illawarra and Milton regions; and the ecological community is the southernmost boundary for many of its component subtropical species (Mills 1989; Mills & Jakeman 1995).

Rainfall varies depending on altitude and distance from the coastline, with higher rainfall areas found closer to the coast or at higher elevations. Table 1 shows climatic data close to the coast where the ecological community occurs. Daily and annual temperature variations are least in coastal areas, which also experience few frost days. The air temperatures are mild, ranging between approximately 6°C (mean daily minimum for July) and 26°C (mean daily maximum for January) near the coast (Tozer et al. 2010), with some cooling as altitude increases – reaching a temperate climate at altitude, beyond the range of the ecological community (Mills & Jakeman 1995).

Orographic<sup>9</sup> effects are substantial where the escarpment meets the coast, between Nowra and the Royal National Park, Sydney (where the ecological community mainly occurs). These result in an average of at least 1100 mm of rainfall per year, with the highest mean annual rainfall exceeding 2000 mm near Barren Grounds, just inland of Kiama (Mills & Jakeman 1995; Tozer et al. 2010).

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<sup>8</sup> Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.  
<http://www.environment.gov.au/land/nrs/science/ibra>

<sup>9</sup> Orographic: Relating to mountains, especially their position and form; and, of clouds or rainfall resulting from the effects of mountains in forcing moist air to rise.

Table 1: Rainfall and temperature in the area where the ecological community occurs.

Weather station	Altitude (metres above sea level)	Mean annual rainfall (mm)	Mean daily max temp (°C) (Jan)	Mean daily min temp (°C) (July)	Mean annual no. of days min $\leq 0.0$ °C
Wollongong (University)	25	1345	25.6	8.4	0
Dapto West	42	1192	-	-	-
Milton (Sarah Claydon Village)	81	1167	-	-	-

Source: Tozer et al. (2010) and Bureau of Meteorology (undated).

### 2.3 Vegetation structure and flora

The following description of the vegetation generally relates to the less disturbed, or ‘reference’ condition, occurrences of the Illawarra–Shoalhaven subtropical rainforest. Many patches of the ecological community have been disturbed, with fire, logging, grazing and ‘under-scrubbing’ having exerted a strong influence on the structural and floristic composition of the ecological community (Mills & Jakeman 1995; Tozer et al. 2010). Some patches, which would have been part of the ecological community, are now so modified that they no longer meet the Key Diagnostic Characteristics or Condition Thresholds (in sections 3.1 and 3.2) for the nationally protected ecological community.

The Illawarra–Shoalhaven subtropical rainforest ecological community is typically a dense, complex rainforest (12 to 25 m tall<sup>10</sup>), with an emergent tree layer up to 35 m or more in height (Mills & Jakeman 1995).

At a local scale, the expression/structure of the Illawarra–Shoalhaven subtropical rainforest varies with aspect, largely because of different micro-climates (e.g. Mills & Jakeman 1995) separately describe a dry and a moist subtropical rainforest type). In drier areas, the ecological community can be considered a Complex Notophyll Vine Forest (CNVF)<sup>11</sup>; in wetter areas a Complex Notophyll Vine-Fern Forest (CNVFF). The ecological community is characterised by its high structural and floristic diversity (Mills & Jakeman 1995).

The ecological community is generally a low to moderately tall closed rainforest. It has a dense mixed tree canopy (canopy cover typically  $\geq 70\%$  on average for a patch in relatively high condition) and a sparse shrub layer (Mills & Jakeman 1995). The groundcover is often sparse, except in moister areas (Tozer et al. 2010). At lowland sites, the ground can be largely covered by rock, often with little soil being visible (Mills & Jakeman 1995); as opposed to bench sites on the escarpment, where ferns are usually abundant and there are few surface rocks.

<sup>10</sup> Height estimates are approximate (e.g. the tree canopy can be quite short on dry, rocky sites).

<sup>11</sup> Based on Webb's (1968) classification system.



Tree species with compound leaves are common and leaves are relatively large (notophyll to mesophyll). There is a relatively low abundance of species from the genera *Syncarpia*, *Acacia*, *Banksia* and *Eucalyptus* (unlike the Littoral Rainforest and Vine Thickets ecological community, where these genera may be more commonly present). Buttresses may be common and vines may be diverse and abundant.

### **2.3.1 Canopy**

The canopy is often multilayered, consisting of an upper, discontinuous layer of emergents, above a typically dense rainforest canopy and subcanopy. Rainforest canopies are generally closed, but in highly disturbed stands the canopy may be irregular and open. There may also be localised open areas due to landscape and terrain, such as rocky outcrops and watercourses. Canopy height varies considerably and structurally some stands of the ecological community are scrub (NSW Scientific Committee 2002a).

The upper, discontinuous layer includes canopy emergents, up to 35 m or more in height, such as *Ficus* spp. (figs), *Dendrocnide excelsa* (Giant Stinging Tree), *Toona ciliata* (Red Cedar). Around Milton, *Alphitonia excelsa* (Red Ash) is commonly an emergent. Typically, non-rainforest species such as eucalypts comprise <30% of canopy emergents. Where they do occur, species such as *Eucalyptus tereticornis* (Forest Red Gum) and *E. quadrangulata* (White-topped Box, Coast White Box) are most typical.

The canopy and subcanopy layers contain a diverse range of species. Three of the most common characteristic species are: *Dendrocnide excelsa* (Giant Stinging Tree), *Streblus brunonianus* (Whalebone Tree) and *Toona ciliata* (Red Cedar); other characteristic species include: *Alectryon subcinereus* (Native Quince), *Alphitonia excelsa* (Red Ash), *Baloghia inophylla* (Brush Bloodwood), *Brachychiton acerfolius* (Flame Tree), *Citronella moorei* (Churnwood), *Claoxylon australe* (Brittlewood), *Cryptocarya glaucescens* (Jackwood), *C. microneura* (Murrogun), *Diospyros australis* (Black Plum), *Diospyros pentamera* (Myrtle Ebony), *Diploglottis australis* (Native Tamarind), *Ehretia acuminata* var. *acuminata* (koda), *Elaeodendron australe* (Red Olive Plum), *Ficus* spp. (figs), *Guioa semiglaucula* (Guioa), *M. howittiana* (Brush Muttonwood), *Myrsine variabilis* (Muttonwood), *Pennantia cunninghamii* (Brown Beech) and *Planchonella australis* (Black Apple) (Mills & Jakeman 1995; NSW Scientific Committee 2002a; Tozer et al. 2010).

### **2.3.2 Climbers**

Vines are typically common, such as: *Celastrus australis* (Staff Climber), *Cissus antartica* (Kangaroo Vine), *Eustrephus latifolius* (Wombat Berry), *Geitonoplesium cymosum* (Scrambling Lily), *Legnephora moorei* (Round Leaf Vine), *Pandorea pandorana* (Wonga Vine), *Parsonia straminea* (Monkey Rope), *Marsdenia rostrata* (Milk Vine), *Gynochthodes jasminoides* (Sweet/Jasmine Morinda), *Smilax australis* (Sarsaparilla) and *Trophis scandens* (Burny Vine).

### **2.3.3 Understorey**

There is typically a sparse understorey of shrubs, seedlings and groundcover plants below the canopy.

### Shrub-small tree layer

Species may include: *Notelaea venosa* (Veined Mock Olive), *Elaeodendron australe* (Red-fruited Olive Plum), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Pittosporum multiflorum* (Orange Thorn), *Breynia oblongifolia* (Coffee Bush), *Croton verreauxii* (Green Native Cascarilla), *Gymnostachys anceps* (Settler's Flax), *Myrsine variabilis* (Muttonwood), *Maclura cochinchinensis* (Cockspur Thorn), *Pittosporum revolutum* (Rough Fruit Pittosporum) and *Wilkiea huegeliana* (Veiny Wilkiea).

### Ground layer

Species may include: *Gymnostachys anceps* (Settlers' Twine), *Oplismenus aimulus* (Australian Basket Grass), *Oplismenus imbecillis* (Creeping Beard Grass) and *Pseuderanthemum variabile* (Pastel Flower). Although not typically abundant, ferns such as *Pellaea falcata* (Sickle Fern), *Asplenium flabellifolium* (Necklace Fern), *Adiantum formosum* (Giant Maidenhair), *Pteris umbrosa* (Jungle Brake), and *Blechnum neohollandicum* (Prickly Rasp Fern) may also be present. Some sites may have a high percentage cover of ferns in the understorey.

## **2.4 Fauna**

The area is a transition zone between north and south coast mesic<sup>12</sup> forests and this is reflected in the diversity of rainforest fauna species. The ecological community includes animals from a range of taxonomic groups. Some of the animal species present in the ecological community are listed in Appendix A. Faunal components often include: *Alectura lathamii* (Australian Brush-turkey), *Anepischetosia maccoyi* (highlands Forest-skink), *Mixophyes balbus* (Stuttering Frog)<sup>13</sup>, *Orthonyx temminckii* (Logrunner), *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Tyto tenebricosa* (Sooty Owl). The mammals and birds of the ecological community in the Illawarra district are relatively well known. Less well known are the other vertebrate fauna groups and the invertebrates (NSW NPWS 2000).

The rainforest fauna is less diverse than it was 200 years ago. The clearing of 75% of the rainforest in the district has caused the local extinction of some species and a dramatic reduction in the populations of others. Subtropical rainforest habitat has been impacted more than any other rainforest type in the Illawarra district (Mills & Jakeman 1995).

### **2.4.1 Mammals**

*Pseudocheirus peregrinus* (Common Ringtail Possum) and *Petaurus breviceps* (Sugar Glider) are typical of the Illawarra–Shoalhaven subtropical rainforest ecological community, along with *Pteropus poliocephalus* (Grey-headed Flying-fox) and *Wallabia bicolor* (Swamp Wallaby). Sugar gliders are more often seen in the emergent Eucalypt trees, rather than in the typical rainforest canopy tree species. Ringtail possums are mostly found in dense *Acmena smithii* (Lilli Pilli) trees and in other small rainforest trees.

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<sup>12</sup> Mesic: A mesic habitat has a moderate or well-balanced supply of moisture.

<sup>13</sup> Now a lot rarer.

Bat species that may occur include *Chalinolobus morio* (Chocolate Wattled Bat) and *Vespadelus vulturnus* (Little Forest Bat) (Mills & Jakeman 1995; NSW NPWS 2000).

Swamp wallaby are commonly seen in moist gullies and on the scrubby edges of rainforest, where they seek shelter (Mills & Jakeman 1995; NSW NPWS 2000). In several places *Vombatus ursinus* (the Bare-nosed Wombat) commonly occurs on the edge of the rainforest, where it intergrades with other vegetation types. Two other common native mammal species in the area are *Antechinus stuartii* (Brown Antechinus) and *Perameles nasuta* (Long-nosed Bandicoot) (Mills & Jakeman 1995).

#### **2.4.2 Reptiles and Amphibians**

Several species of reptiles and amphibians are closely associated with rainforest. Species such as the highlands forest-skink are common in the ecological community, along with *Intellagama lesueurii lesueurii* (Eastern Water Dragon) and *Eulamprus quoyii* (Eastern Water Skink) which are commonly found along stream verges. Lizards are generally not common in the rainforest, particularly away from streams, because there is not enough sunshine under the dense tree canopy for them to warm up and maintain activity (Mills & Jakeman 1995; NSW NPWS 2000).

Frogs are seen, or at least heard near most water bodies, including rainforest streams. Some of the more common species in the ecological community include: *Limnodynastes peronni* (Brown-striped Frog), *Litoria citropa* (Blue Mountains Tree-frog), *Litoria peronii* (Peron's Tree-frog), *Litoria phyllochroa* (Leaf-green Tree-frog) and *Litoria verreauxii* (Verreaux's Tree-frog).

#### **2.4.3 Birds**

Even small patches of rainforest can support forest-dependent bird species. For example, Mills (1984b, in Mills & Jakeman (1995)) recorded most of the rainforest birds of the district in small patches of rainforest in the Shoalhaven Gorge in Morton National Park. Many bird species are nomadic and can be found in remnant rainforest patches surrounded by cleared land and, in the case of pigeons in the fig trees scattered over the coastal rural parts of the district (Mills & Jakeman 1995).

Birds typical of the ecological community include (in approximate order of frequency): *Gerygone mouki* (Brown Gerygone), *Pachycephala pectoralis* (Golden Whistler), *Meliphaga lewinii* (Lewin's Honeyeater), *Rhipidura albiscapa* (Grey Fantail), *Sericornis citreogularis* (Yellow-throated Scrubwren), *Acanthiza pusilla* (Brown Thornbill), *Psophodes olivaceus* (Eastern Whipbird), *Monarcha melanopsis* (Black-faced Monarch), *Zosterops lateralis* (Silvereye), *Rhipidura rufifrons* (Rufous Fantail), *Sericornis frontalis* (White-browed Scrubwren), *Eopsaltria australis* (Eastern Yellow Robin), *Macropygia amboinensis* (Brown Cuckoo-dove), *Ptilinorhynchus violaceus* (Satin Bowerbird) and *Platycercus elegans* (Crimson Rosella) (NSW NPWS 2000).

Birds of prey are not common in the rainforest, but both diurnal and nocturnal species occur there. The main birds of prey habitually associated with the ecological community by day, is *Accipiter novaehollandiae* (Grey Goshawk). At night, the birds of prey include: *Podargus strigoides* (Tawny Frogmouth), *Ninox novaeseelandiae* (Southern Boobook, Morepork) and the NSW-listed *Tyto tenebricosa* (Sooty Owl) (Mills & Jakeman 1995).

#### **2.4.4 Invertebrates**

Well-known insect groups such as the beetles, butterflies, moths and flies are all well represented in the ecological community, along with springtails, which are often found in the moist leaf litter.

Butterflies are among the most prominent insect fauna in the ecological community. Species commonly found in the ecological community include: *Delias nigrina* (Common Jezebel), *Graphium macleayanum* (Macleay's Swallowtail), *Graphium sarpedon* (Blue Triangle), *Heteronympha mirifica* (Wonder Brown) and *Trapezites Symmomus* (Symmomus Skipper). (Mills & Jakeman 1995).

The blue triangle and the Macleay's swallowtail are closely associated with the ecological community, because of their preference for rainforest trees as larval food plants (e.g. they lay their eggs on the Sassafras tree). The wonder brown is common from late spring. The Symmomus Skipper, a large brown skipper with silver markings on the wings, is found in late summer or autumn, on the edges of the ecological community (Mills & Jakeman 1995).

### **3. IDENTIFYING THE NATIONALLY PROTECTED ECOLOGICAL COMMUNITY**

This section provides additional information to help identify areas of the ecological community that are a matter of national environmental significance and so are protected under national environment law. This includes specifying diagnostic characteristics, defining 'a patch', sampling protocols, size and condition thresholds, and further information to consider when planning actions that may have significant impacts.

National listings complement State vegetation and other biodiversity protection laws by enhancing the protection of those components of Australia's biodiversity most at risk of extinction. For ecological communities, national listing focuses legal protection on areas that remain in at least moderate condition, which retain their natural composition and ecological function to a certain degree.

In order to be considered a matter of national environmental significance under national environment law, areas of the ecological community must meet both:

- The **Key diagnostic characteristics**; AND
- at least the minimum **Condition thresholds**.

Key diagnostic characteristics and condition thresholds assist in:

- identifying a patch of native vegetation as being the threatened ecological community;
- determining whether the referral, assessment, approval and compliance provisions of national environment law are likely to apply; and
- distinguishing between patches of different quality.

Because patches of the ecological community may be quite disturbed and/or degraded, condition categories and thresholds have been developed. These offer guidance on whether a patch retains sufficient conservation values to be considered as a matter of national environmental significance. This enables national environment law protection provisions to be focussed on the most valuable elements of the ecological community. Very degraded patches that do not meet the minimum condition thresholds, will be largely excluded from national protection.

Although very degraded or modified patches are not protected, as part of the ecological community listed under national environment law, some patches that do not meet the condition thresholds still have important natural values; and these may be protected through state and local laws, or schemes. They should not be excluded from recovery and other management actions. Suitable recovery and management actions can improve a patch's condition, so that it can be included as part of the nationally listed ecological community - fully protected under national environment law. Management actions should also be designed to restore patches to high condition.

In some cases, the loss and degradation are irreversible; or rehabilitation is impractical because too many natural characteristics have been lost. For instance, areas previously dominated by Illawarra–Shoalhaven subtropical rainforest which are now permanently converted to cropland or development are unlikely to be rehabilitated.

The key diagnostic characteristics presented here summarise the main features of the ecological community. They are intended to aid its identification, noting that more details are provided in the other sections of this document. The other diagnostic considerations should also help to identify the ecological community. Species composition of this ecological community is influenced by, amongst other things: the size of the patch, recent rainfall, drought conditions and disturbance history, including fire and grazing. The key diagnostic characteristics and condition thresholds are designed to allow identification of the ecological community in a variety of conditions.

### 3.1 Key diagnostic characteristics

The national ecological community<sup>14</sup> consists of patches of vegetation (and other associated organisms) that meet the following **key diagnostic characteristics**:

- Occurs in the Sydney Basin IBRA<sup>15</sup> Bioregion. The majority of the ecological community primarily occurs in the Illawarra IBRA Subregion (SYB12) of the Sydney Basin Bioregion. It also occurs in the, Jervis and Sydney Cataract (SYB14 and SYB10) subregions; and, just over their borders into Burratorang (SYB09), Moss Vale (SYB11) and Ettrema (SYB13). It may occur elsewhere in the Sydney Basin Bioregion.
- Occurs near the coast of New South Wales, from the Royal National Park (in the north) to Tabourie Lake (in the south).
- Occurs on the coastal plain, low-lying foothills and escarpment slopes and benches<sup>16</sup> of the eastern coastal escarpment with minor occurrences in the Hacking River catchment; as well as in Kangaroo Valley and sites south-west of Nowra in deep valleys.
- Undisturbed stands have high structural complexity with canopy and emergent trees (sometimes with buttressed roots), epiphytes, mid-stratum trees and shrubs, vines in the canopy and on tree trunks and on the ground; and a heterogeneous ground layer, usually with abundant leaf litter, amongst ferns and forbs.
- The ecological community is typically associated with the more fertile (higher nutrient)<sup>17</sup> soils derived from igneous substrates, such as Permian volcanics and the Triassic Milton Monzonite; but may occur on other substrates (such as the enriched high nutrient colluvial<sup>18</sup> soils on benches of the escarpment – and in deep, sheltered gullies (e.g. where the Hacking River has cut down from sandstone into the shale<sup>19</sup>))

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<sup>14</sup> The EPBC Act defines an 'ecological community' as the “extent in nature in the Australian jurisdiction of an assemblage of native species that inhabits a particular area in nature” (e.g. a group of plants, animals and other organisms interacting in a specific habitat, under relatively similar environmental conditions).

<sup>15</sup> Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.  
<http://www.environment.gov.au/land/nrs/science/ibra>

<sup>16</sup> Bench: A flatter strip of land that runs along a sloped area (a shelf or step-like feature on the way down a hillside). Benches can be formed by the differential erosion of rocks or sediments of varying hardness and resistance to erosion.

<sup>17</sup> These soils are more fertile than those just derived from the sandstone substrates more prevalent in the region.

<sup>18</sup> Colluvial: Pertaining to colluvium (loose material, such as soil or sediments, which has accumulated at the base of a slope through the action of gravity (e.g. talus, avalanche debris and material moved by soil creep, frost action or sheet erosion). As opposed to alluvium (e.g. soil/sediments deposited by a river on a floodplain).

<sup>19</sup> In the Hacking River catchment, upstream of Audley Weir, the ecological community has been identified at sites east and south of Waterfall (including around Bola Creek/Gully and Cedar Creek/Gully).

- It rarely extends onto the upper escarpment slopes; It is usually found below 350 m above sea level (ASL); but there are occurrences up to around 550 – 600 m ASL, for example around Cambewarra Mountain.
- It typically occurs in areas with high annual rainfall (>1000 mm).
- Canopy height of undisturbed stands is generally low - moderately tall (typically 12 - 25 m), with a dense closed forest (typical canopy cover  $\geq 70\%$ ) and some emergent trees (e.g. to 35 m high); although gaps may be present and are included in the patch.
- Whilst the ecological community typically has a subcanopy layer, the groundcover layer is often sparse; although some sites may have a high percentage cover of ferns in the understorey.
- At a local scale, the expression/structure may vary with aspect, because of the different micro-climate this creates. In drier areas, the vegetation type/structure is typically a Complex Notophyll Vine Forest (CNVF); in wetter areas it is typically a Complex Notophyll Vine-Fern Forest (CNVFF).
- A list of typically characteristic native plant species and most commonly occurring native fauna is given at Appendix A; although these species may be abundant or rare, or not necessarily present at a particular site.

### 3.1.1 *Contra indicative features*

- Rainforest with a single uniform canopy layer, no emergents or midstorey AND only a fern-dominated groundlayer are unlikely to be the Illawarra–Shoalhaven subtropical rainforest ecological community<sup>20</sup>. For example, Warm temperate rainforest may often adjoin the ecological community (e.g. higher up the escarpment). However, Warm temperate rainforest is distinguished from the ecological community by its simplified canopy, which is either dominated by: *Ceratopetalum apetalum* (Coachwood), *Doryphora sassafras* (Sassafras), or *Acmena smithii* (Lilly Pilly), or is dominated by combinations of two or three of these species. Whilst these three species may also occur in the Illawarra–Shoalhaven subtropical rainforest ecological community, they only occur in low frequency (i.e. they are not dominant).
- The ecological community is not dominated by *Backhousia myrtifolia* (Grey Myrtle) i.e. it should account for less than half of the total canopy cover within a patch identified as the ecological community.
- The ecological community is not a eucalypt woodland or forest; although there may be variation in the eucalypt density locally within a patch, particularly across a disturbed patch.

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<sup>20</sup> Unless the structure has been modified directly or indirectly by human influences.

- The ecological community is unlikely to occur on relatively infertile, coarse-textured quartz-based geologies and soils, such as coastal sands or those of the widespread Triassic Hawkesbury and Narrabeen Sandstones, or of the Permian Nowra Sandstone<sup>21</sup>;

The Illawarra–Shoalhaven subtropical rainforest ecological community occurs near and can intergrade with the nationally listed ‘Littoral Rainforest and Coastal Vine Thickets of Eastern Australia’ ecological community (aka Littoral Rainforest) in some coastal areas. The ecological community differs from the Littoral Rainforest ecological community in the following features:

- The physical environments where the two ecological communities occurs are differentiated by the level of coastal or estuarine influence (salt-water laden winds);
- In the Sydney Basin, Littoral Rainforest typically occurs within two km of very close to the coast (usually within a few hundred metres in the Illawarra–Shoalhaven area) on non-volcanic substrates, such as littoral hind-dunes and has a more coastal/estuarine influence;
- Illawarra–Shoalhaven subtropical rainforest typically occurs more than 400 m from the coast and has a less coastal/estuarine influence - but it may occur closer, where volcanic substrates occur (e.g. on more elevated, rocky, volcanic latite<sup>22</sup>); and
- Littoral Rainforest and Vine Thickets often has more abundance of species from the genera *Acacia*, *Banksia* and *Eucalyptus*. Diagnostic information for the Littoral Rainforest ecological community is available in its Listing advice, on the Department’s website, at: <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=76>

### 3.2 Condition classes and thresholds for EPBC Act protection

In order to be considered a matter of national environmental significance under national environment law, areas of the Illawarra–Shoalhaven subtropical rainforest ecological community must meet:

- the Key diagnostic characteristics AND
- the minimum Condition thresholds.

The condition thresholds for this ecological community are designed to identify the relatively good quality patches for national protection (i.e. moderate to high value). Table 2 shows the condition classes and thresholds). As the ecological community has been heavily cleared and fragmented, many remnants are small, isolated and in a modified condition. Any remnants that remain largely intact, include mature trees, or are connected to other native vegetation and form a large patch are a high priority for protection and management.

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<sup>21</sup> Unless they are enriched by more fertile, finer-textured substrates (e.g. colluvium, washed/fallen down from substrates higher up the slope).

<sup>22</sup> For example at Killalea and in the Kiama foothills (e.g. on the Kiama basalts and chocolate shales).



Very small, isolated patches subject to high disturbance are likely to no longer have the structure, composition and function of the ecological community and will not meet the minimum condition thresholds for national protection (for example, a few rainforest trees on a farms or roadside, with limited diversity/structural elements).

The ecological community comprises patches that meet the Key diagnostic characteristics (above) and the **minimum condition thresholds** (Moderate condition categories A, B or C) set out below.

Table 2: Condition thresholds for the Illawarra–Shoalhaven subtropical rainforest

Class, category and rationale	Patch size thresholds	Biotic thresholds		
Moderate Condition Classes: (i.e. the <i>proposed</i> minimum condition thresholds to be considered the nationally protected ecological community)				
Moderate Condition – Category A A large patch with moderate to intact canopy AND a diversity of rainforest plants	≥ 1 ha	≥ 50% non-eucalypt canopy cover <sup>1</sup> AND Average ≥ 5 native woody plants from <u>Table A1</u> per 0.04 ha sample plot <sup>2</sup>		
Moderate Condition – Category B A smaller patch with a relatively intact canopy AND a diversity of rainforest plants	≥ 0.1 ha (< 1 ha)	≥ 70% non-eucalypt canopy cover <sup>1</sup> AND Average ≥ 5 native woody plants from <u>Table A1</u> per 0.04 ha sample plot <sup>2</sup>		
Moderate Condition – Category C A smaller patch with a moderate to intact canopy; AND either a high diversity of rainforest plants or part of a large patch of native vegetation	≥ 0.1 ha (< 1 ha)	≥ 50% non-eucalypt canopy cover <sup>1</sup> AND Average ≥ 10 native woody plants from <u>Table A1</u> per 0.04 ha sample plot <sup>2</sup>	OR	The patch is contiguous <sup>3</sup> with another patch of native vegetation that is ≥ 1 ha in size
High Condition Class: (e.g. to provide further information about higher condition patches & / or to guide management and restoration goals)				
High Condition A patch with a relatively intact canopy AND a high diversity of rainforest plants & / OR characteristic birds	≥ 0.1 ha	≥ 70% non-eucalypt canopy cover <sup>1</sup> AND Average ≥ 15 native woody plants from <u>Table A1</u> per 0.04 ha sample plot <sup>2</sup>	OR	≥ 10 native birds from <u>Table A2</u> in the patch

Notes:

<sup>1</sup> **Canopy cover** (measured as projective foliage cover) should be based on representative areas within the whole patch of the ecological community. Projective foliage cover is “the percentage of the sample site occupied by the vertical projection of foliage and woody branches” (National Committee on Soil and Terrain, 2009: p.81). When measuring canopy cover, include emergents, canopy and the subcanopy layer (everything above the ground layer, e.g. above 2m), but exclude *Eucalyptus*, *Corymbia* and *Angophora* species.

<sup>2</sup> **0.04 ha sample plot** – For example, 20 m x 20 m.

<sup>3</sup> **Contiguous** with another patch of native vegetation means the patch is continuous with, or in close proximity (within 100 m) to, another area of native vegetation. The thresholds for canopy cover and native woody plant species apply to the condition of the patch of the ecological community only (i.e. they are not relevant to the contiguous native vegetation). Native vegetation here refers to areas of vegetation where cover in each layer present is dominated by native species.

**NB. Gaps in the canopy, degraded and regenerating areas of lower quality are still part of the patch.** Where weed invasion is significant, natural regeneration of native gap species may be limited. All areas should be considered together, in terms of identifying the entire patch of the ecological community, which should be protected as a Matter of National Environmental Significance (MNES).

### **3.3 Further information to assist in determining presence and avoiding significant impacts**

The following information should also be taken into consideration when applying the key diagnostic characteristics and condition thresholds to assess a site that may include the ecological community and determine the potential impacts on a patch.

Landuse history will have influenced the state in which a patch of the ecological community is expressed. The resulting structure (especially loss of structural elements) in turn affect species richness and diversity. The surrounding vegetation will also influence how important a patch of the ecological community is in the broader landscape. For example, whether it enables movement of native fauna or dispersal of plant material or supports other ecological processes, such as nutrient cycling.

#### **3.3.1 Defining a patch**

A patch is a discrete and mostly continuous area of the Illawarra–Shoalhaven subtropical rainforest ecological community<sup>23</sup>, which meets the Key diagnostic characteristics. It includes small-scale variations, gaps and disturbances, such as tracks, paths or breaks (including exposed soil, leaf litter, cryptogams and watercourses/ drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality of the ecological community. This functionality includes processes such as the movement of wildlife and other

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<sup>23</sup> Note that NSW vegetation assessment tools have defined a ‘patch’ differently – i.e. as an area of native vegetation, of one or more different communities that occur together, separated by a gap of no greater than a set distance (usually 100 m). Also note, the national Threatened Species Scientific Committee uses the term ‘patch’ to describe all of a discrete area of the ecological community (i.e. do not just consider the area that may be directly impacted by an activity – also consider the entire patch of the ecological community as a whole).

pollinators, the dispersal of plant propagules, activities of seed and plant predators, biological water retention and cycling and many other interactions.

Small breaks are generally included in a patch. However, where there is a break in native vegetation cover, from the edge of the tree canopy, of 100 m or more (e.g. due to permanent man-made structures, wide roads or other barriers; or, due to water bodies), the two areas of the ecological community are usually treated as separate patches. Two patches of the ecological community can also be separated by a different type of native vegetation (e.g. natural grassland, or grassy woodland).

Differences in canopy cover, quality, or condition of vegetation, across a patch should not initially be thought of as evidence of multiple patches. Patches can be spatially variable and some areas of a patch, if considered in isolation, might not meet all the Key diagnostic Characteristics and Condition Threshold Criteria. Average quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall vegetation condition and patch boundaries. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition that would apply across different parts of the site respectively. Where the average quality of a larger area falls below the minimum condition thresholds, the next largest area that meets the key diagnostics and minimum condition thresholds should be identified and protected. This may result in multiple patches of the ecological community being identified within the larger area first considered.

### **3.3.2 *Additional buffer zone around a patch***

In addition to the patch itself, a minimum buffer zone that extends 100 m beyond the canopy of the outermost trees in the patch is essential to assist in the preservation of the patch. Its purpose is not specifically to extend the patch through regeneration, although this would be beneficial. A larger buffer zone should be applied, where practical, to protect patches that are of very high conservation value or if patches are located below drainage lines or a source of nutrient enrichment or groundwater drawdown. Judgement should be exercised to determine an appropriate buffer distance depending on circumstances of how a patch may be impacted.

A buffer zone is an area immediately adjacent to a patch of the ecological community (but not part of the community) that is important for protecting it from likely negative impacts. Because the risk of damaging an ecological community is usually greater where actions occur close to a patch, a buffer zone helps shield the patch from nearby activity. The 100 m buffer zone encompasses an area large enough to protect the root zone of edge trees and other components of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, water runoff, soil erosion and other damage and edge effects.

The buffer zone is not part of the patch of the ecological community, but should ideally consist of other native vegetation that is retained wherever possible. Buffer zones may also be degraded areas of non-native vegetation that surround a patch of the ecological community. Nevertheless, practical application of a buffer zone is strongly recommended. For instance, it is recommended that care be exercised in the buffer zone to minimise the risk of any

significant adverse impacts extending into the ecological community, irrespective of the nature of the buffer zone.

To get national environment law approval, actions/changes in land use in the buffer zone must not have a significant impact on the ecological community; but there are exemptions for continuing use (e.g. existing cropping, grazing or maintaining fire breaks). If the use of an area next to a patch of the ecological community will be intensified and this is likely to impact adversely upon the patch, approval under national environment law may also be required to ensure adverse impacts are avoided. The buffer zone may also be a suitable focus for revegetation or other restoration initiatives to extend the patch.

### **3.3.3 *Revegetated areas and areas of regrowth***

Revegetated or replanted sites, or areas of vegetation regrowth can be included as part of the listed ecological community, provided that the revegetated area meets the key diagnostic characteristics and condition thresholds. It is recognised that reconstruction/revegetation often requires long term effort and commitment and results are uncertain. Reconstructing a woodland or forest ecological community to a state that resembles appropriate reference sites can, at best, be extremely slow and ultimately prove unsuccessful (Wilkins et al. 2003).

The Illawarra–Shoalhaven subtropical rainforest ecological community has a relatively high potential for rehabilitation and natural regeneration. Rainforests are dynamic communities that can regenerate naturally following disturbance and structural damage. Some rainforest species store viable seed in the soil (although viability varies between species) but more commonly rainforest species rely on rapid germination and seedlings in the understorey (BSRLG 2005). As canopy gaps appear, the availability of light removes any suppression to seedling growth. The inclusion of patches of natural and managed regeneration reflect the ecological community's ability to regenerate. Degraded patches that are actively managed (i.e. with weeds removed and/or with supplementary planting) are capable of re-establishing themselves and supporting a good ecologically functional state.

### **3.3.4 *Sampling protocol***

Evaluating/sampling a patch can involve developing a quick/simple map of the vegetation condition, diversity, landscape qualities and management history (where possible) of the site. An appropriate sampling strategy should be used that captures the diversity of the site and recognises any variation e.g. due to topography.

Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the ecological community. The Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain 2009) provides relevant survey guidance. Patches can vary markedly in their shape, size, condition and features. As a general principle, sampling protocols and the number of sample plots/transects should include, or allow for, the following:

- sampling in area(s) with the highest apparent number of different native plant species to estimate native species richness of the whole patch;
- significant variation in the vegetation, landscape qualities and management history (where known) across the patch; for instance localised weed cover, drainage lines,

grazed areas, saline zones but also localised variation in dominance of canopy species; and

- an appropriate size and number of plots or transects to provide a representative sample across the full extent of the patch (taking into consideration the shape and condition across the site, as well as providing a good representation of the species present).

Recording the search effort (identifying the number of person hours spent per plot/transect and across the entire patch; along with the surveyor's level of expertise and limitations at the time of survey) is useful for future reference.

Timing of surveys is an important consideration because ecological communities may vary in their appearance through the year and between years, depending on seasonal or climatic conditions. Ideally, surveys should be held in more than one season to maximise the chance of detecting all species present. For example, flowering may be necessary to identify plant species and active growth will indicate population sizes of annual weeds. Immediately after disturbance some species, or groups of species, may not be evident for a time. The presence and detectability of some species may be affected by the time since disturbance such as fire or storms, so surveys should be planned to occur after an adequate time for some recovery. At a minimum, it is important to note climate conditions and what kind of disturbance may have happened within a patch and when that disturbance occurred. Note that rainforests may take a long time to recover their structure after certain disturbances and transitional stages may persist for some time.

### ***3.3.5 Surrounding environment, landscape context and other guidance for impact assessment and mitigation***

The condition thresholds outlined above are the minimum level at which patches are considered part of the nationally listed ecological community and hence are protected as a matter of national environmental significance under national environment law. These thresholds do not represent the ideal state of the ecological community. Patches that are larger, more species rich and less disturbed are likely to provide greater biodiversity value. Additionally, patches that are spatially linked, whether ecologically or by proximity, are particularly important, both as wildlife habitat and corridors – and to the viability of the ecological community into the future.

So, in the context of actions that may have significant impacts, and hence require approval under national environment law, it is important to consider the environment surrounding patches of the listed ecological community. Some patches that meet the condition thresholds occur in isolation and require protection, as well as priority actions, to link them with other patches. Other patches, which are interconnected to similar native vegetation associations, have additional conservation value.

The following indicators should be considered when assessing the impacts of actions, or proposed actions under national environment law - or when considering recovery, management and funding priorities for a particular patch.

- Large size and/or a large area to boundary ratio – larger area/boundary ratios are less exposed and more resilient to edge effect disturbances such as weed invasion and other human impacts.
- Evidence of recruitment of key native plant species or the presence of a range of age cohorts (including through successful assisted regeneration) – for example, tree canopy species are present in a range of sizes from saplings to large hollow-bearing trees.
- Good faunal habitat as indicated by patches containing mature (persistent residual) trees, logs, watercourses, diversity of landscape, contribution to movement corridors;
- High species richness, as shown by the variety of native species.
- Presence of nationally-listed or state-listed threatened species, or key functional species such as key pollinator and dispersal animals.
- Areas of minimal weeds and feral animals, or where these can be managed.
- Connectivity to other native vegetation remnants or restoration works. In particular, a patch in an important position between (or linking) other patches in the landscape. Areas of mosaic native vegetation provide a wider range of habitats that benefits flora and fauna diversity.
- Patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the natural edge of its range are also important due to their rarity, genetic significance, or because of the absence of some threats.

### **3.3.6 *Area critical to the persistence of the ecological community***

The areas considered critical to the survival of the ecological community cover all patches that meet the key diagnostic characteristics for the ecological community. Additional areas, such as adjoining native vegetation, especially buffer zones around patches (see 3.3.2, above), are also important to the survival of the ecological community. While these are not part of the listed ecological community, they should be taken into consideration as part of the broader surrounding environment and landscape context.

## **3.4 Relationship to other vegetation classification systems**

### **3.4.1 *Caveat***

Ecological communities are complex to classify. In each State and Territory different systems are used to classify ecological communities and vegetation types. The various methods of classifying and mapping ecological communities may also vary in accuracy, particularly if distributions are modelled.

Any reference to vegetation and mapping units as equivalent to a national ecological community, at the time of listing, should be taken as indicative rather than definitive. Consideration of whether a nationally protected ecological community is present at any site should focus on how the patch meets the description, particularly the key diagnostic characteristics and condition thresholds for the ecological community.

The south coast of NSW has been the subject of several vegetation mapping exercises for a variety of purposes. Many of the maps rely on modelling of vegetation types, with the results of limited field surveys extrapolated subsequently, based on information such as aerial

photographs. There are various systems of classification and nomenclature used in the maps, many of which have been created for a particular mapping exercise, so the descriptive units used do not fully correspond with each other. Most recently at the time of this assessment (2018-19), NSW OEH has been compiling a comprehensive state-wide vegetation scheme based on the identification of Plant Community Types (PCT). PCTs are building on existing studies, notably the vegetation classification and analysis undertaken by Tozer et al. (2010).

### **3.4.2 NSW Vegetation Units that correspond to the ecological community**

Bearing in mind the limitations stated above, the ecological community corresponds entirely or partly to the following mapped vegetation types:

NSW NPWS (2002b):

- MU4 Lowland Dry-Subtropical Rainforest; and
- MU1 Illawarra Escarpment Subtropical Rainforest<sup>24</sup>.

Mills & Jakeman (1995):

- Type 1 Subtropical rainforest;
- Type 2 Moist Subtropical Rainforest; and
- Type 3 Dry subtropical rainforest.

Tozer et al. (2010) map units<sup>25</sup>:

- RF p111 Subtropical Dry Rainforest; and
- RF p112 Subtropical Complex Rainforest.

NSW Plant Community Types (PCTs):

- 906 Lilly Pilly – Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion; and
- 1300 Whalebone Tree – Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion.

Note. The classification of Mills & Jakeman (1995) was developed specifically for the Illawarra – In a broader context (historically), much of the ecological community would fall within the Dry rainforest (Suballiance 23) and Subtropical rainforest (Suballiance 14) in Floyd (1990) (NSW Scientific Committee 2002a, 2002b).

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<sup>24</sup> Rainforest sites classified as MU1 that are included under Suballiance 14 (such as those at Mt Keira and Minnamurra) are the ones most likely to correspond to the ecological community.

<sup>25</sup> Tozer et al. (2010) notes that with decreasing moisture availability Subtropical Complex Rainforest (**RF p112**) intergrades with the closely related Subtropical Dry Rainforest (**RF p111**). On poorer soils Subtropical Complex Rainforest (RF p112) is replaced by Coastal Warm Temperate Rainforest (**RF p113**). Also, some areas mapped as **WSF p110** Warm Temperate Layered Forest may be included in the ecological community, if they meet the Key Diagnostic Characteristics and condition threshold (e.g. in the hacking River Catchment (including around Bola Creek/Gully and Cedar Creek/Gully)). **WSF p110** is described in the next Section.

### **3.4.3 Similar or related Vegetation Units (or intergrades)**

The rainforests of the Illawarra escarpment and foothills are a distinctive vegetative feature of the region. Only one other place in the Sydney Basin Bioregion has some similarities in climate, landform and vegetation - the Watagan Range in the Lake Macquarie and Lower Hunter Area. However, the Watagan range is set further back from the coast than the Illawarra Escarpment and the temperatures are correspondingly cooler. Both areas have large areas of Warm Temperate Rainforests and subtropical rainforests and they share a similar vegetation structure. Nevertheless, there are substantial differences in the plant species composition of the vegetation of these two areas and the Watagan rainforest is not part of the Illawarra–Shoalhaven subtropical rainforest ecological community (NSW NPWS 2000, 2002a).

Tozer et al. (2010) describes the following Vegetation Units that are similar to (or related to/intergrade with) the Illawarra–Shoalhaven subtropical rainforest ecological community.

**WSF p99 Illawarra Gully Wet Forest** (Illawarra Extent remaining 2532 ha).

A tall eucalypt forest with a moist open understorey, primarily distributed from the Hacking River catchment along the Illawarra escarpment south to Mt Keira, on coastal lowlands near Berry and scattered through coastal foothills and lowlands from Nowra south to Batemans Bay. Typically Illawarra Wet Gully Forest occurs on sheltered slopes and gullies with loamy soils with an annual rainfall in the range of 1000 – 1700 mm. On the northern Illawarra escarpment, Illawarra Wet Gully Forest occupies elevations up to 400 m ASL, however south of Nowra it rarely exceeds 200 m ASL. With increasing soil fertility Illawarra Wet Gully Forest (WSF p99) grades into Warm Temperate Layered Forest (WSF p110) and may be replaced by the Illawarra–Shoalhaven subtropical rainforest ecological community (RF p112) in areas of higher nutrient soils, and in areas long protected from fire (Tozer et al. 2010).

**WSF p110 Warm Temperate Layered Forest** (Illawarra Extent remaining 21 500 ha).

A tall eucalypt forest characterised by an open eucalypt canopy, a dense small tree subcanopy and a moist shrubby understorey. Warm Temperate Layered Forest occurs predominantly south from the Hacking River along the Illawarra scarp, to Nowra and throughout the Kangaroo Valley. Localised occurrences are also recorded from sites as far south as Durras Mountain and as far north as Ku-ring-gai Chase National Park. Within this area it is found below 400m on sheltered slopes in gullies and on escarpments with loamy soils where mean annual rainfall exceeds 1000 mm. Warm Temperate Layered Forest frequently adjoins Subtropical and Warm Temperate rainforest map units, and contains several rainforest taxa below its eucalypt canopy.

**RF p210 Temperate Littoral Rainforest** (Illawarra Extent remaining 194 ha).

A closed forest characterised by a dense tree canopy, lianas, a sparse shrub stratum and an open groundcover. This rainforest is restricted to sand spits and coastal gullies within a few hundred metres of the ocean. Small occurrences are distributed along the coast south from Sutherland, in places where annual rainfall exceeds 950 mm. Local concentrations occur from Garie to Stanwell Park and on the Becroft Peninsula. Temperate Littoral Rainforest shares some species in common with the Illawarra–Shoalhaven subtropical rainforest ecological community (RF p111, RF p112) and replaces these units where Littoral influences predominate



**RFp113. Coastal Warm Temperate Rainforest** (Illawarra Extent remaining 2974 ha).

A closed forest with a dense tree canopy, a subcanopy of small trees, lianas, an open layer of mesic shrubs and a fern-dominated groundcover. This rainforest is widely distributed in small patches, with local concentrations along the Illawarra escarpment, along the escarpment in the Clyde district and along the Murramarang Range on the coast north of Durras. It is found in moist sheltered gullies and on sheltered escarpment slopes on loam to clay loam soils from 0 - 400m ASL with a mean annual rainfall greater than 900 mm. On poorer soils a component of the ecological community (RF p112) is replaced by Coastal Warm Temperate Rainforest (RF p113). Much of its original distribution remains extant and it is represented within several large conservation reserves. Repeated fires may pose a threat to some stands.

### **3.5 Existing protection**

#### **3.5.1 Protection through reservation**

Despite a number of reserves containing the ecological community, its position in the landscape (mostly lower altitude fringes) means only a small area of the ecological community is included in formal conservation reserves. Reserves include Budderoo National Park, Macquarie Pass National Park, Morton National Park, Cambewarra Range Nature Reserve, Devils Glen Nature Reserve, Rodway Nature Reserve and Yatte Yattah Nature Reserve.

Tozer et al. (2010) identifies a total of 130 ha of RF p111 and 440 ha of RF p112 vegetation present in conservation reserves. This represents only 5.4% and 10.7% respectively of remaining estimated total extent; together they have 8.8% of remaining estimated total extent protected. Estimates suggest the remaining pre-clearing RF p111 area in conservation reserves is less than 2%; for RF p112, the estimate is less than 10%.

#### **3.5.2 Protection through State/Territory legislation**

In the northern part of its range, the ecological community largely corresponds to the NSW listed Endangered *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion*. In the southern part of its range, the ecological community largely corresponds to the NSW listed Endangered *Milton Ulladulla Subtropical Rainforest in the Sydney Basin Bioregion*. Details of these two ecological communities are available on the New South Wales OEH website at: <https://www.environment.nsw.gov.au/determinations/IllawarraSubtropicalRainforestSydneyBasinEndComListing.htm> and <https://www.environment.nsw.gov.au/determinations/MiltonUlladullaSubtropicalRainforestSydneyEndComListing.htm>

Occurring nearby, and intergrading with the Illawarra–Shoalhaven subtropical rainforest ecological community in some coastal areas is the NSW listed Endangered *Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* ecological community (aka Littoral Rainforest). Details of the Littoral Rainforest ecological community are available at:

<https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10867>

North of Sydney (The Hawkesbury River notionally marks the southern limit) is the New South Wales listed Endangered *Lowland Rainforest in the NSW North Coast and Sydney*

*Basin Bioregion* endangered ecological community (aka Lowland Rainforest). This is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. The distribution of this ecological community does not overlap with the Illawarra–Shoalhaven subtropical rainforest ecological community. South of the Sydney metropolitan area, Lowland Rainforest is replaced by the NSW listed *endangered Illawarra Subtropical Rainforest of the Sydney Basin Bioregion* mentioned above. Details of the Lowland Rainforest ecological community are available at:

<https://www.environment.nsw.gov.au/determinations/LowlandRainforestEndCom.htm>

Another geographically separate (yet similar in structure) NSW-listed Endangered rainforest ecological community is the *Lowland Rainforest on Floodplain in the NSW North Coast Bioregion*, which occurs north of Newcastle. Details of this ecological community are available at:

<https://www.environment.nsw.gov.au/determinations/LowlandRainforestNorthCoastEndComListing.htm>

### **3.5.3 Other commonwealth listed threatened ecological communities**

The Illawarra–Shoalhaven subtropical rainforest ecological community occurs near and can intergrade with the EPBC listed Critically Endangered *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* ecological community (aka Littoral Rainforest) in some coastal areas.

The ecological community differs from the EPBC listed Littoral Rainforest ecological community in the following features:

- The physical environments where the two ecological communities occurs are differentiated by the level of coastal or estuarine influence (salt-water laden winds):
- In the Sydney Basin, Littoral Rainforest typically occurs very close to the coast (usually within a few hundred metres in the Illawarra–Shoalhaven area) on non-volcanic substrates, such as littoral hind-dunes and has a more coastal/estuarine influence;
- Illawarra–Shoalhaven subtropical rainforest typically occurs more than 400 m from the coast and has a less coastal/estuarine influence - but it may occur closer, where volcanic substrates occur (e.g. on more elevated, rocky, volcanic latite<sup>26</sup>); and
- Littoral Rainforest often has more abundance of species from the genera *Acacia*, *Banksia* and *Eucalyptus*. Diagnostic information for the Littoral Rainforest ecological community is available in its Listing Advice, on the Department’s website, at:

<http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=76>

Also occurring nearby, and intergrading with the ecological community on the coastal plain, is the EPBC listed Critically Endangered *Illawarra and south coast lowland forest and woodland* ecological community. It is a forest or woodland, with a canopy that is typically dominated by *Eucalyptus* or *Angophora* trees. Many patches have a sub-canopy of smaller

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<sup>26</sup> E.G. at Killalea and in the Kiama foothills (e.g. on the Kiama basalts and chocolate shales).

trees as well as a shrub layer and/or a ground layer, which is grassy or sedgy. Proximity to rainforest may increase the number of seedlings or saplings of mesic species. Further information about this ecological community is available in its Conservation advice at: <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=144>

Geographically separate (yet similar in structure) to Illawarra–Shoalhaven subtropical rainforest, i.e. occurring further to the north (from Newcastle to Gladstone), is the EPBC listed Critically Endangered *Lowland Rainforest of Subtropical Australia* ecological community. Further information about this ecological community is available in its Listing Advice at: <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=101>

### 3.5.4 Listed threatened flora and fauna species

The ecological community provides habitat for a range of flora and fauna species listed under the NSW *Threatened Species Conservation Act (1995)* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act (1999)*.

Table 3: Threatened flora and fauna that have been recorded in the ecological community  
Scientific names are current at August 2018.

Scientific Name	Common Name	EPBC Act	NSW TSC Act
<b>Flora</b>			
<i>Daphnandra johnsonii</i>	Illawarra Socketwood	E	E
<i>Cynanchum elegans</i>	White Flowered Wax Plant	E	E
<i>Irenepharsus trypherus</i>	Illawarra Irene; Delicate Cress	E	E
<i>Rhodamnia rubescens</i>	Scrub Turpentine	-	CE
<i>Zieria granulata</i>	Illawarra (Hill) Zieria	E	E
<b>Fauna</b>			
<i>Cercartetus nanus</i>	Eastern Pygmy Possum		V
<i>Chalinolobus dwyeri</i>	Large Eared Pied Bat	V	V
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E
<i>Kerivoula papuensis</i>	Golden-tipped Bat		V
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E
<i>Miniopterus australis</i>	Little Bentwing-bat		V
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		V
<i>Mixophyes balbus</i>	Stuttering Frog	V	E
<i>Mixophyes fasciolatus</i>	Great Barred Frog	E	E
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Ptilinopus magnificus</i>	Wompoo Fruit-dove		V
<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove		V
<i>Ptilinopus superbus</i>	Superb Fruit-dove		V

Scientific Name	Common Name	EPBC Act	NSW TSC Act
<i>Saccolaimus flaviventris</i>	Yellow Bellied Sheath Tailed Bat		V
<i>Tyto tenebricosa</i>	Sooty Owl		V
CE = Critically Endangered; E = Endangered; V = Vulnerable			

Source: (Mills & Jakeman 1995; NSW NPWS 2000).

#### 4. SUMMARY OF KEY THREATS

The key threats to the Illawarra–Shoalhaven subtropical rainforest ecological community are summarised below.

**Clearance of native vegetation.** Historically, this was mostly for forestry and agriculture (followed by urban/peri-urban and infrastructure development); and hard rock quarrying. Further clearing is likely, given increasing development (e.g. expanding urban growth and infrastructure projects, as well as rural-residential blocks).

This threat involves clearing entire remnants, as well as incremental damage from tree removal or lopping, or removal of native understorey vegetation. The consequences of clearing include:

- loss of entire patches of the ecological community;
- further fragmentation into smaller, more isolated patches;
- loss of habitat for native species; and
- patches and populations becoming more susceptible to further degradation.

Remnants with exposed edges are particularly susceptible to light and wind intrusion (which impacts floristic composition) into this naturally dense, closed ecological community.

**Impacts from invasive species.** This includes:

- Exclusion of native plants - many remnants contain non-native plant species, including noxious weeds, pasture species and environmental weeds (e.g. woody weed species, such as African olive (*Olea europaea* ssp. *cuspidata*), lantana (*Lantana camara*) and tobacco bush (*Solanum mauritianum*), which shade and inhibit the growth of other plants); and,
- damage and predation from pest animals (e.g. deer, goats, foxes and feral cats).

**Altered hydrology and water quality at sites.** Altered hydrological conditions, as a result of human land use activities, have been described as a threat to this community, but further information will be required.

**Grazing and trampling and ‘underscrubbing’.** As well as feral animals, grazing and trampling by domestic stock and native fauna can further reduce the quality of the vegetation and destroy plant regrowth and seedlings. The deliberate removal of the understorey beneath the tree canopy (underscrubbing) to open areas up (e.g. to stock and/or enhance grazing, or to create lawns in per-urban areas), can also cause a lot of damage to the ecological community.

**Nutrient enrichment and chemical drift.** Nutrient enrichment can occur through application of inorganic fertilisers for improved pastures or as manure from livestock, as well as runoff

from roads, urban and industrial infrastructure. Pesticide/herbicide spray drift may occur from crops and pastures adjacent to a patch.

**Altered fire regimes.** Changes in the frequency, seasonality, intensity and the patchiness of fires, can change vegetation composition and structure, which may contribute to species loss and structural changes to the ecological community. Increased flammability occurs as a result of invasion by weeds such as C4 grasses and lantana, and also due to changes in the nature of exposed edges of patches.

**Disease and dieback.** Myrtle rust (*Uredo rangelii*) poses an increasing threat in the region. Plants of the ecological community, such as *Acmena smithii* (lilly pilly) *Gossia acmenoides* (scrub ironwood) and *Rhodamnia rubescens* (scrub turpentine), can be harmed by this fungal infection.

**Other urban threats.** Harvesting firewood (removal of coarse woody debris) can disturb and remove fauna habitat; and people and equipment can bring in weeds (seeds, spores etc.). Dumped rubbish can also spread weeds and smother understorey species. Pet animals can predate on fauna and damage flora.

**Climate change.** Potential impacts of climate change include altered fire regimes, decline in tree and understorey health due to prolonged drought and heat stress, damage from more intense storms, exacerbating proliferation of invasive species and disease, and altered regeneration and recruitment of native species.

#### 4.1 Key Threatening Processes

Table 4: Relevant National and State-listed Key Threatening Processes

EPBC Act	NSW BC Act
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners ( <i>Manorina melanocephala</i> )	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners, <i>Manorina melanocephala</i> (Latham, 1802)
Competition and land degradation by rabbits	Competition and grazing by the feral European Rabbit, <i>Oryctolagus cuniculus</i> (L.)
Competition and land degradation by unmanaged goats	Competition and habitat degradation by Feral Goats, <i>Capra hircus</i> Linnaeus 1758
Land clearance	Clearing of native vegetation
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	Anthropogenic Climate Change
Novel biota and their impact on biodiversity Myrtle rust ( <i>Austropuccinia psidii</i> )	Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family <i>Myrtaceae</i>
Predation by European red fox	Predation by the European Red Fox <i>Vulpes vulpes</i> (Linnaeus, 1758)
Predation by feral cats	Predation by the Feral Cat <i>Felis catus</i> (Linnaeus, 1758)

EPBC Act	NSW BC Act
Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs	Predation, habitat degradation, competition and disease transmission by Feral Pigs, <i>Sus scrofa</i> Linnaeus 1758
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
	Bushrock removal
	Herbivory and environmental degradation caused by feral deer
	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
	Invasion and establishment of exotic vines and scramblers
	Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>

## 5. RECOMMENDATIONS BY THE THREATENED SPECIES SCIENTIFIC COMMITTEE

### 5.1 Recommendation on eligibility for listing against the EPBC Act criteria.

On the basis of a preliminary assessment of available scientific information, it is recommended that the Illawarra–Shoalhaven Subtropical Rainforest ecological community is **eligible** for listing as **Critically Endangered**. This was the highest conservation category triggered at the time of this assessment.

#### 5.1.1 Criterion 1 - Decline in geographic distribution

Likely to be assessed as **Endangered**, based on information in the two NSW listings and Tozer et al. (2010) indicating a severe decline in its geographic distribution. Much of the Illawarra–Shoalhaven Subtropical Rainforest ecological community has been cleared and it now often occurs as scattered fragments. Tozer et al. (2010) estimated the Subtropical Dry Rainforest (RF p111) had declined by 80 to 90% (this vegetation unit is closely related to the ecological community); while the Subtropical Complex Rainforest (RF p112) decline was estimated to be between 35 and 50% (this vegetation unit includes areas of the ecological community but does not entirely correspond with it). Decline of the two units combined ranges from between 65 and 80 % of the two combined units (Table 5). The actual loss of the ecological community depends on what proportion of RF p112 contains the ecological community.

Table 5: Extent and decline estimates.

Area remaining (ha)	Pre-European extent (calculated from % remaining estimates in Tozer et al. (2010))		% remaining	
	Low estimate (ha)	High estimate (ha)	High estimate (%)	Low estimate (%)

<b>RF p111</b>	2400	12000	24000	20	10
<b>RF p112</b>	4100	6308	8200	65	50
<b>Total</b>	6500	18308	32200	35	20

Source: Tozer et al. (2010)

### 5.1.2 Criterion 2 – Small geographic distribution coupled with demonstrable threat

Likely to be assessed as **Critically Endangered** against this criterion. The ecological community has a *very restricted* distribution; and the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in the *immediate* future.

Most remnants of the ecological community are now small, some naturally so where patches of subtropical rainforest occupied small areas of suitable habitat within other vegetation types. However initially logging and then clearing for grazing and agriculture has been extensive throughout the coastal plain, which has further cleared and fragmented the ecological community, or caused remaining patches to be exposed within areas of agricultural or urban land use. These activities have been concentrated within the coastal strip due to the low slopes, accessibility and good quality volcanic and alluvial soils, in comparison with the steep rocky cliffs and sandy soils of the escarpment to the west.

Data on the Tozer et al. (2010) vegetation classification units indicate that remnants are now highly fragmented and continue to face mounting threats.

Available patch size data associated with the Tozer units indicate the majority of patches are less than 10 ha in size, the threshold indicative of a *very restricted* geographic distribution. For patches greater than 0.1 ha in size, 96% of RF p111 and 89% of RF p112 are less than 10 ha in size, which is indicative of a very fragmented distribution and potentially critically endangered status (see Table 6).

The ecological community is faced with a number of demonstrable threats to its long-term viability given its fragmentation. Remnant rainforest in this region suffers from edge effects, associated with grazing, light intrusion, wind and weed invasion. Other significant threats include: further clearing (for urban and hobby farm developments, quarrying, road widening and utility easements); inappropriate fire regimes; the cutting of trees for firewood; and rubbish dumping (NSW Scientific Committee, 2002a; 2002b).

Available evidence suggests that a significant decrease/decline in extent or integrity is likely in the immediate future (i.e. 3 generations of any long-lived species believed to play a major role in sustaining the community, up to a maximum of 60 years - i.e. the rainforest canopy tree species).

Table 6: Patch sizes distribution for the ecological community

Size of patch	Number of patches	Percentage of patches
<b>Map unit RF p111</b>		
Small (0.1 - ≤10 ha)	1089	96.1
Medium (>10 - ≤100 ha)	41	3.6
Large (>100 ha)	3	0.3

Total	1133	100
<b>Map unit RF p112</b>		
Small (0.1 - ≤10 ha)	623	89.3
Medium (>10 - ≤100 ha)	69	9.9
Large (>100 ha)	6	0.9
Total	698	100
Note: Patches <0.1 ha were excluded from the analysis, as some of these are likely to be artefacts of spatial processing errors.		

### 5.1.3 *Criterion 3 – Loss or decline of functionally important species*

Whilst there has been significant overall loss of area and degradation in the Illawarra–Shoalhaven Subtropical Rainforest ecological community, evidence for loss of particular functionally important species within remnants is not available at this stage of assessment. There is **insufficient information** to indicate the likely assessment result for this criterion.

What is known is that the dominant tree canopy species and lower stratum tree species that are key structural (and functional) elements of the ecological community are not considered to be threatened in their own right. The functional roles and importance of most other species in this ecological community are, at best, poorly documented in the literature.

### 5.1.4 *Criterion 4 – Reduction in community integrity*

The ecological community is likely to be assessed as **Critically Endangered** for this criterion. There has been a reduction in the integrity of the ecological community at both patch and landscape scales due to past and present threats outlined under ‘4. Summary of Key Threats’, resulting in a *very severe* reduction in integrity across most of its geographic distribution.

Remaining fragments tend to be degraded and continue to be threatened by weed invasion, grazing, fire and urban expansion (Tozer et al., 2010). Other increasing threats are from grazing and predation from feral and domestic animals and climate change. Fragmentation has caused a reduction in patch size, an increase in the distance between patches, more exposed edges and hence greater susceptibility to increased disturbance and degradation. As a result of fragmentation, the ecological community has also suffered local loss of plant and animal diversity and is also less amenable to recovery. Moreover, this increased fragmentation generates secondary processes, such as weed invasion, grazing, increased fire and storm damage and other threats associated with urban encroachment, which severely impact on the structural, compositional and functional integrity of the ecological community.

### 5.1.5 *Criterion 5 – Rate of continuing detrimental change*

There is **insufficient information to determine the eligibility** of the ecological community for listing under this criterion is not available at this stage of assessment.

### 5.1.6 *Criterion 6 – Quantitative analysis showing probability of extinction*

There are no quantitative data available to assess this ecological community under this criterion. As such, there is **insufficient information to determine the eligibility** of the ecological community for listing under this criterion.



## **5.2 Recommendation on whether to have a recovery plan**

A recovery plan is **not recommended** for the Illawarra–Shoalhaven Subtropical Rainforest ecological community at this time.

The main threats to the ecological community and the priority actions required to address them are largely understood. The Conservation Advice and existing NSW documents sufficiently outline the priority actions needed for this ecological community, and enhancing and better resourcing existing mechanisms is likely to be a more effective and efficient way to address recovery of the ecological community than developing a national recovery plan.

Taking into account the benefits of supplementing existing protection with national listing and implementing the priority research and conservation actions outlined in this advice, a separate recovery plan for the ecological community is not required at this time.

## **6. PRIORITY RESEARCH AND CONSERVATION ACTIONS**

### **6.1 Conservation Objective**

The conservation objective (see section 1 above) provides the goal and rationale for the priority actions identified here. The objective is:

To mitigate the risk of extinction of the Illawarra–Shoalhaven Subtropical Rainforest in the Sydney Basin Bioregion ecological community, and help recover its biodiversity and function through protecting it from significant impacts as a Matter of National Environmental Significance under national environmental law and, by guiding implementation of management and recovery, consistent with the recommended priority conservation and research actions set out in this advice.

### **6.2 Principles and standards**

In undertaking priority actions to meet the conservation objective, the overarching principle is that it is preferable to maintain existing areas of the Illawarra–Shoalhaven Subtropical Rainforest ecological community that are relatively intact and of high quality. There are good, practical reasons to do so. It is typically more successful and cost-effective to retain an intact remnant than to allow degradation and then attempt to restore it or another area. The more disturbed and modified a patch of the ecological community, the greater the recovery effort that is required. Also, intact remnants are likely to retain a fuller suite of native plant and animal species, and ecological functions. Certain species may not be easy to recover in practice, if lost from a site.

This principle is highlighted in the National Standards for the Practice of Ecological Restoration in Australia (Standards Reference Group SERA, 2017<sup>27</sup>):

*“Ecological restoration is not a substitute for sustainably managing and protecting ecosystems in the first instance.*

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<sup>27</sup> Society for Ecological Restoration: <http://www.seraustralasia.com/standards/home.html>

*The promise of restoration cannot be invoked as a justification for destroying or damaging existing ecosystems because functional natural ecosystems are not transportable or easily rebuilt once damaged and the success of ecological restoration cannot be assured.”*

*Standards Reference Group SERA (2017) – Appendix 2.*

The principle discourages ‘offsets’ where intact remnants are removed with an undertaking to set aside and/or restore other, lesser quality, sites. The destruction of intact sites always results in a net loss of the functional ecological community because there is no guarantee all the species and ecological functions of the intact site can be replicated elsewhere.

Where restoration is to be undertaken, it should be planned and implemented with reference to the *National Standards for the Practice of Ecological Restoration in Australia*). These Standards guide how ecological restoration actions should be undertaken and are available online from the Standards Reference Group SERA (2017). They outline the principles that convey the main ecological, biological, technical, social and ethical underpinnings of ecological restoration practice. More specific guidance regarding restoration of Illawarra–Shoalhaven Subtropical Rainforest, or information that is regionally specific, may also become available. As restoration ecology is continually developing, it is also important to reflect on the experience of others who have worked on restoring the ecological community, as well as adapting restoration projects as site-level experience accumulates.

To achieve cost-effective investments in conservation management it is important to consider the likely interaction of the various management actions being taken at any one site, as these may be synergistic or antagonistic. There are also likely to be interactions between sites. Additionally, when allocating management resources it is important to consider what is the minimum investment required for success and the follow-up required to secure long-term recovery (for example, for how many years should weed management be repeated).

### **6.3 Priority actions**

Priority actions are recommended for the abatement of threats and supporting recovery of the ecological community. These recommended actions are designed to provide guidance for:

- planning, management and restoration of the ecological community by landholders, NRM and community groups and other land managers;
- determining conditions of approval for relevant controlled actions under national environment law; and
- prioritising activities in applications for Australian Government or other funding programs.

Detailed advice on actions may be available in other documents, such as management plans for weeds, fire or certain parks or regions. The most relevant are listed in section 6.4 below.

This conservation advice identifies priority conservation actions under the following key approaches:

- **PROTECT** the ecological community to prevent further losses;

- RESTORE the ecological community by active abatement of threats, appropriate management, restoration and other conservation initiatives;
- COMMUNICATE, ENGAGE WITH AND SUPPORT people to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery; and,
- RESEARCH AND MONITORING to improve our understanding of the ecological community and the best methods to aid its management and recovery.

These approaches overlap in practice; and form part of an iterative approach to management that includes research, planning, management, monitoring and review.

The actions below do not necessarily encompass all actions in detail that may benefit the Illawarra–Shoalhaven Subtropical Rainforest ecological community. They highlight general but key actions required to at least maintain survival of the ecological community at the time of preparing this Conservation Advice. Actions inconsistent with these actions and that are likely to significantly adversely affect the ecological community should be avoided.

### **6.3.1 *PROTECT the ecological community.***

This key approach includes priorities intended to protect the ecological community by preventing further losses to extent and integrity – i.e. prevent vegetation clearance and direct habitat degradation.

#### Conserve remaining patches

- Prevent and avoid further clearance, fragmentation or detrimental modification of remnants of the ecological community and of surrounding native vegetation; for example, during residential development. High conservation value, less modified and older growth areas are particularly important for retention and management.
- Retain other native vegetation remnants, near patches of the ecological community, where they are important for connectivity, diversity of habitat and act as buffer zones between the ecological community and threats or development zones (e.g. apply recommended buffers of at least 100 m around patches of the ecological community).
- Protect patches identified as the most intact wildlife refuges, or that form important landscape connections, such as wildlife corridors, or that are of regional importance in formal conservation reserves. Consider other remnants for less formal conservation tenures, preferably ones that aim for protection over the long-term. This includes investigating formal conservation arrangements, management agreements and covenants to protect patches on private land. This is particularly important for larger patches or areas that link to other patches of native vegetation and are part of wildlife corridors or migration routes.
- Protect mature trees, particularly with hollows, even if they are dead. Large and old trees may have numerous fissures that provide shelter; support diverse insects and their predators; and act as ‘stepping stones’ for fauna moving between remnants in an otherwise cleared landscape.
- Exclude fire from patches of the ecological community.

- Prevent wood collection (for example, for firewood and fencing) that leads to loss and damage of trees and logs.
- Where regrowth is occurring, provide measures that will support the regrowth to mature (e.g. provide fencing to minimise damage risk).
- Construct wildlife friendly fences to exclude cattle and feral species that incorporate a buffer to protect rainforest remnants and allowing for recruitment and enhanced connectivity.
- Implement measures to prevent or control inappropriate water flows and erosion.
- Plan strategically to minimise further clearing
- Remnants should be properly taken into account during the early stages of zoning and development planning decisions, including strategic planning documents at state, regional and local levels.
- Liaise with local councils and State authorities to ensure that cumulative impacts on the ecological community are reduced as part of broader strategic planning or large projects (e.g. road works, developments).

#### Manage actions to minimise impacts

- Apply the mitigation hierarchy to avoid, then mitigate, then offset potential impacts on the ecological community from development or other actions. The priority is to avoid further clearance and fragmentation of remnants with offsetting as the last resort.
- Plan projects to avoid the need to offset, by avoiding significant impacts to the ecological community.
- In circumstances where impacts cannot be totally avoided, then they should be minimised by:
  - retaining and avoiding damage to high quality patches, which should be managed to retain their benchmark state; and
  - protecting important habitat features, such as large mature trees with hollows as these take many decades to develop and cannot be quickly replaced.
- Where impacts are unavoidable, offsets should be used as a last resort to compensate for the adverse impacts of the action deemed unavoidable. The outcomes of offsetting activities are generally highly uncertain. Any proposals considering offsets for this ecological community should aim to:
  - minimise the need to offset the ecological community by designing development around the ecological community and applying buffers;
  - retain medium and higher quality patches of the ecological community, rather than offset them (particularly with lower quality offset sites);
  - focus on retaining remnants of the ecological community with mature trees;
  - manage and protect offset areas in perpetuity in areas dedicated for conservation purposes – avoid risks that may reduce their size, condition and ecological function in the future;
  - select offset sites as close as possible to the impact site, to allow for local and regional variation in the ecological community;

- increase the area and improve ecological function of existing patches, for example by enhancing landscape connectivity, habitat diversity and condition (e.g. through native vegetation planting, with local rainforest species);
- focus on the restoration of moderate quality patches of the ecological community to achieve high quality condition;
- extend protection to otherwise unprotected sites (e.g. sites that are currently too small or degraded to meet the condition thresholds for national protection, but can reasonably be restored to a better, more intact condition); and
- monitor offset areas and the outcomes they deliver over the long-term, to manage them adaptively and improve understanding of the best ways to manage offsets to deliver biodiversity benefits.

#### Minimise indirect impacts

- Minimise the risk of indirect impacts to the ecological community from actions outside but near to patches of the ecological community.
- Protect and apply appropriate buffers (i.e. at least 100 m), particularly of other native vegetation, around patches of the ecological community to minimise off-site impacts; wider buffers may be required where there is larger scale landscape change, such as changes to catchment hydrology. Buffers also serve as important landscape connections, such as wildlife corridors.

#### Prevent the introduction and spread of exotic species

- Support strong border biosecurity and avoid importing or accidentally introducing invasive species and pathogens into Australia that may have a serious adverse impact on this ecological community.
- Prevent planting of known or potentially invasive species (particularly known transformer species) in gardens, developments and landscaping near the ecological community.
- Avoid planting highly invasive (e.g. bird dispersed) species in or near remnants.
- When conducting activities in or around the ecological community, practise good biosecurity hygiene to avoid spreading weeds or pathogens. For example, keep vehicles and machinery to dedicated roads and out of remnants wherever possible. If vehicles must be taken into remnants ensure vehicles are washed first to remove soil, potential fungal pathogens and weed seeds. Use plants from accredited nurseries (e.g. accredited through the Nursery and Garden Industry Australia's Nursery Industry Accreditation Scheme).
- Minimise unnecessary soil disturbance that may facilitate weed establishment.
- Prevent dumping of garden waste into bushland, especially in or near patches of the ecological community.
- If new weed incursions do occur, detect and control them early, as small infestations are more likely to be able to be eradicated.
- Limit or prevent access of grazing animals to patches of the ecological community (e.g. construct fences).

- Prevent further introduction of feral animals and, where possible, contain pets in nearby residential areas.
- Work with relevant authorities to suppress deer and goat numbers, in line with the regional pest management strategy.
- Control invasive species using best practice bush regeneration techniques by qualified bush regenerators.

### **6.3.2 RESTORE the ecological community**

This key approach includes priorities to restore the ecological community by active abatement of threats, appropriate management, restoration and other conservation initiatives.

- Liaise with landholders and undertake and promote programs that ameliorate threats such as grazing and human disturbance.
- Work with landholders to restore and reconnect patches of the ecological community and include buffers.

#### Manage weeds and pests

- Implement effective integrated control and management techniques for weeds affecting the ecological community and manage sites to prevent the introduction of new, or further spread of, invasive weeds.
- Identify potential new weed incursions early (particularly transformer species) and manage for local eradication, where possible.
- Prioritise weed control in patches for which management is most urgent.
- Target control of key weeds that threaten the ecological community using appropriate methods.
- Encourage appropriate use of local native species in developments in the region through local government and industry initiatives and best practice strategies.
- Ensure chemicals, or other mechanisms used to manage weeds, do not have significant adverse, off-target impacts on the ecological community or adjacent waterbodies.
- Control introduced pest animals through coordinated landscape-scale control programs.

#### Exclude trampling, browsing and grazing

- Promote regeneration by avoiding grazing.
- Strategically manage total herbivore grazing (by native and domestic animals), for instance by fencing off regrowth, revegetation areas, or high value sites to restrict grazers.

#### Undertake restoration

- Undertake restoration, including bush regeneration and revegetation, of poorer and medium quality patches to restore them to high quality.
- Plan and implement restoration with reference to the *National Standards for the Practice of Ecological Restoration in Australia* (Standards Reference Group SERA, 2017).

- Use local native species in restoration/revegetation projects for the ecological community and restore understorey vegetation to a structure and diversity appropriate to the site.
- In general, use locally collected seeds, where available, to revegetate native plant species. However, choosing sources of seed closer to the margins of their range may increase resilience to climate change.
- Ensure commitment to follow up after planting, such as the care of newly planted vegetation by watering, mulching, weeding and use/removal of tree guards.
- Consider the landscape context and other relevant species and communities when planning restoration works. For example, ensure adjacent ecological-communities and threatened species are not adversely impacted by tree planting or other restoration activities.
- Develop a collection program and collect seed from the ecological community for the Australian Seedbank Partnership<sup>28</sup> and/or other relevant programs.
- Implement effective adaptive management regimes using information from available research and management guidelines, for example, see the National Standards for the Practice of Ecological Restoration in Australia, relevant research or advice from local authorities.

### **6.3.3 COMMUNICATE, ENGAGE WITH AND SUPPORT**

This key approach includes priorities to promote the ecological community to build awareness and encourage people and groups to contribute to its recovery. This includes communicating, engaging with and supporting the public and key stakeholders to increase their understanding of the value and function of the ecological community and to encourage and assist their efforts in its protection and recovery. Key groups to communicate with include landholders, land managers, land use planners, researchers, community members and Indigenous communities, particularly Traditional Owner groups.

#### Raise awareness

- Educate landholders about the ecological values of and threats to Illawarra–Shoalhaven Subtropical Rainforest in the Sydney Basin Bioregion.
- Encourage landholders to protect patches through long term private land conservation mechanisms.
- Communicate with landholders/managers, relevant agencies and the public to emphasise the value of the ecological community, the key threats, its significance, and appropriate management. Encourage landholders to talk with local NRM organisations and other knowledgeable groups.
- Undertake effective community engagement and education to highlight the importance of minimising disturbance.

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<sup>28</sup> Australian Seedbank Partnership: [www.seedpartnership.org.au](http://www.seedpartnership.org.au)

- Inform landholders about incentives, such as conservation agreements, stewardship projects, funding and government NRM programs etc. that may apply to help look after sites on private lands.

#### Provide information

- Develop education programs, information products and signage to help the public recognise the presence and importance of the ecological community, and their responsibilities under state and local regulations and national environmental law. This includes preparation of identification guidelines for the ecological community.
- Install signage (and where appropriate fencing, gates, bollards and formal trails) to discourage damaging activities such as the removal of rocks and dead timber, dumping garden waste and other rubbish, creating informal paths and tracks, and the use of off-road vehicles in patches of the ecological community.
- Install significant vegetation markers along roads to designate areas of the ecological community to protect and prevent inappropriate road side maintenance from occurring.
- Promote knowledge about local weeds and what garden plants to avoid planting. Recommend local native species for revegetation and landscaping or safe alternative garden plants.

#### Coordinate efforts

- Encourage local participation in restoration and ‘landcare’ efforts through local conservation groups, creating ‘friends of’ groups, field days and planting projects, etc.
- Liaise with local fire management authorities and agencies and engage their support in fire management of the ecological community. Ensure land managers are given information about how to manage fire risks to conserve any threatened species and ecological communities.
- Support opportunities for traditional owners or other members of the Indigenous community to manage the ecological community.

### **6.3.4 RESEARCH AND MONITORING**

This key approach includes priorities for research into the ecological community, and monitoring, to improve understanding of the ecological community and the best methods to aid its recovery through restoration and protection.

#### Mapping

- Collate existing vegetation mapping information and associated data for this ecological community and identify gaps in knowledge.
- Identify and map the fire interval status of surrounding fire-dependent vegetation.
- Undertake or support and enhance survey programs to:
- Improve mapping of sites where the ecological community is known or likely to be present.
- Conduct targeted field surveys and ground-truth to fill data gaps and clarify the presence and condition of remnants.

#### Options for managing threats



- Research into appropriate and integrated methods to manage weeds that affect the ecological community.

### Monitoring

- Monitor for incursions by new weeds and pest animals.
- Monitor for myrtle rust and signs of new disease.
- It is important that any monitoring is planned before management commences and considers what data are required to address research questions. Monitoring must also be resourced for management activities, especially for those using a novel approach, and applied during and following the management action.
- Monitor changes in the composition, structure and function of the ecological community, including response to all types of management actions and use this information to increase understanding of the ecological community and inform recommendations for future management.

### **6.4 Existing plans relevant to the ecological community**

A number of existing plans relate to management and/or recovery of the Illawarra–Shoalhaven subtropical rainforest ecological community or its component species. These prescriptions were current at the time of publishing. Please refer to the relevant agency’s website for any updated versions or new information that has been published.

Plans prepared for the management and/or recovery of the ecological community (or its component vegetation units and State-listed equivalent communities, or relevant threatened species) include the following.

The NSW Government has issued a targeted strategy for managing the two state-listed endangered ecological communities (that largely correspond to the nationally defined ecological community) under the Saving Our Species program. *Help save the Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* and *Help save the Milton Ulladulla Subtropical Rainforest in the Sydney Basin Bioregion* are available at:

<https://www.environment.nsw.gov.au/savingourspeciesapp/Project.aspx?ProfileID=10427> and <https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10532>

From this work, the following site-scale actions are outlined (at December 2018) in the ‘Action toolbox’ for the state-listed endangered *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* ecological community.

- Conduct a combination of targeted physical and chemical weed control and bush regeneration activities on the site after establishing the weed management requirements based on weeds present and their coverage.
- Undertake ground-based shooting and other management actions if deemed appropriate, consistent with protocols and processes of the Northern Illawarra Deer Management Plan.
- Conduct buffer and infill planting to reduce edge effects and to improve the edge to area ratio using species consistent with the Illawarra Subtropical Rainforest. Protect plantings from damage by deer browsing.

- Assess the requirements for the installation/repairs of fencing to protect occurrences of Illawarra Subtropical Rainforest in the site from trampling and grazing by domestic stock.
- Undertake ground-based shooting and/or trapping of goats.
- Provide educational support to landholders including descriptive information regarding the Illawarra Subtropical Rainforest, its environmental values and activities, and actions that can be done to protect and improve its habitat.
- Conduct surveys for the Illawarra Subtropical Rainforest in the site to determine its extent and condition. Use research to inform management priorities.

A Priorities Action Statement is also available for the state-listed endangered *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* ecological community, at:

<http://www.environment.nsw.gov.au/~media/DC92759E815F49179AD60D0DE2F38212.ashx>

Regional management plans:

Illawarra Councils (2010). Illawarra Biodiversity Strategy (draft). Wollongong City Council, Shellharbour City Council, Kiama Municipal Council. Available at:

[www.wollongong.nsw.gov.au/council/haveyoursay/Pages/IllawarraBiodiversityStrategy.aspx](http://www.wollongong.nsw.gov.au/council/haveyoursay/Pages/IllawarraBiodiversityStrategy.aspx)

Threat abatement plans include:

Department of the Environment (2015). Threat abatement plan for predation by feral cats. Commonwealth of Australia. Available at:

<http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats>

Department of the Environment and Heritage (2016). Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis. Available

at: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/infection-amphibians-chytrid-fungus-resulting-chytridiomycosis-2016>

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008 - 2016).

Threat abatement plan for predation by the European red fox. DEWHA, Canberra. Available at: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox>

Recovery plans prepared for threatened species occurring in the ecological community include:

Department of Environment and Conservation (NSW) (2005). *Zieria granulata* (Illawarra Zieria) recovery plan. Available at: <https://www.environment.nsw.gov.au/research-and-publications/publications-search/zieria-granulata-illawarra-zieria-recovery-plan>

Hunter D and Gillespie GR (2011) National Recovery Plan for the Stuttering Frog *Mixophyes balbus*. Victoria Department of Sustainability and Environment, Melbourne. Available at:

<http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-stuttering-frog-mixophyes-balbus>

Queensland Department of Environment and Resource Management (2011) National recovery plan for the large-eared pied bat *Chalinolobus dwyeri*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available at: <http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-large-eared-pied-bat-chalinolobus-dwyeri>

Victorian Department of Environment, Land, Water and Planning (2016) National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus*. Australian Government, Canberra. Available at: <http://www.environment.gov.au/biodiversity/threatened/recovery-plans/spotted-tailed-quoll>

## **BIBLIOGRAPHY** (Incomplete)

BSRLG [Big Scrub Rainforest Landcare Group] (2005). Subtropical Rainforest Restoration: A practical manual and data source for landcare groups, land managers and rainforest regenerators. Big Scrub Rainforest Landcare Group, Bangalow NSW.

Floyd AG (1990). Australian rainforests in New South Wales (2 Volumes). Surrey Beatty and Sons, Chipping Norton.

Illawarra Councils (2010). Illawarra Biodiversity Strategy (draft). Wollongong City Council, Shellharbour City Council, Kiama Municipal Council. Available at: [www.wollongong.nsw.gov.au/council/haveyoursay/Pages/IllawarraBiodiversityStrategy.aspx](http://www.wollongong.nsw.gov.au/council/haveyoursay/Pages/IllawarraBiodiversityStrategy.aspx)

Mills K & Jakeman J (1995). Rainforests of the Illawarra District. Coachwood Publishing, Jamberoo.

National Committee on Soil and Terrain (2009). Australian Soil and Land Survey Field Handbook. Third Edition. CSIRO Publishing

NSW OEH [Office of Environment and Heritage] (undated a). Species profiles: *Parma Wallaby*, *Sooty Owl*. Available on the internet at:

[www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10501](http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10501)

[www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10821](http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10821)

NSW OEH (2017). Illawarra Subtropical Rainforest in the Sydney Basin Bioregion – profile <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10427>

NSW NPWS [National Parks and Wildlife Service] (2000). Wollongong Local Government Area Bioregional Assessment Study Part II. Fauna of the Illawarra Escarpment, Coastal Plain and Plateau.

NSW NPWS (2002a) Native Vegetation of the Wollongong Escarpment and Coastal Plain. Central CPPD, NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS (2002b). Wollongong Local Government Area Bioregional Assessment Study Part I: Native Vegetation of the Illawarra Escarpment and Coastal Plain. Report for the Commission of Inquiry into Planning and Development of the Illawarra Escarpment.

NSW Scientific Committee (2002a). NSW Threatened Species Scientific Committee Illawarra subtropical rainforest in the Sydney Basin Bioregion - endangered ecological community listing. NSW Scientific Committee - Final determination.

<https://www.environment.nsw.gov.au/determinations/IllawarraSubtropicalRainforestSydneyBasinEndComListing.htm>

NSW Scientific Committee (2002b). NSW Threatened Species Scientific Committee Milton Ulladulla subtropical rainforest in the Sydney Basin Bioregion - endangered ecological community listing. NSW Scientific Committee - Final determination.

<https://www.environment.nsw.gov.au/determinations/MiltonUlladullaSubtropicalRainforestSydneyEndComListing.htm>

PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au>. Accessed December 2018.

Stern H, de Hoedt G & Ernst J (1999). Objective classification of Australian climates. *Aust. Met. Mag.* 49. (2000) 87-96.

Tozer M (2003). The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. *Cunninghamia* 8(1): 1-75.

Tozer M, Turner K, Keith D, Tindall D, Pennay C, Simpson C, MacKenzie B, Beukers P & Cox S (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia*, 11 (3) 359-406.

Webb LJ (1968). Environmental relationships of the structural types of Australian rainforest vegetation. *Ecology* 49 (2): 296-311.

**Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)**  
**Threatened Ecological Communities**

**APPENDIX A – species lists**

*Table A1: Flora of the Illawarra–Shoalhaven subtropical rainforest.*

List of vascular plant species characteristic of the Illawarra–Shoalhaven Subtropical Rainforest ecological community. This is an indicative rather than comprehensive list of plant species present in the ecological community and is based upon vegetation units RF p111 and RF p112 (Tozer et al., 2010), the Final Determinations for the NSW-listed ecological communities (NSW Scientific Committee 2002a, 2002b).

Patches may not include all species on the list, or may include other species not listed. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers.

For the lists derived from Tozer et al., 2010: ‘✓’ indicates those species identified as being of positive diagnostic value for the two map units related to the ecological community.

For the lists derived from NSW Scientific Committee 2002a, 2002b: ‘✓’ indicates species listed as being characteristic of the assemblage of species for each of the two NSW-listed ecological communities.

Note: The table is ordered by species name. Scientific names below reflect updated species’ taxonomy as at December 2018.

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub 1.5–2 m high, stems sometimes weak, stems and leaves velvety	Straggly Lantern-bush, Lantern Bush	Malvaceae	<i>Abutilon oxycarpum</i> var. <i>oxycarpum</i>	✓			
Erect or spreading tree 5–20 m high	Maiden's Wattle	Mimosoideae	<i>Acacia maidenii</i>	✓	✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrubs or trees with smooth to slightly flaky bark; twigs often 4-angled or shortly 4-winged, bark on older stems cracking longitudinally	Lilly Pilly, Midjuburi (Cadigal)	Myrtaceae	<i>Acmena smithii</i>	✓	✓		✓
Shrub to medium-sized tree to 27 m high, glabrous	White Aspen, Yellow Wood	Rutaceae	<i>Acronychia oblongifolia</i>	✓	✓		
Rhizome creeping, much branched, covered with papery scales	Common Maidenhair	Pteridaceae	<i>Adiantum aethiopicum</i>	✓			
Rhizome long-creeping, deeply buried	Black Stem, Black Stem Maidenhair, Giant Maidenhair	Pteridaceae	<i>Adiantum formosum</i>	✓	✓	✓	
Rhizome short-creeping, covered with dark brown scales; rootlets lacking bulbils	Rough Maidenhair Fern	Pteridaceae	<i>Adiantum hispidulum</i>	✓	✓		
Small tree or shrub with branchlets and inflorescences finely hairy	Native Quince, Wild Quince, Bird's Eye	Sapindaceae	<i>Alectryon subcinereus</i>	✓	✓	✓	✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Small to medium-sized tree with buds and young stems grey to golden-brown hairy	Red Ash	Rhamnaceae	<i>Alphitonia excelsa</i>	✓	✓	✓	
Weak, slender, perennial herb with ascending stems to c. 40 cm high		Commelinaceae	<i>Aneilema acuminatum</i>	✓			
Weak, prostrate to ascending perennial herb; stems ascending to c. 20 cm high		Commelinaceae	<i>Aneilema biflorum</i>		✓		
Climbing or straggling shrub	Gum Vine	Aphanopetalaceae	<i>Aphanopetalum resinosum</i>	✓	✓		✓
Fern: Rhizome very long-creeping, rigid, to 6 mm diam., densely covered with brown scales		Tectariaceae	<i>Arthropteris tenella</i>	✓	✓		✓
Rhizome erect, stout bearing even rosettes of radiating fronds; scales brown, ciliate	Bird's Nest Fern	Aspleniaceae	<i>Asplenium australasicum</i>	✓	✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Rhizome short, erect, with dark brown lanceolate scales	Necklace Fern	Aspleniaceae	<i>Asplenium flabellifolium</i>	✓	✓		✓
Shrub or tree with finely flaky bark; young branchlets with spreading hairs	Grey Myrtle, Ironwood	Myrtaceae	<i>Backhousia myrtifolia</i>	✓			
Medium-sized tree exuding a clear sap from the stem when cut that turns bright red	Brush Bloodwood, Ivory Birch, Scrub Bloodwood	Euphorbiaceae	<i>Baloghia inophylla</i>	✓	✓	✓	✓
Rhizome short-creeping, black, densely covered with narrow black scales		Blechnaceae	<i>Blechnum neohollandicum</i> (syn. <i>Doodia aspera</i> )	✓	✓	✓	✓
Rhizome erect, scales of rhizome broad, brown, shiny	Strap Water Fern	Blechnaceae	<i>Blechnum patersonii</i> subsp. <i>patersonii</i>		✓		
Tree to 35 m, deciduous, flowers produced in spring on leafless branches	Flame Tree, Illawarra Flame Tree	Malvaceae	<i>Brachychiton acerifolius</i>		✓	✓	
Shrub to 3 m high	Coffee Bush	Phyllanthaceae	<i>Breynia oblongifolia</i>	✓			✓



				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Large shrub or small tree 3–10 m high; bark papery and peeling; branchlets flexuous; new growth purplish pink	Willow Bottlebrush	Myrtaceae	<i>Callistemon salignus</i>	✓			
Rhizome short; shoots densely tufted. Culms erect, terete to trigonous, smooth below, scabrous above, 40– 80 cm long, c. 1.3 mm diam		Cyperaceae	<i>Carex longebrachiata</i>	✓			
Weak climber with stems to c. 2 m long, pubescent or glabrous; underground stems usually forming small tubers	Native Grape	Vitaceae	<i>Cayratia clematidea</i>	✓		✓	
Climbing dioecious shrub, ± glabrous; stems mostly grey to grey-brown	Staff Climber	Celastraceae	<i>Celastrus australis</i>	✓	✓	✓	
Climber or scrambler, to 5 m high; young stems and petiole with retrorse bristles	Climbing Panax	Araliaceae	<i>Cephalalaria cephalobotrys</i>		✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Medium-sized tree with smooth whitish bark blotched with grey and white lichens and with distinctive horizontal lines encircling the trunk	Coachwood	Cunoniaceae	<i>Ceratopetalum apetalum</i>		✓		
Medium-sized to large tree, not buttressed, bark grey or brown with a thin corky layer; strongly aromatic in all parts if crushed	Oliver's Sassafras	Lauraceae	<i>Cinnamomum oliveri</i>		✓		
Woody climbers with new growth ± rusty-pubescent, often glabrescent with age; tendrils simple or 2-branched	Kangaroo Vine, Water Vine	Vitaceae	<i>Cissus antarctica</i>	✓	✓	✓	✓
Large woody climber with new growth rusty-pubescent; tendrils 2-branched	Water Vine	Vitaceae	<i>Cissus hypoglauca</i>		✓		✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Large tree to 40 m high, trunk channelled with bark fawnish, finely fissured and corky; bark grey-brown; branchlets with appressed brownish hairs	Churnwood	Cardiopteridaceae	<i>Citronella moorei</i>		✓		
Shrub or small tree, often straggling and to c. 9 m high, glabrous or finely pubescent, small branches pale and brittle	Brittlewood	Euphorbiaceae	<i>Claoxylon australe</i>	✓	✓		✓
Shrub or tree, 1–10 m high, usually velvety	Hairy Clerodendrum, Downy Chance Tree	Lamiaceae	<i>Clerodendrum tomentosum</i>	✓	✓		
Perennial herb; stems prostrate and ascending, glabrous or almost so		Commelinaceae	<i>Commelina cyanea</i>	✓			
Shrub or small tree with young stems and petioles often purplish, old leaves often turning orange before falling	Green Native Casarilla	Euphorbiaceae	<i>Croton verreauxii</i>	✓	✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Medium-sized tree, sometimes buttressed, bark brown and ± scaly; young growth covered with appressed, fawn hairs, soon becoming glabrous	Jackwood	Lauraceae	<i>Cryptocarya glaucescens</i>		✓		
Usually a small tree; young growth covered in straight, appressed, fawn hairs, eventually becoming ± glabrous	Murrogun	Lauraceae	<i>Cryptocarya microneura</i>	✓	✓		
Climber or twiner with stems becoming corky, cream to fawn		Apocynaceae	<i>Cynanchum elegans</i>	✓			
Small, tufted perennial, sometimes proliferating		Cyperaceae	<i>Cyperus laevis</i>	✓			
Tufted perennial with short rhizome		Cyperaceae	<i>Cyperus tetraphyllus</i>	✓			
Tree to 40 m with fluted trunks; stinging hairs cause an intense persistent sting	Giant Stinging Tree	Urticaceae	<i>Dendrocnide excelsa</i>	✓	✓	✓	✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub or small tree	Black Plum, Yellow Persimmon, Grey Plum	Ebenaceae	<i>Diospyros australis</i>	✓	✓		✓
Small to medium-sized tree	Myrtle Ebony, Grey Persimmon, Black Myrtle, Grey Plum	Ebenaceae	<i>Diospyros pentamera</i>		✓	✓	
Tree to 30 m high; new growth rusty-tomentose; branchlets strongly ribbed	Native Tamarind	Sapindaceae	<i>Diploglottis australis</i>		✓	✓	
Tree with young shoots and inflorescences silky- pubescent	Sassafras	Atherospermatace ae	<i>Doryphora sassafras</i>		✓		
Tree to 30 m high, often ± deciduous, mostly glabrous; bark grey, smooth.	Koda, Silky Ash, Churnwood	Boraginaceae	<i>Ehretia acuminata</i> var. <i>acuminata</i>	✓	✓	✓	

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Medium-sized to large buttressed tree with pale smooth bark	Silver Quandong, White Quandong, Brown Hearted Quandong, Brownheart, Bountain Beech, Mowbullan Whitewood, Pigeonberry Ash, White Beech, Whitewood	Elaeocarpaceae	<i>Elaeocarpus kirtonii</i>		✓		
Shrub or small tree to 8 m high, dioecious, glabrous.	Red Olive Berry	Celastraceae	<i>Elaeodendron australe</i> var. <i>australe</i> (syn. <i>Cassine</i> <i>australis</i> var. <i>australis</i> )	✓	✓	✓	
Tree to 50 m high; bark persistent on trunk and branches, grey with whitish patches, fibrous-flaky, smooth above, white or grey, shedding in long ribbons	White-topped Box, Coast White Box	Myrtaceae	<i>Eucalyptus quadrangulata</i>	✓	✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Tree to 50 m high; bark smooth, powdery, white or grey, shedding in short ribbons or flakes, sometimes persistent on lower trunk.	Wollongong Woollybutt	Myrtaceae	<i>Eucalyptus saligna X botryoides</i>		✓		
Tree to 50 m high; bark smooth, white or grey, shedding in large plates or flakes	Forest Red Gum, Buringoa (D'harawal)	Myrtaceae	<i>Eucalyptus tereticornis</i>	✓			
Shrub or small tree, branchlets often black	Bolwarra, Copper Laurel	Eupomatiaceae	<i>Eupomatia laurina</i>		✓		
Vine with stems to 6 m long, sometimes much branched	Wombat Berry	Luzuriagaceae	<i>Eustrephus latifolius</i>	✓	✓		✓
Shrub or small tree, branches densely hairy, scabrous	Sandpaper Fig, Creek Sandpaper Fig	Moraceae	<i>Ficus coronata</i>	✓	✓	✓	✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Large spreading tree, epiphytic and strangling in early stages, trunks becoming massive with large buttresses; young stems glabrous	Moreton Bay Fig	Moraceae	<i>Ficus macrophylla</i> subsp. <i>macrophylla</i>		✓	" <i>Ficus</i> spp." Listed in Final Determination	" <i>Ficus</i> spp." Listed in Final Determination
Medium-sized to large strangling tree with massive trunks of coalesced roots, buttressed; young stems glabrous	Small-leaved Fig	Moraceae	<i>Ficus obliqua</i>		✓	" <i>Ficus</i> spp." Listed in Final Determination	" <i>Ficus</i> spp." Listed in Final Determination
Vine with stems to 8 m long	Scrambling Lily	Luzuriagaceae	<i>Geitonoplesium cymosum</i>	✓	✓		✓
Shrub to medium-sized tree	Cheese Tree	Phyllanthaceae	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	✓			
Tree up to 6 m high, bark smooth, grey to dark grey, often ± spotted; new growth pubescent	Guioa	Sapindaceae	<i>Guioa semiglauca</i>	✓	✓	✓	
Perennial herb, not or hardly clumped; rhizome creeping	Settlers' Twine, Boorgay	Araceae	<i>Gymnostachys anceps</i>	✓	✓		✓



				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Woody climber or scrambling shrub, ± glabrous	Sweet Morinda	Rubiaceae	<i>Gynochthodes jasminoides</i> (syn. <i>Morinda jasminoides</i> )	✓	✓		
Shrub or small tree, ± glabrous, stems prickly	Native Rosella	Malvaceae	<i>Hibiscus heterophyllus</i> subsp. <i>heterophyllus</i>	✓		✓	
Rhizome short and erect or oblique	Creeping Shield Fern, Glossy Shield Fern, Shiny Shield Fern	Dryopteridaceae	<i>Lastreopsis acuminata</i>		✓		
Rhizome short-creeping, thick, covered with brown scales	Trim Shield-fern, Trim Shield Fern	Dryopteridaceae	<i>Lastreopsis decomposita</i>	✓	✓		
Rhizome long-creeping, covered with brown scales	Creeping Shield Fern	Dryopteridaceae	<i>Lastreopsis microsora</i> subsp. <i>microsora</i>		✓		
Woody climber with young stems and petioles pubescent or bristly, later ± glabrescent; older stems woody; dioecious	Round-leaf Vine	Menispermaceae	<i>Legnephora moorei</i>	✓	✓	✓	✓
Tree to 40 m with smooth bark marked by oval depressions	Bolly Gum	Lauraceae	<i>Litsea reticulata</i>		✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Tree with solitary stem up to 30 m high (occasionally more), up to 50 cm diam., marked with annular scars and furrows	Cabbage Fan Palm, Cabbage Tree alm, Daranggara (Cadigal), Cabbage Palm, Fan Palm	Arecaceae	<i>Livistona australis</i>		✓		
Woody climbers or straggling shrubs with spines 0.5–2.5 cm long, often longer than leaves on juvenile plants; latex often ± milky	Cockspur Thorn	Moraceae	<i>Maclura cochinchinensis</i>	✓	✓	✓	
Thin-stemmed twiner to 5 m high, stems pubescent, latex milky slightly yellowish	Hairy Milk Vine	Apocynaceae	<i>Marsdenia flavescens</i>	✓	✓		
Climber to c. 10 m high, latex copious, milky	Milk Vine	Apocynaceae	<i>Marsdenia rostrata</i>	✓	✓		✓
Shrub or tree up to 20 m high with papery bark	Prickly-leaved Tea Tree	Myrtaceae	<i>Melaleuca styphelioides</i>	✓			

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub or slender tree up to 27 m high, glabrous or often softly pubescent on young growth and leaflets	Hairy-leaved Doughwood, White Euodia	Rutaceae	<i>Melicope micrococca</i>	✓	✓		
Erect to spreading shrub to 2–5 m high, up to 6 m across, usually dioecious. Bark smooth, grey, with lenticels	Tree Violet	Violaceae	<i>Melicytus dentatus</i> (syn. <i>Hymenanthera dentata</i> )	✓			
Woody climber with twining stems, sometimes tall, branchlets glabrous	Southern Melodinus	Apocynaceae	<i>Melodinus australis</i>		✓		
Rhizome very long-creeping, tough and wiry, scales spreading and persistent	Fragrant Fern	Polypodiaceae	<i>Microsorium scandens</i>		✓		
Shrub or small tree; bark smooth, grey; with terminal buds rusty-hairy	Brush muttonwood	Primulaceae	<i>Myrsine howittiana</i> (syn. <i>Rapanea howittiana</i> )		✓		
Shrub or small tree with terminal buds covered with fawn to brown hairs		Primulaceae	<i>Myrsine variabilis</i> (syn. <i>Rapanea variabilis</i> )	✓			

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Tree to c. 9 m high, often with a dense crown; branchlets grey or brown, usually with conspicuous white lenticels; axillary buds 2–4, pointed, glabrous or hairy	Large Mock-olive, Large-leaved Olive	Oleaceae	<i>Notelaea venosa</i>	✓	✓		✓
Weak trailing perennial to 0.3 m high	Australian Basket Grass, Wavy Beard Grass	Poaceae	<i>Oplismenus aemulus</i>	✓			
Weak trailing perennial to 0.3 m high	Creeping Beard Grass	Poaceae	<i>Oplismenus imbecillis</i>	✓	✓		✓
Tall woody climber, sometimes scrambling in juvenile stages, stems stellate-hairy	Anchor Vine, Pomegranate Vine	Monimiaceae	<i>Palmeria scandens</i>		✓		
Woody scrambler or climber with ± twining branches, glabrous; older branches ± longitudinally ridged and with fawnish bark	Wonga Wonga Vine	Bignoniaceae	<i>Pandorea pandorana</i>	✓	✓		✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Woody vine climbing by adventitious roots and twinning stems, sap watery	Common Silkpod, Monkey Rope	Apocynaceae	<i>Parsonsia straminea</i>	✓	✓		
Rhizome long-creeping with narrow-ovate scales	Sickle Fern	Pteridaceae	<i>Pellaea falcata</i>	✓	✓		✓
Tree to about 25 m high, with irregularly fluted trunk, bark dark grey to brown, often scaly; branchlets glabrous, often strongly zigzagged	Brown Beech	Pennantiaceae	<i>Pennantia cunninghamii</i>		✓	✓	
Large glabrous climber, climbing on tree trunks by small adventitious roots; branches up to 30 cm diam.	Giant Pepper Vine	Piperaceae	<i>Piper hederaceum</i> (syn. <i>Piper novae-hollandiae</i> )		✓	✓	
Rigid, much-branched, sometimes straggling shrub 1–3 m high, branches bearing numerous slender spines, mostly arising from leaf axils; stems brittle	Orange Thorn	Pittosporaceae	<i>Pittosporum multiflorum</i> (syn. <i>Citriobatus pauciflorus</i> )	✓	✓	✓	✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub to c. 3 m high	Wild Yellow Jasmine, Rough Fruit Pittosporum	Pittosporaceae	<i>Pittosporum revolutum</i>	✓			
Tall shrub or tree to 15 m high, glabrous on vegetative parts except for a few hairs on young growth	Native Daphne, Sweet Pittosporum, Snowdrop Tree (L.H.I.), Mock Orange	Pittosporaceae	<i>Pittosporum undulatum</i>	✓	✓		✓
Medium to tall tree	Black Apple, Wild Plum, Yellow Buttonwood, Black Plum, Yellow Bulletwood	Sapotaceae	<i>Planchonella australis</i> (syn. <i>Pouteria australis</i> )	✓	✓	✓	
Non-aromatic shrub, 10–70 cm high, with fleshy tuberous base to c. 3 cm diam.	Cockspur Flower	Lamiaceae	<i>Plectranthus parviflorus</i>	✓			✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Medium to large tree with brown to dark brown bark that is often fissured and scaly on old trees	Plum Pine, Brown Pine	Podocarpaceae	<i>Podocarpus elatus</i>		✓	✓	
Tree to 15 m high, new growth sparsely to densely appressed hairy	Featherwood	Escalloniaceae	<i>Polyosma cunninghamii</i>		✓		
Perennial herb, mostly 15–30 cm high, branches hairy	Pastel Flower	Acanthaceae	<i>Pseuderanthemum variabile</i>	✓	✓		
Rhizome short-creeping, the apex covered with narrow dark brown scales	Jungle Brake	Pteridaceae	<i>Pteris umbrosa</i>		✓		
Rhizome long-creeping, much branched; scales spreading, papery, pale reddish brown, entire	Rock Felt Fern	Polypodiaceae	<i>Pyrrosia rupestris</i>	✓	✓		
Shrub or small tree to 25 m high, bark reddish brown, fissured; young stems densely tomentose	Scrub Turpentine, Brown Malletwood	Myrtaceae	<i>Rhodamnia rubescens</i>	✓			
Sprawling twiner to tall climber; dioecious	Pearl Vine	Menispermaceae	<i>Sarcopetalum harveyanum</i>	✓	✓		✓

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub or small tree to 18 m high	Big Yellow Wood, Yellow Wood	Rutaceae	<i>Sarcomelicope simplicifolia subsp. simplicifolia</i>	✓			
Medium to large tree with finely fissured hard-corky bark	Crabapple, White Birch, White Cherry, Snowberry	Cunoniaceae	<i>Schizomeria ovata</i>		✓		
Shrub to medium-sized tree, ± glabrous, coppice shoots often spinose	Flintwood, Mountain Cherry, Brown Birch, Scolopia	Salicaceae	<i>Scolopia braunii</i>	✓		✓	
Medium-sized tree, irregularly buttressed, crooked and often with coppice shoots near base of trunk; new foliage often reddish	Maiden's Blush, Blush Alder, Blush Carrabeen, Blush Carrobean, Cudgerie	Elaeocarpaceae	<i>Sloanea australis</i>		✓		
Dioecious climber; stems to 8 m long, usually prickly	Lawyer Vine, Wait-a-while, Barbwire Vine	Smilacaceae	<i>Smilax australis</i>	✓	✓		✓
Procumbent or ascending perennial herb, glabrous or almost so, hairy at nodes		Caryophyllaceae	<i>Stellaria flaccida</i>	✓			



				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub or tree to 30 m high; bark dark brown, ± fissured and finely scaly	Scrub Beefwood, Red Silky Oak	Proteaceae	<i>Stenocarpus salignus</i>	✓	✓		
Climber or twiner, slender stems without prickles; dioecious	Snake Vine	Menispermaceae	<i>Stephania japonica var. discolor</i>	✓			✓
Tall shrub or tree, branches with raised lenticels and transverse ridges left by fallen stipules, bark tough; milky latex exudes from broken stems but often sparse	Whalebone Tree	Moraceae	<i>Streblus brunonianus</i>	✓	✓	✓	✓
Shrub or small tree to 15 m high; branchlets glabrous, terminal buds enclosed in glabrous green scales	Buff Hazelwood	Symplocaceae	<i>Symplocos thwaitesii</i>		✓		
Small tree to 7 m high, with brown scaly bark, new growth pubescent	Scentless Rosewood	Meliaceae	<i>Synoum glandulosum subsp. glandulosum</i>		✓		

				Tozer (2010) Positive Diagnostic Species:		NSW TEC characteristic species lists:	
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112	Illawarra Subtropical Rainforest	Milton Ulladulla Subtropical Rainforest
Shrub or small tree with flaky bark; young leafy twigs 4-angled to shortly 4-winged, wings joining above each node to produce a small pocket	Brush Cherry	Myrtaceae	<i>Syzygium australe</i>		✓		✓
Medium-sized to large deciduous tree with brown to grey scaly bark	Red Cedar, Santhana Vembu	Meliaceae	<i>Toona ciliata</i>	✓	✓	✓	✓
Woody climber; stem scabrid	Burny Vine	Moraceae	<i>Trophis scandens subsp. scandens (syn. Malaisia scandens)</i>	✓	✓	✓	✓
Shrub or small tree	Veiny Wilkiea	Monimiaceae	<i>Wilkiea huegeliana</i>	✓	✓	✓	

Table A1 cont.: Flora of the Illawarra–Shoalhaven subtropical rainforest.

Other tree species occurring less frequently in the Tozer et al. 2010 vegetation units:					
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112
Tree to 30 m high; bark persistent, grey, shortly fibrous	Apple, Rough-barked Apple	Myrtaceae	<i>Angophora floribunda</i>	✓	
Tree to 45 m high; bark smooth throughout, powdery, white, grey or pink, often spotted, shedding in small polygonal flakes	Spotted Gum	Myrtaceae	<i>Corymbia maculata</i>	✓	
Tree to 50 m high; bark persistent on lower or full trunk, grey, fibrous-flaky ('box'), smooth above, white to grey, shedding in short ribbons	Coast Grey Box	Myrtaceae	<i>Eucalyptus bosistoana</i>	✓	
Tree to 40 m high; bark persistent on trunk and larger branches, pale brown to red-brown, coarsely platy and fissured, smooth white to grey above, shedding in short ribbons	Bangalay, Southern Mahogany	Myrtaceae	<i>Eucalyptus botryoides</i>	✓	✓

Other tree species occurring less frequently in the Tozer et al. 2010 vegetation units:					
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112
Tree to 40 m high (occasionally 60); bark often persistent on lower trunk (short stocking only), grey to grey brown, fibrous-flaky white, cream or grey above, shedding in short ribbons or plates	Mountain Blue Gum, Round-leaved Gum	Myrtaceae	<i>Eucalyptus deanei</i>	✓	
Tree to 30 m high; bark persistent, grey to red brown, stringy	Thin-leaved Stringybark	Myrtaceae	<i>Eucalyptus eugenioides</i>	✓	
Tree to 50 m high; bark persistent on trunk and larger branches, red-brown to grey-brown, shortly fibrous to stringy, smooth above, white to grey, shedding in long ribbons	Brown Barrel, Cut-tail	Myrtaceae	<i>Eucalyptus fastigata</i>		✓
Tree to 30 m high; bark persistent throughout, grey-black, 'ironbark'	Grey Ironbark	Myrtaceae	<i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>	✓	
Tree to 70 m high; bark persistent on full trunk, grey-brown, shortly fibrous to stringy, smooth above, white to grey, shedding in long ribbons	Blackbutt	Myrtaceae	<i>Eucalyptus pilularis</i>	✓	✓

Other tree species occurring less frequently in the Tozer et al. 2010 vegetation units:					
Species description (NSW PlantNET)	Common names	Family	Species	RF p111	RF p112
Tree to 50 m high; bark smooth, powdery, white or grey, shedding in short ribbons or flakes, sometimes persistent on lower trunk.	Wollongong Woollybutt	Myrtaceae	<i>Eucalyptus saligna</i> X <i>botryoides</i>	✓	
Tall tree with fibrous to stringy, persistent bark	Turpentine	Myrtaceae	<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>	✓	✓

**Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)**  
**Threatened Ecological Communities**

*Table A2: Fauna of the Illawarra–Shoalhaven subtropical rainforest – Birds.*

<b>Common Name - Birds</b>	<b>Scientific name</b>
Australasian Figbird	<i>Sphecotheres vieilloti</i>
Australian Brush Turkey	<i>Alectura lathamii</i>
Australian King Parrot	<i>Alisteris scapulatis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Barred Cuckoo-shrike	<i>Coracina lineata</i>
Bar-shouldered Dove	<i>Geopelia humeralis</i>
Bassian Thrush	<i>Zoothera lunulata</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Black-faced Monarch	<i>Monarcha melanopsis</i>
Brown Cuckoo-dove	<i>Macropygia amboinensis</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Brush Cuckoo	<i>Cuculus variolosus</i>
Bhannel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
Common Koel	<i>Eudynamys taitensis</i>
Crested Shrike-tit	<i>Falcunculus frontatus</i>
Crimson Rosella	<i>Platycercus elegans</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Eastern Rosella	<i>Platycercus adscitus</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Emerald Dove	<i>Chalcophaps indica</i>
<u>Fan-tailed Cuckoo</u>	<i>Cacomantis flabelliformis</i>
Galah	<i>Cacuata roseicapilla</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Green Catbird	<i>Ailuroedus crassirostris</i>
Grey Butcherbird	<i>Cracticus torquatus</i>
Grey Fantail	<i>Rhipidura albiscapa</i>
Grey Goshawk	<i>Accipiter novaehollandiae</i>
Grey Shrikethrush	<i>Colluricincla harmonica</i>
Large-billed Scrubwren	<i>Sericornis magnirostris</i>
Lewin's Honeyeater	<i>Meliphaga lewinii</i>
Little Wattlebird	<i>Anthochaera chrysoptera</i>

<b>Common Name - Birds</b>	<b>Scientific name</b>
Logrunner	<i>Orthonyx temminckii</i>
Mistletoe Bird	<i>Dicaeum hirundinaceum</i>
Noisy Friarbird	<i>Philemon corniculatus</i>
Noisy Pitta	<i>Pitta versicolor</i>
Olive-backed Oriole	<i>Oriolus sagittatus</i>
Olive Whistler	<i>Pachycephala olivacea</i>
Pale-yellow Robin	<i>Tregellasia capito</i>
Pied Currawong	<i>Strepera graculina</i>
Pink Robin	<i>Petroica rodinogaster</i>
Pilotbird	<i>Pycnoptilus floccosus</i>
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Red-browed Treecreeper	<i>Climacteris erythrops</i>
Red-browed Firetail	<i>Emblema temporalis</i>
Regent Bowerbird	<i>Sericulus chrysocephalus</i>
Rose Robin	<i>Petroica rosea</i>
Rose-crowned Fruit-dove	<i>Ptilinopus regina</i>
Rufous Fantail	<i>Rhipidura rufifrons</i>
Satin Bowerbird	<i>Ptilinorhynchus violaceus</i>
Scaley-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>
Shining Bronze-cuckoo	<i>Chrysococcyx lucidus</i>
Silvereeye	<i>Zosterops lateralis</i>
Sooty Owl	<i>Tyto tenebricosa</i>
Southern Boobook	<i>Ninox novaeseelandiae</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Spangled Drongo	<i>Dicrurus hottentottus</i>
Spectacled Monarch	<i>Monarcha trivirgatus</i>
Sulphur-crested Cockatoo	<i>Cacua roseicapilla</i>
Superb Fruit-dove	<i>Ptilinopus superbus</i>
Superb Lyrebird	<i>Menura novaehollandiae</i>
Tawny Frogmouth	<i>Podargus strigoides</i>
Topknot Pigeon	<i>Lopholaimus antarcticus</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
White-headed Pigeon	<i>Columba leucomela</i>
White-naped Honeyeater	<i>Melithreptus lunatus</i>
White-throated Treecreeper	<i>Cormobates leucophaeus or Climacteris leucophaea</i>

<b>Common Name - Birds</b>	<b>Scientific name</b>
Wompoo Fruit-dove	<i>Ptilinopus magnificus</i>
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>
Yellow-throated Scrubwren	<i>Sericornis citreogularis</i>

Source: NSW NPWS (2000); Mills & Jakeman (1995).

*Table A3: Fauna of the Illawarra–Shoalhaven subtropical rainforest – Mammals.*

<b>Common Name - Mammals</b>	<b>Scientific name</b>
Brown Antechinus	<i>Antechinus stuartii</i>
Bush Rat	<i>Rattus fuscipes</i>
Chocolate-wattled Bat	<i>Chalinolobus morio</i>
Common Bentwing-bat	<i>Miniopterus schreibersii</i>
Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>
Common Wombat	<i>Vombatus ursinus</i>
Dusky Antechinus	<i>Antechinus swainsonii</i>
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>
Eastern Horseshoe bat	<i>Rhinolophus megaphyllus</i>
Eastern Pygmy-possum	<i>Cercartetus nanus</i>
Eastern Quoll	<i>Dasyurus viverrinus</i>
Fawn-footed Melomys	<i>Melomys cervinipes</i>
Feathertail Glider	<i>Acrobates pygmaeus</i>
Golden-tipped Bat	<i>Kerivoula papuensis</i>
Gould's Longeared Bat	<i>Nyctophilus gouldi</i>
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>
Lesser Longeared Bat	<i>Nyctophilus geoffroyi</i>
Little Bentwing-bat	<i>Miniopterus australis</i>
Little Forest Bat	<i>Vespadelus vulturnus</i>
Long-nosed Bandicoot	<i>Perameles nasuta</i>
Long-nosed Potoroo	<i>Potororus tridactylus</i>
Mountain Brushtail Possum	<i>Trichosurus caninus</i>
Little Red Flying-fox	<i>Pteropus scapulatus</i>
Parma Wallaby	<i>Macropus parma</i>



<b>Common Name - Mammals</b>	<b>Scientific name</b>
Platypus	<i>Ornithorhynchus anatinus</i>
Red-necked Pademelon	<i>Thylogale thetis</i>
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>
Sugar Glider	<i>Petaurus breviceps</i>
Swamp Wallaby	<i>Wallabia bicolor</i>
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>

Source: NSW NPWS (2000); Mills & Jakeman (1995).

Table A4: Fauna of the Illawarra–Shoalhaven subtropical rainforest – Amphibians.

<b>Common Name -Amphibians</b>	<b>Scientific name</b>
Barred Frog	<i>Mixophyes balbus</i>
Blue Mountains Tree Frog	<i>Litoria citropa</i>
Brown-striped Frog	<i>Limnodynastes peronni</i>
Brown Toadlet	<i>Pseudophryne bibronii</i>
Common Eastern Froglet	<i>Crinia signifera</i>
Giant Barred Frog	<i>Mixophyes iteratus</i>
Great Barred Frog	<i>Mixophyes fasciolatus</i>
Haswell's Froglet	<i>Paracrinia haswelli</i>
Fleay's Barred Frog	<i>Mixophyes fleayi</i>
Freycinet's Frog	<i>Litoria freycineti</i>
Green and Golden Bell Frog	<i>Litoria aurea</i>
Green Tree-frog	<i>Litoria caerulea</i>
Jervis Bay Tree-frog	<i>Litoria jervisiensis</i>
Leaf-green Tree-frog	<i>Litoria phyllochroa</i>
Lesueur's Frog	<i>Litoria lesueuri</i>
Peron's (green) Tree-frog	<i>Litoria peronii</i>
Stuttering Frog	<i>Mixophyes balbus</i>
Verreaux's Tree-frog	<i>Litoria verreauxii</i>

Source: NSW NPWS (2000); Mills & Jakeman (1995).

Table A5: Fauna of the Illawarra–Shoalhaven subtropical rainforest – Reptiles.

Common Name - Reptiles	Scientific name
(Eastern) Bandy-bandy	<i>Vermicella annulata</i>
Common / Eastern Blue-tongue Lizard	<i>Tiliqua scincoides</i>
Common / Southern Scaly-foot	<i>Pygopus lepidopodus</i>
Diamond Python	<i>Morelia spilota</i>
Eastern Water Dragon	<i>Physignathus lesueurii</i>
Eastern Water Skink	<i>Eulamprus quoyii</i>
Golden-crowned Snake	<i>Cacophis squamulosus</i>
Grass (/Dark-flecked Garden Sun-) Skink	<i>Lampropholis delicata</i>
(Pale-flecked) Garden (Sun-) Skink	<i>Lampropholis guichenoti</i>
Highlands Forest-skink	<i>Anepischetosia maccoyi</i>
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>
Rose's Shadeskink	<i>Saproscincus rosei</i>
(Eastern) Small-eyed Snake	<i>Rhinoplocephalus nigrescens</i>
(Yellow-bellied) Three-toed Skink	<i>Saiphos equalis</i>
(Eastern/mainland) Tiger Snake	<i>Notechis scutatus</i>
Weasel (Shade-) Skink	<i>Saproscincus mustelinus</i>

Source: NSW NPWS (2000); Mills & Jakeman (1995).

Table A6: Fauna of the Illawarra–Shoalhaven subtropical rainforest – Insects (lepidoptera).

Common Name	Scientific name
Anderson's Skipper	<i>Toxidia Andersoni</i>
Australian Admiral	<i>Vanessa itea</i>
Blue Triangle	<i>Graphium sarpedon</i>
Banks Brown	<i>Heteronympha banksii</i>
Common Australian Crow	<i>Euploea core</i>
Common brown Ringlet	<i>Hypocysta metirius</i>
Common Grassblue	<i>Zizina labradus</i>
Common Jezebel	<i>Delias nigrina</i>
A moth	<i>Anetus scotti</i>
Common Red-eye	<i>Chaetocneme beata</i>
Dingy Shield Skipper	<i>Signeta tymbophora</i>
Dispar Skipper	<i>Dispar compacta</i>
Doubleday's Skipper	<i>Toxidia doubledayi</i>
Felder's Lineblue	<i>Prosotas felderi</i>
Hairy Lineblue	<i>Erysichton lineata</i>

Macleay's Swallowtail	<i>Graphium macleayanum</i>
Pencilled Blue	<i>Candalides absimilis</i>
Orange Palmdart	<i>Cephrenes augiades</i>
Orchard Butterfly	<i>Papilio aegus</i>
Spotted Brown	<i>Heteronympha paradelpha</i>
Symmomus Skipper	<i>Trapezites Symmomus</i>
Wonder Brown	<i>Heteronympha mirifica</i>
Yellow-banded Dart	<i>Ocybadistes walkeri</i>

Source: Mills and Jakeman (1995).