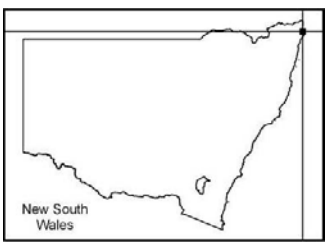
NSW NATIONAL PARKS & WILDLIFE SERVICE

Tyagarah Nature Reserve

Plan of Management



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This plan of management was adopted by the Minister for Energy and Environment on 8 May 2020.

Acknowledgments:

The NSW National Parks and Wildlife Service (NPWS) acknowledges that Tyagarah Nature Reserve is in the traditional Country of the Bundjalung of Byron Bay (Arakwal) people.

This plan of management was prepared by staff of NPWS. Valuable information and comments were provided by the Arakwal people.

For additional information or any inquiries about this reserve or this plan of management, contact the NPWS, Tweed Byron Area Office, PO Box 127, Byron Bay 2481 or by telephone on (02) 6620 9300.

Cover photo: Swamp banksia (Banksia robur) in flower, Tyagarah Nature Reserve. Dianne Mackey/DPIE. All photographs including front cover: Dianne Mackey/DPIE.

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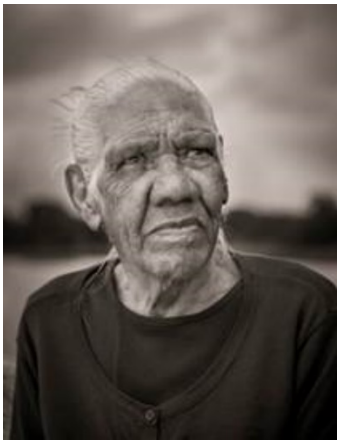
Jingi wallu .... (Welcome)

This plan talks about a special part of the Country of the Bundjalung of Byron Bay (Arakwal) people known as Tyagarah Nature Reserve, which is located on the Far North Coast between the townships of Byron Bay and Brunswick Heads.

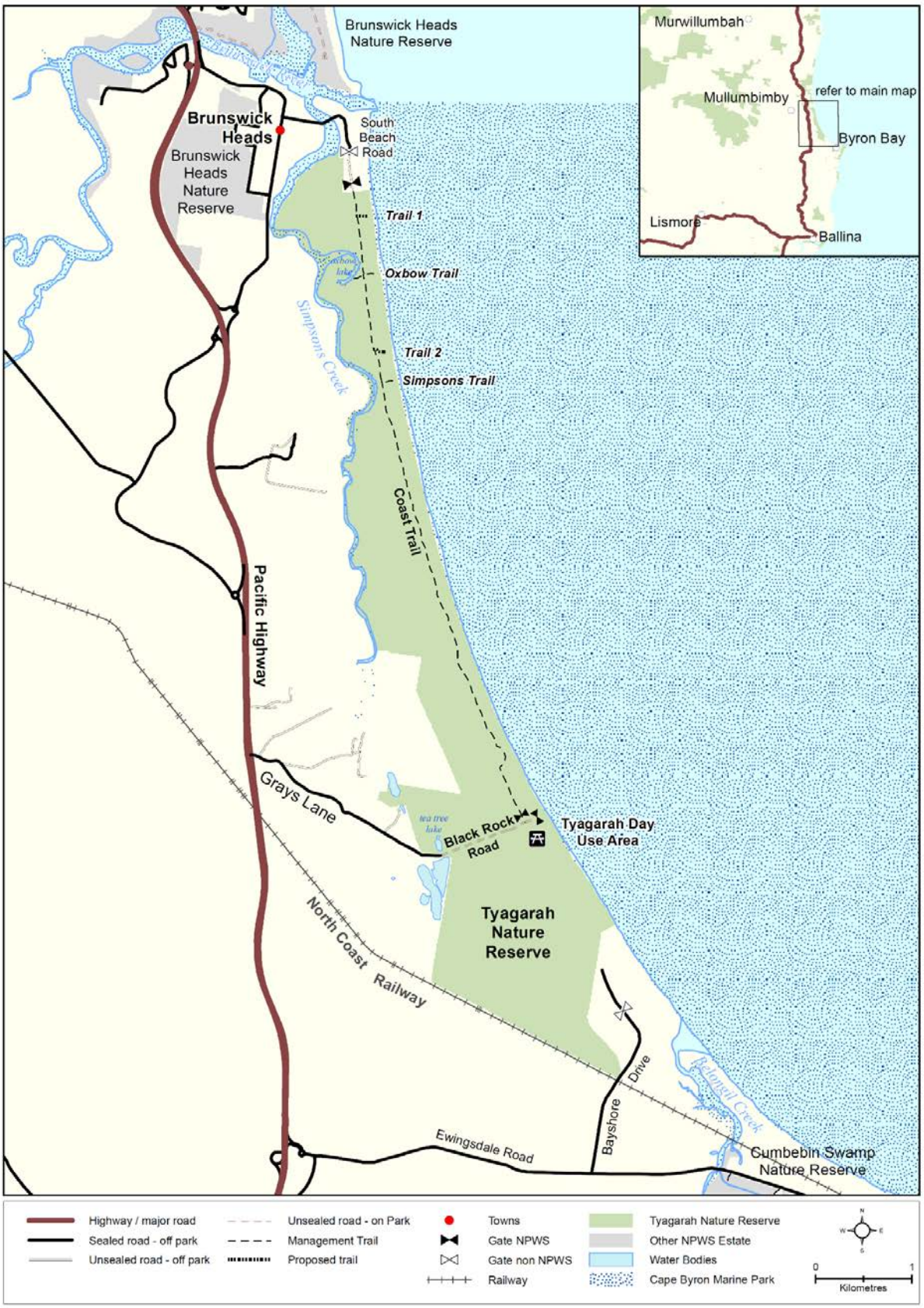
The reserve is an important part of Country to the Arakwal and to other Bundjalung because it is a place of spiritual and cultural significance.

As an outcome of the second Indigenous land use agreement (ILUA 2) between the Arakwal and the NSW Government, a Management Committee has been established. The committee covers the NPWS Byron Coast Area (now part of the Tweed Byron Area), including Tyagarah Nature Reserve, and enables joint management of the reserve by NPWS and the Arakwal. Joint management provides a continuing role for the Arakwal in looking after Country.



D. Nicholls

Dulcie Nicholls
Bundjalung of Byron Bay (Arakwal) Elder



Map 1 Tyagarah Nature Reserve

1. Tyagarah Nature Reserve

1.1 Location, reservation and regional context

Features	Description
Location	Tyagarah Nature Reserve (referred to as the reserve in this plan) is located on the coastal sandplain between the townships of Byron Bay and Brunswick Heads on the NSW Far North Coast (see Map 1).
Area	The reserve is 875 hectares. It encompasses eight kilometres of coastline (the eastern boundary of the reserve being the mean high water mark); a seven-kilometre stretch of Simpsons Creek (part of the reserve's western boundary being the mean high water mark on the western bank of the creek); and two small areas of land on the western bank of Simpsons Creek. The main visitor hub is at the Tyagarah Day Use Area located adjacent to the beach at the end of Black Rock Road. See Map 1. Private land is located west of Simpsons Creek and south-west and south-east of the reserve. Crown land borders the north-east of the reserve and a mix of private land and Byron Shire Council land borders the reserve's southern boundary. The Cape Byron Marine Park borders the reserve to the east (i.e. below the mean high water mark) and includes Simpsons Creek to the west. The marine park is managed by the Department of Primary Industries (DPI) Fisheries.
Reservation date	The reserve was originally gazetted over approximately 750 hectares in 1986. Two additions were made in 1999 and 2002 bringing the total area of the reserve to 875 hectares.
Previous tenure	Crown land was originally gazetted as reserve in 1986 with more Crown land added in 1999 and freehold land added in 2002. The majority of the reserve is zoned 'National Park and Nature Reserve' in the *Byron Local Environmental Plan 2014* (LEP). The reserve was originally gazetted to protect its significant vegetation communities and fauna and as a scientific resource to permit study of its physical and biotic processes. The reserve is named after the locality of Tyagarah. The Geographic Names Board notes various meanings for the name 'Tyagarah' including open grass country, camping area and tussock grass. The Board states that the word is of Aboriginal origin.
Regional context	
Biogeographic region	The reserve is located in the South Eastern Queensland biogeographic region. For the purposes of the *Biodiversity Conservation Act 2016* however, the reserve is considered to be within the North Coast Bioregion as identified by Thackway and Cresswell (1995). The reserve's plant communities complement a suite of wallum plant communities on the NSW Far North Coast protected within Broadwater, Bundjalung and Yuraygir national parks. The term wallum refers to the vegetation of coastal dunes, beach ridge plains and backbarrier flats of southern Queensland and northern NSW (Griffith et al. 2003).
Surrounding land use	Brunswick Heads Nature Reserve is located 200 metres north-west of the reserve, at the southern entrance to the township of Brunswick Heads. Lands adjacent to and nearby the reserve support agriculture, (including tea-tree farming and cattle production), residential and rural residential development, and tourism.

Features	Description
	Areas west of the reserve are largely cleared, apart from two areas both of which are 60–70 hectares and support native remnant and regrowth vegetation. Land surrounding the reserve is zoned 'Rural Landscape' and 'Public Recreation' in the 2014 *Byron LEP*. Other lands have been deferred from the 2014 LEP and retain their zonings in the *Byron Local Environmental Plan 1988* of 'General Rural', 'Rural Investigation', 'Wetlands' and 'Coastal Habitat'.
Other authorities	The reserve is located within the areas of the Arakwal, the Tweed Byron Local Aboriginal Land Council, North Coast Local Land Services and Byron Shire Council.

1.2 Relationship to Country – Cultural landscape context of the reserve

The idea of 'Country' to Aboriginal people

To Aboriginal people, the landscape is made up of many features that are interrelated. These include the lands and waters, plants and animals, special places and stories, historical and current uses, and people and their interactions with each other and place. These features are seen as inseparable and make up what is known as 'Country' to Aboriginal people. While these interrelationships are recognised, this plan addresses many of these topics individually for clarity and ease of use.

The Country of the Bundjalung of Byron Bay (Arakwal) people

The Arakwal and other Bundjalung people have a long and ongoing cultural association with the landscape around Byron Bay, including the reserve. Research into the Bundjalung lands of South East Queensland indicates they have occupied that Country for at least 22,000 years (Neal & Stock 1986).

The Arakwal lodged a Native Title Determination Application in 1994 (NC95/1 - Byron Bay Bundjalung People) over the land and adjoining waters extending from the Brunswick River to the north, past Julian Rocks to the east, Broken Head to the south and around the hinterland areas of Mullumbimby, Coorabell and Bangalow to the west. Parts of the application were settled by Indigenous land use agreements.

A Native Title consent determination, which includes Tyagarah Nature Reserve, was granted by the Federal Court in 2019. In accordance with this, a new ILUA (Cavanbah (Byron Bay) Arakwal Indigenous Land Use Agreement) was registered.

The reserve is an important part of Country to the Arakwal people for a range of reasons, including as a place rich in spiritual and cultural significance. The reserve includes pathways still used by the Arakwal to travel around Country.

The Arakwal recognise the importance of conserving this special place so that current and future generations may learn about its importance, its history and be a part of its future.

2. Legal rules

2.1 Government laws and National Parks and Wildlife Service policies

The management of nature reserves in New South Wales is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* and Regulation, the Biodiversity Conservation Act and the policies of National Parks and Wildlife Service (NPWS).

Other legislation, strategies and international agreements may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* may require the assessment of environmental impacts of works proposed in this plan. The *Heritage Act 1977* may apply to excavation in known archaeological sites or in sites with potential to contain archaeological sites. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* may apply in relation to actions that impact matters of national environmental significance, such as migratory and threatened species listed under that Act. The Commonwealth *Native Title Act 1993* may apply in relation to actions that impact on the native title rights of claimants.

A plan of management is a statutory document under the National Parks and Wildlife Act. Once the Minister has adopted a plan, the plan must be carried out and no operations may be undertaken in the reserve unless they are in accordance with the plan. Management of the reserve is currently subject to *The Byron Coast Group of Nature Reserves Plan of Management* (NPWS 1998), as amended. When adopted, this plan will replace the provisions of the 1998 plan relating to Tyagarah Nature Reserve. This plan will also apply to any future additions to the reserve. Should management strategies or works be proposed in future that are not consistent with this plan, an amendment to the plan will be required.

2.2 Management principles for nature reserves in NSW

Nature reserves are reserved under the National Parks and Wildlife Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena. Under section 30J the Act, nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena
- conserve places, objects, features and landscapes of cultural value
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values
- provide for appropriate research and monitoring.

The primary purpose of nature reserves is to conserve nature. Nature reserves differ from national parks in that the provision of visitor use is not a management purpose or principle. However, historically the dunes closest to the beach were widely used by visitors and local residents for recreation. In acknowledgment of the reserve's recreational values, a visitor hub with limited facilities is provided at the beachfront on Black Rock Road (see Map 1). The remainder of the reserve can be accessed by foot and the management trails can also be accessed by bicycle (see Section 5.2 Managing use of the reserve).

3. The importance and management of Tyagarah Nature Reserve

3.1 Respecting Country – Key values associated with the reserve

The reserve has many values that are important to the Arakwal and the wider community.

'Looking after Country' – reserve conservation and management

- Management of the reserve recognises the rights and responsibilities of the Arakwal and their long and ongoing traditional association with the landscape that includes the reserve.
- The reserve protects Country and allows Arakwal and other Bundjalung people to continue their connection to Country through their cultural aspirations and obligations.
- The reserve protects cultural heritage values, including special places and related cultural stories of the Arakwal and other Bundjalung people.
- The reserve protects a regional wildlife corridor, sensitive coastal dunes, wet and dry heaths, eucalypt forest, littoral and lowland rainforest, swamp forest, saltmarsh, mangroves and wetlands. The reserve supports threatened ecological communities, threatened and migratory species, and their habitats.

'Using and knowing about Country' – use of the reserve, information, research and monitoring

- The reserve provides the Arakwal with opportunities for maintaining culture, including for cultural renewal associated with the sustainable use of wild resources; the transfer of cultural knowledge, customs and stories; and ceremonial and other cultural practices.
- Opportunities for visitors and the wider Byron Bay community to understand and respect the culture and heritage of the Bundjalung people will be provided off-site; primarily through education programs offered at the Cape Byron State Conservation Area (SCA).
- The reserve provides environmental education opportunities relating to Aboriginal cultural values, coastal processes, rehabilitation of degraded areas, threatened ecological communities and threatened and migratory species.
- The Coast Trail running north from the Tyagarah Day Use Area provides visitors with passive recreation opportunities including nature study, bushwalking and cycling. Beach access is provided at the Tyagarah Day Use Area.
- The reserve provides opportunities for appropriate research and monitoring.

4. Looking after Country

4.1 Joint management

> ‘Our people treat Country as our mother, knowledge is handed down and we are responsible for keeping her strong and healthy in equal partnership with NPWS.’
>
> Delta Kay, Arakwal member.

As traditional custodians of the land, Aboriginal people have a unique role to care for and manage Country. This role overlaps with the legislative responsibilities of NPWS to manage land for conservation. NPWS works with Aboriginal people to recognise and capitalise on these mutual interests and responsibilities, including recognising that:

- All parks are part of Aboriginal peoples’ Country and are places where Aboriginal people can care for their Country and access their Country and its resources. Given the history of dispossession in New South Wales, public lands and parks play an important role in the maintenance of Aboriginal culture and connection to Country. Meaningful engagement with Aboriginal communities on the management and use of parks and reserves is essential to ensure that their needs in relation to their Country are met.
- Aboriginal communities obtain cultural, social and economic benefits through being involved in park management.
- NPWS, in partnership with the Aboriginal community, is better able to protect and interpret cultural heritage and to apply Aboriginal knowledge to land management and the conservation of cultural and natural values.
- Visitors to parks have an enriched experience through interaction with Aboriginal people and an understanding of Aboriginal cultural values.

The Arakwal are recognised by the NSW Government as the descendants of Indigenous people who lived and/or held native title rights in the Byron Bay area at the time of first contact with European settlers and have a strong cultural association with the area. The right of the Arakwal to be involved in the management and protection of their Country and heritage is acknowledged.

A series of Indigenous land use agreements (ILUAs) registered under the Commonwealth Native Title Act have been made between the NSW Government and the native title claimants within the claim area. These ILUAs acknowledge that the Bundjalung people of Byron Bay are descendants of Indigenous people who lived and/or held native title in the Byron Bay area at the time of first contact with European settlers in the 1820s and 1830s and that they have a strong cultural association with the area. ‘ILUA 1’ was registered in 2001 and provided for the creation of Arakwal National Park in Byron Bay together with employment, training and joint management opportunities for the native title claimants.

‘ILUA 2’ was registered in 2008 and resulted in significant additions to parks and reserves in the NPWS Byron Coast Area (now part of the Tweed Byron Area). A Native Title consent determination, which includes Tyagarah Nature Reserve, was agreed by the Federal Court in 2019. In accordance with this a new ILUA was registered. In accordance with ILUA 2 and Cavanbah (Byron Bay) Arakwal ILUA, the Byron Coast Area Management Committee has been established to enable the joint management of Byron Coast Area reserves by the Arakwal and NPWS. Joint management aims to provide the Arakwal with meaningful involvement in caring for Country on a day-to-day basis through their employment with NPWS and their role on the Management Committee.

Desired outcome

- Arakwal provide advice to NPWS about the management of the reserve through the Byron Coast Area Management Committee.

Management response

4.1.1. Issues and proposals relating to the care, control and management of the reserve will be referred to the Management Committee for their consideration and recommendations.

4.1.2. Implement the ILUA agreements.

Photo 1 Members of the Arakwal community and NPWS staff on a field trip to the reserve.

4.2 The Story of Country that is now the reserve

A living ancestry and culture

The Arakwal are part of the Bundjalung Nation and their history in the area pre-dates the arrival of Europeans. The descendants of Arakwal ancestor Bobby and Alice Bumberbin lived and raised families in and around the Byron Bay area. The landscape that includes the reserve is an important part of this history.

Despite the changing natural, socio-economic and political environment brought about since European settlement of the area, the Arakwal have maintained their links with Country that includes the reserve. It is important to the Arakwal that their cultural traditions and associations are maintained as this contributes to their identity and wellbeing and shows respect to their ancestors.

Aboriginal sites are places with evidence of Aboriginal occupation or are related to other aspects of Aboriginal culture. They are important as evidence of Aboriginal history and are part of the culture of local Aboriginal people. Highly significant Aboriginal sites are recorded

in the reserve. Complete information on the condition of these sites is unknown. Sites include middens, containing shell material of favoured foods; and artefacts, such as discarded tools and tool workings. While extensive sand mining of near-shore dunes prior to reservation would have impacted on evidence of Aboriginal use of these areas, evidence is expected to occur in unmined areas that have yet to be investigated. The reserve contains middens registered on the Aboriginal Heritage Information Management System (AHIMS) and recommendations guide their management (Piper & Hill 2018). Possibly half of North Coast middens were destroyed by sand mining (Byrne, cited in Collins 1995).

The abundant resources of the reserve and adjacent areas have sustained generations of Bundjalung people. The rainforest, woodlands, heaths, wetlands, beaches, tidal areas, river and sea provided food and materials for making all the requirements of life from fishing lines to boomerangs. An ethnobotanical study has been undertaken with the Arakwal to document culturally valued plants within the Byron Bay area parks and reserves (Low et al. 2003a). Appendix 1 lists some culturally valuable plants known from the reserve. The locations of some of these plants have been mapped (Low et al. 2003b).

Common animals in the reserve such as brush turkeys, ducks, flying-foxes, pigeons, possums, bandicoots, wallabies, snakes and frogs were also important resources for the Elders, their families and their ancestors. All these animals are important to the Arakwal for their conservation, totemic and wild resource values and other cultural values.

In the late 19th century the annual distribution of blankets to Aboriginal people at Brunswick Heads drew people together from surrounding areas. People used this as an opportunity to reconnect while camping on ridges directly west of the reserve and using the resources of the land now forming the reserve for sustenance (Y Stewart 2013, pers. comm.)

Arakwal people, including Jimmy and Linda Kay, established longer-stay, semi-permanent camps adjacent to lands now forming the reserve. These camps were occupied when they worked in the local timber and sugar cane industries. The Arakwal also camped on dunes and elevated areas out of the swamp within the boundaries of what is now the reserve (Y Stewart 2013, pers. comm.).

Simpsons Creek, its tributaries and the ocean were popular for fishing and collecting other foods. The beach formed a significant pathway for Aboriginal people travelling between Belongil Creek and the Brunswick River (Y Stewart 2013, pers. comm.).

Story of land use

In the 19th and early 20th centuries the beaches of the North Coast were the easiest routes for travelling between growing coastal settlements. This practice was commonly known as using the ‘Beach Highway’. The beach between Brunswick Heads and Byron Bay, adjacent to the reserve, was an integral early transport corridor.

The earliest European settlement in Byron Shire was made by cedar-getters in 1849 on the Brunswick River in the vicinity of what later became the township of Brunswick Heads. Brunswick Heads is located adjacent to the reserve’s northern boundary (see Map 1). The town initially developed as a busy seaport and by around 1880 the most valuable timber along the river had been removed. Around this time Aboriginal people were recorded camping at Brunswick Heads where they were employed in the timber industry (Waters 2003). By the 1890s both Byron Bay and Brunswick Heads, located at either end of the reserve, were becoming tourism centres (Waters 2003).

In 1883 and 1884, most of the southern section of what later became the reserve was included in Crown Reserve 1053. In 1904, the northern part of what later became the reserve was gazetted as Crown Reserves R38112 and R38113 (see Figure 1). The reserves were ‘reserved from sale and lease generally for preservation of native flora’. The reserves

were revoked in 1960 and replaced with R82780 which was reserved for ‘Future Public Requirements’.

Late 19th and 20th century parish maps show various land uses undertaken in different parts of what later became the reserve. The central and southern parts were included in the Tweed and Richmond River Goldfields. A road from the north is shown on the 1894 map passing through the south-west and southern parts of land now included in the reserve, en route to Belongil Creek.

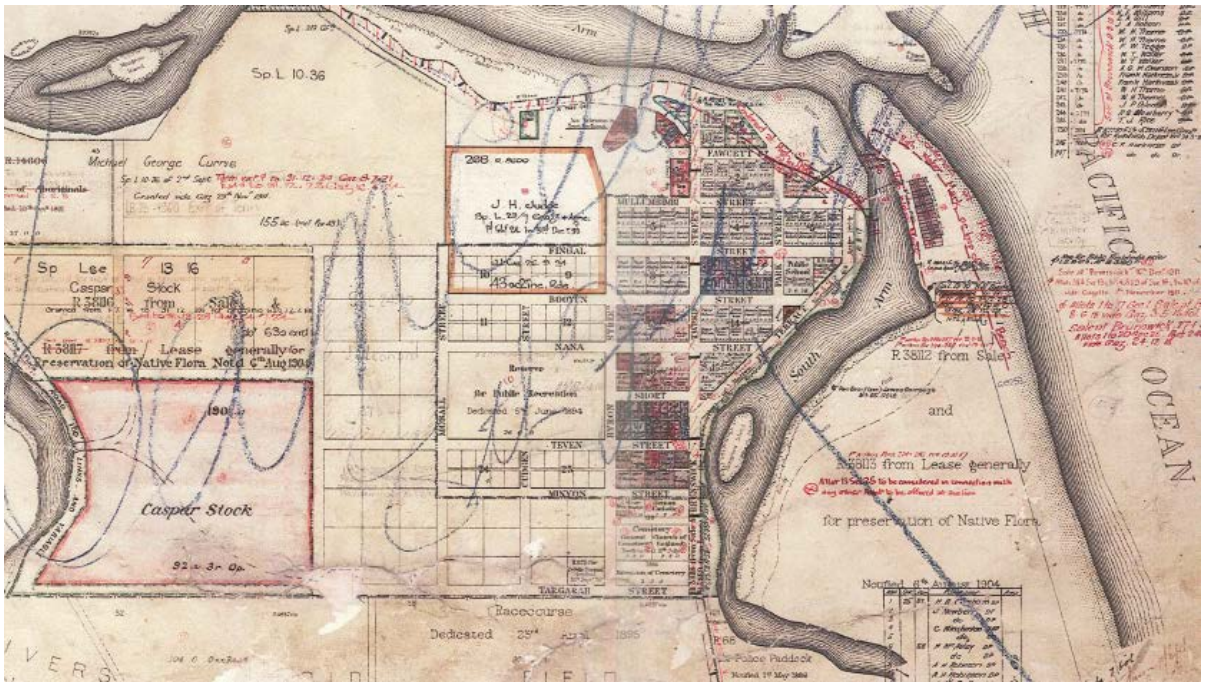


Photo 2 Late 19th century parish map of Brunswick Heads showing land set aside for the ‘preservation of Native Flora’ at the northern end of what later became the Reserve. (Source: Land & Property Information 2015)

Sand mining occurred just south of the reserve during the 1880s and 1890s on beaches and dunes on and around Belongil Beach. It is unknown if southern parts of the reserve were also mined at this time. Parts of the Crown reserves were leased for gold mining, beekeeping, orchards and, by the late 1920s, a coastal sand mining lease appears on the parish map. At this time coastal dunes in the south were reserved for a ‘Roadway and for other public purposes’.

A 1958 aerial photograph (see Photo 2) shows a high degree of disturbance of the frontal dunes and of the north central part of land now comprising the reserve. The remainder appears to support mainly intact vegetation, featuring prominent vegetated dunes that parallel the coast and occupy most of the central and southern parts, and dense vegetation in the north adjacent to Simpsons Creek.

Around the time of the reserve’s gazettal in the mid-1980s, Currumbin Minerals Pty Ltd and Cudgen RZ Ltd held inactive mining leases within the proposed reserve. The beach and adjacent dunes along the length of the reserve were also included in mining leases. The remainder of the reserve supported only a few small mining leases. All mining leases were allowed to run their course but were not activated and the final lease expired in 1999.

Despite the occurrence of these leases, the majority of the reserve was not mined. Mining was concentrated on a narrow strip of land along the frontal and adjacent dunes and on the ‘strandline’, which are parallel dune formations close to Simpsons Creek. Commercial, mechanised, mineral sand mining of these areas during the mid and latter decades of the 20th century caused major alterations to the landscape and the natural environment. The mining process involved extensive clearing of native vegetation, filling and stabilising mined

areas with invasive species such as bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*).

Other land use proposals active around the time of reserve gazettal that did not eventuate, due to the protection afforded by reservation, include dune sewage disposal, a golf course and a coastal road between Byron Bay and Brunswick Heads.

Photo 3 A 1958 aerial photograph of the reserve and adjacent areas. Simpsons Creek can be seen in the north and Belongil Creek in the south. Note the disturbed coastal dunes, prominent parallel dune formations and dense vegetation in the north, adjacent to Simpsons Creek. (Source: Land & Property Information 1958)

During the early 1980s, the Myocum–Tyagarah Progress Association and conservation groups, including the Byron Environmental and Conservation Organisation (BEACON), the National Parks Association of NSW and the Byron Flora and Fauna Conservation Society actively lobbied the NSW Government to protect the Crown land between Byron Bay and Brunswick Heads. In 1985, BEACON conducted a flora and fauna study of the Crown land which highlighted its significant natural heritage values.

Most of the coastal Crown land between Byron Bay and Brunswick Heads was gazetted as Tyagarah Nature Reserve in 1986. The land was reserved to protect its significant vegetation communities and fauna, and as a scientific resource to permit study of physical and biotic processes. An additional area of Crown land was added in 1999 and 37.4 hectares of freehold land was added in 2002.

Desired outcome

- Manage the reserve to protect its biodiversity values and Aboriginal and non-Aboriginal cultural heritage values.
- Involve the Aboriginal community in efforts to conserve and protect the reserve's cultural heritage and biodiversity values and incorporate Aboriginal knowledge, insights and values in these efforts.

Management response

4.2.1. Record the location of Aboriginal and non-Aboriginal heritage sites in the reserve.

4.2.2. Record Aboriginal and non-Aboriginal stories about the reserve and its significance.

4.2.3. Undertake heritage assessments to identify the location, significance and conservation of historic heritage sites/items, including historical archaeological sites, within the reserve.

4.2.4. Obtain legislative approvals for work to, or which may impact, historic heritage, including archaeological sites.

4.3 Native plants and animals

Native plants

The reserve's native vegetation is highly diverse and includes threatened and rare plants and ecological communities. Table 1 lists eight threatened and significant plants recorded in the reserve and their conservation status. Five of these plants occur in rainforest; strangea (*Strangea linearis*) and swamp banksia (*Banksia robur*) grow in heathland, and pink nodding orchid (*Geodorum densiflorum*) is associated with dry sclerophyll and swamp forest.

Table 1 Threatened and significant plants recorded in the reserve

Common name	Scientific name	BC Act status	EPBC Act status
Threatened species			
Arrow-head vine	*Tinospora tinosporoides*	Vulnerable	Vulnerable
Corokia	*Corokia whiteana*	Vulnerable	Vulnerable
Green-leaved rose walnut	*Endiandra muelleri* subsp. *bracteata*	Endangered	
Pink nodding orchid	*Geodorum densiflorum*	Endangered	
Stinking cryptocarya	*Cryptocarya foetida*	Vulnerable	Vulnerable
Other species of conservation significance			
Strangea	*Strangea linearis*	Rare [1]; near southern limit [2]	
Swamp banksia	*Banksia robur*	Disjunct distribution [2]	
Toothed-leaved palm lily	*Cordyline congesta*	Rare [3]	

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm.

Key to conservation status:

[1] Flora of New South Wales (Harden 2002).

[2] Significant Vascular Plants of Upper North East NSW (Sheringham & Westaway 1995).

[3] Rare or Threatened Australian Plants (Briggs & Leigh 1996).

The reserve also supports the following threatened ecological communities (all listed as endangered) under the Biodiversity Conservation Act:

- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Lowland Rainforest on Floodplain in the NSW North Coast Bioregion
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Littoral Rainforest is also included under the Environment Protection and Biodiversity Conservation Act as a critically endangered ecological community named Littoral Rainforest and Coastal Vine Thickets of Eastern Australia. Lowland Rainforest on Floodplain is included in the Commonwealth listing of the critically endangered community Lowland Rainforest of Subtropical Australia.

A wide range of vegetation classes occur in the reserve (see Appendix 2). This diversity is reflected in the reserve's 250 plant species. Briefly, vegetation includes:

- wet and dry heaths, rushlands, sedgelands and swamp forests associated with the dune and swale system oriented parallel with the frontal dune
- patches of rainforest in the eastern part of the reserve, and in the north where they commonly occur close to Simpsons Creek
- mangroves, saltmarsh, rushlands and swamp forests associated with Simpsons Creek (see Photo 3)
- small patches of dry sclerophyll forest and woodland dominated by scribbly gum (*Eucalyptus signata*) mainly located in the central part of the reserve
- a disturbed frontal dune complex recovering from the effects of sand mining.

Photo 4 Saltmarsh and swamp sclerophyll endangered ecological communities adjacent to Simpsons Creek.

The reserve complements a suite of wallum plant communities on the NSW Far North Coast which are protected within Broadwater, Bundjalung and Yuraygir national parks. Wallum plant communities occur on dunefields, beach ridge plains and backbarrier flats of southern Queensland and northern NSW on low-nutrient, acidic soils often with impeded drainage (Griffith et al. 2003).

Investigations (NPWS 1982, 1984) into the conservation values of the area prior to its inclusion in the reserve noted the following significant landscape/floristic attributes:

- The black she-oak (*Allocasuarina littoralis*) – wallum banksia (*Banksia aemula*) dry heath association is unusual as black she-oak is virtually absent, and heath-leaved banksia (*Banksia ericifolia*) is much less common in similar habitats in Broadwater and Bundjalung national parks to the south.
- Dune and swale vegetation contains plant species adapted to higher rainfall than species in similar habitats in Broadwater and Bundjalung national parks.
- A rare, 50-hectare area of swamp forest transitioning to rainforest.
- An example of the widespread and dynamic beach barrier systems of the northern NSW coast.

Native animals

The reserve supports a wide range of native animals including threatened and migratory species. The reserve forms part of a regional coastal wildlife corridor connecting it to coastal habitats around Brunswick Heads to the north, and Belongil Creek and Byron Bay to the south. Three subregional corridors connect to the central-western boundary of the reserve. These corridors, which provide opportunities for dispersal and movement of wildlife, link the reserve to the moist escarpment forests of the Nightcap and Koonyum ranges and beyond via a network of fragmented but significant habitats (Scotts 2003).

Twenty-one threatened animals have been recorded in the reserve (see Appendix 3). An additional 12 animals known from the reserve are protected under international migratory bird agreements listed under the Environment Protection and Biodiversity Conservation Act (see Appendix 3).

There are records of the long-nosed potoroo (*Potorous tridactylus tridactylus*) in the reserve dating back to the 1980s (Mason 1997; Milledge et al. 1986; Parker 2006). Mason (1997) estimated that there were approximately 80 animals in the reserve in the early 1990s. However, since 2004 a number of targeted surveys have failed to find potoroos in the reserve (e.g. Goldingay & Lindsay 2009; Lake 2012; OEH 2011a). The most recent assessment of long-nosed potoroo habitat (Andren et al. 2013) indicates that the reserve is the most important NPWS-managed reserve on the Far North Coast, despite the lack of recent confirmed records, due to the relatively large amount of habitat it contains. However, Andren et al. (2013) identify the need for greater survey effort to properly assess the current status of the Tyagarah – Brunswick Heads population. A long-nosed potoroo was observed in the reserve in April 2016 (A McKinley, 2016, pers. comm., 19 April 2016) and surveys are continuing.

Research (Biolink 2012) into the coastal Byron Shire population of the threatened koala (*Phascolarctos cinereus*) estimates that approximately 240 koalas live on the coastal plain between West Byron, immediately south of the reserve, and Brunswick Heads, immediately north of the reserve. The Myocum–Tyagarah area, which includes part of the reserve, is regarded as one of two major koala population centres on the Byron Shire coast. Evidence of inbreeding has also been recorded which can adversely affect the population. Koala habitat mapping (Biolink 2012) indicates that koalas occupy habitat located largely on private land adjacent to the central-western boundary of the reserve but also utilise habitat within

the reserve. Habitat mapping identified significant areas of secondary habitat in the reserve and smaller areas of primary habitat (see Photo 4).

Photo 5 A female koala and joey in a primary food tree, the swamp mahogany (Eucalyptus robusta), in the reserve. Inbreeding and habitat contraction and fragmentation threaten the local population.

Maintaining native vegetation in wildlife corridors on adjacent land is important as it facilitates the movement of wildlife, which helps to maintain genetic diversity and long-term viability of native animal populations. This is particularly important for threatened animals such as koalas and long-nosed potoroos.

The diverse habitats of the reserve support a range of sedentary, nomadic and migratory native animals. The longer growing, flowering and fruiting season on the NSW North Coast during autumn–winter provides a reliable and plentiful supply of food for migratory and nomadic birds, flying-foxes and micro-bats at a time of year when food is often in short supply elsewhere. Many of these species move from higher elevation, higher latitude or lower latitude habitats occupied during spring–summer to 'winter' on the coastal lowlands (Scotts 2003).

Highly mobile, nectarivorous birds and bats recorded in the reserve that exploit the abundant nectar resources available include: common blossom-bat (*Syconycteris australis*), eastern spinebill (*Acanthorhynchus tenuirostris*), grey-headed flying-fox (*Pteropus poliocephalus*), little lorikeet (*Glossopsitta pusilla*), noisy friarbird (*Philemon corniculatus*), scaly-breasted lorikeet (*Trichoglossus chlorolepidotus*), scarlet honeyeater (*Myzomela sanguinolenta*) and yellow-faced honeyeater (*Lichenostomus chrysops*) (Byron Shire Council 1999; OEH 2016).

Apart from birds moving within Australia along altitudinal or latitudinal gradients, transnational migratory birds arrive from western Alaska, eastern Siberia, various locations in Asia and Papua New Guinea, and nearby island states. Migratory birds recorded in the reserve and their seasonal movements are summarised in Appendix 4.

The reserve's tidal wetlands and adjacent beaches are significant habitats for migratory and non-migratory seabirds and shorebirds. Currently, the reserve extends to the mean high water mark along Tyagarah Beach.

A major contributor to the reserve's high species diversity is that it supports habitat for animals representative of the following five biogeographical subregions (DECCW 2010a, 2010b; Landmark, Ecograph & Terrafocus 1999):

- Bassian — species associated with temperate eucalypt forests of south eastern Australia
- Torresian — species associated with northern Australia tropical, grassy savannah woodlands
- Eyrean — species associated with the arid inland
- Tumbunan — species associated with subtropical rainforests that were formerly extensively distributed across Australia in wetter periods but are now largely restricted to the NSW North Coast and northern Queensland
- Irian — species associated with tropical rainforest typical of lowland New Guinea.

Appendix 5 details animals recorded in the reserve representative of each of the five biogeographic regions and the smaller, northern NSW – South East Queensland coastal plain subregion known as the wallum.

In addition to being significant for nectar-eating birds, the reserve also supports fruit-eating birds. Appendix 6 lists birds recorded in the reserve that utilise rainforest fruits. Many species of birds also utilise the fruits of the reserve's drier, sclerophyll communities and swamp sclerophyll communities. The reserve includes small rainforest patches which are likely to expand under favourable climatic conditions in the absence of fire. Birds utilise these patches as 'stepping stones' between larger coastal and hinterland rainforests. This process supports dispersal of rainforest plants, facilitating rainforest regrowth and helps to maintain the ecological functioning of nearby rainforest remnants. Fruit-eating bats, such as the threatened grey-headed flying-fox, also play a key role in rainforest seed dispersal.

Rainforest is critical to maintaining migratory pathways for fruit doves and cuckoo-shrikes (Brodie, Green & Graham 2002). Birds arriving from higher elevations in winter, for example from the New England Tablelands and nearby areas of the Great Dividing Range, rely on the food and habitat resources available in the network of Big Scrub remnants and coastal rainforests. The Big Scrub comprised 75,000 hectares of lowland subtropical rainforest on volcanic soils located between the Nightcap Range, the coast, Lismore and Wardell which was largely cleared for agriculture in the late 19th century (NPWS 1997). The Big Scrub remnants and coastal rainforests are of particular importance for topknot pigeons (*Lopholaimus antarcticus*) which utilise food available in winter from a range of rainforest plants including the hard corkwood (*Endiandra sieberi*) which is common in parts of the reserve (NPWS 1982).

Common animals of the reserve include the grassland melomys (*Melomys burtoni*), mountain brushtail possum (*Trichosurus vulpecula*), northern brown bandicoot (*Isoodon macrourus*), swamp wallaby (*Wallabia bicolor*), swamp rat (*Rattus lutreolus*), short-beaked echidna (*Tachyglossus aculeatus*), lace monitor (*Varanus varius*), yellow-faced whip snake (*Demansia psammophis*), eastern water dragon (*Intellagama lesueurii*), major skink (*Bellatorias frerei*), common eastern froglet (*Crinia signifera*), rocket frog (*Litoria nasuta*), Pacific black duck (*Anas superciliosa*), crested pigeon (*Ocyphaps lophotes*), little pied cormorant (*Microcarbo melanoleucos*), white-necked heron (*Ardea pacifica*), straw-necked ibis (*Threskiornis spinicollis*), white-bellied sea-eagle (*Haliaeetus leucogaster*), brahminy kite (*Haliastur indus*), purple swamphen (*Porphyrio porphyrio*), silver gull (*Chroicocephalus novaehollandiae*), laughing kookaburra (*Dacelo novaeguineae*), variegated fairy-wren (*Malurus lamberti*), brown honeyeater (*Lichmera indistincta*), Lewin's honeyeater (*Meliphaga lewinii*), white-cheeked honeyeater (*Phylidonyris niger*), eastern whipbird (*Psophodes olivaceus*) and rufous fantail (*Rhipidura rufifrons*).

The reserve's invertebrate fauna is poorly documented, however, mangrove and rainforest communities provide potential habitat for butterfly species at risk. Mangroves provide potential habitat for the mangrove ant-blue (*Acrodipsas illidgei*) and the copper jewel (*Hypochrysops apelles apelles*) which are butterflies in decline (Sands & New 2002). The mangrove ant-blue is listed as endangered by the International Union for the Conservation of

Nature and may be at its southern limit around Brunswick Heads. The NSW range of the copper jewel is believed to have contracted to only one location at Tweed Heads, although it had previously been recorded from around Brunswick Heads (Sands & New 2002).

Rainforest patches in the reserve provide potential habitat for two rainforest-dependent Australian endemic butterflies: the cephenes blue (*Pseudodipsas cephenes*) and the regent skipper (*Euschemon rafflesia*) whose larva depend on specific food plants present in the reserve's rainforest. The cephenes blue is scarce at the southern end of its range in northern NSW and there is concern for the species in New South Wales as there are few areas of known habitat (Braby 2000; Sands & New 2002).

The reserve's wetlands are potential habitat for two threatened dragonflies: coastal petaltail (*Petalura litorea*) and giant dragonfly (*P. gigantea*).

Threats to native plants and animals

Major threats to the reserve's native animals and plants are weeds, pest animals and pathogens, such as amphibian chytrid and the myrtle rust (*Uredo rangelii*) fungus (see Section 4.4 Pests); and climate change (see Section 4.7 Climate Change). Inappropriate fire regimes also threaten the reserve's native species, but to a lesser extent (see Section 4.6 Fire).

Strategies for the recovery of threatened species, populations and ecological communities have been set out in a statewide *Biodiversity Conservation Program* (OEH 2017). These actions are currently prioritised and implemented through the *Saving our Species* program which aims to maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013c).

Individual recovery plans may also be prepared for threatened species to consider management needs in more detail. A national recovery plan, satisfying the requirements of the Environment Protection and Biodiversity Conservation Act and Biodiversity Conservation Act, has been adopted for the Olongburra frog (*Litoria olongburensis*) and the wallum froglet (*Crinia tinnula*) (Meyer et al. 2006). State recovery plans under the Biodiversity Conservation Act have been adopted for the koala (DECC 2008), the little tern (*Sterna albifrons*) (NPWS 2003) and for the green-leaved rose walnut (DEC 2004). Draft national recovery plans have been prepared for the grey-headed flying-fox (DECCW 2009) and the green and golden bell frog (*Litoria aurea*) (DEC 2005), and a draft plan is being prepared for the long-nosed potoroo.

The *Northern Rivers Regional Biodiversity Management Plan* (DECCW 2010b) meets regional recovery planning requirements for the following species recorded in the reserve: black-necked stork (*Ephippiorhynchus asiaticus*), collared kingfisher (*Todiramphus chloris*), common blossom-bat, common planigale (*Planigale maculata*), diamond firetail (*Stagonopleura guttata*), eastern grass owl (*Tyto longimembris*), green-leaved rose walnut, green and golden bell frog, grey-headed flying-fox, koala, little bent-wing bat (*Miniopterus australis*), little tern, long-nosed potoroo, Olongburra frog, eastern osprey (*Pandion cristatus*), pied oystercatcher, stinking cryptocarya (*Cryptocarya foetida*), sooty oystercatcher, southern myotis (*Myotis macropus*) and wallum froglet. The *Northern Rivers Regional Biodiversity Management Plan* also addresses the five threatened ecological communities found in the reserve.

The *Border Ranges Rainforest Biodiversity Management Plan* (DECCW 2010a) meets regional recovery planning requirements for the threatened plants corokia (*Corokia whiteana*) and arrow-head vine (*Tinospora tinosporoides*).

Both the Border Ranges and the Northern Rivers biodiversity management plans encourage a range of recovery actions for listed species including the control of weeds, pest animals

and pathogens (see Section 4.4 Pests) and the application of appropriate fire regimes (see Section 4.6 Fire).

Desired outcome

- Conserve native plants and animals and minimise impacts from introduced species (including pathogens), inappropriate fire regimes and climate change (see Sections 4.4 Pests, 4.6 Fire and 4.7 Climate change).

Management response

4.3.1. Implement actions in the *Biodiversity Conservation Program*, recovery plans and biodiversity management plans for threatened species and ecological communities in the reserve.

4.3.2. Encourage flora, vegetation and fauna surveys of the reserve to address knowledge gaps, including those relating to threatened and migratory species, and threatened ecological communities.

4.4 Pests

Pest species are plants, animals and pathogens that have negative environmental, economic and social impacts and are most commonly introduced species. Pests can have impacts across the range of reserve values, including impacts on biodiversity, cultural heritage, catchment and scenic values.

The *Biosecurity Act 2015* and its regulations provide specific legal requirements for the response, management and control of biosecurity risks, including weeds and pest animals. These requirements apply equally to public and privately owned land. Under this framework, Local Land Services has prepared regional strategic weed management plans and regional strategic pest animal management plans for each of its 11 regions, including the North Coast Region (North Coast LLS 2017, 2018).

The Local Land Services' plans identify priority weeds and pest animals in each of the regions, plus the appropriate management response for the region (i.e. prevention/alert, eradication, containment or asset protection).

NPWS prepares regional pest management strategies which identify the operations and control actions undertaken by NPWS to meet the priorities from regional strategic pest and weed management plans. This also includes other important programs such as the actions listed in the *Biodiversity Conservation Program*, threat abatement plans, and other strategies such as NSW *Biodiversity Priorities for Widespread Weeds* (DPI & OEH 2011).

The overriding objective of the NPWS regional pest management strategy for the reserve (OEH 2012a) is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. The strategy also identifies where other site- or pest-specific plans or strategies need to be developed to provide a more detailed approach. The strategies are regularly updated. Reactive programs may also be undertaken in cooperation with neighbouring land managers, in response to emerging issues.

Pest species that are also key threatening processes may be managed under the *Biodiversity Conservation Program* where it includes key threatening processes strategies. The *Saving our Species* program has developed targeted strategies for managing key threatening processes using the best available information to minimise current and future impacts of key threatening processes on priority biodiversity values, including threatened species and ecological integrity.

The NPWS regional pest management strategy identifies bitou bush as having a widespread distribution in the reserve and the weed giant Parramatta grass (*Sporobolus fertilis*) as occurring on road verges. The weed salvinia (*Salvinia molesta*) occurs in an old sand mining quarry/lake. A reserve-specific weed management strategy is being prepared to provide strategic guidance to integrated weed control in the reserve.

Isolated occurrences of myrtle rust, a significant pathogen of plants in the family Myrtaceae, have recently been detected in the reserve and the amphibian chytrid pathogen has been confirmed as occurring in frog populations.

Cane toads (*Bufo marinus*) are known to occur in the reserve. A plan has been prepared to guide the management and control of cane toads in parks and reserves in New South Wales (OEH 2011b). The reserve is not identified as a priority for cane toad control in that plan in view of their widespread distribution and low likelihood of eradication. Cane toads are identified as a 'containment zone' management species under the Local Land Services Regional Strategic Pest Animal Management Plan (North Coast LLS, 2018).

Pest species with the potential to threaten the survival or evolutionary development of species, populations or ecological communities listed under the Biodiversity Conservation Act may be declared key threatening processes under that Act and/or the Environment Protection and Biodiversity Conservation Act. Table 2 lists key threatening processes relevant to the reserve.

The Biodiversity Conservation Act provides for threat abatement plans to be prepared for key threatening processes. A threat abatement plan has been prepared for predation by the European red fox (OEH 2011d) and invasion of native plant communities by bitou bush (DEC 2006a). A plan is also being developed for predation by feral cats. Threat abatement strategies are also listed in the *Biodiversity Conservation Program*.

Table 2 Key threatening processes relevant to the Reserve

Key threatening process	BC Act	EPBC Act
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	✓	
Anthropogenic climate change	✓	✓
Competition from feral honeybees	✓	
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	✓	✓
Invasion and establishment of the cane toad	✓	✓
Invasion of native plant communities by *bitou bush*	✓	
Invasion of native plant communities by exotic perennial grasses	✓	
Invasion and establishment of exotic vines and scramblers	✓	
Invasion, establishment and spread of *Lantana camara*	✓	
Introduction and establishment of exotic rust fungi of the Order Pucciniales pathogenic on plants of the family Myrtaceae	✓	
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	✓	✓
Predation by feral cats	✓	✓
Predation by the European red fox	✓	✓
Predation by *Gambusia holbrooki* (plague minnow or mosquito fish)	✓	

BC Act = Biodiversity Conservation Act; EPBC Act = Environment Protection and Biodiversity Conservation Act.

Foxes

Foxes suppress native animal populations, particularly medium-sized ground-dwelling and semi-arboreal mammals, ground-nesting birds and freshwater turtles. Foxes have also been implicated in the spread of a number of weed species, such as bitou bush and blackberry, and are known to prey on domestic stock.

Predation by the European red fox was declared a key threatening process in 1998 under the Biodiversity Conservation Act. The NSW fox threat abatement plan (TAP) was initiated in 2001 and revised in 2010 (OEH 2011d). The primary objective of the TAP is to establish long-term control programs to protect priority threatened fauna species and populations. Foxes are being controlled at priority sites across New South Wales to protect biodiversity.

Foxes occur in the reserve and the surrounding area. The fox TAP identifies the reserve as a priority site for fox control due to the threat that fox predation poses to the threatened long-nosed potoroo and threatened shorebirds. A fox baiting program in conjunction with fixed camera monitoring for long-nosed potoroo commenced in 2011 in accordance with the TAP and a site-specific management plan. Foxes are managed as an ‘asset-based protection’ (manage pest animal populations) management species under the Local Land Services Regional Strategic Pest Management Plan (North Coast LLS, 2018).

Bitou bush

Bitou bush is a native of South Africa. It is a state-level priority weed throughout New South Wales and is listed as one of the Australian Government’s Weeds of National Significance. Invasion by bitou bush leads to a decline in the species diversity of affected plant communities and the fauna that depend on them and is listed as a key threatening process under the Biodiversity Conservation Act. It readily invades a wide variety of disturbed and undisturbed coastal plant communities, out-competing native vegetation.

A bitou bush TAP has been prepared (DEC 2006a) which lists actions to abate, ameliorate or reduce the threat posed by bitou bush to threatened species, populations and ecological communities. In the reserve, invasion by bitou bush threatens habitat of the littoral rainforest and swamp sclerophyll forest threatened ecological communities, and threatened and significant rainforest trees and shrubs. Dense and extensive infestations of bitou bush occur in the reserve east of the Coast Trail (see Photo 5) and light to moderate infestations occur west of the trail. The reserve is classified in the TAP as Category 2 (i.e. medium priority) for implementing control.

In 2011 the national northern containment line for bitou bush was revised and moved south from the Tweed River to the border of Tweed and Byron shires (Hamilton & Turner 2013). Bitou bush in the reserve now requires urgent attention due to its strategic position as the largest infestation at the northern end of the northern containment zone. The site-specific management plan prepared in 2006 as part of the bitou bush TAP will be reviewed and updated. Targeted bitou bush control commenced in late 2011. Bitou bush is also being managed as a state priority weed, with the objective of containment according to the North Coast Regional Strategic Weed Management Plan (North Coast LLS,2017).

Photo 6 A cross-section of the frontal dune showing a dense infestation of bitou bush threatening remaining native trees.

Myrtle rust

Myrtle rust is a plant disease caused by the exotic fungus *Puccinia psidii.* It was first detected on the NSW Central Coast in 2010 and has established throughout coastal NSW from the Shoalhaven River north into Queensland. Myrtle rust infects young, actively growing shoots, leaves, flower buds and fruits of plants in the family Myrtaceae.

Genera in the Myrtaceae family recorded in the reserve include *Acmena, Austromyrtus, Callistemon, Corymbia, Eucalyptus, Leptospermum, Melaleuca* and *Syzygium.* Broad-leaved paperbark (*Melaleuca quinquenervia*) is a substantial component of the swamp sclerophyll endangered ecological community in the reserve.

Myrtle rust is considered to have a widespread distribution in the Byron Shire. Infected plants have been identified along the edges of Black Rock Road and along a track to an apiary site in the reserve. The spores of myrtle rust are spread by wind, animals and humans. Myrtle rust is considered to pose a significant threat to the reserve's biological values.

A plan outlining how myrtle rust will be managed in national parks and reserves has been developed and incorporates strategies to limit its spread and to minimise impacts on threatened species and ecological communities (OEH 2011c).

Desired outcome

- Manage pest plants, animals and pathogens to minimise impacts on native plants and animals in accordance with the NPWS regional pest management strategy and other relevant strategies and plans.

Management response

4.4.1. Implement priority bitou bush and fox control strategies in accordance with the relevant pest management strategies, threat abatement plans and any other relevant plans.

4.4.2. Encourage research into the response of the reserve's long-nosed potoroo population to the fox TAP baiting program.

4.4.3. Seek the cooperation of neighbours, where appropriate, in implementing pest animal management programs.

4.4.4. Finalise and implement the reserve-specific weed management strategy, incorporating monitoring.

4.5 Repairing the reserve

Geology and soils

The sandplain on which the reserve is located is dominated by dune and swale formations that parallel the coast and date from the Pleistocene period. Approximately 130,000 years

ago, sea levels were several metres higher than today and sand dunes were deposited in ridges behind the present-day beach to form a distinctive ridge–swale system. The beach ridges are less than three metres high and are interspersed with lower swales which often contain water.

The majority of soils in the reserve belong to the Black Rock soil landscape which is associated with the dominant dune–swale formation. Dune soils comprise well-drained podzols; less well-drained humus and peaty podzols occur in depressions, and wet acid peats are found in swales. These soils are highly permeable, highly acidic, infertile and are highly susceptible to wind erosion (Morand 1994).

The Angels Beach soil landscape occurs on the seaward side of the Black Rock soil landscape. This soil landscape is mainly comprised of sand with a high silica content which is highly permeable, very infertile, has a low water-holding capacity and is subject to wind and wave erosion. These soils were deposited since stabilisation of present sea levels following the last Ice Age during the Holocene period, about 6500 years ago. Where sand mining has occurred, the hind dune areas are a mix of sands and podzols (Morand 1994). Coffee rock outcrops on the beach two to three metres below the crest of dunes occurring at the southern end of the reserve (Photo 6). Coffee rock is comprised of sand cemented with organic matter and indicates a former watertable. The location of coffee rock in the dunes adjacent to the Tyagarah Day Use Area is most likely to be the origin of the name of the locality, Black Rock, and of Black Rock Road.

Areas adjacent to Simpsons Creek north of the oxbow lake belong to the Burns Point soil landscape. Waterlogged sands which are high in silica and solonchaks which are dominated by salt occur on the mangrove flats; very poorly drained humic gleys, grey or greenish in colour, occur in forests and saltmarshes. These soils are subject to tidal flooding and are saline, very infertile and have a high acid sulfate potential (Morand 1994).

The southern part of the reserve forms part of the Belongil wetlands system. The central and northern parts of the reserve north of Black Rock Road generally drain north-west to Simpsons Creek which flows into the Brunswick River near its mouth (NPWS 1998).

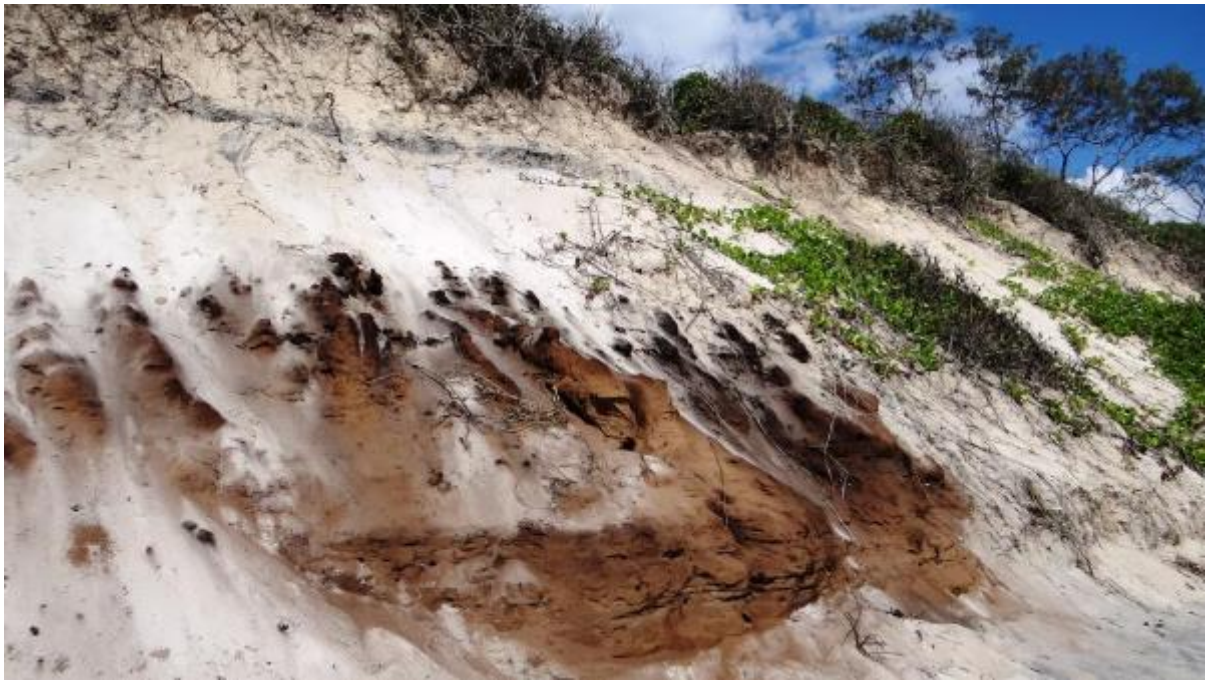


Photo 7 Coffee rock outcropping on the beach adjacent to the Tyagarah Day Use Area indicates the base of an old swamp.

Artificial lakes formed during sand mining occur north and south of Black Rock Road on the reserve and on adjacent private property. The lakes provide habitat for waterbirds and aquatic organisms (NPWS 1998). A small lake of approximately 0.5 hectares in the reserve, north of Black Rock Road, is popular with visitors.

Repair priorities

The reserve's ecosystems are experiencing the ongoing effects of historic sand mining and drainage, and of coastal erosion. Each of these impacts poses different management challenges.

Parts of the reserve are still recovering from the effects of sand mining, particularly frontal and hind dunes. Frontal dunes are also being impacted by coastal erosion. Control of pest plants is required to assist recovery of sand mined areas and adjacent areas where bitou bush, planted to stabilise mined areas, has invaded (see Section 4.4 Pests).

Byron Shire Council mapping indicates that the sandplain area of the reserve has a low probability of occurrence of acid sulfate soils. However, areas close to Simpsons Creek, including the north-west part of the reserve, have a high probability of occurrence. In their natural state these soils are waterlogged or submerged, are often alkaline and are therefore described as potential acid sulfate soils. When exposed or drained they oxidise and produce sulphuric acid and are called actual acid sulfate soils. Acid sulfate soils should not be disturbed, however, it may be necessary to remediate acid sulfate soils that have been exposed or disturbed by past activities such as drainage. Any proposed disturbance to acid sulfate soils would require environmental assessment including preparation of an acid sulfate soils management plan.

In the mid-2000s, the Byron Shire Council Estuary Management Committee proposed installing sandbag weirs at two locations along a drain in the south-west corner of the reserve to address the risk from acid sulfate soils to the Belongil Creek estuary. Since this time, NPWS has obtained a preliminary background report on vegetation at the proposed weir sites (Bower 2006).

Other constructed drains occur within the reserve, all of which pre-date its reservation. Their condition, extent and impacts on biodiversity have not been fully investigated.

The reserve's coastline is significantly affected by coastal erosion. Byron Shire Council's coastal erosion mapping (Byron Shire Council 2010) indicates that most land east of the Coast Trail is under immediate threat of coastal erosion. From the day use area south, frontal and hind dune areas are under immediate threat, including the Tyagarah Day Use Area, and land within 200 metres of the frontal dune may be impacted within 100 years. Construction of beach erosion mitigation structures on land south of the reserve may increase erosion rates within the reserve.

Desired outcome

- Natural coastal processes in the reserve, including shoreline fluctuation and dune erosion, are allowed to continue unimpeded.
- The extent of acid sulfate soils and any associated hazards in the reserve are identified and managed to minimise impacts on the environment and infrastructure.

Management response

4.5.1. Encourage research into the location of acid sulfate soils and constructed drains in the reserve and their condition, extent and impacts on biodiversity and identify any amelioration measures required. In the event that investigations recommend new

structures to ameliorate acid sulfate soils are needed, an amendment to this plan will be required prior to works.

4.5.2. Work with Byron Shire Council and other stakeholders to minimise the impacts on the Belongil Creek estuary caused by acid sulfate soil runoff.

4.6 Fire

The primary objectives of NPWS fire management are to protect life, property and community assets and cultural heritage from the adverse impacts of fire, while also managing fire regimes to maintain and enhance biodiversity. NPWS also assists in developing fire management practices that contribute to conserving biodiversity and cultural heritage across the landscape and implements cooperative and coordinated fire management arrangements with other fire authorities, neighbours and the community (OEH 2013a).

Fire is a natural feature of many environments and is essential for the survival of some plant communities. However, inappropriate fire regimes can lead to the loss of particular plant and animal species and communities, and high frequency fires have been listed as a key threatening process under the Biodiversity Conservation Act. The reserve's rainforests and saline wetlands are fire-sensitive. However, some of the reserve's vegetation communities, such as dry and wet heaths and swamp sclerophyll forests and woodlands, are adapted to fires at specific intensities and intervals.

There have been no major fires in the reserve since its reservation in 1986. In 1984–85, a wildfire originating south of the reserve burnt the south-west part of land now included in reserve. Around this time, a small area in the central section of land now forming the reserve also burnt. Since reservation, fires have burnt small areas close to Brunswick Heads and Byron Bay, primarily having escaped from illegal campfires.

In accordance with the *Rural Fires Act 1997*, the Far North Coast Bush Fire Management Committee has prepared a bush fire risk management plan which covers both public and private lands. The plan identifies community assets at risk, appropriate treatments and a coordinated program to reduce risk to assets. NPWS is actively involved with the Far North Coast Bush Fire Management Committee. The bush fire risk management plan identifies a number of very high fire risk areas/assets adjacent to the reserve, including residential and tourist developments, an industrial area and a Council sewerage treatment works.

A reserve-specific fire management strategy which defines the fire management approach for the reserve was prepared in 2008 (NPWS 2008) and will be updated periodically. The fire management strategy outlines the recent fire history of the reserve; key assets within and adjoining the reserve, including sites of natural and cultural heritage value; fire management zones; and fire control advantages such as management trails and water supply points. It also contains fire regime guidelines for conservation of the reserve's vegetation communities.

The reserve's vegetation is classed as medium to high bushfire risk. Apart from two strategic fire advantage zones on the reserve which protect high risk assets, referred to above, the reserve is classified as a land management zone for the purpose of fire management. The primary fire management objectives for this zone are to protect culturally significant sites and to conserve biodiversity. More information on distribution and use of the reserve by the koala and the long-nosed potoroo is required to ensure fire regimes do not adversely impact these populations. Monitoring of the myrtle rust infestation within the strategic fire advantage zones north of Black Rock Road is required to determine its response to fire and to develop control actions, if required.

Vegetated land adjoining the reserve contains similar vegetation and fuel loads. In some cases neighbouring lands are well-placed to provide effective or complementary strategic fire advantage zones.

Built assets on the reserve that are vulnerable to fire include signage and visitor facilities in and around the Tyagarah Day Use Area. A series of trails provide access to the central, western and southern parts of the reserve for fire management purposes. The trails are located on the reserve but are accessed via adjoining private land. NPWS has obtained the permission of adjoining landowners to use their trails to access the reserve. Negotiations are under way to add a Council road reserve to the reserve for fire management purposes.

NPWS maintains cooperative arrangements with surrounding landowners, the Rural Fire Service and other responsible agencies identified in the bush fire risk management plan. Cooperative arrangements include fire planning, fuel management and information sharing.

Desired outcome

- Negative impacts of fire on life, property and the environment are minimised.
- The potential for spread of bushfires on, from or into the reserve is minimised.
- Fire regimes are appropriate for conservation of native plant and animal communities.
- Culturally significant sites are protected.

Management response

4.6.1. Implement the reserve fire management strategy.

4.6.2. Encourage research into the distribution and use of the reserve by key threatened fauna such as the koala and the long-nosed potoroo and identify implications for fire management.

4.6.3. Monitor the myrtle rust infestation within the strategic fire advantage zone north of Black Rock Road to determine its response to fire and implement control actions as required.

4.7 Climate change

Human-induced climate change is listed as a key threatening process under the Biodiversity Conservation Act (NSW SC 2000) and the associated loss of habitat is listed under the Environment Protection and Biodiversity Conservation Act (TSSC 2001).

The latest information on projected changes to climate are from the NSW and ACT Regional Climate Modelling (NARClim) project (OEH 2014). The climate projections for 2020–2039 are described as ‘near future’; and projections for 2060–2079 are described as ‘far future’. The snapshot shown in Table 3 is for the North Coast Region which includes the reserve (OEH 2014).

Table 3 North Coast climate change snapshot

Projected temperature changes	
Maximum temperatures are projected to increase in the near future by 0.4–1.0°C	Maximum temperatures are projected to increase in the far future by 1.5–2.4°C
Minimum temperatures are projected to increase in the near future by 0.5–1.0°C	Minimum temperatures are projected to increase in the far future by 1.6–2.5°C
The number of hot days will increase	The number of cold nights will decrease

Projected temperature changes	
Projected rainfall changes	
Rainfall is projected to decrease in winter	Rainfall is projected to increase in spring and autumn
Projected Forest Fire Danger Index changes	
Average fire weather is projected to increase during summer and spring	Severe fire weather days are projected to increase in summer and spring

Source: OEH 2014.

The projected increases in temperature, number of hot days and severe fire weather days (OEH 2014) are likely to influence bushfire frequency and intensity across the North Coast Region and result in an earlier start to the bushfire season (DECCW 2010c).

Climate change may significantly affect biodiversity by changing the size of populations and the distribution of species, and altering the geographical extent and species composition of habitats and ecosystems. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates.

The potential impact of climate change on the reserve is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration and pressure from introduced animals. Changes in the fire regime are likely to compound the impacts of other climatic changes; for instance, disturbance by fire together with an increase in summer rainfall is likely to benefit weeds such as lantana.

Highly cleared and fragmented ecosystems, such as lowland rainforests and littoral rainforest, are likely to be at greater risk than more intact ecosystems. In these areas in particular, warmer temperatures are likely to worsen weed infestations. Low-lying subtropical rainforest is likely to undergo further structural change, functional disruption and reduced species diversity (DECCW 2010c).

Based on regional scenarios (DECCW 2010c), the likely impacts of climate change for the reserve are:

- An increase in sea level coupled with storms will cause coastline recession of 20–40 metres by 2050.
- Salt water intruding into watertables is likely to raise the salt-watertable on the coastal sandplain and push the freshwater sitting above it towards the surface. In lower areas, salt water is likely to approach or reach the surface. These physical changes in watertables will change the composition of vegetation in affected areas to plants able to cope with these new conditions (see Photo 7).
- Acid sulfate soil problems are likely to increase in the short term but improve in the longer term with inundation of these low-lying soils (see Section 4.5 Repairing the reserve).

The Department has also mapped climate change corridors along climatic gradients for native animals occupying coastal, dry and moist habitats (DEC 2007). These corridors are predicted to be important for wildlife adapting to the threatening processes of climate change. A corridor for fauna occupying coastal habitats encompasses the reserve and connects it to the Brunswick River and Brunswick Heads Nature Reserve to the north, and Cumbebin Swamp Nature Reserve and other parks and reserves of the Byron coast to the south. Long-nosed potoroo, wallum froglet and Olongburra frog are identified as threatened species at particular risk within this area. Maintaining vegetated linkages between reserves is important to facilitate the migration of species in response to the impacts of climate change.

NPWS will continue to manage threats from climate change to reserve values in a collaborative way with other land managers. The presence of the reserve will improve the resilience of natural and cultural values through the protection of native flora and fauna (DECCW 2010c).

Furthermore, programs to reduce the pressures arising from other threats, such as invasive species and bushfires, will also help reduce the severity of the effects of climate change.

Desired outcomes

- The effects of climate change on natural systems are reduced (see Sections 4.4 Pests, 4.5 Repairing the Reserve and 4.6 Fire).
- Visitor facilities are managed taking into account the likely impacts of climate change (see Section 4.5 Repairing the Reserve).
- Implement approved options from the coastal zone management plan as appropriate and subject to any relevant environmental impact assessment requirements.

Management response

4.7.1. Continue existing fire, pest and weed management and bushland restoration programs and adapt where required to minimise climate change-induced threats.

Photo 8 Climate change is likely to result in saltwater intrusions into watertables resulting in changes to the types of plants growing in swamp forests to favour plants adapted to higher salinity.

5. Using and knowing about Country

5.1 Keeping connected with Country – Cultural renewal

Aboriginal people have adapted and sustained their cultural identity despite the impacts brought about by European settlement. The links Aboriginal people maintain with Country continue to be expressed through stories, descent, occupation and use. Aboriginal people maintain their cultural identity and links with Country through cultural learning passed on by Elders to the following generations.

NPWS recognises that the Arakwal and other Bundjalung people may want to undertake cultural activities in the reserve and that these activities are important to transfer knowledge and to maintain, renew or repair cultural associations with Country. Cultural activities may include the use of wild resources.

Desired outcome

- The Aboriginal community has access to the reserve for cultural activities while ensuring that the reserve's biodiversity values are protected.

Management response

5.1.1. Permit cultural activities in accordance with NPWS consent and any conditions.

5.2 Managing use of the reserve

NPWS parks and reserves provide a range of opportunities for recreation and tourism including opportunities for relaxation and renewal as well as appropriate active pursuits. Visitor opportunities provided in the natural and undeveloped settings afforded by the parks system are mostly those at the low-key end of the spectrum. NPWS aims to ensure that visitors experience, enjoy and appreciate the parks at the same time as conserving and protecting park values.

The reserve is located in the North Coast Region which has a 2016 (projected) population of 519,300 and is expected to grow to 561,700 by 2026 (DPE 2016). The region attracted 11,325,900 visitors in 2015. Approximately 30% of Australian visitors came from Queensland while 24% came from Sydney and 38% from regional NSW (Destination NSW 2016). The reserve's position close to the growth hub of South East Queensland means that potential reserve visitation demand is high. The reserve has few visitor facilities and limited access for visitors. Planning for visitor use of the reserve focuses on low-key use, such as picnicking, bushwalking and nature appreciation. The reserve provides a natural coastal setting which includes sandy beaches, heath, wetland, woodland and rainforest. Most visitor activity in the reserve is concentrated at the Tyagarah Day Use Area and the adjacent beach. Other popular sites are the tea-tree lake on the north side of Black Rock Road, and the Coast Trail running north from the day use area to Brunswick Heads (see Map 1).

Most visitors use the beach or lake, have a picnic, go on a bushwalk or undertake some other form of nature appreciation. The Cape Byron SCA at Byron Bay, five kilometres south, provides a broad range of recreation opportunities, information and visitor facilities. The beach south of the day use area, below high tide mark, is Crown land. Byron Shire Council resolved at an Ordinary Meeting on 27 October 1998 to designate the beach for 'clothes optional' bathing under the *Local Government Act 1993*.

Reserve visitation needs to be carefully managed as visitors can negatively impact on important cultural and natural values. The nature and severity of potential visitor impacts depend on the type, frequency and interaction of activities, visitor numbers and behaviour, site capacity and durability, and the sensitivity of the site's cultural and natural values. An example of this is that visitors attending unapproved dance parties in the reserve have damaged reserve infrastructure and the environment. Peak visitation currently occurs in summer and on long weekends. At these times the capacity of the reserve's limited infrastructure may be exceeded.

In addition to destroying vegetation and infrastructure and dumping rubbish, visitors may also bring their domestic pets, which prey on and disturb native animals and their habitats. Visitors have also reported problems with offensive, obscene or other antisocial behaviour among some users of the tea-tree lake. These matters have been reported to the police and signage has been erected at the tea-tree lake encouraging visitors to report problems to the police.

Similarly, there have been reports of offensive, obscene or antisocial behaviour associated with some users of Council's 'clothes optional' beach, including visitors being inappropriately dressed in the adjacent day use area in the reserve. NPWS reports these matters to the police and NPWS has erected signage in the day use area encouraging people to report any problems to police.

NPWS meets regularly with police to discuss the policing of offensive behaviour in the reserve. The police take action in response to public reports and consultation with NPWS.

At times, the reserve may need to be closed to protect visitors and the environment, including when hazard reduction burns are being carried out, or during natural disasters such as flooding, bushfires and storms. NPWS will erect a gate in order to temporarily close the reserve at these times.

Day use

Day use areas, typically picnic facilities or sites for interpretation and education, are often the main destination for the vast majority of visitors to parks and reserves. The Tyagarah Day Use Area, at the eastern end of Black Rock Road, is the main visitor hub for the reserve and the only location with visitor facilities and interpretation. Black Rock Road, which connects to Grays Lane and the Pacific Highway, is a public park road and the main visitor access to the reserve. It terminates at the day use area (see Photo 8 and Map 1).

Black Rock Road and Grays Lane are unsealed but are accessible by two-wheel drive vehicles. Grays Lane floods seasonally, which cuts public access to the reserve.

The day use area is located in a semi-natural setting, which is recovering from previously unregulated recreational use and possibly from sand mining. The day use area provides a sealed car park for approximately 40 vehicles, picnic tables, toilets, an interpretive display and a beach access track (see Photos 8 and 10). Entry fees were introduced at the day use area in 2000. The day use area will continue to be promoted as the reserve's visitor access hub. Interpretive displays at the day use area will be maintained and updated.

Coastal erosion affects the beach access track which, as a result, is often steep and uneven. When major track deterioration occurs, the beach access track is temporarily closed to protect visitors. The day use area is located behind a frontal dune and periodically wind erosion blows large quantities of sand up the access track and into the car park. No further expansion of the day use area is proposed considering the potential impacts of expansion on the surrounding vegetation and its setting adjoining a receding beachfront (see Section 4.5 Repairing the Reserve).

Photo 9 Tyagarah Day Use Area offers low-key picnic and interpretive facilities.

Bushwalking

Bushwalking allows visitors to be in close contact with the environment and can increase understanding and enjoyment of parks and the environment generally. The reserve provides self-reliant bushwalking opportunities in a largely natural, coastal setting featuring sandy beaches, heath, wetland, woodland and rainforest. A small proportion of visitors who are experienced and equipped for self-reliant bushwalking utilise more remote areas of the reserve.

There are no formal walking tracks within the reserve, however, management trails are used by walkers. The seven-kilometre Coast Trail (see Map 1) is particularly popular with bushwalkers and birdwatchers. This management trail is gated at both ends to prevent unauthorised vehicle access. The surface of the trail is sandy with minimal modification and few signs. Only experienced, self-reliant walkers should attempt to walk the length of the trail as climatic conditions are often harsh, water is not available and the location is relatively remote.

Other management trails used by walkers connect Simpsons Creek and the oxbow lake to the beach.

Horse riding

Horse riding is a popular recreational activity that has cultural associations for many Australians. The NPWS *Strategic Directions for Horse Riding in NSW National Parks* (OEH 2012b) provides a framework to improve horse riding opportunities in eight priority regions in New South Wales, including the Northern Rivers Region. Horse riding is currently permitted nearby including at Nightcap, Goonengerry and Mount Jerusalem national parks.

Horse riding opportunities in numerous national parks in the region are being progressed in accordance with the *Northern Rivers Region Horse Riding Work Plan 2013* (OEH 2013b)

Horse riding has not been permitted in the reserve since its gazettal and there is no current use. Horse riding is not permitted on the section of Black Rock Road within the reserve due to road safety considerations, including the likelihood of conflict with vehicular road users,

particularly in peak visitation periods. Similarly, horse riding is not considered appropriate on management trails in the reserve due to horse riding not being permitted in NPWS nature reserves under the NPWS *Recreational Horse Riding Policy* (DEC 2006b), safety considerations and likelihood of conflict with other well-established recreational uses such as bushwalking and cycling. However, horse riding is currently allowed below mean high water mark on the beach adjoining the reserve under permit from the DPI Fisheries.

Cycling

Under NPWS policy, cycling is only allowed on management trails and park roads in nature reserves where it will not degrade natural or cultural heritage values. In accordance with NPWS policy and the *Sustainable Mountain Biking Strategy* (OEH 2011e) cycling is permitted on the following park roads and management trails: Black Rock Road, Coast Trail, Oxbow Trail, Simpsons Trail and, when up to the required standard, on Trail 1 and Trail 2 (see Map 1). Competitive cycling is not permitted in the reserve.

Black Rock Road is unsealed and is periodically maintained to a standard suitable for two-wheel-drive vehicular access. The generally sandy nature of trails offers opportunities for more experienced riders.

Camping

Camping is not permitted in this nature reserve. Visitor accommodation in nature reserves is only permissible where it is consistent with the management principles for nature reserves, for example, accommodation relating to a research activity. Camping is available at a number of local campgrounds at the nearby towns of Brunswick Heads, Mullumbimby and Byron Bay.

Commercial activities and organised activities

Commercial activities and organised activities of 40 people or more require consent or licensing under the National Parks and Wildlife Act or Regulation. All approved activities must be consistent with the management principles of nature reserves and be compatible with the reserve's cultural and natural heritage values.

Group activities can provide opportunities for people who would otherwise not be able to experience the reserve and can promote environmental understanding and support for conservation. Large groups, however, can have an environmental impact and can restrict opportunities for independent visitors.

All applications for activities will be assessed in accordance with relevant NPWS policies and procedures. Applications for commercial activities and organised activities of 40 people or more will only be considered for the Tyagarah Day Use Area (as it is highly modified and has appropriate, although limited, visitor facilities) and for access to the adjacent beach.

However, NPWS considers that there are much more suitable locations locally for commercial activities and organised activities of 40 or more people, including at Cape Byron SCA, which is located adjacent to the visitor hub of Byron Bay and has adequate infrastructure to support such activities. In view of this, mobile refreshment vendors and equipment hire; commercial recreational activities, such as fitness training and kayak tours; access for surf schools; and events or functions such as weddings and dance parties will not be permitted in the reserve.

However, applications will be considered for (foot) running events on reserve management trails and Black Rock Road and pedestrian-based tour operations from the Tyagarah Day Use Area, which utilise reserve management trails (see Map 1).

Cultural activities

Cultural activities can be undertaken in the reserve by the Aboriginal community (see Section 5.1 Keeping connected with Country, and management response 5.1.1).

Management trails

Management trails are trails that are primarily for park management or other authorised purposes, for example, emergency access and specified recreational activities such as bushwalking and cycling.

A number of management trails exist in the reserve (see Map 1). It is proposed to upgrade two informal footpads to management trails (see Map 1 and Photo 9). Both trails are less than 150 metres in length and connect the Coast Trail to the beach. Upgrading these trails would improve management of the reserve, in particular weed control works. Both trails would also be available for visitor use (i.e. bushwalking and cycling). Use of the trail for certain emergency purposes, such as firefighting is permitted. In the event of fire, middens should be actively protected from damage as far as possible.

Photo 10 *Two informal footpads will be upgraded to enable them to be used for management purposes as well as by visitors.*

Apiary sites

Apiarists maintain seasonal honeybee hives at a site within the reserve. The site is recognised as an existing interest under the National Parks and Wildlife Act as it pre-dates the reserve's gazettal. NPWS policy on beekeeping allows existing sites to continue but does not allow any new or additional sites. The European honeybee (*Apis mellifera*) can have adverse impacts on some native plants and animals including poor flower pollination and competition with native nectar feeders (Paton 1996).

The apiary site is limited in size and is maintained by mowing or slashing. Access to the apiary site is off Black Rock Road via a short mown access trail. While no problems are currently known in the reserve, hive sites have the potential to cause unacceptable environmental impacts and/or user conflicts. Where required, NPWS will aim to negotiate relocation of hives to other areas within the reserve to allow the closure of trails not required for other purposes and/or to minimise the impact of honeybees.

Recreational fishing

Recreational fishing currently occurs in Simpsons Creek and on the beaches adjacent to the reserve. Recreational fishing in these areas is subject to the provisions of the Cape Byron Marine Park zoning plan.

Cape Byron Marine Park

Coastal areas below the mean high water mark east of the reserve, and the tidal water of Simpsons Creek, including stretches of the creek within the reserve, form part of the Cape Byron Marine Park (see Map 1). NPWS and DPI Fisheries aim to ensure that management of the reserve and the marine park are complementary.

Easements and public utilities

There are no easements or public utilities within the reserve.

Desired outcome

- Visitor use is appropriate and ecologically sustainable.
- Visitor facilities and activities are planned and managed to provide a satisfying visitor experience and minimise impacts.
- The impact of apiary activities on the reserve is minimised.

Management response

5.2.1. Cycling is permitted on Black Rock Road, the Coast Trail and other management trails shown on Map 1.

5.2.2. Competitive cycling is not permitted in the reserve.

5.2.3. Camping and horse riding are not permitted in the reserve.

5.2.4. Continue to meet regularly with police to discuss requirements for the policing of offensive behaviour in the reserve.

5.2.4. Erect a gate to enable the temporary closure of the reserve to protect visitors and the environment when necessary. Identify a safe location within the reserve on Black Rock Road, or liaise with Byron Shire Council to identify an appropriate location on Grays Lane.

5.2.5. Upgrade footpads marked on Map 1 as Trail 1 and Trail 2 to management trails.

5.2.6. Maintain management trails as shown on Map 1, taking into account the Tyagarah Nature Reserve Coastal Trail – Aboriginal Cultural Heritage Due Diligence Assessment (Piper & Hill 2018) regarding the management of culturally significant middens.

5.2.7. Applications for commercial activities and organised activities of more than 40 people will only be considered for the Tyagarah Day Use Area and for access to the beach, except for running events on reserve management trails and Black Rock Road and pedestrian-based tours from the day use area utilising management trails as shown on Map 1.

5.2.8. Mobile refreshment vendors, equipment hire, commercial recreational activities (e.g. fitness training, kayak tours, surf schools) and events and functions (such as weddings and dance parties) are not permitted.

5.2.9. Monitor approved activities with respect to cumulative impacts, safety requirements, quality of information being given and compliance with licence or consent conditions and institute controls and/or change consent conditions if necessary.

5.3 Talking about Country – Providing information

Providing information assists the protection of cultural and natural heritage, promotes support for conservation, and increases the enjoyment and satisfaction of visitors. Information about the reserve's biodiversity values is provided at an information shelter at the Tyagarah Day Use Area (see Photo 10).

The nearby Cape Byron SCA provides additional, complementary information on cultural and biodiversity values of the parks and reserves along the Byron coast. The Cape Byron headland in the Cape Byron SCA is also a good vantage point from which to view the reserve's broader landscape setting.

Photo 11 *Information shelter at the Tyagarah Day Use Area provides visitors with information about the reserve's biodiversity values.*

Desired outcome

There is widespread community understanding and appreciation of the reserve's natural and cultural values.

Management response

5.3.1. Develop visitor information about the reserve's recreational opportunities and cultural and biodiversity values.

5.3.2. Consult and involve the Arakwal in the development and the delivery of visitor information and programs on the reserve's Aboriginal cultural values and biodiversity.

5.4 Understanding Country – Research and monitoring

The Arakwal have a broad knowledge of Country as told by the Elders through oral history. NPWS respects this intellectual property and wishes to add to this body of knowledge. Research is an important part of 'Looking after Country' (see Section 4) and 'Knowing about Country' (see Section 5) as it ensures reserve values are clearly identified and managed as well as possible.

Research and monitoring assists NPWS to assess the success of reserve management programs and may trigger specific management actions. In particular, monitoring of plant and animal communities, species and habitats is important to identify changes in their distribution and abundance due to human impacts and the impacts of introduced species, management activities, climate change and responses to natural phenomenon (see Figure 2).

Research and monitoring which assists management of the reserve will be encouraged, such as into Aboriginal and non-Aboriginal cultural heritage; threatened and migratory species and threatened ecological communities; acid sulfate soils; climate change; and pest species and fire and their impacts on native plants and animals (see Sections 4.2 The story of Country, 4.3 Native plants and animals, 4.4 Pests, 4.5 Repairing the reserve, 4.6 Fire and 4.7 Climate change).

Desired outcome

- Research programs enhance NPWS capacity to manage the reserve's values.
- Research and monitoring has minimal impact on the reserve's natural and cultural values.

Management response

5.4.1. Permit research and monitoring, subject to NPWS licensing/consent requirements.

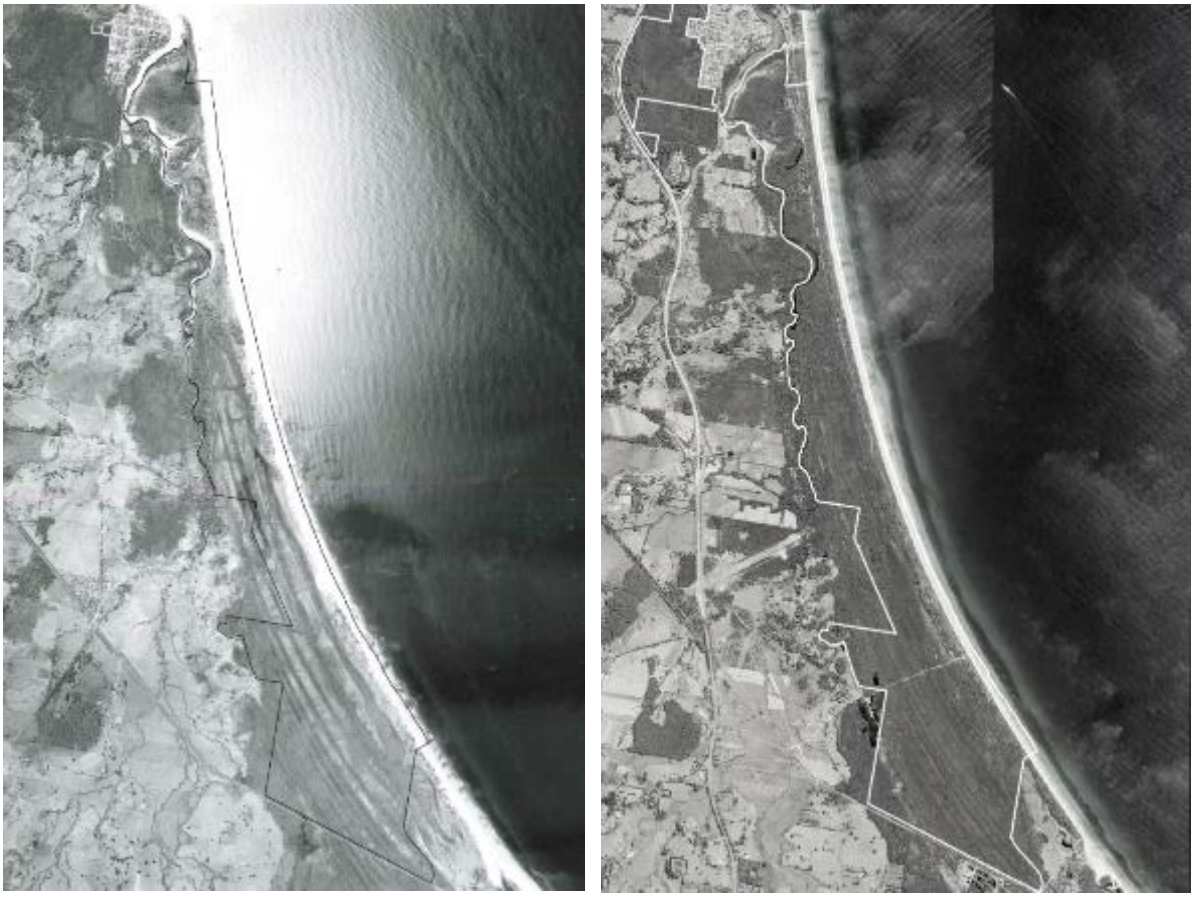


Photo 12 *Aerial photographs from 1958 (left) and 2009 (right) showing regeneration of the reserve's vegetation. Monitoring helps us to understand how vegetation changes over time. (Source: Land & Property Information 1958, 2009)*

6. Plan implementation

This plan of management establishes a scheme of operations for the Tyagarah Nature Reserve. Implementation of this plan will be undertaken within the annual program of NPWS.

Identified activities for implementation are listed in Table 4. Relative priorities are allocated against each activity as follows:

- **High priority** activities are those imperative to achievement of the objectives and desired outcomes. They must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.
- **Medium priority** activities are those that are necessary to achieve the objectives and desired outcomes but are not urgent.
- **Low priority** activities are desirable to achieve management objectives and desired outcomes but can wait until resources become available.
- **Ongoing** is for activities that are undertaken on an annual basis or statements of management intent that will direct the management response if an issue arises.

This plan of management does not have a specific term and will stay in force until amended or replaced in accordance with the National Parks and Wildlife Act.

Table 4 List of management responses

Section no.	Management response	Priority
4.1 Joint management		
4.1.1	Issues and proposals relating to the care, control and management of the reserve will be referred to the Management Committee for their consideration and recommendations.	High
4.1.2	Implement the ILUA agreements.	High
4.2 The Story of Country that is now the Reserve		
4.2.1	Record the location of Aboriginal and non-Aboriginal heritage sites in the reserve.	Medium
4.2.2	Record Aboriginal and non-Aboriginal stories about the reserve and its significance.	Medium
4.4.3	Undertake heritage assessments to identify the location, significance and conservation of historic heritage sites/items, including historical archaeological sites, within the reserve.	High
4.2.4	Obtain legislative approvals for work to, or which may impact, historic heritage, including archaeological sites.	Ongoing
4.3 Native plants and animals		
4.3.1	Implement actions in the *Biodiversity Conservation Program*, recovery plans and biodiversity management plans for threatened species and ecological communities in the reserve.	High
4.3.2	Encourage flora, vegetation and fauna surveys of the reserve to address knowledge gaps, including those relating to threatened and migratory species, and threatened ecological communities.	Ongoing
4.4 Pests		

Section no.	Management response	Priority
4.4.1	Implement priority bitou bush and fox control strategies in accordance with relevant pest management strategies, threat abatement plans and any other relevant plans.	High
4.4.2	Encourage research into the response of the reserve's long-nosed potoroo population to the fox TAP baiting program.	High
4.4.3	Seek the cooperation of neighbours, where appropriate, in implementing pest animal management programs.	Medium
4.4.4	Finalise and implement the reserve-specific weed management strategy, incorporating monitoring.	High
4.5 Repairing the Reserve		
4.5.1	Encourage research into the location of acid sulfate soils and constructed drains in the reserve and their condition, extent and impacts on biodiversity and identify any amelioration measures required. In the event that investigations recommend new structures to ameliorate acid sulfate soils are needed, an amendment to this plan will be required prior to works.	Ongoing
4.5.2	Work with Byron Shire Council and other stakeholders to minimise the impacts on the Belongil Creek estuary caused by acid sulfate soil runoff.	Ongoing
4.6 Fire		
4.6.1	Implement the reserve fire management strategy.	High
4.6.2	Encourage research into the distribution and use of the reserve by key threatened fauna such as the koala and the long-nosed potoroo and identify implications for fire management.	High
4.6.3	Monitor the myrtle rust infestation within the strategic fire advantage zone north of Black Rock Road to determine its response to fire and implement control actions as required.	Ongoing
4.7 Climate change		
4.7.1	Continue existing fire, pest and weed management and bushland restoration programs and adapt where required to minimise climate change-induced threats.	Ongoing
5.1 Keeping connected to Country – Cultural renewal		
5.1.1	Permit cultural activities in accordance with NPWS consent and any conditions.	Ongoing
5.2 Managing use of the reserve		
5.2.1	Cycling is permitted on Black Rock Road, the Coast Trail and other management trails shown on Map 1.	Ongoing
5.2.2	Competitive cycling is not permitted in the reserve.	Ongoing
5.2.3	Camping and horse riding are not permitted in the reserve.	Ongoing
5.2.4	Continue to meet regularly with police to discuss requirements for the policing of offensive behaviour in the reserve.	High
5.2.5	Erect a gate to enable the temporary closure of the reserve to protect visitors and the environment when necessary. Identify a safe location within the reserve on Black Rock Road, or liaise with Byron Shire Council to identify an appropriate location on Grays Lane.	High

Section no.	Management response	Priority
5.2.6	Upgrade footpads marked on Map 1 as Trail 1 and Trail 2 to management trails.	Ongoing
5.2.7	Maintain management trails as shown on Map 1, taking into account the Tyagarah Nature Reserve Coastal Trail – Aboriginal Cultural Heritage Due Diligence Assessment (Piper & Hill 2018) regarding the management of culturally significant middens.	Ongoing
5.2.8	Applications for commercial activities and organised activities of more than 40 people will only be considered for the Tyagarah Day Use Area and for access to the beach, except for running events on reserve management trails and Black Rock Road and pedestrian-based tours from the day use area utilising reserve management trails as shown on Map 1.	Ongoing
5.2.9	Mobile refreshment vendors, equipment hire, commercial recreational activities (e.g. fitness training, kayak tours, surf schools) and events and functions (such as weddings and dance parties) are not permitted.	Ongoing
5.2.10	Monitor approved activities with respect to cumulative impacts, safety requirements, quality of information being given and compliance with licence or consent conditions and institute controls and/or change consent conditions if necessary.	Medium
5.3 Talking about Country – Providing information		
5.3.1	Develop visitor information about the reserve's recreational opportunities and cultural and biodiversity values.	High
5.3.2	Consult and involve the Arakwal in the development and delivery of visitor information and programs on the reserve's Aboriginal cultural values and biodiversity.	High
5.4 Understanding Country – Research and monitoring		
5.4.1	Permit research and monitoring, subject to NPWS licensing/consent requirements.	Ongoing

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Appendix 1. Plants important to the Arakwal for wild resource use

Common name	Scientific name	Use
Bangalow palm	*Archontophoenix cunninghamiana*	Sled, etc.
Blady grass	*Imperata cylindrica*	Roofing shelters, mattress and pillow filling
Blue lilly pilly	*Syzygium oleosum*	Edible fruit
Brown kurrajong	*Commersonia bartramia*	Fibre for weaving nets and bags
Coast morning glory	*Ipomoea brasiliensis*	Skipping rope
Five corners	*Styphelia viridis*	Edible fruit
Geebung	*Persoonia adenantha* *Persoonia stradbrokensis*	Edible fruit
Grass tree	*Xanthorrhoea spp.*	Firewood, aromatic insect-repelling oils, nectar
Grey mangrove	*Avicennia marina*	Shields
Honeysuckle	*Banksia integrifolia*	Nectar, flowers for combs, seedpods for firewood
Lawyer cane	*Calamus muelleri*	Canes for weaving
Long yam	*Dioscorea transversa*	Edible tuber
Mat-rush	*Lomandra longifolia*	Fibre for weaving baskets and bags
Molucca bramble	*Rubus moluccana*	Edible fruit
Midyim	*Austromyrtus dulcis*	Edible fruit
Native parsnip	*Trachymene incisa*	Edible root
Pandanus	*Pandanus tectorius*	Food
Paperbark tea-tree	*Melaleuca quinquenervia*	Roofing shelters, baby blanket, bandage wounds, wrap meat for cooking
Pigface	*Carpobrotus glaucescens*	Food
Raspberries	*Rubus spp.*	Edible fruit
Sandpaper fig	*Ficus coronata*	Leaves for sandpaper
Soft twig-rush	*Baumea rubiginosa*	Fibre for weaving bags
Strangler fig	*Ficus watkinsiana*	Edible fruit
Supplejack	*Flagellaria indica*	Canes for weaving
Wallum banksia	*Banksia aemula*	Edible nectar, brush, fuel
Wallum geebung	*Persoonia virgata*	Edible fruit
Water vine	*Cissus spp.*	Edible fruit, water in stems, vine for climbing

Source: Low et al. 2003a, 2003c.

Appendix 2. Vegetation classes and common plants

Vegetation class	Common plants	
	Common name	**Scientific name**
Saltmarsh	Saltwater couch	*Sporobolus virginicus*
	Samphire	*Sarcocornia quinqueflora*
Mangrove shrubland	River mangrove	*Avicennia marina*
	Grey mangrove	*Aegiceras corniculatum*
Rushland	Common reed	*Phragmites australis*
	Sea rush	*Juncus kraussii*
Sedgeland	Grey rush	*Lepironia articulata*
	Slender twine-rush	*Leptocarpus tenax*
	Didgery sticks	*Baloskion pallens*
	Zig-zag bog rush	*Schoenus brevifolius*
	Bare twig-rush	*Baumea juncea*
Dry heath	Midgenberry	*Austromyrtus dulcis*
	Tree broom-heath	*Monotoca elliptica*
	Wallum banksia	*Banksia aemula*
	Black she-oak	*Allocasuarina littoralis*
	Grass trees	*Xanthorrhoea* spp.
Wet heath	Fern-leaved banksia	*Banksia oblongifolia*
	Heath-leaved banksia	*Banksia ericifolia*
	Olive tea-tree	*Leptospermum liversidgei*
	Prickly tea-tree	*Leptospermum juniperinum*
	Sprengelia	*Sprengelia sprengelioides*
	Knotted scale-rush	*Sporadanthus interruptus*
Swamp sclerophyll forest	Broad-leaved paperbark	*Melaleuca quinquenervia*
	Swamp oak	*Casuarina glauca*
	Swamp mahogany	*Eucalyptus robusta*
Dry sclerophyll forest and woodland	Pink bloodwood	*Corymbia intermedia*
	Scribbly gum	*Eucalyptus signata*
	Black she-oak	*Allocasuarina littoralis*
Rainforest	Tuckeroo	*Cupaniopsis anacardioides*
	Brush box	*Lophostemon confertus*
	Beach acronychia	*Acronychia imperforata*
Disturbed frontal dune complex	Bitou bush	*Chrysanthemoides monilifera*
	Coast banksia	*Banksia integrifolia*
	Coast wattle	*Acacia longifolia* subsp. *sophorae*
	Horsetail she-oak	*Casuarina equisetifolia*
	Tree broom-heath	*Monotoca elliptica*

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm; NPWS 2000.

Appendix 3. Threatened and significant fauna

Common name	Scientific name	Conservation status [1]	Known/likely to occur
Amphibians			
Wallum froglet	*Crinia tinnula*	Vulnerable	Known
Green and golden bell frog	*Litoria aurea*	Endangered [2]	Known [3]
Olongburra frog	*Litoria olongburensis*	Vulnerable [2]	Known
Birds			
Pale-vented bush-hen	*Amaurornis moluccana*	Vulnerable	Likely [4]
Red-necked stint	*Calidris ruficollis*	Bonn CAMBA JAMBA ROKAMBA	Known
Glossy black-cockatoo	*Calyptorhynchus lathami*	Vulnerable	Likely
Eastern reef egret	*Egretta sacra*	CAMBA	Known
Black-necked stork	*Ephippiorhynchus asiaticus*	Endangered	Known
Latham's snipe	*Gallinago hardwickii*	Bonn CAMBA JAMBA ROKAMBA	Known
Little lorikeet	*Glossopsitta pusilla*	Vulnerable	Known
Sooty oystercatcher	*Haematopus fuliginosus*	Vulnerable	Known
Pied oystercatcher	*Haematopus longirostris*	Vulnerable	Known
White-bellied sea-eagle	*Haliaeetus leucogaster*	BC Act, CAMBA	Known
White-throated needletail	*Hirundapus caudacutus*	CAMBA JAMBA ROKAMBA	Known
Caspian tern	*Hydroprogne caspia*	CAMBA JAMBA	Known
Black bittern	*Ixobrychus flavicollis*	Vulnerable	Likely
Mangrove honeyeater	*Lichenostomus fasciogularis*	Vulnerable	Likely
Rainbow bee-eater	*Merops ornatus*	JAMBA	Known
Black-faced monarch	*Monarcha melanopsis*	Bonn	Known
Eastern curlew	*Numenius madagascariensis*	Bonn CAMBA JAMBA ROKAMBA	Known
Whimbrel	*Numenius phaeopus*	Bonn CAMBA JAMBA ROKAMBA	Known
Osprey	*Pandion haliaetus*	Vulnerable	Known
Glossy ibis	*Plegadis falcinellus*	CAMBA	Known
Diamond firetail	*Stagonopleura guttata*	Vulnerable	Known

Common name	Scientific name	Conservation status [1]	Known/likely to occur
Little tern	*Sterna albifrons*	Endangered	Known
Common tern	*Sterna hirundo*	CAMBA JAMBA ROKAMBA	Known
Collared kingfisher	*Todiramphus chloris*	Vulnerable	Known
Eastern grass owl	*Tyto longimembris*	Vulnerable	Known
Mammals			
Little bentwing-bat	*Miniopterus australis*	Vulnerable	Known
Southern myotis	*Myotis macropus*	Vulnerable	Known
Koala	*Phascolarctos cinereus*	Vulnerable [2]	Known
Common planigale	*Planigale maculata*	Vulnerable	Known
Long-nosed potoroo	*Potorous tridactylus*	Vulnerable	Known
Grey-headed flying-fox	*Pteropus poliocephalus*	Vulnerable [2]	Known
Greater broad-nosed bat	*Scoteanax rueppellii*	Vulnerable	Known
Common blossom-bat	*Syconycteris australis*	Vulnerable	Known

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm; Australian Museum Business Services (1995).

Key:

[1] Conservation status:

Listed as vulnerable or endangered under the Biodiversity Conservation Act

International migratory species agreements under the Environment Protection and Biodiversity Conservation Act:

Bonn = Bonn Convention on the Conservation of Migratory Species of Wild Animals;

CAMBA = China - Australia Migratory Bird Agreement;

JAMBA = Japan - Australia Migratory Bird Agreement;

ROKAMBA = Republic of Korea - Australia Migratory Bird Agreement

[2] Species listed as vulnerable under the Environment Protection and Biodiversity Conservation Act.

[3] Species not recorded in subsequent surveys since 1986.

[4] Noted in the Reserve Reference Statement (NPWS 1984).

Appendix 4. Migratory [1] birds recorded in the reserve and their movements

Common name	Scientific name	Breeds in the northern hemisphere, recorded locally in summer	Over-winters in Papua New Guinea and/or Nth Queensland, breeds locally in summer	Migrates north from southern states to over- winter locally	Altitudinal migrants from the New England Tablelands and ranges that overwinter locally
Common tern	*Sterna hirundo*	◙			
Eastern curlew	*Numenius madagascariensis*	◙			
Latham's snipe	*Gallinago hardwickii*	◙			
Whimbrel	*Numenius phaeopus*	◙			
White-throated needletail	*Hirundapus caudacutus*	◙			
Black-faced monarch	*Monarcha melanopsis*		◙		
Brush cuckoo	*Cacomantis variolosus*		◙		
Channel-billed cuckoo	*Scythrops novaehollandiae*		◙		
Clamorous reed-warbler	*Acrocephalus stentoreus*		◙		
Common koel	*Eudynamys orientalis*		◙		
Dollarbird	*Eurystomus orientalis*		◙		
Rufous fantail	*Rhipidura rufifrons*		◙		
Black-faced cuckoo-shrike	*Coracina novaehollandiae*			◙	
Fantailed cuckoo	*Cacomantis flabelliformis*			◙	
Golden whistler	*Pachycephala pectoralis*			◙	◙
Grey fantail	*Rhipidura fuliginosa*			◙	
Shining bronze-cuckoo	*Chalcites lucidus*			◙	
Silvereye	*Zosterops lateralis*			◙	
Tree martin	*Hirundo nigricans*			◙	
Eastern spinebill	*Acanthorhynchus tenuirostris*				◙
Grey fantail	*Rhipidura fuliginosa*				◙
Little friarbird	*Philemon citreogularis*				◙
Topknot pigeon	*Lopholaimus antarcticus*				◙

Common name	Scientific name	Breeds in the northern hemisphere, recorded locally in summer	Over-winters in Papua New Guinea and/or Nth Queensland, breeds locally in summer	Migrates north from southern states to over- winter locally	Altitudinal migrants from the New England Tablelands and ranges that overwinter locally
White-headed pigeon	*Columba leucomela*				■
Yellow-faced honeyeater	*Lichenostomus chrysops*				■

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm; Byron Shire Council (1999).

1 Some species also have resident populations that do not undertake seasonal migratory movement. Some migratory birds may not return to their alternate habitats.

Appendix 5. Animals recorded in the reserve representative of biogeographic subregions

Subregion	Common name	Scientific name
Tumbunan	Barred cuckoo-shrike	*Coracina lineata*
	Dwarf crowned snake	*Cacophis krefftii*
	Regent bowerbird	*Sericulus chrysocephalus*
	Topknot pigeon	*Lopholaimus antarcticus*
Torresian	Bar-shouldered dove	*Geopelia humeralis*
	Blue-faced honeyeater	*Lonchura castaneothorax*
	Chestnut-breasted mannikin	*Entomyzon cyanotis*
	Common planigale	*Planigale maculatus*
	Grassland melomys	*Melomys burtoni*
	Grass owl	*Tyto capensis*
	Little friarbird	*Philemon citreogularis*
	Major skink	*Egernia frerei*
	Northern brown bandicoot	*Isoodon macrourus*
	Red-backed fairy-wren	*Malurus melanocephalus*
	Robust ctenotus	*Ctenotus robustus*
	White-breasted woodswallow	*Artamus leucorynchus*
Bassian	Brown-striped frog	*Limnodynastes peronii*
	Bush rat	*Rattus fuscipes*
	Common eastern froglet	*Crinia signifera*
	Dark-flecked garden sunskink	*Lampropholis delicata*
	Eastern falsistrelle	*Falsistrellus tasmaniensis*
	Eastern spinebill	*Acanthorhynchus tenuirostris*
	Koala	*Phascolarctos cinereus*
	Lace monitor	*Varanus varius*
	Superb fairy-wren	*Malurus cyaneus*
Eyrean	Burton’s snake-lizard	*Lialis burtonis*
	Crested pigeon	*Ocyphaps lophotes*
	Galah	*Eolophus roseicapillus*
	Pied butcherbird	*Cracticus nigrogularis*
	Striped honeyeater	*Plectorhyncha lanceolata*
Irian	Common blossom-bat	*Syconycteris australis*
	Rainbow lorikeet	*Trichoglossus haematodus*

Subregion	Common name	Scientific name
	Scarlet honeyeater	*Myzomela sanguinolenta*
Wallum	Southern emu-wren	*Stipiturus malachurus*
	Wallum froglet	*Crinia tinnula*
	Wallum tree frog	*Litoria olongburensis*

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm; Landmark, Ecograph & Terrafocus 1999.

Appendix 6. Birds of the reserve that feed on rainforest fruits

Common name	Scientific name
Australasian figbird	*Sphecotheres vieilloti*
Black-faced cuckoo-shrike	*Coracina novaehollandiae*
Brown cuckoo-dove	*Macropygia amboinensis*
Eastern koel	*Eudynamys orientalis*
Eastern rosella	*Platycercus eximius*
Lewin's honeyeater	*Meliphaga lewinii*
Mistletoebird	*Dicaeum hirundinaceum*
Olive-backed oriole	*Oriolus sagittatus*
Pied currawong	*Strepera graculina*
Rainbow lorikeet	*Trichoglossus haematodus*
Regent bowerbird	*Sericulus chrysocephalus*
Satin bowerbird	*Ptilonorhynchus violaceus*
Scaly-breasted lorikeet	*Trichoglossus chlorolepidotus*
Silvereye	*Zosterops lateralis*
Topknot pigeon	*Lopholaimus antarcticus*
Torresian crow	*Corvus orru*
Varied triller	*Lalage leucomela*
White-headed pigeon	*Columba leucomela*

Source: Atlas of NSW Wildlife, accessed 2014 at www.environment.nsw.gov.au/wildlifeatlas/about.htm; Holmes 1987.

Appendix 7. Weeds

Common name	Scientific name	Distribution
Crofton weed [1]	*Ageratina adenophora*	Common in places
Ground asparagus [2]	*Asparagus aethiopicus*	Scattered to dense north and south of entrance to the oxbow lake
Climbing asparagus [2]	*Asparagus plumosus*	Rare
Groundsel	*Baccharis halimifolia*	Occasional
Bitou bush [2, 3]	*Chrysanthemoides monilifera*	Moderate to dense east of Coast Trail, light to moderate west of trail
Camphor laurel [1]	*Cinnamomum camphora*	Occasional to common
Coral tree	*Erythrina x sykesii*	Sparse in north-west of reserve
Glory lily [1]	*Gloriosa superba*	Rare
Lantana [1, 3]	*Lantana camara*	Light to dense on southern part of management trail, common to dense on drain spoil south of Black Rock Road
Coast tea-tree	*Leptospermum laevigatum*	Occasional to common east of Coast Trail
Perennial soyabean	*Neonotonia wightii*	Rare
Cape waterlily	*Nymphaea capensis*	Common in lake
Broadleaf paspalum	*Paspalum mandiocanum*	Unknown
	Persicaria spp.	Unknown
Slash pine [1]	*Pinus elliottii*	Sparse
Mexican clover	*Richardia brasiliensis*	Unknown
Coral berry	*Rivina humilis*	Sparse
Salvinia [2]	*Salvinia molesta*	Unknown
Umbrella tree [1]	*Schefflera actinophylla*	Sparse
Climbing nightshade [1]	*Solanum seaforthianum*	Sparse
Giant Parramatta grass [1]	*Sporobolus fertilis*	Occasional along Coast Trail and Black Rock Road

Source: Bower (2006a); A Murray, 2013, pers. comm.; site-specific management plan prepared in 2006 as part of the bitou bush TAP (DEC 2006a).

Key:

[1] Regional level priority weed (North Coast LLS 2017).

[2] State-level priority weed (North Coast LLS 2017).

[3] Weeds of National Significance.