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

Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

1. The Threatened Species Scientific Committee (the Committee) was established under the EPBC Act and has obligations to present advice to the Minister for the Environment (the Minister) in relation to the listing and conservation of threatened ecological communities, including under sections 189, 194N, 266B and 269AA of the EPBC Act.

2. The Committee provided its advice on the 'Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland' ecological community to the Minister as a draft conservation advice in 2017. The Committee recommended that:
    - the ecological community merits listing as **endangered** under the EPBC Act; and
    - a recovery plan is not required for the ecological community at this time.

3. In 2018, the Minister accepted the Committee's advice, and adopted this document as the approved conservation advice. The Minister amended the list of threatened ecological communities under section 184 of the EPBC Act to include the 'Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland' ecological community in the endangered category.

4. A draft conservation advice for this ecological community was made available for expert and public comment for a minimum of 30 business days. The Committee and Minister had regard to all public and expert comment that was relevant to the consideration of the ecological community.

5. New South Wales and Queensland also list (or protect) components of this ecological community under State legislation and local government planning schemes.

6. This approved conservation advice was based on the best available information at the time it was prepared; this includes scientific literature, advice from consultations, and existing plans, records or management prescriptions for this ecological community.

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1 CONSERVATION OBJECTIVE

The conservation objective is to mitigate the risk of extinction of Coastal Swamp Oak Forest, 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 through the recommended priority conservation and research actions set out in this advice.

This conservation advice contains information relevant to the conservation objective by.

- describing what the ecological community is, where it can be found and what vegetation classifications correspond to it (Sections 2 and 3; Appendices A and B);
- key diagnostic features, condition thresholds and supplementary information to identify the ecological community (Section 3 and Appendix C);
- identifying the key threats to the ecological community (Section 4 and Appendix D);
- presenting evidence (listing advice) for why the ecological community merits listing as nationally threatened under the EPBC Act (Section 5 and Appendix E); and,
- outlining the priority conservation and research actions that could appropriately be done to stop decline and support recovery of the ecological community (Section 6).

2 DESCRIPTION OF THE ECOLOGICAL COMMUNITY

2.1 Name of the ecological community

The name of the ecological community is **Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland** (hereafter referred to as "Coastal Swamp Oak Forest" or the "ecological community"). The ecological community was originally placed on the 2014 Finalised Priority Assessment List as the '*Casuarina glauca* (Swamp Oak) Coastal Floodplain Forest'. The name refers to the landscape position, dominant canopy species (sometimes also referred to as swamp she-oak), typical vegetation structure and geographic areas that characterise the ecological community.

2.2 Location and physical environment

The ecological community occurs in sub-tropical, sub-humid and temperate climatic zones from Curtis Island, north of Gladstone, in Queensland to Bermagui in southern New South Wales. The ecological community is found within the South Eastern Queensland (SEQ), NSW North Coast (NNC), Sydney Basin (SYB) and South East Corner (SEC) IBRA7 bioregions (Department of the Environment and Energy, 2012) (see Appendix A).

The extent of the ecological community corresponds to country (the traditional lands) of a number of Indigenous groups, including the Gureng Gureng, Bajtala, Gubbi Gubbi, Yuggera, Bundjalung, Gumbaynggirr, Dainggatti, Biripi, Worimi, Awabakal, Kurin-gai, Eora, Dharug, Tharawa/D'harawal and the Yuin.

The ecological community occurs in coastal catchments, mostly at elevations of less than 20 m above sea-level (ASL) that are typically found within 30 km of the coast. However, this distance varies by catchment; for example, low elevations can occur as far as 40 km inland on the Hawkesbury River, or more than 100 km on the Clarence River. On the mid and north coast of NSW the ecological community may also occur up to 50 m ASL on floodplains of, or coastland flats associated with, former or current coastal river systems (Department of Environment and Climate Change, 2007).

Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period (Sloss et al., 2007). These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). The ecological community can also occur on organosols (peaty soils). Occurrences of swamp oak trees on rocky headlands or other consolidated substrates are not considered to be a part of the ecological community, but areas where soils transition into unconsolidated sediments may contain the ecological community.

The ecological community is typically found where groundwater is saline or brackish, but can occur in areas where groundwater is relatively fresh. It is typically found on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. These are typically associated with low-lying coastal alluvial floodplains and alluvial flats (Keith and Scott, 2005). Minor occurrences can be found on coastal dune swales or flats, particularly deflated dunes and dune soaks.

2.3 Vegetation structure and flora

Coastal Swamp Oak Forest is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of coastal floodplain communities.

The structure of Coastal Swamp Oak Forest can vary from forest to woodland depending on its location in the landscape and disturbance history. The local expression of the ecological community is influenced by soils, history of inundation by tidal flows/estuarine system dynamics, groundwater salinity, site history, disturbance regimes and current land management. Many remaining patches of the ecological community contain regrowth from past clearance or other disturbances, and/or due to naturally occurring river and coastal dynamics. Some patches, for example where drainage is more impeded, may be expressed primarily as sedgeland or rushland, with a very sparse canopy (down to 10 per cent crown cover) of predominantly swamp oak. Other patches may just occur as canopy trees, over dense needle litter with sparse native groundcover.

Where groundwater is more saline, for example on estuarine and/or coastal lake fringes, the ecological community is typically expressed as a low woodland or forest. In these areas, the composition of the understory is more likely to include saline tolerant (typically saltmarsh) species. In more freshwater areas, the ecological community is more likely to demonstrate greater structural diversity – often being expressed as a taller open or rarely closed forest with a diverse understory, typically including a greater abundance of grasses and herbs.

Many patches have a sub-canopy of smaller trees, but the mid-layer or shrub layer is typically sparse. Climbing and epiphytic plant species are commonly observed and are characteristic of Coastal Swamp Oak Forest. The ecological community typically includes a continuous to semi-continuous ground layer that may include either forbs, sedges, grasses and/or plant litter (including branchlets/needles, leaves, bark, twigs). Core plant species for each vegetation layer are described below and a more comprehensive list of plants likely to occur in the ecological community, including threatened plants, is at Appendix B.

2.3.1 Canopy, sub-canopy and mid-layer

The canopy layer is dominated by *Casuarina glauca* (swamp oak, swamp she-oak). This often occurs as a relatively uniform upper layer of swamp oak, with height and density dependent on the local environmental conditions.

A number of *Eucalyptus* spp. can emerge from the canopy, with typical examples including *Eucalyptus tereticornis* (forest red gum), *E. botryoides* (bangalay), *E. grandis* (flooded gum), *E. longifolia* (woollybutt), or *E. robusta* (swamp mahogany).

In more freshwater patches of the ecological community, *Melaleuca* species, including *Melaleuca ericifolia* (swamp paperbark), *M. linariifolia* (narrow-leaved paperbark), *M. quinquenervia* (broad-leaved paperbark), and/or *M. styphelioides* (prickly-leaved paperbark), may occur in the canopy, sub-canopy or as emergents.

If a mid-layer is present it is typically sparse, but a sub-canopy of smaller trees can often be present, typically composed of canopy species, including juvenile swamp oak. Other trees and tall shrubs can occur in the sub-canopy, but the shrubs are typically sparse and the individual species vary with latitude, with rainforest species more likely north of Sydney. Commonly occurring rainforest species include *Acmena smithii* (lilly pilly), *Alphitonia excelsa* (red ash), *Glochidion ferdinandi* (cheese tree), *Myoporum acuminatum* (mangrove boobialla) and north of Sydney, *Cupaniopsis anacardioides* (tuckeroo). Commonly occurring non-rainforest species include *Callistemon salignus* (willow bottlebrush) and *Melaleuca* species (paperbarks) as mentioned previously.

2.3.2 Climbing, epiphytic and parasitic plants

The climbing plant species that is most commonly found in the community is *Parsonsia straminea* (common silkpod). Other climbing species that may occur include *Geitonoplesium cymosum* (scrambling lily), *Stephania japonica* (snake vine), and, in the north, *Cynanchum carnosum* (mangrove vine). Epiphytic plants, such as *Platycerium bifurcatum* (elkhorns) and

Dendrobium teretifolium (pencil orchids), and the stem parasite *Amyema cambagei* (she-oak mistletoe), could also be present.

2.3.3 Ground layer

The ground layer is typically a continuous to semi-continuous cover of either forbs, ferns, sedges, grasses and/or plant litter (including swamp-oak branchlets/needles), but can also often be "patchy," particularly where the ecological community is regenerating. The composition of the ground layer is also influenced by groundwater salinity.

Under less saline conditions, prominent species include *Blechnum indicum* (swamp water fern), *Carex appressa* (tussock sedge), *Centella asiatica* (pennywort), *Commelina cyanea* (scurvy weed), *Dianella caerulea* (blue flax lily), *Entolasia* spp., (panic grasses), *Gahnia clarkei* (saw sedge), *Hypolepis muelleri* (harsh ground fern), *Imperata cylindrica* (blady grass), *Lomandra longifolia* (spiny-headed mat-rush), *Microlaena stipoides* (weeping grass), *Oplismenus imbecillis* (creeping beard grass), *Persicaria decipiens* (slender knotweed) and *Viola banksii* (wild violet) (NSW Scientific Committee, 2004; Miles, 2006; Sheringham et al., 2008; Tozer et al., 2010).

Under more saline conditions, for example on the fringes of estuaries, common species include *Alternanthera denticulata* (lesser joyweed), *Baumea juncea* (bare twig rush), *Cynodon dactylon* (sand couch), *Juncus kraussii* subsp. *australiensis* (sea rush), *Phragmites australis* (common reed), *Samolus repens* (creeping brook or bushweed), *Selliera radicans* (swamp weed), and *Suaeda australis* (austral seablite). Where the ecological community intergrades with saltmarsh, *Atriplex australasica* (native orache), *Enchylaena tomentosa* var. *glabra* (ruby salt bush), *Fimbristylis dichotoma* (tall fringe rush), *Sarcocornia quinqueflora* (beaded samphire), *Sesuvium portulacastrum* (sea purslane), *Sporobolus virginicus* (sand or salt/marine couch) or *Tetragonia tetragonoides* (warrigal greens or New Zealand spinach) often occur.

In the mid north coast of New South Wales, *Alexfloydia repens* (Floyd's grass) can dominate the ground layer of the ecological community at some sites (National Parks and Wildlife Service, 1999a; Andren and Cameron, 2012). The vulnerable *Persicaria elatior* (tall knotweed), which grows on sandy, alluvial soil in swampy areas and riparian herblands along watercourses and lake edges, has also been recorded in the ecological community (Miles, 2017; Threatened Species Scientific Committee, 2008b).

2.4 Fauna

The vegetation of the Coastal Swamp Oak Forest provides diverse habitat values for a wide range of fauna, particularly the crevices and hollows within older trees. Most fauna species that form a part of the Coastal Swamp Oak Forest also inhabit adjacent wetlands, grasslands, woodlands and forests. Many fauna species within the ecological community are listed as threatened under State and/or Commonwealth legislation. Some core and important animal species are described below and a more comprehensive list of animals likely to occur in the ecological community, including threatened fauna, are in the species lists in Appendix B.

2.4.1 Mammals

The ecological community includes a wide range of mammals. Arboreal species such as bats roost in the swamp oak and emergent trees and utilise the sub-canopy and nearby water bodies. Arboreal species associated with Coastal Swamp Oak Forest include *Cercartetus nanus* (eastern pygmy possum), *Myotis macropus* (large-footed or southern myotis), *Phascogale tapoatafa* (brush-tail phascogale), *Pteropus poliocephalus* (grey-headed flying-fox) and *Syconycteris australis* (common blossom bat) (Office of Environment and Heritage, 2017e; Van Dyck and Strahn, 2008). Stands of swamp oak have been identified as a possible secondary habitat for *Phascolarctos cinereus* (koala) populations, which is likely due to intergradation with river flat eucalypt forests and the presence of preferred eucalypts, such as forest red gum, as emergents in the canopy (Millard, 2012).

Ground-dwelling species, utilise the clumping and often dense ground cover, and include *Antechinus stuartii* (brown antechinus), *Perameles nasuta* (long-nosed bandicoot), *Potorous tridactylus* (long-nosed potoroo), *Pseudomys novaehollandiae* (New Holland mouse) and *Rattus lutreolus* (swamp rat) (Office of Environment and Heritage, 2017e). In south-east Queensland and around the border of northern NSW the vulnerable *Xeromys myoides* (water mouse or false water rat) is also likely to be a part of the ecological community, particularly when it is adjacent to areas dominated by mangroves (Department of the Environment and Resource Management, 2010).

2.4.2 Reptiles

Lizards that form a part of the ecological community typically include *Cyclodomorphus michaeli* (mainland she-oak skink) and *Egernia mcpheei* (tree skink). Snakes are also likely to occur in many patches, including *Boiga irregularis* (brown tree snake), *Hemiaspis signata* (black-bellied swamp snake), *Hoplocephalus bitorquatus* (pale-headed snake), *Pseudechis porphyriacus* (red-bellied black snake) and *Tropidechis carinatus* (Clarence River snake or rough-scaled snake) (Cogger, 2014; National Parks and Wildlife Service, 2015).

Freshwater turtles are likely to inhabit the ecological community, as it sits in close proximity to both freshwater and brackish waterbodies and can be inundated for periods of time. The vegetation of the ecological community, along with other riparian vegetation, is important in stabilising river sand banks and islands where turtles lay their eggs. It also provides energy and nutrient input to the aquatic system in the form of leaves, bark and twigs, buffering against high water temperatures, and providing a source of snags for basking (NSW National Parks and Wildlife Service, 2001b).

Species likely to occur in the ecological community are wide ranging turtles such as *Chelodina longicollis* (eastern long-necked turtle) and *Emydura macquarii* (Murray River turtle) (Office of Environment and Heritage, 2017a). In the northern part of its range, the ecological community also may provide habitat for threatened species such as *Elseya albagula* (white-throated snapping turtle), *Elusor macrurus* (Mary River turtle) and *Wollumbinia georgesi* (Bellinger River snapping turtle) (Threatened Species Scientific Committee, 2008a; Threatened Species Scientific Committee, 2014; Threatened Species Scientific Committee, 2016b).

2.4.3 Amphibians

The standing vegetation and patches of dense ground cover, fallen plant material, tree crevices, small hollows and rocks within Coastal Swamp Oak Forest provide diverse habitat for a number of tree frogs (Gibbons and Lindenmayer, 2002; NSW Scientific Committee, 2004; Cogger, 2014).

One species found along the southern part of the extent of the ecological community is *Litoria fallax* (eastern dwarf tree frog), which can be often heard calling from deep within *Gahnia* (saw-sedge) clumps. Larger frogs, such as *Litoria caerulea* (green tree frog), may inhabit moist crevices in large, older trees during the day, emerging at night to hunt. On the New South Wales south coast, the threatened *Litoria aurea* (green and golden bell frog) has been observed moving through the ecological community at night (P. Craven, 2017).

Frogs with more limited distribution within the range of the ecological community include *Litoria olongburensis* (Olongburra frog), found from Woolgoolga (northern NSW) to Lake Woongeel on Fraser Island and other parts of south-east Queensland, *Litoria chloris* (red-eyed tree frog) and *Litoria freycineti* (Freycinet's frog or wallum rocket frog) both found from north of Sydney into south-east Queensland. Other species that may be present in the ecological community include *Crinia tinnula* (wallum froglet) and *Litoria brevipalmata* (green-thighed frog) (Office of Environment and Heritage, 2017e; Cogger, 2014).

2.4.4 Birds

The ecological community includes many birds, which utilise its important shelter and food resources, particularly honey-eaters, insectivores and some waterbirds, including species that specialise in foraging from plants typically associated with the ecological community, such as *Amyema cambagei* (she-oak mistletoe) (Higgins, 1999; Watson, 2011). Examples include the threatened *Anthochaera phrygia* (regent honeyeater) and *Dicaeum hirundinaceum* (mistletoebird).

Insectivores, which forage in the canopy and may use the grasses, pieces of vine and twigs to build nests in the forks of tall trees, include *Acrocephalus australis* (Australian reed warbler), *Pachycephala rufiventris* (rufous whistler), *Malurus* spp. (fairy wrens), *Petroica phoenicea* (flame robin) and *Stipiturus malachurus* (southern emu wren), which nest in the tussocky understorey plants (Higgins, Peter and Steele, 2001; Menkhorst et al., 2017).

Seed eating species include *Neochmia temporalis* (red browed finch), which utilise the abundant sedges, rushes and grasses (Higgins and Peter, 2002). Some parrots are associated with the ecological community, particularly *Pezoporus wallicus* (eastern ground parrot), and *Trichoglossus* spp. (lorikeets), but also the critically endangered *Lathamus discolor* (swift parrot), particularly where there are emergent eucalypts in the canopy. The ecological community sometimes provides food for the *Calyptorhynchus lathami lathami* (glossy black cockatoo) and *Calyptorhynchus funereus* (yellow-tailed black cockatoo) (Marchant and Higgins, 1990; Higgins, 1999; Gibbons and Lindenmeyer, 2002; NSW Scientific Committee, 2004).

Medium-sized birds of prey, such as *Accipiter* spp. (goshawks) may use the emergent eucalypts associated with the ecological community to hunt for frogs, reptiles and birds (Marchant and Higgins, 1993). When occurring in estuarine environments, the bush-stone curlew (*Burhinus grallarius*)--listed as endangered in NSW--is known to use Swamp Oak Coastal Forest as part of its habitat (Murialdo et al., 2015; Robinson, 2006).

Whilst Coastal Swamp Oak Forest is not a primary habitat for waterbirds (NSW Scientific Committee, 2004), some species are known to utilise food resources and roost in standing and fallen trees within the ecological community. Examples include *Butorides striatus* (striated heron), *Botaurus poiciloptilus* (Australasian bittern), *Ixobrychus flavicollis* (black bittern), *Numenius madagascariensis* (eastern curlew), and *Rostratula australis* (Australian painted snipe) (Marchant and Higgins, 1993; Higgins and Davies, 1996). *Nycticorax caledonicus* (Nankeen night heron) and *Egretta novaehollandiae* (white-faced heron) and some ducks regularly roost in Swamp Oak Coastal Forest fringing estuaries, and *Ceyx azureus* (azure kingfisher) and *Todiramphus sanctus* (sacred kingfisher) are frequently observed above estuaries perched on Swamp Oak ready to hunt prey or roost (Higgins and Davies, 1996).

2.4.5 Invertebrates

The moist plant litter, typical of the ecological community, provides food and habitat for a wide range of invertebrates, including gastropods, arachnids, insects and their larvae. Many plants found in the ecological community provide food for butterflies and moths.

A broad range of butterflies, particularly from the family Nymphalidae (Browns), utilise the grasses and some trees (for example, tuckeroo) as larval food plants. The small skipper, *Ocybadistes knightorum* (black grass-dart butterfly), is endemic to riparian zones on the NSW mid-north coast, from Coffs Harbour to Scotts Head. This butterfly is restricted to where its larval food plant, Floyd's grass, occurs (Braby, 2004), which is predominantly in swamp oak or sclerophyll forest where swamp oak and/or broad-leaved paperbark dominate the canopy (Office of Environment and Heritage, 2017; Andren and Cameron, 2012).

Adult butterflies and other insects, including *Trigona carbonaria* (native stingless bees) also pollinate flowering plants and colonise larger trees further up in the canopy. These insects provide food for a number of spiders including *Nephila* spp (the golden orb weavers), which make suspended, sticky, wheel-shaped orb webs between trees and shrubs to trap their prey.

3 IDENTIFICATION OF THE ECOLOGICAL COMMUNITY

Key diagnostic characteristics and condition thresholds are used to identify a patch of native vegetation as being the threatened ecological community; determine whether the referral, assessment, approval and compliance provisions under national environmental law are likely to apply to a patch, and; distinguish between patches of different quality (to aid environmental management decisions).

Coastal Swamp Oak Forest can intergrade with nearby or similar ecological communities (see section 3.5). The key diagnostic characteristics assist to distinguish between these ecological communities. In addition, national listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition. Because the ecological community exhibits various degrees of disturbance and degradation, condition thresholds, classes and categories have been developed. These provide guidance on whether a patch retains sufficient conservation values to be considered as a Matter of National Environmental Significance (MNES), as currently defined under national environmental law.

In order to be considered a MNES, areas of the ecological community must meet both:

- the key diagnostic characteristics AND
- at least the minimum condition thresholds for Category C.

Very small or degraded patches that do not meet the minimum condition thresholds will be excluded from national protection. In many cases, the loss and degradation is irreversible or rehabilitation is impractical because natural characteristics have been removed. For instance, areas permanently converted to improved pastures and/or once swampy areas that have been 'reclaimed' for building purposes, are unlikely to be rehabilitated.

Although very degraded or modified patches are not protected as part of the ecological community listed under national environmental law, it is recognised that some patches that do not meet the condition thresholds may still retain important natural values and may be protected through state and local laws or schemes. In addition, patches that can be restored should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve a patch's condition, such that it subsequently can be included as part of the ecological community fully protected under national environment law. Management actions should also be designed to restore patches to high condition where practical.

Provided that the patch meets the key diagnostic characteristics and condition thresholds, revegetated or replanted sites or areas of regrowth are not excluded from the listed ecological community. Much of the current distribution of Coastal Swamp Oak Forest is comprised of regrowth initiated in response to changes in drainage, including sites that may not have previously supported the ecological community. These regenerating stands are important as very little 'old growth' remains, and are included as a part of the ecological community.

Species composition of this ecological community is influenced by (amongst other things) latitude, the size of the patch, landscape position and the type of surrounding vegetation or land-use, recent rainfall, degree of saline influence, drought conditions and disturbance history (including fire, grazing, drainage and flooding). However, the key diagnostic characteristics and condition thresholds are designed to allow identification of the ecological community irrespective of the season.

3.1 Key Diagnostics

The key diagnostic characteristics presented here are the features that define the ecological community, noting that more details are provided in the other sections of this document. Patches that do not meet the key diagnostics are not the nationally listed ecological community.

The ecological community is defined as patches of vegetation that meet the following key diagnostic characteristics:

- Occurs from south-east Queensland to southern NSW within the South Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions (see Appendix A).
- Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.
- Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.
- Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover[1] of at least 10 per cent.
- Has a canopy of trees dominated[2] by *Casuarina glauca* (swamp-oak, swamp she-oak).

Other characteristics that may help identify the ecological community include:

- Typically occurs where groundwater is saline or brackish.
- Typically occurs within 30km of the coast, but in some areas, such as along tidal river catchments, the ecological community can occur more than 100km inland.
- Does not occur on rocky headlands, sea cliffs or other consolidated sediments.

3.2 Condition thresholds, classes and categories

Extensive land clearing and landscape modification over the past 200 years has permanently altered the state of Coastal Swamp Oak Forest. Much of what remains consists of regrowth, and the integrity of the remaining patches is severely compromised, particularly by weed invasion and changes to hydrological processes.

As the ecological community has been heavily cleared, fragmented and degraded, many remnants are smaller than they once were, or more isolated and/or modified. Very small, narrow and/or isolated patches that are subject to high disturbance and with a non-native ground layer, do not contribute so greatly to the conservation of the ecological community and therefore may not meet the condition thresholds for national protection. However, small and isolated patches that have the potential to be restored and reconnected through weed management and/or revegetation activities, such that they would meet the moderate condition thresholds, could be priorities for management and recovery projects.

[1] Crown cover is measured as the % of the patch covered by the total area of the tree crowns, where the tree crowns are considered to be solid (as per the National Committee on Soil and Terrain, 2009).

[2] A canopy dominated by swamp oak is one where swamp oak is the most abundant tree in the canopy in terms of either crown cover (at least 50% of the canopy crown cover is comprised of swamp oak) or stem density (at least 50% of the total number of trees comprising the canopy are swamp oak).

The condition thresholds for this ecological community (Table 1) are designed to identify the best patches for national protection. Large patches of Coastal Swamp Oak Forest or those parts of large native vegetation patches with high quality native understorey are a higher priority for protection and management.

When assessing a patch of the ecological community for the key diagnostics and condition, it is important to consider other matters such as the patch definition as outlined in Appendix C - Additional information to assist in identifying the ecological community.

Table 1: Condition thresholds, classes and categories for patches of Coastal Swamp Oak Forest

<table>
<tr><td>Condition thresholds
Patch size classes➔
🡻 Vegetation quality classes</td><td>Large patch
The patch is at least 5 ha</td><td>Medium patch
The patch is at least 2 ha and less than 5 ha</td><td>Small contiguous**
patch
The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha</td><td>Small patch
The patch is at least 0.5 ha and less than 2 ha</td></tr>
<tr><td>HIGH QUALITY
Predominantly native understorey
Non-native species comprise less than 20% of total understorey vegetation cover*</td><td>CATEGORY A
A large patch that meets key diagnostics and has a predominantly native understorey</td><td colspan="2">CATEGORY B
A medium patch that meets key diagnostics and has a predominantly native understorey
OR
A small patch that meets key diagnostics and has a predominantly native understorey and is contiguous** with another large area of native vegetation</td><td>CATEGORY C
A small patch that meets key diagnostics and has a predominantly native understorey</td></tr>
<tr><td>GOOD QUALITY
Mostly native understorey
Non-native species comprise less than 50% of total understorey vegetation cover* AND transformer species*** comprise less than 30% of total understorey vegetation cover*</td><td>CATEGORY B
A large patch that meets key diagnostics and has a mostly native understorey</td><td colspan="2">CATEGORY C
A medium patch that meets key diagnostics and has a mostly native understorey
OR
A small patch that meets key diagnostics and has a mostly native understorey and is contiguous** with another large area of native vegetation</td><td></td></tr>
<tr><td>MODERATE QUALITY
Some native understorey
Non-native species comprise less than 80% of total understorey vegetation cover* AND transformer species*** comprise less than 50% of total understorey vegetation cover*</td><td colspan="2">CATEGORY C
A large or medium patch that meets key diagnostics and has some native understorey</td><td></td><td></td></tr>
<tr><td colspan="5">*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.
**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.
***Transformer species (e.g. Chrysanthemoides monilifera, Asparagus spp, Pennisetum spp, Ipomoea spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as Symphyotrichum subulatum (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.</td></tr>
</table>

Patches of the ecological community in the HIGH quality class provide examples to guide restoration of lower condition patches. CATEGORY A represents large patches of high quality and describes those patches that are of the greatest conservation value and highest priority for protection. CATEGORY B represents either medium-sized patches of HIGH quality, or large patches of GOOD quality. CATEGORY C represents either large patches of MODERATE quality, or smaller patches of GOOD or HIGH quality. Patches within any of the CONDITION CATEGORIES A, B or C are subject to the referral, assessment, approval and compliance provisions under national environmental law, depending on the significance of impacts resulting from planned or actual activities. Only patches that do not fit within any of these categories are not expected to be protected under national environment law. Patches that meet CATEGORY B or C thresholds are good candidates for restoration aimed at meeting higher category thresholds.

3.3 Surrounding environment, landscape context and significance considerations

Patches of the ecological community do not occur in isolation. The surrounding vegetation, waterways and other landscape considerations will also influence how important a patch is to the ecological community as a whole. As per the condition categories above, patches that are larger and less disturbed are likely to provide greater biodiversity value. Patches that are spatially linked (such as the small contiguous patches in Table 1), whether ecologically or by proximity, are particularly important as wildlife habitat and to the viability of those patches of the ecological community into the future. However, this still does not necessarily consider the full landscape context. For natural resource management activities or actions that may have 'significant impacts' and require approval under national environment law, it is important to consider the whole environment surrounding patches of the ecological community. For example, in heavily cleared areas, some patches that meet the condition thresholds occur in isolation. Such patches require protection, and could benefit from revegetation activities to link them with other patches. In other areas, patches that are interconnected to other native vegetation may not, in their current state, meet the condition thresholds, but have high conservation value. Such patches could benefit from restoration works to improve their condition so that they do meet the condition thresholds.

The following indicators should be considered when assessing the impacts of proposed actions under national environment law, or when determining priorities for recovery, management and funding:

- Larger area to boundary ratio – such patches are more resilient to edge effect disturbances such as weed invasion and human impacts.
- Patches within or near to a larger native vegetation remnant and that contribute to a mosaic of vegetation types present at a site. Areas of mosaic native vegetation provide a wider range of habitats that benefit flora and fauna diversity. Other patches are important as linkages among remnants, acting as 'stepping stones' of native remnants in the landscape and/or to help fauna to reach freshwater sources. Connectivity includes actual or potential connectivity to restoration works (e.g. native plantings).
- 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, particularly where there is genetic distinction, or absence of some threats. These may include unique variants of the ecological community, e.g. with a unique flora and/or fauna composition, or a patch that contains flora or fauna that have largely declined across the broader ecological community or region.
- Patches in catchments or tidal areas with minimal modification to natural hydrology.
- Patches less likely to be subject to sea-level rise impacts and areas landward of patches that may provide important refuges from sea-level rise (through natural retreat and/or management intervention).

- Evidence of recruitment of key native plant species or the presence of a range of age cohorts (including through successful assisted regeneration or management of sites). For example, swamp oak or other tree species present in in a range of sizes from saplings to large hollow-bearing trees.
- Good faunal habitat as indicated by patches containing diversity of landscape, diversity of plant species and vegetation structure, diversity of age class, presence of movement corridors, mature trees (particularly those with hollows), logs, watercourses, etc.
- Presence of nationally or state-listed threatened species.
- High species richness, as shown by the variety of native understorey plant species, or high number of native fauna species.
- Areas with relatively low levels of weeds and feral animals or where these can be managed efficiently.

3.4 Habitat critical to the survival of the ecological community

The habitat most critical to the survival of the ecological community are those patches that are of a reasonable size and in the best condition (i.e. Categories A and B in Table 1). These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function.

However, this does not mean that areas that otherwise meet the minimum condition thresholds (i.e. Category C in Table 1) are unimportant for the survival of the ecological community. Many of these patches may contain suites of species, habitat features or other characteristics (as per section 3.3) that are important in a regional or local context. Hence, some of these areas are likely to be critical to the survival of the ecological community.

Additional areas such as buffer zones around patches (see information on buffer zones in Appendix C - Additional information to assist in identifying the ecological community), particularly adjoining native vegetation, and areas that meet the description of the ecological community but not the condition thresholds, are also important to the survival of the ecological community. They should still be taken into consideration as part of the surrounding environment and landscape context.

3.5 Relationship to other ecological communities

In New South Wales, the ecological community corresponds with those parts of the NSW-listed endangered ecological community 'Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions' (NSW Scientific Committee, 2004), where the canopy is dominated by *Casuarina glauca*, and where the other key diagnostics and condition thresholds are met. Those parts of the NSW-listed community where *C. glauca* is not abundant and *Melaleuca* spp. dominate the canopy, particularly as found south of Bermagui, will not meet the key diagnostics and are not included as a part of the Coastal Swamp Oak Forest ecological community.

In Queensland, the ecological community coincides with two Regional Ecosystems - RE 12.1.1 (*Casuarina glauca* woodland on margins of marine clay plains) (listed as 'of concern'), and areas within RE 12.3.20 (*Melaleuca quinquenervia, Casuarina glauca* +/- *Eucalyptus tereticornis, E. siderophloia* open forest on low coastal alluvial plains) (listed as 'endangered'), where the canopy is dominated by *Casuarina glauca.* (Queensland Herbarium, 2016).

The boundaries of coastal ecological communities may change over time due to the dynamic nature of these systems. This ecological community is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of floodplain communities.

Nationally listed ecological communities that Coastal Swamp Oak Forest can adjoin or intergrade with include:

- Littoral Rainforest and Coastal Vine thickets of Eastern Australia
- Illawarra and south coast lowland forest and woodland
- Lowland Grassy Woodland in the South East Corner Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Lowland Rainforest of Subtropical Australia
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

In NSW Coastal Swamp Oak Forest may adjoin or intergrade with several other NSW listed ecological communities, including:

- River-flat Forest on Coastal Floodplain of the North Coast, Sydney Basin and South East Corner bioregions (also under consideration for national listing as at September 2017);
- Swamp Sclerophyll Forest on Coastal Floodplain of the NSW North Coast, Sydney Basin and South East Corner bioregions (also under consideration for national listing as at September 2017);
- Freshwater Wetlands on Coastal Floodplain of the NSW North Coast, Sydney Basin and South East Corner bioregions.

In all cases Coastal Swamp Oak Forest can be distinguished from these other communities by the dominance of *Casuarina glauca* in the canopy.

4 SUMMARY OF THREATS

Historically, the landscape where the ecological community occurs was cleared primarily for agriculture and small coastal settlements. The result is that the ecological community occurs within a 'mixed use' landscape with most of the remaining patches occurring in close proximity to coastal areas where population growth and urban development is expected to continue at a rapid rate, particularly in the northern part of the extent.

The range of threats faced by the ecological community include:

- Clearing and fragmentation;
- Weeds;
- Invasive fauna;
- Impacts resulting from agricultural activities, including grazing;
- Changes to hydrology, including from flood mitigation and drainage works;
- Inappropriate fire regimes;
- Impacts resulting from recreational activity; and
- Climate change, particularly sea-level rise.

These threats often interact, rather than act independently. Further details about the threats to the ecological community can be found in Appendix D – Description of threats.

5 SUMMARY OF ELIGIBILITY FOR LISTING AGAINST EPBC ACT CRITERIA

5.1 Criterion 1 – decline in geographic distribution

Much of the historical distribution of the ecological community occurs in areas that are suitable for agriculture and are in close proximity to coastal settlements. Thus it has been extensively cleared for agriculture and coastal development.

The decline in extent since 1750 has been variously estimated for parts of its range, and based on these estimated losses, the ecological community overall has undergone an estimated decline of between 64 per cent and 79 per cent in its geographic distribution since 1750. This loss is considered severe making it eligible for listing as **endangered** under this criterion.

5.2 Criterion 2 – limited geographic distribution coupled with demonstrable threat

Coastal Swamp Oak Forest occurs in a narrow strip along the east coast from Curtis Island in Queensland to near Bermagui in NSW, so its overall extent of occurrence is not limited, but it has a 'limited' area of occupancy of around 32,000 ha. Within this range it typically occurs as a part of a mosaic with other vegetation types, often expressed as relatively linear, narrow patches between estuaries or wetlands and areas of coastal development. It has a median patch size of around 1.1 ha and 89 per cent of patches are less than 10 ha, which is considered to be 'very restricted'.

The nature of its distribution is also defined by its position in the landscape. Coastal Swamp Oak Forest is limited to low-lying areas below 50 m ASL, and typically found at elevations below 20 m ASL, with 65 per cent of the total area of the ecological community currently occurring at elevations of less than 5 m ASL and 12 per cent of the ecological community occurring at elevations of less than 1 m ASL.

It is subject to a range of threats that are exacerbated by its very restricted distribution and its landscape position, including projected sea-level rise and coastal erosion, clearing for coastal development, and the continuing degradation of remaining patches. Coastal Swamp Oak Forest is particularly susceptible to 'coastal squeeze' (see p. 47) resulting from sea-level rise, and as it occurs primarily in small patches in close proximity to areas of coastal development, it is subject to the cumulative effect of many small-scale losses.

Given these pressures, Coastal Swamp Oak Forest is likely to experience the ongoing loss of patches across the full extent of occurrence, such that the ecological community could be lost within the near future. Therefore, due to the nature of its distribution and the threats operating on it, the ecological community is eligible for listing as **endangered** under this criterion.

5.3 Criterion 3 – loss or decline of functionally important species

The dominant canopy species, *Casuarina glauca*, is the species most likely to be functionally important across the range of the ecological community. Although swamp oak has undergone a decline in its extent, synonymous with the decline in the ecological community, as a species it can regenerate and mature quickly under the right conditions and remains common and dominant across the remaining extent of the ecological community. Swamp Oak as a species is not considered threatened or in functional decline at the time of this assessment.

The loss of fauna species from the ecological community is likely to have had a negative effect on ecological function, however, specific data related to the decline of functionally important species is not available. As such, **insufficient information** is available to determine eligibility against any category for this criterion at this time.

5.4 Criterion 4 – reduction in community integrity

The integrity of the ecological community has been severely compromised through various types of local degradation and broad-scale landscape changes throughout the full range of

Coastal Swamp Oak Forest. Invasive species are a serious threat as the productive environment and history of past and ongoing disturbance are particularly conducive to the invasion and spread of weeds.

Past and ongoing changes to hydrology, though widespread construction of floodplain drains, weirs, artificial levees and other structures, also continue to impact on the coastal catchments that provide habitat for Coastal Swamp Oak Forest. Agriculture, including horticulture and grazing, continues to dominate many areas where the ecological community occurs. These impacts are expected to increase pressures on floodplain and coastal vegetation communities as further agricultural and economic opportunities are developed. Sea-level rise and the resulting habitat changes continue to impact Coastal Swamp Oak Forest, and off-road vehicles, illegal waste dumping and sand extraction also continue to threaten this ecological community.

Much of the damage is irreversible and many of the underlying threats continue. This reduction in integrity, as indicated by the degradation of the community, is severe across most of its geographic distribution. While active intervention and restoration works may improve the condition of some patches of Coastal Swamp Oak Forest, the complete restoration of the ecological community across its full range is unlikely, especially as many of the areas it formerly inhabited are now unsuitable due to permanent habitat transformation through altered hydrology or construction of buildings and other infrastructure. Therefore the ecological community is eligible for listing as **endangered** under this criterion.

5.5 Criterion 5 – rate of continuing detrimental change

The ecological community has experienced substantial clearing and fragmentation due to coastal development and agriculture. Pressures associated with these land uses continue, particularly with the increasing development along the New South Wales and Queensland coasts. Detrimental changes resulting from sea-level rises also continue to impact Coastal Swamp Oak Forest through its range.

While detrimental change is likely to continue, there is **insufficient information** available on the rates of loss in the recent past, or planned for the immediate future, across the range of the ecological community, to determine eligibility against any category for this criterion at this time.

5.6 Criterion 6 – quantitative analysis showing probability of extinction

No quantitative analysis has been undertaken showing likelihood of extinction for this ecological community. Therefore there is **insufficient information** available to determine eligibility against any category for this criterion.

6 PRIORITY RESEARCH AND CONSERVATION ACTIONS FOR COASTAL SWAMP OAK FOREST

6.1 Principles and standards

To undertake priority actions to meet the conservation objective, the overarching principle is that it is preferable to maintain existing areas of the ecological community that are relatively intact and of high quality. There are good, practical reasons to do so. It is typically more 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 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, 2016):

> "**Ecological restoration is not a substitute for sustainably managing and protecting ecosystems in the first instance.**
>
> 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. Many projects that aspire to restoration fall short of reinstating reference ecosystem attributes for a range of reasons including scale and degree of damage and technical, ecological and resource limitations."
>
> *Standards Reference Group SERA (2016) – Appendix 2.*

The principle discourages 'off-sets' where intact remnants are removed with an undertaking to set aside and/or restore other, lesser quality, sites. The destruction of intact sites represents 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 (2016)[3]. They outline the principles that convey the main ecological, biological, technical, social and ethical underpinnings of ecological restoration practice.

6.2 Priority actions

Priority actions are recommended for the abatement of threats and supporting recovery of the ecological community. As Coastal Swamp Oak Forest is located around watercourses, actions to protect it often need to consider hydrology and be undertaken both upstream and upslope 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;
- conditions of approval for relevant controlled actions under national environment law; and,
- prioritising activities in applications for Australian Government funding programs.

Detailed advice on actions may be available in specific plans, such as management plans for weeds, fire or certain parks or regions. The most relevant are listed in section 6.3 below.

[3] Society for Ecological Restoration: www.seraustralasia.com/standards/contents.html

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 Coastal Swamp Oak Forest 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.

6.2.1 PROTECT the ecological community.

This key approach includes priorities intended to protect the ecological community by preventing further losses to extent and integrity.

Conserve remaining patches

- Protect and conserve remaining areas of the ecological community, including protecting potential areas of natural or managed retreat (e.g. upslope and upstream of current occurrences).
- Avoid further clearance and destruction of the ecological community.
- 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.
- Protect patches identified as the most intact wildlife refuges or 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.
- Where regrowth is occurring, provide measures that will support the regrowth to mature (e.g. provide fencing to minimise damage risk).

Planning 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).
- Liaise with planning authorities to promote the inclusion of Coastal Swamp Oak Forest protection and projected tidal inundation zones in their plans/responses to climate change, sea-level rise, coastal erosion and in coastal zone management generally.

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 or stags 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 reduce may 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, but also consider future sea-level rise and coastal erosion;
  - increase the area and improve ecological function of existing patches, for example by enhancing landscape connectivity, habitat diversity and condition;
  - focus on the restoration of good and moderate quality patches of the ecological community to achieve high quality condition (see Table 1);
  - 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 delivery 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 (see p. 41), 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.

- Avoid activities that could cause significant hydrological change to patches of the ecological community:
    - Avoid constructing levees, culverts, floodgates etc. that will lead to permanent inundation or permanent tidal restriction of patches of the ecological community, or that will otherwise adversely alter existing inundation/tidal regimes.
    - Avoid constructing outlets/drains that direct stormwater discharge into or near patches of the ecological community.
    - Avoid building roads, railways, weirs, bridges and other structures in a way that alters the natural hydrology.
    - Avoid draining of coastal wetlands.
- Avoid activities that could significantly alter the fire regime of patches of the ecological community:
    - Avoid activities that reduce the connectivity of ground layer fuels that reduce the likelihood of periodic fire, or that will otherwise adversely alter existing fire regimes.
    - Avoid building fire-sensitive infrastructure in or immediately adjacent to patches of the community that will preclude any future ecological burns or encourage too-frequent fire-hazard reduction activities.

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 rainforest species (e.g. bird dispersed) in or around remnants where rainforest species are uncommon or absent in the understorey.
- When conducting activities in or around the ecological community, practise good biosecurity hygiene to avoid spreading weeds or pathogens (see Department of the Environment, 2015c).
- 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 incursions do occur, detect and control them early, as small infestations are more likely to be eradicated.
- Limit or prevent access of grazing animals to patches of the ecological community (e.g. construct fences) where practicable.
- Prevent further introduction of feral animals and, where possible, contain pets in nearby residential areas.

Manage recreational pressures

- Where practical, restrict or prevent recreational vehicle access (including bicycles) to patches of the ecological community and assist through public education measures such as signs.
- Support the use of existing tracks and paths (e.g. erect educational signs and information points and promote their use).
- If constructing new access tracks across patches of the ecological community, implement best practice measures (e.g. use raised platforms) and ensure that access paths/tracks are not inundated at times of high tide.

6.2.2 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.
- Identify and prioritise other specific threats and undertake appropriate on-ground site management strategies where required.

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. Particularly, undertake weed control for bitou bush and boneseed, lantana and exotic vines and scramblers.
- 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:
    - Particularly, instigate pig control programs.

Manage trampling, browsing and grazing

- Retire high conservation areas from grazing and follow up with weed management
- Develop and implement appropriate grazing regimes, including rotational grazing, or 'spelling', for the ecological community if grazing is to continue. These practices will also protect the agricultural values of the patch.
    - Promote regeneration by avoiding prolonged or heavy grazing. Short periods of intense grazing are preferable to leaving stock in for long periods.
    - 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.
    - If stock could carry weeds into the remnant, then it is preferable to exclude stock altogether or admit them only at times when none of the weeds are releasing viable seed. If moving stock to patches of the ecological community, ensure stock are purged of weed seeds (e.g. hold stock in paddocks free from major weed seeds for an appropriate time prior to introduction).
    - Avoid grazing during native plant flowering and seeding times.

Manage fire

- Implement/reinstate appropriate fire management regimes for the ecological community and the landscapes surrounding the ecological community, taking into account results from research:
    - Use available ecological information to understand how fire may impact on key species in the ecological community; for instance, do not burn areas adjacent to

the ecological community when threatened or functionally important flora and fauna are reproducing.
    - Apply mosaic burning patterns, where feasible, during controlled burning of natural vegetation adjacent to the ecological community to increase habitat variability.
    - Do not burn adjacent to the ecological community if soil moisture is very low, or dry conditions are predicted for the coming season as recovery will be too slow and erosion may occur or weeds become established while the ground is bare.
    - Apply a fire regime that allows swamp oak to reach reproductive maturity between fires (i.e. a minimum fire interval of seven years).

Undertake restoration

- Undertake restoration, including bush regeneration and revegetation, of poorer and medium quality patches to restore them to high quality, including restoration of patches that don't currently meet the condition thresholds for protection to a condition that does (see Table 1).
    - Plan and implement restoration with reference to the *National Standards for the Practice of Ecological Restoration in Australia* (Standards Reference Group SERA, 2016).
    - 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 (such as saltmarsh) and threatened and migratory species are not adversely impacted by tree planting or other restoration activities for Coastal Swamp Oak Forest.
- Develop a collection program and collect seed from the ecological community for the Australian Seedbank Partnership[4] 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.
- Investigate options to restore natural hydrological regimes to patches of the ecological community that have been adversely impacted and implement wetland restoration where appropriate. This may include removing or altering seawalls, dykes, causeways or other structures.

6.2.3 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,

[4] Australian Seedbank Partnership: www.seedpartnership.org.au

land managers, land use planners, researchers, community members and Indigenous communities, particularly Traditional Owner groups.

Raise awareness

- 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 (e.g. during recreational activities) and of minimising pollution and littering (e.g. via signage).
- 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 to discourage damaging activities such as the removal of 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.

6.2.4 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 the ecological community and 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.
    - Identify where the best, high quality remnants of the ecological community occur.

Modelling sea-level rise impacts

- Identify and map areas of the ecological community most vulnerable to sea-level rise and coastal erosion to inform planning that will protect areas that allow the ecological community to retreat landward.

Options for managing threats

- Research into appropriate and integrated methods to manage weeds that affect the ecological community.
- Research to identify appropriate fire intensities and intervals.
- Identify areas of the ecological community subject to low fire frequency and identify opportunities for applying appropriate ecological burns.
- Identify areas of the ecological community subject to high fire frequency and identify options for reducing the frequency of fires.

Understanding fire

- Research to gain a better understanding of the ecological consequences of fire-exclusion, including identifying critical thresholds in the process of canopy closure, ground-layer displacement and rainforest invasion.
- Research the population dynamics of swamp oak in remnants with no flammable ground-layer.
- Research the role of low intensity fires for maintaining open structure and ongoing recruitment of open-forest species.

Understanding regrowth

- Research to gain a better understanding of how regrowth stands develop and how they can best be managed alongside other ecological communities, particularly those typically dominated by *Melaleuca* species in the canopy.
- Research the development of regrowth stands of the ecological community to improve understanding of their rate and trajectory of development and evaluate convergence with undisturbed reference states.

Monitoring

- 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.

6.3 Existing plans relevant to the ecological community

Existing plans relevant to this ecological community exist in the form of recovery plans for threatened species within the community, threat abatement plans for threats acting upon this community, regional natural resource management plans, conservation plans and plans of management for National Parks estate that include areas of Coastal Swamp Oak Forest, as well as regional planning documents.

Recovery plans, threat abatement plans and wildlife conservation plans

- Department of Environment, Climate Change and Water (2010d) *Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region.* Department of Environment, Climate Change and Water NSW, Sydney.
  www.environment.gov.au/resource/northern-rivers-regional-biodiversity-management-plan
- Department of Environment, Climate Change and Water (2010) *Border Ranges Rainforest Biodiversity Management Plan - NSW and Queensland*, Department of Environment, Climate Change and Water NSW, Sydney.
  www.environment.gov.au/resource/border-ranges-rainforest-biodiversity-management-plan
- Department of the Environment and Energy (2017b). *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*. Commonwealth of Australia, Canberra.
  www.environment. gov.au/biodiversity/threatened/publications/tap/feral-pig-2017
- Department of the Environment (2015a). *Threat abatement plan for predation by feral cats*. Commonwealth of Australia, Canberra.
  www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats
- Department of the Environment, Water, Heritage and the Arts, (2008a). *Threat abatement plan for predation by the European red fox*, Commonwealth of Australia, Canberra.
  www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox
- Department of the Environment and Energy, (2016a). *Threat abatement plan for competition and land degradation by rabbits*. Commonwealth of Australia, Canberra.
  www.environment.gov.au/biodiversity/threatened/publications/ tap/competition-and-land-degradation-rabbits-2016
- Department of the Environment and Energy (2016b) *Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis*. Commonwealth of Australia, Canberra.
  www.environment.gov.au/biodiversity/threatened/publications/tap/infection-amphibians-chytrid-fungus-resulting-chytridiomycosis-2016
- Department of the Environment, Water, Heritage and the Arts (2008b). *Threat abatement plan for competition and land degradation by unmanaged goats*, Commonwealth of Australia, Canberra.
  www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-unmanaged-goats

- Department of Sustainability, Environment, Water, Population and Communities (2011) *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads*. Commonwealth of Australia, Canberra. www.environment.gov.au/ biodiversity/threatened/ publications/tap/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads
- Department of the Environment (2015b). *Wildlife Conservation Plan for Migratory Shorebirds.* Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/publications/wildlife-conservation-plan-migratory-shorebirds-2016
- Department of the Environment (2015c). *Arrive Clean, Leave Clean: guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems.* Commonwealth of Australia, Canberra. www.environment.gov.au/biodiversity/invasive-species/publications/arrive-clean-leave-clean

Regional conservation or natural resource management (NRM) plans

- SEQC (2016). *Managing Natural Assets for a Prosperous South East Queensland*. www.seqcatchments.com.au/seq-nrm-plan-1/the-seq-nrm-plan
- Department of Environment, Climate Change and Water (2010a) *Far North Coast Regional Conservation Plan*. www.environment.nsw.gov.au/biodiversity/20100982fncrcp.htm
- Department of Environment, Climate Change and Water (2010b) Draft *Mid North Coast Regional Conservation Plan*. www.environment.nsw.gov.au/biodiversity/20100999dmncrcp.htm
- Department of Environment, Climate Change and Water (2010c) *South Coast Regional Conservation Plan.* www.environment.nsw.gov.au/biodiversity/20101000scrcp.htm

Plans of Management for national park estate with areas of swamp oak coastal forest

- The *Maroochy River Conservation Park Management Plan*. www.npsr.qld.gov.au/managing/plans-strategies/pdf/maroochy-river-conservation-park-2000.pdf
- National Parks and Wildlife Service (1999a) *Bongil Bongil National Park Draft Plan of Management.* Office of Environment and Heritage www.environment.nsw.gov.au/publications/parks/bongil-bongil-national-park-draft-plan-of-management-170136.htm

6.4 Recovery plan recommendation

A recovery plan is not recommended for this 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 sufficiently outlines the priority actions needed for this ecological community and many of the threats affecting the ecological community are best managed at a landscape scale, coordinated with management of other ecological communities. In addition, a number of existing documents are relevant to the management and/or recovery of this ecological community or the threats to it, outlined in section 6.2 above.

Taking into account the benefits of supplementing existing protection with national listing and implementing the priority research and conservation actions outlined in section 6.2 above, a separate recovery plan for the ecological community is not required at this time.

APPENDIX A - ADDITIONAL INFORMATION ON MAP UNITS AND REGIONS

Table 2: Map units that may contain[5] Coastal Swamp Oak Forest

Mapping Scheme	Relevant Map Units
Queensland Regional Ecosystems* (Queensland Herbarium, 2016)	**12.1.1** *Casuarina glauca* on margins of marine clay plains (Swamp she oak open forest) **12.3.20** *Melaleuca quinquenervia+/- Casuarina glauca, Eucalyptus tereticornis, E. siderophloia* open forest (Vegetation forest)
Mangrove and associated communities of Moreton Bay (Accad et al., 2016)	**5A(i)a** *Casuarina glauca* open-forest, woodland **5A(i)b** *Casuarina glauca* open-woodland **5A(ii)a** *Casuarina glauca* low open-forest, low woodland **5A(ii)b** *Casuarina glauca* low open-woodland **5B(i)** *Casuarina glauca, Melaleuca quinquenervia* open-forest, woodland, low open-forest **5B(ii)** *Casuarina glauca, Melaleuca quinquenervia* open-forest, low open forest (dying) **5C(i)** *Casuarina glauca, Bruguiera gymnorhiza, Excoecaria agallocha* low open-forest **5C(ii)** *Casuarina glauca, Avicennia marina* subsp. *australasica* low open-forest **5C(iii)** *Casuarina glauca, Avicennia marina* subsp. *australasica, Aegiceras corniculatum*
NSW Plant Community Type PCT Classification (OEH, 2016b)	**1232**: Swamp Oak-Prickly Tea-tree-Swamp Paperbark swamp forest on Coastal Floodplains, Sydney Basin and South East Corner **1234:** Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner **1235:** Swamp Oak swamp forest of the Coastal Lowlands NSW North Coast Bioregion **1236:** Swamp Paperbark-Swamp Oak Tall shrubland on estuarine flats, Sydney Basin and South East Corner **1727:** Swamp-Oak-Sea Rush-*Baumea juncea* swamp forest - Hunter/Central Rivers **1728:** Swamp Oak- Prickly Paperbark Tall sedge forest Central Coast Lower North Coast **1731:** Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley **1800:** Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley
Vegetation classification for the Northern Rivers Catchment Management Area of New South Wales. (Office of Environment & Heritage, 2012a) Vegetation Classification for the Northern Rivers Catchment Management Area of New South Wales. Appendix 8 Vegetation Community Profiles. (Office of Environment & Heritage, 2012b).	**1917:** Swamp Oak forested wetland of saline areas of coastal estuaries **1918:** Swamp Oak forested wetland on the lower Clarence River floodplain, Eastern Queensland Bioregion **1919:**Swamp Oak - Sea Rush swamp forest on saline coastal swamps and flats, South Eastern Queensland Bioregion and NSW North Coast Bioregion **1920:** Swamp Oak – Broad-leaved Paperbark – Willow Bottlebrush floodplain forested wetland **1921:** Milky Mangrove woodland of tidal estuaries **1922:** Swamp Oak - Tuckeroo - Cabbage Palm - Bangalow Palm forest on alluvium on the lower Richmond River floodplain, South Eastern Queensland Bioregion.
NSW Forest Ecosystem Model (Forests Taskforce & NSW CRA/RFA Steering Committee, 1999)	FE143 – Swamp Oak

[5] Note: many of these map units only partially coincide with Coastal Swamp Oak Forest. The presence or absence of the ecological community at any given site must be determined with reference to the key diagnostics and condition thresholds and not by reliance on map units.

NSW Biometric vegetation types (Office of Environment & Heritage, 2013a)	SR649 - Coastal Freshwater Swamp Forest. SR650 - Estuarine Swamp Oak Forest SR651 - Coastal Swamp Paperbark-Swamp Oak Scrub.
South-east NSW vegetation communities (Tozer et al., 2010)	FoW p105 Floodplain Swamp Forest FoW p106 Estuarine Fringe Forest FoW p107 Estuarine Creek Flat Scrub
Tweed Shire Council vegetation mapping units (Kingston et al., 2004)	601 – Swamp she oak closed forest to woodland 402 – Mangrove low closed forest to woodland
Byron Shire vegetation associations (Ecograph and Terrafocus Pty Ltd, 2009)	62 – Swamp oak +/- Paperbark
Port Macquarie Hastings Council vegetation communities (Phillips et al., 2013)	PMVC70 - Swamp Oak Coastal Floodplain Wetland Forest PMVC71 - Swamp Oak-Mixed Eucalypt Coastal Floodplain Wetland Forest Complex
Coffs Harbour Vegetation Mapping (Office of Environment & Heritage, 2012c).	CH_FrW01 - Broad-leaved Paperbark (*Melaleuca quinquenervia*) – Swamp Oak (*Casuarina glauca*) – Willow Bottlebrush (*Callistemon salignus*) floodplain Forested Wetland CH_FrW10 - Swamp Oak (*Casuarina glauca*) – Bare Twig Rush (*Baumea juncea*) – Sea Rush (*Juncus kraussii* subsp. *australiensis*) Saline Forested Wetland CH_SW03- Coastal Dune Soak Swamp Oak (*Casuarina glauca*) – Sand Sedge (*Carex pumila*) – Club Rush (*Ficinia nodosa*) Shrublands and Sedgelands
Bellingen Plant Community Types (PCTs) (Office of Environment & Heritage, 2013a)	BELL_ForW01 - Swamp Oak (*Casuarina glauca*) – Broad-leaved Paperbark (*Melaleuca quinquenervia*) – Willow Bottlebrush (*Callistemon salignus*) floodplain forested wetland. BELL_ForW06 - Swamp Oak (*Casuarina glauca*) forested wetlands of hind dunes. BELL_ForW10 - Swamp Oak (*Casuarina glauca*) forested wetland of estuaries.
Nambucca vegetation communities (Nambucca Shire Council, 2015)	NAM_ForW01 - Swamp Oak forested wetland of saline areas of coastal – Estuaries (PCT 1917) NAM_ForW02- Milky Mangrove Woodland of tidal estuaries (PCT – 1921)
NPWS NSW Coastal Vegetation (Sheringham et al., 2008)	5001/2 – *Casuarina glauca* forest and woodland 40991/2 – Mixed stands of *Melaleuca quinquinerva* – *Casuarina glauca* 40151 – *Casuarina glauca* – *Avicenna marina* ssp *australasica*
Vegetation of the coastal lowlands of Tweed Shire, northern New South Wales, species and conservation (Pressey & Griffith, 1992)	F10 - *Casuarina glauca* tall to very tall open to closed forest

Table 3: Regions where Coastal Swamp Oak Forest occurs (as at September 2017)

Natural Resource Management (NRM) Regions	**South East Queensland** Fitzroy Burnett-Mary South East Queensland. **New South Wales** North-coast Hunter Greater Sydney South East NSW
IBRA bioregions & subregions (IBRA v.7)	**South East Queensland (SEQ)** SEQ 1 Burnett-Curtis Hills and Ranges SEQ 3 Burringbar-Conondale Ranges SEQ 4 Sunshine Coast-Gold Coast Lowlands SEQ 8 Burnett-Curtis Coastal Lowlands SEQ 9 Great Sandy SEQ 13 Clarence Lowlands **NSW North Coast (NNC)** NNC 5 Yuraygir NNC 6 Coffs Coast and Escarpment NNC 7 Macleay Hastings NNC 17 Karuah Manning **Sydney Basin (SYB)** SYB 2 Hunter SYB 5 Yengo SYB 9 Burragorang SYB 12 Illawarra SYB 13 Ettrema SYB 14 Jervis **South East Corner (SEC)** SEC 3 Bateman SEC 2 South East Coastal Ranges

APPENDIX B – SPECIES LISTS

Scientific names are nationally accepted names as per the Australian Plant Census (Council of Heads of Australasian Herbaria, 2016) and NSW Flora Online (Royal Botanic Gardens and Domain Trust, 2016). Note, the total vascular plant species list of the ecological community is considerably larger than the species listed here.

Due to the large latitudinal range of this community, some species will be only relevant in certain parts of the coast. Relevant species are noted if they are known to be limited to the Sydney Basin and further north (N), or the Sydney Basin and further south (S).

Table 4: Characteristic, frequently occurring or threatened flora of Coastal Swamp Oak Forest

Scientific name	Common name/s	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Canopy and emergent species				
Archontophoenix cunninghamiana (N)	Bangalow palm			
Casuarina glauca	swamp oak/swamp she-oak			
Eucalyptus botryoides (S)	southern mahogany/bangalay			
Eucalyptus grandis(N)	flooded gum			
Eucalyptus longifolia (S)	woollybutt			
Eucalyptus robusta	swamp mahogany			
Eucalyptus tereticornis	forest red gum			
Melaleuca ericifolia (S)	swamp paperbark			
Melaleuca quinquenervia(N)	broad leaved paperbark			
Sub-canopy and mid-layer species				
Acacia maidenii	maiden's wattle			
Acacia melanoxylon	blackwood			
Acacia venulosa (N)	an acacia			
Acronychia imperforata	Logan apple			
Acmena smithii	lilly pilly			
Aegiceras corniculatum	river mangrove			
Alphitonia excelsa	red ash/soap tree			
Avicennia marina	grey mangrove			
Breynia oblongifolia(N)	breynia			
Bruguiera gymnorhiza	black mangrove			
Callistemon salignus	willow bottlebrush			
Cladium procerum	leafy twigrush			
Clerodendrum inerme(N)	scrambling clerodendrum			
Cupaniopsis anacardioides(N)	tuckeroo			
Davidsonia jerseyana(N)	Davidson's plum	E	V	
Diospyros mabacea(N)	red fruited ebony	E	E	LC
Diospyros australis	black plum			
Diploglottis campbellii(N)	small leaved tamarind	E	E	
Elaeodendron australe	red olive-berry			
Excoecaria agallocha	milky mangrove			
Ficus coronata	sandpaper fig			
Ficus macrophylla macrophylla	Moreton Bay fig			
Ficus obliqua	small leaved fig			
Floydia praealta(N)	ball nut/possum nut/beefwood	V	V	V

[6] V = vulnerable, E = endangered, CE = critically endangered, M= migratory

[7] LC = least concern, NT = near threatened, V = vulnerable, E = endangered

Scientific name	Common name/s	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Gahnia aspera	razor grass/cut sedge			
Gahnia clarkei	tall saw (sword) sedge			
Glochidion ferdinandi	cheese tree			
Glochidion sumatranum (N)	umbrella cheese tree			
Gossia fragrantissima(N)	sweet/small-leaved myrtle	E	E	LC
Guioa semiglauca	wild quince			
Hibiscus tiliaceus	coast cottonwood			
Homalanthus nutans(N)	native bleeding heart tree			
Litsea australis	brown bolly gum			
Livistona australis	cabbage palm			
Lophostemon suaveolens (N)	swamp mahogany			
Macadamia tetraphylla(N)	rough-shelled bush nut	V	V	V
Mallotus discolor(N)	white kamala			
Myoporum acuminatum	mangrove boobialla			
Melaleuca alternifolia(N)	narrow-leaved paperbark			
Melaleuca biconvexa	biconvex paperbark	V	E	E
Melaleuca ericifolia (S)	swamp paperbark			
Melaleuca decora	white feather honey myrtle			
Melaleuca linariifolia	narrow-leaved paperbark			
Melaleuca quinquenervia(N)	broad leaved paperbark			
Melaleuca styphelioides	prickly leaved tea-tree			
Notelaea longifolia	native olive			
Notelaea venosa	mock olive			
Pittosporum undulatum	sweet pittosporum			
Phragmites australis	common reed			
Psydrax lamprophylla	large leaf canthium			LC
Rhagodia spp.	rhagodia			
Rhizophora stylosa	red mangrove			
Syzygium hodgkinsoniae(N)	red lilly pilly/smooth-bark rose apple	V	V	V
Syzygium moorei(N)	rose apple/coolamon	V	V	V
Tabernaemontana pandacaqui(N)	banana bush			
Climbing, epiphytic and parasitic species				
Angophora inopina	charmhaven apple	V	V	
Amyema cambagei	mistletoe			
Asplenium australasicum	bird's nest fern			
Cassytha glabella glabella	slender devil's twine			
Cynanchum carnosum(N)	mangrove vine			
Dendrobium linguiforme	epiphytic orchid			
Dendrobium teretifolium	pencil orchid			
Dendrobium melaleucaphilum	spider orchid		E	
Echinostephia aculeata(N)	prickly snake vine			
Ficus watkinsiana(N)	strangler fig			
Flagellaria indica(N)	whip vine			
Geitonoplesium cymosum	native asparagus			
Glycine clandestina	twining glycine			
Gynochthodes canthoides	veiny morinda			
Hardenbergia violacea	false sarsparilla			
Maclura cochinchinensis	cockspur thorn			
Marsdenia rostrata	milk vine			

Scientific name	Common name/s	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Morinda jasminoides	sweet morinda			
Notothixos subaureus	golden mistletoe			
Pandorea pandorana pandorana	wonga wonga vine			
Parsonsia straminea	common silkpod			
Platycerium bifurcatum	elkhorn fern			
Platycerium superbum	staghorn fern			
Psilotum nudum	skeleton fork-fern			
Pyrrosia confluens	horsehoe felt fern			
Pyrrosia rupestris	rock felt fern			
Smilax australis	austral sarsparilla			
Stephania japonica var. discolor	snake vine			
Ground layer species				
Acrostichum speciosum	mangrove fern			
Alexfloydia repens$^{(N)}$	Floyd's grass		E	
Alternanthera denticulata	lesser joyweed			
Alocasia brisbanensis	cunjevoi, spoon lily			
Apium prostratum$^{(N)}$	sea celery			
Arthraxon hispidus	hairy jointgrass	V	V	V
Asperula asthenes$^{(N)}$	trailing woodruff	V	V	LC
Austromyrtus dulcis	midyim, midgem berry			
Atriplex australasica	native orache			
Bacopa monnieri	water hyssop			
Baumea articulata	jointed twigrush			
Baumea juncea	bare twigrush			
Blechnum indicum	swamp-water fern			
Bolboschoenus caldwellii	salt club-rush			
Carex appressa	tall sedge			
Centella asiatica	pennywort			
Cheirostylis ovata	jewel orchid			
Commelina cyanea	scurvey-weed, wandering jew			
Cordyline congesta	coast palm lilly			
Crinum pedunculatum	swamp/river lily			
Cynodon dactylon	couch grass			
Cyperus lucidus	sedge/cutty/cutting grass			
Cyperus polystachyos	bunchy sedge			
Cyperus sphaeroideus	a sedge			
Cyperus trinervis	a sedge			
Dianella caerulea	blue flax lily			
Diuris praecox$^{(N)}$	Newcastle/rough doubletail	V	V	
Eclipta platyglossa	yellow eclipta			
Eclipta prostrata	false daisy			
Einadia hastata	saloop/berry saltbush			
Eleocharis acuta	common spike-rush			LC
Enchylaena tomentosa var. *glabra*	ruby/barrier salt bush			
Enydra spp.	enydra			
Entolasia spp.	panic grasses			
Eriochloa procera	Spring-grass/slender cupgrass			LC
Ficinia nodosa=Isolepis nodosa	knobby-club rush			
Fimbristylis dichotoma	common fringe-rush			
Fimbristylis ferruginea	a rush			LC

Scientific name	Common name/s	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Goodenia ovata	hop goodenia			
Isoglossa eranthemoides[(N)]	isoglossa	E	E	
Hydrocotyle verticillata	whorled pennywort/pennyroyal			
Hypolepis muelleri	harsh ground-fern			
Haloragis exalata subsp. *exalata*	square/wingless raspwort	V	V	
Ischaemum australe	a grass			
Isolepis inundata	club rush			
Imperata cylindrica	blady grass			
Juncus kraussii subsp. *australiensis*	sea rush			
Lilaeopsis polyantha	a perennial herb			
Leptinella longipes	a creeping herb			
Lobelia anceps	lobellia			
Lomandra longifolia	spiny-headed mat-rush			
Maundia triglochinoides	water ribbons		V	V
Microlaena stipoides	weeping grass			
Oberonia titania	Norfolk Island/fairy orchid		V	
Oplismenus aemulus	creeping shade grass			
Oplismenus imbecillis	creeping beard grass			
Ottochloa gracillma	pademelon grass			
Paspalum vaginatum	salt-water couch			
Persicaria elatior	tall knotweed	V	V	V
Persicaria decipiens	smart/slender knotweed			
Persicaria hydropiper	water pepper			
Phaius australis[(N)]	lesser swamp-orchid	E	E	E
Pratia purpurascens	whiteroot			
Sacciolepis indica	Indian cupscale grass			
Samolus repens	creeping brook/bushweed			
Sarcocornia quinqueflora	beaded samphire			
Selliera radicans	swamp weed			
Sesuvium portulacastrum	sea purslane			
Smilax australis	austral sarsparilla			
Solanum americanum	glossy nightshade			
Solanum prinophyllum	forest nightshade			
Sporobolus virginicus	sand or salt couch			
Spirodela polyrhiza	greater duckweed			
Suaeda australis	austral seablite			
Ranunculus inundatus	river buttercup			
Tetragonia tetragonoides	New Zealand spinach			
Triglochin striata	streaked arrow grass			
Utricularia aurea	golden bladderwort			
Villarsia exaltata = Liparophyllum exaltatum	erect marsh flower			
Viola banksii	wild violets			
Zoysia macracantha	prickly couch			

Sources: Department of the Environment & Energy (2017c); NSW Scientific Committee (2004); Office of Environment and Heritage (2017e); CSIRO (2017); NSW Scientific Committee (2004); Keith & Scott (2005); Miles (2006); Sheringham et al. (2008); Department of Environment & Climate Change (2008); and, Tozer et al. (2010).

Table 5: Characteristic, frequently occurring or threatened fauna of Coastal Swamp Oak Forest

Scientific name	Common name	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Mammals				
Antechinus agilis	agile antechinus			
Antechinus flavipes	yellow-footed antechinus			
Antechinus stuartii	brown antechinus			
Cercartetus nanus	eastern pygmy possum		V	
Chalinolobus dwyeri	large-eared pied bat	V	V	V
Chalinolobus nigrogriseus	hoary wattled bat		V	
Dasyurus maculatus maculatus (S)	spotted-tailed quoll	E	V	V
Hydromys chrysogaster	water rat			
Isoodon macrourus	northern brown bandicoot			
Isoodon obesulus obesulus (S)	southern brown bandicoot	E	E	
Falsistrellus tasmaniensis	eastern false pipistrelle		V	LC
Macropus giganteus	eastern grey kangaroo			
Macropus rufogriseus	red-necked wallaby			
Miniopterus australis	little bentwing bat		V	LC
Miniopterus schreibersii oceanensis	eastern bentwing bat		V	LC
Mormopterus norfolkensis	eastern free-tail bat		V	LC
Myotis macropus = Myotis adversus	large-footed myotis		V	
Perameles nasuta	long-nosed bandicoot			
Petauroides volans	greater glider	V	E	LC
Petaurus australis	yellow bellied glider			
Petaurus norfolcensis	squirrel glider		V	
Petaurus breviceps	sugar glider			
Phascogale tapoatafa	brush-tailed phascogale		V	LC
Phascolarctos cinereus	koala	V	V	V
Planigale maculata	common planigale		V	LC
Potorous tridactylus	long-nosed potoroo		V	
Pseudomys novaehollandiae	New Holland mouse/Pookila	V	V	LC
Pteropus poliocephalus	grey-headed flying fox	V	V	LC
Rattus lutreolus	swamp rat			
Saccolaimus flaviventris	yellow-bellied sheathtail bat		V	LC
Scoteanax rueppellii	greater broad-nosed bat		V	LC
Sminthopsis leucopus (S)	white-footed dunnart		V	V
Syconycteris australis (N)	eastern blossom-bat		V	
Trichosurus caninus (N)	mountain brushtail possum			
Xeromys myoides(N)	water mouse (false water rat)	V		V
Reptiles				
Amphibolurus muricatus	jacky lizard			
Bellatorias major	land mullet			
Boiga irregularis	brown tree snake			
Chelodina longicollis	eastern long-necked turtle			
Cyclodomorphus gerrardii	pink-tongued lizard			
Cyclodomorphus michaeli	mainland she-oak skink			
Egernia mcpheei(N)	tree skink			
Elseya albagula	white-throated snapping turtle	CE		E
Elusor macrurus	Mary River turtle	E		E
2016Emydura macquarii	Murray River turtle			

Scientific name	Common name	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Hemiaspis signata	black-bellied swamp snake			
Hoplocephalus bitorquatus (N)	pale-headed snake		V	LC
Intellagama lesueurii	eastern water dragon			
Wollumbinia georgesi	Bellinger River snapping turtle	CE	CE	
Tiliqua nigrolutea	blotched blue tongue lizard			
Tropidechis carinatus (N)	Clarence River/rough-scaled snake			
Pseudonaja textilis	eastern brown snake			
Pseudechis porphyriacus	red-bellied black snake			
Amphibians				
Crinia tinnula	tinkling frog		V	V
Lechriodus fletcheri	Fletcher's frog			
Limnodynastes dumerilii	eastern banjo frog (pobblebonk)			
Limnodynastes peroni	brown-striped frog			
Litoria aurea	green and golden bell frog	V	E	
Litoria brevipalmata	green-thighed frog		V	V
Litoria caerulea	green tree frog			
Litoria chloris	red-eyed tree frog			
Litoria citropa	Blue Mountains tree frog			
Litoria cooloolensis (N)	Cooloo segdgefrog			NT
Litoria fallax	dwarf green tree frog			
Litoria freycineti	wallum rocket frog			V
Litoria latopalmata	broad-palmed frog			
Litoria olongburensis (N)	wallum sedgefrog	V	V	V
Litoria revelata	revealed frog			
Litoria wilcoxii	Wilcox's frog			
Platyplectrum ornatum	ornate burrowing frog			
Uperoleia mahonyi (N)	Mahony's toadlet		E	
Birds				
Accipiter novaehollandiae	grey goshawk			
Acrocephalus australis	Australian reed warbler			
Anseranas semipalmata	magpie goose		V	
Anthochaera phrygia	regent honeyeater	CE	CE	E
Ardea modesta	eastern great egret			
Botaurus poiciloptilus	Australasian bittern	E	E	
Butorides striatus	striated heron			
Bubulcus ibis = Ardea ibis	cattle egret			
Burhinus grallarius	bush stone-curlew		E	
Calidris tenuirostris	great knot	CE, M	V	E
Calyptorhynchus funereus	yellow-tailed black cockatoo			
Calyptorhynchus lathami lathami	glossy black cockatoo			
Ceyx azureus	azure kingfisher			
Charadrius leschenaultii	greater sand plover	V, M	V	V
Cracticus tibicen	Australian magpie			
Coturnix ypsilophora	brown quail			
Dasyornis brachypterus	eastern bristlebird	E	E	E
Dendrocygna arcuata	wandering whistling duck			
Dicaeum hirundinaceum	mistletoebird			
Dromaius novaehollandiae (N)	emu			
Egretta garzetta	little egret			
Egretta novaehollandiae	white-faced heron			

Scientific name	Common name	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Ephippiorhynchus asiaticus	black-necked stork		E	
Epthianura albifrons	white-fronted chat		V	
Erythrotriorchis radiatus	red goshawk	V	CE	E
Grantiella picta	painted honeyeater	V	V	V
Haliaeetus leucogaster	white-bellied sea-eagle		V	
Haliastur indus	Brahminy kite			
Irediparra gallinacea	comb-crested jacana		V	
Ixobrychus flavicollis	black bittern		V	LC
Lathamus discolor	swift parrot	CE	E	E
Leucosarcia picata = Leucosarcia melanoleuca	Wonga pigeon			
Limosa limosa	black-tailed godwit	M	V	
Lophoictinia isura	square-tailed kite		V	LC
Malurus cyaneus	superb fairy wren			
Malurus lamberti	variegated wren			
Malurus melanocephalus	red-backed fairy wren			
Merops ornatus	rainbow bee-eater			
Neochmia temporalis	red browed firetail			
Ninox connivens	barking owl		V	LC
Ninox strenua	powerful owl		V	V
Numenius madagascariensis	eastern curlew	CE, M		E
Nycticorax caledonicus	Nankeen night heron			
Pandion cristatus	eastern osprey	M	V	
Pachycephala rufiventris	rufous whistler			
Parvipsitta pusilla	little lorikeet		V	
Petroica phoenicea	flame robin		V	
Pezoporus wallicus wallicus	eastern ground parrot		V	V
Pomatostomus temporalis temporalis	grey-crowned babbler		V	
Rhipidura albiscapa	grey fantail			
Rostratula australis	Australian painted snipe	E	E	V
Stictonetta naevosa	freckled duck		V	
Stipiturus malachurus	southern emu wren			V
Trichoglossus haematodus	rainbow lorikeets			
Trichoglossus chlorolepidotus (N)	scaley breasted lorikeets			
Threskiornis spinicollis	straw-necked ibis	M		
Todiramphus sanctus	sacred kingfisher			
Tringa nebularia	common greenshank	M		
Tringa stagnatilis	marsh sandpiper	M		
Tyto longimembris	eastern grass owl		V	LC
Tyto novaehollandiae	masked owl		V	LC
Xenus cinereus	Terek sandpiper	M	V	LC
Invertebrates				
Argynnis hyperbius inconstans (N)	laced fritillary	CE	E	E
Australothele nambucca (N)	large curtain web spider			
Delias aganippe	spotted jezebel			
Hypochrysops delicia	moonlight jewel			
Megadolomedes australianus	giant water spider			
Nephila spp.	golden orb weaving spider			
Ocybadistes knightorum (N)	black grass-dart/Knight's dart		E	
Petalura litorea (N)	coastal petaltail		E	

Scientific name	Common name	Listing status as at August 2017		
		EPBC Act[6]	NSW Act[6]	Qld Act[7]
Psychonotis caelius taygetus	small green-banded blue			
Tisiphone abeona	varied sword grass brown			
Spodoptera picta	lily caterpillar			
Trigona carbonaria	stingless native bees			

Sources: Marchant & Higgins (1990, 1993); Higgins & Davies (1996); Higgins (1999); Higgins, Peter & Steele (2001); Higgins & Peter (2002); Van Dyck & Strahan (2008); Watson (2011); Cogger (2014); Department of the Environment & Energy (2017c); Office of Environment & Heritage (2017e).

Table 6: Invasive plants known to be affecting the ecological community

Scientific name	Common name
Araujia sericiflora	moth plant
Asparagus asparagoides	bridal creeper
Baccharis halimifolia	groundsel bush
Chrysanthemoides monilifera	bitou bush
Cinnamomum camphora	camphor laurel
Conyza spp.	fleabanes
Cyperus eragrostis	umbrella sedge
Eichhornia crassipes	water hyacinth
Hydrocotyle bonariensis	American pennywort
Ipomoea cairica, I. purpurea and *I. indica*	morning glories
Lantana camara	lantana
Ligustrum lucidum	large-leaved privet
Ligsutrum sinense	Chinese privet/small-leaved privet
Ludwigia spp.	ludwigia
Ochna serrulata	ochna
Paspalum dilatatum	paspalum
Paspalum mandiocanum	broad-leaf paspalum
Pennisetum clandestinum	kikuyu
Rubus fruticosis agg.	blackberries
Salvinia molesta	salvinia
Schefflera actinophylla	umbrella tree
Senna pendula	winter senna
Solanum pseudocapsicum	Madeira winter cherry
Solanum nigrum	black-berry nightshade
Symphyotrichum subulatum = Aster subulatus	saltmarsh aster
Tradescantia fluminensis	wandering jew
Verbena bonariensis	purpletop

APPENDIX C - ADDITIONAL INFORMATION TO ASSIST IN IDENTIFYING THE ECOLOGICAL COMMUNITY

Identifying a patch

A patch is a discrete and mostly continuous area of the ecological community, as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances.

Boundary of a patch

The edge of the patch extends to the outer edge of swamp oak tree canopy. Where the canopy is sparse or interrupted, the edge of the patch is defined by the shortest distance between the outer edges of the canopies of each of the outermost trees.

Breaks in a patch

When it comes to defining a patch of the ecological community allowances are made for "breaks" up to 30 metres between areas that meet the key diagnostics. Such breaks may be the result of watercourses or drainage lines, tracks, paths, roads, gaps made by exposed areas of soil, and areas of localised variation in vegetation that do not meet the key diagnostics. Such breaks do not significantly alter the overall functionality of the ecological community and form a part of the patch. They should be included in the calculation of the size of the patch, and taken into account when determining the overall condition of the patch.

For example, a single patch could include two areas of the ecological community that meet the key diagnostics, but are separated by < 30 m mangroves lining a watercourse.

Where there is a break in the ecological community of 30 metres or more (e.g. due to permanent artificial structures, wide roads or other barriers, water bodies or other types of vegetation) then the gap indicates that separate patches are present.

Patch condition and variation within a patch

Patches of Coastal Swamp Oak Forest may contain areas that vary in structural or biological complexity. One part of a patch may have a larger number of mature species and more ecological diversity, whereas another part of the same patch may demonstrate fewer mature trees and less groundcover. Areas with soil exposed and/or plant litter can be expected within this ecological community. Variation in quality or condition of vegetation across a patch should not be considered to be evidence of multiple patches.

Patches of the ecological community can be spatially variable and are often characterised by one or more areas within a patch that meet higher condition threshold criteria amongst areas of lower condition. Average quality across the largest area that meets the key diagnostics should be used in determining overall vegetation condition. All areas that meet the key diagnostics, regardless of their condition, are generally included in patch size calculations.

Where the average condition falls below the minimum condition thresholds for a vegetation patch as a whole, the largest area or areas that meet minimum condition thresholds should be specified as the patch or patches of the nationally listed ecological community. This may result in multiple patches of the ecological community being identified within the overall area first identified as meeting the key diagnostics.

Buffer zones

A buffer zone is a contiguous area adjacent to a patch that is important for protecting the integrity of the ecological community. As the risk of indirect damage to an ecological community is usually greater where actions occur close to a patch, the purpose of the buffer zone is to minimise this risk by guiding land managers to be aware that the ecological community is nearby and take extra care. For instance, the buffer zone will help 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, polluted water runoff and other damage. The best buffer zones are typically comprised of other native vegetation.

The buffer zone is not part of the ecological community, so while having a buffer zone is strongly recommended, it is not formally protected as a Matter of National Environmental Significance and is not included in the calculation of the patch size. To avoid the need to refer an action for approval under national environmental law, changes in use of the land that falls within the buffer zone must not have a significant impact on the ecological community, but there are exemptions for continuing use (e.g. cropping, grazing or maintaining existing fire breaks). If the use of an area that directly adjoins a patch of the ecological community will be intensified, approval under national environmental law may be required. The buffer zone may also be a suitable focus for revegetation or other restoration initiatives.

The recommended minimum buffer zone is 30 m from the outer edge of the patch (as defined by the edge of the tree canopy) as this distance accounts for likely influences upon the root zone. 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.

Survey protocols

Patches of the ecological community can vary markedly in their shape, size, condition and features. Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the patch. The NSW Native Vegetation Type Standard (Sivertson, 2009) and the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009) may provide guidance in some aspects. The size, number and spatial distribution of plots or transects must be adequate to represent variation across the patch. Sampling should address likely variation in species richness (any areas with apparently high native species richness should be included in the sample) and significant variation in the vegetation, landscape qualities and management history (where known) across the patch. For instance, localised weed cover, drainage lines, burned or grazed areas, saline zones. Plots of 0.04 ha (quadrats of 20 x 20 m) will be suitable (Tozer, 2003; Tozer et al., 2010). It is recommended to record the search effort (identifying the number of person hours spent per plot and across the entire patch; along with the surveyor's level of expertise and limitations at the time of survey).

APPENDIX D – DESCRIPTION OF THREATS

Historically, the landscape where the ecological community occurs was cleared primarily for agriculture and small coastal settlements. Consequently, the ecological community now occurs within a 'mixed use' landscape. Many remaining patches occur in close proximity to coastal areas where population growth and urban development is expected to continue at a rapid rate, particularly in the northern part of the extent (Department of Environment, Climate Change and Water, 2010a; Department of Planning and Environment, 2017).

The key threats faced by the ecological community are described here to help explain why this ecological community merits listing as threatened. These threats often interact, rather than act independently.

Clearing and fragmentation

Extensive land clearing and landscape modification for agricultural and coastal development over the past 200 years has reduced the extent of the ecological community. This remains an ongoing threat as most of the remaining ecological community, as well as potential regrowth areas, occurs in close proximity to regional centres or on productive agricultural land.

Clearing of native vegetation continues for housing and light industrial developments and associated infrastructure, upgraded and redirected transport corridors, recreational access and amenity, and in some areas, sandmining. Some waterfront areas (typically on crown land), have suffered the illegal removal of the ecological community by adjacent landowners, usually to open up coastal views. The ongoing loss of remnants of the ecological community, plus the decreased size of remaining remnants, leads to greater vulnerability to threats due to fragmentation and the impacts of edge effects.

As Coastal Swamp Oak Forest occurs as small patches in a mosaic environment, connectivity with other patches of the ecological community within the mosaic is important, as few individual patches are large enough on their own to provide sufficient species and genetic diversity to ensure their long term survival. The loss of individual small patches therefore also has an impact on the surrounding patches and the ecological community overall as this connectivity is broken.

Weeds

Invasion by non-native plant species is a major threat to this ecological community (Keith and Scott, 2005; Tozer et al., 2010). It is often a result of physical disturbance to the vegetation structure of the community; landfill associated with adjacent urban and industrial infrastructure, including sporting fields; soil disturbance; dumping of building or excavation waste, rubbish and garden refuse; encroachment of garden plants with spread assisted by birds, wind, water and altered drainage patterns; polluted runoff from urban and agricultural areas; construction of roads and other utilities; or grazing by domestic livestock or feral animals. Invasion of some weed species can also be a result of changed fire regimes (Queensland Herbarium, 2016).

In addition, invasive aquatic forbs, notably *Eichhornia crassipes* (water hyacinth), *Ludwigia* spp and *Salvinia molesta* (salvinia) pose an ongoing threat to the aquatic habitat component of the ecological community and can alter shelter, food or breeding resources available to the fauna within the ecological community (Department of Environment, Climate Change and Water, 2008; Tozer et al., 2010).

Some weeds can transform the character, condition, or nature of the ecological community by aggressively competing with native species for resources, promoting or suppressing fire, stabilising sand, promoting erosion, colonising intertidal sediments, or accumulating litter and/or salt (Richardson et al., 2000; Tozer et al., 2010). For example, *Asparagus*

asparagoides (bridal creeper) a problematic vine that smothers native vegetation and encourages the accumulation of litter and nutrients, and *Chrysanthemoides monilifera* (bitou bush and boneseed) which stablises sediments and rapidly spreads to form a monoculture, are identified species that can dominate the ecological community in NSW (NSW Scientific Committee 2004). Camphor laurel (*Cinnamomum camphora*), umbrella tree (*Schefflera actinophylla*), small-leaved privet (*Ligustrum sinense*), large-leaved privet (*Ligustrum lucidum*), winter senna (*Senna pendula*), *Pennisetum* spp. (feathergrasses and mission grasses), and *Ipomoea* spp. (morning glories) are also transformative weeds in this ecological community. One study found that *Stenotaphrum secundatum* (Buffalo Grass) invasion affects recruitment, including reduced germination of *Casuarina glauca* (Gooden and French, 2014). In Queensland and parts of NSW, *Lantana camara* (lantana) can contribute to more frequent low intensity fires (Queensland Herbarium, 2016). Annual weeds, such as *Symphyotrichum subulatum* (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not typically be considered as transformer weeds in this ecological community.

A more complete list of weeds affecting the ecological community is at Table 6 in Appendix B – .

Invasive fauna

The ecological community, particularly its faunal elements, is subject to a range of impacts from invasive animals. These include:

- Predation habitat destruction through trampling and soil disturbance, competition and disease transmission by feral pigs;
- Predation and spread of invasive plant species by dogs, foxes, cats, and other feral species;
- Grazing and trampling pressures from rabbits, goats, deer and other feral herbivores, which can leave the ecological community open to erosion and weed invasion;
- Competitive or lethal impacts to faunal elements from invasive noisy miners, honeybees, cane toads and diseases.

Feral pigs (*Sus scrofula*), are noted as a particular threat to Coastal Swamp Oak Forest. As opportunistic omnivores they can have direct impacts such as preying on a range of small animals, eggs, carrion and foliage, or digging up invertebrates, underground fungi, fruit, seeds, roots, tubers, bulbs. This impacts upon the ecological community by altering plant species composition and succession, nutrient and water cycles and degrading water quality. In addition, feral pigs can transmit disease to other animals within the ecological community (Department of the Environment and Energy, 2017b).

Predatory mammals are considered major threats to a number of fauna species within the ecological community, such as the endangered southern brown bandicoot (*Isoodon obesulus obesulus*) and the long-nosed bandicoot (*Perameles nasuta*) (Threatened Species Scientific Committee, 2016a; Department of the Environment, 2015a; National Parks and Wildlife Service, 2001a). Cats and foxes in particular threaten a large number of animals that form part of the ecological community, including quolls, birds, reptiles and frogs. Cats are also likely to predate upon large insects, fish, freshwater crustaceans and turtle hatchlings. Feral cats can host disease-causing agents, some of which can be transmitted to native mammals (Department of the Environment, Water, Heritage and the Arts, 2008a; Department of the Environment, 2015a). Wild dogs are also known to predate upon a range of native fauna including other threatened species such as koalas (*Phascolarctos cinereus*) (NSW Scientific Committee, 2009).

Feral herbivores, such as rabbits, goats and deer, also have direct impacts on both flora and fauna that form the ecological community. By grazing on native vegetation, they remove plants, prevent regeneration and compete with reptiles and other grazing species for food and shelter. They can overgraze areas, which contributes to slope instability and soil erosion (Department of the Environment and Energy, 2016a), and invasive weeds seeds can be carried in their dung. Faecal matter also contributes to high nutrient load in waterbodies (Department of the Environment, Water, Heritage and the Arts, 2008b). Rabbits can also have secondary effects, such as supporting populations of introduced cats and foxes, and exposing burrowing species to increased predation.

The faunal elements of the ecological community are also subject to a range of threats resulting from competition with invasive species and from infectious diseases. A number of the native birds that form a part of the ecological community, including the critically endangered swift parrot, the little lorikeet, the vulnerable painted honeyeater, the scarlet robin and the flame robin, are impacted by competition from aggressive and abundant native species such as the noisy miners (*Manorina melanocephala*). Feral honeybees also compete with other species, including phascogales and gliders and the vulnerable Superb Parrot (*Polytelis swainsonii),* for tree hollows, pollen and nectar, and therefore are likely to disrupt natural pollination processes of the ecological community (Department of the Environment and Energy, 2017a; NSW Scientific Committee, 2002).

The cane toad (*Rhinella marina,* formerly *Bufo marinus*) is common throughout the Queensland extent of the ecological community and has been recorded in patches in the northern NSW extent, such as Bungawalbin and the Clarence River Estuary (Department of Environment and Climate Change, 2008). Cane toads are likely to have an impact on faunal components of the ecological community such as frogs, including the vulnerable green and golden bell frog (*Litoria aurea),* some snakes and other large reptiles, birds and quolls. For Aboriginal people using traditional food sources, the impact of cane toads on some of the native predator species used as bush tucker (such as goannas) is also of concern (Wesson, 2009). In terms of pathogens, birds in the ecological community, in particular the critically endangered swift parrot, can be affected by beak and feather disease, and frogs, including the vulnerable green and golden bell frog are threatened by chytrid fungus.

Impacts resulting from agricultural activities, including grazing

Many of the alluvial areas along the east coast of Australia have been grazed and forested since the early to mid-19th century. The need for land for agriculture has driven both the clearing of the ecological community and draining the wetlands it is a part of. Large areas that formerly supported this ecological community are now occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, etc.) and, on the far north coast, cane fields. Remaining stands of the ecological community within this landscape can suffer from weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock.

Overgrazing can degrade the ecological community through vegetation loss (grazing and trampling), soil compaction (hard hoofed stock), disturbing sediments and increasing nutrient levels. In addition, water has been diverted for irrigation of crops and to fill farm dams (Department of Environment and Climate Change, 2008; Keith and Scott, 2005; Pressey and Griffith, 1992).

Changes to hydrology, including from flood mitigation and drainage works

A considerable number of floodplain areas that encompass the ecological community have been, or are at risk of being, drained of their water to enhance urban, peri-urban and agricultural development (Department of Environment and Climate Change, 2008; Kingston and Storey, 2004; Office of Environment and Heritage, 2016a; Tozer et al., 2010).

For example, from the earliest days of European settlement, individual settlers attempted to use the backswamps on the floodplains of the north coast of NSW, but with limited success – the swamps remained largely undrained, and were generally only used for opportunistic rough grazing in dry seasons. After 1862, a greater coordination of effort and intervention by the state commenced. By the early 1900s, drainage unions or trusts were formed on the major coastal floodplains to enable adjacent landholders to arrange for co-ordinated drainage systems, which were designed and constructed by the NSW Department of Public Works. Major works were constructed in most catchments on the north coast, particularly during the period from 1906 to 1914. Following a long dry period that ended in the late 1940s, flooding returned to floodplains that had been extensively alienated, subdivided and settled, causing considerable damage and loss of life. This triggered an era of major 'flood mitigation' works, much of which consisted of swamp drainage. In the 1960s and 1970s a more widespread use of headworks and floodgates to drain to local low tide level removed the last vestiges of swamp in most areas (Tulau, 2011).

Large areas of habitat formerly occupied by the ecological community have been directly drained by construction of artificial channels (e.g. Pressey, 1989; Boulton and Brock, 1999). Areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith, 1992).

Other water regulation activities and works in coastal areas, including water held in storage for consumptive use, stormwater drains and outfalls, and the construction of roads and buildings, result in sedimentation, eutrophication and hydrological changes that can impact the form and function of the ecological community. The construction of extensive roads and motorways along the east coast, particularly raised motorways and railways, has also substantially affected drainage, hydrological connectivity and tidal inflows.

Consequences of these changes include habitat loss, reduced water quality, sedimentation and changed hydrologic regime, and therefore the continued loss and/or degradation of patches of the ecological community. This detrimentally impacts upon the faunal components of Coastal Swamp Oak Forest, particularly those with specialised habitat and dietary requirements, including waterbirds, fish, invertebrates and other wetland fauna (Department of Environment, Climate Change and Water, 2010; Kingston et al., 2004).

Hydrological changes created through levee and weir construction, artificial drainage and irrigation, can also trigger acid sulphate soils, which have the potential for severe impacts on the vegetation and fauna of the ecological community, as well as water quality (Department of Environment, Climate Change and Water, 2010). For example, significant discharge of acid sulfate soil products into the Manning River estuary in northern NSW has had adverse impacts on water quality, aquatic ecology, oyster production and commercial and recreational fishing (Greater Taree City Council, 2010).

Inappropriate fire regimes

Fire regimes have been changed throughout the extent of the ecological community in association with the growth of agriculture and urban development. In rural areas, fire is used to promote green pick for livestock and in urban areas, and hazard reduction management can increase fire frequency. The amount of fallen timber and other plant litter can be diminished during such burns. Arson can also be an issue, particularly on urban fringes. Alternately, fire management, altered land practices and vegetation changes can also decrease fire frequency. Fire history records indicate that throughout much of its extent, Coastal Swamp Oak Forest is predominantly affected by low-frequency fire (Baker, 2017).

The impact of this upon the ecological community is poorly known. The ecological community occurs exclusively on fire-prone coastal floodplains with limited topographical protection from fire, and typically exists within a matrix of predominantly fire-prone vegetation and is therefore highly likely to be adapted to recurrent landscape fires (Baker, 2017). Swamp oak trees are reported to re-sprout from trunk and higher branches after high intensity fire and can root sucker (Benson and McDougall, 1995). Swamp oak as a species is likely to decline with low frequency fire or fire-exclusion. This is primarily due to the species requiring fire to create an open canopy, bare soil and high light levels in order to grow germinate, establish and grow to maturity. The absence of fire can suppress germination and seedling growth by allowing accumulation of a deep litter layer and the development of a dense shady understorey dominated by rainforest species (Baker, 2017). A number of other characteristic species, including *Melaleuca quinquenervia, M. decora, M. ericifolia, M. linariifolia, Eucalyptus botryoides, Alphitonia excelsa, Glycine clandestina* and *Goodenia ovata,* are also likely to decline with low-frequency fire (Baker, 2017).

In Queensland, the more saline elements of the ecological community are considered to require disturbance to maintain structure (Queensland Herbarium, 2016), but changes in the fire regime may result in species decline and changes to vegetation structure, as well as promoting the spread of other species, particularly invasive weeds such as lantana.

High intensity or frequent fires may slow or prevent regeneration and lead to lower species richness. High intensity fires may kill trees and fauna and lead to whipstick regeneration (Queensland Herbarium, 2016). Endangered plants within the ecological community that are most likely to be affected by fire include the endangered southern swamp orchid (*Phaius australis*) (Office of Environment and Heritage, 2017d). The resulting habitat changes are also likely to detrimentally impact on resident fauna such as bandicoots, gliders and potoroos (Tozer et al., 2010; Office of Environment and Heritage, 2017d).

Impacts resulting from recreational activity

The threat of recreational activity includes impacts from a range of activities where people access areas of the ecological community. Visitor disturbance results in soil compaction and disturbance, erosion from foot, cycle, trail bike and four wheel drive tracks, fishing and boat ramp access points, the introduction of pests and the creation of new planned and unplanned tracks. Increased visitation to adjacent beaches and watercourses results in increased demand for and use of visitor facilities, such as walking tracks, viewing platforms, toilet blocks and picnic areas. Other impacts in such areas include the dumping of cars, rubbish and garden waste, which can cause weed infestation. Local governments along the extent of the ecological community have been dealing the impacts of recreational activities by undertaking on-ground works, community education and planning.

Climate change, sea-level rise and 'coastal squeeze'

Major impacts of climate change are likely to be played out through interactions with other threatening processes, including habitat loss and degradation, invasion of exotic species and changes to hydrological and fire regimes (Auld and Keith, 2009; Department of Environment, Climate Change and Water 2010; Dunlop and Brown, 2008). Rising sea-levels, changes to salinity and invasive animal and plant species are likely to cause widespread changes in biodiversity along coastal fringes (Department of Environment, Climate Change and Water, 2010). For example, one study looked at the impacts of climate change sea-level rise on *Ocybadistes knightorum* (black grass dart butterfly), whose food plant and habitat is largely confined to Swamp Oak Coastal Forest and paperbark habitats, and estimated that 85 per cent of the butterfly's current habitat will become unsuitably saline by 2100 (Andren and Cameron, 2014).

The ecological community will be potentially affected by sea-level rise and associated coastal erosion, saline intrusion, temperature rises, CO2 fertilisation, altered fire regimes, new invasive species, and changes in storm behaviour (Department of Environment, Climate Change and Water 2008). A particular threat to Coastal Swamp Oak Forest resulting from climate change is the threat of sea-level rise. Projections (Table 7) indicate that sea-levels are likely to rise between 90 and 270mm above 1990 levels by 2050, and up to 810mm above 1990 levels by the end of the century (CSIRO 2012).

Table 7: Projected sea-level rise since 1990

Year	Minimum projected sea-level rise (mm)	Maximum projected sea-level rise (mm)
2020	40	100
2030	60	150
2040	80	200
2050	90	270
2070	130	450
2100	180	810

Source: CSIRO (2012)

Sea-level rise will lead to inundation of parts of the coastal zone, accelerated erosion and saline intrusion into coastal waterways and wetlands. Low-elevation coastal deltas, floodplains and estuaries will be affected. If the land is uninhabited, there is an opportunity for landward migration of many coastal communities, such as mangroves and saltmarshes, as sea-levels rise. However, if there are built structures, such as roads or settlements, that prevent this migration landward (as in much of south-eastern Australia), these communities are likely to be reduced by a process called 'coastal squeeze'. Even where there may be limited opportunity for migration inland, this is likely to be at the expense of other higher terrain ecosystems (Department of Climate Change 2009).

This 'coastal squeeze' is a particular threat to Coastal Swamp Oak Forest, as it may be replaced by more littoral communities migrating landward, such as saltmarsh or mangroves, while the landward areas have been converted to pasture or replaced by development. There is some evidence already for land migration of mangroves at the expense of other communities squeezed between higher land or built structures and the invading mangroves (Department of Climate Change 2009). In the Wide Bay-Burnett region there has been an observed replacement of Coastal Swamp Oak Forest by more littoral communities migrating landward (Currie, 2017).

Latitudinal shift in the distribution of this ecological community is also a plausible response to climate change, but the area to shift into may not be available or suitable, because of coastal development, soil types or competition with other vegetation communities (Paice and Chambers, 2016). Groundwater salinity is considered a potential influence of regrowth dynamics for the ecological community. This can be affected by both altered hydrology and potentially sea water incursion as result of rising sea-levels (Keith and Scott, 2005).

Key threatening processes

Key threatening processes (KTPs) have been defined at the national level under national environmental law and for NSW under state legislation. Those most relevant to Coastal Swamp Oak Forests are listed in Table 8 below.

Table 8: Potentially relevant key threatening processes.

EPBC Act-listed key threatening processes	NSW-listed key threatening processes
Land clearance	Clearing of native vegetation
	Removal of dead wood and dead trees
	Loss of hollow bearing trees
	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	Anthropogenic climate change
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
Novel biota and their impact on biodiversity	Invasion, establishment and spread of *Lantana camara*
	Invasion of native plant communities by exotic perennial grasses
	Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)
	Invasion and establishment of exotic vines and scramblers
	Competition from feral honeybees *Apis mellifera* L.
	Herbivory and environmental degradation caused by feral deer
	Predation and hybridisation by Feral Dogs, *Canis lupus familiaris*
Predation, habitat degradation, competition and disease transmission by feral pigs	Predation, habitat degradation, competition and disease transmission by feral pigs
Predation by feral cats	Predation by the feral cat (*Felis catus*)
Predation by European red fox	Predation by the European red fox (*Vulpes vulpes*)
Competition and land degradation by rabbits	Competition and grazing by the feral European rabbit *(Oryctolagus cuniculus)*
Competition and land degradation by unmanaged goats	Competition and habitat degradation by Feral Goats *Capra hircus*
The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).	Invasion and establishment of the Cane Toad (*Bufo marinus*)
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala*
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	Infection by Psittacine Circoviral (beak and feather) disease affecting endangered psittacine species and populations
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

APPENDIX E – ELIGIBILITY FOR LISTING AGAINST THE EPBC ACT CRITERIA

Criterion 1 – decline in geographic distribution

	Critically endangered	Endangered	Vulnerable
Its decline in geographic distribution is **either**:	very severe	**severe**	substantial
a) Decline relative to the longer-term (beyond 50 years ago e.g. since 1750); **or**,	≥90%	**≥70%**	≥50%
b) Decline relative to the shorter-term (past 50 years).	≥80%	≥50%	≥30%

Eligible under Criterion 1 for listing as endangered.

Evidence:

Coastal Swamp Oak Forest is found along the heavily populated eastern Australian coastline. It occurs mostly on productive, alluvial soils that have been historically attractive for primary industries, such as logging, grazing and agriculture. It has been cleared throughout its range for agriculture; housing, industrial and other coastal developments; transport and infrastructure corridors; recreational access and amenity; and in some areas, sandmining.

For example, between 75 to 90 per cent of Coastal Swamp Oak Forest has been cleared from the far north coast of New South Wales (Department of Environment, Climate Change and Water 2010a). In this area Coastal Swamp Oak Forest was widespread before European settlement and is now largely found only in reserves (Kingston and Storey, 2004). In Queensland the ecological community has been extensively cleared for sugar cane and urban development, with most of this clearing occurring prior to 1997 (Queensland Herbarium, 2016).

The decline in extent since 1750 of various vegetation associations representing Coastal Swamp Oak Forest has been variously estimated for parts of its range, including Queensland (representing 18 per cent of the full extent of the ecological community), northern NSW (52 per cent of the ecological community) and southern NSW (24 per cent of the ecological community) (Table 9). For a small area in mid-NSW there are no estimates of pre-1750 extent, but it is likely the rate of loss for this region is similar to the rest of the coast.

Table 9: Estimated decline in Coastal Swamp Oak Forest since 1750

Region	Map unit	Estimated loss (%)
Queensland	RE 12.1.1	38%
	RE 12.3.20	81%
Northern NSW	FE143	63%
Southern NSW	FoW 105	80-95%
	FoW 106	80-95%
	FoW 107	15-30%

Source: Accad et al (2017); Ecological (2005); and, Tozer et al (2010)

Based on these estimated losses, and the relative proportion of Coastal Swamp Oak Forest found in each region, the ecological community overall has undergone an estimated decline across its range of between 64 per cent and 79 per cent in its geographic distribution since 1750. Therefore the balance of evidence indicates this loss is severe (≥70 per cent), making it eligible for listing as endangered under this criterion.

Criterion 2 – limited geographic distribution coupled with demonstrable threat

Its geographic distribution is:	**Very restricted**	**Restricted**	**Limited**
2.1. Extent of occurrence (EOO)	< 100 km^2 = <10,000 ha	<1,000 km^2 = <100,000 ha	<10,000 km^2 = <1,000,000 ha
2.2. Area of occupancy (AOO)	< 10 km^2 = <1,000 ha	<100 km^2 = <10,000 ha	**<1,000 km^2 = <100,000 ha**
2.3. Average patch size	**< 0.1 km^2 = <10 ha**	< 1 km^2 = <100 ha	-
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 (within 10 years, or 3 generations of any long-lived or key species, whichever is the longer, up to a maximum of 60 years)	Critically endangered	Endangered	Vulnerable
the Near future (within 20 years, or 5 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years)	**Endangered**	Endangered	Vulnerable
the Medium-term future (within 50 years, or 10 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years)	Vulnerable	Vulnerable	Vulnerable

Eligible under Criterion 2 for listing as endangered.

Evidence:

Coastal Swamp Oak Forest occurs in a relatively narrow strip along the east coast from Curtis Island in Queensland to near Bermagui in NSW, so its overall extent of occurrence is not limited. Its current distribution has been estimated based on vegetation units that correspond with the ecological community (details on corresponding map units are included in Appendix A - Additional information on map units and regions). Based on this analysis, it has an area of occupancy of around 32,000 ha, which is considered to be 'limited'. However, within this range it typically occurs as a part of a mosaic with other vegetation types, often expressed as relatively linear, narrow patches between estuaries or wetlands and areas of coastal development. It is highly fragmented, both naturally and as a result of past disturbance, with a median patch size of around 1.1 ha. Overall, 89 per cent of patches are less than 10 ha, which is considered to be 'very restricted' (Figure 1).

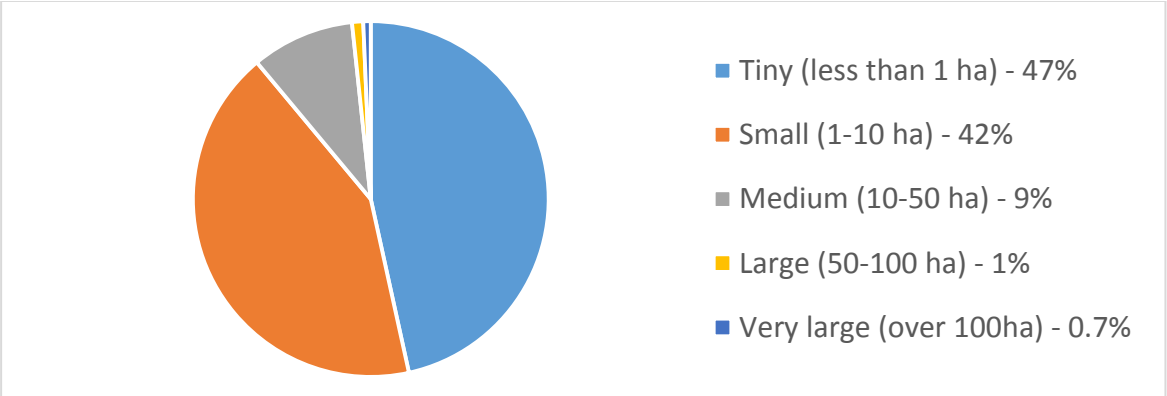

Figure 1: Patches of Coastal Swamp Oak Forest by size class

Source: Accad et al. (2017); Kingston & Hall (2011); Ecograph & Terrafocus Pty Ltd (2009); Ecological (2005); Nambucca Shire Council (2015); Telfer & Kendall (2006); Phillips, Chang & Kordas (2013); Tozer et al. (2010); Office of Environment & Heritage (2012c), (2013a), (2013b) and (2016a).

The nature of its distribution is also defined by its position in the landscape. Coastal Swamp Oak Forest is limited to low-lying areas below 50 m above sea-level (ASL), and typically found at elevations below 20 m ASL, with about 65 per cent of the total area of the ecological community currently occurring at elevations of less than 5 m ASL and about 12 per cent of the ecological community occurring at elevations of less than 1 m ASL (Table 10).

Table 10: Amount of Coastal Swamp Oak Forest by height above sea-level

Height above sea-level	Estimated area of Coastal Swamp Oak Forest (hectares)	Proportion of total ecological community
Less than 1 m ASL	3816	12%
Less than 2 m ASL	14,964	47%
Less than 5 m ASL	20,910	65%
Less than 10 m ASL	24,926	78%
Less than 20 m ASL	29,989	94%
Less than 50 m ASL	31,950	100%

Source: Accad et al. (2017); Kingston & Hall (2011); Ecograph & Terrafocus Pty Ltd (2009); Telfer & Kendall (2006); Ecological (2005); Nambucca Shire Council (2015); Phillips, Chang & Kordas (2013); Tozer et al. (2010); Office of Environment & Heritage (2012c), (2013a), (2013b) and (2016a).

Many of the threats (see Appendix D – Description of threats) acting on Coastal Swamp Oak Forest are exacerbated by its very restricted distribution and its landscape position, including sea-level rise, clearing for coastal development, and the continuing degradation of remaining patches.

With nearly two thirds of the ecological community occurring below 5 m ASL, and often in a position landward of mangroves or saltmarsh, Coastal Swamp Oak Forest is particularly susceptible to coastal erosion and 'coastal squeeze' resulting from sea-level rise. Current projections indicate that sea-levels could rise as much as another 50mm in the immediate future, 100mm in the near future and 350mm in the medium term future (Table 11).

Saltwater intrusions will influence the extent of tidal limits inland, with a subsequent shift in the salinity gradients of wetland systems and the unconsolidated sediments on which the ecological community occurs. Coupled with existing permanent development structures on the inland side of the ecological community, and the forecast increase in coastal development for the east coast of Australia, the capacity of Coastal Swamp Oak Forests to retreat from the impacts of sea-level rise is seriously compromised. This indicates that a high proportion of existing Coastal Swamp Oak Forest remnants could be lost as a result of sea-level rise, coastal erosion and 'coastal squeeze' in the near future.

Table 11: projected sea-level rise for the immediate, near and medium-term future

Year	Maximum projected sea-level rise since 1990 (see Table 7)	Maximum projected additional sea-level rise from 2020 estimate
Immediate future (10 years) 2030	150 mm	50 mm
Near future (20 years) 2040	200 mm	100 mm
Medium-term future (50 years) 2070	450 mm	350 mm

Source: CSIRO, 2012

Additionally, as Coastal Swamp Oak Forest occurs primarily in small patches in close proximity to areas of coastal development, it is particularly susceptible to the cumulative effect of many small-scale losses. For example, in NSW it is considered the ecological community most at risk from proposed development scenarios, particularly urban and rural residential development (Department of Environment, Climate Change and Water, 2010).

In the far north coast region of New South Wales (Ballina, Byron, Lismore, Richmond Valley and Tweed), Coastal Swamp Oak Forest is recognised as being over-cleared, and is considered to be the ecological community that will be most impacted by development in the near future (Department of Environment, Climate Change and Water, 2010).

As it occurs in a mosaic environment, connectivity with other patches of the ecological community is important to maintain Coastal Swamp Oak Forest throughout its range. Most patches of Coastal Swamp Oak Forest occur within close proximity to other patches of the ecological community, with more than half the patches located within 100m of another patch, and 90 per cent of patches occurring within 500m of another patch (Table 12). This increases their susceptibility to cumulative losses, as the loss of individual patches can isolate the remaining patches they were connected to.

Table 12: Proximity of patches of Coastal Swamp Oak Forest to each other

Distance to closest patch	Number of patches	% of patches
Within 50m	1525	27%
Within 100m	3093	55%
Within 500m	5040	90%
Within 1km	5400	96%
Within 2km	5543	99%
More than 2km	72	1%

Source: Accad et al. (2017); Kingston & Hall (2011); Ecograph & Terrafocus Pty Ltd (2009); Ecological (2005); Nambucca Shire Council (2015); Telfer & Kendall (2006); Phillips, Chang & Kordas (2013); Tozer et al. (2010); Office of Environment & Heritage (2012c), (2013a), (2013b) and (2016a).

This continued loss to clearance and the fragmentation and degradation of remaining patches could be reasonably expected to result in the overall loss of the ecological community within the near future.

Given these pressures, Coastal Swamp Oak Forest is likely to experience the ongoing loss of patches across the full extent of occurrence, such that the ecological community could be lost within the near future. Therefore, due to the nature of its distribution and the threats operating on it, the ecological community is eligible for listing as **endangered** under this criterion.

Criterion 3 – loss or decline of functionally important species

Category	Critically endangered	Endangered	Vulnerable
For a population of a native species likely to play a major role in the community, there is a:	very severe decline (at least 80% over the last 10 years or three generations, whichever is longer)	severe decline (at least 50% over the last 10 years or three generations, whichever is longer)	substantial decline (at least 20% over the last 10 years or three generations, whichever is longer)
to the extent that restoration of the community is not likely to be possible in:	the immediate future (10 years, or 3 generations of any long-lived or key species, whichever is the longer, up to a maximum of 60 years)	the near future (20 years, or 5 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years)	the medium-term future (50 years, or 10 generations of any long-lived or key species, whichever is the longer, up to a maximum of 100 years)

Insufficient information available for listing under Criterion 3.

Evidence:

The dominant canopy species, *Casuarina glauca*, is the species most likely to be functionally important across the range of the ecological community. It has undergone a decline in its extent in eastern Australia, synonymous with the decline in the ecological community, but remains common and dominant across the remaining extent of the ecological community. Swamp oak trees are lost a result of losing patches of the ecological community, it is not the loss of swamp oak as a species that is driving the decline of the ecological community.

Further, as a species swamp oak regenerates and matures quickly under the right conditions, including becoming invasive in some situations, particularly outside its natural range in South Australia and Western Australia. For example, it is a Category 3 declared plant in South Australia, where it is has been widely planted for windbreaks and stock shelter, roadside amenity, and dryland salinity control, and has subsequently become naturalised, particularly on river banks (PIRSA, 2017). Swamp Oak as a species is not therefore considered threatened or in functional decline at the time of this assessment.

A number of threatened species occur in the ecological community, but none are identified as of particular functional significance for the ecological community across its range. Other species are likely to be locally important to the functioning and health of the ecological community in different areas, but are not necessarily important across the full range of the ecological community, as different species may fulfil these ecological functions in different areas.

For example, bandicoot foraging performs an important role in maintaining the health of the ecological community. Acting as a dispersal agent, they dig in the leaf litter and soil to find insects, fungi, plant root nodules and bulbs. They also eat fruit, seeds and other plant material on the ground. North of the Hawkesbury River in NSW the role is carried out by the northern brown bandicoot (*Isoodon macrourus*). The long-nosed bandicoot (*Perameles nasuta*) is most commonly found in coastal Sydney, whereas the endangered southern brown bandicoot (*Isoodon obesulus obesulsus*) is limited to the south coast of New South Wales (Office of Environment and Heritage, 2017c).

Studies specific to functional species in Coastal Swamp Oak Forest are not available, but it is known that the relationships between its component species are important for maintaining ecosystem function. Vegetative components of the ecological community are important as they provide food and habitat for fauna components of the community. A large proportion of Coastal Swamp Oak Forest is regrowth (Office of Environment and Heritage, 2016a).

Regrowth trees lack hollows that are found in older trees and therefore reduce the ecological complexity and functionality of the ecological community. Faunal components of the ecological community, such as digging mammals, flying foxes, birds and insects are important for nutrient cycling, dispersal of fungi, seed burial and/or dispersal, water infiltration, and pollination. The loss or reduction of such fauna affects the condition and resilience of the ecological community. However, specific data related to the decline of particular functionally important species, across the range of the ecological community, is not available. Coastal Swamp Oak Forest is therefore not eligible for listing in any category under this criterion.

Criterion 4 – reduction in community integrity

Category	Critically endangered	Endangered	Vulnerable
The reduction in its integrity across most of its geographic distribution is:	very severe	**severe**	substantial
as indicated by degradation of the community or its habitat, or disruption of important community processes, that is:			

Eligible under Criterion 4 for listing as endangered.

Evidence:

Coastal Swamp Oak Forest has experienced a loss of between 64 and 79 per cent of its original extent and the integrity of the remaining patches are severely compromised by the threats acting across the landscape associated with past and current land use, particularly weed invasion and changes to hydrological processes.

For example, only 6 percent of what remains in the Sydney metropolitan area (riverflat areas of the Cumberland Plain and in the Hunter Valley, and around estuarine areas in the Sydney Basin) is not visibly disturbed. Regrowth comprises nearly 40 per cent of these patches. More than half of the ecological community in this region remain threatened by diverse and abundant cover of invasive weeds. Exotic weeds and weedy shrubs occur mainly in cleared, or previously cleared patches (Office of Environment and Heritage, 2016a).

Reduction in integrity through weed invasion

Invasive species are a serious threat to Coastal Swamp Oak Forest. The productive environment and history of past and ongoing disturbance are particularly conducive to the invasion and spread of weeds. For example, in Byron Shire, camphor laurel was found to be affecting 75 per cent of patches of the ecological community (Ecograph and Terrafocus, 2009). In the Sydney Metropolitan area 18 per cent of patches were found to be 'extensively disturbed' by weeds, with 58 per cent of patches 'broadly disturbed'. Only 5 per cent of patches were found to have less than 10 per cent weed disturbance (Office of Environment and Heritage, 2016a).

In the Cumberland Plain and Hunter Valley most patches of the ecological community are threatened by a diverse and abundant cover of invasive weeds, including small-leaved privet (*Ligustrum sinense*) and bridal creeper (*Asparagus asparagoides*) (Office of Environment and Heritage, 2016a). In the Sydney Basin and South East Corner, elements of the ecological community are threatened by the proliferation of exotic species such as the spiny rush (*Juncus acutus*), lantana (*Lantana camara*) and buffalo grass (*Stenotaphrum secundatum*), and in Georges River National Park patches of pampas grass (*Cortaderia selloana*) have established (Office of Environment and Heritage, 2016a).

In northern NSW, camphor laurel (*Cinnamomum camphora*) is known to have contributed to the disturbance and modification of Coastal Swamp Oak Forest (Ecograph and Terrafocus, 2009; Kingston et al., 2004) and the Clarence River Estuary in particular has been identified as being impacted by groundsel (*Baccharis halimifolia*) and prickly pear (*Opuntia stricta*) (Department of Environment and Climate Change, 2008).

In Queensland, lantana (*Lantana camara*) and corky passionflower (*Passiflora suberosa*) are recognised as occurring within the ecological community at up to 50 per cent of sites representative of the relevant regional ecosystems (see Appendix A - Additional information on map units and regions); broad-leaved pepper tree (*Schinus terebinthifolius)*, blue billy-goat weed (*Ageratum houstonianum)*, emilia (*Emilia sonchifolia)*, and morning glory (*Ipomoea cairica)* occur in 38 per cent of representative sites; groundsel (*Baccharis halimifolia*), sour grass (*Paspalum conjugatum)*, spear thistle (*Cirsium vulgare)*, thickhead (*Crassocephalum crepidioides)* and ochna (*Ochna serrulata)* occur in 25 per cent of representative sites; with numerous other weed species commonly found at 20 per cent or less of representative sites (Queensland Herbarium, 2014).

Reduction in integrity through altered hydrology

Past and ongoing changes to hydrology continue to impact on the coastal catchments that provide habitat for Coastal Swamp Oak Forest. For example, altered drainage, water pollutants, including increased nutrients and increased sedimentation has been identified as a threat to the ecological community in both riparian and estuarine occurrences of the ecological community in the Sydney Basin and the South-East Corner bioregions (Office of Environment and Heritage, 2016a).

In the southern extent, Coastal Swamp Oak Forest has been significantly impacted upon by the draining of wetlands, such as around Wollogorang Lagoon and the Nowra Floodplain (Tozer, et al., 2010). Significant areas of wetland were drained in the past for agricultural and pastoral development around the Hawkesbury River (Windsor) and the Shoalhaven (Nowra) while more localised infilling and reclamation of wetlands continues for urban, industrial or recreational development in the Sydney – Illawarra metropolitan area and around expanding settlements on the south coast (Tozer, et al., 2010). In the Sydney Metropolitan area the rate of stormwater runoff from sealed surfaces into areas of the ecological community has also increased, for example around the Lane Cove and Georges Rivers (Tozer, et al., 2010).

In the Clarence lowlands (from Ballina to Coutts Crossing in northern NSW), a survey of wetland condition found six out of the seven ‘wetland clusters’ (representing groups of interrelated wetlands and adjacent riparian habitat) identified as containing Coastal Swamp Oak Forest to be impacted by extensive drainage and construction works such as levees and barrages, including the floodplain and the intertidal area of the Clarence Estuary (Department of Environment and Climate Change, 2008). These changes have encouraged the encroachment of broad-leaved paperbark in some areas, and many of these ‘wetland clusters’ are also affected by acid sulphate soils and low pH conditions as a result of the modification (Keith and Scott, 2005).

Reduction in integrity through other processes

Agriculture, including horticulture and grazing, continues to dominate the mid-north coast of New South Wales, with the future location of farmland to support existing and small-lot primary production being identified, particularly around Coffs Harbour (Nambucca Council, 2015; Office of Environment and Heritage, 2016a; Department of Planning and Environment, 2017). In the Clarence Valley, the impact of agricultural activities on the ecological community has been assessed as high to very high, particularly on the Clarence River Estuary, a significant freshwater and intertidal habitat (Department of Environment and Climate Change, 2008).

These impacts are expected to increase pressures on floodplain and coastal vegetation communities as agricultural and economic opportunities with the rapidly expanding population of South East Queensland are sought by northern NSW councils over the next 20 years (Department of Planning and Environment, 2017).

The integrity of the ecological community is also affected by sea-level rise. This impact is more widespread than simply the patches lost to inundation, and includes impacts from the resulting accelerated erosion and saline intrusion, the subsequent shift in the salinity gradients of the groundwater and unconsolidated sediments on which Coastal Swamp Oak Forest occurs, and changes to species composition resulting from the altered soil and water. The degree to which these changes impact the ecological community vary along the coast depending on local circumstances, but given that 65 per cent of the total area of the ecological community currently occurs at elevations of less than 5 m ASL and 12 per cent of the ecological community occurs at elevations of less than 1 m ASL (Table 10), these threats are relevant to a large proportion of the remaining extent of Coastal Swamp Oak Forest.

The risk of increased fire frequency and severity has been identified as a threat for Coastal Swamp Oak Forest ecological community throughout its range, for example in the Clarence River Valley (Department of Environment, Climate Change and Water, 2010). Alternately, Coastal Swamp Oak Forest is also noted as being affected by reduced fire frequencies, with 83-94 per cent of it being underburnt compared to fire interval guidelines (Baker, 2017).

Off-road vehicles, illegal waste dumping and sand extraction also continue to threaten this ecological community (NSW Scientific Committee 2001). Across the extent of the ecological community, threats resulting from recreation activities and tourism are growing, particularly in natural areas where there is a synergistic interaction between residential development, tourism pressure and associated recreational activity. Bush-walking and four wheel drive vehicles are of increasing concern particularly with increasing urban and suburban development, as a retiring and youth population seek to move from metropolitan areas (Rand, 2012; Smith and Doherty 2006). For example, by 2036 at least 12.2 million "tourist visits" are expected to the north coast region (Department of Planning and Environment, 2017).

Conclusion

Much of the damage is irreversible and many of the underlying threats continue. This reduction in integrity, as indicated by the degradation of the community, is severe across most of its geographic distribution. While active intervention and restoration works may improve the condition of some patches of Coastal Swamp Oak Forest, the complete restoration of the ecological community across its full range is unlikely, especially as many of the areas it formerly inhabited are now unsuitable due to permanent habitat transformation through altered hydrology or construction of buildings and other infrastructure. Therefore the ecological community is eligible for listing as **endangered** under this criterion.

Criterion 5 – rate of continuing detrimental change

Category	**Critically endangered**	**Endangered**	**Vulnerable**
Its rate of continuing detrimental change is:	very severe	severe	substantial
as indicated by a) rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: OR or b) intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	very severe (80%)	severe (50%)	serious (30%)

Insufficient information available for listing under Criterion 5.

Evidence:

Historically the primary change affecting the ecological community has been clearing for agriculture and grazing. In recent decades the primary cause of clearing has been urbanisation and coastal development. These pressures are ongoing, particularly with the increasing development along the northern NSW and southern Queensland coasts.

Population growth has been fastest along the coast, with an increase of approximately 300,000 people to the area within 30km of the coast in NSW and Qld each year since 1991 (Clark and Johnston 2016a). Coastal development follows this increase in population. For example, between 2011 and 2016, over 145,000 new urban lots were created within 30km of the coast in NSW and Qld as rural and other land was replaced with urban development (Clark and Johnston, 2016b).

As a consequence of this growth in population, housing, jobs, agribusiness and related infrastructure such as roads and airports are expected to increase substantially over the next twenty years, particularly on the NSW north coast where the population is expected to increase by 76,000 (Department of Planning and Environment, 2017). This will require an estimated 46,000 new residential dwellings and constitute a 16 per cent increase along the North Coast (to the Queensland border), particularly in the Tweed, Coffs Harbour and Port Macquarie-Hastings LGAs. Associated with this population growth, the Pacific Highway upgrade, between Newcastle and Queensland, is expected to cater for an 83 per cent increase in freight transport and is likely to substantially affect drainage, hydrological connectivity and tidal inflows (Office of Environment and Heritage, 2016a).

The NSW south coast is also expecting a substantial population increase of over the next 25 years. For example, the Illawarra-Shoalhaven region is anticipating needing an additional 35,400 new homes by 2036 to meet the demands of population growth and demographic change (Department of Planning and Environment, 2015), and an additional 60,000 people (representing a population increase of nearly 40 per cent) are expected to move to the coastal centres of Batemans Bay, Bega, Ulladulla, Moruya, Narooma, Merimbula and Vincentia (Department of Environment, Climate Change and Water, 2010b). This is likely to cause considerable impact as much of the ecological community in these areas has already been cleared (Tozer, et al., 2010).

Likewise, Queensland is also expecting its population to increase significantly within the next 20 years. South East Queensland is one of the fastest growing areas in Australia and is predicted to have an additional one million people settled there by 2026, bringing the total population to 3.7 million (Department of Natural Resources and Mines, 2006). The mean annual population change is expected to be at least 20 per cent for each local government area from the Fraser Coast to Gladstone and 17 per cent for the Sunshine and Gold Coast council areas (Office of Economic and Statistical Research, 2011).

The ecological community is also affected by sea-level rise, which represents an ongoing threat of both loss and degradation of remaining patches. With 65 per cent of the total area of the ecological community currently occurring at elevations of less than 5 m ASL and 12 per cent of the ecological community occurring at elevations of less than 1 m ASL (Table 10), and sea-level projections indicating average sea-level rises of between 20mm and 50mm every ten years, both in the recent past and into the future (Table 7), a large proportion of the remaining extent of the ecological community is susceptible to this threat. The area of Coastal Swamp Oak Forest that is impacted by this will continue to increase as sea-levels continue to rise.

As well as direct clearing and sea-level rise, there are a range of ongoing activities associated with coastal development that are having detrimental impacts. Hydrological change, incursions of weeds and feral animals and recreational pressures are all impacting this ecological community.

Although there has been, and continues to be, detrimental change to the ecological community as a result of this coastal development, data are insufficient to determine rates of loss in the recent past, or planned for the immediate future, across the range of the ecological community, so Coastal Swamp Oak Forest is not eligible for listing in any category under this criterion.

Criterion 6 – quantitative analysis showing probability of extinction

Category	**Critically endangered**	**Endangered**	**Vulnerable**
A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution, is:	at least 50% in the immediate future (10 years or 3 generations up to a maximum of 60 years)	at least 20% in the near future (20 years or 5 generations up to a maximum of 100 years)	at least 10% in the medium-term future (50 years or 10 generations up to a maximum of 100 years)

No quantitative analysis has been undertaken showing likelihood of extinction for this ecological community. Therefore there is **insufficient information** available to determine eligibility against any category for this criterion.

APPENDIX F – TRADITIONAL OWNERSHIP AND INDIGENOUS CULTURAL VALUES AND USE

Traditional Owners of Coastal Swamp Oak Forest

Indigenous peoples have occupied the coastal flats, creeks, rivers, estuaries, sand dunes and sea country of the east coast of Australia for tens of thousands of years. The coastal landscape provides a direct link with traditional spiritual and material culture. The Coastal Swamp Oak Forest ecological community is of substantial cultural significance to a number of Indigenous Nation groups, including the Gureng, Bajtala, Gubbi Gubbi, Yuggera, Bundjalung, Gumbaynggirr, Dainggatti, Biripi, Worimi, Awabakal, Kurin-gai, Dharug, Tharawa/D'harawal and the Yuin[8]

Image 1: An elk-horn sits in the fork of a swamp oak, trapping plant litter, Bongil Bongil National Park, October 2016.

Some areas where the ecological community occurs continue to be used in a traditional way. Some places are being co-managed between the Traditional Owners and non-Indigenous landowners, such as National Parks. One of the Indigenous Protected Areas (IPAs) that contains Coastal Swamp Oak Forest is the Gumma (Gum-ma) IPA. This IPA is comprised of 111 hectares, just south of Nambucca Heads on the New South Wales north coast, and is managed by the Nambucca Heads Local Aboriginal Land Council on behalf of its traditional owners, in cooperation with the Commonwealth (Department of the Prime Minister and Cabinet, 2012b). The *Baga Baga* and *Ngambaa* clans of the *Gumbaynggirr* have been the traditional owners of the Gumma area for at least 6,000 years. The Gumma IPA complements the estuarine system for the jointly owned *Gaagal Wanggaan* (South Beach) National Park. The forest part of the IPA shelters animals commonly found in the ecological community, for example the yellow-bellied glider, microbats and the long-nosed potoroo (For more information on Gumma IPA see: https://www.environment.gov.au/indigenous/ipa/declared/gumma.html).

Another place of significance to the Gumbaynggirr community is Bongil Bongil National Park – a 'place where one stays a long time' because of the abundance of food. This area has excellent examples of Coastal Swamp Oak Forest and its considerable cultural values. (Arrawarra Sharing Culture Project, 2017; English, 2002; North Coast Local Land Services, 2016; National Parks and Wildlife Service, 1999a).

On the south coast of New South Wales, north of Bateman's Bay, the Murramurang Aboriginal Area also has areas of Coastal Swamp Oak Forest that can be linked to its Traditional Owners, the Dhurga clan of the NSW south coast's Tharawa/D'harawal (National Parks and Wildlife Service, 1998).

Indigenous cultural values associated with the ecological community

Traditional uses of the plants and animals found in the ecological community range from food and water, to materials to build camps and useful implements, to medicine plants and spiritual values connected to the Dreamtime (Australian Museum Consulting, 2015). A large number of plants and animals that inhabit the ecological community are part of the rich Aboriginal culture and heritage found in Coastal Swamp Oak Forest.

[8] AIATSIS Map of Indigenous Australia: aiatsis.gov.au/explore/articles/aiatsis-map-indigenous-australia

Camps were established along the river, creeks and waterholes, in the dense scrub. Nets and other strong twines used for hunting were made from reeds and vines associated with the ecological community. The 'swampy' landscape helped to trap large game like kangaroo. Women would gather eggs from the nests of waterbirds as well as other animals and plants (Australian Museum Consulting, 2015; Benson and Howell, 1990; Maynard, 2014; Smith, 2011). Aboriginal communities through the extent of the ecological community aspire to continue to care for their cultural landscape and to ensure that there are plenty of plants and animals to provide food, medicine and fibre to the whole community (Benson and Howell, 1990; North Coast Local Land Services, 2016).

Examples of traditional Indigenous use.

Canopy and other trees

The main tree found in the ecological community is swamp oak or swamp sheoak (*Casuarina glauca*). Along with "ti-tree" (or tea trees; paperbarks (*Melaleuca* spp)), swamp oak was traditionally used to make tools like boomerangs, boondis, nulla nullas, spears shields and coolamons. Swamp oak was also used also used to build shelters and sometimes canoes.

Image 2: Shedded bark of broad-leaved paperbark, Bongil Bongil National Park, October 2016.

Paperbarks (*Melaleuca* spp) can often form part of the ecological community, depending on how close it is to saltwater areas. The broad-leaved paperbark (*Melaleuca quinquinerva*), commonly found on the mid and north coast of NSW and into Queensland, had both practical and medical applications. The soft bark from this tree could be used to line huts or coolamons, and other parts of the tree were to make a medicine for respiratory illness (Arrawarra Culture Project, 2017).

The fruit of lilly pillies (*Acmena smithii*) and other trees and shrubs provided a good source of vitamins. Another tree with cultural importance was the red ash (or soap tree) (*Alphitonia excels)*, which was used to make an antiseptic, particularly to help with green ant bites. The trees and blossoms also provided habitat for native bees, which provided wild bush honey useful for treating sore throats, colds and constipation (Australian Museum Consulting, 2015).

Image 3: Red ash or soap tree in Coastal Swamp Oak Forest in Bongil Bongil National Park, October 2016.

Image 4: A mature swamp oak with common silkpod climbing into canopy in Bongil Bongil National Park, October 2016.

Climbers

Coastal Swamp Oak Forest is known for the vines, like common silkpod (*Parsonsia straminea*), that climb up the tree trunk and into the canopy. These were often used to make ropes and string for netting. Other climbers and scramblers, like native sarsaparilla (*Smilax australis*) were used to relieve pain, arthritis and coughs and to make a tonic that purifies the blood and manage diabetes. The shoots of another vine (*Geitonoplesium cymosum*) were eaten (Australian Museum Consulting, 2015).

Ground layer plants

Other plants found in the ecological community that traditionally provided food and medicine include swamp water fern (*Blechnum indicum)*, saw (sword) sedge (*Gahnia clarkei*), spiny headed mat rush (*Lomandra longifolia*), native wandering jew (*Commelina* spp), and tuckeroo (*Cupaniopsis anacardioides)* (Arrawarra Culture Sharing Project, 2017).

Image 6: Swamp lily indicates where to find freshwater.

Image 6: The spiny-headed mat-rush could be used for a variety of purposes including for food and indicates where small marsupials and reptiles can be found. It can also be used to make eel traps, bags, baskets, mats, string, jewellery, medicine.

Animals

Image 7: the burrow of a bandicoot is concealed beneath a thick patch of *Commelina* in Bongil Bongil National Park

Some culturally important animals that live in Coastal Swamp Oak Forest include pademelon, echidna, bandicoots, snakes, possums, flying fox and goanna. The ecological community is also important for some wetland species like ducks and other waterbirds like brolga and jabiru, freshwater turtles, crabs, fish (such as mullet and eels) and a bivalve mollusc called "cobra" which eats into submerged timber (Arrawarra Sharing Culture Project, 2014; English, 2002; Maynard, 2014; Mathews, 2010; North Coast Local Land Services, 2016; Smith, 2011; Wesson, 2009).

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